United States Department of Agriculture

Colville National Forest Land Management Plan

Ferry, Pend Oreille, and Stevens Counties, Washington

Final Programmatic Environmental Impact Statement

Volume I. Summary, Chapters 1, 2, and 3 (through Soil Resources)

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Cover Photo: Curlew Valley (view from Vulcan Mountain)

Colville National Forest
Land Management Plan
Stevens, Ferry, and Pend Oreille Counties of Washington State

Final Programmatic Environmental Impact Statement

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Abstract: This final environmental impact statement (FEIS) documents the analysis of six alternatives (no action, proposed action, and alternatives P, R, B, and O) developed by the Forest Service for the programmatic management of approximately 1.1 million acres administered by the Colville National Forest. The alternatives are described in chapter 2. The accompanying revised land management plan (revised forest plan) reflects the preferred alternative, which is alternative P. The no action alternative would keep in place the management direction from the 1988 land and resource management plan (1988 forest plan), as amended.

The proposed action and alternatives P, R, B, and O address the following needs for action: (1) maintain or restore ecological conditions that contribute to the recovery and viability of terrestrial plant and wildlife species; (2) manage forest vegetation conditions to be more resilient to disturbances; (3) address climate change implications and vulnerabilities; (4) address changed social and economic conditions and preferences in light of ecosystem capacity; (5) accelerate improvement in watershed condition across the forest; and (6) integrate watershed and aquatic strategies across the Forest.

Alternatives P, R, B, and O address new information and concerns that emerged during the implementation of the 1988 forest plan and comply with Federal laws, regulations, and policies. These alternatives also address significant issues (unresolved conflicts with the proposed action) that were identified from comments received during the scoping and public involvement period.

The Forest Service will use the predecisional administrative review process, also referred to as the objection process described in 36 CFR 219 Subpart B of the 2012 planning rule. This process gives an individual or entity an opportunity for an independent Forest Service review and resolution of issues before the approval of a plan revision; this subpart identifies who may file objections to a plan revision, the responsibilities of the participants in an objection, and the procedures that apply to the review of the objection. Generally, individuals and entities who have submitted substantive formal comments related to this plan revision during the opportunities for public comment for this decision may file an objection.

Send Objections to:

Email: objections-chief@fs.fed.us

FAX: (202) 649-1172

Regular mail, UPS, FedEx, and hand deliveries:

USDA Forest Service
Attn: Chris French, Objection Reviewing Officer
1400 Independence Ave., SW
EMC-PEEARS, Mailstop 1104
Washington, DC 20250

Office hours are Monday through Friday, 8:00am to 4:30pm, excluding Federal holidays. Please be explicit that the objection is for the Colville National Forest revised land management plan.

Date Objections Must Be Received:

Within 60 days following publication of the notice of availability of the ROD and FEIS in the Federal Register. The notice is expected to be published on or around August 31, 2018; however, it is the objector's responsibility to calculate the end of the 60-day period.

Summary

Proposed Action

The Colville National Forest (Forest) proposes to revise its 1988 land management plan (1988 forest plan). The area affected by the proposal includes about 1.1 million acres of public land. The revised land and resource management plan (revised forest plan) would allocate National Forest System (NFS) lands to 13 management areas (MAs) including: Administrative and Recreation Sites, Backcountry, Backcountry Motorized, Focused Restoration, General Restoration, Nationally Designated Trails, Research Natural Areas, Riparian Management Areas, Scenic Byways, the Kettle Crest Recreation Area, Wild and Scenic Rivers, Wilderness-Congressionally Designated, and Wilderness-Recommended. The proposed MAs represent different management themes with varying emphasis such as vegetation management, watershed restoration, motorized and non-motorized recreation, or special designations designed to sustain the social, economic, and ecological attributes of the Forest.

Allocation to a specific MA is not intended to mandate or direct the Forest Service to propose or implement any action; rather, the MAs provide direction on desired conditions and allowable activities and uses, as described in the revised forest plan, regarding:

- Timber harvest/timber production;
- Commercial and personal use of special forest products and firewood;
- Fire (planned and unplanned ignitions);
- Livestock grazing;
- Motorized use;
- Mechanized use;
- Over-snow motor vehicle use;
- Road construction and reconstruction; and
- Minerals

Purpose and Need

The purpose of the action is to revise the 1988 forest plan for the Colville National Forest. The revised forest plan would guide natural resource management activities on the Forest, and address changed conditions and direction that have occurred since the original forest plan (1988 forest plan), while meeting the objectives of Federal law, regulation, and policy. Specifically, the revised forest plan would provide management direction for forest resources both forestwide and specific to management areas.

Over the 29-year life of the 1988 forest plan, economic, social, and ecological conditions have changed. New laws, regulations, and policies are in place. Congressional direction, court decisions, conservation agreements, recovery plans, and scientific findings contribute to changed management conditions and support the need for revision. Endangered Species Act species listings have been updated, and new information based on monitoring and scientific research is available. Specific need for change topics include wildlife habitat, vegetative systems, climate change, social systems, and aquatic and riparian systems.

Due to these changed conditions and the age of the 1988 forest plan, the Colville National Forest began the process of revising its plan in 2003. The need for revision is based on legal requirements, changed conditions, and the Analysis of the Management Situation (USDA Forest Service 2011, 2017). Revision is also warranted because the forest plan is beyond the 10- to 15-year duration provided by the National Forest Management Act (NFMA) (16 U.S.C. 1606(e) (5) (A)).

Public Involvement

The Colville National Forest started forest plan revision in 2003, followed by public participation, which began in 2004, with community workshops about the need to change the existing forest plan. The Forest held workshops in communities throughout northeastern Washington, with additional workshops on specific topics, including wilderness and recreation from 2005 to 2008. Meetings with representatives from local counties began in 2004, and were held on a continuous basis throughout the forest plan revision process. Government-to-government consultation with Tribal nations and staff-to-staff consultation with their resource specialists began early in the process and continues. The Forest Service works closely with the Washington State Department of Natural Resources, Washington State Department of Fish and Wildlife; and the United States Department of Homeland Security and the US Fish and Wildlife Service. A 2007 memorandum of agreement with the Washington State Association of Counties provides a framework for our work with the three local counties. Three federally recognized Tribes have engaged at varied levels: the Colville Confederated Tribes (the Forest’s largest neighbors), and the Spokane and Kalispel Tribes. We held additional meetings with interest groups, user groups, State and Federal officials, Tribal staff, and industry groups.

In June 2011, the Forest Service published a combined notice announcing that the proposed actions for the Colville and Okanogan-Wenatchee National Forests were available for public review and comment. Public meetings and outreach efforts continued through 2013, based on the information related to both forests.

The 90-day comment period per the 2011 notice drew 27,274 comment letters, of which 889 contained unique and substantially different comments. We received letters, emails, form letters, and public comment forms from Tribes, individuals, organizations, agencies, businesses, and groups from 15 states in the United States and British Columbia, Canada; however, this does not include state affiliation for all of the form letters. The Forests analyzed 3,250 comments from the 889 comment letters to identify the significant issues driving the alternatives.

After the comment period, the regional forester determined that the most effective process to reflect public input and resource needs was to separate the Colville and Okanogan-Wenatchee National Forests’ plan revision effort. Moving forward from that decision in 2014, the forest plan revision documents reflect issues and alternatives specific to the Colville National Forest only. The Okanogan-Wenatchee National Forest is in the process of developing a proposed forest plan and completing a separate analysis specific to its resource needs and public input specific to that forest. All input, including public comments received as part of the combined forest effort, related to the Colville National Forest were considered during development of the FEIS and revised forest plan.

A 90-day public comment period for the draft environmental impact statement (DEIS) and draft revised plan was initiated by publication of a Federal Register Notice on February 19, 2016. Another notice was published in the Federal Register on March 25, 2016, to extend the public comment period for an additional 45 days. During the 135-day comment period, plan revision information was available to the public electronically on the Forest website and an on-line open house site, and available in paper copy and on CD at local libraries and each Forest office. The Forest Supervisor and plan revision team members continued to meet with Tribal representatives and County Commissioners, as well as interested groups and agencies, to provide information and discuss potential concerns.

The Forest received 926 comment letters, of which 363 contained unique or substantially different comments. Letters, emails, form letters and public comment forms from Tribes, individuals, organizations, agencies, businesses and groups from 25 states as well as British Columbia and Quebec, Canada; however, this does not include state or country affiliation for all of the comments received.[1] The Forest analyzed 2,058 comments from these comment letters to identify possible changes to existing alternatives or need to develop new alternatives.

Significant Issues

Six significant issues led to the development of multiple programmatic strategies (or alternatives) for revising the plan. A summary of these alternatives as well as analysis of the environmental consequences they pose are the focus of this FEIS.

- Old forest (late-successional) management, and timber production
- Motorized recreation trails
- Access
- Recommended wilderness areas
- Wildlife
- Riparian and aquatic resource management

Alternatives

The six issues led the agency to develop six alternatives. Table 1 provides a short description of each alternative.

Table 1. Short description of alternatives considered in detail

Alternative	Description
No Action Alternative - 1988 Forest Plan	The no action alternative reflects current management direction under the existing 1988 forest plan, as amended and implemented. It provides the basis for comparing the existing condition to the proposed action and the alternatives. This alternative includes direction in the Inland Native Fish Strategy for the Intermountain, Northern, and Pacific Northwest Regions (INFISH) and the Management Direction Establishing Riparian, Ecosystem and Wildlife Standards for Timber Sales (Eastside Screens). Harvest of trees over 21-inches in diameter would continue to be prohibited. Scheduled timber harvest is suitable on 52% of the forest. Incidental timber harvest for specific resource benefit is allowed on an additional 31% of the forest. Annual projected wood sale quantity (PWSQ) volume is 41 million board feet (MMBF), with an estimated wage contribution of $19,335,000. Planned ignitions (prescribed fire) are suitable on 97% of the forest (outside congressionally designated wilderness). Unplanned ignitions (wildland fire use) are suitable on 90% of the forest. There is no recommended wilderness under the no action alternative. Approximately 11% of the forest is managed for non-motorized recreation opportunities, including the Salmo-Priest Wilderness (congressionally designated).

[1] Several form letters and emails were received without complete address information.

Alternative	Description
	The no action alternative includes riparian habitat conservation areas (RHCAs) and the priority watershed network established under INFISH. It manages toward the 8 riparian goals established under INFISH.
Proposed Action	The June 2011 proposed action was developed to address the need for change, and considers early public participation that began in 2003. The emphasis of this alternative is to apply active vegetation management in a dynamic landscape approach to increase vegetation resilience and move the landscape toward desired conditions. Landscape ecology concepts would be applied to provide for ecological resilience to disturbances, including the effects of climate change. New science related to the recovery of terrestrial and aquatic threatened and endangered species would be applied. Vegetation requirements in Eastside Screens are addressed with desired conditions to be within HRV by stand size class. Down and coarse wood and biological legacies are addressed in a similar manner. The Eastside Screens 21-inch diameter limit is replaced by structural stage and wildlife habitat direction. Scheduled timber harvest would be suitable on 63% of the forest. Timber harvest would be allowed for other resource benefit on an additional 20% of the forest. Annual PWSQ volume would be 62 MMBF, with an estimated wage contribution of $31,224,000. Planned and unplanned ignitions would be suitable on 100% of the forest. An additional 101,400 acres of wilderness would be recommended, including the Kettle Crest. Existing inconsistent uses (such as mountain bike and chainsaw use) would continue in Recommended Wilderness Management Areas until such time as designated as wilderness by Congress. Approximately 21% of the forest is suitable for non-motorized recreation opportunities. Backcountry and Backcountry Motorized Management Areas represent 14% of the forest. The proposed action adopts the Aquatic and Riparian Conservation Strategy (ARCS 2008), replacing INFISH with a long-term strategy that uses best science and aligns species and water quality recovery plans. It focuses on desired conditions for aquatic and riparian function, and watershed condition. The proposed action includes a key watershed network, replacing the priority watersheds established under INFISH.
Alternative P (Preferred Alternative)	Alternative P is similar to the proposed action in the overall vegetation management approach and outputs, and backcountry recreation management would be similar to the proposed action. Vegetation requirements in Eastside Screens are addressed with desired conditions to be within HRV by stand size class. Down and coarse wood and biological legacies are addressed in a similar manner. The 21” diameter limit is replaced by structural stage and wildlife habitat direction, and a guideline for large tree management. Scheduled timber harvest would be suitable on 63% of the forest. Timber harvest would be allowed for other resource benefit on an additional 19% of the forest. Annual PWSQ volume would be 62 MMBF, with an estimated wage contribution of $31,224,000. Planned and unplanned ignitions would be suitable on 100% of the forest. An additional 61,700 acres of wilderness would be recommended, not including the Kettle Crest. Existing inconsistent uses (such as mountain bike and chainsaw use) would continue in recommended wilderness until such time as designated as wilderness by Congress. No new motorized or mechanized recreation opportunities would be allowed. Approximately 21% of the forest is suitable for non-motorized recreation opportunities. Backcountry and Backcountry Motorized Management Areas represent 17% of the forest. Approximately 80,300 acres would be managed as the Kettle Crest Recreation Area. This management area allocation would protect outstanding recreation opportunities in a semi-primitive setting while allowing continued motorized and mechanized recreation opportunities. Alternative P would incorporate much of ARCS (2016). It would also increase riparian protection through additional plan components developed under the Colville ARCS, and expand the key watershed network by including Cee Cee Ah Creek as a key watershed.

Alternative	Description
Alternative R	Alternative R was developed to address concerns from conservation groups, and would emphasize a large-scale reserve approach for late-successional forest structure, emphasizing a passive management approach to reach desired conditions. Eastside Screens 21-inch diameter limit on cutting live trees would be retained. Down and coarse wood and biological legacies are addressed in a similar manner. Scheduled timber harvest would be suitable on 12% of the forest. Timber harvest would be allowed for other resource benefit on an additional 70% of the forest. Annual projected wood sale quantity (PWSQ) volume would be 14 MMBF, with an estimated wage contribution of $6,692,000. Planned and unplanned ignitions would be suitable on 100% of the forest. An additional 209,000 acres of wilderness would be recommended, including the Kettle Crest. Existing inconsistent uses (such as mechanized, motorized, and rental cabins) would not be allowed to continue in recommended wilderness. Approximately 24% of the forest is suitable for non-motorized recreation opportunities. Backcountry and Backcountry Motorized Management Areas represent 2% of the forest. Alternative R would use a similar aquatic strategy approach as the proposed action alternative through incorporation of a modified version of ARCS (2008). It includes a key watersheds network.
Alternative B	Alternative B was developed based on recommendations from the Northeast Washington Forestry Coalition (NEWFC), and points of consensus with public workgroups. It is designed to address the concerns of multiple constituencies in one alternative by balancing land allocations between areas emphasizing active management (timber management zones) (44%), a mix of active and passive management (restoration areas) (31%), and passive management (recommended and designated wilderness) (23%). Where plan components were not identified by the collaborative group, the 1988 Colville Forest Plan (no action alternative) would provide plan direction (remain unchanged). Eastside Screens 21-inch diameter limit on cutting live trees and the large-scale reserve approach for late-successional forest structure would be retained. Additional plan components would limit timber harvest in late-successional structure to dry plant association groups only. Scheduled timber harvest would be suitable on 37% of the forest. Timber harvest would be allowed for other resource benefit on an additional 46% of the forest. Annual PWSQ volume would be 37 MMBF, with an estimated wage contribution of $17,428,000. Planned and unplanned ignitions would be suitable on 100% of the forest. An additional 220,300 acres of wilderness would be recommended, including the Kettle Crest. Existing inconsistent uses (such as mechanized and motorized uses, and rental cabins) would not continue in Recommended Wilderness Management Areas. Approximately 24% of the forest is suitable for non-motorized recreation opportunities. Backcountry and Backcountry Motorized Management Areas represent 1% of the forest. Alternative B would retain and integrate INFISH, including the priority watersheds, and continue management of riparian habitat conservation areas similar to the no action alternative.

Alternative	Description
Alternative O	Alternative O would balance land allocations, similar to alternative B, between areas emphasizing active management (Responsible Management Areas) (39%), emphasizing a mix of active and passive management (Restoration Areas) (34%), and emphasizing passive management (backcountry and recommended/designated wilderness) (25%). Where plan components were not identified by the collaborative group, the 1988 Colville Forest Plan (no action alternative) would provide plan direction (remain unchanged). Eastside Screens 21-inch diameter limit on cutting live trees and the large-scale reserve approach for late-successional forest structure would be retained. Additional plan components would be included to limit mechanical restoration treatments (timber harvest) to a one-time entry. Scheduled timber harvest would be suitable on 33% of the forest. Timber harvest would be allowed for other resource benefit on an additional 49% of the forest. Annual PWSQ volume would be 38 MMBF, with an estimated wage contribution of $17,465,000. Planned and unplanned ignitions would be suitable on 100% of the forest. An additional 15,900 acres would be recommended as wilderness. Existing inconsistent uses (such as mountain bike and chainsaw use) would continue in recommended wilderness until such time as designated as wilderness by Congress. No new motorized or mechanized recreation opportunities would be allowed. Approximately 21% of the forest is suitable for non-motorized recreation opportunities. Backcountry and Backcountry Motorized Management Areas represent 21% of the forest. Approximately 99,000 acres would be managed as the Kettle Crest Recreation Area. This management area allocation would protect outstanding recreation opportunities in a semi-primitive setting while allowing continued motorized and mechanized recreation opportunities. Alternative O would adopt ARCS (2008) similar to the proposed action. It includes a key watersheds network.

All alternatives represent, to varying degrees, the principles of multiple-use, and ecological and economic sustainability. The alternatives provide basic protection of forest resources and comply fully with applicable laws, regulations, and policies. In addition, all the alternatives would:

- Meet the purpose and need for change or address one or more significant issues;
- Conserve soil and water resources and not allow significant or permanent impairment of the productivity of the land;
- Provide protections for riparian areas;
- Maintain air quality that meets or exceeds applicable Federal, State, and/or local standards or regulations;
- Include measures for preventing the destruction or adverse modification of critical habitat for threatened and endangered species;
- Protect heritage resources;
- Recognize the unique status of American Indian Tribes and their rights retained by trust and executive order with the United States, including consultation requirements;
- Provide sustained multiple uses, products, and services in an environmentally acceptable manner (including minerals, timber, livestock forage, and recreation opportunities);
- Retain existing designated areas (e.g., wilderness areas, scenic byways, national scenic trails); and

- Retain all existing permitted activities and facilities, bringing all permits into compliance as soon as practicable.

The following would not change among alternatives:

- **Developed Recreation Sites** – Existing developed recreation sites would be retained in all alternatives, and no developed recreation sites would be removed or created. Allocation of administrative recreation sites would remain constant for all action alternatives.
- **Eligible Wild and Scenic Rivers** – The two rivers identified as eligible for inclusion in the Wild and Scenic River System for the 1988 forest plan (multiple segments totaling 8 miles) are carried forward in this revision effort and would not vary by alternative.
- **Designated Wilderness** – The Salmo-Priest Wilderness Designation would remain constant for all alternatives.
- **Research Natural Areas (RNAs)** – Allocations of RNAs would remain constant for all action alternatives.

Comparison of Alternatives

Chapter 3 presents a detailed description of the effects of the alternatives. Table 2 provides a summary of effects by revision topic.

Table 2. Comparison of some plan revision key indicators

Resource and Indicator	No action	Proposed Action	Alternative P	Alternative R	Alternative B	Alternative O
Vegetation						
Uses a Fixed Reserves, connectivity corridors and Diameter Limit Management Approach for Managing Late-successional Reserves and Old Forest Habitat Versus Dynamic Landscape Management Approach	Fixed reserves, connectivity corridors and diameter limit	Dynamic landscape	Dynamic landscape	Fixed reserves and diameter limit	Fixed reserves, connectivity corridors and diameter limit	Fixed reserves, connectivity corridors and diameter limit
Timber Production[2]						
Acres/Percentage Suitable for Timber Production	535,700 52%	653,200 63%	656,600 63%	129,400 12%	384,500 37%	347,500 33%
Acres/Percent Harvest Allowed for Other Resource Objectives	323,050 31%	205,550 20%	202,150 19%	729,350 70%	474,250 46%	511,250 49%
Projected Wood Sale Quantity[3] MMBF CCF	41 82,800	62 125,900	62 125,400	14 28,900	37 77,000	38 77,000
Roads						
Percent of Forest Suitable for Roads	83%	73%	75%	75%	74%	74%
Recommended Wilderness						
Acres/Percent Recommended for wilderness	0	101,400 9%	61,700 6%	209,000 19%	220,300 20%	15,900 1%
Recreation						
Percent Forestwide Where Roads, Trails, and Areas may be Designated for Motor Vehicle Use	89%	79%	80%	76%	75%	78%
Designation of Kettle Crest Recreation Area	No	No	Yes	No	No	Yes
Wildlife						
Old Forest Management Plan Direction Contribution to Viability	Low	Moderate	High	High	Low	Low
Riparian Habitat						
Number of Subwatersheds with Improved Trend	7	12	15	15	15	7

[2] All outputs represent modeled annual measurements
[3] Projected wood sale quantity includes both commercial and non-commercial (e.g., firewood) wood products sold, on average, per year.

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Volume I. List of Figures

Acronyms

ACS	Aquatic Conservation Strategy
AEC	Aquatic Ecological Condition
AIS	Aquatic Invasive Species
ARCS	Aquatic and Riparian Conservation Strategy
ARS	Aquatic Restoration Strategy
ASQ	Allowable Sale Quantity
ATV	All-terrain Vehicle
AUM	Animal Unit Month
BC	Backcountry Non-Motorized
BCM	Backcountry Motorized
BLM	Bureau of Land Management
BMP	Best Management Practice
BMU	Bear Management Unit
BPA	Bonneville Power Administration
CCF	Hundred Cubic Feet
CEQ	Council on Environmental Quality
CER	Comprehensive Evaluation Report
CFR	Code of Federal Regulations
CNF	Colville National Forest
CWA	Clean Water Act
CWPP	Community Wildfire Protection Plan
DEIS	Draft Environmental Impact Statement
DSM	Decision Support Model
EIS	Environmental Impact Statement
EO	Executive Order
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FERC	Federal Energy Regulatory Commission
FLPMA	Federal Lnad Policy and Management Act
FR	Federal Register
FRCC	Fire Regime Condition Class
FSH	Forest Service Handbook

FSM	Forest Service Manual
GDE	Groundwater-dependent Ecosystems
GIS	Geographic Information System
HRV	Historical Range of Variability
HUC	Hydrologic Unit Code
ICBEMP	Interior Columbia Basin Ecosystem Management Project
IGBC	Interagency Grizzly Bear Committee
INFISH	Inland Native Fish Strategy
IRA	Inventoried Roadless Area
KCRA	Kettle Crest Recreation Area
LCAS	Lynx Conservation Assessment and Strategy
LSOF	Late-Successional Old Forest
LTA	Landtype Association
LTSY	Long-term Sustained Yield Capacity
LUGI	Land Use Grant Instrument
MA	Management Area
MIS	Management Indicator Species
MMBF	Million Board Feet
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MUSYA	Multiple Use Sustained Yield Act
MVUM	Motor Vehicle Use Map
NAAQ	National Ambient Air Quality Standard
NEPA	National Environmental Policy Act
NFMA	National Forest Management Act
NFS	National Forest System
NHD	National Hydrography Dataset
NHPA	National Historic Preservation Act
NOA	Notice of Availability
NVUM	National Visitor Use Monitoring
OHV	Off-highway Vehicle
PACFISH	Pacific Anadromous Fish Strategy
PIBO	PACFISH/INFISH Biological Opinion
PILT	Payments in Lieu of Taxes

PTSQ	Projected Timber Sale Quantity
PUD	Public Utility District
PWA	Potential Wilderness Area
PWSQ	Projected Wood Sale Quantity
RACR	Roadless Area Conservation Rule
RHCA	Riparian Habitat Conservation Area
RMA	Riparian Management Area
RMO	Riparian Management Objective
RNA	Research Natural Area
ROD	Record of Decision
ROS	Recreation Opportunity Spectrum
RW	Recommended Wilderness
SIO	Scenic Integrity Objective
SMS	Scenery Management System
SOC	Species of Concern
SPM	Semi-primitive Motorized
SPNM	Semi-primitive Non-Motorized
TE	Threatened or Endangered (species)
TES	Threatened, Endangered and Sensitive (species)
TMDL	Total Maximum Daily Load
USC	United States Code
USDA	United States Department of Agriculture
USDI	United States Department of Interior
USFS	United States Forest Service
USGS	United States Geological Survey
WAC	Washington Administrative Code
WAP	Watershed Action Plan
WCF	Watershed Condition Framework
WDFW	Washington Department of Fish and Wildlife
WDoE	Washington Department of Ecology
WQIP	Water Quality Implementation Plan
WRIA	Water Resources Inventory Areas
WSR	Wild and Scenic River
WUI	Wildland-urban Interface

Chapter 1. Purpose of and Need for Action

The Forest Service prepared this programmatic final environmental impact statement (FEIS) in compliance with the National Environmental Policy Act (NEPA) and other relevant Federal laws and regulations. This FEIS discloses the environmental impacts that would result from the proposed action and alternatives. This document is organized into four chapters:

- ***Chapter 1. Purpose of and Need for Action.*** This chapter includes the history of the proposal, the purpose of and need for action, and the agency's proposal for achieving that purpose and need. This section also details how the Forest Service informed the public of the proposal and how the public responded.
- ***Chapter 2. Alternatives, including the Proposed Action.*** This chapter provides a more detailed description of the agency's proposed action and alternative methods for achieving the stated purpose. These alternatives were developed based on significant issues raised by the public and other agencies. Finally, this section provides a summary table of the environmental consequences associated with each alternative.
- ***Chapter 3. Affected Environment and Environmental Consequences.*** This chapter describes the environmental effects of implementing the proposed action and other alternatives. This analysis is organized by resource area, significant issues, and environmental component.
- ***Chapter 4. Consultation and Coordination.*** This chapter provides a list of preparers and agencies consulted during the development of the FEIS.
- ***Appendices.*** The appendices provide more detailed information to support the analyses presented in the FEIS.
- ***Index.*** The index provides page numbers by document topic.

Additional documentation, including more detailed analyses of project-area resources, may be found in the project planning record located at the Colville National Forest Supervisor's Office.

Background

The Colville National Forest is managed by the Forest Service, an agency of the U.S. Department of Agriculture (USDA). As required by the National Forest Management Act (NFMA) of 1976 (16 U.S.C. 1604, et seq.), the Forest Service currently manages Colville National Forest under a land management plan (forest plan) approved in 1988. The 1988 forest plan, including its amendments, is the main document that guides Forest decision-making with respect to managing natural resources (e.g., soil, water, vegetation, and ecosystems) and human uses (e.g., recreation, thinning, livestock grazing, firewood gathering, special use permits, and search for solitude) of the Colville National Forest. The Newport Ranger District is still part of the Kaniksu National Forest, but has been administered by the Colville National Forest since 1974. Throughout this document, the terms "Colville National Forest" and "Forest" refer to both the Colville and that portion of the Kaniksu National Forest that Colville National Forest administers.

The Colville National Forest is proposing to revise its 1988 forest plan. Per direction in the NFMA and its implementing regulations found in 36 CFR 219 (1982 Rule), every national forest must revise its land management plan:

- Every 10 to 15 years;

- When conditions or demands in the area covered by the plan have changed significantly;
- When changes in agency policies, goals, or objectives would have a significant effect on forest level programs; and
- When monitoring and evaluation indicate revision is necessary.

During the 30-year life of the forest plan, economic, social, and ecological conditions have changed. New laws, regulations, and policies are in place. Congressional direction, court decisions, conservation agreements, recovery plans, and scientific findings contribute to changed management conditions and support the need for revision. Endangered Species Act species listings have been updated, and new information based on monitoring and scientific research is available.

Due to these changed conditions and the age of the plan, the Colville National Forest began the process of revising its plan in 2003. During this process, the Forest developed multiple programmatic strategies (or alternatives) for revising its plan. A summary of these alternatives (chapter 2) as well as analysis of the environmental consequences (chapter 3) they pose are the focus of this FEIS.

Development of the Proposed Action

The Colville and Okanogan-Wenatchee National Forests began a joint forest plan revision effort in 2004, with community workshops, county representative meetings, and Tribal consultation. In June 2011, the scoping of the proposed action was initiated with the Federal Register Notice of Intent to Prepare an EIS and Revised Forest Plan. That scoping notice indicated the Forests would be revising under the provisions of the national forest planning regulations in effect prior to November 9, 2000, referred to in this document as the 1982 planning rule. (See the following hyperlink for the 1982 procedures: http://www.fs.fed.us/emc/nfma/includes/nfmareg.html.)

On May 9, 2012, the agency established a new planning rule (referred to as the 2012 planning rule). The 2012 planning rule was developed to take into account changes in our understanding of science and land management. It requires the use of best available science, and emphasizes collaboration. The 2012 planning rule replaces the 1982 planning rule, but provides transition language at 36 CFR 219.17(b)(3), allowing the responsible official to elect to use the provisions of the prior planning regulations to prepare plan amendments and revisions. The responsible official has elected to continue to follow the provisions of the planning regulations in effect prior to May 9, 2012 (1982 planning rule), as indicated in the 2011 Notice of Intent. However, in consideration of transition time requirements, the Forest has developed the monitoring plan per 36 CFR 219.12 of the 2012 Rule.

In 2014, after review of public input and the feasibility of the combined process, the regional forester determined that separating the Colville and Okanogan-Wenatchee National Forests' revision efforts was the best way to reflect public input and resource needs. While the analyses for the forests are still considering all public comments received to date, the Colville FEIS and associated documents reflect issues and alternatives specific to the Colville National Forest.

The revised forest plan updates the desired conditions, objectives, standards, guidelines, areas with special designations, suitability, and monitoring requirements that will guide management of the Colville National Forest for the next 10 to 15 years. It also changes the description and allocation of the management areas to achieve forestwide desired conditions and to provide opportunities for a range of activities. The revised forest plan accompanying this FEIS addresses the need for changes as described below.

Planning Area

The 1.1-million-acre Colville National Forest is located in the northeastern corner of Washington State within Ferry, Stevens, and Pend Oreille Counties. Ranger district offices are located in Republic, Kettle Falls, Metaline Falls, and Newport. The supervisor's office is located in Colville (see figure 1).

Waters from the Colville National Forest feed Lake Roosevelt on the Columbia River, which is impounded by the Grand Coulee Dam, the largest power-supplying dam in the United States. The Grand Coulee Dam generates 21 billion kilowatt-hours of electricity per year, supplying power to Washington, Oregon, Idaho, Montana, Wyoming, Colorado, California, Nevada, New Mexico, Utah, Arizona, and Canada. In addition, two hydropower projects have acreage on the Colville National Forest on the Pend Oreille River. Boundary Dam generates one-third of Seattle City Light's power, and Box Canyon Dam supplies power for Pend Oreille County. Both dams also supply power to other western states and Canada at times of peak production.

Plant species data include about 2,400 vascular and nonvascular plant and fungi taxa that occur on the Forest and vicinity. Of those, 41 (USDA Forest Service 2015e) have been identified as Pacific Northwest Region sensitive species. The moonwort species, *Botrychium lineare*, occurs here at the only site in Washington State, thriving on the Colville National Forest. In addition, two wildflower-viewing sites are documented and described for public recreation opportunities. The wide range of geological and soil types, precipitation, and elevations spanning warm valley bottoms to cold mountain peaks create a diverse assortment of plant communities.

Three hundred twenty-three known species of vertebrate wildlife occur in the Forest, including 73 species of mammals, 234 birds, 9 reptiles, and 7 species of amphibians. Thirty-one species or sub-species of fish inhabit Colville National Forest waters. Unique wildlife species such as red-tailed chipmunk, northern bog lemming, and woodland caribou live on the Forest (USDA Forest Service 2015e). The Selkirk Mountains and Kettle River Range are also the only place in America where woodland caribou, moose, elk, mule deer, and white-tailed deer share the same habitat. Northeastern Washington is home to approximately 65 percent of Washington State's white-tailed deer population, with a majority of them on the Colville National Forest.

The very eastern portion of the Forest is included in the Selkirk Grizzly Bear Recovery Area. The recovery area is one of two in Washington State and one of six in the Nation. It includes the Selkirk Mountains Ecosystem of northern Idaho, southern British Columbia, and northeastern Washington. The recovery area supports a small population of grizzly bears estimated at 40 to 50 bears.

The Forest also contains recovery area and designated critical habitat for the last remaining herd of woodland caribou in the continental United States. The recovery area for the Selkirk Mountain woodland caribou, the most endangered mammal in the continental United States, includes a portion of the Colville National Forest and public lands in northern Idaho and southern British Columbia. The 2015-2016 winter census conducted by biologists in British Columbia, Canada, estimates that 12 animals remain in the entire recovery area.

The Forest does not contain designated critical habitat for Canada lynx, but follows current science direction for managing Canada lynx habitat (ILBT 2013). The Kettle Crest is identified as a core area important for the recovery of Canada lynx in Washington. The Colville National Forest completed a three-year hair-snagging survey in 2011 to determine if a lynx population remained in the Kettle Range. No lynx were documented.

Bull trout is federally listed as a threatened species under the Endangered Species Act. Portions of streams on the Forest have been designated as critical habitat for the recovery of this species.

The yellow-billed cuckoo is federally listed as a threatened species under the Endangered Species Act. Yellow-billed cuckoos are extremely rare in Washington, with only 12 observed between 1950 and 2000 (WDFW 2012b). Eight of these occurred in eastern Washington, mostly near the Cascades (WDFW 2012b). A single bird was observed on the Little Pend Oreille National Wildlife Refuge in 2012.

The Forest provides a variety of recreation opportunities. The Salmo-Priest Wilderness (31,400 acres) is an example of the Okanogan Highlands landform and is the only wilderness in the northeastern section of the state. The Forest hosts 80 miles of National Recreation Trails. Two of the longest trails are the Kettle Crest (44 miles) and the Shedroof Divide (22 miles). The other two National Recreation Trails are the Lakeshore Trail, also known as Sullivan Lake (4 miles), and Pass Creek-Grassy Top (8 miles). The International Selkirk Loop is one of 31 routes in the Nation designated as an All American Road. It winds through northeastern Washington, northern Idaho, and southeastern British Columbia. The loop received the national Rural Community Assistance Action Award from the Chief of the Forest Service for 2000 to 2001.

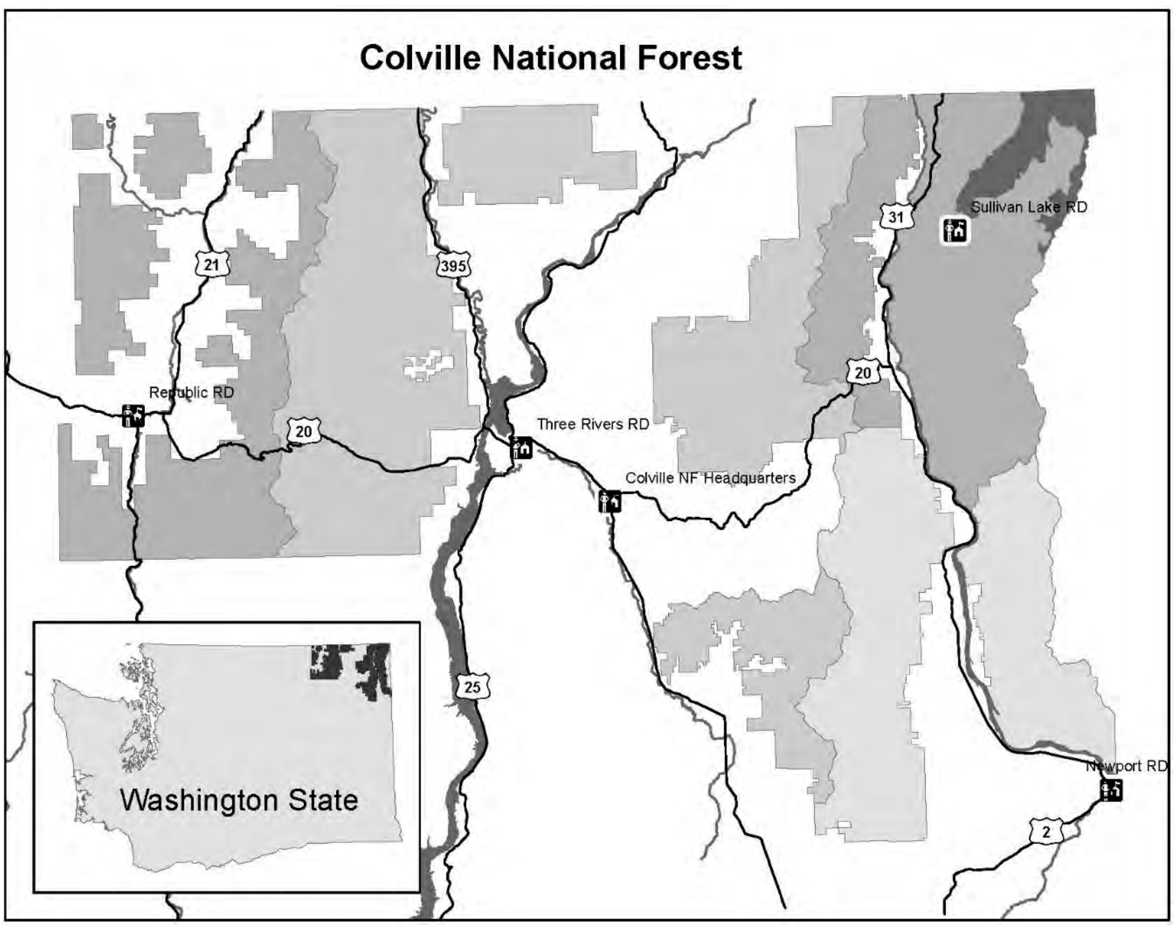


Figure 1. Colville National Forest vicinity map

Need for Change

The forest supervisor initiated forest plan revision based on legal requirements and significant changes that have occurred in conditions and demands since the 1988 forest plan went into effect. The Analysis of the Management Situation (USDA Forest Service 2011, 2017) documents the need to establish or change forest plan management direction. Revision is also warranted because the forest plan is beyond the 10- to 15-year duration provided by the NFMA.

Using the information from the Analysis of the Management Situation, as well as information provided through public engagement and outreach with various public groups, organizations, agencies, officials, and individuals, the Colville National Forest identified five recommended needs for change in the 1988 forest plan.

Wildlife Habitat

There is a need to maintain or restore ecological conditions that contribute to the recovery and viability of terrestrial plant and wildlife species. The 1988 forest plan needs to be updated to reflect new species listings, new designated critical habitat, and current science related to plant and animal species and their habitats. Some wildlife species have been added to the Federal Threatened and Endangered Species List and some have included a new designation of critical habitat (woodland caribou). A considerable body of information is now available concerning the viability of terrestrial wildlife and plant species of management focus. This includes viability assessments for the Interior Columbia Basin and for northeastern Washington. Key factors that influence viability of many of the species assessed include habitat alteration due to timber harvest, wildfire, and other vegetation management activities; restoration of riparian and wetland habitats; and reduction of habitat effectiveness and connectivity due to the potential impacts of roads. Climate change may alter how water systems function and it is projected to exacerbate the loss of old forest habitat due to increased fire rates. This creates a need to restore watershed conditions to be more resilient to disturbances to provide for the recovery and viability of wildlife and plant species.

Vegetative Systems

There is a need to manage forest vegetation conditions to be more resilient to disturbances. Haugo et al. (2015) analyzed restoration needs across Oregon and Washington and found that one of the areas with the highest level of need for restoration was northeastern Washington, including the Colville National Forest. A need for both disturbance and succession related change was shown. Several other recent studies have shown the need for active restoration across western forests (Brown et al. 2004, Hessburg et al. 2005, Franklin et al. 2008). The Douglas-fir dry and Northern Rocky Mountain mixed conifer forest types on the Colville National Forest are departed from their historical range of variation and are susceptible to disturbances such as insect and disease outbreaks, wildfire and climate change. The 1988 forest plan does not adequately address the need to manage forests toward their historical range of variation. Thus, there is a need to revise the forest plan to focus restoration actions in Douglas-fir dry and Northern Rocky Mountain mixed conifer landscapes, and create conditions that are more resilient to anticipated disturbances. Lodgepole pine forest types are also in need of updated management direction that addresses the challenges described above. For example, historically, frequent fires maintained low tree abundance on dry landscapes with fire cycles lengthening with Euro-settlement. Over time, stand density has increased due to fire suppression. In the absence of fire and without human intervention, competition for water and nutrients, insect and disease mortality, the number of shade-tolerant species, range of even-age class structure, and amount of dead material have increased (Everett et al. 2007). In the past 10 to 15 years, fire acres in eastern Washington have increased with amplified severity reflective of higher fuels levels and tree mortality influences, along with longer fire seasons. Experimental work has shown that these increasing trends can be reduced through active management when applied at a landscape scale (Schwilk et al. 2009).

Climate Change

There is a need to address climate change implications and vulnerabilities. Gaines et al. (2012) found key vulnerabilities related to vegetation and habitat management, and aquatic and infrastructure resources. These vulnerabilities include conservation of biodiversity, and the restoration of resilient forests and disturbance regimes, and water quality and quantity, the risk to roads and other facilities from changes to hydrologic regimes, and at-risk aquatic species and habitats.

The 1988 forest plan does not address the potential effect of climate change. Recent scientific findings on climate change (Intergovernmental Panel on Climate Change (IPCC) 2014 and Gaines et al. 2012) have dramatically improved our understanding of how ecosystems have changed and are likely to change in the future. Changing climate conditions have affected ecosystem composition, structure, process, and spatial pattern, altering the character and distribution of habitats for surrogate plant and animal species. In addition, climate change has altered, and will continue to alter disturbance regimes, including forest insects and diseases, fire, and hydrologic regimes. Future conditions may be more favorable to some undesired non-native plant, wildlife, and aquatic species (IPCC 2014 and Gaines et al. 2012). The full impact of climate change on ecosystems is uncertain, but an integrated management direction that provides flexibility to respond to a changing environment is needed to maintain or restore the resilience of the national forests in the face of these changes.

Social Systems

There is a need to address changed social and economic conditions and preferences in light of ecosystem capacity. Colville National Forest provides a variety of opportunities for recreating, working, and practicing cultural and spiritual traditions. In turn, communities provide infrastructure and skills to support forest management. Sustainable social and economic opportunities depend on well-functioning and resilient ecological systems. During the past 20 years, demographic and economic changes have altered how people use and access the Forest. Plan revision needs to address changed social, economic, and ecological conditions. There is a need for the Forest to contribute to predictable and sustained flows of economic and social benefits (e.g., ecosystem services[4]) within the capability of the ecosystem. Social changes include an increasing demand, largely due to population growth, for a variety of recreation opportunities on public lands. An example of changes in recreation use and visitor preferences is a trend toward shorter-duration visits to the Forest compared to those in the past with visitors more likely to stay for a day or weekend, rather than for longer periods Forest visitors are also more ethnically diverse than in the past. In addition, demand for recreation opportunities in ‘front country’ areas is greater than for backcountry areas. New activities and modes of travel continue to appear, e.g., mountain bicycles with over-snow tires and snowmobiles that resemble motorcycles. Plan

[4] Ecosystem services are commonly defined as the benefits people obtain from ecosystems. Ecosystem services include basic services—provisioning services like the delivery of food, fresh water, wood and fiber, and medicine—and services that are less tangible and harder to measure but equally critical: regulating services like carbon sequestration, erosion control, and pollination; cultural services like recreation, ecotourism, and educational and spiritual values; and supporting services like nutrient cycling, soil formation, and primary productivity. http://www.fs.fed.us/ecosystemservices/About_ES/faq.shtml#ecoservices

revision needs to address such a shift, within the capability of the available infrastructure and the ecosystem. Economic shifts in markets for certain types of timber products and declines in timber harvests have caused many eastern Washington wood processors to close. Plan revision needs to address the types and extent of forest management activities that can be accomplished within projected budgets.

Aquatic and Riparian Systems

There is a need to focus efforts to improve watershed condition across the Forest. The 1988 forest plan and amendments do not adequately provide integrated management direction to maintain and restore properly functioning watersheds that provide a range of benefits on and off the Colville National Forest. This is supported by new science, the listing of bull trout (*Salvelinus confluentus*) under the Endangered Species Act (1988), designation of critical habitat for bull trout (2010), information provided by the bull trout recovery plan (2015), and the results of new assessment tools such as the national Watershed Condition Framework. Properly functioning watersheds provide stable and productive ecological systems and allow for conditions that support aquatic species viability and self-sustaining populations, contribute to the recovery and de-listing of threatened and endangered species, and restore stream systems that do not meet Washington State water quality standards (WADoE 2014f).

There is also a need to integrate watershed and aquatic strategies across the Forest. The Colville Forest Plan was completed in 1988, and was amended by the Inland Native Fish Strategy[5] (INFISH) (USDA Forest Service 1995a) in 1995. Since 1988, the Aquatic Restoration Strategy (ARS) (USDA Forest Service 2005b), the Aquatic and Riparian Conservation Strategy (ARCS) (USDA Forest Service 2016a) and the Watershed Condition Framework (Potyondy and Geier 2010) have been developed to reflect management direction recommended by current research and supported by regional and national policy. The 2008 ARCS, substantially updated in the 2016 version of ARCS, is a Forest Service Pacific Northwest Regional operational strategy that reinforces the foundation of existing forest plan strategies, including broad-scale passive restoration, and strategically focused active restoration and guides implementation through establishment of specific goals and objectives and a formal process for near-term active restoration. The 2010 National Watershed Condition Framework process evaluated current conditions at the subwatershed scale and identified priority subwatersheds where focused restoration could improve watershed condition on NFS lands. ARCS is a refinement of previous forest plan strategies (including the Northwest Forest Plan[6], PACFISH[7], and INFISH) incorporating key concepts from the ARS and watershed condition framework, and is intended to provide the core set of desired conditions, suitability, objectives, standards and guidelines for aquatic and riparian management. ARCS provides additional watershed direction intended to restore and maintain watershed conditions and processes that sustain a full range of ecosystem services and support beneficial uses of water, with a focus on protection and restoration of native

[5] Inland Native Fish Strategy provides interim direction to protect habitat and populations of resident native fish outside of anadromous fish habitat in eastern Oregon, eastern Washington, Idaho, western Montana, and portions of Nevada. http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsbdev3_033158.pdf

[6] The Northwest Forest Plan was developed to adopt coordinated management direction for the lands administered by the USDA Forest Service and the USDI Bureau of Land Management and to adopt complimentary approaches by other Federal agencies within the range of the northern spotted owl. The management of these public lands must meet dual needs: the need for forest habitat and the need for forest products. http://www.fs.usda.gov/detail/r6/landmanagement/planning/?cid=fsbdev2_026990

[7] PACFISH is an interim strategy for managing anadromous fish-producing watersheds in eastern Oregon and Washington, Idaho, and portions of California. http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsbdev3_033465.pdf

anadromous and non-anadromous fisheries. Consistency and integration of new research and regional and national direction on restoration and protection of watershed and aquatic habitat and function will contribute to the restoration and maintenance of riparian and aquatic habitats and beneficial uses of water and increase resilience to disturbance.

Decision Framework

The entire environmental impact statement process, including the Draft EIS and Final EIS, is meant to inform the responsible official (the regional forester) so that s/he can decide which alternative (the proposed action, no action, or another alternative) to choose.

This is a programmatic FEIS. The decisions that result from this process are broad-scale planning decisions that will guide the selection and design of future projects and activities on the Colville National Forest. Programmatic decisions are made in the land and resource management plan, and they are expressed as goals (identified as desired conditions), objectives, standards, guidelines, management area allocations, areas with special designations, suitability, and monitoring. The land and resource management plan provides a broad framework that guides project-level decisions, but does not authorize, fund, or carry out any site-specific activities. Instead, the land and resource management plan establishes limitations on what actions may be authorized and what conditions must be met during project-level decision making.

A land and resource management plan establishes key decisions for the long-term management of a national forest. The land and resource management plan approval results in:

1. Establishment of forestwide multiple-use goals and objectives including a description of the desired condition of the Forest and projections of goods and services that may be produced during the planning period (36 CFR 219.11(b), 1982 Rule)
2. Establishment of forestwide management requirements (standards and guidelines) (36 CFR 219.13 – 219.27, 1982 Rule)
3. Establishment of management area direction and prescriptions, including associated standards and guidelines, including possible actions (see appendix B of the revised land and resource management plan) (36 CFR 219.11(c), 1982 Rule)
4. Determination of suitability of lands for resource production (i.e., timber production and other uses) (36 CFR 219.14, 219.16, and 219.20, 1982 Rule)
5. Establishment of monitoring and evaluation requirements that provide a basis for a periodic determination and evaluation of the effects of management practices (36 CFR 219.12, 2012 Rule)
6. Recommendation to Congress of areas eligible for wilderness designation as required (36 CFR 219.17 (a), 1982 Rule) and rivers eligible for inclusion in the National Wild and Scenic Rivers System as required (16 U.S.C. 1271-1287, 36 CFR 297, 47 FR 39454)

The regulations guiding the forest plan revision process give latitude to the Forest Service to determine the scope of topics included in the revision.

The Pacific Northwest Regional Forester will review the proposed plan, alternatives, and environmental consequences, and then decide which plan alternative best addresses the desired conditions, multiple-use opportunities, diverse needs of people, and sustainable management of the Colville National Forest as well as meeting the requirements of the National Forest Management Act and the Multiple-Use Sustained-Yield Act.

Relationship to Other Law, Regulation, Policy, and Strategic Guidance

Forest Service direction and guidance for managing National Forest System (NFS) lands comes from several sources and is not altered by forest plan revision. National and regional direction includes laws, executive orders, and regulations. Forest Service policy guides activities on national forests. All forest activities must comply with national direction and reflect national policy.

The hierarchy of management direction ranges from national and regional direction to site-specific, project-level direction when the land and resource management plan is implemented. Figure 2 shows the primary levels of direction.

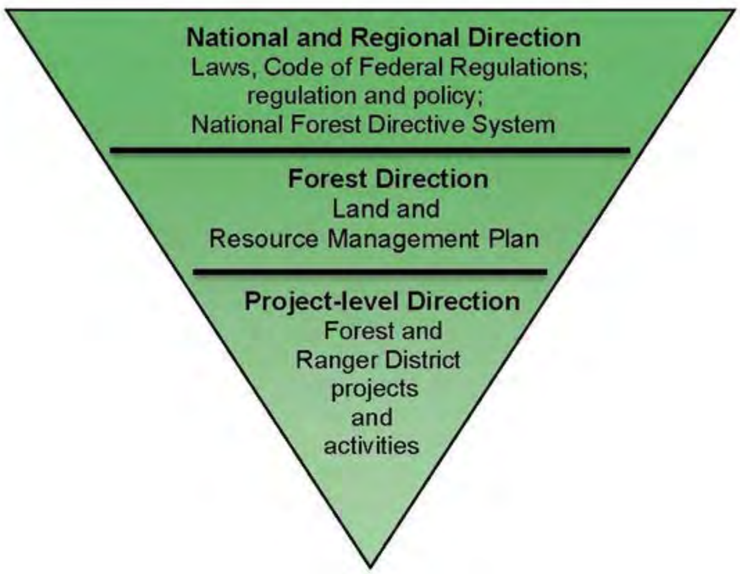


Figure 2. Hierarchy of management direction for all national forests

National and Regional Direction and Guidance

As a Federal land management agency, the Forest Service must follow all applicable laws and regulations. If laws change or are amended, or if new laws are enacted, the Forest Service will comply with the changes or additions. The same situation applies to executive orders and agency policy, as expressed in Forest Service Manual (FSM) and Handbook (FSH) directives. This direction does not need to be restated in the land and resource management plan. Wherever the laws, regulations, or policies have more stringent requirements than land and resource management plan direction, the Forest must and will comply with those requirements.

Examples of Federal laws with which forest plans must be consistent are the Endangered Species Act, the National Historic Preservation Act, Wilderness Act, Clean Water Act, Clean Air Act, Multiple-use Sustained Yield Act, and the National Forest Management Act. Guidance for these laws comes from the Code of Federal Regulations (CFR), and the Forest Service Directive System (the Forest Service Handbooks and Forest Service Manuals). That material is not repeated in the revised land and resource management plan, but a summary of these may be found on the Forest Service national website at http://www.fs.fed.us/publications/.

National rules applicable to all national forests, such as the Travel Management Rule (36 CFR Parts 212, 251, 261, and 295) and the 2001 Roadless Area Conservation Rule (36 CFR Part 294) continue to apply, are not repeated in the revised land and resource management plan, and may not be altered through the forest plan revision process.

Guidance for forest plans is from the USDA Forest Service Strategic Plan (http://www.fs.fed.us/plan/). This national-level plan is a framework for the NFS annual performance plan. It guides units such as individual national forests or ranger districts in proposing project-level work, while considering the opportunities and challenges detailed in their local unit plans. Like individual forest plans, the strategic plan focuses on outcomes or results that are to be achieved over time. Forest plans consider the National Strategic Plan in developing desired conditions and objectives. A goal of the USDA Strategic Plan FY2015–2020 is to restore, sustain, and enhance the Nation's forests, with a desired outcome for forests and grasslands to be healthy, productive, diverse, and resilient to disturbance.

The Interior Columbia Basin Ecosystem Management Project (1994–2000) was a broad-scale effort to develop scientific knowledge of the ecological and biophysical trends, risks, and opportunities within the interior portion of the Pacific Northwest. One outcome of that project is the Interior Columbia Basin Strategy (2003; revised 2014) which includes an interagency memorandum of understanding (2014) that outlines how the strategy will be used to guide the amendment and revision of land and resource management plans for USDA Forest Service and United States Department of Interior (USDI) Bureau of Land Management administered lands within the Columbia Basin.

The Colville National Forest contributes to the accomplishment of national strategic guidance in accordance with its own unique combination of social, economic, and ecological conditions. The proposed plan helps define the Forest's role in advancing the agency's national strategy and reflects the national goals, which are based on the Government Performance and Results Act (2010).

Forest-specific Resource Plans

A forest may have a subordinate plan, such as a wilderness management plan or recreation management plan, which serves to implement the land and resource management plan. These plans are consistent with the land and resource management plan.

Project-level Decisions

A forest plan does not authorize site-specific activities. Project activities such as timber harvest, trail construction, or motor vehicle use designations occur through subsequent project-specific decision-making, consistent with land and resource management plan direction. Once finalized, the Forest will carry out on-the-ground projects and activities designed to accomplish management objectives and move the project area toward desired conditions described in the revised plan. Projects and activities will be subject to the National Environmental Policy Act and other applicable laws and regulations. Project decisions must be consistent with the land and resource management plan.

Decisions Authorized per the 1988 Forest Plan

Once finalized in a record of decision, the revised land and resource management plan will replace the 1988 forest plan and the management direction within the 1988 forest plan will no longer be applicable. The record of decision accompanying this final EIS specifies how the final revised plan direction affects on-going contracts, permits, project decisions, and activities. It also specifies when the Forest transitions to the revised land and resource management plan. After the effective date of the revised plan, all new project decisions, contracts, permits, renewals, and other activities will be consistent with the plan direction.

Relationship to Other Entities

Forest Service planning regulations require the agency to review the planning and land use policies of other Federal agencies, State and local governments, and Indian Tribes. The review includes:

1. Consideration of the objectives of other Federal, State and local governments, and Indian Tribes, as expressed in their plans and policies;
2. An assessment of the interrelated impacts of these plans and policies;
3. A determination of how each Forest Service plan should deal with the impacts identified; and,
4. Where conflicts with Forest Service planning are identified, consideration of alternatives for their resolution.

Agencies and governing entities contacted between 2003 and 2017 include Fish and Wildlife Service, Washington Department of Fish and Wildlife, Washington State Department of Ecology, Kalispel Tribe of Indians, Confederated Tribes of the Colville Reservation, Spokane Tribe of Indians, Ferry County Board of Commissioners, Pend Oreille County Board of Commissioners, and Stevens County Board of Commissioners.

County Governments

Local government officials from the counties within and adjacent to the Colville National Forest have been invited to participate in land and resource management plan development since the beginning of the planning effort (2003). Forest representatives have met with individual county board of commissioners as well as met with combined boards and with county departments. Between 2005 and 2016, the Forest Service met specifically with county commissioners more than 69 times. In addition, county commissioners participated in plan revision collaboration and workgroup meetings, and Forest Service representatives met with various county committees and departments such as Stevens County Public Lands Advisory Committee.

Each county’s comprehensive plan has been assessed and considered during the revised plan development (Ferry County (2013, updated 2016), Pend Oreille County (2013, updated 2015), Stevens County (2008), and Okanogan County (2014)). The county land use plans describe local government goals and objectives for land management and provide opportunities for coordination between the Forest Service and the county. The following information is a summary of the full review that is located in the project record.

The over-arching theme of the Ferry County comprehensive plan’s vision statement is that “Ferry County would like to preserve its character and identity.” Ferry County offers a rural character of natural beauty and abundance. This includes values such as independence, privacy, and personal freedom that attract many people seeking both permanent residence and seasonal refuge. The primary goals that tie to national forest management include:

1. Maintain a rural land use style,
2. Preserve agricultural lands of long-term commercial significance.

3. Preserve natural resources throughout the County and offer special protection to areas designated as critical areas, or environmentally sensitive areas.
4. Provide safe and convenient areas for use of motorized and non-motorized vehicles and equipment;
5. Increase job opportunities and broaden the economic base in Ferry County through encouragement of industry that is compatible with other land uses; and
6. Support multiple use on public lands.
7. Encourage and accommodate as many diverse recreational activities and areas as possible that are compatible with other land uses.

The Pend Oreille County comprehensive plan’s vision is based on a Statement of Values: Why We Live Here, where natural resources are conserved and land is used efficiently, ensuring that new development is compatible with the surrounding uses, sensitive to the surrounding natural areas, and retains the rural character of the community. Specific goals that connect with national forest management include:

1. Maintaining the rural character of Pend Oreille County,
2. Protecting the traditional rural ways of making a living;
3. Encouraging employment opportunities;
4. Maintaining an efficient, safe, and environmentally responsible road system;
5. Supporting new development that is consistent with a realistic assessment of the availability of water, protecting groundwater recharge areas, and preventing the contamination of vulnerable groundwater resources;
6. Protecting environmentally sensitive areas;
7. Providing necessary public facilities and services, in places and at levels proportionate to planned development intensity and environmental protection. (Forest Service Landing Strip (Sullivan Lake), Sullivan Lake Ranger Station and Newport Ranger Station have been designated by Pend Oreille County as Essential Public Facilities); and
8. Coordinating and collaborating with the U.S. Forest Service and other public resource agencies and managers to inventory recreational opportunities and promote the shared use and full enjoyment of publicly owned land in the County.

The comprehensive county plan’s (2008) vision for Stevens County emphasizes healthy landscapes where natural resources are conserved and land is used efficiently. Natural resources are well managed, healthy, productive and provide a steady, sustainable stream of products for economic viability while maintaining and enhancing opportunities for recreation. Specific goals related to national forest management include:

1. Economic development as one of the considerations in the process of land use planning, transportation planning, infrastructure planning, and the determination of urban growth areas.
2. Sustainable management decisions for public lands shall consider the diversity of customary practices, traditions, culture and ways of life found throughout the County
3. Maintain and enhance natural resource-based industries in the County, protect critical areas including surface and groundwater resources, and provide for the stewardship and productive use of forest, mineral, and agricultural lands.

4. Protect and enhance the character and quality of rural areas in ways that promote traditional rural lifestyles and industries,
5. Provide an efficient, functional, and environmentally responsible transportation network throughout Stevens County by utilizing and maintaining existing infrastructure, integrating transportation planning with other elements of the comprehensive plan, and coordinating with other Federal, State, Tribal and local agencies.
6. Support the retention, enhancement, and development of recreation areas and activities, and parks and open space within Stevens County.

The west side of the Colville National Forest borders Okanogan County. The comprehensive county plan’s (2014) vision for Okanogan County emphasizes independence, privacy, and personal freedom for its citizens, works to strengthen the local economy, while also putting forth efforts to maintain a clean and healthy environment. The plan advocates for resource-based industries and activities such as agriculture, forestry, fishing, mining, and recreation while providing forest-related jobs for the local economy. The following uses are priority uses in support of the County's forestry economy:

1. Harvest and processing of forest products.
2. Equipment yards, repair and maintenance operations.
3. Manufacturing that requires proximity to forest products.
4. Home occupations and home-based industries.
5. Residential uses including vacation rental, single family, extended family, and farm worker housing, with covenants to assure compatibility with resource activities.

Although the interdisciplinary team did not find any direct conflicts or inconsistencies between the proposed plan’s management direction and the counties’ natural resource management objectives (where found), the county representatives perceive potential issues regarding economic effects related to recommended wilderness, expected timber outputs, and motorized access.

All elements of the above plans were considered while developing alternatives for the Colville National Forest plan revision. The social and economic impacts to the counties are discussed in more detail in chapter 3.

State

Several Washington State agencies either are affected by, or affect, Forest management. These include Washington Department of Fish and Wildlife, Washington Department of Natural Resources, and Washington State Department of Ecology. The Forest coordinated information with these State agencies during all phases of the plan revision process. Those offices provided formal comments during the scoping and other public involvement stages. Statewide assessments were considered in the development of the revised land and resource management plan.

Tribes

American Indian Tribes are sovereign nations. They are government entities with which the Forest Service has established and continues to maintain government-to-government relationships. In government-to-government consultation, the Forest Service acknowledges the sovereignty of federally recognized American Indian Tribes and the special government-to-government relationship between the Tribes and the United States through Executive Order (E.O.) 13175 (November 6, 2000).

Tribes have reserved rights and privileges for their Tribal members on any off-site reservation lands ceded through treaties or executive orders to the U.S. Government. The Forest Service manages some of those off-reservation lands ceded through treaties or executive orders. Therefore, the agency has certain legal responsibilities to American Indian Tribes. The Forest Service is required to manage the lands under their stewardship with full consideration of the Federal trust responsibility and Tribal rights and interests, particularly reserved rights where they exist. In meeting these responsibilities, the agency consults with the Tribes whenever proposed policies or management actions may affect their interests.

Members of the planning interdisciplinary team consulted Tribal representatives during development of the revised forest plan. The forest supervisor met with the Kalispel Tribe of Indians, Spokane Tribe of Indians, and the Confederated Tribes of the Colville Reservation; as a result, specific Tribal comments were incorporated in this FEIS and revised forest plan.

Federal

Management of Federal lands adjacent to the Colville National Forest was considered in the formulation of alternatives and their cumulative effects, including lands managed by the Fish and Wildlife Service, and USDI Bureau of Land Management. The forest also coordinated with U.S. Customs and Border Protection, U.S. Air Force, and the Regional Interagency Executive Committee.

Consideration of national scenic trails, utility corridors, recommended wilderness, and other management concerns across boundaries were discussed with the Okanogan-Wenatchee and Idaho Panhandle National Forests. The forests met to ensure management problems were not created because of Colville National Forest proposed forest plan direction.

Public Involvement

The Colville National Forest started forest plan revision in 2003 in a combined process with the Okanogan-Wenatchee National Forest. Public participation began in 2004. Workshops about the need to change the existing forest plan were held in communities throughout northeastern Washington. Additional workshops on specific topics, including wilderness and recreation were held from 2005 to 2008. A 2007 memorandum of agreement with the Washington State Association of Counties provides a framework for our work with the three local counties. Meetings with representatives from local counties began in 2004, and are being held on a continuing basis throughout the forest plan revision process. Three federally recognized Tribes have engaged at varied levels: the Colville Confederated Tribes (the Forest’s largest neighbors), and the Spokane and Kalispel Tribes. Government-to-government consultation with Tribal nations and staff-to-staff consultation with their resource specialists began early in the process and continues. The Forest Service works closely with the Washington State Department of Natural Resources, Washington State Department of Fish and Wildlife; and the United States Department of Homeland Security and the US Fish and Wildlife Service. Additional meetings with interest groups, user groups, State and Federal officials, Tribal staff, and industry groups were held.

In June 2011, the Forest Service published a combined notice announcing the proposed actions for the Colville and Okanogan-Wenatchee National Forests were available for public review and comment. Public meetings and outreach efforts continued through 2013, based on the information related to both forests.

The 90-day comment period per the 2011 notice for the proposed action alternative drew 27,274 comment letters, of which 889 contained unique and substantially different comments. We received letters, emails, form letters, and public comment forms from Tribes, individuals, organizations, agencies, businesses, and groups from 15 states in the United States and British Columbia, Canada; however, this does not include state affiliation for all of the form letters. We analyzed 3,250 comments from the 889 comment letters to identify the significant issues driving the alternatives.

Another 90-day public comment period for the draft environmental impact statement (DEIS) and draft revised plan was initiated by publication of a Federal Register Notice on February 19, 2016. Another notice was published in the Federal Register on March 25, 2016, to extend the public comment period for an additional 45 days. During the 135-day comment period, plan revision information was available to the public electronically on the Forest website and an on-line open house site, and available in paper copy and on CD at local libraries and each Forest office. The forest supervisor and plan revision team members continued to meet with Tribal representatives and County Commissioners, as well as interested groups and agencies, to provide information and discuss potential concerns.

The Forest received 926 comment letters of which 363 contained unique or substantially different comments. Letters, emails, form letters and public comment forms from Tribes, individuals, organizations, agencies, businesses and groups from 25 states as well as British Columbia and Quebec, Canada; however, this does not include state or country affiliation for all of the comments received.[8] The Forest analyzed 2,058 comments from these comment letters to identify possible changes to existing alternatives or need to develop new alternatives.

As stated previously, the regional forester determined that the most effective process to reflect public input and resource needs was to separate the Colville and Okanogan-Wenatchee National Forests' plan revision effort. This FEIS reflects issues and alternatives specific to the Colville National Forest only. The Okanogan-Wenatchee National Forest is developing a proposed forest plan and completing a separate analysis specific to its resource needs and public input specific to that forest. All input, including public comments received as part of the combined forest effort that relate to the Colville National Forest, were considered during development of this FEIS and the revised land and resource management plan.

Significant Issues

Public, Tribal, State, and local agency comments play an important role in the forest plan revision process. We reviewed all comments submitted on the proposed action to determine how they would be considered in the analysis. The Council on Environmental Quality regulations at 1501.7 (a) (2) state that the agency will, "Determine the scope (§1508.25) and the significant issues to be analyzed in depth in the environmental impact statement." We identified comments on old forest management, motorized recreation trails, road access, recommended wilderness, wildlife habitat, and riparian and aquatic resource management as significant issues used to formulate alternatives. Other comments were used to refine the proposed action while still meeting the purpose of and need for plan revision; and others are considered in the environmental analyses. A report on the public comments is provided on the forest plan revision website: https://www.fs.usda.gov/detail/colville/landmanagement/planning/?cid=stelprd3824594

[8] Several form letters and emails were received without complete address information.

Following are the significant issues that led to the development of the alternatives described in chapter 2.

Old Forest (Late-successional) Management, and Timber Production

Some members of the public are concerned that the proposed action does not protect old forests and wildlife habitat as well as the 1988 forest plan. Other members of the public asked for increased timber production because they are concerned that the proposed action does not allow enough timber production, which hurts the economy. Some are also concerned that the proposed action limits the Forest Service's ability to defend forests from insects, disease, and fire.

Other members of the public are concerned that the proposed action does not safeguard old forests and wildlife.

Evaluation Criteria

The following indicators were used to evaluate this issue and to develop the variations between the alternatives:

- The effects on local economy (through commercial timber outputs) of alternative approaches in providing late structure forests.
- The risk of wildfire, especially adjacent to communities.
- Contribution to the recovery and viability of late structure/old forest-dependent species.

Key indicators:

- Predicted output, uses and activity levels
    - ♦ Timber (volumes are shown in hundred cubic feet (CCF) and million board feet (MMBF) depending on software used for data modelling)
    - ♦ Estimated percentage and number of forest structural stages (after 20, 50, and 100 years)
    - ♦ Estimated acres by percent departure and wildfire risk level (fire regime condition class)
- Economic and social sustainability
    - ♦ Estimated economic differences between alternatives
- Location and acres of allocations, specifically related to roaded access within wildland-urban interface (WUI)
- Comparison to the proposed action of the contribution to viability of late structure/old forest-dependent species

Motorized Recreation Trails

Public comments reflected opposing desires regarding motorized recreation opportunities, particularly the distribution and quantity of motorized trails. Some members of the public expressed concern that the distribution and quantity of motorized trails negatively affects tourism and the local economy, while other stakeholders[9] said that they want fewer miles of motorized trails and that they don't like the resource damage, noise, and conflict associated with them.

The public also raised concerns about the distribution and number of motorized and non-motorized trails. Some stakeholders said that the distribution and number affect tourism and the local economy in the plan area.

Evaluation Criteria

The following indicators were used to evaluate this issue and to develop the variations between the alternatives:

- The distribution of motorized and non-motorized recreation areas to assess contribution to motorized / non-motorized recreation opportunities.
- The contribution of motorized recreation on the national forest to the local county economy.
- Contribution to the recovery and viability of wildlife and aquatic species that are sensitive to human disturbances that result from motorized recreational activities.

Key indicators:

- Predicted output, uses and activity levels for motorized/non-motorized use
  - ♦ Wildlife - location and acres of allocations for motorized use
  - ♦ Recreation - location, miles, and acres of allocation for motorized and non-motorized use
- Economic and social sustainability
  - ♦ Employment, income, and tax contributions related to recreation
  - ♦ Evaluation of access to motorized and non-motorized trails

Access

Some stakeholders expressed concern that the proposed action does not provide enough roads for recreation, grazing, fire suppression, timber harvest, and firewood collection. They commented that lack of access would have a negative impact on economic well-being.

Other stakeholders said they are concerned that the Forest Service does not have the capacity to maintain its current roads, and that unmaintained roads negatively affect wildlife viability, water quality, and fish populations.

Evaluation Criteria

The following indicators were used to evaluate this issue and to develop the variations between the alternatives:

- Evaluate the effects of road density limits on roaded access for recreation use, wildfire suppression, and vegetation management activities, specifically commercial timber harvest.
- Evaluate whether the management direction concerning road density, road location and objectives for treatment of high-risk roads is effective in restoration or preservation of watershed and hydrologic function and in contributing to the viability of aquatic, terrestrial

[9] Stakeholders = members of the public that have an interest in use and management of the Colville National Forest.

plant, and wildlife species whose population and habitat are known to be sensitive to the impacts of roads.

Key indicators:

- Predicted output, uses, and activity levels
    - ♦ Location and amount of allocations suitable for roads
    - ♦ Changes in road density desired conditions by allocation
    - ♦ Relative contribution to the recovery and viability of surrogate species
    - ♦ Objectives for reduction in miles of high-risk roads
- Economic and social sustainability
    - ♦ Social impact related to recreation opportunities
    - ♦ Economic contribution related to timber production

Recommended Wilderness Areas

While forest plans may make a preliminary recommendation for additional wilderness, only Congress can designate wilderness. Some stakeholders are concerned that the proposed action recommends too much additional wilderness. They commented that more wilderness areas hurt the economy by limiting timber harvest, grazing, mountain biking, and motorized recreation. Members of the public also raised concerns about the increased cost of managing additional wilderness, and are concerned that some proposed wilderness areas do not meet the appropriate criteria for that designation.

Other stakeholders said that the proposed action does not include enough additional wilderness areas; they want more. There were concerns that the recommendations did not include areas that may have outstanding wilderness character, and did not include areas that may contribute to wildlife habitat connectivity. Additionally, some members of the public are concerned about protecting the uniqueness of these areas, and they said that additional wilderness improves the local economy. Commenters expressed concern that proposed direction may not maintain wilderness character prior to wilderness designation by Congress.

Evaluation Criteria

The following indicators were used to evaluate this issue and to develop the variations between the alternatives:

- Whether recommended wilderness areas contribute to the need for wilderness.
- The availability tradeoffs, especially summer and winter motorized uses.
- The market and non-market costs and benefits associated with wilderness.

Key indicators:

- Predicted output, uses, and activity levels
    - ♦ Location and amount of recommended wilderness
    - ♦ Miles of trail available for mechanized or motorized use
    - ♦ Acres suitable for timber harvest and grazing

Wildlife

The public is concerned that the proposed action does not adequately protect wildlife. They said that they want more protection for federally listed species such as grizzly bear, lynx, caribou, and other wildlife species of concern such as wolverine and northern goshawk. To protect these species, stakeholders said they want connected habitats, habitats that are not disturbed by roads and trails, as well as more large trees and snags.

Other stakeholders are concerned that increasing wildlife protection decreases opportunities for recreation, timber production, and livelihoods.

Evaluation Criteria

The following indicators were used to evaluate this issue and to develop the variations between the alternatives:

- Contribution to habitat connectivity for surrogate wildlife species.
- Contribution to the recovery and viability of snag-dependent wildlife species.
- Contribution to the recovery and viability of surrogate and listed wildlife species.

Key indicators:

- A comparison of the relative contribution to provide habitat connectivity for surrogate wildlife species.
- A comparison of the relative contribution to the viability of snag-dependent wildlife species.
- A comparison of the relative contribution to the recovery and viability of surrogate wildlife species.
- A comparison of the relative contribution to the recovery and viability of listed wildlife species.

Riparian and Aquatic Resource Management

Some members of the public expressed concern that the proposed action does not adequately protect riparian areas such as those adjacent to streams, lakes, wetlands, and rivers. Public comments raised concerns that the proposed action does not provide watershed and aquatic resource protections that are as effective as 1988 forest plan direction. Concerns centered on managing possible detrimental impacts of uses such as roads, livestock grazing, and motorized trails in riparian areas.

Other members of the public are concerned that the protection of these aquatic resources limits timber production, grazing, and recreation. Other stakeholders commented that there is a need to balance uses. Another concern raised was potential impact of increased aquatic protection on ability to effectively manage grazing allotments.

Evaluation Criteria

The following indicators were used to evaluate this issue and to develop the variations between the alternatives:

- The viability of threatened, endangered, and sensitive plants within riparian corridors.

- The effectiveness of riparian management area widths and other plan components related to aquatic conservation in riparian and upland areas to contribute to and enhance the recovery of threatened, endangered and sensitive fish species, and maintain or restore watershed function, water quality, and natural flow regime.
- Contribution to the recovery and viability of riparian-dependent wildlife species.

Key indicators:

- Acres designated for riparian habitat management.
- Plan components for protection and restoration of water resources and riparian systems.
- Acres within key and INFISH priority watersheds.
- Relative contribution to recovery and viability of riparian-dependent surrogate wildlife and fish species.
- Predicted trends for sensitive plant species.

Other Issues

The Colville National Forest received comments that were considered and may have related plan components, but did not drive development of alternatives. The National Environmental Policy Act regulations, in Sec. 1501.7 (3) direct agencies to "…identify and eliminate from detailed study the issues which are not significant or which have been covered by prior review (§1506.3), narrowing the discussion of these issues in the statement to a brief presentation of why they will not have a significant effect on the human environment or providing a reference to their coverage elsewhere." Specifically, these comments are:

- Outside the scope of the proposed action
- Already decided by law, regulation, or other higher level decision
- Irrelevant to the decision to be made
- Conjectural and not supported by scientific or factual evidence: or
- Those that contributed to other sections, such as the purpose of and need for action, or the scope of the analysis

Some of the comments are of widespread public interest. Below is a summary of those areas of interest with an explanation of how they are considered in the forest plan revision process. It should be understood these comments were not arbitrarily dismissed as they continue to provide useful information.

Other Topics Related to the Decision to be Made

The following list is not all-inclusive, but it does highlight key topics of interest to the public that will not be addressed in the FEIS.

Boundaries Designated By Congress

It is outside the authority of the Forest to move any boundary established by Congress. Congressionally designated areas on the Colville National Forest include the Salmo-Priest Wilderness and the Pacific Northwest National Scenic Trail. Changes to these congressionally designated areas are not included in the forest plan revision effort.

Eligible Wild and Scenic Rivers

Commenters expressed the desire to see more rivers eligible for inclusion in the Wild and Scenic Rivers System. The determination of eligibility for designation under the Wild and Scenic Rivers Act is made through a process outlined in the Forest Service Handbook, 1909.12 Chapter 80. Rivers found to be eligible remain eligible until a suitability assessment is completed, or another eligibility process is conducted.

The responsible official has the discretion to determine whether and to what extent an issue is appropriate for consideration in plan revision. As there has not been a change in circumstances since the inventory completed for the 1988 forest plan, evaluation of eligibility for additional rivers was not a revision topic and is not addressed in the FEIS. The revised plan carries forward the rivers identified as eligible for inclusion in the Wild and Scenic River System for the 1988 forest plan and includes plan components to maintain the free-flowing characteristic and outstandingly remarkable values of eligible rivers. Rivers eligible for inclusion in the Wild and Scenic River System do not vary by alternative.

2001 Roadless Area Conservation Rule (36 CFR Part 294)

The proposed action includes management direction for inventoried roadless areas identified in the 2001 Roadless Area Conservation Rule. On October 21, 2011, the 10th Circuit Court of Appeals reversed the Wyoming District Court and upheld the USDA's 2001 Roadless Rule in *Wyoming* v. *United States Department of Agriculture*. The decision by the 10th Circuit resolves 10 years of litigation. The ruling confirms that the agency has the authority to manage and protect roadless lands within the National Forest System and that the department complied with all applicable laws in adopting the 2001 Roadless Rule. Under the 2001 Roadless Rule, new road construction and reconstruction are generally prohibited in inventoried roadless areas, and timber harvest is only permitted under a few limited exceptions. It is outside the authority of the revised land and resource management plan to make any changes to boundaries of inventoried roadless areas.

Allotment Management

Many people expressed concerns regarding domestic cattle grazing. Some people want to end grazing on national forests altogether. Eliminating grazing is inconsistent with Forest Service policy. Opening and closing allotments or changing allotment boundaries are site-specific decisions not made in this forest plan revision process. The revised land and resource management plan and alternatives identify suitable uses (including grazing) for each management area and the FEIS discloses the effects of grazing on other resources. Alternatives are not designed to change boundaries, end grazing, or make site-specific changes to allotments. The revised land and resource management plan describes management direction, such as desired conditions for the variety of vegetation types within grazing allotments, that may result in future changes to allotment management plans.

Travel Management

In 2005, after much study and public input, the Forest Service published the Travel Management Rule, Title 36 Parts 212, 251, 261, and 295 of the Code of Federal Regulations; its goal was to regulate the use of motor vehicles on NFS lands while managing the transportation system to balance social, economic, and ecological conditions. The Travel Management Rule is comprised of three main sections, which are identified as Subparts A, B, and C.

Subpart A: Administration of the Forest Transportation System directs national forests to identify the most ecologically, economically, and socially sustainable transportation system. This is accomplished at both the forestwide scale and the project level by using a process known as travel analysis. Travel Analysis Reports are used to inform decisions regarding roads. In 2014, the Colville National Forest completed a Forestwide Travel Analysis Report in response to Subpart A. Recommendations from the Forestwide Travel Analysis Report have been incorporated into the land and resource management plan in the form of plan components which address ecological, economic, and social sustainability of the road system, including road density recommendations for some management areas. These plan components will be used to inform future decisions on roads at the project level. Any decisions regarding specific roads will be accomplished at the project level, as has been done in the past.

Subpart B: Designation of Roads, Trails and Areas for Motor Vehicle Use requires National Forests to designate a system of roads, trails, and areas that are open to motor vehicle use for both off-highway and highway-legal vehicles on a Motor Vehicle Use Map (MVUM). The premise of the rule is that roads, trails, and areas are closed to motor vehicle use unless designated as open on the MVUM. The Colville National Forest began a collaborative process of designating roads and trails open to motor vehicle use in 2005 and published the first MVUM in 2008. The Forest continues to modify its MVUM annually to reflect decisions that have been made regarding the transportation system and its uses. While the land and resource management plan addresses suitability of roads and motor vehicle use in the different management areas, it does not open or close any roads or change current designations for motor vehicle use.

Subpart C: Use by Over-Snow Vehicles (OSV) (revised in February 2015) addresses over-snow motorized use of trails, roads and areas on NFS lands and requires the agency to designate routes and areas where OSV use is permitted on an OSV Use Map. The revised land and resource management plan addresses suitability of winter motorized uses in different management areas. Analysis and direction in the FEIS, revised land and resource management plan and record of decision will be used to inform the implementation of Subpart C of the Travel Management Rule and the development of a Colville National Forest OSV Use Map.

As discussed above, the revised land and resource management plan does not make any specific decisions regarding the designation or closure of existing roads or areas for motor vehicle use. The revised land and resource management plan helps guide the Colville National Forest in its continuing implementation of the Travel Management Rule and provides direction regarding the management of the transportation system. Some people asked that the Travel Management Rule be set aside, or that previous decisions to designate roads, trails, or areas for motor vehicle use be modified in the revised land and resource management plan. It is not within the authority of the responsible official to set aside law, regulation, or policy.

Climate Change

Climate change concerns appeared in several comments. Some people do not consider climate change a proven phenomenon, while others feel it should be the central impetus for change. Forest Service policy is to consider the effects of climate change in forest plan revisions (Considering Climate Change in Land Management Plan Revisions, memorandum, 2010). Climate change is likely to affect all vegetation types and biophysical resources, result in consequences for many resources, affect the resilience of road and trail networks and other forest infrastructure, and is part of the dynamic baseline condition. All alternatives focus on designing desired conditions to provide healthy, resilient forests and more resilient infrastructure (e.g., trails, campgrounds, roads) in the face of climate change and other disturbance factors. Climate change is identified in the purpose of and need for action section of this FEIS as a reason for updating the 1988 forest plan.

Access for People with Disabilities

People commented that denial of motor vehicle access to people with disabilities violates the Americans with Disabilities Act. The Americans with Disabilities Act defers to Section 504 of the Rehabilitation Act of 1973, which says that no person with a disability can be denied participation in a Federal program available to all other people solely because of his or her disability. In conformance with section 504, wheelchairs or mobility devices are welcome on all NFS lands that are open to foot travel, and they are specifically exempted from definition as a motor vehicle in section 212.1 of the Travel Management Rule (36 CFR 212.1). There is no legal requirement to allow people with disabilities to use off-highway vehicles (OHVs) or other motor vehicles on roads, trails, and areas closed to motor vehicle use. Reasonable restrictions on motor vehicle use, applied consistently to everyone, are not discriminatory. This concern has been decided by law.

Budget

Many people commented that the revised land and resource management plan should not be constrained by a budget. However, it is not realistic or reasonable to ignore expected funding levels during forest plan revision. Increases in budgets beyond expected levels could result in a faster rate of achievement of the desired conditions than those projected by alternative. Recent budget trends are essentially level or slightly declining, and those trends are expected to continue in the near future. This is not a significant issue to be analyzed in the FEIS because the land and resource management plan does not influence or control the budget for the Forest.

Many people commented that budget considerations should be included in the development of land and resource management plan objectives, commenting that budgets affect delivery of goods and services people value about a national forest, such as trails and campgrounds, well-maintained roads to drive, and the availability of people to monitor activities and enforce rules to prevent resource damage. The proposed objectives do consider budget trends.

Fees

Some commenters raised the topic of fees for a variety of forest products and uses. Fees are an administrative decision and are outside the scope of the forest plan revision process.

Solar and Wind-generated Power

National- and regional-level assessments of potential for solar and wind power indicate the Colville National Forest does not offer a high potential for either energy source; therefore, there is no need to develop specific guidance in the revised land and resource management plan.

Recreation Residences

Recreation residence permits are issued or renewed as a site-specific decision. Such decisions are not included in the plan revision process or decision.

Record of Decision, Nationwide Application of Fire Retardant on National Forest System Land, December 13, 2011

This record of decision established new national direction for the use of fire retardant applied from aircraft to manage fires, and will be carried forward unchanged. The new direction includes procedures for monitoring and reinitiating consultation with Fish and Wildlife Service if aerially applied fire retardant affects certain species or habitat. The direction also provides greater protection for cultural resources

Application of Laws and Regulations

Many commenters asked that existing laws and regulations be specifically mentioned and interpreted as to applicability in the revised land and resource management plan, such as enlarging on the list of multiple uses a national forest should have in relation to the Multiple-Use Sustained-Yield Act. It is not the role or purpose of a land and resource management plan to interpret laws and regulations. Forest Service direction for managing NFS lands comes from several levels. National and regional direction includes laws, executive orders, and regulations. Forest Service policy guides activities on the Forest. All Forest activities must comply with national direction and reflect national policy. Applicable laws and regulations apply to the Colville National Forest and cannot be overridden by a land and resource management plan, making this issue outside the scope of the forest plan revision process.

Administrative or Site-specific Actions

Many commenters requested the inclusion of administrative actions, such as adding lookouts to the recreation rental program. Administrative actions are made outside the authorities of the revised land and resource management plan. Commenters also asked that the revised land and resource management plan make site-specific actions such as installing an outhouse at a specified trailhead. The revised land and resource management plan provides broad guidance and information for project and activity decision-making on the Colville National Forest for approximately the next 15 years. Forest plans are strategic in nature. They do not include project and activity decisions. Those decisions are made later or outside the land and resource management plan when proposals for a specific action in a specific area are made and analyzed, and there is the opportunity for public involvement.

Changes Between Draft and Final Environmental Impact Statements

Minor editorial changes, such as corrections to spelling and grammatical errors, corrections and clarifications to the use of acronyms, and visual formatting have been made throughout this document. This FEIS also contains new information and/or analysis developed since the time of the DEIS. These changes are summarized below.

Changes to Chapter 1

Additional details added to public involvement section reflect ongoing public involvement since the time of the draft EIS. Tables summarizing alternatives were updated. Information about the number and types of species occurring on the Forest was updated.

Changes to Chapter 2

- Changes common to more than one alternative:
    - ♦ No action, proposed action, alternatives P, B, R, O- additional detail was added for descriptions of all alternatives. Table comparing the suitability of management areas across alternatives was added (table 21).
    - ♦ Proposed action, alternatives P, B, R, O- addition of approximately 2,000 acres of land in the Sheep Creek area due to a recently completed land acquisition. These acres were

allotted to the general restoration management area in all alternatives except for alternative O, where they were allotted to responsible restoration management area.

- ♦ Alternatives P and O- Kettle Crest Special Interest Area changed to Kettle Crest Recreation Area. Discussions of special interest areas and special areas have been changed to use the term "areas with special designations".

- Changes to alternative P (preferred alternative):
    - ♦ Cee Cee Ah subwatershed was added to the key watershed network and changed from general restoration to Focused Restoration Management Area.
    - ♦ Approximately 7,000 acres of recommended wilderness were changed to backcountry or general restoration due to refinement of management boundaries and response to public comment.
    - ♦ Updates to the Aquatic and Riparian Conservation Strategy (ARCS) have been made since the draft EIS. These changes are reflected in the various resource sections in chapter 3, and contained in appendix H.
- Additional discussion of alternatives considered but not fully developed. These changes cover alternatives that were suggested during the 135-day comment period.

Changes to Chapter 3

- Changes to all resource analysis sections to reflect the changes made to alternative P.
- Updated discussion on climate change.
- Updated wildlife section discussion of Threatened, Endangered and Sensitive species to include analysis of wolverine and yellow-billed cuckoo.
- General updates made through all resource area discussions including reorganization of information to increase readability, updated and additional information based on internal discussions and response to public comment.
- Some terminology has been changed between the draft and final EIS to reduce confusion and update best available scientific information. Both the terrestrial and aquatic sections of the DEIS referred to Species of Conservation Concern. Species of Conservation Concern have a specific definition and process for selection under the 2012 planning rule that is not applicable to the plans revised under the 1982 planning rule. To avoid confusion with the 2012 planning rule and its implementing regulations, Species of Conservation Concern is not used in this FEIS. Rather, the following categories of species are discussed. These categories fully comply with the 1982 planning rule, NFMA, the 2012 planning rule monitoring program development (CFR 219.12), and the obligation to utilize best available science. It is important to note that species can fall within one or more of the groups defined below. For example, the white-headed woodpecker is a management indicator species, a focal species, and a surrogate species.
    - o Management indicator species (MIS) - Management indicator species were used for the purpose of assessing the impacts of the alternatives on wildlife and fish populations as directed in the 1982 planning rule (CFR 219.19 (a) (1) and (2)). The no-action alternative (no change in current management) was evaluated in terms of the management indicator species listed in the 1988 forest plan.

- Focal species - Although this plan revision was developed under the 1982 planning rule, it is required that all land management plans be updated to include a monitoring strategy that addresses the status of focal species as directed in the 2012 planning rule (36 CFR 219.12 (c) (1)). Focal species are not intended to be a proxy for other species. Instead, they are species whose presence, numbers, or status are useful indicators that are intended to provide insight into the integrity of the larger ecological system, the effects of management on those ecological conditions, and the effectiveness of the CFR 219.9 provisions.
- Surrogate species - The DEIS and FEIS used surrogate species status and trend to provide insights to the integrity of the larger ecological system to which it belongs. They serve an umbrella function in terms of encompassing habitats needed for other species, are sensitive to the changes likely to occur in the area, or otherwise serve as an indicator of ecological sustainability. The long-term sustainability of the surrogate species is assumed to be representative of a group of species with similar ecological requirements and this group is assumed to respond in a similar manner to environmental change (Suring et al. 2011).
- Threatened, Endangered and Sensitive Species - Threatened, Endangered and Sensitive species terminology did not change between DEIS and FEIS. The Endangered Species Act of 1973 requires all Federal agencies to conserve endangered and threatened species and ensure that actions authorized, funded, or carried out by them are not likely to jeopardize the continued existence of any T&E species or result in the destruction or adverse modification of their critical habitats. Forest Service Manual (FSM) 2670 requires review of actions and programs authorized, funded or carried out by the Forest Service to determine their potential for effect on threatened and endangered species and species proposed for listing. FSM 2670 also requires review of programs and activities as part of the National Environment Policy Act of 1969 to determine their potential effect on sensitive species.

Changes to Appendices

- Added appendices E through J.

Chapter 2. Alternatives, Including the Proposed Action

Introduction

This chapter describes and compares the alternatives considered for revising the 1988 Colville Forest Plan. This section also presents the alternatives in comparative form, describing the differences between each alternative and providing a clear basis for choice among options by the decisionmaker and the public. The revision includes changing all, or a portion of, the programmatic decisions that make up the 1988 forest plan. Some of the information used to compare alternatives is based on the design of the alternative (i.e., the arrangement of management areas) and some of the information is based on the social, environmental, and economic effects of implementing that alternative (i.e., expected outcomes for social, economic, or ecological conditions). This chapter provides the following four discussions:

- Development of alternatives;
- Description of each alternative considered in detail, including the preferred alternative and elements common to all alternatives;
- Alternatives considered but eliminated from detailed study; and
- Comparison of alternatives.

Development of Alternatives

As discussed in chapter 1, this revision of the land and resource management plan is based on the “need for change.” Key issues were identified in public comment on the proposed action. These issues drove alternative development. Additional issues common to all alternatives were also identified and considered in the effects analysis. Some additional items are addressed in the revision because they are required by planning regulations (i.e., 36 CFR 219.14 through 219.26 (1982 planning rule)).

The no action alternative reflects current management practices under the 1988 forest plan, as amended and implemented, and provides the basis for comparing alternatives to current management and levels of output. While all alternatives provide a wide range of multiple uses, goods, and services, some give slightly greater emphasis to selected resources based on the alternative’s response to various revision topics.

The proposed action is based on the need for change identified in the Analysis of the Management Situation, implementation and monitoring of the 1988 forest plan, and early public working group meetings (2004). The alternatives to the proposed action were developed through the public meetings that continued through 2008 and public comments on the 2011 proposed action scoping. The alternatives represent a range of possible management options from which to choose.

Forest plans do not make budget decisions. However, alternatives emphasize different programs to different degrees, with an expectation of appropriate funding. Should Congress emphasize specific programs by appropriation, a redistribution of priorities would follow, regardless of the alternative implemented.

All alternatives to the proposed action considered in detail respond to the need for change or address one or more significant issue. However, not all possible alternatives were carried into detailed study, as the list of options would have been prohibitively large. Instead, the responsible official identified those alternatives that both met the criteria and created a reasonable range of outputs, direction, costs, management requirements, and effects from which to choose. All alternatives considered in detail would meet law, regulation, and policy.

Alternatives Considered in Detail

In addition to the no action alternative and the proposed action, the Forest Service developed four action alternatives, which respond to the needs for change and issues identified by the public. Table 3 provides a short description of each alternative. Additional detail is provided in the following sections. Table 21 below shows a comparison of suitability by management area across the alternatives. Acres listed for each alternative description are approximate.

Table 3. Short description of alternatives considered in detail

Alternative	Description
No Action Alternative-1988 Forest Plan	The no action alternative reflects current management practices under the existing 1988 forest plan, as amended and implemented. It provides the basis for comparing the existing condition to the proposed action and the alternatives. This alternative includes direction in the Inland Native Fish Strategy for the Intermountain, Northern, and Pacific Northwest Regions (INFISH) and the Management Direction Establishing Riparian, Ecosystem and Wildlife Standards for Timber Sales (Eastside Screens). Harvest of trees over 21-inches in diameter would continue to be prohibited. Scheduled timber harvest is suitable on 52% of the forest. Incidental timber harvest for specific resource benefit is allowed on an additional 31% of the forest. Annual projected wood sale quantity (PWSQ) volume is 41 MMBF, with an estimated wage contribution of $19,335,000. Planned ignitions (prescribed fire) are suitable on 97% of the forest (outside congressionally designated wilderness). Unplanned ignitions (wildland fire use) are suitable on 90% of the forest. There is no recommended wilderness under the no action alternative. Approximately 11% of the forest is managed for non-motorized recreation opportunities, including the Salmo-Priest Wilderness (congressionally designated). The no action alternative includes riparian habitat conservation areas (RHCAs) and the priority watershed network established under INFISH. It manages toward the 8 riparian goals established under INFISH.
Proposed Action	The June 2011 proposed action was developed to address the need for change, and considers early public participation that began in 2003. The emphasis of this alternative is to apply active vegetation management in a dynamic landscape approach to increase vegetation resilience and move the landscape toward desired conditions. Landscape ecology concepts would be applied to provide for ecological resilience to disturbances, including the effects of climate change. New science related to the recovery of terrestrial and aquatic threatened and endangered species would be applied. Vegetation requirements in Eastside Screens are addressed with desired conditions to be within HRV by stand size class. Down and coarse wood and biological legacies are addressed in a similar manner. The Eastside Screens 21-inch diameter limit is replaced by structural stage and wildlife habitat direction. Scheduled timber harvest would be suitable on 63% of the forest. Timber harvest would be allowed for other resource benefit on an additional 20% of the forest. Annual PWSQ volume would be 62 MMBF, with an estimated wage contribution of $31,224,000. Planned and unplanned ignitions would be suitable on 100% of the forest. An additional 101,400 acres of wilderness would be recommended, including the Kettle Crest. Existing inconsistent uses (such as mountain bike and chainsaw use) would continue in Recommended Wilderness Management Areas until such time as designated as wilderness by Congress. Approximately 21% of the forest is suitable for non-motorized recreation opportunities. Backcountry and Backcountry Motorized Management Areas represent 14% of the forest. The proposed action adopts the Aquatic and Riparian Conservation Strategy (ARCS 2008), replacing INFISH with a long-term strategy that uses best science and aligns species and water quality recovery plans. It focuses on desired conditions for aquatic and riparian function, and

Alternative	Description
	watershed condition. The proposed action includes a key watershed network, replacing the priority watersheds established under INFISH.
Alternative P (Preferred Alternative)	Alternative P is similar to the proposed action in the overall vegetation management approach and outputs, and backcountry recreation management would be similar to the proposed action. Vegetation requirements in Eastside Screens are addressed with desired conditions to be within HRV by stand size class. Down and coarse wood and biological legacies are addressed in a similar manner. The 21” diameter limit is replaced by structural stage and wildlife habitat direction, and a guideline for large tree management. Scheduled timber harvest would be suitable on 63% of the forest. Timber harvest would be allowed for other resource benefit on an additional 19% of the forest. Annual PWSQ volume would be 62 MMBF, with an estimated wage contribution of $31,224,000. Planned and unplanned ignitions would be suitable on 100% of the forest. An additional 61,700 acres of wilderness would be recommended, not including the Kettle Crest. Existing inconsistent uses (such as mountain bike and chainsaw use) would continue in recommended wilderness until such time as designated as wilderness by Congress. No new motorized or mechanized recreation opportunities would be allowed. Approximately 21% of the forest is suitable for non-motorized recreation opportunities. Backcountry and Backcountry Motorized Management Areas represent 17% of the forest. Approximately 80,300 acres would be managed as the Kettle Crest Recreation Area. This management area allocation would protect outstanding recreation opportunities in a semi-primitive setting while allowing continued motorized and mechanized recreation opportunities. Alternative P would incorporate much of ARCS (2016). It would also increase riparian protection through additional plan components developed under the Colville ARCS, and expand the key watershed network by including Cee Cee Ah Creek as a key watershed.
Alternative R	Alternative R was developed to address concerns from conservation groups, and would emphasize a large-scale reserve approach for late-successional forest structure, emphasizing a passive management approach to reach desired conditions. Eastside Screens 21-inch diameter limit on cutting live trees would be retained. Down and coarse wood and biological legacies are addressed in a similar manner. Scheduled timber harvest would be suitable on 12% of the forest. Timber harvest would be allowed for other resource benefit on an additional 70% of the forest. Annual projected wood sale quantity (PWSQ) volume would be 14 MMBF, with an estimated wage contribution of $6,692,000. Planned and unplanned ignitions would be suitable on 100% of the forest. An additional 209,000 acres of wilderness would be recommended, including the Kettle Crest. Existing inconsistent uses (such as mechanized, motorized, and rental cabins) would not be allowed to continue in recommended wilderness. Approximately 24% of the forest is suitable for non-motorized recreation opportunities. Backcountry and Backcountry Motorized Management Areas represent 2% of the forest. Alternative R would use a similar aquatic strategy approach as the proposed action alternative through incorporation of a modified version of ARCS (2008). It includes a key watersheds network
Alternative B	Alternative B was developed based on recommendations from the Northeast Washington Forestry Coalition (NEWFC), and points of consensus with public workgroups. It is designed to address the concerns of multiple constituencies in one alternative by balancing land allocations between areas emphasizing active management (timber management zones) (44%), a mix of active and passive management (restoration areas) (31%), and passive management (recommended and designated wilderness) (23%). Where plan components were not identified by the collaborative group, the 1988 Colville Forest Plan (no action alternative) would provide plan direction (remain unchanged). Eastside Screens 21-inch diameter limit on cutting live trees and the large-scale reserve approach for late-successional forest structure would be retained. Additional plan components would limit timber harvest in late-successional structure to dry plant association groups only.

Alternative	Description
	Scheduled timber harvest would be suitable on 37% of the forest. Timber harvest would be allowed for other resource benefit on an additional 46% of the forest. Annual PWSQ volume would be 37 MMBF, with an estimated wage contribution of $17,428,000. Planned and unplanned ignitions would be suitable on 100% of the forest. An additional 220,300 acres of wilderness would be recommended, including the Kettle Crest. Existing inconsistent uses (such as mechanized and motorized uses, and rental cabins) would not continue in Recommended Wilderness Management Areas. Approximately 24% of the forest is suitable for non-motorized recreation opportunities. Backcountry and Backcountry Motorized Management Areas represent 1% of the forest. Alternative B would retain and integrate INFISH, including the priority watersheds, and continue management of riparian habitat conservation areas similar to the no action alternative.
Alternative O	Alternative O would balance land allocations, similar to alternative B, between areas emphasizing active management (Responsible Management Areas) (39%), emphasizing a mix of active and passive management (Restoration Areas) (34%), and emphasizing passive management (backcountry and recommended/designated wilderness) (20%). Where plan components were not identified by the collaborative group, the 1988 Colville Forest Plan (no action alternative) would provide plan direction (remain unchanged). Eastside Screens 21-inch diameter limit on cutting live trees and the large-scale reserve approach for late-successional forest structure would be retained. Additional plan components would be included to limit mechanical restoration treatments (timber harvest) to a one-time entry. Scheduled timber harvest would be suitable on 33% of the forest. Timber harvest would be allowed for other resource benefit on an additional 49% of the forest. Annual PWSQ volume would be 38 MMBF, with an estimated wage contribution of $17,465,000. Planned and unplanned ignitions would be suitable on 100% of the forest. An additional 15,900 acres would be recommended as wilderness. Existing inconsistent uses (such as mountain bike and chainsaw use) would continue in recommended wilderness until such time as designated as wilderness by Congress. No new motorized or mechanized recreation opportunities would be allowed. Approximately 21% of the forest is suitable for non-motorized recreation opportunities. Backcountry and Backcountry Motorized Management Areas represent 21% of the forest. Approximately 99,000 acres would be managed as the Kettle Crest Recreation Area. This management area allocation would protect outstanding recreation opportunities in a semi-primitive setting while allowing continued motorized and mechanized recreation opportunities. Alternative O would adopt ARCS (2008) similar to the proposed action. It includes a key watersheds network.

The Preferred Alternative

The responsible official, the regional forester for the Pacific Northwest Region, has identified alternative P as the preferred alternative for this FEIS, which is presented as the revised forest plan.

Elements Common to All Action Alternatives

All action alternatives represent, to varying degrees, the principles of multiple-use and ecological and economic sustainability. The alternatives provide basic protection of forest resources and comply fully with applicable laws, regulations, and policies. In addition, all the alternatives would:

- Meet the purpose and need for change and/or address one or more significant issues;
- Conserve soil and water resources and not allow significant or permanent impairment of the productivity of the land;
- Provide protections for riparian areas;
- Contribute to the recovery and viability of terrestrial and aquatic wildlife and plant species;
- Maintain air quality that meets or exceeds applicable Federal, State, and/or local standards or regulations;
- Include measures for preventing the destruction or adverse modification of critical habitat for threatened and endangered species;
- Protect heritage resources;
- Recognize the unique status of American Indian Tribes and their rights retained by trust and executive order with the United States, including consultation requirements;
- Provide sustained multiple uses, products, and services in an environmentally acceptable manner (including minerals, timber, livestock forage, and recreation opportunities);
- Retain existing designated areas (e.g., wilderness areas, scenic byways, national scenic trails); and
- Retain all existing permitted activities and facilities.[10]

In addition, the following plan components are common to all alternatives. (The components are described in detail in the revised forest plan, which accompanies this document.)

Desired Conditions (Goals)

Desired conditions (also known as goals) include descriptions of desired outcomes because of Forest Service management. The desired conditions are described in detail in the revised forest plan which accompanies this document.

Objectives

Objectives are time-specific, measurable statements of a desired rate of progress toward a desired condition or conditions. They should be based on reasonably foreseeable budgets.

[10] All permits will be reviewed for compliance with the revised forest plan. Any permit found to be out of compliance will be brought into compliance as soon as practicable using a variety of tools, including modifications or amendments to the permit.

Forestwide Standards and Guidelines

Standards and guidelines include design considerations, mitigations, and constraints for project-level decisions. Although the action alternatives share some common forestwide standards and guidelines, many vegetation and road-related components vary by alternative. Riparian area plan components also vary by alternative.

Suitability of Uses

The criteria for the suitability of various uses (e.g., livestock grazing, timber harvest, recreation opportunity) are the same in all alternatives. However, when the criteria are applied to the different alternatives, there may be variations in the amount of land suitable for certain uses (i.e., if an alternative has more recommended wilderness, there could be less land suitable for motorized use).

Monitoring Strategy

Monitoring and evaluation provide the strategy for determining the degree to which on-the-ground management is maintaining or making progress toward desired conditions. All action alternatives share a common monitoring framework, whereas the monitoring strategy for the no action alternative is unique.

Plan Components Common to All Action Alternatives

Management direction for the following resource topic areas remains unchanged between action alternatives.

Vegetation

All action alternatives include the same long-term vegetation desired condition, which is defined by the historical range of variability (HRV). The historical range of variability refers to the dynamic behavior and function of ecosystems before dramatic changes occurred with European settlement, generally considered to be the mid-1800s for this area (Aplet and Keeton 1999). The historical range of variability provides a framework to determine changes to ecosystem attributes that have occurred between historical and current conditions and recognizes that ecosystems experience a range of conditions across which processes are resilient and self-sustaining.

We used an assessment of forest dynamics and the historical range of forest structure to develop a range of desired representation across structural stages within five vegetation types (Douglas-fir dry; Northern Rocky Mountain conifer; Spruce/Subalpine fir; Subalpine fir/Lodgepole pine; and Western red cedar/Western hemlock). These vegetation types reflect the plant association groups found on the Colville National Forest.

Having a range of forest structural stages provides resilience and is compatible with maintaining characteristic disturbance processes such as wildland fire, insects and diseases, as well as habitat conditions for associated wildlife species. A range of structure contributes to aesthetic settings, particularly along scenic byways and highways.

Table 4 and table 5 describe forestwide desired conditions for each vegetation type. Although all action alternatives include similar desired conditions for vegetation structure, the management approaches used to achieve desired condition vary by alternative. Each alternative description provides more detail.

Table 4. Desired condition for forest structure (percent)

Vegetation Type	Early*	Mid Open	Mid Closed	Late Open	Late Closed
Douglas-fir dry	6-16	2-8	4-13	38-78	1-32
Northern Rocky Mountain mixed conifer	9-25	1-3	18-30	4-6	44-60
Western hemlock / Western red cedar	4-24	0	7-27	0	55-83
Subalpine fir / Lodgepole pine	45-65	0	33-53	0	3
Spruce / Subalpine fir	14-46	0	13-41	0	29-57

*Structure Definition

Early	Trees less than 10 inches diameter at breast height (d.b.h.) or canopy cover less than 10 percent
Mid Open	Trees 10 to 20 inches d.b.h., canopy cover 10 percent and greater, but less than 40 percent
Mid Closed	Trees 10 to 20 inches d.b.h., canopy cover 40 percent or greater
Late Open	Trees 20 inches d.b.h. or greater, canopy cover 10 percent and greater, but less than 40 percent
Late Closed	Trees 20 inches d.b.h. or greater, canopy cover 40 percent or greater

Table 5. Expected patch sizes for each vegetation type

Vegetation Type	Patch Size	Opening Size	Description
Douglas-fir dry	Highly variable	Primarily small (less than 5 acres) with occasional openings greater than 10 acres in very limited circumstances. Openings less than 40 acres in nearly all cases.	Larger patches of open canopied stands would have included tree clumps and openings at a scale finer than that of an individual stand.
Northern Rocky Mountain Mixed Conifer	Variable (5 to 1,000 acres)	Openings generally less than 40 acres in size, with the majority of patches being less than 5 acres in size.	Mixed-severity fire generates variable patches and openings, though most openings in this type would have historically been relatively small.
Western red cedar / Western hemlock	Medium to large (constrained primarily by spatial arrangement)	Generally commensurate with patch sizes.	The primary limiting factor on patch and opening size for this type is the spatial arrangement of the vegetation type itself. Because it does not generally occur in large contiguous areas of the Colville, smaller patches and openings would occur here than typical for this vegetation type.
Subalpine fir / Lodgepole pine	Variable, ranging up to 1,000s of acres	Highly variable, with many small-medium patches (less than 40 acres) and a few larger patches up to 1,000 acres or more in size.	Predominantly smaller patches would have been interspersed with few, larger patches. The larger patches were historically created during extreme fire weather events much as they are today.
Spruce / Subalpine fir	Generally less than 500 acres, with the majority of patches less than 40 acres	Generally commensurate with patch sizes.	Both patch and opening size is primarily limited by spatial arrangement on the Colville National Forest. As a result, smaller patches and openings would occur here than is typical for this vegetation type.

All action alternatives provide the same desired conditions (goals), standards and guidelines for non-forested vegetation types. Non-forested vegetation types such as subalpine and montane meadows, shrub-lands and wetlands are managed as unique habitats for plants and wildlife.

Invasive Species and Pesticide Use

The 1988 forest plan management direction for invasive species and pesticide use mainly comes from the *Pacific Northwest Region Invasive Plant Program Preventing and Managing Invasive Plants Record of Decision* (USDA Forest Service 2005a), which amended the plan. The Forest also maintains a list of best management practices for preventing the introduction, establishment and spread of invasive plants. Management direction for other invasive taxa and pesticide use in general is outdated in the 1988 forest plan.

Analysis within the *Pacific Northwest Region Invasive Plant Program Preventing and Managing Invasive Plants Final Environmental Impact Statement* (USDA Forest Service 2005a) remains valid, and along with national policy provides the basis for management direction under all action alternatives. In all action alternatives, this management direction would be updated to reduce redundancy and provide better consistency with national policy. In addition, the focus on invasive plants has been broadened to include other invasive taxa (animals, pathogens, aquatic species) and pesticide use guidance has been clarified. Management direction for invasive species and pesticide use has been updated in the revised plan for clarity in response to public comments and regional review.

Wildland Fire Management

Naturally, ignited wildfires would be managed to meet multiple objectives across the entire forest, with the exception of administrative and recreation sites. This includes both protection objectives and natural resource management objectives. The objectives for a specific fire would depend upon its location, the conditions under which it is burning and the relative risks and benefits associated with the fire. These objectives may change as a fire moves across the landscape and as conditions change over time. Analysis of weather conditions, ignition location, and resource concerns would be used to make decisions related to the use of natural ignitions to achieve resource benefits.

Planned ignition would be allowed to achieve resource objectives forestwide in all action alternatives. Desired conditions, guidelines, and standards for wildland fire management would remain the same across all alternatives. The *Record of Decision, Nationwide Application of Fire Retardant on National Forest System Land, December 13, 2011* (USDA Forest Service 2011c*)* established new national direction for the use of fire retardant applied from aircraft to manage wildfires and would be applicable across all alternatives.

Air Quality

The State of Washington regulates air quality. Existing laws and regulations define requirements. Desired conditions and standards would remain the same as shown in the revised forest plan across all alternatives.

Soils

Management direction for soils would be common across all action alternatives.

Grizzly Bear

The Forest has occupied grizzly bear habitat. Management of grizzly bear habitat does not vary between action alternatives. Grizzly bear management is defined by the 1986 Interagency Grizzly Bear Guidelines, Colville National Forest Guidelines for Management in Occupied Grizzly Bear Habitat (USDA Forest Service 1988c), Grizzly Bear Recovery Plan (USFWS 1993), and Amended Biological Opinion for the Continued Implementation of the Colville National Forest and the Idaho Panhandle National Forests Forest Plans (USFWS 2001). The Forest would incorporate management guidance from these documents and/or future section 7 consultation documents as appropriate in all action alternatives considered in this FEIS.

Woodland Caribou and Canada Lynx

Management for woodland caribou and Canada lynx would not vary between action alternatives. Woodland caribou habitat management currently follows direction identified in the 2001 USFWS biological opinion for seasonal habitat needs and the Colville National Forest winter recreation strategy[11] (USDA Forest Service 2003). Current management direction for Canada lynx is provided through the Canada Lynx Interagency Agreement that relies on the science summarized in the Canada Lynx Conservation Assessment and Strategy (ILBT 2013). The Forest would incorporate the management guidance from these documents and/or future section 7 consultation documents as appropriate in all action alternatives considered in this FEIS.

Heritage

Laws and regulations provide guidance for protecting and managing heritage resources. The heritage resource is also coordinated with the State Historic Preservation Office and Indian Tribes. This emphasis and protection would be the same in all alternatives.

Livestock Grazing

The revised plan proposes no changes in the status, location, or boundaries of permitted range allotments or type of livestock**.** However, plan components that affect management of livestock grazing would vary by alternative.

Minerals, Locatable

NFS lands with Public Domain status and open to locatable mineral entry under the Mining Law of 1872, as amended (30 U.S.C. 22 et. seq.), would be managed in accordance with Forest Service policy and regulations. For all alternatives that include recommended wilderness, those areas remain open to locatable mineral entry until designated by Congress. Desired conditions, guidelines, and standards concerning locatable minerals would be common to all alternatives.

Minerals, Leasable

The disposal of leasable minerals from NFS Lands would follow Forest Service policy and regulations. The Secretary of the Interior has the authority to issue leases and permits on NFS lands. Under various Statutes, leases are subject to the consent, and the issue of terms and conditions by the Secretary of Agriculture and/or the Forest Service before leases are issued on NFS lands.

Minerals, Saleable

The disposal of mineral material from NFS lands remains a discretionary action under all alternatives, and would be managed in accordance with Forest Service policy and regulations. Recommended wilderness would remove those lands from consideration for mineral material disposals.

Motorized Recreation Suitability

Motorized recreation would not be suitable in research natural areas, backcountry areas, national scenic trail areas (except where the trail crosses open system roads), recreation/wildlife areas, designated wilderness areas, and recommended wilderness in all alternatives. Suitability for motorized use varies

[11] The Colville National Forest winter recreation strategy was completed to balance the needs of secure winter habitat for caribou with access for winter recreation activities.

within other management areas depending on the type of recreation emphasized in an area (based on the recreation opportunity spectrum), or with wildlife habitat emphasis.

Current seasonal restrictions for deer and elk winter range would be maintained in all alternatives.

Wild and Scenic Eligible Rivers

As there has not been a change in circumstances since the inventory was completed for the 1988 forest plan, evaluation of eligibility for additional rivers was not a revision topic and is not addressed in the FEIS. The two rivers identified as eligible for inclusion in the Wild and Scenic River System for the 1988 forest plan (8 miles) are carried forward in this revision effort and would not vary by alternative. All action alternatives would include plan components to maintain the free-flowing characteristic and protect the outstandingly remarkable values of eligible rivers.

Table 6. Colville National Forest eligible wild and scenic rivers by segment and classification

River name	Recommended classification	Miles
South Fork Salmo River	Wild	5
Kettle River	Recreational	3

Scenery Management System

Scenery would be managed through the scenery management system (USDA Forest Service 1995c) in all action alternatives. The valued landscape character descriptions would not replace other desired conditions, such as vegetation. Rather, the vegetation desired conditions are a key component of the valued landscape character. Scenic integrity objective zones would overlay the management areas. The direction for scenery management applies regardless of the management area boundary. Applicability of plan direction is guided by the principle that where there is an overlap of scenery management direction with other plan components, the most restrictive plan direction applies, depending on site-specific conditions and the activity or use.

Lands and Special Uses

The Forest Service “Lands” program includes activities such as landownership adjustment, boundary and title management (including land exchanges and acquisitions, granting or accepting of easements), and other activities that are primarily real estate-type actions. The goals of this program include: (1) consolidating landownership patterns to meet the objectives of forest land and resource management plans and to improve land management efficiencies; (2) securing and protecting the rights, title, land, and resources of public land from unauthorized use and occupancy; and (3) providing legally defensible boundaries and accurate, complete landownership records of NFS lands. These program activities will continue and management direction would not change across the action alternatives.

The Forest administers a variety of land and recreation uses under special use permits, leases, or easements. The types of recreation and special use opportunities would remain the same across alternatives, although the areas and acres of the forest where they might occur vary. Revised forest plan management direction applicable to areas defined by special use permit, lease, or easement would not change across the action alternatives.

Management Areas

Although all alternatives include management area allocations with applicable desired conditions, standards, and guidelines, the land management emphasis, acres, names, and associated plan components of the management areas vary by alternative. The no action alternative (the 1988 forest plan) identifies

13 management areas based on vegetation and land use. The action alternatives offer a varying array of management area prescriptions designed to respond to the need for change or address significant issues. Management area direction ranges from areas emphasizing passive management in wilderness (natural processes dominate vegetation change) to areas emphasizing active management in Focused Restoration or Responsible Management Areas (vegetation management through timber harvest and planned fire use).

Table 7 provides an overview of all proposed management areas and their application across alternatives. A '-' indicates the management area is not included in the indicated alternative. Maps of the alternatives are provided in the supplement folder and on the website. Two management areas overlay other management areas as shown with an asterisk (*) in the table. These are the riparian habitat conservation/riparian management areas in all alternatives, and the Kettle Crest Recreation Area in alternatives P and O.

Table 7. Proposed management area (MA) descriptions, and percentages and acres of total forest by alternative

Management Areas	Description	No Action	Proposed Action	Alternative R	Alternative P	Alternative B	Alternative O
Wood/Forage	The management goal is to achieve optimum production of timber products while protecting basic resources. Other resource outputs such as forage will also occur.	39% 424,000	-	-	-	-	-
Scenic/ Timber	The management goal is to provide a natural appearing foreground, middle, and background along major scenic travel routes while providing wood products.	20% 217,100	-	-	-	-	-
Old Growth Dependent Species Habitat/ Late Forest Structure	The management goal is to provide essential habitat for wildlife species that require late and old forest habitat components (e.g., structure such as large and old trees, large snags, and downed wood) and contribute to the maintenance of diversity of wildlife habitats and plant communities.	3% 32,900	-	51% 568,200	-	-	-
Caribou Habitat[12]	The management goal is to provide seasonal habitats for woodland caribou to contribute the Colville National Forest portion of a fully recovered population as specified in the Caribou Recovery Plan.	3% 30,300	-	-	-	-	-
Winter Range	The management goal is to meet the habitat needs of deer and elk to sustain carrying capacity at 120 percent of the 1980 level, while managing other resources (e.g., timber harvest, recreation) consistent with fish and wildlife management objectives.	12% 126,500	-	-	-	-	-
Scenic/Winter Range	The management goal is to provide a natural appearing foreground, middle, and background along major scenic travel routes while providing for winter range management.	7% 76,100	-	-	-	-	-

[12] The woodland caribou recovery area is integrated with the Focused Restoration Management Area under the proposed action and alternative P, and integrated with the Late Forest Structure Management Area in alternative R.

Management Areas	Description	No Action	Proposed Action	Alternative R	Alternative P	Alternative B	Alternative O
Focused Restoration/ Active Restoration B[13]	Management area emphasis would focus on the restoration of ecological integrity and ecosystem function at the landscape scale using both active management (mechanical treatment and prescribed fire) and passive management (natural processes, including disturbances and succession) to restore natural processes and improve resiliency, while emphasizing important fish and wildlife habitats. Spatially, these areas include the key watersheds, and grizzly bear and caribou recovery areas not included in Backcountry and Backcountry Motorized Management Areas. The active management focus in key watersheds would promote riparian goals.	-	23% 257,200	-	28% 312,500	-	-
General Restoration/ Active Restoration C[14]	Management area emphasis would focus on enhancing ecological integrity and ecosystem function at the landscape scale using active management (mechanical treatment and prescribed fire) to restore natural processes and improve resiliency.	-	49% 536,300	22% 244,800	44% 489,200	-	-
Active Management/ Responsible Management Areas	Management area emphasis would be to use active forest management (mechanical treatment and prescribed fire) to provide forest products to the local economy and move the forest toward desired conditions for resilience to insects, disease, and uncharacteristic wildfire. While the management emphasis would be the same for both these MAs, the "Responsible Management Area" was named through a collaborative process and is retained to honor the collaborative process.	-	-	-	-	43% 479,200	39% 433,400

[13] In the proposed action provided to the public in June 2011, Focused Restoration was labeled as Active Restoration B.
[14] In the proposed action provided to the public in June 2011, General Restoration was labeled as Active Restoration C.

Management Areas	Description	No Action	Proposed Action	Alternative R	Alternative P	Alternative B	Alternative O
Restoration	Like the Focused and General Restoration MAs, management area emphasis would focus on the restoration of ecological integrity and ecosystem function at the landscape scale using both active management (mechanical treatment and prescribed fire) and passive management (natural processes, including disturbances and succession) to restore natural processes and improve resiliency, with limited mechanical treatment in late forest structure habitat. The landscape would be natural appearing in the majority of this management area, but in comparison to the Backcountry and Backcountry Motorized Management Areas, these areas have NFS roads and areas of intensive, concentrated management activity or facilities.	-	-	-	-	31% 338,500	34% 369,500
Backcountry/ Semi-Primitive Non-Motorized	Management area emphasis would be to provide non-motorized backcountry recreation opportunities in a natural-appearing landscape. Mechanized uses may be allowed. The MA would contribute habitat conditions for species that benefit from an unroaded and summer non-motorized landscape.	8% 86,900	8% 90,800	2% 20,200	12% 129,100	less than 1% 4,800	16% 174,300
Backcountry Motorized/ Semi-Primitive Motorized	Management area emphasis would be to provide motorized backcountry recreation opportunities in a natural-appearing landscape. Summer motorized use would be suitable and allowed where identified on the Forest's Motor Vehicle Use Map. Both cross-country and trail-based winter over-snow vehicle use would be suitable. Mechanized would also be suitable. These MAs would contribute habitat conditions for species that benefit from an unroaded landscape.	1% 13,600	6% 61,700	less than 1% 7,000	5% 54,600	less than 1% 6,600	5% 53,700
Recreation/ Recreation/Wildlife Ski Areas	The management area goal is to provide roaded and unroaded recreation opportunities in a natural appearing setting, to provide semi-primitive motorized and non-motorized recreation while meeting objectives of wildlife management, and to provide for quality winter recreation opportunities including downhill skiing, Nordic skiing, and other compatible uses. (This MA includes general recreation, recreation/wildlife, and skiing areas in the 1988 forest plan.)	5% 58,400	-	-	-	-	-

Management Areas	Description	No Action	Proposed Action	Alternative R	Alternative P	Alternative B	Alternative O
Wilderness – Congressionally Designated	Congress has designated the Salmo-Priest Wilderness on the Colville National Forest (31,400 acres). Management area emphasis is, and would continue to be under all action alternatives, to preserve the five qualities of wilderness character - untrammeled, natural, undeveloped, opportunities for solitude or primitive and unconfined recreation, and other features of values. In addition, the management areas direction in all alternatives proposes specific objectives, standards, and guidelines for the use of prescribed fire in wilderness.	3% 31,400	3% 31,400	3% 31,400	3% 31,400	3% 31,400	3% 31,400
Wilderness – Recommended	Management area emphasis would be to protect and maintain the social and ecological characteristics that provide the basis for the wilderness recommendation. Depending on the alternative (see detailed alternative descriptions), uses inconsistent with wilderness character including motorized trail maintenance and reconstruction, and mechanized uses (e.g., mountain biking) may be allowed to continue until Congress takes action to designate the areas as wilderness.	-	9% 101,400	19% 209,000	6% 61,700	20% 220,300	1% 15,900
Research Natural Areas	Research natural areas (RNA) are established to provide study and protection of a full range of habitat types and remain in a relatively unaltered condition for non-manipulative research, observation, and study. Plan direction would continue to emphasize maintaining the research values of the areas. Management activities in a research natural area must be consistent with the purposes for which the RNA was established (or proposed) or specifically maintain the values of the RNA.	less than 1% 5,300	less than 1% 5,800	less than 1% 5,800	less than 1% 5,800	less than 1% 5,800	less than 1% 5,800
Wild and Scenic Rivers*	Portions of two rivers on the Colville National Forest, the Kettle River (classified as recreational) and the South Fork Salmo River (classified as wild), have been identified as being eligible for inclusion in the National Wild and Scenic River Inventory. Plan direction would continue to emphasize maintaining the free-flowing characteristic and outstandingly remarkable values for which the river is determined eligible.	less than 1%	less than 1%	less than 1%	less than 1%	less than 1%	less than 1%

Management Areas	Description	No Action	Proposed Action	Alternative R	Alternative P	Alternative B	Alternative O
Scenic Byways	Management area emphasis would be to maintain or enhance the qualities of the byway. The Colville National Forest includes all or part of the Sherman Pass Scenic Byway (designated as both a Washington State Scenic Byway and a National Forest Scenic Byway), the North Pend Oreille Scenic Byway (designated as a Washington State Scenic Byway), and the International Selkirk Loop (designated as an All-American Road). A ½-mile distance zone on either side of the byway centerline defines the Scenic Byway Management Area. Management direction would only apply to portions of the byway within NFS lands.	less than 1%	2% 19,600	2% 18,000	2% 19,300	2% 17,600	2% 19,600
Nationally Designated Trails*	Management direction is for all nationally designated trails located within the administrative boundaries of NFS lands. The corridor where management direction applies consists of the visible foreground, which is generally one-half mile in width either side of the centerline of the trail, including viewpoints, water sources, campsites, and spur trails to these features.	less than 1%	less than 1%	less than 1%	less than 1%	less than 1%	less than 1%
Kettle Crest Recreation Area*	The Backcountry and Backcountry Motorized Management Areas within the KCRA would be managed to maintain their existing semi-primitive characteristics while allowing recreation activities inconsistent with wilderness designation to continue, such as mountain biking, OHV riding, and the use of a recreation rental cabin. This management area overlays other management areas. If there are management area guidance conflicts, the most protective guidance will apply. Management area emphasis would be to ensure protection of the values for which the area is designated.	-	-	-	7% 80,300	-	9% 99,000
Administrative and Recreation Sites (Includes permitted and developed recreation sites)*	The sites are established as separate management areas rather than overlays or inclusions in other management areas. The management direction remains unchanged from the 1988 forest plan.	less than 1%	less than 1%	less than 1%	less than 1%	less than 1%	less than 1%

Management Areas	Description	No Action	Proposed Action	Alternative R	Alternative P	Alternative B	Alternative O
RHCA/RMAs*	Depending on alternative, riparian habitat would be allocated to riparian management areas (RMA) under the Aquatic and Riparian Conservation Strategy (ARCS) or riparian habitat conservation areas (RHCA) under Interim Inland Native Fish Strategy for the Intermountain, Northern, and Pacific Northwest Regions (INFISH). This MA would overlay other MAs. They are mapped at the forest-scale, therefore locations may change based on project-level reconnaissance. RMAs and RHCAs occur on the margins of standing and flowing water and widths vary depending on feature type. The RMA/RHCA MA emphasis is to maintain and restore the riparian structure and function of perennial and intermittent streams, ponds, reservoirs, lakes, seeps, spring, and wetlands. This MA also provides connectivity for riparian-dependent plants and animals.	14%	16%	16%	16%	14%	16%
TOTAL[15]		100	100	100	100	100	100

*Overlaps with other management areas

[15] Numbers in this table are rounded, and several management areas overlap other management areas; therefore, not all columns add up to exactly 100 percent.

Alternatives Description

The no action alternative is the 1988 land management plan as amended, and serves as a baseline for comparison of the action alternatives. The proposed action is based on the need for a change as described in chapter 1. Additional action alternatives were developed in response to significant issues the public raised during the 2011 comment period. Each sub-heading in this section (e.g., Timber Production, Access, Recommended Wilderness) represents an issue as described in chapter 1. A comparison of alternatives is included at the end of this section (see table 22, page 76). Maps of each alternative are located in the map packet accompanying this FEIS, and on the project website.

No Action

The no action alternative is the 1988 land management plan as amended. Major amendments to the current land management plan include the Interim Inland Native Fish Strategy for the Intermountain, Northern, and Pacific Northwest Regions (INFISH) (1995), Continuation of Interim Management Direction Establishing Riparian, Ecosystem and Wildlife Standards for Timber Sales (Eastside Screens) (1995), and the Pacific Northwest Region Invasive Plant Program, Preventing and Managing Invasive Plants (2005).

The no action alternative (1988 forest plan) includes 13 management areas, emphasizing scenery, timber production, and wildlife habitat. Table 8 provides a description of the goals of each management area. See also map 1 in enclosed map packet.

Table 8. No action alternative (1988 forest plan) management areas and acres

Management Area*	Management area goal and description	Acres
Old Growth Dependent Species Habitat (1)	Provide essential habitat for wildlife species that require late and old forest habitat components (e.g., structure such as large and old trees, large snags, and downed wood) and contribute to the maintenance of diversity of wildlife habitats and plant communities.	32,900
Caribou Habitat (2)	Provide seasonal habitats for woodland caribou to contribute the Colville National Forest portion of a fully recovered population as specified in the Caribou Recovery Plan.	30,300
Recreation (3a) Recreation/Wildlife (3b) Downhill Skiing (3c)	Provide roaded and unroaded recreation opportunities in a natural appearing setting, to provide semi-primitive motorized and non-motorized recreation while meeting objectives of wildlife management, and to provide for quality winter recreation opportunities including downhill skiing, Nordic skiing, and other compatible uses. (This MA includes general recreation, recreation/wildlife, and skiing areas in the 1988 forest plan.)	43,200 13,200 2,000
Research Natural Area (4)	Provide study and protection of a full range of habitat types and remain in a relatively unaltered condition for non-manipulative research, observation, and study. Plan direction would continue to emphasize maintaining the research values of the areas. Management activities in a research natural area must be consistent with the purposes for which the RNA was established (or proposed) or specifically maintain the values of the RNA. The no action alternative includes five established RNAs and three proposed RNAs.	5,300

Management Area*	Management area goal and description	Acres
Scenic Timber (5)	Provide a natural appearing foreground, middle, and background along major scenic travel routes while providing wood products.	217,100
Scenic/Winter Range (6)	Provide a natural appearing foreground, middle, and background along major scenic travel routes while providing for winter range management.	76,100
Wood/Forage (7)	Achieve optimum production of timber products while protecting basic resources. Other resource outputs such as forage will also occur.	424,000
Winter Range (8)	Meet the habitat needs of deer and elk to sustain carrying capacity at 120 percent of the 1980 level, while managing other resources (e.g., timber harvest, recreation) consistent with fish and wildlife management objectives.	126,500
Wilderness-Congressionally Designated (9)	Preserve the five qualities of wilderness character - untrammeled, natural, undeveloped, opportunities for solitude or primitive and unconfined recreation, and other features of values. In addition, the management areas direction in all alternatives proposes specific objectives, standards, and guidelines for the use of prescribed fire in wilderness. The no action alternative contains the Salmo-Priest Wilderness.	31,400
Semi-Primitive, Motorized Recreation (10)	Provide motorized backcountry recreation opportunities in a natural-appearing landscape. Summer motorized use would be suitable and allowed where identified on the Forest's Motor Vehicle Use Map. Both cross-country and trail-based winter over-snow vehicle use would be suitable. Mechanized would also be suitable. These MAs would contribute habitat conditions for species that benefit from an unroaded landscape.	13,600
Semi-Primitive, Non-Motorized Recreation (11)	Provide non-motorized backcountry recreation opportunities in a natural-appearing landscape. Mechanized uses may be allowed. The MA would contribute habitat conditions for species that benefit from an unroaded and summer non-motorized landscape.	86,900

*Scenic byways, administrative sites, and riparian habitat conservation areas are not management areas, but are managed as overlays/management areas under 1988 plan direction.

No Action Alternative Relationship to the Significant Issues and the Need for Change

Late-successional and Old Forest Management

The 1988 forest plan management direction emphasizes a fixed reserves approach for old growth habitat (management area (MA) 1) on about 3 percent of the forest (approximately 32,900 acres). Maintaining a fixed reserve system does not guarantee all the allocated acres are in a condition that currently contain old forests. Due to ongoing natural disturbance processes (fire or insect and disease), some stands may currently be in an early or midseral forest structural stage. Fixed reserves are at least 300 acres in size, no scheduled timber harvest is permitted, and appropriate suppression occurs on all wildfires.

Vegetation management on all other lands follows the Eastside Screen amendment, designed to maintain habitat components for species associated with eastside late-successional forests including retention of live trees over 21 inches d.b.h. (diameter at breast height). The intent of the screens was to retain key habitat features, promote vigor and health of the forests, and preserve management options until replaced by a landscape-scale analysis process.

Timber Production and Vegetation Management

The 1988 forest plan describes the long-term sustained yield (LTSY) for the forest at 170 million board feet (MMBF) per year with an annual allowable sale quantity (ASQ) of 123 MMBF.

However, amendments such as INFISH and the Eastside Screens have changed the implementation of the forest plan, reducing both the LTSY and the ASQ. The effects of these subsequent amendments are included in chapter 3.

Scheduled timber production is suitable on 52 percent of the forest and occurs in the wood/forage and scenic/timber management areas. The annual projected wood sale quantity under the no action alternative (1988 forest plan, as amended) is 41 MMBF. Timber harvest is allowed to achieve objectives for other resources, such as wildlife habitat improvement, on 31 percent of the forest in various other management areas (see table 21 below).

Depending on vegetation type, different types of silvicultural treatments area applied to achieve desired conditions across the management areas where timber harvest is suitable. In the Douglas-fir dry vegetation type, partial harvest is the primary vegetation management tool. Thinning, regeneration harvest, and mechanical fuels treatments are used in the northern Rocky Mountain mixed conifer vegetation type. Regeneration harvest would be the primary tool in the subalpine fir/lodgepole pine vegetation type, with some mechanical fuels treatments. Prescribed fire would be used in Douglas-fir dry, northern Rocky Mountain conifer, and subalpine fir/lodgepole pine vegetation types.

Motorized Recreation Trails

The 1988 forest plan provides direction for both summer and winter motorized use. It identifies where motorized recreation use may not be authorized or may be limited for the protection of aquatic, plant and wildlife habitats. In addition, summer motorized recreation use is also restricted to those routes (roads and trails) identified on the Forest’s current-year MVUM, which was developed in response to Subpart B of the 2005 Travel Management Rule (Forest Plan Amendment #31 – Clarification of Forest Plan Direction Regarding Motor Vehicle Use (2008). Summer motorized trails make up 36 percent of the total summer trail miles designated for motor vehicle use on the Forest.

About 1 percent of the forest, or 13,600 acres are in a semi-primitive (backcountry) motorized recreation management area, providing limited motorized recreation opportunities in an unroaded setting.

Access

Currently, the Colville National Forest manages approximately 4,000 miles of NFS roads. The 1988 forest plan identifies 83 percent of the Forest as suitable for road construction (see table 21, below), but plan direction requires newly constructed project roads to be closed to motorized access after use unless otherwise justified in a site-specific analysis. Road density desired conditions vary from less than 1 mile per square mile to 1.5 miles per square mile of open road depending on the management area emphasis to protect species such as elk and deer. Road density desired conditions do not consider closed maintenance level (ML) 1 roads, and do not address the potential impacts of the road system on hydrologic and aquatic function and habitat. Additional direction from the Interagency Grizzly Bear Committee (IGBC) describes open road density (1 mile per square mile) and total road density (2 miles per square mile) within bear management units in the Selkirk Ecosystem of the Grizzly Bear Recovery Zone. Other access management and road construction suitability guidance comes from the 2013 Lynx Conservation Assessment and Strategy, the Caribou Winter Recreation Strategy, and the 2001 Roadless Area Conservation Rule.

However, there is concern that the current road system is not aligned with current and future management objectives or budgets. In addition, the 1988 forest plan does not address how roads and road management may affect hydrologic function and processes, and water quality, or the best science related to road-related disturbance effects to a broader list of species.

Recommended Wilderness

The 1988 forest plan does not include any recommendations for additional wilderness. The Salmo-Priest Wilderness (congressionally designated) covers about 3 percent of the Colville National Forest.

Wildlife

The 1988 forest plan emphasizes habitat for deer and elk through guidelines for human access (see previous Access section), retention or creation of thermal cover, and retention or creation of forage. Other species were addressed through management area designation or specific standards and guidelines. In 1995, the land and resource management plan was amended with the Eastside Screens to provide additional management guidance for wildlife species associated with late successional and old forest habitat such as habitat connectivity and nesting habitat management requirements. This included direction for maintaining connectivity between late/old structure stands; managing snag and down wood forest components; and protection of goshawk nesting and post-fledging habitat. However, this was intended to be interim direction, and implementation over the last 20 years has revealed shortcomings in this one-suite of species management approach. In addition to the issues related to addressing vegetative system resiliency for late-successional and old forests discussed previously, the diameter size emphasis of the Eastside Screens lacks direction for other important habitat structure elements such as snags and downed logs.

In addition, the no action alternative does not address the need to incorporate the conservation strategy, critical habitat, and recovery plan direction for federally listed species and best science for providing viability for other at-risk species.

Riparian and Aquatic Resources

The Colville forest plan was amended by the Inland Native Fish Strategy (INFISH) (USDA Forest Service 1995a), which provides additional watershed direction intended to restore and maintain the ecological health of watersheds and aquatic ecosystems on NFS lands for native resident fisheries. INFISH established riparian habitat conservation areas (RHCA) and a priority watershed network. INFISH includes riparian goals rather than desired conditions, and riparian management objectives (RMOs) that define numeric stream habitat objectives for width to depth ratio, bank stability, bank angle, large woody debris, stream temperature, percent fine sediment, dominant substrate, and pool frequency, that describe high quality habitat. RMOs were developed from existing stream habitat data and were designed to provide benchmarks for evaluation of current stream conditions. INFISH also incorporated additional goals, standards and guidelines (with no distinction between standards and guidelines) to restore and maintain riparian and aquatic resources into the Colville Forest plan (see appendix H).

The 1995 INFISH was intended to be an interim strategy and does not provide as comprehensive a watershed, aquatic, and riparian conservation and restoration strategy as ARCS. Continuing with the interim strategy would not address the need to integrate restoration of terrestrial and aquatic ecosystems or facilitate integrated management of aquatic resources with upslope terrestrial vegetation and recreation management.

Riparian Widths

RHCAs defined in INFISH are areas where riparian-dependent ecosystems receive primary emphasis, and management activities are subject to specific standards and guidelines (USDA Forest Service 1995a). Timber harvest is authorized only where it is needed to maintain or meet riparian management objectives. Road construction and motorized use are authorized within the parameters of INFISH standards and guidelines and attainment of RMOs.

RHCA widths are shown in table 9. RHCA widths may be increased or decreased when necessary to attain RMOs when site-specific data supports the change.

Table 9. Riparian habitat conservation area (RHCA) width

Stream and water body classification	RHCA width
Fish-bearing streams	300 feet slope distance on each side (600 feet total)
Permanently flowing non-fish-bearing streams	150 feet slope distance on each side (300 feet total)
Ponds, lakes, reservoirs and wetlands greater than 1 acre	150 feet slope distance around feature
Seasonally flowing or intermittent streams, wetlands less than 1 acre	100 feet slope distance in priority watersheds, 50 feet slope distance in non-priority watersheds.

Priority Watershed Network

INFISH priority watersheds on the Colville National Forest were originally designated in 1998 and updated in 2001. INFISH designated as “priority” watersheds those areas “having excellent habitat or strong assemblages of inland native fish, particularly bull trout, or watersheds that provide for population distribution goals, or watersheds having a high restoration potential” (USDA Forest Service 1995a). The INFISH priority network on the Colville National Forest is shown in figure 3 and includes approximately 214,300 acres. RHCA widths in priority watersheds under INFISH are wider than RHCA widths in non-priority watersheds for non-fish-bearing intermittent streams and wetlands less than 1 acre (table 9). In INFISH priority watersheds, watershed analysis is required before certain road activities and construction of new recreation facilities are permitted in RHCAs, and there are specific protections against increased sedimentation through prioritization of road treatments in priority watersheds.

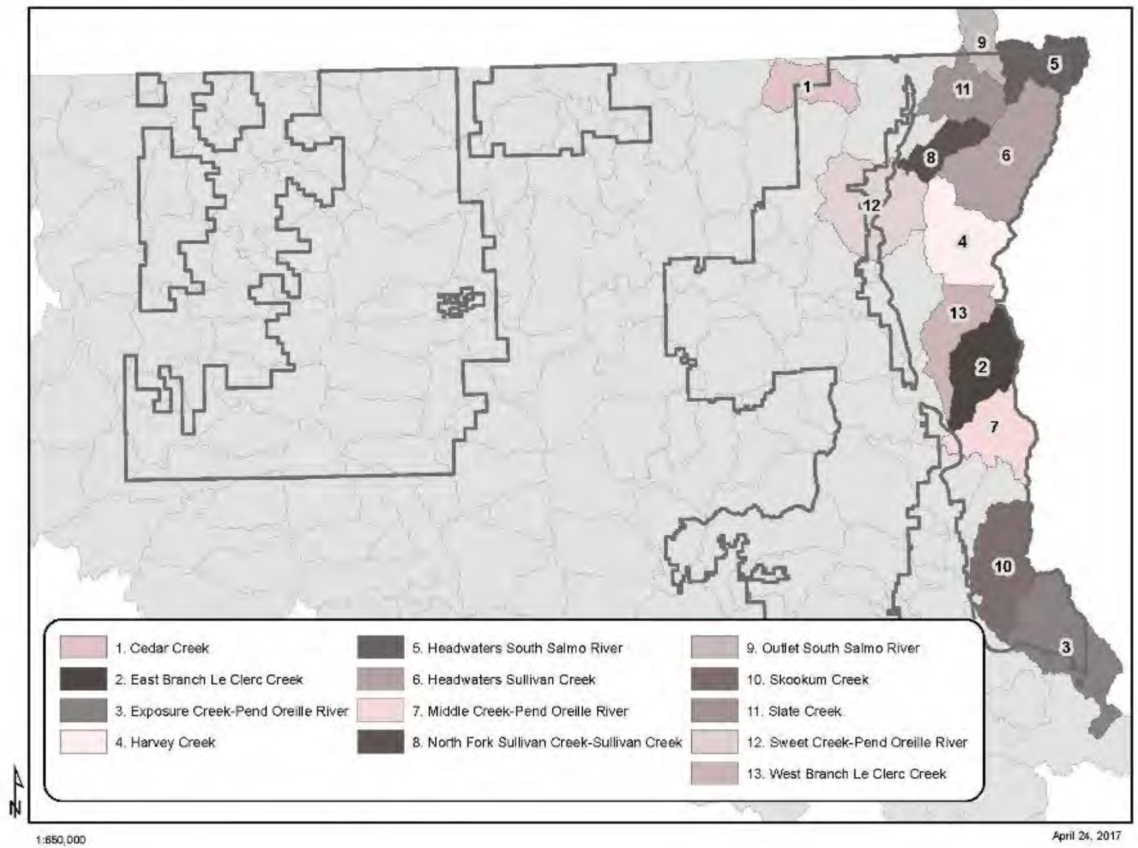


Figure 3. INFISH priority watersheds for no action and alternative B

Proposed Action

The proposed action was developed to address the need for change related to managing vegetation to be more resilient to disturbances, to maintain or restore ecological conditions that contribute to species diversity and the recovery and viability of at-risk species, and to provide integrated management direction to maintain and restore properly functioning watersheds. It also addresses the need to provide a sustainable flow of timber and both motorized and non-motorized recreation opportunities to provide economic and social contributions to the community and nation. See chapter 1 for further information on development of the proposed action.

In particular, the proposed action: (1) addresses the intent of the eastside screens by applying landscape ecology concepts to provide for ecological resilience to disturbances, including wildfire and the effects of climate change (2) incorporates science related to the recovery of terrestrial and aquatic threatened and endangered species, such as conservation strategies and recovery plans (3) integrates plan components for water resources and riparian areas, and (4) recommends 101,400 acres as additions to the Wilderness Preservation System.

The proposed action includes several management areas that are different from the no action alternative (see table 10). Both active management (which includes timber harvest, non-commercial thinning, planned ignitions) and passive management (which includes using unplanned ignitions and natural processes) would be used to move vegetation toward desired conditions. See also map 2 in enclosed map packet.

Table 10. Proposed action management areas and acres

Management Area	Management area goal and description	Acres
Active Restoration B*	Emphasis would focus on the restoration of ecological integrity and ecosystem function at the landscape scale using both active management (mechanical treatment and prescribed fire) and passive management (natural processes, including disturbances and succession) to restore natural processes and improve resiliency, while emphasizing important fish and wildlife habitats. Spatially, these areas include the key watersheds, and grizzly bear and caribou recovery areas not included in Backcountry and Backcountry Motorized Management Areas, and some acres designated as old growth, scenic/timber, wood/forage and winter range in the no action alternative. The active management focus in key watersheds would promote riparian goals.	257,200
Active Restoration C*	Management area emphasis would focus on enhancing ecological integrity and ecosystem function at the landscape scale using active management (mechanical treatment and prescribed fire) to restore natural processes and improve resiliency. Spatially, these areas include some acres designated as old growth scenic/timber, wood/forage and winter range in the no action alternative.	536,300
Backcountry	Same as description of semi-primitive, non-motorized recreation in table 8, no action. Spatially, these areas are distributed differently than the no action alternative.	90,800
Backcountry Motorized	Same as description of semi-primitive, motorized recreation in table 8, no action. Spatially, these areas are distributed differently than the no action alternative.	61,700
Research Natural Area	Same as described in table 8, no action. The proposed action alternative retains the five established RNAs from the no action alternative and retains one proposed RNA from the 1988 forest plan. The proposed action also includes, and one new proposed RNA See appendix I for more information on RNAs.	5,800
Scenic Byways	Management area emphasis would be to maintain or enhance the qualities of the byway. The Colville National Forest includes all or part of the Sherman Pass Scenic Byway (designated as both a Washington State Scenic Byway and a National Forest Scenic Byway), the North Pend Oreille Scenic Byway (designated as a Washington State Scenic Byway), and the International Selkirk Loop (designated as an All-American Road). A ½-mile distance zone on either side of the byway centerline defines the Scenic Byway Management Area. Management direction would only apply to portions of the byway within NFS lands.	19,600
Wilderness-Congressionally Designated	Same as described in table 8, no action. The proposed action includes the Salmo-Priest Wilderness.	31,400
Wilderness-Recommended	Protect and maintain the social and ecological characteristics that provide the basis for the wilderness recommendation.	101,400
Administrative and Recreation Sites	The sites are established as separate management areas rather than overlays or inclusions in other management areas. The management direction remains unchanged from the 1988 forest plan.	less than 1%

Management Area	Management area goal and description	Acres
Nationally Designated Trails	Management direction is for all nationally designated trails located within the administrative boundaries of NFS lands. The corridor where management direction applies consists of the visible foreground, which is generally one-half mile in width either side of the centerline of the trail, including viewpoints, water sources, campsites, and spur trails to these features.	***less than 1%
Riparian Management Areas	Depending on alternative, riparian habitat would be allocated to riparian management areas (RMA) under the Aquatic and Riparian Conservation Strategy (ARCS) or riparian habitat conservation areas (RHCA) under Interim Inland Native Fish Strategy for the Intermountain, Northern, and Pacific Northwest Regions (INFISH). This MA would overlay other MAs. They are mapped at the forest-scale, therefore locations may change based on project-level reconnaissance. RMAs and RHCAs occur on the margins of standing and flowing water and widths vary depending on feature type. The RMA/RHCA MA emphasis is to maintain and restore the riparian structure and function of perennial and intermittent streams, ponds, reservoirs, lakes, seeps, spring, and wetlands. This MA also provides connectivity for riparian-dependent plants and animals.	16%
Wild and Scenic Rivers	Plan direction would continue to emphasize maintaining the free-flowing characteristic and outstandingly remarkable values for which the river is determined eligible.	less than 1%

* Active Restoration B is called focused restoration in alternative P.

** Active Restoration C is called general restoration in alternatives P and R.

*** Nationally designated trails, riparian management areas, and wild and scenic rivers would be managed as overlays/management areas and are displayed as a percentage of the Forest.

Proposed Action Alternative Relationship to the Significant Issues

Late-Successional and Old Forest Management

Unlike the 1988 forest plan (no action alternative), the proposed action would use a dynamic landscape approach[16] for providing late forest structure and allowing late structure forests to shift location in response to ecological processes (e.g., wildfires). Forestwide desired conditions for forest structure would be based on historical range of variability (see table 4). Late-successional forests would be managed in different ways depending on the management area-specific desired conditions. For example, in management areas where roads are present, planned ignition and timber harvest may both be utilized whereas in areas with less access or with other management emphasis, unplanned ignitions may be the optimal tool.

Timber Production and Vegetation Management

Scheduled timber production would be suitable on 63 percent of the forest (see table 21). The annual projected wood sale quantity would be 62 MMBF. Timber harvest for other resource objectives would be allowed on 20 percent of the forest.

Timber harvest (scheduled and for other resource objectives) would take place mostly within Active Restoration B (focused restoration) and Active Restoration C (general restoration) Management Areas (see table 21). In the Douglas-fir dry and northern Rocky Mountain mixed conifer vegetation types, variable density thinning would be the primary tool for commercial vegetation management. Mechanical fuels treatments would also be used in these vegetation

[16] See chapter 3 for a detailed description of the dynamic landscape approach.

types. Mixed and light severity prescribed fire would be used in open-canopy stands on a 20-year rotation to maintain open conditions in the Douglas-fir dry and northern Rocky Mountain mixed conifer vegetation types. Shelterwood harvest with reserves would be the primary commercial vegetation management tool in the subalpine fir and lodgepole pine vegetation type. Stand-replacing prescribed fire would also be used in the subalpine fir and lodgepole pine vegetation type. Western red cedar/Western hemlock and spruce/subalpine fir vegetation types would not be managed with timber harvest or prescribed fire.

Motorized Recreation Trails

The proposed action would increase the opportunity for backcountry motorized and non-motorized recreation to address the increase in visitor use due to population growth and changing demographics described in the need for change related to social systems. It would offer a range of recreation settings in both the front (roaded setting) and backcountry (unroaded setting) to accommodate how people use and access the Forest.

Approximately 6 percent of the Forest would be allocated to the Backcountry Motorized MA, which would be suitable for summer and winter motorized recreation (see table 21). Approximately 8 percent of the Forest would be allocated to the Backcountry MA, which would emphasize non-motorized recreation opportunities and would not be suitable for motorized recreation. (Both would be suitable for mechanized use, such as mountain biking). The other roaded management areas would provide an additional 71 percent of the Forest as suitable for summer and winter motorized recreation.

Access

The proposed action would reduce suitability for roads to 73 percent of the Forest (compared to 83 percent in the no action alternative) due to designation of new management areas that are not suitable for road building, including recommended wilderness and proposed RNAs (see table 21). It would also include desired conditions for total road densities to address terrestrial wildlife (e.g., grizzly bear), hydrologic function, and aquatic species (e.g., bull trout) habitat needs while continuing to maintain an access system of authorized roads that are safe, affordable, and environmentally sound. The road density desired conditions would vary from 2.0 miles per square mile in the Active Management B (focused restoration) Management Area to 3.0 miles per square mile in the Active Management C (general restoration) Management Area (both averaged at the 5th field watershed).

Recommended Wilderness

By law, all NFS lands must be evaluated for possible wilderness recommendation during the plan revision process. This evaluation showed a need for additional wilderness opportunities on the forest.

The proposed action would recommend 101,400 acres (9 percent of the forest) for wilderness. These areas would primarily include Abercrombie-Hooknose, Bald Snow, Hoodoo, Profanity, and Salmo-Priest Adjacent Inventoried Roadless Areas. Revised forest plan components would direct that the wilderness character and potential is to remain intact for each area recommended until congressional action is taken or the area is released from consideration through a future plan amendment or revision. Existing inconsistent uses (e.g., mountain bikes and chainsaw use) would be allowed to continue, but no new motorized or mechanized recreation opportunities would be allowed.

Table 11. Proposed action recommended wilderness

Recommended wilderness	Acres
Abercrombie-Hooknose	35,100
Bald Snow	15,200
Hoodoo	11,000
Profanity	26,600
Salmo-Priest Adjacent	13,500

Wildlife

Considerable new science has developed since the 1988 forest plan concerning the viability of a wide-array of wildlife species that are present on the forest (Lehmkuhl et al. 1997, Wisdom et al. 2000, Raphael et al. 2001). In addition, methods for assessing species viability and choosing which species to assess has changed (Soule 1987, Marcot et al. 2001, Beissinger and McCullough 2002, Suring et al. 2011). The surrogate species approach was used to evaluate species and ecosystem viability (USDA Forest Service 2006b). Surrogate species are intended to represent ecological conditions that generate sustainable ecosystems.

In addition to the ecosystem plan components for managing vegetation through a dynamic landscape approach and addressing habitat connectivity through road density desired conditions (described above under Access), the proposed action would include species-specific management direction for surrogate wildlife species associated with late-successional habitat structures through proposed plan components for late successional habitat, retention of snag habitat, and down woody debris. Focal species would be used for monitoring.

Table 12. Surrogate and focal species for proposed action

Species Common Name	Species Scientific Name	Focal (F)/ Surrogate (S) Species
American marten	*Martes americana*	S
Bald eagle	*Haliaeetus leucocephalus*	S
Bighorn sheep	*Ovis canadensis*	S
Black-backed woodpecker	*Picoides arcticus*	F/S
Canada lynx	*Lynx canadensis*	S
Cassin's finch	*Haemorhous cassinii*	S
Columbia spotted frog	*Rana luteiventris*	S
Eared Grebe	*Podiceps nigricollis*	S
Fox sparrow	*Passerella iliaca*	S
Fringed myotis	*Myotis thysanodes*	S
Golden eagle	*Aquila chrysaetos*	S
Harlequin duck	*Histrionicus histrionicus*	S
Lark Sparrow	*Chondestes grammacus*	S
Lewis' woodpecker	*Melanerpes lewis*	S
MacGillivray's warbler	*Oporornis tolmiei*	F/S
Marsh Wren	*Cistothorus palustris*	S
Northern bog lemming	*Synaptomys borealis*	S
Northern goshawk	*Accipiter gentilis*	F/S
Northern Harrier	*Circus hudsonius*	S
Pallid Bat	*Antrozous pallidus*	S
Peregrine Falcon	*Falco peregrinus*	S
Pileated woodpecker	*Dryocopus pileatus*	S
Sage Thrasher	*Oreoscoptes montanus*	S
Tiger Salamander	*Ambystoma tigrinum*	S
Townsend's big-eared bat	*Corynorhinus townsendii*	S
Western bluebird	*Sialia mexicana*	S
White-headed woodpecker	*Picoides albolarvatus*	F/S
Wilson's Snipe	*Gallinago delicata*	S
Wolverine	*Gulo gulo*	S
Wood Duck	*Aix sponsa*	S
Bull trout	*Salvelinus confluentus*	F/S
Redband/rainbow trout	*Oncorhynchus mykiss gairdneri*	F/S
Westslope Cutthroat	*Oncorhynchus clarkii lewisi*	F/S

Riparian and Aquatic Resources

The proposed action would address the need for updated, integrated direction for watershed, aquatic and riparian management and would increase the pace and scale of aquatic restoration. Riparian and aquatic resource direction that would be included in the proposed action is based on the 2008 Region 6 ARCS (USDA Forest Service 2008a), which is a refinement of earlier strategies and plans including the Aquatic Restoration Strategy (ARS; USDA Forest Service

2005c), the Northwest Forest Plan (USDA Forest Service and USDI BLM 1994), PACFISH (USDA and USDI 1995), and INFISH (USDA Forest Service 1994c and 1995a). ARCS includes designation of riparian management areas, designation of a key watershed network, and a core set of desired conditions, objectives, standards and guidelines, designed to provide ecological conditions conducive to maintaining, restoring, and enhancing habitat necessary to sustain aquatic and riparian-dependent species on NFS lands.

Riparian Widths

Riparian management areas (similar to riparian habitat conservation areas under INFISH) are areas where riparian-dependent resources receive primary emphasis and are designated for all streams and aquatic features. Riparian management areas (RMAs) would not prohibit management activities such as vegetation treatment, but management in RMAs should contribute to maintaining or moving RMAs toward desired conditions. Compared to the no action alternative, the RMAs in the proposed action would be more protective due to the increased RMA-widths on intermittent streams and natural lakes and ponds.

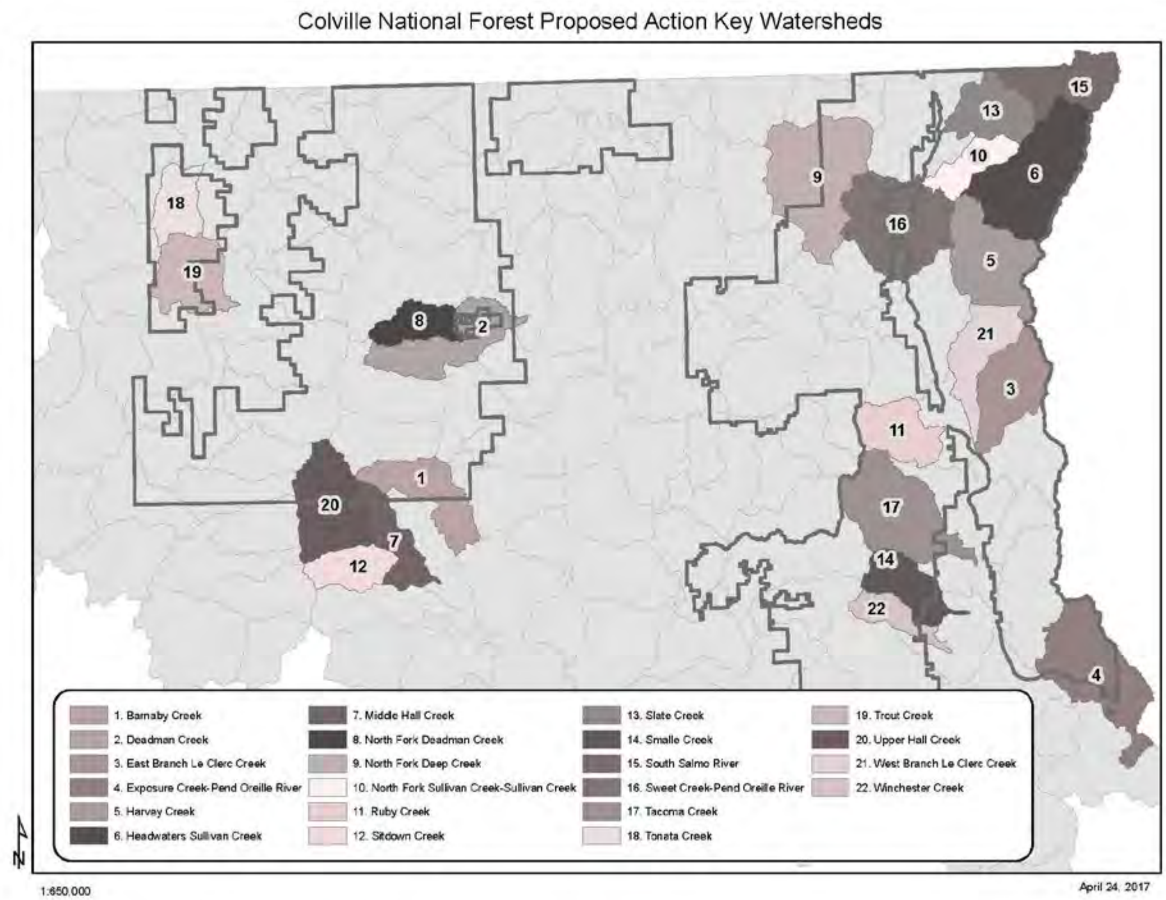
Table 13. Riparian management area width

Stream and water body classification	Riparian Management Area width
Fish-bearing streams	300 feet slope distance on each side (600 feet total)
Permanently flowing non-fish-bearing streams	150 feet slope distance on each side (300 feet total)
Lakes and natural ponds	300 feet slope distance around feature
Constructed ponds, and reservoirs and wetlands greater than 1 acre	150 feet slope distance around feature
Seasonally flowing or intermittent streams; wetlands, seeps, and springs less than 1 acre, and unstable or potentially unstable areas	100 feet slope distance from stream (200 feet total), 100 feet slope distance around wetland, seep, spring, or unstable or potentially unstable area

Key Watersheds

Key watersheds are a network of watersheds that serve as strongholds for important aquatic resources or have the potential to do so through focused restoration (USDA Forest Service 2008a). Key watersheds are designated at the subwatershed scale and were selected based on population condition of surrogate aquatic species (interior redband trout, westslope cutthroat trout, and bull trout), and aquatic habitat condition and function. Management in key watersheds minimizes risk and maximizes restoration and preservation of ecological health. The key watershed network in the proposed action was identified in 2011, and would expand the INFISH priority network in the no action alternative with the addition of 13 additional subwatersheds. Four subwatersheds in the INFISH priority network were not included in the key watershed network for the proposed action because they did not have the aquatic habitat conditions or surrogate species population necessary for designation as a key watershed.

The proposed action also includes measureable restoration objectives for key watersheds. Watershed restoration, stream restoration, road treatment, range improvement, and riparian vegetation objectives are designed to move toward desired conditions. The establishment of a key watershed network and measurable restoration objectives for key watersheds is a significant difference between the proposed action and the no action alternative.



Note: Management direction and desired conditions apply only to NFS lands. Portions of key watersheds outside the Colville National Forest boundary are shown for informational purposes only.

Figure 4. Key watershed network under the proposed action

Alternative P (Preferred Alternative)

Alternative P responds to public concern that management direction as shown in other alternatives could result in lower revenue to local economies, reduced ability to address fuel levels and wildfire risk to adjacent communities, protection of water quality, and ability to provide a mix of recreation opportunities, while also addressing multiple-use management and development of resilient landscapes. This alternative would propose the same management areas as the proposed action, but would vary the location of those allocations on the landscape with the intent to provide a sustained flow of economic contributions to the local communities, and adds the Kettle Crest Recreation Area.

In particular, alternative P would: (1) apply landscape ecology concepts to provide for ecological resilience to disturbances, including wildfire and the effects of climate change, (2) incorporate science related to the recovery of terrestrial and aquatic threatened and endangered species, (3) integrate plan components for water resources and riparian areas using Colville ARCS, (4) recommend 61,700 acres as additions to the Wilderness Preservation System, and (5) designate the Kettle Crest Recreation Area (approximately 80,300 acres).

Both active management (timber harvest, non-commercial thinning, and planned ignitions), and passive management (unplanned ignitions and natural processes), would be utilized to move vegetation toward desired conditions. Management area descriptions are the same as those described under the proposed action (see table 10). See also map 3 in enclosed map packet.

Table 14. Alternative P (preferred alternative) management areas and acres

Management Area	Management area goal and description	Acres
Backcountry	Same as described in the proposed action (table 10).	129,100
Backcountry Motorized	Same as described in the proposed action.	54,600
Focused Restoration*	Same as described in the proposed action.	312,500
General Restoration**	Same as described in the proposed action.	489,200
Research Natural Area	Same as described in the proposed action.	5,800
Scenic Byways	Same as described in the proposed action.	19,300
Wilderness-Congressionally Designated	Same as described in the proposed action.	31,400
Wilderness-Recommended	Same as described in the proposed action.	61,700
Kettle Crest Recreation Area	The Backcountry and Backcountry Motorized Management Areas within the KCRA would be managed to maintain their existing semi-primitive characteristics while allowing recreation activities that do not conform with wilderness designation to continue, such as mountain biking, OHV riding, and the use of a recreation rental cabin. This management area overlays other management areas. If there are management area guidance conflicts, the most protective guidance will apply. Management area emphasis would be to ensure protection of the values for which the area is designated.	80,300
Administrative and Recreation Sites	Same as described in the proposed action.	less than 1%
Nationally Designated Trails	Same as described in the proposed action.	***less than 1%
Riparian Management Areas	Same as described in the proposed action.	16%
Wild and Scenic Rivers	Same as described in the proposed action.	less than 1%

* Focused restoration is called active management B under the proposed action.

** General restoration is called active management C under the proposed action.

*** Nationally designated trails, riparian management areas, and wild and scenic rivers would be managed as overlays/management areas and are displayed as a percentage of the Forest.

Alternative P Relationship to the Significant Issues and the Need for Change

Late-Successional and Old Forest Management

Unlike the no action alternative, alternative P would use the dynamic landscape approach described in the proposed action to manage vegetation toward desired conditions (table 4).

Timber Production

Scheduled timber production would be suitable on 63 percent of the Forest, in the Focused and General Restoration Management Areas. The annual projected wood sale quantity would be 62 MMBF. Timber harvest for other resource objectives would be allowed on 19 percent of the forest, across various other management areas (see table 21).

Variable density thinning would be the primary tool for active commercial vegetation management in the Focused and General Restoration Management Areas in the Douglas-fir dry and northern Rocky Mountain mixed conifer vegetation types. Mechanical fuels treatments would also be used in these vegetation types. Mixed and light severity prescribed fire would be used in open-canopy stands on a 20-year rotation to maintain open conditions in the Douglas-fir dry and northern Rocky Mountain mixed conifer vegetation types. Shelterwood harvest with reserves would be the primary commercial vegetation management tool in the subalpine fir and lodgepole pine vegetation type. Stand-replacing prescribed fire would be used in the subalpine fir and lodgepole pine vegetation type. No vegetation treatments would occur in the Western red cedar/Western hemlock and spruce/subalpine fir vegetation types.

Motorized Recreation Trails

Alternative P is similar to the proposed action, increasing the opportunity for backcountry (unroaded setting) motorized and non-motorized recreation opportunities. Approximately 5 percent of the forest would be allocated to the Backcountry Motorized MA, which would be suitable for summer and winter motorized recreation. Approximately 12 percent of the Forest would be allocated to the Backcountry MA, which would emphasize non-motorized recreation opportunities and would not be suitable for motorized recreation. (Both would be suitable for mechanized use.) The other roaded management areas would provide an additional 73 percent of the forest as suitable for summer and winter motorized recreation.

Kettle Crest Recreation Area

Alternative P would designate approximately 80,300 acres as the Kettle Crest Recreation Area (KRCA), on the north side of Sherman Pass. The KCRA overlays other management areas. Management area emphasis would be to ensure protection of the values for which the area is designated. The area contains Backcountry, Backcountry Motorized, Focused and General Restoration Management Areas. Within the KCRA, these areas would be managed to maintain their existing semi-primitive characteristics while allowing recreation activities that do not conform with wilderness designation to continue, such as mountain biking, OHV riding, and the use of a recreation rental cabin. If there are management area guidance conflicts within the KRCA overlay, the most protective guidance would apply.

Access

Alternative P would reduce suitability for roads to 75 percent of the forest (compared to 83 percent in the no action alternative). Management areas where construction of new roads is prohibited include backcountry, backcountry motorized, research natural areas and both designated and recommended wilderness (see table 21). Similar to the proposed action, it would also include desired conditions for total road densities to address terrestrial wildlife (e.g., grizzly bear), hydrologic function, and aquatic species (e.g., bull trout) habitat needs while continuing to maintain an access system of authorized roads that are safe, affordable, and environmentally sound. However, to accelerate improvement in watershed function, alternative P road density desired conditions would vary from no greater than 1.0 mile per square mile in the Focused Restoration MA to no greater than 2.0 miles per square mile in the General Restoration MA (both averaged at the 5th field watershed). Objectives for treatment of roads to decrease hydrologic risk and sediment delivery would move toward meeting road density desired conditions.

Recommended Wilderness

Alternative P would recommend approximately 61,700 acres of wilderness (table 15) (6 percent of the Forest). These areas would include Abercrombie-Hooknose, Bald Snow, and Salmo-Priest Adjacent roadless areas. In response to public comment, boundaries for these recommended wilderness areas were further refined, reflecting differences in acres for these areas under alternative P, compared to other alternatives. Revised forest plan components would direct that the wilderness character and potential for each area recommended is to remain intact until congressional action is taken or the area is released from consideration through a future plan amendment or revision. Existing inconsistent uses (mountain bike and chain saw use) would be allowed to continue until such time the recommended wilderness is designated by Congress, but no new motorized or mechanized recreation opportunities would be allowed. Monitoring of existing uses is included to ensure that no increase in inconsistent uses occurs.

Table 15. Alternative P recommended wilderness areas

Recommended wilderness area	Acres
Abercrombie-Hooknose	29,300
Bald-Snow	17,400
Salmo-Priest Adjacent	14,900

Wildlife

Like the proposed action, alternative P would provide ecosystem plan components for managing vegetation through a dynamic landscape approach, and would address habitat connectivity through road density desired conditions and motorized recreation suitability (described above). It would also include species-specific management direction for surrogate wildlife species that are associated with these late-successional habitat structures through proposed plan components for large trees, retention of snag habitat, and down wood.

Riparian and Aquatic Resources

Riparian and aquatic resource direction in alternative P would be based on guidance provided in the 2016 version of the Region 6 ARCS, and would incorporate additional management direction to address issues specific to the Colville National Forest. The incorporation of additional desired conditions, objectives, and standards and guidelines is referred to as Colville ARCS (see appendix H). Additional plan direction in the Colville ARCS includes (see comparison table in part II of appendix H):

1. Additional desired conditions for general water resources and roads in RMAs.
2. Clarity to riparian management area objectives that address improvement of riparian function at dispersed and developed recreation sites, restoration of riparian processes altered by roads, and restoration of upland vegetation in riparian management areas toward historical range of variation.
3. Additional objectives for key watersheds tied to the National Watershed Condition Framework and threatened, endangered and sensitive species recovery plans.

4. Plan components to prevent and control aquatic invasive species, improve watershed and aquatic habitat function, improve aquatic organism passage, and address livestock grazing effects to greenline areas.
5. Higher numeric objectives for reduction in road erosion and sedimentation risk, treatment of aquatic invasive and non-native aquatic species, replacement or removal of culverts to improve aquatic habitat and reduce failure risk, and improvement of dispersed recreation sites.
6. Inclusion of an objective for completion of watershed analysis to guide restoration.

Riparian Widths

RMA widths would be the same as the proposed action (table 13).

Key Watersheds

At the time the proposed action was released to the public, the key watershed network was delineated at the subwatershed scale. Boundaries, names, and numbers of subwatersheds have changed since that release, and additional fish distribution and aquatic habitat data were gathered. The key watershed network in alternative P was updated using the most current (2014) subwatershed delineations, fish distribution data, and aquatic habitat condition data (figure 5). The key watershed network is larger in alternative P than in all other alternatives.

Compared to the proposed action, six subwatersheds were added to the key watershed network and three subwatersheds were removed because they had less than 25 percent Colville National Forest ownership.

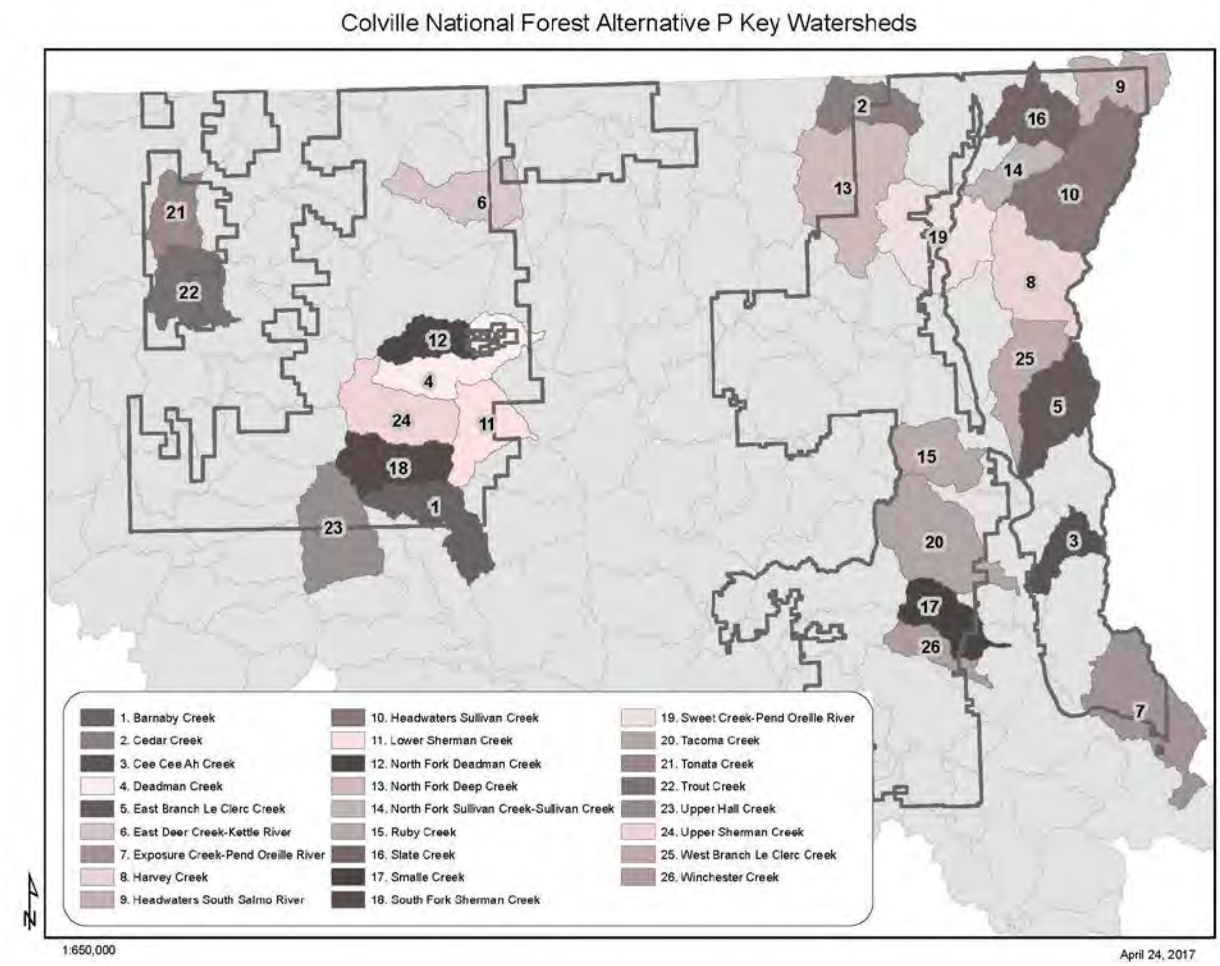


Figure 5. Key watershed network under alternative P

Alternative R

Alternative R responds to the public comments that support static late forest structure reserve land allocations, emphasis on maintaining habitat components for species associated with eastside late successional forests, and a 21-inch upper diameter limit on cutting live trees. Public issues concerning potential impacts that road access and summer motorized trail use may have on aquatic, riparian, and wildlife habitats, including grizzly bear core areas and habitat connectivity are addressed through lower road density desired conditions, fewer acres allocated for backcountry motorized recreation, and a high proportion of recommended wilderness areas. Alternative R responds to public comments that the proposed action does not provide watershed, aquatic, and riparian resource protections that are as effective as 1988 forest plan direction. Aquatic direction and plan components in alternative R are based on a modified version of ARCS (referred to throughout this document as ARCS-modified), which adds clarification to desired conditions, objectives, standards, and guidelines to address issues specific to the Forest (see comparison table in part II of appendix H).

In particular, alternative R would: (1) substantially increase late-successional reserves in both the number of acres and the size and connectivity of the areas, (2) integrate plan components for water resources and riparian areas using ARCS-modified, and (3) recommend 209,000 acres as additions to the Wilderness Preservation System.

Although active management (timber harvest, non-commercial thinning, and planned ignitions) would be used as management tools where suitable, alternative R would have more emphasis on passive management (unplanned ignitions and natural processes) to move vegetation toward desired conditions as a result of management area allocations. See also map 4 in enclosed map packet.

Table 16. Alternative R management areas and acres

Management Area	Management area goal and description	Acres
Backcountry	Same as described in the proposed action (table 10).	20,200
Backcountry Motorized	Same as described in the proposed action.	7,000
General Restoration*	Same as described in the proposed action.	244,800
Late Forest Structure**	Same as described in no action (table 8).	568,200
Research Natural Area	Same as described in the proposed action.	5,800
Scenic Byways	Same as described in the proposed action.	18,000
Wilderness-Congressionally Designated	Same as described in the proposed action.	31,400
Wilderness-Recommended	Same as described in the proposed action.	209,000
Administrative and Recreation Sites	Same as described in the proposed action.	less than 1%
Nationally Designated Trails	Same as described in the proposed action.	***less than 1%
Riparian Management Areas	Same as described in the proposed action.	16%
Wild and Scenic Rivers	Same as described in the proposed action.	less than 1%

* General restoration is called active restoration C in the proposed action.

** Late forest structure is called old growth dependent species habitat in the no action alternative.

*** Nationally designated trails, riparian management areas, and wild and scenic rivers would be managed as overlays/management areas and are displayed as a percentage of the Forest.

Alternative R Relationship to the Significant Issues and the Need for Change

Late-successional and Old Forest Management

Like the no action alternative, this alternative would use a fixed reserve management approach to maintain late forest structure in fixed geographic locations. Fixed reserves would be allocated across 51 percent of the Forest in a late structure MA. Most acres (approximately 70 percent) that were designated focused or general restoration in alternative P are included in the late structure MA in alternative R. In a change from the no action alternative, timber harvest would be used as a management tool in the late forest structure MA to maintain and improve resiliency of the late and old forest habitat components (e.g., structure such as large and old trees, large snags, and downed wood). In addition, alternative R would retain emphasis on maintaining habitat components for species associated with eastside late successional forests and the 21-inch upper diameter limit on cutting live trees.

Timber Production and Vegetation Management

Scheduled timber production would be suitable on 12 percent of the forest, in some general restoration areas. The annual projected wood sale quantity would be 14 MMBF. Timber harvest for other resource objectives would be allowed on 70 percent of the Forest, Late Structure and General Restoration Management Areas.

Partial harvest, variable density thinning, and shelterwood with reserves would be the primary tools for active commercial vegetation management under alternative R. Mixed-severity prescribed fire would be used in open-canopy stands on a 20-year rotation to maintain open conditions in the Douglas-fir dry and northern Rocky Mountain mixed conifer vegetation types. Stand-replacing prescribed fire would be used in the subalpine fir and lodgepole pine vegetation type.

Motorized Recreation Trails

The amount of area allocated to backcountry recreation opportunities (unroaded setting) is similar to the no action alternative. Less than 1 percent of the Forest would be allocated to the Backcountry Motorized MA (suitable for summer and winter motorized recreation) and approximately two percent of the Forest would be allocated to a Backcountry MA (not suitable for motorized recreation). Backcountry areas are primarily within inventoried roadless areas (see appendix F for maps of IRAs). Both backcountry and backcountry motorized would be suitable for mechanized recreation use (see table 21). Although the other roaded MAs would provide an additional 73 percent of the Forest as suitable for summer and winter motorized recreation, the increase in recommended wilderness (see alternative R recommended wilderness description) would reduce both motorized and mechanized recreation opportunities compared to no action.

Access

Similar to alternative P, alternative R would reduce suitability for roads to 75 percent of the Forest (compared to 83 percent in the no action alternative). It would also include desired conditions for total road densities to address terrestrial wildlife (e.g., grizzly bear), hydrologic function, and aquatic species (e.g., bull trout) habitat needs while continuing to maintain an access system of authorized roads that are safe, affordable, and environmentally sound. The road density desired conditions would vary from no greater than 1.0 mile per square mile in the Late Forest Structure MA to no greater than 2.0 miles per square mile in the General Restoration MA (both averaged at the 5th field watershed).

Recommended Wilderness

This alternative would recommend 209,000 acres (19 percent of the Forest) as wilderness, including the area that would be designated as the Kettle Crest Recreation Area under alternative P. The areas that would be recommended are described in table 17. Forest plan components would direct that the wilderness character and potential for each recommended area is to remain intact until congressional action is taken or the area is released from consideration through a future plan amendment or revision. Unlike the proposed action and alternative P, existing inconsistent uses (mechanized and motorized use such as mountain bikes and chainsaw use) would not be suitable, and a site-specific prohibition (per 36 CFR 261) would be required.

Table 17. Alternative R recommended wilderness

Recommended Wilderness Area	Acres
Abercrombie-Hooknose	37,700
Bald Snow	18,800
Cougar Mountain	6,200
Deer Creek	5,800
Grassy Top	2,200
Hall Mountain	7,900
Harvey Creek	5,700
Hoodoo	11,100
Jackknife	8,900
Owl Mountain	11,100
Profanity	37,800
Quartzite	5,300
Salmo-Priest Adjacent	16,000
South Huckleberry	9,700
Thirteenmile	10,900
Twin Sisters	14,600

Wildlife

Although alternative R would maintain the fixed reserves management approach for late-successional and old forest habitat similar to the no action alternative, it also would include species-specific management direction for surrogate wildlife species (similar to proposed action and alternative P) that are associated with these late-successional habitat structures through proposed plan components for large trees, retention of snag habitat, and down woody debris. Compared to the no action alternative, habitat connectivity would be addressed through reduced road density desired conditions and reduced acres suitable for motorized recreation. (See alternative R motorized trail recreation, access, and recommended wilderness descriptions).

Riparian and Aquatic Resources

Riparian management area widths are the same in alternative R as the proposed action and alternative P. The key watershed network (figure 6) and designation process, and riparian and aquatic resource goals, objectives, standards, and guidelines (ARCS-modified) were updated and expanded from the proposed action to add clarity to individual plan components (see comparison table in part II of appendix H). Desired conditions for general water resources, key watersheds, and RMAs have been updated and clarified in alternative R compared to the proposed action. An additional desired condition addressing roads in RMAs is included in alternative R. A desired condition was also added to alternative R to address the existing condition in focus and priority watersheds. The key watershed network is expanded from the proposed action, is the same as in alternative O, and is similar to alternative P, but includes one less subwatershed. Operational constraints were also considered in the evaluation of each standard and guideline within ARCS to develop ARCS-modified included in alternative R. Unlike the no action alternative, this addresses the need for updated, integrated direction for watershed, aquatic, and riparian management.

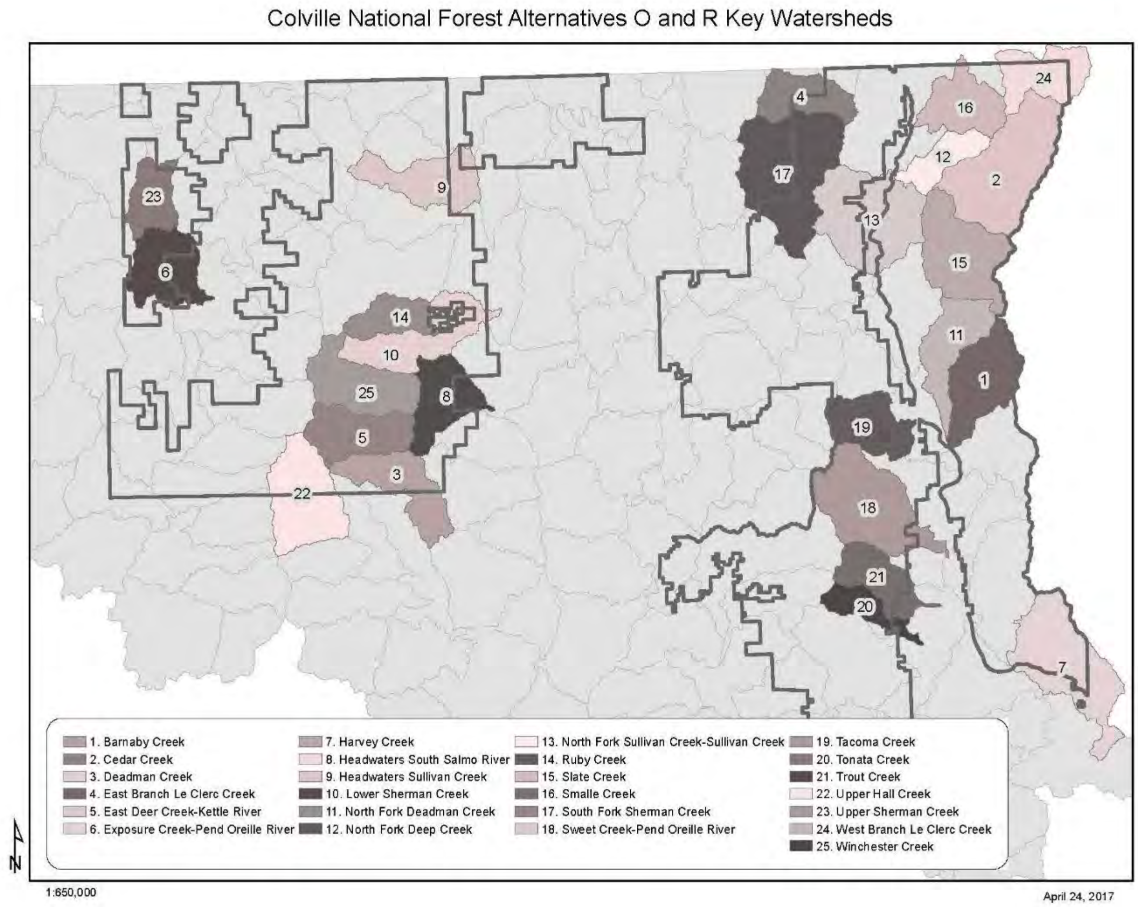


Figure 6. Key watershed network under alternatives R and O

Alternative B

Alternative B combines feedback from timber and environmental interest groups and incorporates management strategies supported by the Northeast Washington Forestry Coalition during public comment related to the proposed action (2011) and development of alternatives. Alternative B would address the concerns of multiple constituencies in one alternative by balancing land allocations between areas emphasizing active management (timber management zones), emphasizing a mix of active and passive management (restoration areas), and emphasizing passive management (designated and recommended wilderness).

Like the no action alternative, alternative B would retain the Eastside Screens, the 21-inch upper diameter limit for cutting live trees, and the large-scale fixed reserve approach for late-successional forest structure. However, it would include additional plan components to limit timber harvest in late-successional structure to dry plant association groups only.

Where plan components were not identified by the collaborative group, the 1988 forest plan (no action alternative) would provide plan direction (remain unchanged).

Alternative B includes the active management and restoration management areas. Timber harvest, non-commercial thinning and planned ignitions (active management) would be emphasized in the active management MA, although the retention of the Eastside Screens would limit their continued application over time. Passive management (unplanned ignitions and natural processes) would be emphasized in the other management areas across the Forest. See also map 5 in enclosed map packet.

Table 18. Alternative B management areas and acres

Management Area	Management area goal and description	Acres
Active Management Area	Management area emphasis would be to use active forest management (mechanical treatment and prescribed fire) to provide forest products to the local economy and move the forest toward desired conditions for resilience to insects, disease, and uncharacteristic wildfire.	479,200
Backcountry	Same as described in the proposed action (table 10).	4,800
Backcountry Motorized	Same as described in the proposed action.	6,600
Research Natural Area	Same as described in the proposed action.	5,800
Restoration	Like the Focused and General Restoration MAs, management area emphasis would focus on the restoration of ecological integrity and ecosystem function at the landscape scale using both active management (mechanical treatment and prescribed fire) and passive management (natural processes, including disturbances and succession) to restore natural processes and improve resiliency, with limited mechanical treatment in late forest structure habitat. The landscape would be natural appearing in the majority of this management area, but in comparison to the Backcountry and Backcountry Motorized Management Areas, these areas have NFS roads and areas of intensive, concentrated management activity or facilities.	338,500
Scenic Byways	Same as described in the proposed action.	17,600
Wilderness-Congressionally Designated	Same as described in the proposed action.	31,400
Wilderness-Recommended	Same as described in the proposed action.	220,300
Administrative and Recreation Sites	Same as described in the proposed action.	less than 1%
Nationally Designated Trails	Same as described in the proposed action.	*less than 1%
Riparian Management Areas	Same as described in the proposed action.	16%
Wild and Scenic Rivers	Same as described in the proposed action.	less than 1%

* Nationally designated trails, riparian management areas, and wild and scenic rivers would be managed as overlays/management areas and are displayed as a percentage of the Forest.

Alternative B Relationship to the Significant Issues and the Need for Change

Late-Successional and Old Forest Management

Like the no action alternative, this alternative would use a fixed reserve management approach to maintain late forest structure in fixed geographic locations on 31 percent of the Forest (restoration management area). However, alternative B would include plan components to exclude timber harvest as a management tool in late-successional mixed conifer stands. Restoration of ecological integrity and ecosystem function would be achieved primarily through natural process with limited active management activity in late forest structure habitat. In addition, alternative B would retain the 21-inch upper diameter limit on cutting live trees.

Timber Production and Vegetation Management

Scheduled timber production would be suitable on 37 percent of the Forest, in the active management area. The annual projected wood sale quantity would be 37 MMBF. Timber harvest for other resource objectives would be allowed on 46 percent of the Forest.

Variable density thinning and shelterwood with reserves would be the primary vegetation management tools in all vegetation types with the exception of the spruce/subalpine fir type, which would not be managed under alternative B. Prescribed fire of varying intensity is expected in the Douglas-fir dry, Northern Rocky Mountain mixed conifer, and subalpine fir/lodgepole pine (wilderness only) vegetation types.

Motorized Recreation Trails

Alternative B would provide less backcountry motorized recreation opportunities (unroaded setting) than the no action alternative as less than one percent would be allocated to the Backcountry Motorized MA. Although an additional 74 percent of the Forest would be suitable for summer and winter motorized recreation in the other roaded management areas, the increase in recommended wilderness (see alternative B recommended wilderness description), would reduce both motorized and mechanized recreation opportunities compared to the no action alternative.

Access

Alternative B would reduce suitability for roads to 74 percent of the Forest (compared to 83 percent in the no action alternative) due to management areas that are not suitable for road construction, such as recommended wilderness. Additionally, this alternative would cap total miles of NFS roads at the current level (about 4,000 miles) and would include a standard stating that for any miles added to the NFS road system, an equal amount of existing road miles would be required to be decommissioned. This standard was developed to address public concerns about potential resource damage caused by the road system and would be intended to mitigate road-related resource impacts in contrast with the road density desired condition approach of the proposed action.

Recommended Wilderness

Alternative B would recommend 220,300 acres (20 percent of the Forest) for wilderness. The areas that would be recommended are described in table 19. Forest plan components would direct that the wilderness character and potential for each area recommended is to remain intact until congressional action is taken or the area is released from consideration through a future plan amendment or revision. Like alternative R, existing inconsistent uses (mechanized and motorized use, such as mountain bikes and chainsaw use) would not be suitable and a site-specific prohibition (per 36 CFR 261) would be required.

Table 19. Alternative B recommended wilderness

Recommended Wilderness Area	Acres
Abercrombie-Hooknose	37,600
Bald Snow	19,900
Bodie Mountain	4,500
Clackamas Mountain	400
Cougar Mountain	6,100
Deer Creek	5,800
Grassy Top	2,200
Hall Mountain	7,900
Harvey Creek	5,700
Hoodoo	11,700
Jackknife	8,900
Jackson Creek	3,000
Owl Mountain	11,100
Profanity	37,600
Quartzite	5,400
Salmo-Priest Adjacent	16,000
South Fork Mountain	1,200
South Huckleberry	9,900
Thirteenmile	10,900
Twin Sisters	14,500

Wildlife

Like the no action alternative, alternative B would maintain the fixed reserves management approach for late-successional and old forest habitat, but it also would include species-specific management direction for surrogate wildlife species (like the proposed action) that are associated with these late-successional habitat structures through proposed plan components for retention of snag habitat and down woody debris. Also, compared to the no action alternative, habitat connectivity would be addressed through reduced acres suitable for roads and motorized recreation. (See alternative B motorized trail recreation, access, and recommended wilderness descriptions.)

Riparian and Aquatic Resources

Like the no action alternative, alternative B would continue riparian and aquatic management under INFISH. Riparian habitat conservation area widths, the priority watershed network, and riparian and aquatic resource goals objectives, standards, and guidelines would all remain the same as the 1988 forest plan.

Alternative O

Alternative O was designed to reflect areas of agreement expressed by participants at a series of public meetings that focused on motorized recreation, wilderness recommendations, and vegetation management.

Similar to alternative B, the intent of alternative O would be to balance land allocations between areas emphasizing active management (Responsible MA), emphasizing a mix of active and passive management (Restoration MA), and emphasizing passive management (Backcountry MAs and recommended/designated wilderness). Like the no action alternative, this alternative would retain the Eastside Screens, 21-inch upper diameter limit for cutting live trees, and the large-scale reserve approach for late-successional forest structure.

Where the collaborative group did not identify plan components, the proposed action would provide plan direction. This would include management direction to (1) incorporate science related to the recovery of terrestrial and aquatic threatened and endangered species and (2) integrate plan components for water resources and riparian areas (ARCS).

Alternative O would designate 99,000 acres as the Kettle Crest Recreation Area. The Backcountry and Backcountry Motorized Management Areas within the recreation area would be managed to maintain their existing semi-primitive character while allowing for non-wilderness recreation activities to continue, such as mountain biking, OHV riding, and use of a rental cabin, in a semi-primitive setting. See also map 6 in enclosed map packet.

Table 20. Alternative O management areas and acres

Management Area	Management area goal and description	Acres
Backcountry	Same as described in the proposed action (table 10).	174,300
Backcountry Motorized	Same as described in the proposed action.	53,700
Research Natural Area	Same as described in the proposed action.	5,800
Responsible*	Same as described in alternative B (table 18).	433,400
Restoration	Same as described in alternative B.	369,500
Scenic Byways	Same as described in the proposed action.	19,600
Wilderness-Congressionally Designated	Same as described in the proposed action.	31,400
Wilderness-Recommended	Same as described in the proposed action.	15,900
Kettle Crest Recreation Area	Same as described in alternative P (table 14).	99,000
Administrative and Recreation Sites	Same as described in the proposed action.	less than 1%
Nationally Designated Trails	Same as described in the proposed action.	**less than 1%
Riparian Management Areas	Same as described in the proposed action.	16%
Wild and Scenic Rivers	Same as described in the proposed action.	less than 1%

* Responsible management area was named through a collaborative process and the name is retained to honor that process. The management area description is the same as active management in alternative B.

** Nationally designated trails, riparian management areas, and wild and scenic rivers would be managed as overlays/management areas and are displayed as a percentage of the Forest.

Alternative O Relationship to the Significant Issues and the Need for Change

Late-Successional and Old Forest Management

Like the no action alternative and alternative B, this alternative would use a fixed reserve management approach to maintain late forest structure in fixed geographic locations on

34 percent of the Forest (restoration management area). It would include plan components to exclude timber harvest as a management tool in late-successional mixed conifer stands. Restoration of ecological integrity and ecosystem function would be achieved primarily through natural process with limited active management activity in late forest structure habitat. In addition, alternative O would retain the 21-inch upper diameter limit on cutting live trees.

Timber Production and Vegetation Management

Scheduled timber production would be suitable on 33 percent of the Forest, in the responsible management area. Timber harvest for other resource objectives would be allowed on 49 percent of the Forest. The annual projected wood sale quantity would be 38 MMBF.

Anticipated vegetation management tools and estimated (modeled) acres of treatment per year in alternative O are the same as alternative B.

Motorized Recreation Trails

Alternative O would increase the opportunity for backcountry (unroaded setting) motorized and non-motorized recreation opportunities. Approximately 5 percent of the Forest would be allocated to the Backcountry Motorized MA (suitable for summer and winter motorized recreation) and approximately 16 percent would be allocated to the Backcountry MA (not suitable for motorized recreation). (Both would be suitable for mechanized use.) An additional 73 percent of the Forest would be suitable for summer and winter motorized recreation in the other roaded MAs.

Kettle Crest Recreation Area

Unique to this alternative and in acknowledgement of ongoing public disagreement around wilderness recommendations, a 99,000-acre recreation area along the Kettle Crest would be created, including areas both north and south of Sherman Pass (unlike alternative P, which only includes the area north of Sherman Pass). Participants in the Colville Collaborative group (2006-2008) that worked on forest plan issues around wilderness and vegetation management agreed that the Kettle Crest was a special area for semi-primitive recreation opportunities, but did not agree that the area should be wilderness because of the impacts to recreation opportunities such as mountain biking and OHV riding as well as motorized trail maintenance. Management emphasis of the Kettle Crest Recreation Area would emphasize outstanding recreational values in a semi-primitive setting and would allow uses (roads, motorized and non-motorized recreation, and vegetation management for example) to the extent that the uses were in harmony with the special recreation values of the area.

Access

Alternative O would reduce suitability for roads to 74 percent of the Forest (compared to 83 percent in the no action alternative) due to management areas that are not suitable for road building, such as the Kettle Crest Recreation Area, backcountry non-motorized and recommended wilderness. Additionally, this alternative would cap total miles of NFS roads at the current level (about 4,000 miles) and would include a standard stating that for any miles added to the NFS road system, an equal amount of existing road miles would be required to be decommissioned. This standard was developed to address public concerns about potential resource damage caused by the road system and would be intended to mitigate road-related resource impacts, in contrast with the road density desired condition approach of the proposed action.

Recommended Wilderness

Alternative O would recommend only the Salmo-Priest Adjacent area (15,900 acres, or 1 percent of the Forest) for wilderness. Forest plan components would direct that the wilderness character and potential for each area recommended is to remain intact until congressional action is taken or the area is released from consideration through a future plan amendment or revision. Like the proposed action and alternative P, existing inconsistent uses would be allowed to continue, but no new motorized or mechanized recreation opportunities (such as mountain bike and chainsaw use) would be allowed.

Wildlife

Like the no action alternative, alternative B would maintain the fixed reserves management approach for late-successional and old forest habitat, but it also would include species-specific management direction for surrogate wildlife species that are associated with these late-successional habitat structures through proposed plan components for retention of snag habitat and down woody debris. Also, compared to the no action alternative, habitat connectivity would be addressed through reduced acres suitable for roads and motorized recreation. (See alternative O motorized trail recreation, access, and recommended wilderness descriptions.)

Riparian and Aquatic Resource Management

Like the proposed action, riparian and aquatic resource direction would be integrated through the implementation of the 2008 ARCS. However, the key watershed network and designation process would be the same as alternative R.

Comparison of Alternatives

The following tables summarize and compare the alternatives. Table 21 compares the suitability of each management area for major types of uses across the alternatives. Table 22 provides a summary of effects by revision topic.

Table 21. Comparison of management area suitability by alternative

Management Areas	No Action	Proposed Action	Alt. P	Alt. R	Alt. B	Alt. O	Road construction	Scheduled Timber production	Timber harvest for other resource objectives	Summer motorized recreation	Winter motorized recreation
Old Growth Dependent Species Habitat/ Late Forest Structure	3%	-	-		-	-	No	No	-	Yes if habitat integrity is maintained	Yes if habitat integrity is maintained
Late Forest structure	-	-	-	51%			Yes --1 mi/mi^2 desired condition for road density	Yes	-	Yes	Yes
Caribou Habitat[17]	3%	-	-	-	-	-	No	No	-	Yes if habitat integrity is maintained	Yes if habitat integrity is maintained
Recreation	4%	-	-	-	-	-	Yes	Yes	-	Suitable in MA 3A and 3C; Not suitable in MA 3B	Suitable in MA 3A and 3C; Not suitable in MA 3B
Recreation/Wildlife	1%	-	-	-	-	-	No	No	-	Yes	Yes
Downhill Skiing	less than 1%	-	-	-	-	-	No	No	-	Yes	Yes
Research Natural Areas	less than 1%	less than 1%	less than 1%	less than 1%	less than 1%	less than 1%	No	No	No	No	No
Scenic/Timber	20%	-	-	-	-	-	Yes	Yes	-	Yes	Yes
Scenic/Winter Range	7%	-	-	-	-	-	Yes	Yes	-	Yes--seasonal closures may be implemented	Yes--seasonal closures may be implemented
Wood/Forage	39%	-	-	-	-	-	Yes	Yes	-	Yes	Yes

[17] The woodland caribou recovery area is integrated with the Focused Restoration Management Area under the proposed action and alternative P, and integrated with the Late Forest Structure Management Area in alternative R.

Management Areas	No Action	Proposed Action	Alt. P	Alt. R	Alt. B	Alt. O	Road construction	Scheduled Timber production	Timber harvest for other resource objectives	Summer motorized recreation	Winter motorized recreation
Winter Range	12%	-	-	-	-	-	Yes	Yes	-	Yes--seasonal closures may be implemented	Yes--seasonal closures may be implemented
Wilderness–Congressionally Designated	3%	3%	3%	3%	3%	3%	No	No	No	No	No
Backcountry (Semi-Primitive Non-Motorized)	8%	8%	12%	2%	less than 1%	16%	No	No	Yes	No	No
Backcountry Motorized (Semi-Primitive Motorized)	1%	6%	5%	less than 1%	less than 1%	5%	No	No	Yes	Yes	Yes--limited by wildlife restrictions
Scenic Byways	less than 1%	2%	2%	2%	2%	2%	Yes; No—within SPNM ROS[18]	No	Yes	Yes; No—within SPNM ROS	Yes; No—within SPNM ROS
Wild & Scenic Rivers	less than 1%	less than 1%	less than 1%	less than 1%	less than 1%	less than 1%	Yes—recreational, No--Wild	No	Yes—recreational, No--Wild	Yes—recreational, No--Wild	Yes—recreational, No--Wild

[18] Semi-Primitive Non-Motorized Recreation Opportunity Spectrum class

Management Areas	No Action	Proposed Action	Alt. P	Alt. R	Alt. B	Alt. O	Road construction	Scheduled Timber production	Timber harvest for other resource objectives	Summer motorized recreation	Winter motorized recreation
Nationally Designated Trails	less than 1%	less than 1%	less than 1%	less than 1%	less than 1%	less than 1%	Yes	No	Yes	No	Yes-- Existing trails and cross-country routes, except in designated wilderness or recommended wilderness; No--new trails or cross-country routes
Administrative & Recreation Sites (Includes permitted and developed recreation sites)	less than 1%	less than 1%	less than 1%	less than 1%	less than 1%	less than 1%	Yes	No	Yes	Yes-- In campgrounds with designated motorized trails	Yes
RHCA/RMAs*	14%	16%	16%	16%	14%	16%	Yes--within standards and guidelines	No--except where needed to maintain or meet RMOs	Yes--vegetation management can be used as a tool to meet or maintain desired conditions, goals and objectives	Yes--within standards and guidelines; No-- Play areas, or new designated motorized use areas, except road/trail stream crossings	Yes--within standards and guidelines
Wilderness-Recommended	-	9%	6%	19%	20%	1%	No	No	No	No	No
Kettle Crest Recreation Area	-	-	7%	-	-	9%	No/Yes-- within standards and guidelines	No/ Yes—if consistent with underlying MA	Yes	Yes-- if consistent with underlying MA	Yes-- if consistent with underlying MA

Management Areas	No Action	Proposed Action	Alt. P	Alt. R	Alt. B	Alt. O	Road construction	Scheduled Timber production	Timber harvest for other resource objectives	Summer motorized recreation	Winter motorized recreation
Focused Restoration	-	-	28%	-	-	-	Yes--1 mi/mi^2 desired condition for road density	Yes	Yes	Yes	Yes
Focused Restoration[19] (Active Restoration B)	-	23%	-	-	-	-	Yes--(road density desired condition = 2 mi/mi^2)	Yes	Yes	Yes	Yes
General Restoration	-	-	44%	22%	-	-	Yes--2 mi/mi^2 desired condition for road density	Yes	Yes	Yes	Yes
General Restoration[20] (Active Restoration C)	-	49%	44%	-	-	-	Yes (road density desired condition = 3 mi/mi^2)	Yes	Yes	Yes	Yes
Active Management/ Responsible Management Areas	-	-	-	-	44%	39%	Yes	Yes	-	Yes	Yes
Restoration	-	-	-	-	31%	34%	Yes	Yes	Yes	Yes--seasonal closures may be implemented	Yes--seasonal closures may be implemented

[19] In the proposed action provided to the public in June 2011, Focused Restoration was labeled as Active Restoration 2.
[20] In the proposed action provided to the public in June 2011, General Restoration was labeled as Active Restoration 3.

Table 22. Comparison of some plan revision key indicators

Resource and Indicator	No action	Proposed Action	Alternative P	Alternative R	Alternative B	Alternative O
Vegetation						
Uses a Fixed Reserves, connectivity corridors and Diameter Limit Management Approach for Managing Late-successional Reserves and Old Forest Habitat Versus Dynamic Landscape Management Approach	Fixed Reserves, connectivity corridors and Diameter Limit	Dynamic Landscape	Dynamic Landscape	Fixed Reserves and Diameter Limit	Fixed Reserves, connectivity corridors and Diameter Limit	Fixed Reserves, connectivity corridors and Diameter Limit
Timber Production[21]						
Acres/Percentage Suitable for Timber Production	535,700 52%	653,200 63%	656,600 63%	129,400 12%	384,500 37%	347,500 33%
Acres/Percent Harvest Allowed for Other Resource Objectives	323,050 31%	205,550 20%	202,150 19%	729,350 70%	474,250 46%	511,250 49%
Projected Wood Sale Quantity[22] MMBF CCF	 41 82,800	 62 125,900	 62 125,400	 14 28,900	 37 77,000	 38 77,000
Roads						
Percent of Forest Suitable for Roads	83%	73%	75%	75%	74%	74%
Recommended Wilderness						
Acres/Percent Recommended for wilderness	0	101,400 9%	61,700 6%	209,000 19%	220,300 20%	15,900 1%
Recreation						
Percent Forestwide Where Roads, Trails, and Areas may be Designated for Motor Vehicle Use	89%	79%	80%	76%	75%	78%
Designation of Kettle Crest Recreation Area	No	No	Yes	No	No	Yes
Wildlife						
Old Forest Management Plan Direction Contribution to Viability	Low	Moderate	High	High	Low	Low
Riparian Habitat						
Number of Subwatersheds with Improved Trend	7	12	15	15	15	7

[21] All outputs represent modeled annual measurements

[22] Projected wood sale quantity includes both commercial and non-commercial (e.g., firewood) wood products sold, on average, per year.

Alternatives Considered but Eliminated from Detailed Study

Federal agencies are required by the NEPA to rigorously explore and objectively evaluate all reasonable alternatives and to briefly discuss the reasons for eliminating any alternatives that were not developed in detail (40 CFR 1502.14). Public comments received in response to the proposed action provided suggestions for alternative methods to address the need for change. Some of these alternatives may have been outside the scope of the need to revise the land and resource management plan, duplicative of the alternatives considered in detail, or determined to be components that would cause unnecessary environmental harm. Therefore, a number of alternatives were considered but dismissed from detailed consideration for reasons summarized on the following pages. Public comments received on the DEIS and draft revised land and resource management plan included some suggestions for additional alternatives. See the response to comments for additional information regarding alternatives considered and eliminated from detailed study

Biological Capability Only

It was suggested that biological capability should be the only consideration in developing alternatives, rather than considering budget or perceived political or social constraints.

First generation forest plans were developed and approved under national direction unconstrained by budget assumptions. Without considering reasonably foreseeable budgets, the 1980s-era forest plan established unrealistic expectations of activity and output. It would be disingenuous to continue to portray unrealistic objectives based on unconstrained or much higher budget levels. The Forest Service has learned it is important to analyze the effects of plan alternatives within the fiscal capability of the unit, because financial constraints are often the primary limiting factor in achieving desired conditions.

Alternatives that give priority to a single resource

The public suggested alternatives that would emphasize protection and restoration of watershed conditions or the unconstrained use of mineral-rich areas over all other resources. Alternatives that would not meet the intent of the NFMA’s regulations for revising forest plans were also suggested.

Use of biological considerations only, or managing the Forest as if it were all critical habitat for threatened or endangered species, in developing alternatives would not meet the intent of NFMA regulations for revising forest plans. The regulations speak to considering ranges of resource outputs, being responsive to public issues and management concerns, and delivering plans that provide for multiple uses. Access to and use of minerals is already covered by existing law, regulation, and policy.

Snowpack alternative

This alternative would emphasize retaining snowpack and returning stream flows to historic levels, implying that current stream flows are less than past conditions. The suggested approach to accomplish this would be by limiting tree cutting. However, increasing the density of the forest canopy would not feasibly increase stream flows (water yield). Rather research has shown that water yields increase and run-off time is altered when a substantial amount of the tree canopy area of a forested watershed is removed (Bosch and Hewlett 1982).

Inventoried Roadless Areas alternatives

Some members of the public suggested an alternative that promoted removing any constraints to road building and commercial timber harvest within inventoried roadless areas.

However, management of inventoried roadless areas (outside of Idaho and Colorado), must follow the 2001 Roadless Area Conservation Rule (36 CFR 294 Subpart B). The rule generally prohibits new road construction and reconstruction in inventoried roadless areas, and timber harvest is only permitted under a few limited exceptions. Access for the exploration of locatable minerals pursuant to the General Mining Law of 1872 is not prohibited by the rule, nor is reasonable access for the development of valid claims. Determination of access for exploration or development of locatable minerals is found at 36 CFR part 228 Subpart A. While the NEPA allows consideration of alternatives that are contrary to rules, this issue has been litigated and affirmed by the courts.

Forest Rangeland and Renewable Resources Planning Act

The planning regulations at 36 CFR 219.12(f)(6) (1982) require that at least one alternative be developed "which responds to and incorporates the RPA [Resources Planning Act] Program tentative resource objectives for each forest displayed in the regional guide."

The last RPA Program was developed in 1995. The requirement for an "RPA Program" was replaced in the Government Performance and Results Act of 1993 with a requirement for the agency to develop a Strategic Plan. Currently, the Forest Service Strategic Plan (FY2015 to 2020) provides broad overarching national guidance for forest planning and national objectives for the agency. All of the alternatives considered in detail in this FEIS integrate these broad strategic objectives.

Minimum Level of Management

Under this alternative, only the minimum level of management needed to maintain and protect the Forest as a part of the National Forest System would be accomplished. No acres would be classified as suitable for timber production or grazing, no trees would be harvested, and no timber would be produced. Management would be solely focused on preventing resource damage or addressing the safety of forest visitors and would be limited to management of the recreation facilities, roads and trails. Treatments in wildland-urban interface areas would continue to meet liability concerns.

It was determined that this alternative should not be considered in further detail because it would not meet the need for change identified for revising the 1988 forest plan or address the significant issues raised by the public. It would also not meet the legal requirements of the Multiple Use Sustained Yield Act and National Forest Management Act to provide for multiple uses and benefits of the national forests.

Alternatives with varying levels of recommended wilderness

Many comments received on the DEIS contained suggestions for alternatives with different amounts of recommended wilderness, in general, more acres or less acres than proposed in the preferred alternative. The responsible official determined that the range of alternatives in this FEIS is adequate regarding the options for recommended wilderness. Suitability of recommended wilderness areas was carefully analyzed by the interdisciplinary team using national Forest Service Handbook direction (FSH 1909.12 Chapter 70, January 2007). The methodology and effects are included in chapter 3 of this FEIS and in the Recreation Specialist Report. The no action alternative would not recommend any new wilderness, and the acres of existing congressionally designated wilderness would remain the same. Alternative B would recommend the most acres of additional wilderness (220,300 acres). All areas that may be suitable for inclusion in the national wilderness preservation system are included in alternative B except for one, the Lost Creek area. Under alternative O, the Salmo-Priest Adjacent area that may be suitable for inclusion in the national wilderness preservation system (approximately 15,900 acres) is the only area that would be included. The proposed action and alternative P include levels of recommended wilderness between no action and alternative B.

The amount and location of recommended wilderness included in each alternative reflects a range of not only recommended wilderness, but also the effect of the recommended wilderness areas on motorized recreation, economic impact to counties and local communities, and public comment related to other desired uses of the forest.

Alternatives that address various aspects of motorized and non-motorized recreation

Many comments received on the DEIS suggested that more opportunities for motorized recreation should be provided, or conversely, more opportunities for non-motorized recreation should be provided. Comments included that the Forest develop an alternative that would designate all reasonable routes for dual use (highway-legal and motorized recreational vehicles) or that the revised plan should include designation of specific types of routes (for both motorized and non-motorized users).

The forest decided not to fully develop these suggested alternatives because the FEIS analyzes varying opportunities for both motorized and non-motorized recreation across the alternatives. The revised land and resource management plan only identifies management areas where motorized recreation is a suitable use, and does not preclude the development or improvement of trails, or designation of routes at the project level. Site-specific road or trail designations are not included in the revised plan, but would be analyzed at the individual project level.

An alternative that includes a management plan for the Pacific Northwest Trail

One commenter suggested that the Forest should include the comprehensive management plan for the Pacific Northwest National Scenic Trail, or Pacific Northwest Trail (PNT).

The nature and purposes of the PNT will be identified in the Pacific Northwest National Scenic Trail Comprehensive Plan, anticipated to be completed in 2019. The Comprehensive Plan will also identify specific uses that are compatible and incompatible with the nature and purposes. This direction will be incorporated in the revised forest plan through amendment, as necessary where plan components conflict or do not provide for the nature and purposes identified in the Comprehensive Plan. The revised forest plan does identify specific uses that are not compatible with the purposes for which the trail was designated and which may not be authorized in the management area.

Requirements of the National Trails System Act have been brought into agency policy through FSM 2353. Many requirements of the National Trails System Act will be met through the Comprehensive Plan, anticipated to be completed in 2019. Direction from the Comprehensive Plan—including any relocations of the PNT—will be incorporated into the revised land and resource management plan through amendment, as necessary, where plan components conflict or do not provide for the nature and purposes of the PNT.

An alternative that implements 36 CFR 212 subpart A

One commenter suggested an alternative that would be more aggressive in managing the forest road system to implement Subpart A (36 CFR 212). The Forest did not pursue fully developing this alternative because the revised land and resource management plan includes desired conditions and objectives for road management. None of the alternatives put restrictions or a limit on the rate at which the Forest transportation plan is implemented. The ability of the Forest to manage these roads is budget-dependent, and specific management actions are determined during project-level NEPA analysis. Therefore, rate of implementation would not support development of another alternative.

Alternatives with varying levels of livestock grazing

Some commenters suggested that the Forest should consider alternatives that would identify ways to increase livestock grazing to meet local demand, while others felt that the Forest should look for ways to reduce the level of grazing by domestic livestock including total removal of grazing authorizations.

Ultimately, the responsible official decided not to analyze these alternatives in detail because livestock grazing is a suitable use of NFS lands and level of grazing is determined for each allotment under project-level NEPA analysis. Determinations about the type and amount of grazing, seasonal restrictions, and site-specific direction are determined during that project-level analysis. The purpose of the land and resource management plan is to identify whether domestic livestock grazing is a suitable use for each management area and provide objectives, standards, and guidelines that guide project-level analysis to move those lands toward desired conditions.

Alternatives with increased vegetation management

Several commenters suggested alternatives that would increase the amount of timber and fuels treatments, including an accelerated restoration, or departure schedule, alternative. The range of alternatives considered in detail covers varying amounts of annual timber outputs. Some commenters suggest that 80 MMBF per year was a target that would allow the Forest to meet the desired future conditions in a shorter period of time. However, modeling conducted by the interdisciplinary team showed that this was not necessarily the case. Additionally, a departure schedule is not required to meet any law, policy, or regulation, and outputs modeled in the preferred alternative are based on ecological considerations, as well as forest staffing and budget.

An alternative that would remove riparian management area widths was also suggested. Action alternatives P, O, and R and the proposed action include components from the ARCS. No action and alternative B would retain INFISH direction. Both the ARCS and INFISH aim to protect riparian and aquatic habitat, which has been identified as a critical component of healthy ecosystems. Maintaining ARCS direction in the alternatives considered in detail helps the Forest ensure compliance with the Clean Water Act and Endangered Species Act, while responsibly managing aquatic resources.

Alternatives with no commercial activities or development

Some commenters suggested alternatives that would not allow commercial timber removal, road and trail construction, mining, or any use of the land or waters that would interfere with wildlife and their habitat. The NFMA requires the agency to provide for multiple uses of the land and a sustained yield of timber. The Mining Law of 1872 also protects miners' rights on Federal land. Because of these legal requirements, an alternative that would eliminate commercial activities and development was not considered for development in detail.

Citizens Alternative

One commenter suggested an alternative that would have the agency take a more passive management role. Suggested aspects of this alternative included emphasizing carbon storage, protecting old growth, protecting characteristics of roadless areas, reducing the road network improving management of livestock grazing, and including enforceable standards in the plan (please see response to comments appendix E for further details of this suggested alternative).

The responsible official determined that many aspects of this alternative had been considered in the analysis for the no action and action alternatives. Carbon storage, downed wood, snags and old growth are analyzed for each alternative considered in detail. All inventoried roadless areas are proposed for Backcountry, Backcountry Motorized, or Recommended Wilderness Management Area designation, which will protect existing characteristics of these areas. The preferred alternative includes components addressing water quality, riparian and fish habitat, soils and sedimentation, wildlife conservation, and habitat protection. The preferred alternative also includes monitoring requirements to help ensure that these plan components are met and will be effective.

Because of the multiple use and sustained yield requirement of NFMA, combining all the suggested components of this alternative, which focuses on more restorative and passive management actions, this alternative was not fully developed. Developing this alternative in detail would not have led to viable alternative to be selected for implementation.

Wild Horse Alternative

One commenter suggested that the Forest should introduce wild horses to the Colville National Forest and described some of the effects that they thought could benefit the forest. The Forest chose not to pursue fully developing this alternative because there are no Wild Horse Territories (FSM 2260; 2003) on the Colville National Forest and introducing non-native animal species is outside the scope of forest planning.

Mineral Availability Alternative

One commenter suggested that the Forest develop an alternative that excludes mineral-rich areas and areas with existing mining claims from Backcountry and Recommended Wilderness Management Areas. The Forest decided not to fully develop this alternative because this is addressed in the no action alternative and alternative O; and some existing mining claims and other mineral-rich areas are within inventoried roadless areas, and the Mining Law of 1872, as amended, already provides protection of mining rights. Modifications made to alternative P between the DEIS and FEIS based on additional field review and public comments partially address this request. The responsible official determined a sufficient range of alternatives related to minerals and mining claims is included in the FEIS.

Chapter 3. Affected Environment and Environmental Consequences

Introduction

This chapter summarizes the physical, biological, social, and economic environments of the planning area and the predicted effects of implementing each alternative on those environments. It also presents the scientific and analytical basis for the comparison of alternatives presented in chapter 2. More detailed information, including methodology and assumptions, can be found in the resource specialist reports located in the "Plan Set of Documents" on the website and available upon request.

For estimating the effects at the programmatic-forest plan level, the assumption has been made that the kinds of resource-management activities allowed under the plan component direction are reasonably foreseeable future actions to achieve the desired conditions. However, the specific location, design, and extent of such activities are generally not known at this time. The decisions are made on a site-specific (project-by-project) basis. Therefore, the discussions here refer to the potential for the effect to occur and are in many cases only estimates. The effects analyses are useful when comparing and evaluating alternatives on a forestwide basis, but are not intended to be applied directly to specific locations on the Forest.

Related Information

The following is explanatory information related to effects analysis discussed in this chapter.

Programmatic Framework of the Land Management Plan

The proposed plan and its alternatives do not authorize implementation of management activities described in the effects analyses. The proposed plan and its alternatives provide a programmatic framework that guide site-specific actions, but they do not authorize, fund, or carry out any project or activity.

Because the proposed plan does not authorize or mandate any site-specific projects or activities (including ground-disturbing actions), there can be no direct effects. However, there may be implications or long term environmental consequences of managing the forests under this programmatic framework. The proposed plan sets the stage for what future management actions are needed to achieve desired outcomes (desired conditions, objectives, areas with special designations) and provides the sideboards (suitability, standards, guidelines) under which future activities may occur in order to manage risks to ecological, social, and economic environments. To actually implement site-specific projects, project and activity-level planning, environmental analysis and decisions must occur. For example, the proposed plan may contain direction to close or rehabilitate roads in order to benefit riparian areas; however, a subsequent site-specific analysis and decision must be made for proposals that involve road closures or decommissioning.

Environmental Analysis and Overall Assumptions

In development of the environmental analyses that follow, the best available science was considered and is documented in the "Plan Set of Documents." The environmental analyses focus on the need for change and issues identified through the scoping process. Overall assumptions were made in the analyses of alternatives and include the following.

Fiscal capability assumption

To evaluate the effects of the plan alternatives, assumptions are needed about the level of management activities over the life of the land and resource management plan, which is 10 to 15 years. The level of management activities for the Colville National Forest is based on a reasonable idea of the fiscal capability of the Forest. Fiscal capability is subject to variation during the Federal budget process over the course of the next 15 years, but for the purposes of land management planning the fiscal capability is based on the current situation and recent trends in Forest budget. As fiscal capability changes in the future, management activities on the ground may increase or decrease. The following is a brief summary of the fiscal capability.

Budget Trends

For the past 5 years, the total budget has averaged $17 million per year. The 5-year funding levels have remained at a relatively constant level (they varied up to 10 percent) and are expected to remain around this level for the near future.

Based on the above budget trend, this analysis assumes the following:

- The expected amount of acres treated (prescribed fire, mechanical fuels, stand improvement activities, or timber harvest) will remain constant over the life of the land and resource management plan, approximately 6,000 to 12,000 acres per year on average.
- Roadwork on the Forest will average 20 miles per year of reconstruction, construction or decommissioning over the life of the plan.

Agreements and Partnerships

The Forest has received funding outside the allocated budget for special projects from special budget allocations, such as those for collaborative forest restoration. Several partnerships with organizations provide grant monies for projects and provide substantial volunteer time. They are not included in the fiscal capability because these opportunities are unusual, tied to specific management activities, and/or time-limited.

Climate Change Assumption

This analysis draws on existing synthesis and assessments prepared by the Intergovernmental Panel on Climate Change (IPCC) and U.S. Climate Change Science Program Science Assessment Products (CCSP SAP) as well as information from Forest Service Research to provide an overview of consistent scientific information on climate change projections for the planning area. Specifically assumptions about climate change for the planning area is based on information developed by the Forest Service Pacific Northwest Research Station, University of Washington Climate Change Group, and the Forest Service Climate Change Resource Center. The key area of risk identified and related to this analysis is the expected forest mortality and long-term transformation of forest landscapes, caused by the combined effects of increasing wildfire risk, changing precipitation patterns, insect outbreaks, and increased spread of tree diseases (Climate Change Impacts Group 2004, Kunkel et al. 2013, USDA Forest Service 2014b).

Short-term Uses and Long-term Productivity

NEPA requires consideration of “the relationship between short-term uses of man’s environment and the maintenance and enhancement of long-term productivity” (40 CFR 1502.16). As declared by Congress, this includes using all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare; create and maintain conditions under which man and nature can exist in productive harmony; and fulfill the social, economic, and other requirements of present and future generations of Americans (NEPA Section 101). Short-term uses are those that generally occur for a finite period. Long-term productivity refers to the ability of the land to produce a continuous supply of a resource.

The change in the programmatic management of the Colville National Forest under any of the action alternatives would not provide for any short-term uses that would jeopardize the long-term productivity of the lands and resources of the Forest because productivity is addressed at the project level. Descriptions of short-term and long-term environmental consequences can be found in the Affected Environment and Environmental Consequences by Resource section of this chapter.

Unavoidable Adverse Environmental Consequences

The proposed plan provides a programmatic framework that guides site-specific actions, but does not authorize, fund, or carry out any project or activity. Therefore, decisions made in the revised forest plan do not cause unavoidable adverse environmental consequences. The application of standards and guidelines during future project and activity decision-making would provide resource protection measures and would limit the extent and duration of any adverse environmental impacts. For a detailed discussion of types of environmental consequences expected from future activities, see specific resource topic areas in this chapter.

Irreversible and Irretrievable Commitments of Resources

Irreversible commitments of resources are those that cannot be regained, such as the extinction of a species or the removal of mined ore. Irretrievable commitments are those lost for a period but could be regained, such as the temporary loss of timber productivity in forested areas kept clear for use as a power line right-of-way or road.

Because the proposed plan does not directly authorize or mandate any site-specific project or activity (including ground-disturbing actions), none of the alternatives causes an irreversible or irretrievable commitment of resources. Future project-level decisions under any of the alternatives may result in potential irreversible or irretrievable commitments of resources, which would be disclosed accordingly.

American Indian Religious Freedom Act

Agencies must make a good faith effort to understand how American Indian religious practices may come into conflict with other forest uses and consider any adverse impacts on these practices in their decision-making practices. Within the boundaries of the Colville National Forest, there are three potentially affected Tribes: the Confederated Tribes of the Colville Reservation, Spokane Tribe of Indians and Kalispel Tribe of Indians. Federal guidance for Tribal consultation directs the Forest to increase and improve the involvement of Tribes in the decision-making process in the areas where our decisions affect Tribes and their Tribal rights and interests. There is a trust responsibility with regard to managing the resources on which the reserved rights are based.

The Forest is also required to consult with all federally recognized Tribes that had/have traditional uses within the Forest boundary. This consultation extends to the Kalispel Tribe of Indians, the Spokane Tribe of Indians, and the Confederated Tribes of the Colville Reservation. No effects on American Indian social, economic, or subsistence rights are anticipated as a result of this forest plan revision effort. No matter which alternative is chosen for implementation, the Forest will be required to consult with Tribes when management activities may impact Tribal rights and/or cultural sites and cultural use, according to the Consultation Protocol. Formal consultation with the Confederated Tribes of the Colville Reservation was initiated in 2003. Formal consultation with the Spokane and Kalispel Tribes was initiated in 2015.

Desired conditions for American Indian rights and interests, for all action alternatives, would be for the Colville National Forest to:

- recognize and maintain culturally significant species and the habitat necessary to support healthy, sustainable, and harvestable plant and animal populations to ensure that rights reserved by Tribes are not significantly impacted or diminished;
- recognize, ensure, and accommodate Tribal member access to the Forest for the exercise of Tribal rights and cultural uses consistent with law, policy, and regulation; and
- recognize and protect traditional cultural areas as associated with the traditional beliefs of a Tribe about its cultural history.

Prime Farmland, Rangeland, and Forestland

No rangeland or forestland as defined by the National Resource Conservation Service has been identified in the planning area. There are approximately 6,500 acres of prime farmland located on the Colville National Forest. Forest plan revision or the forest plan would not directly affect such lands, although implementation of the revised forest plan could have indirect effects. Regardless of the alternative selected for implementation, NFS lands would be managed with sensitivity to the values of these designated lands.

Threatened, Endangered and Sensitive Species

Potential effects to species listed under the Endangered Species Act (ESA) can be found in chapter 3, as well as in the Wildlife, Aquatics, Fisheries, and Botany Specialist Reports (project file). Management direction to protect the threatened, endangered, candidate, and sensitive species, or to provide for their habitats, can be found in the revised forest plan (forestwide and management area desired conditions, standards, and guidelines).

Wetlands and Floodplains

The forest plan revision and forest plans do not directly implement any management activities that would result in loss of wetland or floodplains. Revised forestwide management direction identifies the need to restore currently degraded wetlands and floodplains, and provides a broad spectrum of standards and guidelines designed to protect soil, water, riparian, and aquatic resources. The goals and intent of Executive Orders (E.O.) 11988 (Floodplain Management) and 11990 (Protection of Wetlands) would be met through compliance with this direction. Documentation for this conclusion can be found in this FEIS (chapter 3) and in the revised forest plan (desired condition, standards, and guidelines).

Conflicts with Other Agency or Government Goals or Objectives

Contact, review, and public involvement with other Federal and State agencies indicate no major conflicts between the revised forest plan and the goals and objectives of other governmental entities.

Regulatory Framework

Relevant Laws, Regulations, and Policy that Apply

As a Federal land management agency, the Forest Service must follow all applicable laws and regulations. If laws change or are amended, or if new laws are enacted, the Forest administration will comply with the changes or additions. The same situation applies to executive orders and agency policy, as expressed in Forest Service Manual (FSM) and Handbook (FSH) directives. These laws are considered in the course of the analysis of effects. A more comprehensive list of laws, regulations and policy is located in appendix D.

Guidance for these laws comes from the Code of Federal Regulations (CFR), and the Forest Service Directive System (the Forest Service Handbooks and Forest Service Manuals).

National rules applicable to all national forests, such as the Travel Management Rule (36 CFR Parts 212, 251, 261, and 295) and the 2001 Roadless Area Conservation Rule (36 CFR Part 294) apply.

Federal laws of which forest plans and revised forest plans must be consistent are:

Clean Air Act of 1970 (42 U.S.C. §7401 et seq.) – This act is the comprehensive Federal law that regulates air emissions from stationary and mobile sources. Among other things, this law authorizes the Environmental Protection Agency to establish National Ambient Air Quality Standards (NAAQS) to protect public health and public welfare and to regulate emissions of hazardous air pollutants.

Clean Water Act of 1977 (33 U.S.C. §1251 et seq.) – Establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulates quality standards for surface waters.

Endangered Species Act of 1973 (ESA) (16 U.S.C 1531-1536, 1538-1540) **–** Provides for the conservation of species that are endangered or threatened throughout all or a significant portion of their range, and the conservation of the ecosystems on which they depend.

Federal Land Policy Management Act of 1976 – Requires public lands to be managed in a manner that will protect the quality of scientific, scenic, historical, ecological, environmental, air and atmospheric, water resource, and archaeological values; and that, where appropriate, will preserve and protect certain public lands in their natural condition and that will provide for outdoor recreation and human occupancy and use.

Forest and Rangeland Renewable Resources Planning Act of 1974 (RPA) (As Amended Through Public Law 106-580, Dec. 31, 2000) (16 U.S.C. 1601) – Establishes standards for how the Forest Service manages the national forests, requires the development of land management plans for national forests and grasslands, and directs the Forest Service to develop regular reports on the status and trends of the Nation’s renewable resources on all forest and rangelands.

Granger-Thye Act of 1950 - Allows concessionaire fees for recreation facilities to be reduced for work performed to maintain and enhance those facilities.

Healthy Forests Restoration Act of 2003 (16 U.S.C. 6501 et seq.) – Expedites the preparation and implementation of hazardous fuels reduction projects on Federal land and assisting rural communities, states and landowners in restoring healthy forest and watershed conditions on State, private and Tribal lands.

Multiple-Use Sustained Yield Act of 1960 – States that the national forests are established and shall be administered for outdoor recreation, range, timber, watershed, and wildlife and fish purposes, and authorizes and directs the Secretary of Agriculture to develop and administer the renewable surface resources of the national forests for the multiple use and sustained yield of products and services.

National Environmental Policy Act of 1969 (NEPA) (42 U.S.C. 4321 et seq.) – Directs all Federal agencies to consider and report the potential environmental impacts of proposed Federal actions, and established the Council on Environmental Quality.

National Forest Management Act of 1976 (NFMA) (Act of October 22, 1976; 16 U.S.C. 1600) – Requires the provision for multiple use and sustained yield of products and services in accordance with the Multiple-Use, Sustained-Yield Act of 1960, and the coordination of outdoor recreation, range, timber, watershed, wildlife, fish, and wilderness.

National Historic Preservation Act (Public Law 89-655; 16 U.S.C. 470 et seq.) **–** Provides for the preservation of historical and archaeological sites in the U.S. The act created the National Register of Historic Places, the list of National Historic Landmarks, and the State Historic Preservation Offices.

Wilderness Act of 1964 (16 U.S.C. 1121, 1131-1136) **–** Created the National Wilderness Preservation System, which protects nearly 110 million acres of wilderness areas in states throughout the Nation.

Affected Environment and Environmental Consequences by Resource

This section includes analysis of each of the resources affected by the alternatives and is arranged in the following order:

Forest Vegetation	Economic
Botany	Social
Climate Change	Heritage
Fire	Livestock Grazing
Invasive Plants	Minerals and Geology
Fisheries	Recreation
Hydrology	Scenery
Soil	Special Uses
Wildlife	Tribal

Forest Vegetation

This section analyzes the issue of old forest management and timber production as it relates to six different alternatives for the revised land and resource management plan on the Colville National Forest. The classification of vegetation on the forest is described, and the historical range of variation is compared to the current condition. Recent timber harvest levels, as well as projected future levels are described for each alternative. The projected vegetation structure after 100 years is modeled and compared to the historical range of variation for each alternative.

Affected Environment

Background

The Colville National Forest is considered to be part of the Northern Rocky Mountains, with the Kettle River Range on the west half of the Forest, and the Selkirk Mountains defining the eastern half (Bailey 1995). The Cascade mountain range lies to the west of the area and has a significant influence on precipitation patterns and rain shadow effects that influence vegetation on the Colville National Forest.

Vegetation on the Colville National Forest is highly complex and varied as a result of a wide diversity of soil parent materials, highly diverse topography, interaction of continental and maritime climatic patterns, significant and persistent disturbance processes that include fire, insects, and disease, and strong influences by larger scale climatic events including the El Niño Southern Oscillation and the Pacific Decadal Oscillation (Heyerdahl et al. 2008).

Climate patterns for the Colville are influenced by a transition between an intense rain shadow effect in the west formed by the Cascades, and the inland expression of maritime climate in the east caused by the convergence and uplifting of moist air masses over the Rockies. The result is a considerable west-east variation in precipitation across the Forest. This variation can be seen expressed in vegetation from open, dry Douglas-fir types along the Okanogan-Ferry County line on the western boundary of the Forest, to more moist hemlock-red cedar vegetation types near the Idaho border on the eastern boundary of the Forest (Williams et al. 1995, Gaines et al. 2012)

Soil parent material is highly varied and originates from sedimentary, igneous, and metamorphic processes. The entire area has been influenced by glaciation and has been covered by major continental ice sheet advances in the past, as evidenced by rounded off hills and glacial deposits of varying depths. Volcanic influences are also frequently evident with columnar basalt layers and volcanic ash, including deposits from the large Mt. Mazama eruption, as well as more recent deposits from the Mt. St. Helens eruption in 1980 (Quigley et al. 1996a).

Vegetation Types

Vegetation types for the planning area are based on plant association groups, which are groups of plant associations with similar moisture and temperature regimes. Plant associations are defined by the climax vegetation that would exist on a site in the absence of disturbance and are described for the Colville National Forest in Williams et al. (1995). The plant association group data was produced in 2012, and covers the entire Colville National Forest (Henderson 2012).

The Colville is composed primarily of the dry Douglas-fir vegetation type, characterized by ponderosa pine and Douglas-fir plant associations across the lower elevations of the Forest. On the eastern, wetter half of the Forest, Northern Rocky Mountain mixed conifer stands dominate at higher elevations and more northerly aspects, with western hemlock plant associations and a variety of tree species such as western red cedar, western larch, and western white pine. On the western, drier side of the Forest, similar elevations and aspects produce stands in the Douglas-fir dry type or subalpine fir/lodgepole pine type, and are frequently found with western larch and Douglas-fir. Table 23 shows the vegetation types across the Forest. The majority of acres occurring are in the Douglas-fir dry vegetation type, followed by the Northern Rocky Mountain mixed conifer type. Additional details about methods for vegetation classification was can be found in the Vegetation Specialist Report.

Table 23. Vegetation types, approximate total acres, and percentage of total forested acres

Vegetation Type	Acres	Percentage of Forested Acres
Douglas-fir dry	486,045	45%
Northern Rocky Mountain mixed conifer	308,365	28%
Western red cedar/western hemlock	95,820	9%
Subalpine fir/lodgepole pine	173,699	16%
Spruce/subalpine fir	20,240	2%

Forest Structure

Forest structure is the horizontal and vertical arrangement of trees and includes size (diameter) and canopy (crown) cover. Forest structure information comes from the Landscape Ecology, Modeling, Mapping, and Analysis Gradient Nearest Neighbor (GNN) data. The GNN data is a consistently interpreted vegetation data set based on an imputation processes utilizing a 2012 Landsat image (GNN 2012). Forest Inventory and Analysis plots, Continuous Vegetation Survey plots, ecology plots, and other established vegetation plots were utilized as source data in the imputation process. For this analysis, forest structure is classified into five general classes based on diameter and canopy cover as shown in table 24. Barrett et al. (2010) and Haugo et al. (2015) used a similar approach to defining structure classes, and the GNN data (2012) lends itself well to easily analyzing forest structure at multiple scales using these definitions. It is important to note that the structure class definitions in table 24 are easily analyzed using GNN and many other data sources, but for measurements in the field further analysis will be required to determine conversion factors between canopy cover and trees per acre or basal area per acre.

Table 24. Structure class definitions based on canopy cover diameter

Structure Class	Definition
Early	Trees less than 10 inches d.b.h. or canopy cover less than 10 percent
Mid Open	Trees 10 to less than 20 inches d.b.h., canopy cover 10 percent or greater and less than 40 percent
Mid Closed	Trees 10 to less than 20 inches d.b.h., canopy cover 40 percent or greater
Late Open	Trees 20 inches or greater d.b.h., canopy cover 10 percent or greater and less than 40 percent
Late Closed	Trees 20 inches or greater d.b.h., canopy cover 40 percent or greater

Forest structure has a great influence on how stands develop, which species are able to grow and reproduce, and has been identified as an important factor in assessing fire behavior as well as providing various wildlife habitats (Oliver and Larson 1996). For example, dry Douglas-fir stands in closed structure classes have a higher composition of shade-tolerant species such as grand fir, are more susceptible to stand-replacing fire, and have a higher risk for defoliation and bark beetle-related mortality (Agee 1993). Forest structural stages are a product of successional processes and include both natural and human-influenced disturbance. There are several major disturbance processes that influence forest structural stage development including fire; insects and diseases; windthrow; climate variations such as droughts, landslides and avalanches; and human-induced influences such as livestock grazing, prescribed fire, and timber harvest.

Table 25 shows total acres in each structure class and vegetation type as of 2012, along with total percentages. The majority of the Forest is in the mid closed structure class (57 percent), with lesser amounts in the early (19 percent) and late closed (15 percent) classes, and very little in either mid or late open classes.

Table 25. Approximate total acres and percentages in each structure class and vegetation type, 2012

	Early	Mid Open	Mid Closed	Late Open	Late Closed	Total (Acres)	Total (%)
Douglas-fir dry	58,325 (12%)	34,023 (7%)	277,046 (57%)	24,302 (5%)	92,349 (19%)	486,045	45%
Northern Rocky Mountains mixed conifer	58,589 (19%)	12,335 (4%)	200,437 (65%)	3,084 (1%)	33,920 (11%)	308,365	28%
Spruce/subalpine fir	4,250 (21%)	0 (0%)	12,144 (60%)	0 (0%)	3,846 (19%)	20,240	2%
Subalpine fir/lodgepole pine	57,321 (33%)	6,948 (4%)	85,113 (49%)	3,474 (2%)	22,581 (13%)	173,699	16%
Western hemlock/western red cedar	33,537 (35%)	0 (0%)	49,826 (52%)	0 (0%)	12,457 (13%)	95,820	9%
Total (Acres)	212,023	53,306	624,566	30,860	151,116	1,085,907	
Total (%)	19%	5%	57%	3%	15%		

The structure data used to develop current conditions does not include changes that occurred in 2015, when several large fires occurred across the Forest, affecting forest structure. Approximately 90,000 acres (3 percent of total forest area) burned on Colville National Forest lands with varying severity. Approximately 36,000 acres, or 40 percent of the burned area, experienced high tree mortality (over 75 percent basal area loss), predominantly in the Douglas-fir dry and subalpine fir/lodgepole pine vegetation types. These vegetation types would have a resulting decrease in the amount of mid-closed or late-closed structure class and an increase in the amount of early structure. Early structure in the subalpine/fir lodgepole pine type would have the greatest change, increasing approximately from 33 percent to 43 percent, while the Douglas-fir dry type would increase from 12 percent to 14 percent. The larger change in the subalpine fir/lodgepole pine type is characteristic of fires in this vegetation type, which are generally infrequent but highly severe (Agee 1993). These changes from the fires generally moved the affected vegetation types toward the historical range of variability discussed below.

Historical Range of Variability

The historical range of variability (HRV) refers to the dynamic behavior and functioning of ecosystems before dramatic changes occurred with European settlement, generally considered to be the mid-1800s for this area (Aplet and Keeton 1999). The HRV provides a framework to determine changes to ecosystem attributes that have occurred between historical and current conditions and recognizes that ecosystems experience a range of conditions across which processes are resilient and self-sustaining. When allowed to move beyond the limits of the range of variability, ecosystems may move into a state of disequilibrium or disorganization (Kaufmann et al. 1994, Holling and Meffe 1996, Egan and Howell 2001).

A state and transition model, ST-Sim (2014), was used to simulate forest dynamics and development of forest structure through time. The model simulated 300 years of growth and change for each vegetation type and average values from years 101 to 300 were used to develop HRV ranges. This is a similar approach to developing HRV that has been used in several other efforts including Barrett et al. (2010), Blankenship et al. (2015), and Haugo et al. (2015). Table 26 compares current structure conditions (as of 2012) for each vegetation type to HRV.

Table 26. Historical range of variability percentages by vegetation type for each structure class compared to 2012 conditions

		Early	Mid Open	Mid Closed	Late Open	Late Closed
Douglas-fir dry	2012	12*	7	57	5	19
	Historical	6-16	2-8	4-13	38-78	1-32
Northern Rocky Mountain mixed conifer	2012	19	4	65	1	11
	Historical	9-25	1-3	18-30	4-6	44-60
Western hemlock/Western red cedar	2012	35	0	52	0	13
	Historical	4-24	0	7-27	0	55-83
Subalpine fir/Lodgepole pine	2012	33	4	49	2	13
	Historical	45-65	0	33-53	0	3
Spruce/Subalpine fir	2012	21	0	60	0	19
	Historical	14-46	0	13-41	0	29-57

*Shaded cells are within HRV

The dry Douglas-fir type has experienced a significant amount of departure from historical conditions. Dry Douglas-fir forests that historically experienced frequent, low-severity fires have missed several fires due to over a century of fire exclusion and suppression, which has resulted in substantial increases in fuel loadings and the number of small trees. The historically open stands within the dry Douglas-fir vegetation type, with their mosaic pattern of tree clumps or patches and openings, have now filled in with younger trees, resulting in a more uniform stand structure, increased ladder fuels, increased stand densities, increased fuel continuity, and decreased spatial heterogeneity across the landscape. This is reflected in the high percentage of mid closed structure compared to historical conditions. Due to these altered stand conditions, active management through thinning, as well as time for trees to grow, will be required to move stands from mid closed to late open structure.

The Northern Rocky Mountain mixed conifer type has undergone changes similar to the dry Douglas-fir type, with fire exclusion causing increased tree density, an abundance of mid closed structure, and a lack of late structure classes. This vegetation type historically experienced mixed-severity fires that could be tens of thousands of acres in size and resulted in a range of structure classes, age classes, and opening sizes. Most of this type is now in a mid-closed structure and will require time to grow into late closed structure.

The western hemlock/western red cedar vegetation type is found in the wettest areas of the Forest and is characterized by a mixed severity disturbance regime, with fires historically covering tens of thousands of acres and producing a variety of stand conditions, but generally causing severe enough conditions for stand replacement. Current conditions show that the majority of this type is in the mid closed structure class and will require time to grow into late closed structure.

The spruce/subalpine fir type is represented mostly by wetter areas on the west side of the Forest and were historically a mix of early, mid closed, and late closed structure classes due to the high-severity disturbance regime found around these areas. Generally, this type is surrounded by either Northern Rocky

Mountain mixed conifer or subalpine fir/lodgepole pine types and would be influenced by the adjacent disturbances. Currently, most of this type is in the mid closed structure class and will require time to grow into late closed.

The subalpine fir/lodgepole pine type shows an abundance of late closed stage and a lack of early stage, which is consistent with fire exclusion and the ecology of lodgepole pine dominated stands. Given the effects of mountain pine beetle (which generally attacks and kills lodgepole pine over 8 inches d.b.h. or 80 years of age) and an infrequent high-severity stand-replacing fire regime, there historically would be little late structure in this type, and the majority would be in early and mid-structure classes. Current conditions show that as a result of lack of disturbance, additional acres of this type have transitioned into the late closed stage than were historically present, likely due to the lack of disturbance required to move these stands back to an early stage. Current conditions in both the mid open and late open show small percentages, whereas historically, these would not have existed. This is likely due to recent management in lodgepole pine stands, where canopy cover has been temporarily reduced. The fires of 2015 likely increased the early structure class by around 10 percent, reducing the mid closed by around 9 percent and the late closed by around 1 percent, but still leaving this vegetation type having an excess of late closed structure class and a deficit of early structure class.

For all vegetation types except subalpine fir/lodgepole pine, there is an abundance of mid closed structural stage and a lack of late stages. The amount of late forest structure across the Colville National Forest has been influenced by fire, land management practices, high levels of bark beetles and defoliating insects, climate variability, and fire suppression. With fire exclusion, late seral, shade-tolerant species have increased in proportion to shade-intolerant early seral species. As a consequence, stand structures have changed from relatively open single- or two-storied stands dominated by large individuals of fire-resistant species, to denser, smaller-stemmed, multi-layered stands with a high proportion of fire sensitive, late seral species (Everett et al. 1994, Williams et al. 1995, Hessburg and Agee 2003).

Current late forest structure levels reflect the fire history of the Forest. During the period from the 1910s into the 1930s, a number of large-scale fires occurred across portions of the landscape (Catlin et al. 2005). Significant numbers of large and old trees were killed in these fires and harvested afterward. Approaching 100 years after some of these initial fires, forest structure across the landscape has slowly been transitioning into a mid-seral, closed canopy situation. Also, portions of the Colville had unsuccessful homestead activity and the lands once cleared for homestead development are slowly growing into mid-seral, closed-canopy stands. The majority of forest stands are in a mid-closed structure condition, showing smaller tree sizes than would be expected historically, and for the dry type, more canopy cover.

Insects and Diseases

Levels of insect- and pathogen-related mortality across eastern Washington have been widely publicized over the past several years (WA DNR 2014-2). Fire suppression, grazing, and harvesting have been identified as the principal factors resulting in increased stocking levels, increased levels of mid and late seral species, and homogenization of spatial patterns. Widespread fires in the 1920s and 1930s also created large areas of even-aged forests. All of these factors contribute to conditions that support larger scale and more persistent insect outbreaks (Hessburg et al. 1994). Insect and disease affected acres have consistently exceeded fire affected acres for the Colville National Forest.

A recent report from the Washington Department of Natural Resources (WA DNR 2014-2) notes that for all lands in eastern Washington, the acres of trees killed or damaged by insects and diseases is 150 percent greater than in the 1990s, 200 percent greater than in the 1980s, and 175 percent greater than in the 1970s, based on data from aerial surveys.

The National Insect and Disease Risk Map predicts continued high levels of insect- and disease-related mortality over the 15-year period between 2013 and 2027, with particularly high levels occurring in northeastern Washington and on the Colville National Forest as shown in figure 7 (Krist et al. 2014). Over 42 percent (449,400 acres) of the Colville National Forest is identified as experiencing greater than 25 percent basal area loss between 2013 and 2027 due to insects and diseases based on the National Insect and Disease Risk Map. The majority of this risk comes from mountain pine beetle, western pine beetle, Douglas-fir beetle, and root diseases. Basal area is the cross-sectional area of a tree stem including the bark measured at 4.5 feet off the ground and is used as a measure of tree density. Currently, most of the mountain pine beetle mortality is occurring in roadless areas or other places where timber harvest is limited and even-aged stands of lodgepole pine are found.

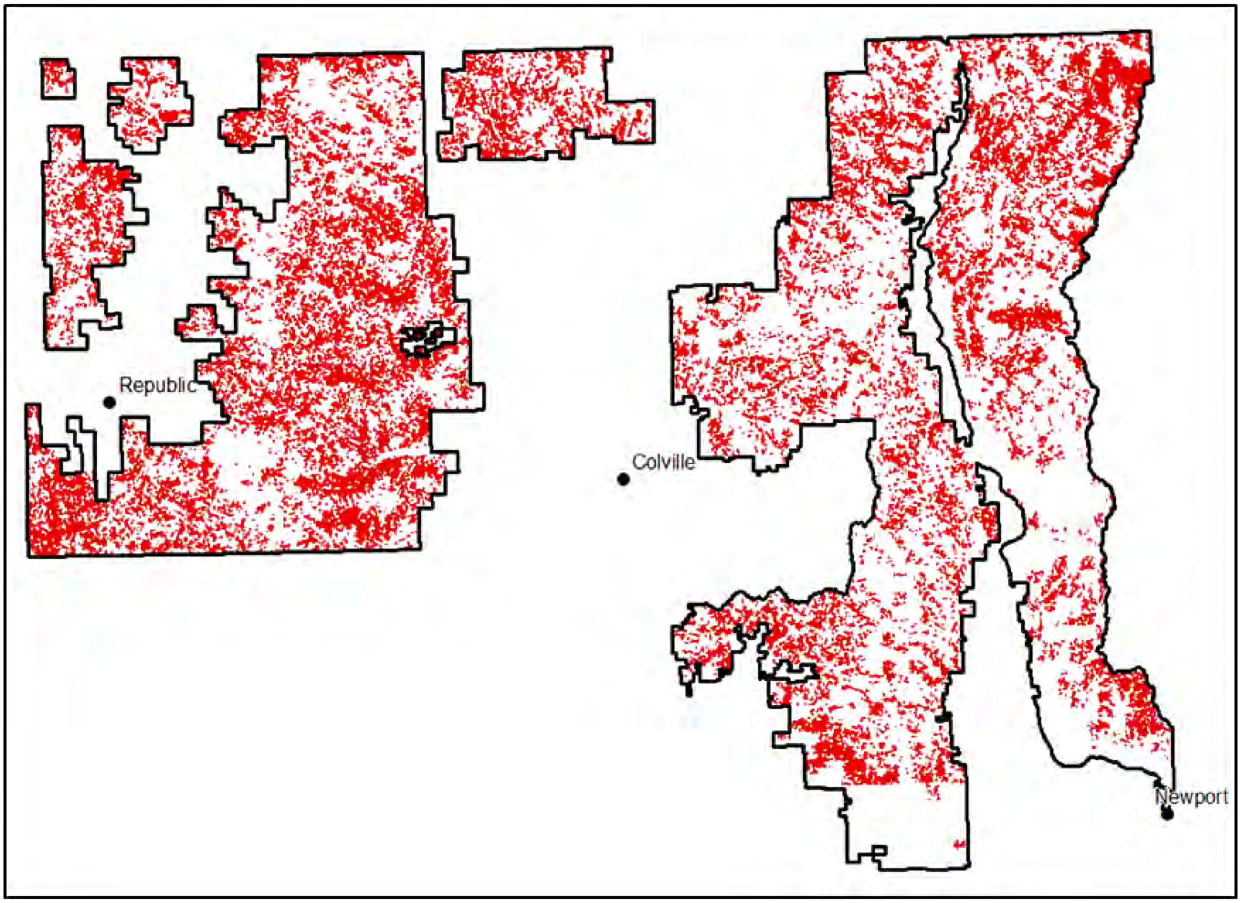


Figure 7. National Insect and Disease Risk Map for the Colville National Forest.
Red areas show where more than 25 percent of the total live basal area is at risk of loss within the next 15 years.

In 2012, a forest health hazard warning was issued by the State of Washington for portions of eastern Washington, including the western portion of the Colville National Forest within Ferry County. The purpose of the warning is to call attention to areas of emerging damage and susceptible forest conditions, and to help coordinate timely actions by landowners to address the situation. This represented the first time this state authority was ever used since its inception. The designation was focused on western spruce budworm and pine beetles, and was based on recent insect damage data from aerial surveys, projected future damage from risk maps, and potential for on-the-ground action to address the damage (WA DNR 2014-1).

Recent Aerial Detection Survey flights from 2011 to 2015 have noted increases in pine bark beetles and declining amounts of western spruce budworm. Increases in bark beetles can be attributed to the increasing amounts of older lodgepole pine across the landscape, as evidenced by most of these vegetation types being in a mid-closed or late-closed structure class. Higher tree densities, as well as an increase in mid-to-late successional species such as Douglas-fir and grand fir have contributed to conditions that are favorable to insect outbreaks (Ferrell 1986, Gibson et al. 2009, Schmitz and Gibson 1996). Multi-layered tree canopies dominated by Douglas-fir and grand fir facilitate western spruce budworm outbreaks, which have been seen at increased levels since 2011, but as of 2015, appear to be declining (Blackford 2004). The non-native disease white pine blister rust is also contributing to tree stress, resulting in increased mortality of whitebark pine, a keystone species in high-elevation forests (Campbell et al. 2011).

After four years of defoliation by spruce budworm from 2011 to 2014, bark beetle activity has been increasing. Defoliators (e.g., western spruce budworm) do not kill trees directly; however, continued defoliation over a number of years impacts tree defense capabilities and results in vulnerability to mortality from bark beetles (Fellin and Dewey 1982). In general, increases in insect activity, particularly pine beetles, can result in tree mortality, changing forest structure, altered hydrologic regimes, reduced economic return, increased ground fuels, and increased fire severity (Hyde et al. 2016).

Infestation of mountain pine beetle in lodgepole pine has been somewhat persistent since 1980, but shows a general increase in acres after 2000. Most of this increase can be attributed to lodgepole pine stands that were established after widespread fires in the 1930s reaching approximately 80 years of age and becoming more susceptible to beetle attack and mortality (Gibson et al. 2009). Some of the increase may also be due to climate change impacts where mountain pine beetles at higher elevations are completing life cycles in one year instead of two years and more larvae are surviving warmer winters (Williams and Liebhold 2002, Mitton and Ferrenberg 2014, Rosenberger et al. 2012). Mountain pine beetle attacks can have the potential of changing crown fire rates within lodgepole tree canopies (Page et al. 2012). Future risk estimates show that up to 23 percent of lodgepole pine on the Forest could be killed due to mountain pine beetle (Krist et al. 2014). In addition, Douglas-fir bark beetle is likely to increase in the future, with up to 30 percent of Douglas-fir experiencing mortality by 2027 due to expected stand density and tree size conditions (Krist et al. 2014).

The native root diseases, laminated root rot, Armillaria root disease, and Heterobasidion root disease, have increased the amount of mortality and growth loss due to a shift toward later successional stages, which corresponds with more susceptible tree species (Lockman and Kearns 2016). Estimates in this area show that 5 to 14 percent of the total basal area could be lost to root diseases (Krist et al. 2014).

Dwarf mistletoe species are generally host-specific and damaging on ponderosa pine, western larch, and Douglas-fir. When larger trees are heavily infected, they experience severe growth loss that can lead to decreased survival. Smaller trees can be stunted in growth and are unlikely to develop into large trees. Multi-storied stands of the same tree species cause spread and intensification of dwarf mistletoe. Management practices that have left infected residual trees in the overstory with regeneration of the same tree species in the understory have caused an increase in the presence of dwarf mistletoes on the landscape.

Increased tree densities, root diseases, dwarf mistletoes, defoliators and bark beetles all impact current and future forest vegetation structure and species composition.

Need for Change

The forest has identified different needs that require action as described in chapter 1 of the FEIS, three of which are directly addressed in this section. The first is the need to manage forest vegetation conditions to be more resilient to disturbances. As noted previously, HRV is a means to assess changes that have occurred and provide a reference condition within which ecosystems are resilient and responsive to disturbances. By maintaining and/or restoring a forest structure similar to that which occurred and evolved under a historical disturbance regime, ecosystems would be better able to absorb disturbances while retaining the same basic structure and ways of functioning and would have a greater capacity to adapt to stress and change. By developing HRV ranges within each vegetation type, and then assessing how well each alternative moves vegetation toward these ranges, it is possible to estimate how forest management might affect resiliency.

The second need related to forest vegetation is to address climate change implications and adaptations. This is highly related to the first need, as improving forest resilience by promoting ecological processes and diversity in vegetation composition and structure is also likely to lead to ecosystems more adapted to climate change (Millar et al. 2007, DeRose and Long 2014). Additionally, some alternatives (proposed action and P) provide additional flexibility in responding to climate change impacts by having management areas that allow a variety of management options to address unforeseen impacts (Gaines et al. 2012).

The third need related to forest vegetation is social and economic conditions. This section specifically addresses timber production levels between the alternatives and provides estimates of outputs needed to move forest vegetation toward desired conditions.

Haugo et al. (2015) analyzed restoration needs across Oregon and Washington and found that one of the areas with the highest level of need for restoration was northeastern Washington, including the Colville National Forest. A need for both disturbance and succession related change was shown. Several other recent studies have shown the need for active restoration across western forests (Brown et al. 2004, Hessburg et al. 2005, Franklin et al. 2008). Methods for restoration are project specific, but generally include modification of forest structure and species composition to move individual stands and larger landscapes toward HRV (Jain and Graham 2005).

Environmental Consequences

Methodology

A state and transition model, ST-Sim (2014), was used to simulate forest dynamics and development of forest structure. This model was used to analyze forest structure through time for each vegetation type, as well as to calculate potential timber production outputs. The model showed how different potential management areas (MAs) and actions affect forest structure and forest products through time. The model simulated growth and change for 300 years for each vegetation type and HRV values were compared to forest structure at 100 years for each alternative. One hundred years was selected as the point to compare structure because within this time period stands have generally had time to grow and change from at least one structure class to another, most disturbances in each of the vegetation types have had a chance to occur, and the overall trajectory of the vegetation type is evident. Disturbances such as wildfire and insects were included in the model with complete details available in appendix G. This analysis was completed prior to the fires that occurred in 2015, and do not reflect changes from those disturbances.

Current and anticipated budgets control workforce levels and set priorities, and thereby constrain the number of acres of treatments that would be likely to occur. Table 27 shows the three treatment types that were modeled to occur annually, along with estimated acres for each action by vegetation type and alternative. Alternatives with the same modeled treatment types were combined in table 27. Timber harvest was modeled to comply with the requirement to have non-declining timber output over time. Additional details of how actions were modeled can be found in appendix G.

Table 27. Average annual treatment acres modeled by vegetation type and alternative

Vegetation Type	Treatment Type	No Action	Proposed Action and Alt. P,	Alt. R	Alts. B and O
Douglas-fir dry	Mechanical Fuels Treatment	615	3,074	615	1,229
	Prescribed Fire	2,153	2,153	2,153	2,153
	Timber Harvest	500	2,500	500	1,000
Northern Rocky Mountain Mixed Conifer	Mechanical Fuels Treatment	481	1,925	0	963
	Prescribed Fire	1,686	1,686	1,686	1,686
	Timber Harvest	388	1,550	0	775
Western red cedar/western hemlock	Mechanical Fuels Treatment	0	0	0	309
	Prescribed Fire	0	0	0	0
	Timber Harvest	0	0	0	0
Subalpine Fir/Lodgepole pine	Mechanical Fuels Treatment	0	0	0	0
	Prescribed Fire	1,040	1,040	1,040	1,040
	Timber Harvest	1,900	950	475	475

Three management categories were defined to model vegetation across the forest through time, with each plan management area assigned to a category. These management categories are wilderness/other, harvest, and production. The wilderness/other category consists of congressionally designated areas or areas proposed for wilderness designation where active vegetation management is generally limited to the use of wildfire and prescribed burning. The harvest category includes those areas where scheduled timber harvest is not planned, and where there would only be incidental timber harvest for specific resource benefit to meet management objectives, and where incidental activities such as road building would be rare. The production category includes areas where scheduled timber harvest would be planned, and where a full suite of active management could occur, including harvest, prescribed fire, and mechanical fuels treatment. See appendix G for a full listing of management areas and categories.

State and transition models are only an approximation of complex forest dynamics (Turner et al. 2001). However, they can provide useful information on how forest structure changes through time, and what types of outputs can be expected. The individual state and transition models for each vegetation type used for this effort were originally developed under the Integrated Landscape Assessment Project (ILAP 2013) and then modified based on local knowledge and experience (see appendix G for details).

Incomplete and Unavailable Information

Climate Change

While it is possible to reflect potential climate change influences with state and transition models, the results here would not show any potential climate change influences due to the unknown factors of how much change, where the change would influence system dynamics, and how fast the change could occur. Climate science currently does not have forest-scale predictions and probabilities needed for state and transition modeling. Climate models vary in how vegetation might respond at a pixel level, but general trends exist across models (Littell et al. 2011).

Even given the uncertainty of how vegetation would respond to climate change, there is broad consensus that moving forests toward more resilient conditions should be a general goal of forest management (Millar et al. 2007, DeRose and Long 2014). Resilience has been defined as “the ability of an ecosystem and its component parts to absorb, or recover from the effects of disturbances through preservation, restoration, or improvement of its essential structures and functions and redundancy of ecological patterns across the landscape” (FSM 1909.12). Moving forest structure across the landscape toward HRV is one way to increase resilience for managing lands where future climate is uncertain (Keane et al. 2009).

Summary of Effects

Historical Range of Variability

Table 28 shows modeled forest structure conditions for all alternatives and vegetation types compared to HRV at 100 years. Alternative O has the most structure classes (16) within HRV at 100 years, while alternative B has 15. The proposed action and alternatives P and R have 12 structure classes within HRV, and the no action alternative has the least with 8 structure classes within HRV. It is important to note that the amounts of each structure class vary with time, and choosing a different point in time would result in alternatives having a different number of structure classes within HRV. For instance, alternative O is within HRV at 100 years for late closed in Douglas-fir dry, but at 110 years it is above HRV. Also, table 28 does not attempt to indicate how far above or below HRV a structure class may be. For instance, in the Northern Rocky Mountain mixed conifer type, late open structure is within HRV for alternative O (5 percent), but not in alternative P (7 percent), even though alternative P is just 1 percent higher than the HRV range (4 to 6 percent).

Table 29 shows the departure index for each vegetation type and alternative. To evaluate how each vegetation type compares to HRV, a departure value was calculated using the same method used to evaluate fire regime condition class (FRCC) (Barrett et al. 2010). This method uses the midpoint of HRV and calculates percent departure for each structure class within each vegetation type and a total departure index for each vegetation type. This departure is then weighted by area of each vegetation type across the Forest to produce a total departure index for the alternative. The departure index shows the magnitude of departure from HRV for each vegetation type, and reflects an overall score of how well each alternative moves toward the desired condition of HRV. A lower departure index shows that the vegetation type or alternative is closer to HRV conditions.

Table 28. Modeled forest structure levels at 100 years compared to HRV for all vegetation types and alternatives

Structure Class	HRV	No Action	Proposed Action	Alt. R	Alt. P	Alt. B	Alt. O
Early Structure							
Douglas-fir dry	6-16	5	8*	8	8	12	11
Northern Rocky Mountain mixed conifer	9-25	4	2	3	2	8	6
Western hemlock/western red cedar	4-24	0	0	0	0	2	2
Subalpine fir/lodgepole pine	45-65	38	56	59	57	62	55
Spruce/subalpine fir	14-46	4	3	3	3	3	3
Mid Open							
Douglas-fir dry	2-8	2	6	3	6	4	4
Northern Rocky Mountain mixed conifer	1-3	0	1	1	1	1	2
Western hemlock/western red cedar	0	0	0	0	0	0	0
Subalpine fir/lodgepole pine	0	21	11	5	11	1	1
Spruce/subalpine fir	0	0	0	0	0	0	0
Mid Closed							
Douglas-fir dry	4-13	7	4	8	5	10	8
Northern Rocky Mountain mixed conifer	18-30	14	12	13	12	10	11
Western hemlock/western red cedar	7-27	0	0	0	0	8	8
Subalpine fir/lodgepole pine	33-53	26	22	27	21	30	37
Spruce/subalpine fir	13-41	34	32	34	33	32	30
Late Open							
Douglas-fir dry	38-78	49	59	45	59	42	45
Northern Rocky Mountain mixed conifer	4-6	0	7	4	7	4	5
Western hemlock/western red cedar	0	0	0	0	0	0	0
Subalpine fir/lodgepole pine	0	5	3	2	2	0	0
Spruce/subalpine fir	0	0	0	0	0	0	0
Late Closed							
Douglas-fir dry	1-32	37	22	35	22	32	32
Northern Rocky Mountain mixed conifer	44-60	83	77	80	77	77	77
Western hemlock/western red cedar	55-83	100	100	100	100	90	90
Subalpine fir/lodgepole pine	3	11	9	7	9	6	6
Spruce/subalpine fir	29-57	63	65	63	63	64	67
Total Structure Classes Within HRV		8	12	12	12	15	16

* Note: Shaded cells are within HRV.

Results of the modeling and departure analysis show that alternative O has the least amount of departure while the no action alternative has the most. The proposed action and alternative P are slightly higher than alternative O in total landscape departure, but result in the least amount of departure in the Douglas-fir dry type, which is the most common vegetation type on the forest.

Table 29. Departure index for each vegetation type and alternative based on modeled structure levels at 100 years

Vegetation Type	No Action	Proposed Action	Alt. R	Alt. P	Alt. B	Alt. O
Douglas-fir dry	20.5	8.5	19.5	7.5	18	15.5
Northern Rocky Mountain mixed conifer	30	28	27	28	25	24
Western hemlock/western red cedar	31	31	31	31	21	21
Subalpine fir/lodgepole pine	33	20	15	21	12	5
Spruce/subalpine fir	26	27	27	27	27	27
Total Departure *	**26**	**18**	**22**	**18**	**19**	**17**

* Higher departure index indicates more departure from HRV.

Old Forest Management and Timber Production

Old Forest Management

All alternatives create late open structure in dry Douglas-fir within the historical range of variation at 100 years; however, alternative P and the proposed action reach HRV sooner than other alternatives. Results past 100 years indicate that all alternatives maintain the late open structure in Douglas-fir dry within HRV, although alternative P and the proposed action create and maintain more than the other alternatives, because late closed stands are managed to create late open conditions under these alternatives. Figure 8 shows how each alternative moves the Douglas-fir dry type toward HRV in the late open structure class.

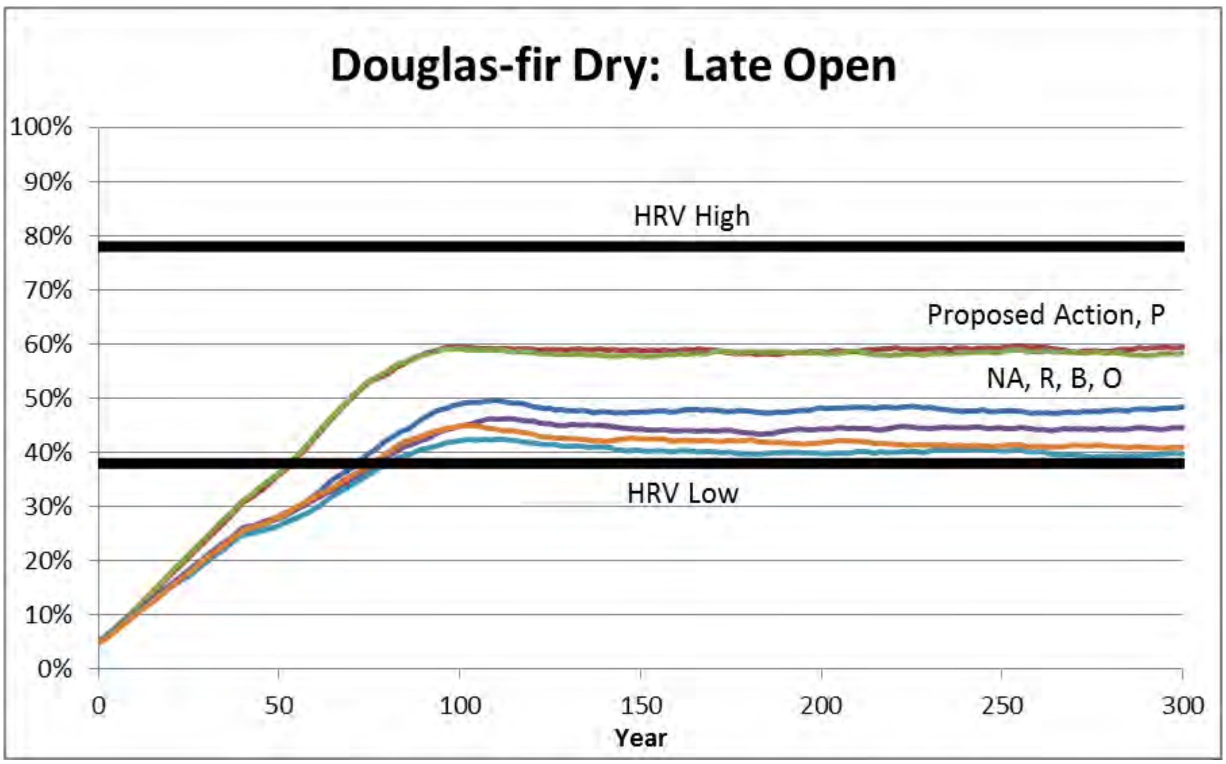


Figure 8. Modeled late open structure amounts for the Douglas-fir dry vegetation type for each alternative

The proposed action and alternatives P, B, and O result in the late closed structure class being within HRV in the Douglas-fir dry type at 100 years. The proposed action and alternative P create enough late closed structure to reach the midpoint of the HRV range and then maintain it there over the 300-year-long modeling period. Alternatives B and O result in an amount of late closed structure that is at the high point of HRV at 100 years and hovers there or goes slightly above HRV over the 300-year modeling period. No action and alternative R create slightly too much late closed structure and are outside of HRV at 100 years and the entire modeling period. Figure 9 shows how each alternative moves the late closed structure class within the Douglas-fir dry type toward HRV.

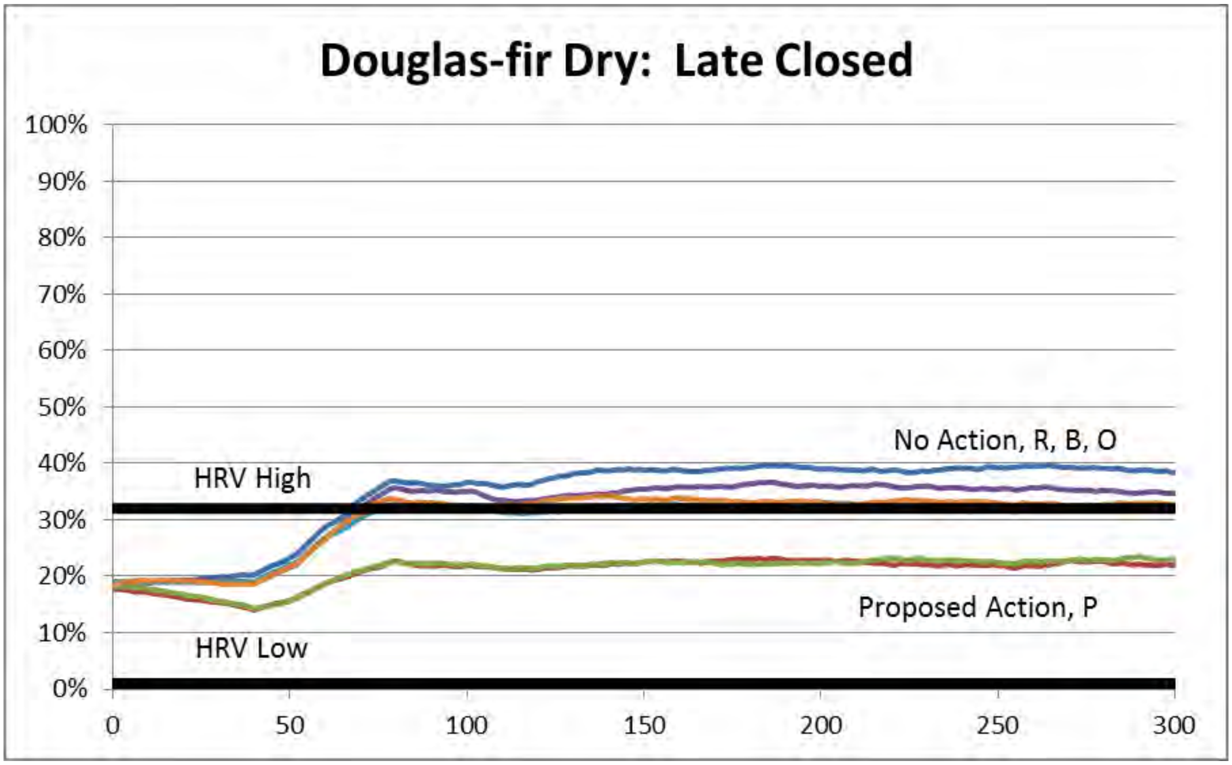


Figure 9. Modeled late closed structure amounts for the Douglas-fir dry vegetation type for each alternative

All alternatives create an abundance of late closed structure class in the Northern Rocky Mountain mixed conifer type at 100 years. There is a small window of time when late closed structure is within HRV; however, it quickly exceeds the upper limit. Figure 10 shows how each alternative is within HRV around 60 to 80 years, but then quickly moves out of HRV and maintains it there for the 300-year modeling period. This excess is caused because the growth in this vegetation type exceeds the removals from management and disturbance that were assumed in the modeling; hence, most of this vegetation type eventually ends up in the late closed structure class. Appendix G has complete details of these assumptions and of how many acres were expected to be managed each year.

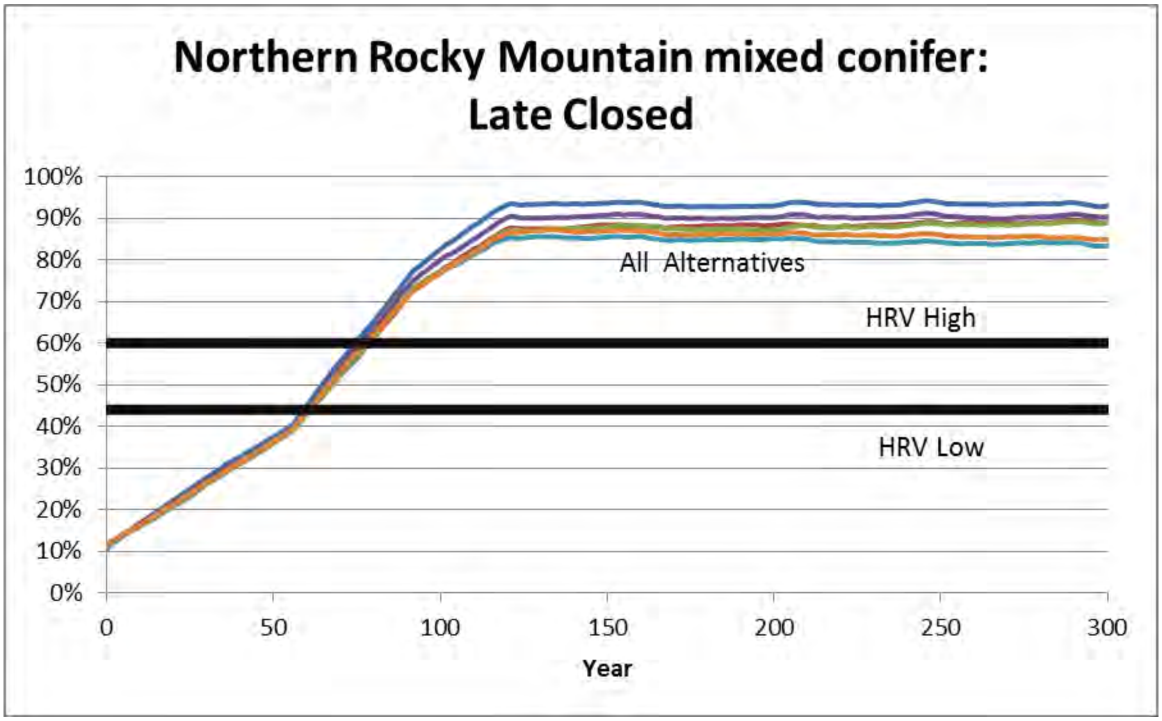


Figure 10. Modeled late closed structure amounts for the Northern Rocky Mountain mixed conifer vegetation type for each alternative

Table 30 shows the approximate total acres of late structure for each vegetation type and alternative for comparison purposes. The no action alternative creates the most late structure, followed by the proposed action and alternative P.

Table 30. Approximate acres of late structure class for each vegetation type and alternative at 100 years

Structure Class and Vegetation Type	No Action	Proposed Action	Alt. R	Alt. P	Alt. B	Alt. O
Late Open						
Douglas-fir dry	238,162	286,767	218,720	286,767	204,139	218,720
Northern Rocky Mountain mixed conifer	0	21,586	12,335	21,586	12,335	15,418
Subalpine fir/lodgepole pine	8,772	5,263	3,509	3,509	0	0
Total Late Open	246,934	313,615	234,564	311,861	216,474	234,139
Late Closed						
Douglas-fir dry	179,837	106,930	170,116	106,930	155,534	155,534
Northern Rocky Mountain mixed conifer	255,943	237,441	246,692	237,441	237,441	237,441
Western hemlock/western red cedar	95,820	95,820	95,820	95,820	86,238	86,238
Subalpine fir/lodgepole pine	19,298	15,789	12,281	15,789	10,526	10,526
Spruce/subalpine fir	12,751	13,156	12,751	12,751	12,954	13,561
Total Late Closed	563,649	469,136	537,660	468,731	502,693	503,300
Total Late Structure	**810,583**	**782,751**	**772,223**	**780,592**	**719,167**	**737,439**

Timber Production

The National Forest Management Act (NFMA) and the 1982 planning rule require identification of lands that are not suited for timber production. No timber harvesting shall occur on these lands except for salvage or that necessary to protect other multiple use values. Lands are also identified that are suitable for sustained timber production. To be part of the suitable forest land base, the land must be assigned to a management prescription that includes the basic elements of sustained timber removal and regeneration in compliance with the Multiple-Use Sustained-Yield Act. Table 31 shows timber suitability by alternative as determined by this method. Appendix G contains full details of how these numbers were developed.

Table 31. Timber suitability by alternative

Suitability Class	No Action	Proposed Action	Alternative R	Alternative P	Alternative B	Alternative O
Suitable – Timber Production	535,700 (52%)	653,200 (63%)	129,400 (12%)	656,600 (63%)	384,500 (37%)	347,500 (33%)
Unsuitable – Restoration Harvest only	323,050 (31%)	205,550 (20%)	729,350 (70%)	202,150 (19%)	474,250 (46%)	511,250 (49%)
Unsuitable – No Harvest	179,193 (17%)	179,193 (17%)	179,193 (17%)	179,193 (17%)	179,193 (17%)	179,193 (17%)

The 1982 planning rule also requires the calculation of long-term sustained yield capacity (LTSY) based on productivity and the calculation of allowable sale quantity (ASQ) that is tied to lands that are suitable for timber production.

The long-term sustained yield is the highest uniform wood yield that may be sustained given multiple-use objectives on lands managed for timber production. LTSY assumes that all suitable land for timber production is in the desired condition. LTSY was calculated assuming that the HRV midpoint for each structure class was the desired condition.

The ASQ reflects the quantity of timber that may be sold from lands suitable for timber production, within tree utilization standards, for the first decade of the plan, given an unlimited budget. It is expressed as an annual average throughout the plan. ASQ defines the upper bounds of the quantity of timber that could be produced within a planning period. Like the LTSY calculation, the desired condition was assumed to be the midpoint of HRV for each structure class. However, in contrast to LTSY, ASQ is constrained to the time period covered by the plan, so it may include harvest from lands that are not yet in the desired condition. Since the desired condition requires more forest stands within a late structure condition, time is required for the trees to grow larger, and therefore, harvest yields from these stands are not included in the calculation of the ASQ.

The projected quantity of forest products to be offered for sale was also calculated for each alternative. The projected wood sale quantity (PWSQ) is the estimated quantity of timber and all other wood products that are expected to be sold from the plan area for the plan period. The PWSQ consists of the projected timber sale quantity as well as other woody material such as fuelwood, firewood, or biomass that is also expected to be available for sale. The PWSQ includes volume from timber harvest for any purpose (except salvage or sanitation harvest) from all lands in the plan area based on expected harvests that would be consistent with the plan components. The PWSQ is also based on the planning unit’s fiscal capability and organizational capacity. PWSQ is neither a target nor a limitation on harvest, and is not an objective unless the responsible official chooses to make it an objective in the plan.

The projected timber sale quantity (PTSQ) is the estimated quantity of timber meeting applicable utilization standards that is expected to be sold during the plan period. As a subset of PWSQ, PTSQ includes volume from timber harvest for any purpose (except salvage or sanitation harvest) from all lands in the plan area based on expected harvests that would be consistent with the plan components. The PTSQ is also based on the planning unit's fiscal capability and organizational capacity. PTSQ is neither a target nor a limitation on harvest, and is not an objective unless the responsible official chooses to make it an objective in the plan.

Table 32 shows the LTSY and the ASQ, PWSQ, and PTSQ for the first decade for each alternative. See appendix G for details of how each number was calculated, as well as PWSQ and PTSQ numbers for the second decade.

Table 32. Average annual volumes (million board feet (MMBF)) by alternative

	No action	Proposed Action	Alternative R	Alternative P	Alternative B	Alternative O
LTSY	18.3	97.5	7.5	97.4	13.9	12.2
ASQ	18.3	67.6	7.5	67.0	13.9	12.2
PWSQ	40.6	62.1	14.3	61.8	37.4	37.5
PTSQ	26.9	48.4	9.3	48.1	23.7	23.8

The ASQ and LTSY values calculated for no action and alternatives R, B, and O are significantly lower than those for the proposed action and alternative P, because of the number of acres of suitable land for timber production and the requirement of the 1982 planning rule to provide a sustained yield of timber. This requires the achievement and maintenance in perpetuity of a high-level annual or regular periodic output of the timber without impairment of the productivity of the land. Additional information on harvest volume calculations can be found in appendix G.

No Action Alternative

The no action alternative follows the 1988 Colville Forest Plan as amended. Management direction under the 1988 forest plan contains an old growth-dependent species habitat management area that is a fixed reserve approach for late forest structure on about 3 percent of the Forest (approximately 32,859 acres), in reserves of at least 300 acres in size. Late forest structure management within these reserves would primarily be passive, where structural changes would be the result of successional processes, insects and disease interactions, and fire that escapes initial attack. Some treatments may occur to reduce fire risk by fuels reduction or manipulation of structure and species composition to increase tree vigor to maintain old structure for a longer period of time. This alternative continues the use of the Eastside Screens, and all future actions that affect forest vegetation would be assessed and compared to HRV, with the goal of moving the overall landscape toward HRV.

Table 33 shows which vegetation management options are available in each of the management areas. Note that this table includes non-forest acres, as well as other acres within individual management areas where timber harvest would not occur as per restrictions under NFMA (that is, areas with concerns for irreversible resource damage, reforestation difficulties, or unsuitable soils for harvest). Approximately 36,100 acres (3 percent) are within management areas where no timber harvest, prescribed burning, or fuels treatments will occur. This is the only alternative where prescribed burning is not allowed in the Wilderness Management Area. The majority (58 percent or about 641,100 acres) of the Forest is within a management area that is suitable for scheduled timber harvest, fuels treatments, and prescribed burning. Approximately 424,700 acres (39 percent) are within management areas where fuels treatments, prescribed burning, and timber harvest for resource benefit are allowed, but are not suitable for scheduled timber production.

Table 33. Vegetation management allowed within each management area for the no action alternative

Vegetation Management	Management Area	Acres
No timber harvest, prescribed fire, or fuels treatments allowed.	Wilderness Research Natural Area **Total Acres**	31,400 5,300 **36,700 (3%)**
No scheduled timber harvest; incidental timber harvest for specific resource benefit to meet management objectives, prescribed fire, and mechanical fuels treatment allowed.	Caribou Habitat Downhill Skiing Old Growth Dependent Species Habitat Recreation Recreation/Wildlife Scenic/Winter Range Semi-Primitive, Motorized Recreation Semi-Primitive, Non-Motorized Recreation Winter Range **Total Acres**	30,300 2,000 32,900 43,200 13,200 76,100 13,600 86,900 126,500 **424,700 (39%)**
Scheduled timber harvest, prescribed fire, and mechanical fuels treatment allowed.	Wood/Forage Scenic/Timber **Total Acres**	424,000 217,100 **641,100 (58%)**

Table 34 shows the number of acres within each vegetation type that are either suitable or unsuitable for scheduled timber production. Note that non-forest acres are not included and rounding errors from geographic information system (GIS) analysis will cause total acres to not match other tables. For lands unsuitable for timber production, there are still areas where timber harvest is allowed for resource benefit, but is not scheduled or included in sustained yield calculations.

Table 34. Timber suitability acres by vegetation type for the no action alternative. Acres are approximate due to GIS rounding error.

Timber Suitability Class		Douglas-fir dry	Northern Rocky Mountain mixed conifer	Western hemlock / western red cedar	Subalpine fir / lodgepole pine	Spruce / subalpine fir	Total
Suitable **- Timber Production**	Acres (% of veg type)	208,327 (43%)	203,409 (66%)	40,932 (43%)	84,333 (49%)	8,756 (41%)	545,757 (50%)
Unsuitable **- Restoration Harvest**	Acres (% of veg type)	145,050 (30%)	63,651 (21%)	34,247 (36%)	60,845 (35%	9,323 (44%)	313,116 (29%)
Unsuitable - No Harvest	Acres (% of veg type)	132,177 (27%)	40,897 (13%)	20,274 (21%)	28,446 (16%)	3,224 (15%)	225,018 (21%)

Scheduled timber production is suitable on 50 percent of forested vegetation and is predominantly in the Douglas-fir dry (38 percent of suitable lands), Northern Rocky Mountain mixed conifer (37 percent of suitable lands), and subalpine fir/lodgepole pine (15 percent of suitable lands) types. Harvest treatments in Douglas-fir dry would primarily consist of partial removals to move stands toward more open conditions. Low-severity prescribed burning would take place in open structure classes, helping to maintain them in an open state. In the mixed conifer and subalpine fir/lodgepole pine types, there would be regeneration harvests of small and medium-sized trees, with reserves of larger-sized trees. Mixed-severity prescribed burning would take place in the mixed conifer type to mimic historical disturbance. Timber harvest for other resource objectives is allowed on 29 percent of forested vegetation and would entail the same suite of activities as the scheduled timber production area.

Under the no action alternative, the majority of acres treated through vegetation management would occur through the use of prescribed fire (56 percent), followed by timber harvest (32 percent) and mechanical fuels treatments (13 percent). Timber harvest activity would be focused on the subalpine fir/lodgepole pine type under the no action alternative, with some harvest in Douglas-fir dry and Northern Rocky Mountain mixed conifer types. Mechanical fuels treatments would occur in Douglas-fir dry and Northern Rocky Mountain mixed conifer types. Prescribed fire treatments would occur in Douglas-fir dry, Northern Rocky Mountain mixed conifer, and subalpine fir/lodgepole pine types. There would be no vegetation management expected in western hemlock/western red cedar types. Complete details of which management actions were modeled in each suitability class and vegetation type are available in appendix G.

Modeling Results

Table 35 shows modeling results at 100 years and indicates that the no action alternative has 8 structure classes within HRV, the lowest number of any alternative. The departure analysis indicates a departure index of 26 for the no action alternative, the highest of any alternative, indicating this alternative results in a more departed landscape compared to HRV than any other alternative.

Table 35. Modeling results at 100 years for the no action alternative

		Early	Mid Open	Mid Closed	Late Open	Late Closed	Departure Index
Douglas-fir dry	HRV	6-16	2-8	4-13	38-78	1-32	
	100 Years	5	2*	7	49	37	20.5
Northern Rocky Mountain mixed conifer	HRV	9-25	1-3	18-30	4-6	44-60	
	100 Years	4	0	14	0	83	30
Western hemlock/western red cedar	HRV	4-24	0	7-27	0	55-83	
	100 Years	0	0	0	0	100	31
Subalpine fir/lodgepole pine	HRV	45-65	0	33-53	0	3	
	100 Years	38	21	26	5	11	33
Spruce/subalpine fir	HRV	14-46	0	13-41	0	29-57	
	100 Years	4	0	34	0	63	26
Total Landscape Departure:							26

*Shaded cells are within HRV. Numbers shown represent percentages.

Thinning treatments in dry Douglas-fir would generally be focused on mid closed stands, and would move these stands into late open classes over the 100-year modeling period. Because harvest treatments would only occur on a portion of these mid closed stands, the remainder would move into the late closed structure without other disturbances. Prescribed fire is also used to maintain open structure classes. Modeling results indicate that in the Douglas-fir dry vegetation type, the current excess of mid closed structure class moves into the late open and late closed structure classes. At 100 years, mid open, mid closed, and late open are all within HRV. At 100 years, the dry Douglas-fir vegetation type is more departed under this alternative than under any other alternative.

In the Northern Rocky Mountain mixed conifer type, there is an excess of the late closed class (83 percent), and a deficit in all other structure classes. Thinning treatments would be focused on mid closed stands, with prescribed fire occurring all closed structure classes. This alternative results in the Northern Rocky Mountain mixed conifer type having a higher departure index than under any other alternative.

All of the western hemlock/western red cedar type is in the late closed structure class, because there was no active management prescribed in this vegetation type. No structure class is within HRV in this vegetation type. This alternative results in a departure index of 31 in this vegetation type, which is the same as the proposed action and alternatives R and P.

For subalpine fir/lodgepole pine, the majority is in the early structure class (38 percent), with the remainder in mid closed (26 percent) and 11 percent in late closed. Harvest treatments would occur in mid closed stands and no prescribed fire would be used. No structure classes are within HRV in this vegetation type and this alternative has the highest departure index in this vegetation type of any alternative.

In the spruce/subalpine fir type, results show that there would be a lack of early structure class (only 4 percent), although there would be an abundance of late closed type (63 percent). The remainder is in the mid closed type (34 percent). Only the mid closed structure class is within HRV for this vegetation type. No vegetation management would occur in this vegetation type. This vegetation type has a departure index of 26 under this alternative, which is one less than every other alternative.

Old Forest Management and Timber Production

The no action alternative creates the most late structure of any alternative, the majority of the late structure will be in late, closed conditions. Table 36 shows approximate acres that were modeled to be in late open and late closed structure classes in 100 years.

Maintaining a fixed reserve system does not guarantee all the acres within the reserve are in a condition that contains late forest structure. Because of ongoing natural disturbance processes such as fire or insects, some stands within the Old Growth Dependent Species Habitat management areas may actually be in an early or mid-forest structural stage and not considered late structure forest. Due to management restrictions in reserves under the no action alternative, there is no opportunity to maintain or enhance the conditions through active management if there is little or no actual late forest structure within the reserve, or if forest structures are altered through future disturbances.

Table 36. Approximate acres of late forest structure in 100 years for the no action alternative

Structure Class	No Action
Late Open	
Douglas-fir dry	238,162
Northern Rocky Mountain mixed conifer	0
Subalpine fir/lodgepole pine	8,772
Total Late Open	246,934
Late Closed	
Douglas-fir dry	179,837
Northern Rocky Mountain mixed conifer	255,943
Western hemlock/western red cedar	95,820
Subalpine fir/lodgepole pine	19,298
Spruce/subalpine fir	12,751
Total Late Closed	563,649
Total Late Structure	**810,583**

With continuation of the Eastside Screens, management options differ between vegetation types depending on the amount of late structure. In vegetation types that are below HRV for late closed or late open structure, no trees 21inches d.b.h. or greater can be harvested and no timber harvest activities can occur within late structure classes, unless it is moving one late structure class to another late structure class. In vegetation types that are within HRV in both late open and late closed structure, trees 21inches d.b.h. or greater can be harvested and timber harvest activities can occur within these late structure stands as long as late structure does not fall below HRV. This means that under the no action alternative there would be no harvesting of trees 21 inches d.b.h. or greater in any vegetation type for approximately the first 50 years due to late structure being below HRV. The mid closed structure class could be managed to create early or move toward late open, but no harvest activities could occur within late structure stands. The one exception to this could occur in Douglas-fir dry late closed stands that are currently within HRV. In these stands, management could move structure toward late open, but without the ability to remove trees 21 inches d.b.h. or greater, it can be difficult to reduce canopy cover enough to qualify as late open structure. Modeling results show that all alternatives eventually create enough late open in the Douglas-fir dry to be within HRV; however, the no action alternative gets there more slowly and produces less than the proposed action and alternative P.

Without management or other disturbance, mid closed stands would move into late closed structure and management opportunities would be limited to create late open structure resulting in an excess of late closed structure in all vegetation types. Higher stocking in these late closed stands creates stand density levels that can be within the zone of competition-induced mortality, where trees are experiencing increased levels of mortality from high levels of competition for resources such as light and water. The risk of mortality from bark beetles and other insects and stand-replacing fire is greatly increased, and could result in a loss of late structure. However, in the no action alternative, late closed structure in Douglas-fir dry is only slightly above HRV (by 5 percent), so there is less concern with late closed stand density than in other vegetation types that have a higher degree of departure from HRV.

The annual projected wood sale quantity under the no action alternative is 41 MMBF, with only the proposed action and alternative P projected to produce more volume. Approximately 68 percent of this volume is expected to be merchantable sawtimber, with the remaining volume composed of other woody material such as fuelwood and biomass. This alternative has lower sawtimber output than the proposed action and alternative P due to fewer acres that are suitable for scheduled timber production and the continuation of the Eastside Screens direction.

In summary, modeling shows that in 100 years the no action alternative moves the least number of structure classes to within HRV, has the most departed landscape, produces the most total late forest structure, and has a moderate projected timber volume output.

Proposed Action

The proposed action implements a landscape approach using active management to move forest structure toward HRV. The main difference between the proposed action and alternative P is the number of acres recommended for wilderness. This alternative replaces Eastside Screens with a series of desired HRV conditions, desired wildlife habitat conditions, and a guideline for large tree retention.

The landscape approach to forest structure management proposed in this alternative and alternative P allows active management across larger areas than other alternatives. This, in turn, allows structure to be better managed because there is no reliance on fixed reserves, which may or may not contain the desired structure type. All future actions that affect forest vegetation would be assessed and compared to HRV, with the goal of moving the overall landscape toward HRV. Restoring forest structure would result in also moving species composition, process, and spatial pattern toward more resilient conditions.

Restoring landscape heterogeneity through forest structure results in a high flexibility to adjust to climate change influence and provides reduced risk of fire to adjacent communities. Forest lands in the active restoration areas would be managed using variable density thinning, free selection, and other silvicultural treatments tailored to meet both landscape and site-specific objectives (Franklin et al. 2007, Graham et al. 2007, Aukema and Carey 2008, Puettmann et al. 2009, Franklin and Johnson 2012, DeRose and Long 2014).

Table 37 shows vegetation management options available in each of the management areas. Note that this table includes non-forest acres, as well as other acres within individual management areas where timber harvest would not occur as per restrictions under NFMA (that is, areas with concerns for irreversible resource damage, reforestation difficulties, or unsuitable soils for harvest). Approximately 138,600 acres (13 percent) are within areas where management is limited to the use of wildfire and prescribed burning, and no timber harvest or fuels treatments will occur. The majority (72 percent or about 793,500 acres) of the Forest is within a management area that is suitable for scheduled timber harvest, fuels treatments, and prescribed burning. Approximately 172,100 acres (16 percent) are within management areas where fuels treatments, prescribed burning, and timber harvest for resource benefit are allowed, but are not suitable for scheduled timber production.

Table 37. Vegetation management allowed within each management area for the proposed action

Vegetation Management	Management Area	Acres
No timber harvest. Prescribed fire and wildfire use allowed.	Wilderness Wilderness – Recommended Research Natural Area **Total Acres**	31,400 101,400 5,800 **138,600 (13%)**

Vegetation Management	Management Area	Acres
No scheduled timber harvest; incidental timber harvest for specific resource benefit to meet management objectives, prescribed fire, and mechanical fuels treatment allowed.	Backcountry Backcountry Motorized Scenic Byways **Total Acres**	90,800 61,700 19,600 **172,100 (16%)**
Scheduled timber harvest, prescribed fire, and mechanical fuels treatment allowed.	Active Restoration B Active Restoration C **Total Acres**	257,200 536,300 **793,500 (72%)**

Table 38 shows the number of acres within each vegetation type that are either suitable or unsuitable for scheduled timber production. Note that non-forest acres are not included and rounding errors from GIS analysis will cause total acres to not match other tables. For lands unsuitable for timber production, there are still areas where timber harvest is allowed for resource benefit but is not scheduled or included in sustained yield calculations.

Table 38. Timber suitability by vegetation type for the proposed action

Timber Suitability Class		Douglas-fir dry	Northern Rocky Mountain mixed conifer	Western hemlock / western red cedar	Subalpine fir / lodgepole pine	Spruce / subalpine fir	Total
Suitable – Timber Production	Acres* (% of veg type)	298,992 (61%)	222,748 (72%)	55,757 (59%)	76,572 (44%)	6,414 (30%)	660,483 (61%)
Unsuitable – Restoration Harvest	Acres* (% of veg type)	43,748 (9%)	27,595 (9%)	9,673 (10%)	32,902 (19%)	5,169 (24%)	119,087 (11%)
Unsuitable – No Harvest	Acres* (% of veg type)	143,775 (30%)	57,060 (19%)	29,528 (31%)	65,312 (37%)	9,802 (46%)	305,477 (28%)

*Acres are approximate due to GIS rounding error.

Scheduled timber production is suitable on 61 percent of forested vegetation and is predominantly in the Douglas-fir dry (45 percent of suitable lands), Northern Rocky Mountain mixed conifer (34 percent of suitable lands), and subalpine fir/lodgepole pine (12 percent of suitable lands) types. Harvest treatments in Douglas-fir dry would primarily consist of partial removals as stand improvement, along with low-severity prescribed fire, with a variable density thinning as the final harvest. These treatments are meant to move stands toward more open conditions. In the mixed conifer type, there will be variable density thinning along with mixed-severity prescribed fire, but no partial removal stand improvement. These treatments would move this vegetation type toward more late closed structure, while introducing openings of various sizes and breaking up the continuity of the canopy. In the subalpine fir/lodgepole pine type, there would be shelterwood with reserves as the final harvest along with severe prescribed fire, which would attempt to mimic the historical disturbance regime in this type. Timber harvest for other resource objectives is allowed on 11 percent of forested vegetation, and would entail the same suite of activities as the scheduled timber production area.

Under the proposed action, acres treated through vegetation management would be equally split between timber harvest (34 percent), mechanical fuels treatments (34 percent), and prescribed fire treatments (33 percent). Timber harvest activity would be focused on the Douglas-fir dry type, with some harvest in

Northern Rocky Mountain mixed conifer and subalpine fir/lodgepole pine types. Mechanical fuels treatments would occur in Douglas-fir dry and Northern Rocky Mountain mixed conifer types. Prescribed fire treatments would occur in Douglas-fir dry, Northern Rocky Mountain mixed conifer, and subalpine fir/lodgepole pine types. There would be no vegetation management expected in western hemlock/western red cedar types. Complete details of which management actions were modeled in each suitability class and vegetation type are available in appendix G.

Modeling Results

Table 39 shows modeling results at 100 years and indicates that the proposed action has 12 structure classes within HRV, which is the same as alternatives R and P, but less than alternatives B and O. The departure analysis indicates a departure index of 18, which is the same as alternative P and lower than the other alternatives except for O, indicating this alternative results in a less departed landscape compared to HRV than any alternative except for P and O.

Table 39. Modeling results at 100 years for the proposed action

		Early	Mid Open	Mid Closed	Late Open	Late Closed	Departure Index
Douglas-fir dry	HRV	6-16	2-8	4-13	38-78	1-32	
	100 Years	8*	6	4	59	22	8.5
Northern Rocky Mountain mixed conifer	HRV	9-25	1-3	18-30	4-6	44-60	
	100 Years	2	1	12	7	77	28
Western hemlock/western red cedar	HRV	4-24	0	7-27	0	55-83	
	100 Years	0	0	0	0	100	31
Subalpine fir/lodgepole pine	HRV	45-65	0	33-53	0	3	
	100 Years	56	11	22	3	9	20
Spruce/subalpine fir	HRV	14-46	0	13-41	0	29-57	
	100 Years	3	0	32	0	65	27
Total Landscape Departure:							18

* Shaded cells are within HRV. Numbers shown represent percentages.

Modeling results indicate that in the Douglas-fir dry vegetation type, late open structure would occupy the most area (59 percent), followed by late closed (22 percent). All structure classes are within HRV for this vegetation type. Thinning treatments in dry Douglas-fir would generally be focused on mid closed stands, and would move these stands into mid open and eventually late open classes over the 100-year modeling period. Treatments, including thinning, prescribed burning, and mechanical fuels treatments, would also occur in late structures to maintain those stands within either a late open or late closed class. At 100 years, the dry Douglas-fir vegetation type has the second lowest departure index of any alternative.

In the Northern Rocky Mountains mixed conifer type, the majority of structure would be in the late closed class (77 percent), followed by mid closed (12 percent). Thinning treatments would be focused in mid closed stands, with prescribed burning occurring in open and closed stands. Mid open is the only structure class within HRV in this vegetation type, while both late open and late closed are above HRV, and early and mid-closed are below HRV. This vegetation type has a departure index of 28, which is higher than alternatives R, B, and O, but lower than the no action alternative.

For western hemlock/western red cedar, 100 percent is within the late closed structure class. No structure class is within HRV for this vegetation type, largely because no active management is assumed to occur within this type. It has a departure index of 31, which is the same as no action and alternatives R, and P, but higher than alternatives B and O.

For subalpine fir/lodgepole pine, the majority is within the early structure class (56 percent), followed by mid closed (22 percent) and mid open (11 percent). Harvest treatments in this type are focused on mid closed stands with stand-replacing prescribed fire used as well. Early is the only structure class within HRV in this vegetation type and it has a departure index of 20, which is lower than no action and alternative P, but higher than the other alternatives.

In the spruce/subalpine fir type, results show that there would be a lack of early structure class (3 percent) and an abundance of late closed type (65 percent). The remainder is in the mid closed class (32 percent). Both early and late closed are outside of HRV in this vegetation type. No vegetation management is expected to occur in this type. This vegetation type has a departure index of 27, which is the same as all other alternatives except no action, which is slightly less departed.

Old Forest Management and Timber Production

The proposed action creates the second most late structure of any alternative, only exceeded by the no action alternative. Table 40 shows approximate acres that were modeled to be in late open and late closed structure classes in 100 years.

Table 40. Approximate acres of late forest structure in 100 years for the proposed action

Structure Class	Proposed Action
Late Open	
Douglas-fir dry	286,767
Northern Rocky Mountain mixed conifer	21,586
Subalpine fir/lodgepole pine	5,263
Total Late Open	313,615
Late Closed	
Douglas-fir dry	106,930
Northern Rocky Mountain mixed conifer	237,441
Western hemlock/western red cedar	95,820
Subalpine fir/lodgepole pine	15,789
Spruce/subalpine fir	13,156
Total Late Closed	469,136
Total Late Structure	**782,751**

This alternative proposes to use a landscape approach to forest structure management that allows structure classes to shift around the landscape in response to disturbance. Instead of fixed reserves intended to contain late forest structure, this alternative would have late structure contained throughout the landscape and all actions that affect forest vegetation would be assessed and compared to HRV, with the goal of moving the overall landscape toward HRV. The proposed action replaces Eastside Screens with a series of desired HRV conditions and desired wildlife habitat conditions.

The proposed action, along with alternative P, moves late structure classes in the Douglas-fir dry type (the largest vegetation type on the Forest) to the midpoint of HRV and has the least amount of departure in this type. More importantly, this alternative, along with alternative P, produces a higher percentage of total late structure in late open structure (40 percent of total late structure), compared to other alternatives. This would decrease fire severity and insect risk, while increasing resiliency in the face of climate change and other disturbances (Franklin et al. 2007, Graham et al. 2007, Puettmann et al. 2009, Franklin and Johnson 2012, DeRose and Long 2014).

The annual projected wood sale quantity under the proposed action is 62 MMBF. Both the proposed action and alternative P are projected to produce the most volume. Approximately 79 percent of this volume is expected to be merchantable sawtimber, with the remaining volume composed of other woody material such as fuelwood and biomass.

In summary, modeling shows that in 100 years other alternatives move more structure classes to within HRV, but the proposed action (along with alternative P) create the second least departed landscape, produces the second most total late forest structure, and has the highest projected timber volume output. In addition, the proposed action alternative (along with alternative P) have the highest percentage of total late forest structure in late open, which is expected to result in increased resilience of late forest habitats.

Alternative R

This alternative implements an expanded late forest structure reserve network, contains high levels of recommended wilderness, and retains a production-oriented general forest area utilizing two-aged management practices. The late forest structure reserve network is based on northern goshawk occupied territories, elevational criteria, and currently identified late forest structures based on GNN data. Late forest structure reserves would have little active management. This alternative continues the use of Eastside Screens.

Late forest structure management under alternative R would primarily be passive, where structural changes would be the result of successional process, insect and disease interactions, wildfire and prescribed burning. All future actions that affect forest vegetation would be assessed and compared to HRV, with the goal of moving the overall landscape toward HRV. Some treatments may occur to reduce fire risk by fuels reduction or manipulation of structure and species composition to increase tree vigor to maintain old structure for a longer period of time. Also, fuels reduction would take place in areas that fall within WUI areas.

Table 41 shows which vegetation management options are available in each of the management areas. Note that this table includes non-forest acres, as well as other acres within individual management areas where timber harvest would not occur as per restrictions under NFMA (that is, areas with concerns for irreversible resource damage, reforestation difficulties, or unsuitable soils for harvest). Approximately 246,200 acres (22 percent) are within areas where management is limited to the use of fire and no timber harvest or fuels treatments will occur. The majority (56 percent or about 613,400 acres) of the Forest is within a management area where fuels treatments, prescribed burning, and timber harvest are allowed for resource benefit, but are not suitable for scheduled timber production. Approximately 244,800 acres (22 percent) are within management areas that are suitable for scheduled timber harvest, fuels treatments, and prescribed burning.

Table 41. Vegetation management allowed within each management area for alternative R

Vegetation Management	Management Area	Acres
No timber harvest. Prescribed fire and wildfire use allowed	Wilderness Wilderness – Recommended Research Natural Area **Total Acres**	31,400 209,000 5,800 **246,200 (22%)**
No scheduled timber harvest; incidental timber harvest for specific resource benefit to meet management objectives, prescribed fire, and mechanical fuels treatment allowed	Backcountry Backcountry Motorized Scenic Byways Late Forest Structure **Total Acres**	20,200 7,000 18,000 568,200 **613,400 (56%)**
Scheduled timber harvest, prescribed fire, and mechanical fuels treatment allowed	General Restoration **Total Acres**	244,800 **244,800 (22%)**

Table 42 shows the number of acres within each vegetation type that are either suitable or unsuitable for scheduled timber production. Note that non-forest acres are not included and rounding errors from GIS analysis will cause total acres to not match other tables. For lands unsuitable for timber production, there are still areas where timber harvest is allowed for resource benefit, but is not scheduled or included in sustained yield calculations.

Table 42. Timber suitability by vegetation type for alternative R

Timber Suitability Class		Douglas-fir dry	Northern Rocky Mountain mixed conifer	Western hemlock / western red cedar	Subalpine fir / lodgepole pine	Spruce / subalpine fir	Total
Suitable – Timber Production	Acres* (% of veg type)	100,407 (21%)	54,133 (18%)	13,344 (14%)	33,208 (19%)	2,855 (13%)	203,947 (19%)
Unsuitable – Restoration Harvest	Acres* (% of veg type)	219,212 (45%)	180,671 (59%)	46,899 (49%)	50,925 (29%)	4,297 (20%)	502,004 (46%)
Unsuitable – No Harvest	Acres* (% of veg type)	166,390 (34%)	72,241 (24%)	34,743 (37%)	90,453 (52%)	14,205 (67%)	378,032 (35%)

*Acres are approximate due to GIS rounding error

Scheduled timber production is suitable on 19 percent of forested vegetation and is predominantly in the Douglas-fir dry (49 percent of suitable lands), Northern Rocky Mountain mixed conifer (27 percent of suitable lands), and subalpine fir/lodgepole pine types (16 percent of suitable lands). Harvest treatments in Douglas-fir dry would primarily consist of partial removals as stand improvement and a shelterwood with reserves as the final harvest. No prescribed burning would take place in Douglas-fir dry timber production areas. These treatments would maximize timber production, while still leaving some of the remnant stand intact. In the mixed conifer type, there would be variable density thinning along with mixed-severity prescribed fire, but no partial removal stand improvement. These treatments would move this vegetation type toward more late closed structure, while introducing openings of various sizes and breaking up the continuity of the canopy. In the subalpine fir/lodgepole pine type, there would be shelterwood with reserves final harvests along with severe prescribed fire, which would mimic the historical disturbance regime in this type. All of these harvest treatments are meant to maximize timber production, while still retaining some untreated portions of stands.

Timber harvest for other resource objectives is allowed on 46 percent of forested vegetation and would entail generally the same suite of activities as the scheduled timber production area with the exception of the Douglas-fir dry type, where variable density thinning would be used for the final harvest and light prescribed burning would be used to maintain open structure types.

Under alternative R, the majority of acres treated through vegetation management would occur with the use of prescribed fire (75 percent), followed by timber harvest (15 percent) and mechanical fuels treatments (10 percent). Timber harvest activity would occur in about equal proportions between the Douglas-fir dry and subalpine fir/lodgepole pine types. Mechanical fuels treatments would only occur in Douglas-fir dry types. Prescribed fire treatments would occur in Douglas-fir dry, Northern Rocky Mountain mixed conifer, and subalpine fir/lodgepole pine types. There would be no vegetation management expected in western hemlock/western red cedar types. Complete details of which management actions were modeled in each suitability class and vegetation type are available in appendix G.

Modeling Results

Table 43 shows modeling results at 100 years and indicates that alternative R has 12 structure classes within HRV, which is the same as the proposed action and alternative P, but less than alternatives B and O. The departure analysis indicates a departure index of 22, which is higher than any alternative except for no action, indicating this alternative results in a more departed landscape compared to HRV than any alternative except for no action.

Table 43. Modeling results at 100 years for alternative R

		Early	Mid Open	Mid Closed	Late Open	Late Closed	Departure Index
Douglas-fir dry	HRV	6-16	2-8	4-13	38-78	1-32	
	100 Years	8*	3	8	45	35	19.5
Northern Rocky Mountain mixed conifer	HRV	9-25	1-3	18-30	4-6	44-60	
	100 Years	3	1	13	4	80	27
Western hemlock/western red cedar	HRV	4-24	0	7-27	0	55-83	
	100 Years	0	0	0	0	100	31
Subalpine fir/lodgepole pine	HRV	45-65	0	33-53	0	3	
	100 Years	59	5	27	2	7	15
Spruce/subalpine fir	HRV	14-46	0	13-41	0	29-57	
	100 Years	3	0	34	0	63	27
Total Landscape Departure:							22

*Shaded cells are within HRV

Modeling results indicate that in the Douglas-fir dry vegetation type, most structure would be within the late open class (45 percent), followed by late closed (35 percent). All structure classes except for late closed are within HRV. Both thinning and final harvest treatments would be focused on mid closed stands, with prescribed fire used only in the late forest management area to maintain open structure. Stand improvement thinning would also occur in early structure stands. While the proposed action and alternative P maintain both late open and late closed around the midpoint of the HRV range, this alternative results in an amount of late open closer to the lower HRV limit, while having an overabundance of late closed. This vegetation type has a departure index of 19.5, which indicates the Douglas-fir dry type is more departed under this alternative than any alternative other than no action.

In the Northern Rocky Mountains mixed conifer type, late closed contains the most area (80 percent), with mid closed (13 percent) taking up most of the remainder. Mid open (1 percent) and late open (4 percent) are the only structure classes within HRV, and there is a lack of early (3 percent). Thinning treatments would be focused on mid closed stands with mixed-severity prescribed fire used in all closed structure classes. The mixed conifer type has a departure index of 27, which is higher than alternatives B and O, but lower than the other alternatives.

For western hemlock/western red cedar, all structure is within the late closed class (100 percent). No structure class is within HRV for this vegetation type, largely because no active management is assumed to occur in this type. It has a departure index of 31, which is the same as the other alternatives other than B and O.

For subalpine fir/lodgepole pine, the early structure class is dominant (59 percent), followed by mid closed (27 percent) and late closed (7 percent). Early is the only class within HRV at 100 years for this vegetation type. Harvest treatments in this vegetation type would be focused on mid closed stands and high-severity prescribed fire would be used in all structure classes except early. This vegetation type has a departure index of 15, which is higher than alternatives B and O, but lower than the other alternatives.

In the spruce/subalpine fir type, results show that there would be a lack of early structure class (3 percent), and an abundance of late closed class (63 percent). The remainder is in the mid closed class (34 percent), which is within HRV for this vegetation type. Both early and late closed are outside of HRV in this vegetation type. No active management is assumed to occur in this vegetation type. This vegetation type has a departure index of 27, the same as all other alternatives except no action, which is slightly less departed.

Old Forest Management and Timber Production

Alternative R creates less late structure than no action, the proposed action, and alternative P, but more than alternatives B and O. Table 44 shows approximate acres that were modeled to be in late open and late closed structure classes in 100 years.

Maintaining a fixed reserve system does not guarantee all the allocated acres are in a condition that currently contain old forests. Due to ongoing natural disturbance processes such as fire or insects, some stands within reserves may actually be in an early or mid-seral forest structural stage. Due to management restrictions in reserves under alternative R, there is no opportunity to maintain or enhance the conditions through active management if there is little or no actual late forest structure within the reserve, or if forest structures are altered through future disturbances.

Table 44. Approximate acres of late forest structure in 100 years for alternative R

Structure Class	Alternative R
Late Open	
Douglas-fir dry	218,720
Northern Rocky Mountain mixed conifer	12,335
Subalpine fir/lodgepole pine	3,509
Total Late Open	234,564
Late Closed	
Douglas-fir dry	170,116
Northern Rocky Mountain mixed conifer	246,692
Western hemlock/western red cedar	95,820
Subalpine fir/lodgepole pine	12,281
Spruce/subalpine fir	12,751
Total Late Closed	537,660
Total Late Structure	**772,223**

With continuation of the Eastside Screens, management options differ between vegetation types depending on the amount of late structure. In vegetation types that are below HRV for late closed or late open structure, no trees 21 inches d.b.h. or greater can be harvested and no timber harvest activities can occur within late structure classes, unless it is moving one late structure class to another late structure class. In vegetation types that are within HRV in both late open and late closed structure, trees 21inches d.b.h. or greater can be harvested and timber harvest activities can occur within these late structure stands as long as late structure does not fall below HRV. This means that under alternative R there would be no harvesting of trees 21 inches d.b.h. or greater in any vegetation type for approximately the first 50 years due to late structure being below HRV. The mid closed structure class could be managed to create early or move toward late open, but no harvest activities could occur within late structure stands. The one exception to this could occur in Douglas-fir dry late closed stands that are currently within HRV. In these stands, management could move structure toward late open, but without the ability to remove trees 21 inches d.b.h. or greater, it can be difficult to reduce canopy cover enough to qualify as late open structure. Modeling results show that all alternatives eventually create enough late open in the Douglas-fir dry to be within HRV; however, alternative R gets there more slowly and produces less than the proposed action and alternative P.

Without management or other disturbance, mid closed stands would move into late closed structure and management opportunities would be limited to create late open structure resulting in an excess of late closed structure in all vegetation types. Higher stocking in these late closed stands creates stand density levels that can be within the zone of competition-induced mortality, where trees are experiencing increased levels of mortality from high levels of competition for resources such as light and water. The risk of mortality from bark beetles and other insects and stand-replacing fire is greatly increased, and could result in a loss of late structure. However, in alternative R, late closed structure in Douglas-fir dry is only slightly above HRV (by 5 percent), so there is less concern with late closed stand density than in other vegetation types that have a higher degree of departure from HRV.

The annual projected wood sale quantity under alternative R is 14 MMBF. This is the lowest projected volume of any alternative. Approximately 67 percent of this volume is expected to be merchantable sawtimber, with the remaining volume composed of other woody material such as fuelwood and biomass. This alternative has lower sawtimber output than all other alternatives due to fewer acres that are suitable for scheduled timber production and also the continuation of the Eastside Screens direction.

In summary, modeling shows that in 100 years, alternative R moves the same number of structure classes to within HRV as the proposed action and alternative P, but has one of the most departed landscapes, produces a moderate amount of late structure, and has the lowest projected timber volume output.

Alternative P

This alternative implements a landscape approach to managing forest structures by using active management to improve adaptability and resilience and move the landscape toward HRV. The main difference between the proposed action and alternative P is the number of acres recommended for wilderness. This alternative replaces Eastside Screens with a series of desired HRV conditions, desired wildlife habitat conditions, and a guideline for large tree retention.

Table 45 shows which vegetation management options are available in each of the management areas. Note that this table includes non-forest acres, as well as other acres within individual management areas where timber harvest would not occur as per restrictions under NFMA (that is, areas with concerns for irreversible resource damage, reforestation difficulties, or unsuitable soils for harvest). Approximately 98,900 acres (9 percent) are within management areas where management is limited to the use of fire, and no timber harvest or fuels treatments will occur. The majority (73 percent or about 801,700 acres) of the Forest is within a management area that is suitable for scheduled timber harvest, fuels treatments, and prescribed burning. Approximately 203,000 acres (18 percent) are within management areas where fuels treatments, prescribed burning, and timber harvest are allowed for resource benefit, but are not suitable for scheduled timber production.

Table 45. Vegetation management allowed within each management area for alternative P

Vegetation Management	Management Area	Acres
No timber harvest. Prescribed fire and wildfire use allowed.	Wilderness	31,400
	Wilderness – Recommended	61,700
	Research Natural Area	5,800
	Total Acres	**98,900 (9%)**
No scheduled timber harvest; incidental timber harvest for specific resource benefit to meet management objectives, prescribed fire, and mechanical fuels treatment allowed.	Backcountry	129,100
	Backcountry Motorized	54,600
	Scenic Byways	19,300
	Total Acres	**203,000 (18%)**
Scheduled timber harvest, prescribed fire, and mechanical fuels treatment allowed.	General Restoration	489,200
	Focused Restoration	312,500
	Total Acres	**801,700 (73%)**

Table 46 shows the number of acres within each vegetation type that are either suitable or unsuitable for scheduled timber production. Note that non-forest acres are not included and rounding errors from GIS analysis will cause total acres to not match other tables. For lands unsuitable for timber production, there are still areas where timber harvest is allowed for resource benefit but is not scheduled or included in sustained yield calculations.

Table 46. Timber suitability by vegetation type for alternative P

Timber Suitability Class		Douglas-fir dry	Northern Rocky Mountain mixed conifer	Western hemlock / western red cedar	Subalpine fir / lodgepole pine	Spruce / subalpine fir	Total
Suitable – Timber Production	Acres* (% of veg type)	303,084 (62%)	224,013 (73%)	56,506 (59%)	76,931 (44%)	6,385 (30%)	666,919 (61%)
Unsuitable – Restoration Harvest	Acres* (% of veg type)	43,509 (9%)	30,270 (10%)	10,470 (11%)	50,746 (29%)	9,262 (43%)	144,257 (13%)
Unsuitable – No Harvest	Acres* (% of veg type)	139,757 (29%)	53,500 (17%)	28,600 (30%)	46,899 (27%)	5,708 (27%)	274,464 (25%)

* Acres are approximate due to GIS rounding error

Scheduled timber production is suitable on 61 percent of forested vegetation and is predominantly in the Douglas-fir dry (45 percent of suitable lands), Northern Rocky Mountain mixed conifer (34 percent of suitable lands), and subalpine fir/lodgepole pine (12 percent of suitable lands) types. Harvest treatments in Douglas-fir dry would primarily consist of partial removals as stand improvement, along with low-severity prescribed fire, with a variable density thinning as the final harvest. These treatments are meant to move stands toward more open conditions. In the mixed conifer type, there will be variable density thinning along with mixed-severity prescribed fire, but no partial removal stand improvement. These treatments would move this vegetation type toward more late closed structure while introducing openings of various sizes and breaking up the continuity of the canopy. In the subalpine fir/lodgepole pine type there would be shelterwood with reserves as the final harvest along with severe prescribed fire which would attempt to mimic the historical disturbance regime in this type. Timber harvest for other resource objectives is allowed on 13 percent of forested vegetation and would entail the same suite of activities as the scheduled timber production area.

Under alternative P, acres treated through vegetation management would be equally split between timber harvest (34 percent), mechanical fuels treatments (34 percent), and prescribed fire treatments (33 percent). Timber harvest activity would be focused on the Douglas-fir dry type under the proposed action, with some harvest in Northern Rocky Mountain mixed conifer and subalpine fir/lodgepole pine types. Mechanical fuels treatments would occur in Douglas-fir dry and Northern Rocky Mountain mixed conifer types. Prescribed fire treatments would occur in Douglas-fir dry, Northern Rocky Mountain mixed conifer, and subalpine fir/lodgepole pine types. There would be no vegetation management expected in western hemlock/western redcedar types. Complete details of which management actions were modeled in each suitability class and vegetation type are available in appendix G.

Modeling Results

Table 47 shows modeling results at 100 years and indicates that alternative P has 12 structure classes within HRV, which is the same as the proposed action and alternative R, but less than alternatives B and O. The departure analysis indicates a departure index of 18, which is the same as the proposed action and lower than the other alternatives except for O, indicating this alternative results in a less departed landscape compared to HRV than any alternative other than the proposed action and O.

Table 47. Modeling results at 100 years for alternative P

		Early	Mid Open	Mid Closed	Late Open	Late Closed	Departure Index
Douglas-fir dry	HRV	6-16	2-8	4-13	38-78	1-32	
	100 Years	8	6	5	59	22	7.5
Northern Rocky Mountain mixed conifer	HRV	9-25	1-3	18-30	4-6	44-60	
	100 Years	2	1	12	7	77	28
Western hemlock/western red cedar	HRV	4-24	0	7-27	0	55-83	
	100 Years	0	0	0	0	100	31
Subalpine fir/lodgepole pine	HRV	45-65	0	33-53	0	3	
	100 Years	57	11	21	2	9	21
Spruce/subalpine fir	HRV	14-46	0	13-41	0	29-57	
	100 Years	3	0	33	0	63	27
Total Landscape Departure:							18

* Shaded cells are within HRV

Modeling results indicate that in the Douglas-fir dry vegetation type, late open structure would occupy the most area (59 percent), followed by late closed (22 percent). All structure classes are within HRV for this vegetation type. Thinning treatments in dry Douglas-fir would generally be focused on mid closed stands, and would move these stands into mid open and eventually late open classes over the 100-year modeling period. Treatments, including thinning, prescribed burning, and mechanical fuels treatments, would also occur in late structures to maintain those stands within either a late open or late closed class. At 100 years, the dry Douglas-fir vegetation type has a departure index of 7.5, which is the lowest of any alternative.

In the Northern Rocky Mountains mixed conifer type, the majority of structure is within the late closed class (77 percent) and mid closed (12 percent). Mid open (1 percent) is the only structure class within HRV, although late open (7 percent) is just 1 percent higher than HRV. There is a lack of early (2 percent) and mid closed (12 percent). Thinning treatments would be focused in mid closed stands, with prescribed burning occurring in open and closed stands. The Northern Rocky Mountain mixed conifer type has a departure index of 28 under this alternative, which is higher than alternatives B and O, but lower than the other alternatives.

For western hemlock/western red cedar, all of the structure is within the late closed type (100 percent). No structure class is within HRV in this vegetation type, largely because no active management is assumed to occur within this type. There is a departure index of 31, which is the same as other alternatives except for B and O.

For subalpine fir/lodgepole pine, the early structure class dominates (57 percent), with lesser amounts in mid closed (12 percent) and late closed (9 percent). Early is the only structure class within HRV. Harvest treatments in this type are focused on mid closed classes with stand-replacing prescribed fire used as well. This type has a departure index of 21, which is higher than any alternative other than no action.

In the spruce/subalpine fir type, results show that there would be a lack of early structure class (3 percent), although there would be an abundance of late closed class (63 percent). Only mid closed (33 percent) is within HRV in this vegetation type, with early being below HRV and late closed being above HRV. No active management is assumed to occur in this vegetation type. This vegetation type has a departure index of 27, the same as all other alternatives except no action, which is slightly less departed.

Old Forest Management and Timber Production

Alternative P creates more late structure than alternatives R, B, and O, but less than no action and proposed action. Table 48 shows approximate acres that were modeled to be in late open and late closed structure classes in 100 years.

Table 48. Approximate acres of late forest structure in 100 years for alternative P

Structure Class	Alternative P
Late Open	
Douglas-fir dry	286,767
Northern Rocky Mountain mixed conifer	21,586
Subalpine fir/lodgepole pine	3,509
Total Late Open	311,861
Late Closed	
Douglas-fir dry	106,930
Northern Rocky Mountain mixed conifer	237,441
Western hemlock/western red cedar	95,820
Subalpine fir/lodgepole pine	15,789
Spruce/subalpine fir	12,751
Total Late Closed	468,731
Total Late Structure	**780,592**

This alternative proposes to use a landscape approach to forest structure management that allows structure classes to shift around the landscape in response to disturbance. Instead of fixed reserves intended to contain late forest structure, this alternative would have late structure contained throughout the landscape and all actions that affect forest vegetation would be assessed and compared to HRV, with the goal of moving the overall landscape toward HRV.

Alternative P replaces Eastside Screens with a series of desired HRV conditions, desired wildlife habitat conditions, and a guideline for large tree retention which emphasizes retention and recruitment of large trees across the landscape, but allows cutting of individual large trees when needed to meet desired conditions for structural stages, along with several other exceptions.

Alternative P, along with the proposed action, moves late structure classes in the Douglas-fir dry type (the largest vegetation type on the Forest) to the midpoint of HRV and has the least amount of departure in this type. More importantly, this alternative, along with the proposed action, produces a higher percentage of total late structure in late open structure (40 percent of total late structure) compared to other alternatives. This would decrease fire severity and insect risk, while increasing resiliency in the face of climate change and other disturbances (Franklin et al. 2007, Graham et al. 2007, Puettmann et al. 2009, Franklin and Johnson 2012, DeRose and Long 2014).

The annual projected wood sale quantity under alternative P is 62 MMBF. Both the proposed action and alternative P are projected to produce the most volume. Approximately 79 percent of this volume is expected to be merchantable sawtimber, with the remaining volume composed of other woody material such as fuelwood and biomass.

In summary, modeling shows that in 100 years other alternatives move more structure classes to within HRV, but alternative P (along with the proposed action) creates the second least departed landscape, produces the third most total late forest structure, and has the highest projected timber volume output. In addition, alternative P (along with the proposed action) has the highest percentage of total late forest structure in late open, which is expected to result in increased resilience of late forest habitats.

Alternative B

This alternative emphasizes two management areas that focus on forest vegetation: the restoration management area, which emphasizes late forest structure; and the active management area, which emphasizes timber production by using two-aged regeneration harvests. Input from the Northeast Washington Forestry Coalition is included in this alternative. Proposed management not provided in the coalition's alternative comes from the proposed action. This alternative also responds to those advocating for increased wilderness and to public concerns that the amount and location of summer and winter motorized use may impact aquatic, riparian and wildlife habitats. This alternative continues the use of Eastside Screens and all future actions that affect forest vegetation would be assessed and compared to HRV, with the goal of moving the overall landscape toward HRV.

Table 49 shows vegetation management options available in each of the management areas. Note that this table includes non-forest acres, as well as other acres within individual management areas where timber harvest would not occur as per restrictions under NFMA (that is, areas with concerns for irreversible resource damage, reforestation difficulties, or unsuitable soils for harvest). Approximately 257,500 acres (23 percent) are within areas where management is limited to the use of fire and where no timber harvest or fuels treatments will occur. The majority (44 percent or about 479,200 acres) of the forest is within a management area that is suitable for scheduled timber harvest, fuels treatments, and prescribed burning. Approximately 367,500 acres (33 percent) are within management areas where fuels treatments, prescribed burning, and timber harvest are allowed for resource benefit, but are not suitable for scheduled timber production. It is important to note that in this alternative the restoration management area is not considered suitable for scheduled timber production and, as such, does not influence timber yield calculations such as ASQ or LTSY.

Table 49. Vegetation management allowed within each management area for alternative B

Vegetation Management	Management Area	Acres
No timber harvest. Prescribed fire and wildfire use allowed.	Wilderness Wilderness – Recommended Research Natural Area **Total Acres**	31,400 220,300 5,800 **257,500 (23%)**
No scheduled timber harvest; incidental timber harvest for specific resource benefit to meet management objectives, prescribed fire, and mechanical fuels treatment allowed.	Backcountry Backcountry Motorized Scenic Byways Restoration **Total Acres)**	4,800 6,600 17,600 338,500 **367,500 (33%)**
Scheduled timber harvest, prescribed fire, and mechanical fuels treatment allowed.	Active Management **Total Acres**	479,200 **479,200 (44%)**

Table 50 shows the number of acres within each vegetation type that are either suitable or unsuitable for scheduled timber production. Note that non-forest acres are not included and rounding errors from GIS analysis will cause total acres to not match other tables. For lands unsuitable for timber production, there are still areas where timber harvest is allowed for resource benefit but is not scheduled or included in sustained yield calculations.

Table 50. Timber suitability by vegetation type for alternative B

Timber Suitability Class		Douglas-fir dry	Northern Rocky Mountain mixed conifer	Western hemlock / western red cedar	Subalpine fir / lodgepole pine	Spruce / subalpine fir	Total
Suitable – Timber Production	Acres* (% of veg type)	214,328 (44%)	119,647 (39%)	29,663 (31%)	27,254 (16%)	2,371 (11%)	393,263 (36%)
Unsuitable – Restoration Harvest	Acres* (% of veg type)	101,933 (21%)	115,067 (37%)	29,809 (31%)	54,956 (31%)	4,770 (22%)	306,535 (28%)
Unsuitable – No Harvest	Acres* (% of veg type)	169,740 (35%)	72,500 (24%)	35,532 (37%)	92,369 (53%)	14,211 (67%)	384,352 (35%)

*Acres are approximate due to GIS rounding error

Scheduled timber production is suitable on 36 percent of forested vegetation and is predominantly in Douglas-fir dry (54 percent of suitable lands) and Northern Rocky Mountain mixed conifer (30 percent of suitable lands) types. Harvest treatments would primarily consist of partial removals as stand improvement and a shelterwood with reserves as the final harvest. These treatments are meant to emphasize timber production while still retaining some untreated patches. No prescribed burning would take place in any vegetation type within the timber production area.

Timber harvest for other resource objectives is allowed on 28 percent of forested vegetation and would treat Douglas-fir dry, mixed conifer, and western red cedar/western hemlock types with variable density thinning. These treatments would move these vegetation types toward more late closed structure, while introducing openings of various sizes and breaking up the continuity of the canopy. Subalpine fir/lodgepole pine would have a shelterwood with reserves as the final harvest, which would mimic the historical disturbance regime in this type. Douglas-fir, mixed conifer, and subalpine fir/lodgepole pine types would use prescribed fire as well. These treatments are meant to restore structure and move stands toward HRV.

Under alternative B, the majority of acres treated through vegetation management would occur with the use of prescribed fire (51 percent), followed by mechanical fuels treatments (26 percent) and timber harvest (23 percent). Timber harvest would occur in Douglas-fir dry, Northern Rocky Mountain mixed conifer, and subalpine fir/lodgepole pine types. Mechanical fuels treatments would primarily occur in Douglas-fir dry and Northern Rocky Mountain mixed conifer types, with some treatments in western hemlock/western red cedar types. Prescribed fire treatments would occur in Douglas-fir dry, Northern Rocky Mountain mixed conifer, and subalpine fir/lodgepole pine types. Complete details of which management actions were modeled in each suitability class and vegetation type are available in appendix G.

Modeling Results

Table 51 shows modeling results at 100 years and indicates that alternative B has 15 structure classes within HRV, which is more than any other alternative. The departure analysis indicates a departure index of 19, which is higher than the proposed action and alternatives P and O, indicating this alternative results in a more departed landscape compared to HRV than those alternatives.

Table 51. Modeling results at 100 years for alternative B

		Early	Mid Open	Mid Closed	Late Open	Late Close d	Departure Index
Douglas-fir dry	HRV	6-16	2-8	4-13	38-78	1-32	
	100 Years	12*	4	10	42	32	18
Northern Rocky Mountain mixed conifer	HRV	9-25	1-3	18-30	4-6	44-60	
	100 Years	8	1	10	4	77	25
Western hemlock/western red cedar	HRV	4-24	0	7-27	0	55-83	
	100 Years	2	0	8	0	90	21
Subalpine fir/lodgepole pine	HRV	45-65	0	33-53	0	3	
	100 Years	62	1	30	0	6	12
Spruce/subalpine fir	HRV	14-46	0	13-41	0	29-57	
	100 Years	3	0	32	0	64	27
Total Landscape Departure:							19

*Shaded cells are within HRV

Modeling results indicate that in the Douglas-fir dry vegetation type, most of the structure is within the late open class (42 percent), followed by late closed (32 percent), early (12 percent), mid closed (10 percent), and mid open (4 percent). All structure classes are within HRV for this vegetation type. Thinning and harvest treatments would be focused on mid closed stands, while prescribed fire would also be used in the restoration management area to maintain open structure classes. While the proposed action and alternative P maintain both late open and late closed around the midpoint of the HRV range, this alternative results in an amount of late open closer to the lower HRV limit, while having an amount of late closed that is at the upper HRV limit. This vegetation type has a departure index of 18, which is higher than the proposed action and alternatives P and O.

In the Northern Rocky Mountains mixed conifer type, late closed occupies the most area (77 percent), while mid closed (10 percent) and early (8 percent) make up nearly all of the rest. Thinning treatments would be focused on mid closed stands, and prescribed fire would be used in the restoration management area in closed structure classes to mimic natural mixed-severity fire. Mid open and late open are the only structure classes within HRV for this vegetation type, while there is an overabundance of late closed and a lack of early and mid-closed. There is a departure index of 25, which is the second lowest of any alternative.

For western hemlock/western red cedar, most structure is within the late closed class (90 percent), while mid closed (8 percent) and early (2 percent) make up the rest. Harvest and thinning treatments would be focused on mid closed stands. Mid closed is the only structure class within HRV, while both early and late closed are outside of HRV. This vegetation type has a departure index of 21, which, along with alternative

O, is the lowest. This is because only alternatives B and O have treatments modeled in this vegetation type.

For subalpine fir/lodgepole pine, the vast majority of area is within the early structure class (62 percent), while mid closed (30 percent) and late closed (6 percent) make up the remainder. Harvest treatments would be focused on mid closed stands with high-severity prescribed fire occurring in wilderness areas. Only the early type is within HRV for this vegetation type, with both mid closed and late closed outside of HRV. The subalpine fir/lodgepole pine type has a departure index of 12, which is the second lowest of any alternative.

In the spruce/subalpine fir type, results show that there would be a lack of early structure class (3 percent), although there would be an abundance of late closed type (64 percent). Mid closed (32 percent) is within HRV, while both early and late closed are outside of HRV. No active management is assumed to occur in this vegetation type. This vegetation type has a departure index of 27, the same as all other alternatives except no action, which is slightly less departed.

Old Forest Management and Timber Production

Alternative B creates the least amount of late structure of any alternative. Table 52 shows approximate acres that were modeled to be in late open and late closed structure classes in 100 years.

Table 52. Approximate acres of late forest structure in 100 years for alternative B

Structure Class	Alternative B
Late Open	
Douglas-fir dry	204,139
Northern Rocky Mountain mixed conifer	12,335
Subalpine fir/lodgepole pine	0
Total Late Open	216,474
Late Closed	
Douglas-fir dry	155,534
Northern Rocky Mountain mixed conifer	237,441
Western hemlock/western red cedar	86,238
Subalpine fir/lodgepole pine	10,526
Spruce/subalpine fir	12,954
Total Late Closed	502,693
Total Late Structure	**719,167**

Maintaining a fixed reserve system does not guarantee all the allocated acres are in a condition that currently contain old forests. Due to ongoing natural disturbance processes such as fire or insects, some stands in reserves may actually be in an early or mid-seral forest structural stage. Due to management restrictions in reserves under alternative B, there is no opportunity to maintain or enhance the conditions through active management if there is little or no actual late forest structure within the reserve, or if forest structures are altered through future disturbances.

With continuation of the Eastside Screens, management options differ between vegetation types depending on the amount of late structure. In vegetation types that are below HRV for late closed or late open structure, no trees 21 inches d.b.h. or greater can be harvested and no timber harvest activities can occur within late structure classes, unless it is moving one late structure class to another late structure class. In vegetation types that are within HRV in both late open and late closed structure, trees 21 inches d.b.h. or greater can be harvested and timber harvest activities can occur within these late structure stands as long as late structure does not fall below HRV. This means that under alternative B there would be no harvesting of trees 21 inches d.b.h. or greater in any vegetation type for approximately the first 50 years due to late structure being below HRV. The mid closed structure class could be managed to create early or move toward late open, but no harvest activities could occur within late structure stands. The one exception to this could occur in Douglas-fir dry late closed stands, which are currently within HRV. In these stands, management could move structure toward late open, but without the ability to remove trees 21 inches d.b.h. or greater, it can be difficult to reduce canopy cover enough to qualify as late open structure. Modeling results show that all alternatives eventually create enough late open in the Douglas-fir dry to be within HRV; however, alternative B gets there more slowly and produces less than the proposed action and alternative P.

Without management or other disturbance, mid closed stands would move into late closed structure, and management opportunities would be limited to create late open structure, resulting in an excess of late closed structure in all vegetation types except the Douglas-fir dry, which is at the upper limit of HRV in late closed. Higher stocking in these late closed stands creates stand density levels that are within the zone of competition-induced mortality, where trees are experiencing increased levels of mortality from high levels of competition for resources such as light and water. The risk of mortality from bark beetles and other insects and stand-replacing fire is greatly increased, and could result in a loss of late structure.

The annual projected wood sale quantity under alternative B is 37 MMBF. This is the second lowest projected volume of any alternative, with only alternative R producing less. Approximately 65 percent of this volume is expected to be merchantable sawtimber, with the remaining volume composed of other woody material such as fuelwood and biomass. This alternative has lower sawtimber output than the proposed action and alternative P due to fewer acres that are suitable for scheduled timber production and also the continuation of the Eastside Screens direction.

In summary, modeling shows that in 100 years, alternative B moves the second most structure classes to within HRV, has a moderately departed landscape, produces the least amount of late structure, and has a moderate projected timber volume output compared to the other alternatives.

Alternative O

This alternative proposes two management areas to address vegetation management: the restoration management area to develop late forest structure, and the responsible management area that emphasizes timber production, using two-aged regeneration harvests. The total percentage of the Forest allocated to vegetation management is similar to alternative B, though alternative O has a greater percentage in the restoration management area than alternative B. The Forest Service fully developed this alternative using the proposed action to fill in the gaps not addressed in the collaborative process. This alternative continues the use of Eastside Screens and all future actions that affect forest vegetation would be assessed and compared to HRV, with the goal of moving the overall landscape toward HRV.

Table 53 shows which vegetation management options are available in each of the management areas. Note that this table includes non-forest acres, as well as other acres within individual management areas where timber harvest would not occur as per restrictions under NFMA (that is, areas with concerns for irreversible resource damage, reforestation difficulties, or unsuitable soils for harvest). Approximately 53,100 acres (5 percent) are within management areas where no timber harvest or fuels treatments will occur. The majority (56 percent or about 617,100 acres) of the Forest is within a management area where fuels treatments, prescribed burning, and timber harvest are allowed for resource benefit, but are not suitable for scheduled timber production. Approximately 433,400 (39 percent) of the Forest is suitable for scheduled timber harvest, fuels treatments, and prescribed burning. It is important to note that in this alternative, the restoration management area is not considered suitable for scheduled timber production, and, as such, does not influence timber yield calculations such as ASQ or LTSY.

Table 53. Vegetation management allowed within each management area for alternative O

Vegetation Management	Management Area	Acres
No timber harvest. Prescribed fire and wildfire use allowed.	Wilderness Wilderness – Recommended Research Natural Area **Total Acres**	31,400 15,900 5,800 **53,100 (5%)**
No scheduled timber harvest; incidental timber harvest for specific resource benefit to meet management objectives, prescribed fire, and mechanical fuels treatment allowed	Backcountry Backcountry Motorized Scenic Byways Restoration **Total Acres**	174,300 53,700 19,600 369,500 **617,100 (56%)**
Scheduled timber harvest, prescribed fire, and mechanical fuels treatment allowed.	Responsible **Total Acres)**	433,400 **433,400 (39%)**

Table 54 shows the number of acres within each vegetation type that are either suitable or unsuitable for scheduled timber production. Note that non-forest acres are not included and rounding errors from GIS analysis will cause total acres to not match other tables. For lands unsuitable for timber production, there are still areas where timber harvest is allowed for resource benefit, but is not scheduled or included in sustained yield calculations.

Table 54. Timber suitability by vegetation type for alternative O

Timber Suitability Class		Douglas-fir dry	Northern Rocky Mountain mixed conifer	Western hemlock / western red cedar	Subalpine fir / lodgepole pine	Spruce / subalpine fir	Total
Suitable – Timber Production	Acres* (% of veg type)	184,302 (38%)	117,885 (38%)	26,980 (28%)	24,890 (14%)	2,171 (10%)	356,228 (33%)
Unsuitable – Restoration Harvest	Acres* (% of veg type)	166,232 (34%)	142,035 (46%)	45,875 (48%)	118,528 (68%)	16,118 (75%)	488,788 (45%)
Unsuitable – No Harvest	Acres* (% of veg type)	135,233 (28%)	47,107 (15%)	22,067 (23%)	31,163 (18%)	3,067 (14%)	238,637 (22%)

*Acres are approximate due to GIS rounding error

Scheduled timber production is suitable on 33 percent of forested vegetation and is predominantly in Douglas-fir dry (52 percent of suitable lands) and Northern Rocky Mountain mixed conifer (33 percent of suitable lands) types. Harvest treatments would primarily consist of partial removals as stand improvement and a shelterwood with reserves as the final harvest. These treatments are meant to emphasize timber production, while still retaining some untreated patches. No prescribed burning would take place in any vegetation type within the timber production area.

Timber harvest for other resource objectives is allowed on 45 percent of forested vegetation, and would treat Douglas-fir dry, mixed conifer, and western red cedar/western hemlock types with variable density thinning. These treatments would move these vegetation type toward more late closed structure while introducing openings of various sizes and breaking up the continuity of the canopy. Subalpine fir/lodgepole pine would have a shelterwood with reserves as the final harvest which would mimic the historical disturbance regime in this type. Douglas-fir dry, mixed conifer, and subalpine fir/lodgepole pine types would use prescribed fire as well. These treatments are meant to restore structure and move stands toward HRV.

Under alternative O, the majority of acres treated through vegetation management would occur with the use of prescribed fire (51 percent), followed by mechanical fuels treatments (26 percent), and timber harvest (23 percent). Timber harvest would occur in Douglas-fir dry, Northern Rocky Mountain mixed conifer, and subalpine fir/lodgepole pine types. Mechanical fuels treatments would primarily occur in Douglas-fir dry and Northern Rocky Mountain mixed conifer types, with some treatments in western hemlock/western red cedar types. Prescribed fire treatments would occur in Douglas-fir dry, Northern Rocky Mountain mixed conifer, and subalpine fir/lodgepole pine types. Complete details of which management actions were modeled in each suitability class and vegetation type are available in appendix G.

Modeling Results

Table 55 shows modeling results at 100 years and indicates that alternative O has 16 structure classes within HRV, more than any other alternative. The departure analysis indicates a departure index of 17, which is lowest of any alternative, indicating this alternative results in the least overall departed landscape compared to HRV than any other alternative.

Table 55. Modeling results at 100 years for alternative O

		Early	Mid Open	Mid Closed	Late Open	Late Closed	Departure Index
Douglas-fir dry	HRV	6-16	2-8	4-13	38-78	1-32	
	100 Years	11*	4	8	45	32	15.5
Northern Rocky Mountain mixed conifer	HRV	9-25	1-3	18-30	4-6	44-60	
	100 Years	6	2	11	5	77	24
Western hemlock/western red cedar	HRV	4-24	0	7-27	0	55-83	
	100 Years	2	0	8	0	90	21
Subalpine fir/lodgepole pine	HRV	45-65	0	33-53	0	3	
	100 Years	55	1	37	0	6	5
Spruce/subalpine fir	HRV	14-46	0	13-41	0	29-57	
	100 Years	3	0	30	0	67	27
Total Landscape Departure:							17

*Shaded cells are within HRV

Modeling results indicate that in the Douglas-fir dry vegetation type, most of the structure would be within a late open class (45 percent) and late closed (32 percent). Thinning and harvest treatments would be focused on mid closed stands, with prescribed fire used in the restoration management area to maintain open structure classes. All structure classes are within HRV for this vegetation type. While the proposed action and alternative P maintain both late open and late closed around the midpoint of the HRV range, this alternative results in an amount of late open closer to the lower HRV limit, while having an amount of late closed that is at the upper HRV limit. This vegetation type has a departure index of 15.5, which is higher than the proposed action and alternative P, but lower than the other alternatives.

In the Northern Rocky Mountains mixed conifer type, late closed structure occupies the most area (77 percent), followed by mid closed (11 percent), early (6 percent), late open (5 percent) and mid open (2 percent). Harvest and thinning treatments would be focused on mid closed stands, with prescribed fire used in the restoration management area to mimic mixed-severity fire. Mid open and late open are within HRV, while there is an overabundance of late closed and a lack of early and mid-closed. It has a departure index of 24, which is the lowest of any alternative indicating that this alternative does the best job of managing this vegetation type toward HRV, though no alternative maintains the late closed class in this vegetation type within HRV.

For western hemlock/western red cedar, the bulk of structure is within the late closed class (90 percent), with mid closed (8 percent) and early (2 percent) occupying the rest. Harvest and thinning treatments would be focused on mid closed stands. Only mid closed is within HRV for this vegetation type, while both early and late closed are outside of HRV. This vegetation type has a departure index of 21, which, along with alternative B, is the lowest of any alternative. This is because only alternatives B and O have treatments modeled in this vegetation type.

For subalpine fir/lodgepole pine, 55 percent is within the early structure class, while 37 percent is within mid closed, and 6 percent in late closed. Harvest treatments would occur in mid closed stands, with high-severity fire occurring in wilderness areas. Early and mid-closed are within HRV for this vegetation type, while there is an overabundance of late closed. This vegetation type has a departure index of 5, which is the lowest of any alternative.

In the spruce/subalpine fir type, results show that there would be a lack of early structure class (3 percent) and an abundance of late closed type (67 percent). Mid closed (30 percent) is the only structure class that is within HRV, while both late closed and early are outside of HRV. No active management is assumed to occur in this vegetation type. This vegetation type has a departure index of 27, the same as all other alternatives except no action, which is 1 percent less departed.

Old Forest Management and Timber Production

Alternative O creates a lower amount of late structure than any alternative other than alternative B alternative. Table 56 shows approximate acres that were modeled to be in late open and late closed structure classes in 100 years.

Maintaining a fixed reserve system does not guarantee all the allocated acres are in a condition that currently contain old forests. Due to ongoing natural disturbance processes such as fire or insects, some stands within reserves may actually be in an early or mid-seral forest structural stage. Due to management restrictions in reserves under the O alternative, there is no opportunity to maintain or enhance the conditions through active management if there is little or no actual late forest structure within the reserve, or if forest structures are altered through future disturbances.

Table 56. Approximate acres of late forest structure in 100 years for alternative O

Structure Class	Alternative O
Late Open	
Douglas-fir dry	218,720
Northern Rocky Mountain mixed conifer	15,418
Subalpine fir/lodgepole pine	0
Total Late Open	234,139
Late Closed	
Douglas-fir dry	155,534
Northern Rocky Mountain mixed conifer	237,441
Western hemlock/western red cedar	86,238
Subalpine fir/lodgepole pine	10,526
Spruce/subalpine fir	13,561
Total Late Closed	503,300
Total Late Structure	**737,439**

With continuation of the Eastside Screens, management options differ between vegetation types depending on the amount of late structure. In vegetation types that are below HRV for late closed or late open structure, no trees 21 inches d.b.h. or greater can be harvested and no timber harvest activities can occur within late structure classes, unless it is moving one late structure class to another late structure class. In vegetation types that are within HRV in both late open and late closed structure, trees 21inches d.b.h. or greater can be harvested and timber harvest activities can occur within these late structure stands as long as late structure does not fall below HRV. This means that under alternative O there would be no harvesting of trees 21inches d.b.h. or greater in any vegetation type for approximately the first 50 years due to late structure being below HRV. The mid closed structure class could be managed to create early or move toward late open, but no harvest activities could occur within late structure stands. The one exception to this could occur in Douglas-fir dry late closed stands, which are currently within HRV. In these stands management could move structure toward late open, but without the ability to remove trees 21 inches d.b.h. or greater, it can be difficult to reduce canopy cover enough to qualify as late open structure. Modeling results show that all alternatives eventually create enough late open in the Douglas-fir dry to be within HRV; however, alternative O gets there more slowly and produces less than the proposed action and alternative P.

Without management or other disturbance, mid closed stands would move into late closed structure, and management opportunities would be limited to create late open structure, resulting in an excess of late closed structure in all vegetation types except the Douglas-fir dry, which is at the upper limit of HRV in late closed. Higher stocking in these late closed stands creates stand density levels that are within the zone of competition-induced mortality, where trees are experiencing increased levels of mortality from high levels of competition for resources such as light and water. The risk of mortality from bark beetles and other insects and stand-replacing fire is greatly increased, and could result in a loss of late structure.

The annual projected wood sale quantity under alternative O is 38 MMBF. Only alternatives R and B have lower projected volumes. Approximately 66 percent of this volume is expected to be merchantable sawtimber, with the remaining volume composed of other woody material such as fuelwood and biomass. This alternative has lower sawtimber output than the proposed action and alternative P due to fewer acres that are suitable for scheduled timber production and also the continuation of the Eastside Screens direction.

In summary, modeling shows that in 100 years, alternative O moves the most structure classes to within HRV and has the least departed landscape, but produces the second lowest amount of late structure and has a moderate projected timber volume output compared to the other alternatives.

Cumulative Effects

Past, Present, and Foreseeable Activities Relevant to Cumulative Effects Analysis

The area for considering cumulative effects includes the lands within the Colville National Forest administrative boundary.

Socio-economic choices can have the potential to influence cumulative effects. In the recent past, there have been some significant shifts in ownership of lands previously managed for industrial forestry objectives or large ranches being sold with possible conversion to other uses. Management objectives of the new owners, mostly unknown at this time, could influence a number of dynamics such as water quality and quantity, habitat connectivity, and fire management.

The cumulative environmental effects of the proposed management under all alternatives are to move a portion of the vegetation toward desired conditions. These efforts would contribute to overall landscape restoration goals and increase the resilience and adaptability of forest vegetation.

Botany

This section considers two groups of rare plants that occur or may occur in the planning area, federally listed threatened, endangered, or proposed and USDA Forest Service Region 6 sensitive plant species . Threatened and endangered species are those formally listed by the Fish and Wildlife Service (USFWS) under the Federal Endangered Species Act (ESA).

Affected Environment

The Colville National Forest (Forest) does not currently have any federally threatened, endangered, or proposed threatened plant species. Any newly designated or discovered taxa listed by the ESA would be managed appropriately throughout the life of the revised forest plan.

Sensitive species include those vascular and non-vascular plant taxa and fungi from the 2015 R6 Regional Forester’s Sensitive Species List. Lists are periodically updated as new data on species occurrences, threats, and risks as well as habitat conditions and trends are assessed to inform species conservation status, vulnerability, and conservation priority.

Since 1988, sensitive species surveys and review of other data documented additional populations of many species, with the result that some were judged more secure and others rare and at risk. For example, in 1988, *Viola renifolia* was thought to be extirpated in Washington state, but through plant survey efforts, 83 sites are now documented on the Colville National Forest. Other species like *Botrychium minganese* turned out to be more widespread than previously thought and these were removed from the regional sensitive species list.

Many threatened, endangered, and sensitive (TES) plant species depend on special or unique habitats that may be rare or represent a small portion of a particular landscape. In forested landscapes, these TES plant habitats include meadows; wetlands, including marshes, bogs, fens, carrs, swamps, springs and seeps; riparian areas; alpine fellfields; rock outcrops; cliffs; and talus.

For the purpose of analyses and discussion of the current affected environment, rare plant habitats were grouped into five types as described in the Forest Service Natural Resource Management Threatened, Endangered, and Sensitive Plants application (NRM TESP) database (2017) and the *Field Guide to the Rare Plants of Washington* (Camp and Gamon 2011). Plants within each group share broad environmental similarities and natural disturbance regimes, resource potential, and management opportunities that facilitate assessment of sensitive species site and habitat conditions and trends. Table 57 displays the distribution of rare plant taxa and sites across the environmental gradient of the Colville National Forest.

Table 57. Sensitive plant habitat groups, number of species within each habitat and number of occurrences (sites)

Habitat Group	Number of Sensitive Species	Number of Sites
Alpine and subalpine meadows, fellfields, and parklands	5	41
Cliffs, talus, and rock outcrops	2	16
Dry meadows, open dry forests, and shrub steppe	5	99
Moist openings and wet forests	6	239
Wetlands, moist meadows, and riparian	23	219

While plant diversity is an important attribute across all the habitat groups, the table shows that plant habitats encompassing wetlands, moist meadows, and riparian ecosystems provide habitat for the bulk of the documented sensitive plant species. Since 1998 and the implementation of the NRM TESP database, rare plant surveys have been conducted on 92,000 acres of the Forest to meet a number of management concerns. Information on occurrences is lacking on the remainder of the planning area.

Environmental Consequences

Assumptions

- Diversity objectives would be achieved for all native plant species through ecosystem diversity (coarse filter) plan components except for federally listed species (if discovered) and R6 sensitive species. The latter classes of plants are managed with consideration of species and habitat specific plan components including desired conditions, objectives, standards, and guidelines (fine filter).
- A conservation outcome for any group of sensitive species reflects the conservation outcome for each species in that group.
- Current vacant grazing allotments would continue in non-grazing status.

Introduction

Under the 1982 planning rule, national forests were required to manage habitat in order to maintain viable populations of existing species in planning areas. The planning rule further defines a viable population as “one which has the estimated numbers and distribution of reproductive individuals to insure its continued existence is well distributed in the planning area.”

Critical information about factors limiting rare species distributions and populations is often lacking and until studies describing the complex abiotic and biotic interactions between species and their environments can be completed, conservation principles would advocate for a cautious approach to rare plant species management. As budgets limit study efforts, it is often enough to determine that there are a critical number of well-distributed, stable rare plant occurrences that ensure continued viability of the species of concern in the planning area. Particularly, this threshold is sought when the determination is that threats associated with resource management are countered with abatement, avoidance, or mitigation actions. In addition, species security is enhanced if habitat effectiveness is maintained in special and unique habitats supporting rare plant populations. Habitat effectiveness may be enhanced directly through management activities that reduce risks or indirectly by enhancing ecosystem integrity and resilience. It is, however, relevant to achieving conservation goals that sensitive plant source populations be protected from disturbances outside the historical range of variation. The details of life history traits and reproduction as well as interactions such as herbivory, mutualism (two organisms of different species benefitting from a relationship), and pollinator ecology remain incomplete due to the sheer number of candidates for priority study. Progress is measured incrementally as annual sensitive species inventories are entered into corporate databases for future analyses of condition and trend.

Process

Conservation outcomes for the sensitive species are summarized below for all alternatives and focus on risks to maintaining viable plant populations and habitats within the plan area. Generally, the action alternatives were not driven by plant viability issues. Therefore, a set of TES plant, soil, vegetation, riparian management area, and livestock grazing desired future condition statements, objectives, standards, and guidelines are assessed as contributing to plant viability. This was done in threat-risk matrix associated with changes in alternative management areas. Some effects to species viability were similar across alternatives. Where a set of plan components had differing influence on conservation outcomes, the results are described below.

This assessment occurs within a vulnerability, threat and risk matrix inherent in land and resource management planning. Threats were identified from literature (Camp and Gamon 2011) and local NRM TESP database sources (USDA Forest Service 2017a). Viability risk to TES plant species (High, Medium, or Low) is defined as occupied habitat exposed to activities that damage or degrade habitat or populations. High risk is defined as impact levels that affect the Forest’s ability to contribute to TES plant viability. This is defined as greater than 67 percent of occupied habitat appreciably impacted. In conclusion, plan components, including desired future conditions, objectives, standards, guidelines, land suitability, and land management allocations, as well as habitat group affinities are evaluated to describe the degree to which risks would be managed to affect desired conservation outcomes under each plan alternative.

Conservation Outcomes

Table 58 summarizes viability outcomes for each habitat group by alternative. For all habitat groups except “wetlands, moist meadows, and riparian,” the proposed action and other action alternatives “may impact individuals or habitat, but will not likely contribute to a trend toward Federal listing or cause a loss of viability to the population or species” (MIIH). For “wetlands, moist meadows, and riparian,” the no action alternative would result in an action that “will impact individuals or habitat and may contribute to a trend toward Federal listing or cause a loss of viability to the population or species” (WIFV=Will Impact Future Viability).

Table 58. Species summary of viability outcomes by alternatives

Habitat Groups	No Action	Proposed Action	Alt. R	Alt. P	Alt. B	Alt. O
Alpine and subalpine meadows, fellfields, parklands	MIIH	MIIH	MIIH	MIIH	MIIH	MIIH

Habitat Groups	No Action	Proposed Action	Alt. R	Alt. P	Alt. B	Alt. O
Cliffs, talus, rock outcrops	MIIH	MIIH	MIIH	MIIH	MIIH	MIIH
Dry meadows, open dry forests, shrub steppe	MIIH	MIIH	MIIH	MIIH	MIIH	MIIH
Moist openings, wet forests	MIIH	MIIH	MIIH	MIIH	MIIH	MIIH
Wetlands, moist meadows, riparian	WIFV	MIIH	MIIH	MIIH	MIIH	MIIH

Spatial and Temporal Context for Effects Analysis

The spatial context for effects analysis includes all lands within the Colville National Forest administrative boundary. Temporal consideration is given to management of rare plant resources on the Forest for a period of 15 to 20 years in the future, the approximate life of the land and resource management plan.

Past, Present, and Foreseeable Activities Relevant to Cumulative Effects Analysis

Resource management plans for other Federal, State, and Tribal lands adjacent to the Forest include provisions for the protection and management of rare plant resources. The Okanogan-Wenatchee National Forest, Idaho Panhandle National Forests, Bureau of Land Management, Fish and Wildlife Service, Washington State Department of Natural Resources, Washington Dept. of Fish and Wildlife, Kalispel Indian Reservation, and Colville Confederated Tribes recognize resource values associated with the maintenance of rare plant populations and supporting habitat. Sensitive species lists may differ in details because of different agency criteria and agency habitat ownership. The state lists and state ranks are developed and maintained by the Washington Natural Heritage Program in collaboration with public agency, university, and private cooperators with botanical interests. The Pend Oreille County Public Utility District (PUD) and Seattle City Light have conducted rare plant surveys and are implementing conservation measures as needed in compliance with hydroelectric licenses on the eastern portion of the Forest along the Pend Oreille River. Allotment management plans (AMPs) have recently been completed with current management direction and future AMPs would incorporate changes as plan revision is implemented.

Summary of Effects

Plan components, including desired future conditions, objectives, standards, guidelines, land suitability, and land management allocations, as well as habitat group affinities are evaluated to describe the degree to which risks would be managed to effect desired conservation outcomes under each plan alternative. Many of the effects are common to all alternatives and plant habitat groups, are summarized here, and will not be discussed further. Other effects are evaluated by plant habitat group and alternative in the Effects for Alternatives by Plant Habitat Group section.

Climate Change

The effects of climate change are common to all five rare plant habitat groups and all alternatives. Climate change predictions for the Inland Pacific Northwest include average temperature increases, changes in precipitation amounts, precipitation patterns, snowpack accumulations, snowmelt, and run-off regimen (Climate Impacts Group, University of Washington, 2013). These changes would affect extant sensitive plant populations and habitat components resulting in shifting spatial physiological optimums and habitat effectiveness. The detailed changes are unknown at the forest plan scale, but some general conclusions allow the relative ranking of vulnerable habitats and species:

- High-elevation alpine and subalpine habitats may shift upward in elevation with increasing temperatures and result in loss of suitable habitat on the higher mountainous areas (Astrup Felde et al. 2012, Miller-Struttmann et al. 2015, Munson and Sher 2015, Walther et al. 2002).
- Cliffs, talus, and rock outcrops where small changes in available moisture seeps and increased evapotranspiration[23] demand would impact plants established in stressful, rocky environments.
- Dry shrublands, grasslands, and forests supporting sensitive plants may experience greater evapotranspiration and changes in moisture patterns and drought that impact plant species composition and cover and, thus, habitat effectiveness of these communities (EcoAdapt 2015).
- Moist openings and wet forests may shrink in extent as both groundwater and precipitation input changes reduced and higher temperatures create greater evapotranspiration demand leading to compositional and structural shifts in associated plant communities (EcoAdapt 2015).

In addition, climate change components would interact with pollinator ecology, plant phenology, invasive plant infestations, habitat connectivity, and fire regime shifts to indirectly impact existing sensitive species populations and their habitats (Miller-Struttmann et al. 2015). Shifts in some of these habitat factors may outpace the ability of plant species to adapt to changing environments (Walther et al. 2002). This leads to more isolated populations that increases stress in already vulnerable species. Condition and trend monitoring, and conservation of genetic material in seed banks have been identified as strategies to deal with these changing environments.

Fire suppression on Federal lands has led to fuels accumulation in some fire types, resulting in wildfires that are uncharacteristic in both fire effects and scale. Climate change may affect those factors and lead to more frequent or higher severity fires within these habitats (Devine et al. 2012). Plan alternatives that promote landscape-scale restoration of sustainable vegetation types within historical and future ranges of variation would also provide habitat capable of supporting sensitive species populations. Restoration of the historic fire regime and the use of fire as a tool in ecosystem recovery efforts would improve current vegetation condition and positively influence the trend trajectory (Franklin and Johnson 2012, Ingalsbee 2015).

In all of these situations, understanding site and vegetation dynamics, monitoring the most vulnerable species, off-site gene conservation with seed collections and storage, and population supplementation would help meet conservation goals. The responses of sensitive plants to additional environmental stressors are unknown and may result in negative conservation outcomes.

Alteration of hydrologic regime

All alternatives provide guidance and direction regarding wetlands and riparian areas in each of the five rare plant habitat groups. Wetlands and riparian areas would be managed as riparian management areas or riparian habitat conservation areas where aquatic and riparian-dependent resources receive primary emphasis and where special management direction applies. While there are small differences in riparian widths associated with each alternative, the risk analysis was unable to detect a small change between alternatives. Therefore, the species risk ratings were unchanged between the set of alternatives and were evaluated as a single factor common to all alternatives. Plant and aquatic/riparian standards and guidelines common to all alternatives promote the maintenance or enhancement of riparian/wetland processes and functions, including hydrologic connectivity and regime, and would protect existing sensitive species sites and suitable habitat from degradation.

[23] Loss of water from the soil both by evaporation and by transpiration from plants.

Gopher disturbance

Northern gophers have been identified as an herbivore threat to several sensitive species occupying meadows and riparian rare plant habitat groups (Case et al. 2013, Jones et al. 2008). Gopher populations could reach thresholds, which would affect both habitat effectiveness and plant population conditions and trends for *Botrychium hesperium*, *B. paradoxum*, *B. pedunculosum*, and *Ophioglossum pusillum*. Preferred food for these underground-dwelling herbivores include herbaceous material (grass, roots, and forbs) produced during the growing season as well as tree and shrub material during the winter months. Their tunneling and mound-building activity could disturb existing plants. Exposure of mineral soil could create an opportunity for invasive plants to become established in meadow habitats and compete with sensitive plants.

Gophers are ecosystem engineers and provide valuable ecosystem services including improvement of soil properties and as prey species supporting a host of predators in a complex food web (Case et al. 2013, Jones et al. 2008). Monitoring gopher mounds for indicators of potential impacts and implementing integrated pest management practices if needed would reduce the likelihood of negative effects to the sensitive species. Risks associated are generally low, but may be medium when large gopher populations become established in meadow ecosystems. Essentially, the species risk ratings were unchanged for the full set of alternatives and were evaluated as a single factor common to all alternatives.

Invasive plants

Invasive plants were identified as a threat to three of the rare plant habitat groups:

- Dry meadows, open dry forests, shrub steppe, rocky sites
- Moist openings and wet forest sites
- Wetlands, moist meadows, riparian areas

The invasive plant risk rating is from analyses of effects (both direct competition and nearby threat occurrence) represented by invasive plant infestation proximity to sensitive plant sites. That rating was completed during analyses to identify priority watersheds for the Watershed Condition Framework (USDA Forest Service 2015f). The total percentage of area for these two categories (direct competition and threat impact) was rated as Low, Medium, or High. An elevated risk was associated with particular species occurrences in priority watersheds and includes *Botrychium hesperium* from dry meadows, open dry forests, as well as *Botrychium ascendens, Botrychium crenulatum, Cicuta bulbifera,* and *Dryopteris cristata* from wetlands, moist meadows and riparian areas. If the invasive threat was alternatively identified in the literature or database observations, then the risk was rated as low. That was the situation for *Botrychium pedunculosum, Sisyrinchium montanum,* and *Viola renifolia* in moist openings and wet forest sites. The sensitive species risk ratings and plan components related to invasive plants were unchanged for the set of alternatives and were evaluated as a single factor common to all alternatives. An integrated invasive plant management program with emphases on prevention, effective control, and restoration would improve conservation outcomes.

Livestock grazing and trampling

For all rare plant habitat groups except cliffs, talus and rock outcrops, livestock grazing and trampling may affect sensitive plants directly and habitat effectiveness indirectly. These interactions depend on the palatability of the plant species for certain livestock and the fragility of habitat components that, together, influence habitat effectiveness. Improperly timed herbivory (i.e., grazing) removes current year's vegetative growth and flower or fruit structures before maturation. Recurrent annual grazing during the growing season would interrupt critical life history events and may affect seedling recruitment and subsequent maintenance of population structure. Demographic studies support the critical need for periodic reproductive success in perennial vegetation systems. It is crucial, as well, for annual plants to produce reproductive structures and annual seed crops, in particular during poor growing years. A link between carbohydrate storage and plant vigor is affected by heavy season-long grazing and can lead to individual plant impacts and changes in plant community composition and structure (Kovalchik and Clausnitzer 2004).

Trampling affects not only the vegetation directly, but the soils and habitat supporting rare plant populations. This is particularly an issue in maintenance of wet soils throughout the grazing season after attainment of range readiness in terrestrial vegetation types (Kovalchik and Clausnitzer 2004). Lowered habitat effectiveness, reflected in the reduced ability to support desired vegetation components and ecosystem functions, could be a detrimental outcome. Maintenance of soil productive capacity and essential attributes is critical for the contribution of ecosystem services from Forest lands. This grazing and trampling risk is assessed as the proportion of each species' total occupied habitat occurring within allotments and represents the exposure of these sensitive species to impacts. It is recognized that plant sensitivity to both grazing and trampling varies spatially and temporally with attributes of the grazing system and site-specific characteristics including associated plant species, soil moisture, and soil texture, in addition to seasonal sensitivity shifts connected to plant phenology. Risks were assigned for the active growing season.

Plant collecting

For all rare plant habitat groups and alternatives, unauthorized plant collection risk levels are associated with ease of access to sites and habitat. Documented sites within roadless areas (such as wilderness, recommended wilderness, research natural areas, etc.), or with lower road densities are at lower risk than those occurring in management areas with higher density roads and public access. While there are permits for commercial or personal use of native plant materials, terms and conditions associated with plant collection prohibit sensitive and listed plant taxa from collection. Should they be found on the forest, the collection of federally listed plant species can only be authorized under the authority of the Fish and Wildlife Service. Scientific plant materials collection of sensitive species (also personal use permit) authorization is delegated from Region 6 to the Forest level and should not affect sensitive plant populations. Risks associated with unauthorized plant collection have been identified for three sensitive species (*Cypripedium parviflorum*, *Eurybia merita*, and *Gaultheria hispidula*) discussed below by habitat group. There is little risk for the remaining 35 taxa, because they have not been identified as targets for collection.

Effects for Alternatives by Plant Habitat Group

The threats and risks to sensitive plant occurrences within a particular management area are altered by forestwide and management area plan components, including desired future conditions, standards, and guidelines for suitable conservation outcomes. Effects, therefore, vary by plant habitat group and alternative and are discussed below for each group.

Alpine and Subalpine Meadows, Fellfields, and Parklands Habitat Group

Summary of Effects

The conservation outcome is the same for all alternatives: May impact individuals or habitat, but will not likely contribute to a trend toward Federal listing or cause a loss of viability to the population or species.

Alpine and subalpine meadows, fellfields, and parklands habitats are generally a high vulnerability group with exposure to environmental change from climatic and fire regime factors (Miller-Struttmann et al. 2015, Munson and Sher 2015). Whitebark pine is exposed to threats from wildfire, mountain pine beetle, and white pine blister rust, as well as environmental changes (Devine et al. 2012). Additionally, this group of species has exposure to livestock grazing, recreational activity, hydrologic regime alteration, and plant collecting. Together, this creates high to medium levels of risk for desired conservation outcomes.

Conservation measures in the current direction do not focus on essential habitat components and critical life history events that support development of sustainable populations and maintenance of high habitat effectiveness. They do not consider climate change as an additional environmental stressor. The no action alternative would maintain existing conditions and trends, vulnerabilities, and risks to these sensitive species. Indications are that trends for some sensitive plant populations and habitat are declining under current management. On the other hand, action alternatives (i.e., the proposed action and alternative P) that promote landscape-scale restoration of sustainable vegetation types within historical and future ranges of variation would continue to provide capable habitat as a corollary to protection of the source populations. This includes restoration of disturbances, such as fire, that are responsible for landscape character. The proposed conservation goals to maintain or enhance existing populations are mediated by application of plan components. These include protective standards and guidelines as well as implementation of plant monitoring that targets population and habitat conditions and trends.

Although alternatives R and B would allocate similar acres to the Recommended Wilderness Management Area, where human-caused effects may be reduced, the risks are driven by threats somewhat independent of that management allocation. In addition, the remaining action alternatives allocate more acreage of this habitat to the Backcountry Management Area where effects on sensitive plant species are similar to those in recommended wilderness, so the conservation outcome across all alternatives is the same.

Threats and Risks to Viability

Alteration of hydrologic regime

Some of these sensitive plant occurrences are found in headwater or streamside environments where this habitat element may frame conservation concerns. This threat includes activities that affect the amount, timing, or quality of water maintaining sensitive plant habitat within wetlands and riparian sites. The risk rating is related to the exposure of plant sites to potential change. This is assessed as the proportion of the total occupied habitat of each species that occurs within wetland or riparian ecosystems (Low: 0 to 33 percent, Moderate: 34 to 67 percent, High: 68 to 100 percent). Risks associated with this threat are generally medium; however, the effect is somewhat magnified by the high vulnerability of most species found in this rare plant habitat group.

Insects and Disease

Detailed information on threats of insect and disease affecting sensitive species is lacking for most taxa. However, there are assessments describing the existing threats for the whitebark pine ecosystem from both white pine blister rust and mountain pine beetle (USFWS 2011b, Spies et al. 2010). Across the range of whitebark pine, these agents have contributed significantly to recent tree mortality. This species is a candidate for Federal listing with a “warranted but precluded” finding issued in 2011. Continued implementation of the Pacific Northwest whitebark pine restoration strategy would be a critical management action to accomplish conservation goals. In the Pacific Northwest, whitebark pine is highly vulnerable to insects and diseases such as mountain pine beetle and white pine blister rust (Devine et al. 2012), thus, the risk is rated as high for this species and low for the remainder of the sensitive species in this rare plant habitat group.

Plant collecting

See summary of effects section. In addition, a low risk is associated with unauthorized plant collection for *Eurybia merita* in this habitat group. There is little risk for the remaining four taxa, since they have not been identified as targets for collection.

Recreational use

This threat category includes site use and development, and trail use and construction. Two species in this group, *Carex proposita* and *Eurybia merita*, occur in meadow habitats that are favored for recreational use or trails development. The risk for these taxa was high when exposure of 67 percent or more of existing sites occurred in management areas with non-wilderness recreation emphases. Potential effects include disturbance from trampling and camping. Vulnerability is high because of the limited number of sites and plants, and the total size of all occurrences. The proposed conservation goal to maintain or enhance existing populations is mediated by application of plan components including protective standards and guidelines as well as implementation of monitoring that targets population and habitat conditions and trends. Establishing trails and camping areas in locations that avoid these populations in addition to monitoring and initiating further surveys in suitable habitat are management actions that would improve conservation outcomes for these two species.

Cliffs, Talus, and Rock Outcrops Habitat Group

Summary of Effects

The conservation outcome is the same for all alternatives: May affect individuals or habitat, but will not likely contribute to a trend toward Federal listing or cause a loss of viability to the population or species (MIIH).

Cliffs, talus, and rock outcrops habitats supporting *Cryptogramma stelleri, Dryas drummondii* var. *drummondii*, and *Lycopodium dendroideum* are a high vulnerability group with exposure to threats including environmental change from climatic factors and recreation use.

The no action alternative would maintain existing conditions and trends, vulnerabilities, and risks to these sensitive species. Indications are that current population trends are static or improving. However, conservation measures in the current direction do not focus on essential habitat components Critical life history events that support development of sustainable populations and maintenance of high habitat effectiveness nor do they consider climate change as an additional environmental stressor. On the other hand, action alternatives that promote conservation goals to maintain or enhance existing populations are mediated by application of plan components. These include protective standards and guidelines as well as implementation of plant monitoring that targets population and habitat conditions and trends.

Threats and Risks to Viability

Recreational use

This threat category includes site use and development, and trail use and construction. The risk for these taxa was high if exposure of 67 percent or more of existing sites occurred in management areas with non-wilderness recreation emphases. Potential effects include disturbance from recreational trampling, climbing, and shoreline development. Vulnerability is high because of the limited number of sites and plants, and the total size of all occurrences. The proposed conservation goal to maintain or enhance existing populations is mediated by application of plan components including protective standards and guidelines as well as implementation of monitoring that targets population and habitat conditions and trends. Establishing trails, climbing routes, and camping areas in locations that avoid these populations would contribute to the sustainability of these three species. Effectiveness monitoring and initiating further surveys in suitable habitat also support conservation goals. All action alternatives provide guidance and direction to accomplish these actions, while the no action alternative lacks specific direction.

Road building and maintenance

Risk associated with road building and maintenance is related to direct effects of physical disturbance to sensitive plant populations. The potential use of native rock sources for road construction and surfacing includes identification of borrow pits and gravel sources. The risk for these species occurrences in this habitat group is currently low since the species occur, principally, in unroaded allocations.

Dry Meadows, Dry Forests, and Shrub Steppe Habitat Group

Summary of Effects

The conservation outcome is the same for all alternatives: May impact individuals or habitat (MIIH), but will not likely contribute to a trend toward Federal listing or cause a loss of viability to the population or species.

Dry meadows, open dry forests, and shrub steppe habitats supporting *Astragalus microcystis, Botrychium ascendens, B. hesperium, B. paradoxum,* and *B. pedunculosum* are rated for vulnerability as medium to high vulnerability with exposure to threats including environmental change, gopher disturbance, invasive plants, livestock grazing and trampling, recreation use, road building, and timber harvest activities.

The no action alternative would maintain existing conditions and trends, vulnerabilities, and risks to these sensitive species. Indications are that current population trends are static or improving while habitat condition may be trending downward. Conservation measures in current direction do not focus on essential habitat components and critical life history events that support development of sustainable populations and maintenance of high habitat effectiveness nor do they consider climate change as an additional environmental stressor. On the other hand, action alternatives that promote conservation goals to maintain or enhance existing populations is mediated by application of plan components. These include protective standards and guidelines as well as implementation of plant monitoring that targets population and habitat conditions and trends.

The risks to sensitive plant occurrences within a particular management area are altered by forestwide and MA plan components including desired future conditions, standards, and guidelines for effective conservation outcomes.

Threats and Risks to Viability

Environmental change

This threat is used to qualitatively summarize the effects to the environment supporting sensitive plant species. It includes factors such as climate change, fire regime shifts, plant succession, and soil raveling and erosion. Plan alternatives that promote landscape-scale restoration of sustainable vegetation types within historical and future ranges of variation would also provide habitat capable of supporting sensitive species populations. Restoration of the historic fire regime and the use of fire as a tool in ecosystem recovery efforts would improve current vegetation condition and influence habitat trend trajectory in a positive sense.

In some portions of the landscape, soil-forming processes, including soil raveling and erosion, continue to affect sensitive plant environments for *Astragalus microcystis* and affect existing populations. The genus

Astragalus has an affinity for early seral stages in disturbance regimes, so it is possible the species could be adequately maintained. Site observations indicate the species has increased its cover in disturbed areas left to recover. Timber harvest activities conducted adjacent to occupied shrublands, livestock grazing, and prescribed fire are management activities that affect this species. Improper livestock grazing, unnaturally high fire frequency, and invasion by exotic plants are the biggest threats to the sensitive species occupying these habitats. Higher fire frequencies are to be expected with a higher proportion of non-native invasive species in the plant community.

Recreational use

This threat category includes site use and development, trail use and construction, and recreational vehicle use. Ten species have been identified to occur in habitats that are favored for recreational development such as shorelines, or in meadows accessed by off-highway vehicle (OHV) users, or on cliffs in potential rock-climbing routes. In this habitat group, *Astragalus microcystis* and the *Botrychium* species are exposed to these risks. The risk for these taxa was high, if exposure of 67 percent or more of existing sites occurred in management areas with non-wilderness recreation emphases.

The risk from OHV incursions into occupied habitat has recently declined to a low level with the completion of the Colville National Forest Travel Management Subpart B analysis; OHV use in vulnerable habitat is restricted. Otherwise, the risk is high for recreational developments including trails. Establishing trails and camping areas in locations that avoid these populations would reduce risk and contribute to the sustainability of these three species. The proposed conservation goal to maintain or enhance existing populations is mediated by application of plan components including protective standards and guidelines as well as implementation of monitoring that targets population and habitat conditions and trends. Effectiveness monitoring and initiating further surveys in suitable habitat also support conservation goals. All action alternatives provide guidance and direction to accomplish these actions, while the no action alternative lacks specific direction.

Road building and maintenance

Risk associated with road building and maintenance is related to direct effects of physical disturbance to sensitive plant populations. Risk for the species would be elevated (Medium to High) for the no action alternative. These risks would be reduced in the proposed action and other action alternatives. Since additional plan components mediate desired conservation outcomes in all action alternatives, the total effects would be reduced and would support sensitive species sustainability.

Timber harvest activities

The risks associated with timber harvest activities include direct effects to plant populations from physical effects as well as indirect effects from environmental site changes due to light, moisture, or soil property alterations related to the treatments.

Some of the indirect effects may benefit early seral species in a forested landscape. Potential exposure to this threat is high, but total effects would be reduced by both plan components and potential species responses to management activities. All alternatives support sensitive species sustainability outcomes.

Moist Openings and Wet Forests Habitat Group

Summary of Effects

The conservation outcome is the same for all action alternatives: May impact individuals or habitat (MIIH), but will not likely contribute to a trend toward Federal listing or cause a loss of viability to the population or species.

Moist openings and wet forest habitats support *Botrychium crenulatum, Lycopodium dendroideum, Sisyrinchium montanum,* and *Viola renifolia*. Two of those species are rated as highly vulnerable (*Sisyrinchium montanum* and *Lycopodium dendroideum*); *Botrychium crenulatum* and *Viola renifolia* are rated low vulnerability. High vulnerability reflects a low number of sites and total plants, and small total size of occupied sites. Exposure to threats include alteration of hydrologic regime, environmental change, gopher disturbance, invasive species, livestock grazing and trampling, recreation use, road building, and timber harvest activities.

The no action alternative would maintain existing conditions and trends, vulnerabilities, and risks to these sensitive species; local data indicate that current site trends are mixed with static and improving trends for *Lycopodium dendroideum* and *Viola renifolia,* respectively. Conservation measures in current direction do not focus on essential habitat components and critical life history events that support development of sustainable populations and maintenance of high habitat effectiveness, nor do they consider climate change as an additional environmental stressor. On the other hand, action alternatives that promote conservation goals to maintain or enhance existing populations are mediated by application of plan components. These include protective standards and guidelines as well as implementation of plant monitoring that targets population and habitat conditions and trends.

Threats and Risks to Viability

Alteration of hydrologic regime

Some of these sensitive plant occurrences are found in streamside environments where this habitat element frames conservation concerns. This threat includes activities that affect the amount, timing, or quality of water maintaining sensitive plant habitat within wet forest and wet openings. The risk rating is related to the exposure of plant sites to potential change. This is assessed as the proportion of the total occupied habitat of each species that occurs within wetland or riparian ecosystems (Low: 0 to 33 percent, Moderate: 34 to 67 percent, High: 68 to 100 percent). Risks associated with this threat are high and medium; however, the effect is somewhat magnified by the high vulnerability of two species found in this habitat group.

Environmental change

This threat is used to qualitatively summarize the effects to the environment supporting sensitive plant species. In this habitat group, discussion focus is on climate change (see summary of effects section) and fire regime shifts.

Fire suppression on Federal lands has led to fuels accumulation in some fire types with resultant wildfires that are uncharacteristic in both fire effects and scale. Additionally, in fire-maintained meadows, past fire suppression and subsequent plant succession may affect habitat effectiveness for taxa in this group like *Sisyrinchium montanum*. Plan alternatives that promote landscape-scale restoration of sustainable vegetation types within historical and future ranges of variation would also provide habitat capable of supporting sensitive species populations. Restoration of the historic fire regime and the use of fire as a tool in ecosystem recovery efforts would improve current vegetation condition and influence habitat trend trajectory in a positive sense.

Recreational use

This threat category principally includes recreational vehicle use. Ten species have been identified to occur in habitats that are favored for recreational development such as shorelines, or in meadows accessed by OHV users, or on cliffs in potential rock-climbing routes; in this habitat group *Sisyrinchium montanum* is exposed to risks of OHV use in meadows. The risk for this taxa was medium to low in management areas with non-wilderness recreation emphases.

The risk from OHV incursions into occupied habitat has recently declined to a low level with the completion of the Colville National Forest Travel Management Subpart B analysis; OHV use in vulnerable habitat was restricted. Establishing trails and camping areas in locations that avoid populations of these four sensitive species would reduce risk and contribute to the sustainability of these taxa. The proposed conservation goal to maintain or enhance existing populations is mediated by application of plan components including protective standards and guidelines as well as implementation of monitoring that targets population and habitat conditions and trends. Effectiveness monitoring and initiating further surveys in suitable habitat also support conservation goals. All action alternatives provide guidance and direction to accomplish these actions, while the no action alternative lacks specific direction.

Road building and maintenance

Risk associated with road building and maintenance is related to direct effects of physical disturbance to sensitive plant populations. Risks for these four species are low to medium for all alternatives because of the lower percent of occurrences in roaded areas. There are slightly lower risks in the proposed action and alternatives P and R, but the difference has no effect on the conservation outcome. Even a medium risk becomes a conservation concern for *Sisyrinchium montanum* because of the high vulnerability of this species. These risks are reduced in action alternatives because additional plan components mediate desired conservation outcomes.

Timber harvest activities

The risks associated with timber harvest activities include direct effects to plant populations from physical impacts as well as indirect effects from environmental site changes due to light, moisture, or soil property alterations related to the treatments.

Potential exposure to this threat is variable for this suite of species. Risk remains high to medium for *Viola renifolia* across all action alternatives. For *Lycopodium dendroideum* and *Sisyrinchium montanum*, risks are generally low to medium. These differences reflect the degree of fidelity to MAs in which timber harvest occurs across alternatives. Total effects are reduced by common plan components across the action alternatives. All alternatives support sensitive species sustainability outcomes.

Wetlands, Moist Meadows, and Riparian Habitat Group

Summary of Effects

The conservation outcome for the no action alternative is: Will affect individuals or habitat with a consequence that the action may contribute to a trend toward Federal listing or cause a loss of viability to the population or species. The conservation outcome is the same for all action alternatives: May effect individuals or habitat, but will not likely contribute to a trend toward Federal listing or cause a loss of viability to the population or species.

Wetlands, moist meadows, and riparian habitats support the majority of the Forest sensitive plant species, 20. Only one of these taxa is rated as low vulnerability; the remainder are rated high (nine species) and medium vulnerability (10). Seven species in this group are represented on the Forest by a single occurrence; six taxa with fewer than 10 individual plants are documented. High vulnerability reflects a low number of sites and total plants, and small total size of occupied sites. Exposure to threats include alteration of hydrologic regime, environmental change, gopher disturbance, invasive plants, livestock grazing and trampling, plant collection, recreation use, road building, timber harvest activities, and windthrow (trees uprooted or broken by wind).

Local data indicate that current habitat trends are mixed with 43 wetland, moist meadow, or riparian sites trending downward in habitat effectiveness. Population trends are mixed with seven species indicating declining trends, nine are static, and eight have improving trends (the remaining three have no indication). The no action alternative would maintain existing conditions and trends, vulnerabilities, and risks to these sensitive species. In particular, the nine highly vulnerable species are at risk of loss of sustainability. Conservation measures in current direction do not focus on essential habitat components and critical life history events that support development of sustainable populations and maintenance of high habitat effectiveness nor do they consider climate change as an additional environmental stressor. On the other hand, action alternatives that promote conservation goals to maintain or enhance existing populations are mediated by application of plan components. These include protective standards and guidelines as well as implementation of plant monitoring that targets population and habitat conditions and trends.

Threats and Risks to Viability

Alteration of hydrologic regime

Most of these sensitive plant occurrences are found in wetlands, moist meadows, and riparian habitats where this habitat element frames conservation concerns. This threat includes activities that affect the amount, timing, or quality of water maintaining sensitive plant habitat within this group, including maintenance of ecosystem services from beavers. The risk rating is related to the exposure of plant sites to potential change. This is assessed as the proportion of the total occupied habitat of each species that occurs within wetland or riparian ecosystems (Low: 0 to 33 percent, Moderate: 34 to 67 percent, High: 68 to 100 percent). Risks associated with this threat are high for 19 species and medium for the remaining one. However, plan components proposed for all but the no action alternative are expected to maintain habitat effectiveness for the species in this group.

Environmental change

This threat is used to qualitatively summarize the affects to the environment supporting sensitive plant species. In this habitat group, discussion focus is on climate change and fire regime shifts. This habitat group is a top priority when considering climate change effects and mitigation measures in project planning and implementation. In addition, climate change may lead to more frequent or higher severity fires within these habitats. Plan alternatives that promote landscape-scale restoration of sustainable vegetation types within historical and future ranges of variation would also provide habitat capable of supporting sensitive species populations. Restoration of the historic fire regime and the use of fire as a tool in terrestrial ecosystems would inform recovery efforts in these habitats.

Livestock grazing and trampling

See summary of effects section. The species risk ratings were unchanged for the set of alternatives and were evaluated as a single factor common to all alternatives; nine species were rated as high risk, two were rated as medium risk, and nine as low risk; two of the high vulnerability species in this group are exposed to excessive risk from livestock grazing and trampling. The risk from this threat is a contributing factor in determination of the conservation outcome for species in this habitat group. The action alternatives address this risk with plan components, standards and guidelines to contribute to species viability.

Plant collecting

See summary of effects section. In addition, risks associated with unauthorized plant collection have been identified for two species in this rare plant habitat group. The risk is high for *Cypripedium parviflorum* and low for *Gaultheria hispidula*. There is little risk for the remaining 18 taxa, since they have not been identified as targets for collection.

Recreational use

This threat category principally includes recreational vehicle use. Ten species have been identified to occur in habitats that are favored for recreational development such as shorelines, or in meadows accessed by OHV users, or on cliffs in potential rock-climbing routes; in this habitat group, *Botrychium paradoxum, Botrychium pedunculosum, Dryopteris cristata, Geum rivale*, and *Ophioglossum pusillum* are exposed to risks of OHV use in meadows. The risk for these taxa is medium to low in management areas with non-wilderness recreation emphases. The risk from OHV incursions into occupied habitat has recently declined to a low level with the completion of the Colville National Forest Travel Management Subpart B analysis; OHV use in vulnerable habitat was restricted.

Establishing trails and camping areas in locations that avoid populations of these 20 sensitive species would reduce risk and contribute to the sustainability of these taxa. The proposed conservation goal is to maintain or enhance existing populations. Application of plan components, including protective standards and guidelines and implementation of monitoring that targets population and habitat conditions and trends, is mediated. Effectiveness monitoring and initiating further surveys in suitable habitat also support conservation goals. All action alternatives provide guidance and direction to accomplish these actions, while the no action alternative lacks specific direction.

Road building and maintenance

Risks associated with road building and maintenance are related to direct effects of physical disturbance to sensitive plant populations. Risks for these 20 species are low for all alternatives because of the lower percentage of species occurrences in roaded areas and the currently existing and proposed direction on maintenance of ecosystem integrity within the wetland-riparian habitat group. There are slightly lower risks in the proposed action and alternatives P and R, but the difference has no effect on the conservation outcome. Additionally, road density and location standards contribute to species viability by lowering risks from associated impacts. Nonetheless, monitoring high vulnerability species when road management activities may affect sites would inform continuing conservation measures.

Timber harvest activities

The risks associated with timber harvest activities include direct effects to plant populations from physical impacts as well as indirect effects from environmental site changes due to light, moisture, or soil property alterations related to the treatments.

Potential exposure to this threat is low for this suite of species. Total effects are reduced by common plan components that maintain and promote ecosystem integrity, process, and function across the alternatives. All alternatives support sensitive species sustainability outcomes for this particular threat.

Windthrow

Since the majority of the Forest sensitive species are found in wetland or riparian habitats, a windthrow (trees uprooted or broken by wind) risk to existing sites and habitats has been identified. The risk results from the interaction of site factors, extreme weather events, and the ability of a tree to withstand strong winds without breakage or blowdown, including rooting habit and root and stem disease occurrence. Where this threat negatively affects existing sensitive species populations or affects habitat effectiveness, it is associated with sites in conifer- or hardwood-dominated riparian stands. However, if blowdown occurs at the edge of wetland habitats, it is generally an addition to habitat diversity. The windthrow threat is generally a low risk except for sites supporting *Botrychium lineare* and *B. crenulatum* where it is elevated to a medium level because of past events. In addition, the interaction of this threat alone with vulnerability ratings implies different outcomes for the two *Botrychiums* and it reinforces the conservation risk associated with a single, chance event affecting a lone site supporting a small population

(*B. lineare*). While the alternatives that address ecosystem integrity and resilience with landscape-level restoration goals can be judged to provide less risk for this threat, the species risk ratings were unchanged for the set of alternatives and were evaluated as a single factor common to all alternatives.

Cumulative Effects (Common to all Alternatives)

Cumulative effects include the past, present, and reasonably foreseeable future activities that contribute to TES plant species viability. Resource management plans for other Federal, State, and Tribal lands adjacent to the Colville National Forest include provisions for the protection and management of rare plant resources. The cumulative effect of adjacent lands management would not change any of the direct and indirect effects because management direction supports rare plant viability. While sensitive species lists may differ in details because of different agency criteria and agency habitat ownership, the state lists and state ranks are developed and maintained by the Washington Natural Heritage Program in collaboration with public agency, university, and private cooperators with botanical interests. Resource management projects focused on restoration of riparian and terrestrial resources associated with the Northeast Washington Forest Vision 2020 project are assumed to follow management direction that would contribute to the viability of TES plant species and would not contribute to additional cumulative effects. The Pend Oreille PUD relicensing would not contribute to further effects and would implement conservation measures as needed to renew hydroelectric licenses. Allotment management plans would be managed to standard and would not contribute further to cumulative effects.

Climate Change

This climate change discussion compiles and synthesizes scientific information on past and projected trends in regional climate and climate-related impacts to NFS lands. It also identifies possible management options to reduce ecosystem vulnerability to climate change and to increase ecosystem resilience to both climate and non-climate stressors.

Background on Climate Change

Warming of the climate system is evident from observation of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level (IPCC 2014). Climate change is expected to profoundly alter vegetation structure and composition, terrestrial ecosystem processes, and the delivery of important ecosystem services over the next century. Since 1750, atmospheric carbon dioxide (CO_2) concentrations have increased from 280 to over 390 parts per million (ppm) and are expected to continue rising, reaching 450 to 875 ppm by 2100 (Peterson et al. 2014). The scientific community generally agrees that substantial warming of Earth’s surface (2.0 to 4.5 °C) will accompany the increasing concentration of greenhouse gases in the atmosphere. Carbon dioxide (CO_2) is a prominent greenhouse gas (IPCC 2014).

Terrestrial ecosystems strongly influence the global carbon cycle and combined with oceans, are estimated to absorb about half of the carbon dioxide (CO_2) currently being released by human activities (Dilling et al. 2003). Simulated global patterns of carbon flux suggest that western United States forests are a carbon sink (Potter and Klooster 1999). Temperate forest ecosystems contain a significant amount of soil carbon (Rasmussen 2006) and tree-based carbon (Hurteau et al. 2008). These carbon stocks are significant resources that prevent additional significant carbon inputs into the global carbon cycle and provide a mechanism for carbon storage from natural and anthropogenic sources.

Carbon Stewardship

The management of forest and ecosystem carbon is an important responsibility of land management agencies. This is not to imply that maximizing carbon storage should be the most important or overriding purpose of land management. Carbon sequestration is one of many ecosystem services that national forest systems provide. Carbon sequestration should be considered in context with other benefits or services provided (USDA Forest Service 2014b). Carbon management is complex. Carbon stewardship needs to consider ecosystem function and risk of disturbance to carbon (i.e., wildfire) (Hurteau et al. 2009).

Management to maximize carbon storage or alter carbon storage in an ecosystem needs to take place in context with other natural processes as well as land management goals and objectives. Forest carbon management (carbon stewardship) may be best articulated through the following principles (USDA Forest Service 2014b). These principles are intended to provide considerations for integrating carbon management with planning processes and efforts to adapt to climate change. The following principles are intended to be refined, updated, and integrated based on field experience and best available science as it continues to emerge.

- Emphasize ecosystem function and resilience first. Carbon sequestration capacity depends on sustaining and enhancing ecosystem function to maintain resilient forests adapted to changing climate and other conditions.
- Recognize carbon sequestration as one of many ecosystem services. Carbon sequestration is one of the many benefits provided by forests, grasslands, and forest products, now and in the future. Carbon sequestration should be considered in context with other ecosystem services.
- Consider system dynamics and scale in decision making. Evaluate carbon sequestration and cycling at landscape scales over long time frames. Explicitly consider uncertainties and assumptions in evaluating carbon sequestration consequences of ecosystem stewardship options.
- Use the best information and methods to make decisions concerning carbon stewardship. Base carbon stewardship and policy decisions on the best available science based knowledge and information about system response and carbon cycling in ecosystems and wood products. Use this information wisely by dealing directly with uncertainties, risks, opportunities, and tradeoffs through sound and transparent risk management practices.
- Work for program integration and balance. Carbon stewardship and management is part of a balanced and comprehensive program of sustainable ecosystem management and response to ecosystems outside the historical range of variability. As such carbon stewardship has ecological, economic, and social implications and interactions with other Forest Service programs and strategies.

Forest-level Predictions of Climate Change

Though the science of predicting potential climate change has been improving, currently there is no site-specific information available that would indicate the potential rate or direction of climate change at a level detailed enough to use for vegetation modeling or specific land management at the Forest or project level. Scientific research and historical data have allowed for the development of models at regional scale that develop general predictions of potential future scenarios over the long term. Analysis for specific years or specific areas on the Colville National Forest is not possible with current models or analysis.

Regional Climate Change Overview

The following section summarizes observed and projected changes in climate based on the scientific literature (Gaines et al. 2012).

Atmospheric concentrations of carbon dioxide (CO_2) and other greenhouse gases have increased rapidly over the past century or more. Atmospheric CO_2 concentrations are expected to continue to rise for the foreseeable future, although future rates of increase may vary with changes in the global economy and the success or failure of international efforts to reduce or limit the growth of greenhouse gas emissions. Although atmospheric CO_2 concentrations are of concern primarily because of their potential to influence global temperatures (i.e., the "greenhouse effect"), higher CO_2 concentrations may also influence vegetation growth and water-use efficiency and are therefore linked more directly to forest ecosystem functioning and natural resource management. Other greenhouse gases affected by land management are methane (CH_4) and, to a much lesser extent, nitrous oxide (N_2O) emissions from motorized vehicles including heavy equipment (IPCC 2014).

Temperatures have been increasing in Washington State over the past century. In the last 100 years, temperatures have increased by about 1.5 °Fahrenheit (Mote 2003a). The warming trends have been strongest in the winter months and weakest in the autumn months. Precipitation has also been increasing during the past century with the largest relative increases occurring during the spring in the eastern portion of the state (Mote 2003b).

The Climate Impacts Group at the University of Washington has projected future changes in climate of the Pacific Northwest based on climate projections produced for the Intergovernmental Panel on Climate Change (IPCC) fourth assessment report. They predict that temperatures will raise an average of 0.5 °F per decade over the next century (Elsner et al. 2009), a potentially larger increase than experienced in the past 100 years. Predictions are for warming trends to be greater in the eastern part of the state. Precipitation projections for the region are more variable than temperature projections. In general, precipitation is predicted to increase in the winter and decrease in the summer (Mote et al. 2005a).

Winter temperatures play a large role in determining whether precipitation falls as snow or rain. Despite increases in precipitation in eastern Washington State, warming temperatures have led to decreases in snowpack. Mote (2003a) reported reductions of 30 to 60 percent in April 1 snowpack from 1920 through 2000 over much of Washington state. The largest decreases in snowpack have been at lower elevations (less than 5,900 feet). Projected temperature increases for the coming century are expected to increase the proportion of winter precipitation falling as rain, increase the frequency of winter flooding, reduce snowpack, increase winter streamflow, result in earlier peak flows, and decrease late spring and summer flows (Hamlet et al. 2007, Hamlet and Lettenmaier 1999). The snowpack in the Cascades is projected to decrease by 44 percent by 2020, and by 58 percent by 2040, relative to the recent past. Peak runoff is expected to occur 4 to 6 weeks earlier (Climate Change Impacts Group 2004), while reduced summer streamflows would be more common and widespread (Miles et al. 2000, Snover et al. 2003, Stewart et al. 2004). April 1 snow water equivalent (SWE) is projected to decrease by an average of 27 to 29 percent across the state by the 2020s, 37 to 44 percent by the 2040s, and 53 to 65 percent by the 2080s (Elsner et al. 2009). SWE on April 1 is an important metric for evaluating snowpack changes because in the PNW, the water stored in the snowpack on April 1 is strongly correlated with summer water supply. The reduction of snowpack in the regions of highest elevation is projected to be less significant. There is no discussion of uncertainty or confidence intervals in the modeling methodology presented in the above references.

Baseline Climate Data

Temperatures increased across the region from 1895 to 2011, with a regionally averaged warming of about 1.3 °F (Kunkel et al. 2013). While precipitation has generally increased, trends are small as compared to natural variability. Both increasing and decreasing trends are observed among various locations, seasons, and time periods of analysis. Studies of observed changes in extreme precipitation use different time periods and definitions of "extreme," but none find statistically significant changes in the

Northwest (Groisman et al. 2004). These and other climate trends include contributions from both human influences (chiefly heat-trapping gas emissions) and natural climate variability, and consequently, are not projected to be uniform or smooth across the landscape or through time.

As a result of changes in long-term average trends, some conditions/events we now consider to be extreme will occur more frequently or with greater magnitude, while others will occur less frequently (e.g., more unusually warm periods and fewer cold spells). In many cases, changes in the frequency and magnitude of extreme events (droughts, severe fires, etc.) will have the most significant and long-lasting consequences for land and resource management.

Projected Climate Trends

The climate observations and projections reported here are long-term trends in average conditions. Climate has varied and will continue to vary, from year-to-year and decade-to-decade around the long-term trend. The effects of longer-term climate trends may be either amplified or moderated by climate variability resulting from the shorter-term El Niño Southern Oscillation and the Pacific Decadal Oscillation.

The Pacific Northwest is projected to be within a range of an 11 percent decrease to a 12 percent increase for 2030 to 2059 and a 10 percent decrease to an 18 percent increase for 2070 to 2099 in annual precipitation (Mote and Salathe 2010). For every season, some models project decreases and some project increases (Kunkel et al. 2013), yet one aspect of seasonal changes in precipitation is largely consistent across climate models. For scenarios of continued growth in global heat-trapping gas emissions, summer precipitation is projected to decrease by as much as 30 percent by the end of the century (Kunkel et al. 2013, Mote and Salathe 2010). Northwestern summers are presently dry and although a 10 percent reduction (the average projected change for summer) is a small amount of precipitation, unusually dry summers have many noticeable consequences, including low streamflow and greater extent of wildfires due to lower fuel moisture levels throughout the region (Littell et al. 2010). Projected temperature increases are large relative to natural variability; the relatively small projected changes in precipitation are likely to be masked by natural variability for much of the century (Deser et al. 2012).

Description of Observed and Projected Changes

Climate models are unanimous in projecting increasing average annual temperatures over the coming decades in the Pacific Northwest. The average of multiple climate model projects predicts annual temperatures will increase 2.2 °F by the 2020s and 3.5 °F by the mid-21st century, compared to the average for 1970 to 1999. (Mote and Salathe 2010) Temperature increases are projected to occur during all seasons, with the greatest increases projected in summer. Beyond mid-century, model projections diverge substantially in response to differences among scenarios in assumed emissions, with increases in average annual temperature ranging from 5.9 °F to 9.7 °F in the Pacific Northwest by the end of the 21st century (Binder et al. 2009).

Projected changes in Pacific Northwest precipitation are more variable among models, but generally suggest no substantial change in the average annual amount of precipitation from the variability experienced during the 20th century (Kunkel et al. 2013). Given the variability in results among models, projections of precipitation are considered less certain than temperature projections. Most of the models project decreases in summer precipitation, increases in winter, and little change in the annual mean (Climate Change Impacts Group 2004).

Observed regional warming has been linked to changes in the timing and amount of water availability in basins with significant snowmelt contributions to streamflow. Since around 1950, area-averaged snowpack on April 1 in the Cascade Mountains decreased about 20 percent (Mote 2006, Pierce et al.

2008), spring snowmelt occurred 0 to 30 days earlier depending on location, late winter/early spring streamflow increases ranged from 0 percent to greater than 20 percent as a fraction of annual flow (Hidalgo et al. 2009, USDI Reclamation 2011) and summer flow decreased 0 percent to 15 percent as a fraction of annual flow (Stewart et al. 2005), with exceptions in smaller areas and shorter time periods (Mote et al. 2008). It is unknown if snowmelt predictions for the Cascade Mountains reflect potential conditions for the mountains of the Colville National Forest.

Hydrologic response to climate change will depend upon the dominant form of precipitation in a particular watershed, as well as other local characteristics including elevation, aspect, geology, vegetation, and land use (Mote 2003a, Safeeq et al. 2013). The largest responses are expected to occur in basins with significant snow accumulation, where warming increases winter flows and advances the timing of spring melt (Hidalgo et al. 2009, Hamlet and Lettenmaier 2005). By 2050, snowmelt is projected to shift three to four weeks earlier than the 20th century average, and summer flows are projected to be substantially lower, even for predicted greenhouse gas emissions scenarios that assumes substantial emissions reductions (Elsner et al. 2009). Basins with a significant groundwater component may be less responsive to climate change than indicated by other research literature (Tague et al. 2008).

Changes in river-related flood risk depends on many factors, but warming is projected to increase flood risk the most in mixed basins (those with both winter rainfall and late spring snowmelt-related runoff peaks) and remain largely unchanged in snow-dominant basins; 27 regional climate models project increases of 0 percent to 20 percent in extreme daily precipitation, depending on location and definition of “extreme” (for example, annual wettest day). Averaged over the region, the number of days with more than 1 inch of precipitation is projected to increase 13 percent in 2041 to 2070 compared with 1971 to 2000 under a scenario that assumes a continuation of current rising emissions trends, though these projections are not consistent across models (Wehner 2013). This increase in heavy downpours could increase flood risk in mixed rain-snow and rain-dominant basins.

Climate Change in Northeastern Washington

Increasing temperatures and a greater annual variation in precipitation in northeastern Washington are predicted from expected increases in anthropogenic CO_2. The Pacific Northwest has warmed, on average, 1.3 °F between 1895 and 2011, with statistically significant warming occurring in all seasons except for spring. All but five of the years from 1980 to 2011 were warmer than the 1901 to 1960 average. The trend is for continued future warming. The frost-free season (and the associated growing season) has lengthened by 35 days from 1895 to 2011 in the Pacific Northwest. (Snover et al. 2013, Parks 2010) Temperature records show significant seasonal and annual decreases in the number of frost days and changes in spring minimum temperatures. Warmer spring temperatures coupled with increases in mean and variance of spring precipitation correspond strongly to earlier snowmelt out, an increased number of snow-free days, and observed changes in stream flow timing and discharge (Pederson et al. 2011).

The variation in precipitation will have effects on water release timing, length of the growing season, and soil moisture conditions. Predicted increases in early season snowmelt/late season precipitation (Miller et al. 2003) (which will increase fuel loading due to greater understory growth) and hotter, drier summers have the high potential to increase wildfire activity and associated carbon emissions from forested areas (Miller and Urban 1999, Kim 2005). Research shows increases in understory biomass with amplified pollution and climate change, suggesting future increases in fire severity and fire size (Hurteau and North 2009). Climate change modelers agree that climate will become more extreme as oscillations between wet and drought conditions become more common. It is suggested that land managers not recreate a fixed pre-settlement condition, but strive for forest conditions that are more resilient and resistant to uncharacteristic disturbance impacts (North et al. 2009, Millar et al. 2008).

There has been a general decline in snowpack; Cascade spring snowpack has declined 23 percent between 1930 and 2007. There is predicted a relatively steady loss rate of snowpack at 2.0 percent per decade, yielding a loss of 16 percent from 1930 to 2007. (Stoelinga et al. 2010) Over the past four decades, records show a tendency toward decreased snowpack with peak snow water equivalent arriving and melting out earlier. The declining snowpack will result in earlier stream flow timing, small increase in annual stream flow, increasing winter stream flow, and declining summer stream flow (Snover et al. 2013).

Disturbance to Forest Carbon on the Colville National Forest

The long-term capacity of forest ecosystems and harvested wood products to sequester and store carbon depends in large part on their health, resilience, adaptive capacity, and utilization of timber. Under a changing climate, forests may be increasingly affected by many factors such as multi-year droughts, insects and diseases, wildfires, and catastrophic storms, which all affect the capability of forests to store carbon. Maintaining healthy forest structure and composition may not eliminate disturbance, and may in fact entail additional low-magnitude disturbance, but is likely to reduce the risk of large and long-term carbon losses through catastrophic disturbance. Forest ecosystems capable of adapting to changing conditions would sequester carbon and store it more securely over the long term, while also furnishing woody materials to help reduce fossil fuel use. For forests managed for timber products, it is important to account for the carbon that is retained in harvested wood as well as substitution effects of using wood instead of other energy-intensive materials since these quantities may be large and should not be considered as emitted carbon dioxide. At the time of writing and modeling, the 2015 fire season had not been completed and carbon data were not available.

Observed Trends in Forest Carbon

Analyses of trends in North American terrestrial ecosystem productivity during the late 20th century based on satellite imagery generally confirm a net carbon sink for the North American continent, although there is considerable year-to-year and geographical variation (Potter et al. 2007, Running et al. 2004, Nemani et al. 2003, Potter et al. 2003, Slayback et al. 2003, Hicke et al. 2002, Myneni et al. 2001). The inter-annual and spatial variability of productivity are commonly attributed to anomalies in seasonal temperature and precipitation, and ecosystem disturbances such as drought, fire, and insect and disease outbreaks (Potter et al. 2008, Piao et al. 2007, Potter et al. 2007, Boisvenue and Running 2006, Angert et al. 2005, Goetz et al. 2005, Running et al. 2004, Nemani et al. 2003, Nemani et al. 2002).

Estimates find that the terrestrial ecosystems of the United States remove approximately 505 million metric tons (Mt) of carbon per year (± 50 percent) from the atmosphere and store it as plant material and soil organic matter (King et al. 2007, Pacala et al. 2007). Estimates of the net sink from forests, forest soils and wood products range from 203 to 293 Mt C per year, or roughly half of the total sink. Wood products account for approximately 6 to 12 percent (30 to 57 Mt per year) of the total United States carbon sink (US EPA 2008, Birdsey et al. 2007) Forests and wood products offset approximately 10 to 20 percent of United States fossil fuel emissions (US EPA 2008, Pacala et al. 2007).

The reservoir of stored carbon in United States forests is approximately 42,700 to 66,600 Mt (US EPA 2008, Birdsey et al. 2007). Public forestlands contain approximately 37 percent of this carbon reservoir. National Forests store an estimated 8,900 Mt of carbon, or from 13 to 21 percent of all forest carbon of the United States. (Smith and Heath 2004) Carbon stocks on the Colville National Forest contribute approximately 0.14 percent to 0.21 percent of the total United States forest carbon reservoir on public lands (USDA Forest Service 2014b). Trends in carbon stocks and flux on the Colville National Forest can be inferred from 20th century trends in forest age and structure classes. Recent scientific literature documents the general pattern of changes in carbon stocks and net ecosystem productivity. On the

Colville National Forest, the distribution of forest age and structure classes has changed substantially since the early 20th century. Intermediate age classes (40 to 100 years of age) have increased in area, while the amount of young stands has decreased. In most forest types, the abundance of older, late successional stands has declined. The cause of these changes varies by forest type and geographic location, but the most widespread agents of change are bark beetles, root diseases, white pine blister rust, timber harvest, and the substantial decline in acres burned since 1940. A significant portion of the increase in intermediate age classes is the result of forest re-growth following large stand-replacing fires in the early 20th centuries.

Total carbon stocks decline as a result of disturbance and then increase, rapidly during intermediate years and then at a declining rate, over time until another significant disturbance (regeneration timber harvest or tree mortality resulting from drought, fire, insects, disease or other causes) kills large numbers of trees. Carbon flux and net ecosystem productivity are lowest, and usually negative (a carbon source to the atmosphere) in young stands (0 to 30 years) following disturbance because carbon emissions from decay of dead biomass exceed the amount of carbon removed from the atmosphere by photosynthesis within the stand. As the stand develops, net ecosystem productivity increases and the stand becomes a carbon sink. Net ecosystem productivity and carbon sink strength generally peak at the intermediate stage of stand development, then decline with age but often remain positive (Canadell et al. 2007, Pregitzer and Euskirchen 2004).

Hessburg et al. (2000) constructed historical and current vegetation maps from 1932 to 1966 and 1981 to 1993 aerial photographs, respectively for sample sub-basins within the Interior Columbia River Basin. Comparing historical and current vegetation maps, they found that forests of northeastern Washington, northern Idaho, and northwestern Montana experienced a significant increase in area of intermediate structural classes. Stand initiation structures (new forests) declined significantly due to fire exclusion, despite timber harvest activity. However, they noted that timber harvest activities reduced the abundance of medium- and large-sized trees distributed in other forest structures as remnants of stand-replacing fires.

Net ecosystem productivity is defined as gross primary productivity (GPP) minus ecosystem respiration (ER) (Chapin et al. 2006). It reflects the balance between (1) absorbing CO_2 from the atmosphere through photosynthesis (GPP) and (2) the release of carbon into the atmosphere through respiration by live plants, decomposition of dead organic matter, and burning of biomass (ER). When net ecosystem productivity is positive, carbon accumulates in biomass. Ecosystems with positive net ecosystem productivity are referred to as a carbon sink. When net ecosystem productivity is negative, ecosystems emit more carbon than they absorb. Ecosystem with negative net ecosystem productivity is referred to as a carbon source.

The following information is based on the publication Climate Change Advisor’s Office, Office of the Chief, 2014, Baseline Assessment of Forest Carbon Stocks Including Harvested Wood Products – USDA Forest Service, Pacific Northwest Region. It is stated in the methodology that at scales of the individual national forest level, uncertainty can exceed 25 percent and at the individual carbon pool level (seven separate pools were modeled) that uncertainty can exceed 100 percent. The estimates of carbon pools and fluxes come from a draft pre-decisional document.

As of 2012, the Colville National Forest stores approximately 93.5 teragrams (Tg) of carbon. A teragram is one trillion grams, a unit of mass equal to 10^{12} grams. A gram is equal to the weight of a paperclip; 454 grams makes a pound. From 1990 to 2012, the modeled number varies from 90 to 94 Tg.

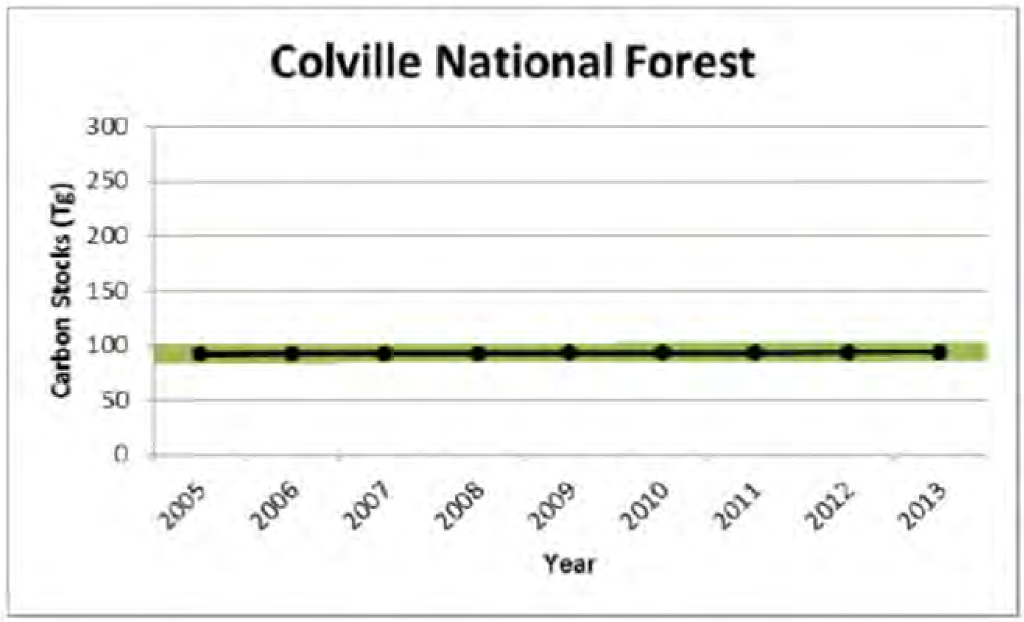


Figure 11. Total forest ecosystem carbon stocks and uncertainty estimates (95 percent confidence level)

The average density of forest carbon is approximately 200 megagrams of carbon per hectare (Mg C/ha) (approximately 200 U.S. tons) on the Colville National Forest (USDA Forest Service 2014b).

Projected trends in forest carbon stocks and flux estimates indicate that currently Colville National Forest is a net carbon sink, absorbing approximately 0.2 Tg of carbon a year. In the early 1990s, it is modeled that the Colville was a net carbon source releasing approximately 0.7 Tg of carbon a year (USDA Forest Service 2014b). All these modeled numbers are within the uncertainty intervals suggesting that in a given year the Colville can be a net source or sink for carbon.

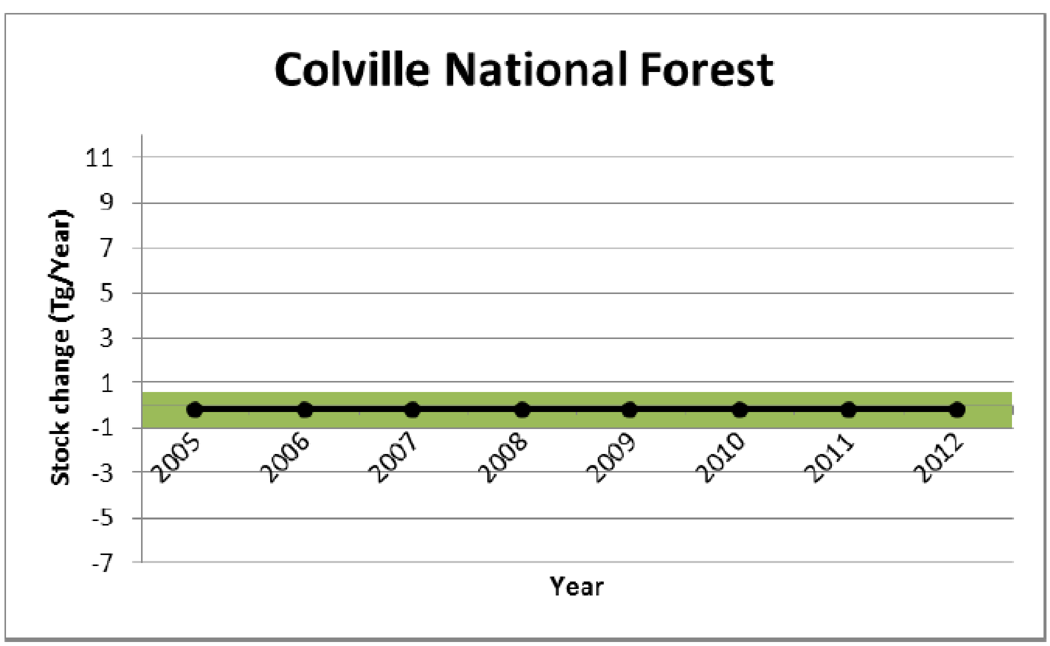


Figure 12. Carbon stock flux and uncertainty estimates (95 percent confidence level)

Harvested wood products (HWP) are products made from wood including lumber, panels, paper, paperboard, and wood used for fuel (Skog 2008). HWP fraction of the carbon pool is small compared to ecosystem carbon (Butler et al. 2014). In the context of total forest carbon, including both ecosystem carbon and carbon from harvested wood products, it is estimated that HWP carbon stocks represent 5.25 percent of total forest carbon storage associated with national forest in the Pacific Northwest Region in 2012. This is 5 times less than the uncertainty in the national level modeling and up to 20 times less than the uncertainty in modeling specific carbon pools (USDA Forest Service 2014b). At the national level, based on EPAs total U.S. HWP 2005 stock estimate of 2,354 Tg of carbon (US EPA 2012), the Pacific Northwest Region HWP carbon stocks represent 5.8 percent of total HWP carbon stocks (Butler et al. 2014). Recent literature suggestions that in the Pacific Northwest Region of the Forest Service the decay of HWP harvested from 1909 to 2012 now exceeds additions to the HWP carbon pool from products harvested from NFS lands (Butler et al. 2014).

Environmental Consequences

For applicable resources, the possible environmental consequences associated with climate change are discussed in this section.

Effects of Different Alternatives on Climate Change and Carbon Resources

At the forest scale, all of the alternatives are expected to have similar discharges of greenhouse gases and the same effects on carbon storage. The amount of prescribed fire, fuel reduction, and timber harvest treatments completed on NFS lands are consistent throughout the alternatives. These are the major components in greenhouse gas emissions and potential changes in carbon storage and are the same across alternatives and thus most likely would not change. The number of cattle on the Forest is determined through site-specific allotment management plans and not through forest plan revision. The extent of high-severity wildfire is dependent on weather and ignition events and cannot be predicted or modeled at a forest scale.

Total ecosystem carbon and greenhouse gas emissions would remain on the same trends as discussed in previous sections. The tools and methodologies for accurate modeling of greenhouse gas emissions are not available for modeling at a forest scale.

Resource Vulnerabilities on the Colville National Forest

The following identified vulnerabilities were developed during a two-day workshop of Forest Service mangers and scientists. These managers and scientists reviewed current climate change science and identified resources vulnerable to expected climate change (Gaines et al. 2012).

Based on the scientific understanding developed on the first day of the two-day climate change workshop, participants were asked to identify and rank resources (as high, moderate, or low) in relation to perceived vulnerability to climate change. Vulnerability was defined as the extent to which a natural or social system is susceptible to sustained damage from weather extremes, climate variability, and change (and other interactive stressors) (Binder et al. 2009). Vulnerabilities were categorized into those related to the management of vegetation and habitats, and those related to aquatics and infrastructure. The vulnerabilities related to vegetation and habitat management included two general themes: the conservation of biodiversity, and the restoration of resilient forests and disturbance regimes. The vulnerabilities related to aquatic and infrastructure resources included water quality and quantity, the risk to roads and other facilities from changes to hydrologic regimes, and at-risk aquatic species and habitats (Gaines et al. 2012).

Table 59. Resource vulnerabilities on the Colville National Forest

Resource Vulnerability Area	Ranking	Vulnerability
Vegetation and habitat	**High**	• Plant migration could reduce the presence of white bark pine and shift the location of other forest types reducing the availability of alpine habitats (such as expansion of plant populations to higher elevations due to changes in snowpack levels and temperature changes). • Habitat specialists (caribou, lynx, and wolverine denning habitat) will have the most difficult time adjusting. • Riparian and wetland habitats may be particularly vulnerable. • Habitat connectivity will be reduced for some species and may be most detrimental for low-mobility habitat specialists. • Dry forest stands with high tree densities and fuel loads become increasingly susceptible to fire, insects, diseases, and drought. • Larger and more frequent disturbances could make it difficult for forests/habitats to recover and cause them to be more susceptible to invasive species. • Past management for timber production and fire exclusion has made old forests more susceptible to fire, including severe fire. • Species with narrow ecological amplitude and endemics may be at high risk for local extinction.
	Moderate	• Elk and deer may be vulnerable to increased diseases. • Species on the edges of their ranges or with limited mobility may be at risk for local extinction. Reevaluations may be necessary to provide for fine filter provisions to maintain species viability.
	Low	• Habitat generalists (grizzly bear, wolves, red squirrel, black bear) that are more mobile may fair better. • Increased carbon dioxide might increase growth of already overstocked stands.
Aquatic and infrastructure	**High**	• Municipal/agricultural watersheds may lose the capacity to deliver water at current levels. • Reduced cold water in streams could reduce fish habitat availability and alter the timing of spawning or the ability of fish to spawn. • Roads and other facilities could be threatened by increased frequency of extreme hydrologic events such as floods and debris flows. • Some aquatic species could become more susceptible to disease and changes in stream productivity. • Water availability for ecosystem processes (e.g., soil water for plant growth) could be reduced or shifted seasonally.
	Moderate	• Ski area operation could be affected by reduced winter snowpack. • Riparian areas could become harder to manage as stream networks become smaller and less connected (loss of perennial headwater streams). • Grazing allotments may be changed owing to changes in water availability and forage productivity.
	Low	• Sustaining Tribal use areas may become more difficult as resources become scarcer. • Roads may require more maintenance owing to increased use. Facilities may receive greater use (and wear) from longer recreational seasons.

Management Strategies for the Adaptation to Climate Change

In 2008, the U.S. Climate Change Science Program produced a report: Preliminary Review of Adaptation Options for Climate-Sensitive Ecosystems and Resources. One chapter was developed by U.S. Forest

Resource research scientists and other outside scientists directly concerning the current science available on adaptation responses for NFS lands (Joyce et al. 2008).

Below is a summary of specific adaptation responses that have potential to allow the Colville National Forest to create resilient landscapes and assist in the management of natural systems within the dynamics of climate change. This summary is in line with the Forest Carbon Principles presented above: developing resilience, promoting diversity and function in ecosystems, and using the best scientific knowledge to understand systems and manage them for the long term.

- Reducing, minimizing, or eliminating the potential for introduction, establishment, spread and impact of invasive species across all landscapes and ownerships.
- Under a changing climate, landscape fragmentation may exacerbate or cause unexpected changes in species and ecosystems.
- Primary premise for adaptive approaches is that change, novelty, uncertainty, and uniqueness of individual situations are expected to define the planning backdrop of the future. No single approach would fit all situations.
- The Forest Service needs to implement a variety of management approaches to reduce the impact of existing stressors on NFS lands.
- Resistance practices include thinning and fuels abatement treatments at the landscape scale to reduce crown fire potential and risk of insect epidemic, maintaining existing fuel-breaks.
- Maintaining prior species may require significant extra and repeated efforts to supply needed nutrients and water, remove competing understory, fertilize young plantations, develop a cover species, thin, and prune.

While there may be specific questions that research scientists need additional data and work to answer, the Forest Science and related universities and institutions have a robust base of scientific research and management strategies that can respond to the changing conditions of climate change: the direct, indirect, and cumulative effects of variations in temperature and water availability that would occur in the coming decades.

Summary

The modelled predictions of climate change in the future are for increasing temperatures, changes in how precipitation occurs across the landscape (less snow persistence), higher stream peak flows, and increases in summer moisture stress. Current and future management of NFS lands can use adaptation principles and the base of scientific research to manage the land and resources of the Colville National Forest for the benefit of the people of the United States and ensure the Forest is conserved for multiple uses by future generations.

The effects analysis for each resource will consider climate change in their effects analysis based on this summary.

Fire

Fire managers have been faced with increasing costs, urban development, and unprecedented fire behavior. Decades of government policy directed at extinguishing every fire on public lands have contributed to the disruption of natural fire processes. This section summarizes effects related to fire from the specialist report and based on indicators of fire regime condition class and management options in the wildland-urban interface (Curtis 2017).

Background

National Fire Policy and Wildland-urban Interface

The current Federal Wildland Fire Management Policy was signed in 1995 and updated in 2001, 2003, and 2009. The Federal Wildland Fire Management Policy guides the philosophy, direction, and implementation of fire management planning, activities, and projects on Federal lands. The policy helps ensure consistency, coordination, and integration of wildland fire management programs and related activities throughout the Federal Government.

On August 8, 2000, the President directed the Secretaries of the Department of Agriculture and the Department of the Interior to prepare a report recommending how best to respond to that year's severe fires, reduce the impacts of those fires on rural communities, and ensure sufficient fire management resources in the future. On September 8, 2000, the President accepted their report, "Managing the Impacts of Wildfires on Communities and the Environment," which provided an overall framework for fire management and forest health programs (66 FR 751-777).

These recommendations initiated a number of policies including the National Fire Plan, the Healthy Forests Initiative, long-term stewardship contracting authority, and the Healthy Forests Restoration Act. These policies led to the preparation of Community Wildfire Protection Plans (CWPPs) to define the WUI and to establish priorities for wildfire preparedness and hazardous fuels reduction work in these areas.

The wildland-urban interface, commonly referred to as WUI, exists where humans and infrastructure intermix with wildland fuels. There are 17 communities within 10 miles of the Colville National Forest boundary that have been identified both as communities at risk by county CWPPs and identified as "Urban Wildland Interface Communities with the Vicinity of Federal Lands That Are at High Risk from Wildfire" (Federal Register Vol. 66 No. 160). They include Addy, Chewelah, Colville, Curlew, Cusick, Danville, Ione, Kettle Falls, Laurier, Malo, Marcus, Metaline, Metaline Falls, Newport, Orient, Republic, and Usk. In addition, the county CWPPs also list communities at risk that are not included on the Federal Register. They include Aladdin, Arden, Barstow, Bluecreek, Boyds, Clayton, Daisy, Dalkena, Diamond Lake, Echo, Evans, Furport, Loon Lake, Marble, Northport, Onion Creek, Orin, Toroda, Valley, and Waitts. While the CWPP listed communities that are not included on the Federal Register list will not have treatments reported in the Forest Service Activity Tracking System, projects on the Forest would continue to benefit these communities by reducing wildfire risk along the forest boundary near these communities. The entirety of Ferry, Stevens, and Pend Oreille counties were analyzed and included in each county's CWPP.

Affected Environment

Fire History and Behavior

The Colville National Forest is grouped into five broad forest types. These groupings are based on potential vegetation and response to disturbance, particularly fire. All five types can be categorized as forested conifer systems, with elevation, aspect, and moisture determining the species.

Disturbance in general and fire in particular plays a critical role in shaping and maintaining forested ecosystems. The manner in which fire behaves in a system both historically and contemporarily can be described in terms of two key metrics: frequency and severity. Fire frequency is measured and reported here as mean fire return interval. Both historic and current mean fire return intervals are noted in each description below. Historic, or natural fire return intervals and severity are used as a point of comparison as they represent the levels with which natural, functioning ecosystems develop and persist. For the purpose of this analysis, mean fire return interval refers to how often (on average) the vegetation type would have fire move across its entirety. For example, historically, fire burned across all dry Douglas-fir stands approximately every 40 years (Landfire 2007), and is noted as having a historic mean fire return interval of 40 years. Given current fire suppression and the rate of prescribed fire being used, it would take 188 years for fire to burn across all dry Douglas-fir stands, and is noted as having a current fire return interval of 188 years. It is important to note that the natural fire return interval and associated severity is quite different for each vegetation type. Table 60 summarizes the change in fire return intervals for each vegetation type.

Table 60. Historic versus current fire return interval (years)

Vegetation Type	Historic Fire Return Interval	Current Fire Return Interval
Dry Douglas-fir	40	188
Subalpine Fir/Lodgepole Pine	225	225
Mesic Mixed Conifer	50-150	233
Western Red Cedar/Western Hemlock	200	200
Spruce/Subalpine Fir	150	218

The vegetation type's historic fire return interval is largely driven by the same environmental factors that determine dominant vegetation, namely climate, elevation, and soil type.

Across much of the lower elevations of the Forest, sites are occupied by dry Douglas-fir stands which were historically characterized by frequent, low-intensity fires. Within these stands, late forest structure was historically represented by both open canopy (less than 40 percent canopy cover) and closed canopy (greater than 40 percent canopy cover) large and very large trees. Historically, the dry Douglas-fir vegetation type would have supported 38 to 78 percent of the stands that were classified as Late Development Open, with 1 to 32 percent classified as late development closed. Mid development open stands occurred across 2 to 8 percent of this vegetation type, and 4 to 13 percent was classified as mid development closed. These stand characteristics were developed and maintained by frequent surface fires in the mid-open and late-open structures that kill seedlings/saplings and prevented widespread closed canopy conditions. Surface fires in the limited mid development closed stands were historically rare, and given the surface fuel build–up, most fire in the closed stands burned with mixed severity, which would transition the stands to mid-development open. With regular fire return intervals, mid-open stands would transition to late-open stands. Late-open conditions would continue while frequent fire intervals persisted. Missing fire returns would allow for establishment of younger cohorts of understory trees and transition stands to a late-closed condition (Landfire 2007). Late-closed conditions in the dry Douglas-fir type are important features on the landscape; however, widespread closed canopy systems are prone to large-scale stand-replacing fire events that were not historically widespread in this system and are detrimental to ecosystem health and integrity. The historic mean fire return interval in this forest type was approximately 40 years and in the northern ranges younger age/size classes may be more extensive owing to larger and more frequent mixed or stand-replacement fires. This type is extensive on the Colville National Forest, but has not been captured adequately in previous mapping projects (Landfire (2007) Biophysical Setting Model Descriptions).

This forest type has a current mean fire return interval of 188 years, meaning that fire is not currently playing its natural role in this system. This increase in fire return interval has led to unnatural amounts of mid-development closed stands across the vegetation type putting the system at risk for uncharacteristically severe fire events.

At higher elevations along the Kettle Crest, subalpine fir/lodgepole pine stands are the dominant vegetation. These subalpine fir/lodgepole stands were historically characterized by a long fire return interval (over 225 years) and historically supported primarily stand-replacing fire events. Within subalpine fir/lodgepole pine stands, historic conditions had only 2 percent of this vegetation type in late development closed canopy conditions, and typically did not support late development open canopy stands, due to high-severity fire being the dominant disturbance regime. Historically, 33 to 53 percent of the stands would have been in mid development closed canopy conditions, with 45 to 65 percent in early development. Mid and late forest structure in this vegetation type would persist until fire occurrence (naturally stand-replacing), and would revert to early development. The current mean fire return interval in this vegetation type is 225 years (Landfire 2007) indicating that fire is currently occurring at natural levels.

East of the Columbia River at mid-elevation and higher, Northern Rocky Mountain (mesic) mixed conifer stands dominated the landscape. This vegetation type naturally supported primarily mixed-severity fire with a 50- to 150-year return interval creating a mosaic of mid and late development closed canopy stands and small, patchy open-canopied stands. Open-canopied stands would historically regrow into closed stands quickly (less than 30 years) due to recruitment and canopy infill, therefore, the location of open canopy conditions shifted across the landscape through time. Within these mixed conifer stands, late development open stands historically occurred across only 4 to 6 percent of this vegetation type, while 44 to 60 percent of the stands would have represented late development closed conditions. Mid development open was considered to be 1 to 3 percent, and 18 to 30 percent was classified as mid development closed. Early development stands accounted for 9 to 25 percent of the vegetation type. Fires were mostly mixed-severity with a 50- to 150-year frequency. Current mean fire return interval is 233 years (Landfire 2007), indicating that fire levels are less frequent than historic levels and fire is not currently playing its natural role in shaping the landscape.

Scattered through drainages east of the Kettle Crest, western red cedar/western hemlock stands were the dominant vegetation. Within western red cedar/western hemlock stands, historically 55 to 83 percent of stands were in late development closed conditions, with no late development open stands. High-severity fire occurred approximately every 200 years, reverting late development stands to early development, which occupied 4 to 24 percent of vegetation type. Mid development closed stands occurred on 7 to 27 percent of the landscape. There was historically no mid development open stands. This forest type had longer fire return intervals, approximately 200 years (Landfire 2007), with high-severity fire. This forest type is still within range of its historic mean fire return interval indicating that fire is playing its natural role in shaping and maintaining this system.

Spruce/subalpine fir stands occupied drainages at higher elevations along the Kettle Crest, and in some limited areas of the Kaniksu Mountains. Spruce/subalpine fire stands historically had 29 to 57 percent of stands in the late development closed condition, with no late development open stands. Thirteen to 41 percent of the vegetation type was in mid development closed canopy conditions, and 14 to 46 percent in early development. Replacement fire historically occurred every 150 years. The current mean fire return interval in this forest type is 218 years (Landfire 2007) indicating that fire is occurring less frequently than necessary to shape and maintain this system.

Over a century of fire suppression practices have impacted the ability of fire to play its natural role across the Forest. Fire frequency and severity has been altered from historic condition in most vegetation types contributing to shifts in vegetative conditions outside the natural range of variation and in places creating conditions susceptible to uncharacteristic fire events.

On the Colville National Forest, fire season is generally June 1 to October 1. The potential for lightning is most likely during this period as temperatures begin to climb and relative humidity values are low. From 2000 to 2014, the majority (85 percent) of fire starts on the Forest were caused by lightning, with an average of 20 fire starts per year. The remaining fires (15 percent) were caused by equipment, smoking, campfires, arson, or miscellaneous causes. All fires on Colville National Forest land during this timeframe took place between the months of April and October. During this time, 14,700 acres burned on the Colville National Forest from unplanned ignitions.

Fire Regime Condition Class

A natural fire regime is a general classification of the role fire would play across a landscape in the absence of modern human mechanical intervention, but it includes the influence of aboriginal burning (Agee 1993). Fire regimes are described in terms of fire frequency and severity. Coarse-scale definitions for natural fire regimes have been developed by Hardy et al. (2001) and Schmidt et al. (2002), and interpreted for fire and fuels management by Hann and Bunnell (2001) and Hann et al. (2008). The five natural fire regimes are classified based on average number of years between fires (fire frequency) combined with the severity of the fire on the dominant overstory vegetation. These five regimes are:

> **Fire Regime I** – 0- to 35-year frequency and low (surface fires most common) to mixed severity (less than 75 percent of the dominant overstory vegetation replaced);
>
> **Fire Regime II** – 0- to 35-year frequency and high (stand-replacement) severity (greater than 75 percent of the dominant overstory vegetation replaced);
>
> **Fire Regime III** – 35- to 100+ year frequency and mixed severity (less than 75 percent of the dominant overstory vegetation replaced);
>
> **Fire Regime IV** – 35- to 100+ year frequency and high (stand-replacement) severity (greater than 75 percent of the dominant overstory vegetation replaced;
>
> **Fire Regime V** – 200+ year frequency and high (stand-replacement) severity.

All fire regimes are represented across the Forest, though Fire Regime V is present only in isolated patches. The following table shows the fire regime groups for each vegetation type on the Colville National Forest.

Table 61. Fire regime groups by vegetation type for the Colville National Forest

Vegetation Type	Fire Regime Group	Historic Frequency	Historic Severity
Douglas-fir dry	Fire Regime Group I	40 years	Surface
Subalpine fir / Lodgepole pine	Fire Regime Group IV	>225 years	Replacement
Northern Rocky Mountain Mixed Conifer	Fire Regime Group III	50-150 years	Mixed-Severity
Western Redcedar / Western Hemlock	Fire Regime Group V	>200 years	Replacement
Spruce / Subalpine fir	Fire Regime Group IV	150 years	Replacement

Fire regime condition class (FRCC) is a metric that quantifies how departed a system is from historical conditions in relation to fire, the role fire historically played in that system, and vegetative structure (Hann and Bunnell 2001, Hardy et al. 2001, Hann et al. 2008). FRCC is an estimate of the departure from the natural fire regime. FRCC assessments measure departure in two main components of ecosystems: (1)

fire regime (fire frequency and severity) and (2) by comparing the abundances of each seral stage (by potential vegetation type) to historical amounts. There are three classes of FRCC, based on low (FRCC 1), moderate (FRCC 2), and high (FRCC3) departure from the central tendency of the natural fire regime structure (Hann and Bunnell 2001, Hardy et al. 2001, Barrett et al. 2010). FRCC 1 is considered to be within the historic range of fire regimes, while FRCC 2 and FRCC 3 are outside the range. While fire rates and severity play a role in determining FRCC, vegetation structure plays an equal role. Changes and manipulation of structural stages on the landscape through means other than fire (e.g., commercial harvest, mechanical fuels reduction, insect and disease outbreaks, etc.) play an equal role in determining FRCC.

In FRCC 1 (less than 33 percent departure), there is little to no departure from the historic range. Vegetation composition, structure, and fuels are similar to those of the historic regime and do not pre-dispose the system to risk of loss of key ecosystem components. Wildland fires are characteristic of the historical fire regime behavior, severity, and patterns, being departed from historical frequencies by no more than one return interval.

In FRCC 2 (33 to 66 percent departure) vegetation composition, structure, and fuels have moderate departure from the historic regime and pre-dispose the system to risk of loss of key ecosystem components. Wildland fires are moderately uncharacteristic compared to the historical fire regime behaviors, severity, and patterns, being departed (either increased or decreased) from historical frequencies by more than one return interval. This results in moderate changes to one or more of the following: fire size, frequency, intensity, severity, or landscape patterns (Hardy et al. 2001).

In FRCC 3 (greater than 66 percent departure) vegetation composition, structure, and fuels have high departure from the historic regime and predispose the system to high risk of loss of key ecosystem components. Wildland fires are highly uncharacteristic compared to the historical fire regime behaviors, severity, and patterns. Fire frequencies have departed from historical frequencies by multiple return intervals. This results in dramatic changes to one or more of the following: fire size, frequency, intensity, severity, or landscape patterns (Hann and Bunnell 2001, Hardy et al. 2001).

An FRCC analysis of Forest lands was completed using the FRCC software application. See Methodology under Environmental Consequences for a full description of model inputs, assumptions, and limitations.

Currently, much of the Colville National Forest has some degree of departure from historic conditions as a result of past fire and timber management. Because of these departed conditions, fire does not currently play its historic role across much of the landscape, and as a result, the Colville is at risk of losing key ecosystem components such as soil quality, large trees, and habitat.

Table 62. Current conditions by vegetation type

Vegetation Type	Landfire Biophysical Setting	Acres	Avg Departure	FRCC*	VCC**	Frequency Departure	Severity Departure
Douglas-fir dry	1010451 - Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest – Ponderosa Pine – Douglas-fir	486,000	71	3	2	89%	87%

Vegetation Type	Landfire Biophysical Setting	Acres	Avg Departure	FRCC*	VCC**	Frequency Departure	Severity Departure
Subalpine fir / Lodgepole pine	1010452 – Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest – Larch	173,700	35	1	1	6%	47%
Northern Rocky Mountain Mixed Conifer	1010471 – Northern Rocky Mountain Mesic Montane Mixed Conifer Forest	308,400	51	2	2	66%	45%
Western Redcedar / Western Hemlock	1010471 - Northern Rocky Mountain Mesic Montane Mixed Conifer Forest (95%) / 1010472 - Northern Rocky Mountain Mesic Montane Mixed Conifer Forest - Cedar Groves (5%)	95,800	53	2	2	66%	45%
Spruce / Subalpine fir	1010560 - Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland (90%) / 1011610 - Northern Rocky Mountain Conifer Swamp (10%)	20,200	26	1	1	1%	44%

*FRCC = fire regime condition class
**VCC = vegetation condition class

Need for Change

Old Forest Management and Timber Production

In the revision of the land and resource management plan, three broad-scale concerns drove the need to consider how we address old forest management, especially the current reserve system approach at the landscape scale. These are:

- Contemporary fire rates and severity are not in line with historic ranges for many vegetation types. In the Douglas-fir dry type, a lack of frequent, low-severity fire and contemporary/historic vegetation management has led to fuel accumulation and stand structure that is conducive to large, stand-replacing fire events that were not historically common. Likewise, a lack of mixed-severity and stand-replacing fire in systems that were historically maintained by them along with contemporary forest management practices has led to an imbalance of structure states. Projected impacts from climate change have the potential to interact with and increase uncharacteristic levels of disturbance. This elevates the importance of restoring landscape resiliency.

There is an additional concern for at-risk stands that contribute to late forest structure because these stands typically have heavy fuel accumulation and dense canopies, both of which increase potential for fire transmission and spread. While stand-replacing fire is not uncharacteristic in many of the vegetation types on the Forest, the potential for high-severity fire in late forest structure is particularly concerning because the Forest has considerably less old forest and associated habitat on the landscape than would have historically occurred. This lack of landscape redundancy in late forest structures means that even moderate acreage loss due to fire events would further exacerbate the imbalance of forest structures.

Access

Three broad concerns drove the need to address road density:

1) current funding is not sufficient to properly maintain the existing road system at current operational maintenance levels,
2) the current road system is not aligned with current and future resource management objectives, and
3) the existing road management direction is confusing and difficult to follow because it is scattered throughout 1988 forest plan (Colville National Forest Land and Resource Management Plan), forest plan amendments (Eastside Screens) (USDA Forest Service 1995b), Interim Inland Native Fish Strategy for the Intermountain, Northern, and Pacific Northwest Regions (INFISH) (USDA Forest Service 1995a), national-level decisions (the Roadless Rule), and interim policy (e.g., Grizzly Bear No-Net-Loss, Lynx Agreement, the Interior Columbia Basin Strategy).

In addition, access to wildfires and fuel treatment locations continues to be a concern. As road density increases or decreases, response time to wildfires would change accordingly. Costs for fuel treatments would also change depending on the level of access.

Recommended Wilderness Areas

By law, all NFS lands must be evaluated for possible wilderness recommendation during the plan revision process. The result of that evaluation shows whether a need exists for additional wilderness and what trade-offs may exist if the area is eventually designated part of the National Wilderness Preservation System.

Currently, the Salmo-Priest Wilderness covers about 3 percent of the Colville National Forest and evaluation showed a need for additional wilderness opportunities on the Forest. A review of possible areas showed some are available to fill this need.

Environmental Consequences

Methodology

This analysis examines how the plan alternatives address the risk of uncharacteristic wildfire and how well they contribute to returning wildfire to a more natural role. This is done by comparing the existing FRCC with the projected FRCC for each alternative to determine the percentage indicating how well each alternative contributes to moving the Forest toward desired conditions. Analysis results are shown by average departure, which is the amount of departure in percent from historic conditions. FRCC 1 is less than 33 percent departed, FRCC 2 is 33 to 66 percent departed, and FRCC 3 is greater than 66 percent departed from historic conditions.

All alternatives use mechanical and fire treatments to reduce fuel loads and tree densities, thus reducing the risk of uncharacteristic wildfires, which pose threats to ecosystems and communities. However, some alternatives have more of a management emphasis on the restoration of and development of healthy, resilient ecosystems. As a result, some alternatives are expected to be more effective in changing the risk of uncharacteristic fire than others. These treatments assist in moving forested systems into more natural landscape conditions, thereby, allowing fire to play a more natural role. FRCC is a tool used to determine if a landscape is moving toward desired conditions. It measures how close or far a system has departed from its natural fire regime.

All of the alternatives contain objectives for treating (mechanical and burning) vegetation to improve structure and composition, including reducing surface/ladder fuels and canopy density. However, some alternatives focus these efforts only in certain areas while managing for other objectives (including timber production) elsewhere. This FRCC outcome was compared by alternative at 20 years of implementation, the expected length of the plan, plus time allotted to develop a new forest plan. At 20 years in the future, some movement toward desired conditions would be seen, but effecting change in natural processes at current and expected levels as prescribed by these alternatives would likely take much longer than 20 years.

The FRCC software application was used to analyze the vegetation and fire regime departure for the Colville National Forest lands. The FRCC software application uses biophysical settings (BpS) and their associated succession classes (S-Class) as the baseline for pre-European settlement disturbance processes. A description of the biophysical settings and associated S-Classes can be found at www.landfire.gov. The FRCC software application quantifies the departure of current vegetation structure and composition, fire severity, and fire frequency from a set of reference conditions representing the historical range of variation. The tool derives several metrics of departure at the S-Class, BpS, and landscape levels.

Fire frequency and severity need to be calculated to use the tool, and are utilized to determine the amount of departure from reference frequencies and severities. To estimate current fire frequency, an analysis of historic and current fires was conducted. Following the methods contained in the FRCC Guidebook, a Fire Atlas mapping both planned and unplanned ignitions was created with data from 1909 to 2014. Local knowledge and expert opinion determined that an average of 75 percent of the acres within burn perimeters were actually burned during the fires, and this average was used to determine actual acres burned within each biophysical setting. The total area burned was divided by Fire Atlas time period to estimate current mean annual burned acres. The total acres of each BpS were divided by the reference fire return interval to determine historic mean annual burned acres. The reduction factor (historic/current) was multiplied by the reference return interval to determine current mean fire return interval. Reference fire return intervals were used for Fire Regime IV areas as the reference return interval was longer than the fire atlas data years.

Current potential fire severity was calculated by running the Flammap fire behavior model using a landscape file from Landfire (www.landfire.gov). Fuel model, canopy bulk density, canopy cover, canopy base height, canopy height, aspect, slope, and elevation layers comprise the landscape file. Using 90th percentile weather conditions derived from analyzing local weather stations, a Flammap run with flame length and crown fire activity outputs was created. For the purpose of the analysis, surface fire was considered Low Severity (0 to 25 percent tree mortality), passive crown fire was considered Mixed Severity (26 to 75 percent tree mortality), and active crown fire was considered High Severity (76 to 100 percent tree mortality). A value for each severity was assigned (Low, 15 percent; Mixed, 50 percent, High 90 percent), then the mid-point severity was multiplied by percentage of each BpS it was present on. The results were added together to calculate the current severity for each BpS.

For each alternative, S-class layers were modified to match vegetation modelling results. The fire atlas data were updated to add new fires, both planned and unplanned ignitions. The amount of planned ignitions in each BpS was determined by analyzing historic planned ignition acres completed, and averaging the acres completed each year. To determine the amount of unplanned ignitions that could be used to meet resource objectives, historic lightning data was analyzed in the areas where fire could be managed in this manner during periods when fire effects would produce low-mixed severity fire. Using the Fire Spread Probability tool, the ignitions were run using moderate fire conditions typically experienced in the last 30 to 60 days of the typical fire season. Using these conditions meets the intent of using fire to meet resource objectives with low and mixed severity effects. Fire frequency was then updated and entered into the FRCC software application. Fire severity was calculated by taking the amount of acres treated per alternative (commercial thinning, prescribed fire, and mechanical fuels reduction) in each BpS and then reducing the amount of high- and mixed-severity fire based on the assumption that 50 percent of treatments would focus on moving high-severity areas to mixed-severity, 40 percent of treatments would focus on moving mixed-severity to low-severity, and that 10 percent of treatments would focus on maintaining low fire severity conditions.

Assumptions

- Modelled treatments, fire severity, and fire return intervals would closely match actual conditions in the future.
- Budget would allow for implementation of all mechanical and prescribed fire treatments.

Spatial and Temporal Context for Effects Analysis

The administrative boundary of the Colville National Forest is the spatial extent of this analysis. The temporal context for the affected environment is 105 years, which is the oldest data for wildfires in the Forest's corporate GIS database. For the effects analysis, the temporal context looks forward 20 years in regards to FRCC.

Summary of Effects

Fire Regime Condition Class

Mean fire return intervals decrease with the use of prescribed fire and allowing unplanned ignitions to be managed for resource benefit. Mean fire return interval only considers prescribed fire and wildfire on the landscape. Fire severity is generally reduced across the landscape in areas where any type of treatment (mechanical and/or fire) is implemented.

Table 63 shows average FRCC percent departure by forest type after 20 years. This is a relatively short time for management to affect changes at the forest scale, so only a 2 to 3 percent decrease is seen in the Douglas-fir dry forest type under the action alternatives. Mechanical and prescribed fire treatments in the Douglas-fir dry forest type would focus on reducing fire severity, but due to the stands missing multiple fire returns, the relatively high mean fire return interval continues to keep this vegetation type severely departed from historic conditions.

The most notable changes occur in western red cedar/western hemlock stands. These stands have a longer mean fire return interval and are still within range of historic fire returns. In all alternatives, these stands would continue to move toward more late development closed conditions that more closely match historic conditions.

Table 63. Twenty-year predicted average fire regime condition class percent departure by forest type and alternative

Vegetation Type	Current	No Action	Proposed Action	Alt. P	Alt. R	Alt. B	Alt. O
Douglas-fir dry	71	69	67	67	67	68	67
Subalpine fir / lodgepole pine	35	29	23	24	23	21	22
Northern Rocky Mountain mixed conifer	51	53	49	49	48	48	48

Vegetation Type	Current	No Action	Proposed Action	Alt. P	Alt. R	Alt. B	Alt. O
Western red cedar / western hemlock	53	52	50	49	50	48	49
Spruce / subalpine fir	26	33	33	31	32	32	32

Overall, the differences in management prescribed are not sufficient to change FRCC in the 20-year time period, though some vegetation types do begin trending toward a change in FRCC.

Access

As road densities decrease, or roads are closed to allow for new roads, fire response times would likely increase, though there is “no evidence for an effect of linear feature presence or densities” (roads, powerlines, pipelines) on fires escaping during initial attack (Arienti et al. 2006). In addition, although fire boundaries are influenced by multiple topographic and vegetation constraints, roads tend to have the largest influence of any single variable, particularly in lower elevation landscapes with relatively high road densities (Narayanaraj and Wimberly 2011).

Wilderness

Current management of the Salmo-Priest Wilderness would remain largely unchanged across all alternatives.

Recommended wilderness areas are discussed in each alternative.

All alternatives except no action allow for prescribed fire use in wilderness. For all alternatives the following criteria would need to be met prior to planning for prescribed fire in wilderness:

- There is an unnatural buildup of fuel;
- The treatment would increase the probability of accepting naturally occurring wildfire disturbance in wilderness when treating areas outside the wilderness boundary would not fully achieve this outcome;
- Strategies use minimum suppression techniques and are designed to maintain and restore the vegetation conditions that are characteristic of wilderness.

Given these restrictions, changes to FRCC within the wilderness from prescribed fire application is expected to be negligible.

Wildland-urban Interface

All alternatives would restrict treatment in portions of the WUI, as it is mapped in the county CWPPs. In all alternatives, except no action, recommended wilderness, current wilderness, and research natural areas would not allow timber harvest to be used as a tool. Recommended wilderness is the most restrictive management allocation in all alternatives that drives the differences in acres unsuitable for mechanical treatment. In the no action alternative, management areas 1, 3b, 3c, 4, 9, 10, and 11 do not allow timber harvest. Table 64 shows by alternative how many acres within the WUI would not allow timber harvest as a tool.

Table 64. Wildland-urban interface acres unsuitable for mechanical treatment

Alternative	Acres
No Action	62,700
Proposed Action	29,700
P	23,300
R	84,100
B	92,100
O	13,200

No Action Alternative

Overall, the Forest would remain moderately departed from historic fire return intervals and severities. Stand departures would change from current conditions as follows:

Table 65. No action alternative predicted departure by vegetation type

Vegetation Type	Landfire Biophysical Setting	Acres	Average Departure	Departure Compared to Current Conditions	VCC*	Frequency Departure	Severity Departure
Douglas-fir dry	1010451 - Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest – Ponderosa Pine – Douglas-fir	486,000	69%	Down 2%	2	87%	86%
Subalpine fir / Lodgepole pine	1010452 - Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest – Larch	173,700	29%	Down 6%	1	6%	47%
Northern Rocky Mountain Mixed Conifer	1010471 – Northern Rocky Mountain Mesic Montane Mixed Conifer Forest	308,400	53%	Up 2%	2	66%	38%
Western Redcedar / Western Hemlock	1010471 – Northern Rocky Mountain Mesic Montane Mixed Conifer Forest (95%) / 1010472 – Northern Rocky Mountain Mesic Montane Mixed Conifer Forest – Cedar Groves (5%)	95,800	52%	Down 1%	2	66%	38%
Spruce / Subalpine fir	1010560 - Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland (90%) / 1011610 - Northern Rocky Mountain Conifer Swamp (10%)	20,200	33%	Up 7%	2	1%	44%

*VCC = vegetation condition class

Vegetation departures would generally continue to increase in most vegetation types. Mechanical treatments would account for the lower departure value in Western Redcedar/Western Hemlock stands, as these stands typically would not experience enough wildfire or prescribed fire to account for the change in departure. The landscape would be 57 percent departed from historic conditions with a landscape FRCC of 2.

Old Forest Management and Timber Production

Mechanical fuels reduction and prescribed fire treatments could occur as scheduled treatments across 82 percent of the landscape. Treatments would be planned following direction from the 1988 forest plan as amended. A fixed reserve approach would be used to manage late forest structure, where no scheduled timber harvest is permitted.

Within dry Douglas-fir stands, modeling 20 years in the future predicts, 15 percent of the stands would be classified as late development open, and 19 percent of the stands as late development closed. The largest amount of stands (53 percent) would be classified as mid development closed. Closed canopied stands, especially those in the mid development stage are particularly susceptible to stand-replacing fire events due to dense canopies and abundant ladder fuels. Once late development open structure was reached, regular fire treatments would be needed to maintain this condition.

Within subalpine fir/lodgepole pine stands modeling 20 years in the future predicts, 2 percent of stands would be classified as late development closed, with no stands classified as late development open. Late forest structure in this vegetation type would persist until fire occurrence, and would revert to early development.

Within mixed conifer stands, modeling 20 years in the future predicts, 22 percent of the stands within this vegetation type would be considered late development closed, with 0 percent late development open.

Within western red cedar/western hemlock stands, modeling 20 years in the future predicts 34 percent of the stands would be classified as late development closed. These stands would continue to experience natural stand-replacement fire if left to natural disturbances.

Within spruce/subalpine fire stands, modeling 20 years into the future predicts, 16 percent of the vegetation type would be classified as late development closed. Replacement fire historically occurred every 150 years, with that fire return interval and severity expected to persist without management intervention.

Ecosystem departure would be rated as low across 23 percent of the landscape, supporting the retention of late forest structure in the Douglas-fir dry type as low-severity fire moves through those areas that typically experienced low-severity fire. Mixed- and high-severity fire would also be expected if fire plays its natural role in all other vegetation types. Seventy-seven percent of the landscape exhibits a departure from natural fire process and would remain predisposed to losing key ecosystem components, which could threaten late forest structure and timber production.

Wilderness

There would be no recommended wilderness areas in the no action alternative. Management of the Salmo-Priest Wilderness would not change. Use of unplanned and planned ignitions would continue to be prohibited.

Stands would remain in their current fire regime condition class, but would continue to miss fire cycles, which would lead to progression to FRCC 2 and 3, leaving them at risk of losing key ecosystem components.

Proposed Action

Stand departures relating to fire frequency and severity would change from current conditions as follows:

Table 66. Proposed action alternative predicted departure by vegetation type

Vegetation Type	Landfire Biophysical Setting	Acres	Average Departure	Departure Compared to Current Conditions	VCC*	Frequency Departure	Severity Departure
Douglas-fir dry	1010451 - Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest – Ponderosa Pine – Douglas-fir	486,000	67	Down 4%	2	89%	86%
Subalpine fir / Lodgepole pine	1010452 - Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest – Larch	173,700	23	Down 12%	1	6%	47%
Northern Rocky Mountain Mixed Conifer	1010471 – Northern Rocky Mountain Mesic Montane Mixed Conifer Forest	308,400	49	Down 2%	2	66%	38%
Western Redcedar / Western Hemlock	1010471 – Northern Rocky Mountain Mesic Montane Mixed Conifer Forest (95%) / 1010472 – Northern Rocky Mountain Mesic Montane Mixed Conifer Forest – Cedar Groves (5%)	95,800	50	Down 3%	2	66%	38%
Spruce / Subalpine fir	1010560 - Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland (90%) / 1011610 - Northern Rocky Mountain Conifer Swamp (10%)	20,200	33	Up 7%	2	1%	44%

*VCC = vegetation condition class

The use of prescribed fire and allowing for unplanned ignitions to be used to meet resource benefits would work toward lowering the mean fire return interval slightly. Fire severity would be moderated through the use of mechanical treatments and prescribed fire. The landscape overall is 54 percent departed from historic conditions, resulting in a landscape FRCC of 2.

Old Forest Management and Timber Production

Mechanical fuels reduction and prescribed fire treatments could occur as scheduled treatments across 71 percent of the landscape. Treatments would be planned using a “whole landscape” approach which would promote late forest structure in shifting locations across the Forest over broad time horizons as treatments work to enhance and maintain old forest conditions. Rather than designating specific geographic locations where old forest would be managed for, this alternative seeks to develop and maintain overall landscape proportions of old forest while recognizing that specific locations change through time due to natural and anthropogenic disturbance. This approach closely mimics historic landscape patterns represented by a mosaic of forest structure shaped by fire of differing severities. The whole landscape approach aims to promote fire-resilient species composition and structure at the landscape scale, specifically in vegetation types that would historically have fire-resilient species such as ponderosa pine, Douglas-fir, and western larch. Unplanned ignitions would be managed for resource benefit across the Forest when site-specific objectives could be met.

Prescribed fire use would slightly decrease the mean fire return interval, though the landscape would still remain severely departed from historic return intervals. Treatments are expected to shift some high fire severity areas to moderate severity, and some moderate severity areas to low severity as overall fuel loading and canopy closure is reduced. Overall, the landscape FRCC remains moderately departed with an FRCC 2. Fire is able to play its natural role across 27 percent of the Forest, maintaining resilient stands in those areas. These areas would include both low- and mixed-severity fire regimes. However, 73 percent of the Forest is at risk of losing key ecosystem components, which could threaten both timber production and late forest structure.

Within dry Douglas-fir stands, modeling 20 years in the future predicts 17 percent of the stands would be classified as late development open, and 17 percent of the stands as late development closed. The largest amount of stands (50 percent) would be classified as mid development closed. Closed-canopied stands, especially those in the mid development stage, are particularly susceptible to stand-replacing fire events due to dense canopies and abundant ladder fuels. Once late development open structure was reached, regular fire treatments would be needed to maintain this condition.

Within subalpine fir/lodgepole pine stands, modeling 20 years into the future predicts 12 percent of stands would be classified as late development closed, with no stands classified as late development open. Late forest structure in this vegetation type would persist until fire occurrence, and would revert to early development.

Within mixed conifer stands, modeling 20 years into the future predicts, 20 percent of the stands within this vegetation type would be considered late development closed, with 2 percent late development open.

Within western red cedar/western hemlock stands, modeling 20 years into the future predicts 18 percent of the stands would be classified as late development closed and would continue to experience natural stand-replacement fire if left to natural disturbances.

Within spruce/subalpine fire stands, 20 years into the future predicts 16 percent of the vegetation type would be classified as late development closed. Replacement fire historically occurred every 150 years, with that fire return interval and severity persisting without management intervention.

Ecosystem departure would be rated as low across 27 percent of the landscape, supporting the retention of late forest structure in the Douglas-fir dry type as low-severity fire moves through those areas that typically experienced low-severity fire. Mixed- and high-severity fire would also be expected if fire plays its natural role in all other vegetation types. Seventy-three percent of the landscape exhibits a departure from natural fire process and would remain predisposed to losing key ecosystem components, which could threaten late forest structure and timber production. Losing key ecosystem components in late forest structure would impact dependent surrogate wildlife species habitat (Gaines 2017).

Recommended Wilderness Areas

Approximately 101,400 acres would be recommended for wilderness. Tools for fire management would remain unchanged until Congress acts to designate the areas as wilderness. If areas are designated by Congress, the use of some tools for fire management (i.e., chainsaws, helispots, etc.) would require approval prior to their use.

Alternative R

Stand departures of each vegetation type would change as follows:

Table 67. Alternative R predicted departure by vegetation type

Vegetation Type	Landfire Biophysical Setting	Acres	Average Departure	Departure Compared to Current Conditions	VCC*	Frequency Departure	Severity Departure
Douglas-fir dry	1010451 - Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest – Ponderosa Pine – Douglas-fir	486,000	67	Down 4%	2	87%	86%
Subalpine fir / Lodgepole pine	1010452 – Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest – Larch	173,700	23	Down 12%	1	6%	47%
Northern Rocky Mountain Mixed Conifer	1010471 – Northern Rocky Mountain Mesic Montane Mixed Conifer Forest	308,400	48	Down 3%	2	66%	38%
Western Redcedar / Western Hemlock	1010471 – Northern Rocky Mountain Mesic Montane Mixed Conifer Forest (95%) / 1010472 – Northern Rocky Mountain Mesic Montane Mixed Conifer Forest – Cedar Groves (5%)	95,800	50	Down 3%	2	66%	38%
Spruce / Subalpine fir	1010560 - Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland (90%) / 1011610 - Northern Rocky Mountain Conifer Swamp (10%)	20,200	32	Up 6%	2	1%	44%

*VCC = vegetation condition class

Stand departure would be lower in all vegetation types except Spruce/Subalpine fir. Mean fire return intervals would decrease slightly through the use of prescribed fire and the use of unplanned ignitions. Fire severity would be reduced through the use of mechanical treatments and prescribed fire. Overall, the landscape would be 53 percent departed from historic conditions with an FRCC of 2.

Old Forest Management and Timber Production

Within dry Douglas-fir stands, modeling 20 years into the future predicts 16 percent of the stands would be classified as late development open, and 18 percent of the stands as late development closed. The largest proportion of stands (52 percent) would be classified as mid development closed. Closed canopied stands, especially those in the mid development stage are particularly susceptible to stand-replacing fire events due to dense canopies and abundant ladder fuels. Once late development open structure was reached, regular fire treatments would be needed to maintain this condition.

Within subalpine fir/lodgepole pine stands, modeling 20 years into the future predict 12 percent of stands would be classified as late development closed, with no stands classified as late development open. Late forest structure in this vegetation type would persist until fire occurrence, and would revert to early development.

Within mixed conifer stands, modeling 20 years into the future predicts 22 percent of the stands within this vegetation type would be considered late development closed, with 1 percent late development open.

Within western red cedar/western hemlock stands, modeling 20 years into the future predicts 33 percent of the stands would be classified as late development closed and would continue to experience natural stand-replacement fire if left to natural disturbances.

Within the spruce/subalpine fire stands, modeling 20 years into the future, 17 percent of the vegetation type would be classified as late development closed. Replacement fire historically occurred every 150 years, with that fire return interval and severity persisting without management intervention.

Ecosystem departure would be rated as low across 39 percent of the landscape, supporting the retention of late forest structure in the Douglas-fir dry type as low-severity fire moves through those areas that typically experienced low-severity fire. Mixed and high-severity fire would also be expected if fire plays its natural role in all other vegetation types. Sixty-one percent of the landscape exhibits a departure from natural fire process and would remain predisposed to losing key ecosystem components, which could threaten late forest structure and timber production. Losing key ecosystem components in late forest structure would impact dependent surrogate wildlife species habitat (Gaines 2017).

Recommended Wilderness Areas

Approximately 209,000 acres would be recommended as wilderness under alternative R. Mechanized and motorized uses would not be allowed prior to Congress acting to designate the areas as wilderness. Some fire management tools (chainsaws, helispots, etc.) would require approval prior to their use in the recommended wilderness.

Alternative P

Alternative P would change stand departure in each vegetation type as follows:

Table 68. Alternative P predicted departure by vegetation type

Vegetation Type	Landfire Biophysical Setting	Acres	Average Departure	Departure Compared to Current Conditions	VCC*	Frequency Departure	Severity Departure
Douglas-fir dry	1010451 - Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest – Ponderosa Pine – Douglas-fir	486,000	67	Down 4%	2	89%	86%

Vegetation Type	Landfire Biophysical Setting	Acres	Average Departure	Departure Compared to Current Conditions	VCC*	Frequency Departure	Severity Departure
Subalpine fir / Lodgepole pine	1010452 - Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest – Larch	173,700	24	Down 11%	1	6%	47%
Northern Rocky Mountain Mixed Conifer	1010471 – Northern Rocky Mountain Mesic Montane Mixed Conifer Forest	308,400	49	Down 2%	2	66%	38%
Western Redcedar / Western Hemlock	1010471 – Northern Rocky Mountain Mesic Montane Mixed Conifer Forest (95%) / 1010472 – Northern Rocky Mountain Mesic Montane Mixed Conifer Forest – Cedar Groves (5%)	95,800	49	Down 4%	2	66%	38%
Spruce / Subalpine fir	1010560 - Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland (90%) / 1011610 - Northern Rocky Mountain Conifer Swamp (10%)	20,200	31	Up 5%	2	1%	44%

*VCC = vegetation condition class

Stand departure would decrease in all vegetation types except Western Red Cedar/Western Hemlock and Spruce/Subalpine fir. This is due to no treatments being modeled in Western Red Cedar/Western Hemlock stands, and limited treatments in Spruce/Subalpine Fir Stands. Mean fire return intervals would decrease slightly through the use of prescribed fire and the use of unplanned ignitions. Fire severity would be reduced through the use of mechanical treatments and prescribed fire. Overall, the landscape would be 55 percent departed from historic conditions, with a landscape FRCC of 2.

Old Forest Management and Timber Production

Within dry Douglas-fir stands, modeling 20 years in the future predicts 18 percent of the stands would be classified as late development open, and 17 percent of the stands as late development closed. The largest amount of stands (45 percent) would be classified as mid development closed. Closed-canopied stands, especially those in the mid development stage are particularly susceptible to stand-replacing fire events due to dense canopies and abundant ladder fuels. Once late development open structure was reached, regular fire treatments would be needed to maintain this condition.

Within subalpine fir/lodgepole pine stands, modeling 20 years into the future predicts 12 percent of stands would be classified as late development closed, with no stands classified as late development open. Late forest structure in this vegetation type would persist until fire occurrence, and would revert to early development.

Within mixed conifer stands, modeling 20 years into the future predicts 21 percent of the stands within this vegetation type would be considered late development closed, with 1 percent late development open.

Within western red cedar/western hemlock stands, modeling 20 years into the future predicts 36 percent of the stands would be classified as late development closed and would continue to experience natural stand-replacement fire if left to natural disturbances.

Within the spruce/subalpine fire stands, modeling 20 years into the future predicts 20 percent of the vegetation type would be classified as late development closed. Replacement fire historically occurred every 150 years, with that fire return interval and severity persisting without management intervention.

Ecosystem departure would be rated as low across 26 percent of the landscape, supporting the retention of late forest structure in the Douglas-fir dry type as low-severity fire moves through those areas that typically experienced low-severity fire. Mixed and high-severity fire would also be expected if fire plays its natural role in all other vegetation types. Seventy-four percent of the landscape exhibits a departure from natural fire process and would remain predisposed to losing key ecosystem components, which could threaten late forest structure and timber production. Losing key ecosystem components in late forest structure would impact dependent surrogate wildlife species habitat (Gaines 2017).

Recommended Wilderness Areas

Approximately 61,700 acres would be recommended as wilderness. Mountain bike and chainsaw use would be allowed to continue until Congress acts to designate the areas as wilderness. Some fire management tools (helispots, etc.) would require approval prior to their use in the recommended wilderness.

Alternative B

Stand departures relating to fire frequency and severity would change from current conditions as follows:

Table 69. Alternative B predicted departure by vegetation type

Vegetation Type	Landfire Biophysical Setting	Acres	Average Departure	Departure Compared to Current Conditions	VCC*	Frequency Departure	Severity Departure
Douglas-fir dry	1010451 - Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest – Ponderosa Pine – Douglas-fir	486,000	68	Down 3%	2	89%	86%
Subalpine fir / Lodgepole pine	1010452 - Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest – Larch	173,700	21	Down 14%	1	6%	47%
Northern Rocky Mountain Mixed Conifer	1010471 - Northern Rocky Mountain Mesic Montane Mixed Conifer Forest	308,400	48	Down 3%	2	66%	38%
Western Redcedar / Western Hemlock	1010471 – Northern Rocky Mountain Mesic Montane Mixed Conifer Forest (95%) / 1010472 – Northern Rocky Mountain Mesic Montane Mixed Conifer Forest – Cedar Groves (5%)	95,800	48	Down 5%	2	66%	38%
Spruce / Subalpine fir	1010560 - Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland (90%) / 1011610 - Northern Rocky Mountain Conifer Swamp (10%)	20,200	32	Up 6%	2	1%	44%

*VCC = vegetation condition class

Stand departure is lowered in all vegetation types except Spruce/Subalpine Fir. Overall, mean fire return intervals decrease slightly, and severity is changed through the use of mechanical and prescribed fire treatments. Overall, the landscape is 51 percent departed from historic conditions, and has a landscape FRCC of 2.

Old Forest Management and Timber Production

Late forest structure restoration is the highest priority within the Restoration Zone management area of alternative B, which encompasses 31 percent of the Forest. Restoring late forest structure in dry forest types would allow fire to resume its natural role in those areas, as species composition and structure would support resiliency to low-severity fire in the Douglas-fir dry type. Some restoration activities (timber harvest for example) would not occur in moist mixed conifer forests, meaning that mixed and high-severity fire would continue to be expected in those areas. Because mixed and high-severity fire serves critical natural processes in the moist mixed conifer type, this is expected to enhance and improve fire regime condition class within the restoration zone management area.

The Active Management area includes 43 percent of the Forest. All activities (timber harvest, thinning, prescribed fire) are available for use as treatments focus on a stable flow of forest products in all vegetation types. The vegetation treatments prescribed in the active management area are primarily designed to promote production of wood products. These treatments have limited value in restoring natural disturbance and fire process into these forested ecosystems.

Within dry Douglas-fir stands, modeling 20 years in the future predicts 15 percent of the stands would be classified as late development open, and 19 percent of the stands as late development closed. The largest proportion of stands (49 percent) would be classified as mid development closed. Closed-canopied stands, especially those in the mid development stage are particularly susceptible to stand-replacing fire events due to dense canopies and abundant ladder fuels. Once late development open structure was reached, regular fire treatments would be needed to maintain this condition.

Within subalpine fir/lodgepole pine stands, modeling 20 years into the future predicts 12 percent of stands would be classified as late development closed, with no stands classified as late development open. Late forest structure in this vegetation type would persist until fire occurrence, and would revert to early development.

Within mixed conifer stands, modeling 20 years into the future predicts 21 percent of the stands within this vegetation type would be considered late development closed, with 1 percent late development open.

Within western red cedar/western hemlock stands, modeling 20 years into the future predicts 35 percent of the stands would be classified as late development closed and would continue to experience natural stand-replacement fire if left to natural disturbances.

Within spruce/subalpine fire stands, modeling 20 years into the future predicts 16 percent of the vegetation type would be classified as late development closed. Replacement fire historically occurred every 150 years, with that fire return interval and severity persisting without management intervention.

Ecosystem departure would be rated as low across 38 percent of the landscape, supporting the retention of late forest structure in the Douglas-fir dry type as low-severity fire moves through those areas that typically experienced low-severity fire. Mixed and high-severity fire would also be expected if fire plays its natural role in all other vegetation types. Sixty-two percent of the landscape exhibits a departure from natural fire process and would remain predisposed to losing key ecosystem components, which could threaten late forest structure and timber production. Losing key ecosystem components in late forest structure would impact dependent surrogate wildlife species habitat (Gaines 2017).

Recommended Wilderness Areas

Approximately 220,300 acres would recommended as wilderness under alternative B. Mechanized and motorized uses would not be allowed prior to Congress acting to designate the areas as wilderness. Some fire management tools (chainsaws, helispots, etc.) would require approval prior to their use in the recommended wilderness.

Alternative O

Alternative O would change stand departure of vegetation types as follows:

Table 70. Alternative O predicted departure by vegetation type

Vegetation Type	Landfire Biophysical Setting	Acres	Average Departure	Departure Compared to Current Conditions	VCC*	Frequency Departure	Severity Departure
Douglas-fir dry	1010451 – Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest – Ponderosa Pine – Douglas-fir	486,000	67	Down 4%	2	87%	84%
Subalpine fir / Lodgepole pine	1010452 - Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest – Larch	173,700	22	Down 13%	1	6%	47%
Northern Rocky Mountain Mixed Conifer	1010471 – Northern Rocky Mountain Mesic Montane Mixed Conifer Forest	308,400	48	Down 3%	2	66%	38%
Western Redcedar / Western Hemlock	1010471 – Northern Rocky Mountain Mesic Montane Mixed Conifer Forest (95%) / 1010472 – Northern Rocky Mountain Mesic Montane Mixed Conifer Forest – Cedar Groves (5%)	95,800	49	Down 4%	2	66%	38%
Spruce / Subalpine fir	1010560 - Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland (90%) / 1011610 - Northern Rocky Mountain Conifer Swamp (10%)	20,200	32	Up 6%	2	1%	44%

*VCC = vegetation condition class

Departure would decrease across all vegetation types except Spruce/Subalpine fir. Mean fire return intervals would decrease slightly with the use of prescribed fire and the use of unplanned ignitions. Fire severity would be reduced through the use of mechanical treatments and prescribed fire. Overall, the landscape would be 52 percent departed from historic conditions, with a landscape FRCC of 2.

Old Forest Management and Timber Production

Within dry Douglas-fir stands, modeling 20 years in the future predicts 15 percent of the stands would be classified as late development open and 19 percent of the stands as late development closed. The largest proportion of stands (50 percent) would be classified as mid development closed. Closed-canopied stands, especially those in the mid development stage are particularly susceptible to stand-replacing fire events due to dense canopies and abundant ladder fuels. Once late development open structure was reached, regular fire treatments would be needed to maintain this condition.

Within subalpine fir/lodgepole pine stands, modeling 20 years into the future predicts 12 percent of stands would be classified as late development closed, with no of stands classified as late development open. Late forest structure in this vegetation type would persist until fire occurrence, and would revert to early development.

Within mixed conifer stands, modeling 20 years into the future predicts 21 percent of the stands within this vegetation type would be considered late development closed, with 1 percent late development open.

Within western red cedar/western hemlock stands, modeling 20 years into the future predicts 34 percent of the stands would be classified as late development closed.

Within spruce/subalpine fire stands, modeling 20 years into the future predicts 18 percent of the vegetation type would be classified as late development closed. Replacement fire historically occurred every 150 years, with that fire return interval and severity persisting without management intervention.

Ecosystem departure would be rated as low across 35 percent of the landscape, supporting the retention of late forest structure in the Douglas-fir dry type as low-severity fire moves through those areas that typically experienced low-severity fire. Mixed and high-severity fire would also be expected if fire plays its natural role in all other vegetation types. Sixty-five percent of the landscape exhibits a departure from natural fire process and would remain predisposed to losing key ecosystem components, which could threaten late forest structure and timber production. Losing key ecosystem components in late forest structure would impact dependent surrogate wildlife species habitat (Gaines 2017).

Recommended Wilderness Areas

Approximately 15,900 acres would be recommended as wilderness. Mechanized uses would be allowed to continue until Congress acts to designate the areas as wilderness. If the areas are designated by Congress as wilderness, approval to use some tools (chainsaws, helispots, etc.) would need to be obtained prior to their use.

Cumulative Effects (Common to all alternatives)

Past, Present, and Foreseeable Activities Relevant to Cumulative Effects Analysis

Of all the ongoing and foreseeable future actions that have the potential to affect fire, especially unwanted wildfire, climate change is likely to be the single most important factor. The effects of climate change would likely combine with some of the effects that result from implementing the alternatives, to produce cumulative impacts. In general, the fire seasons are expected to become longer, large wildfires are expected to occur more often, and total area burned is expected to increase. By increasing the amount of prescribed fire use, as well as the amount of natural, unplanned ignitions that are used to meet resource objectives, the action alternatives would be expected to partially offset predicted effects from the climate change. The more fire use (and mechanical treatments) that occurs as a result of the action alternatives, the greater the fuels would be reduced and the forest vegetation restored to more resistant and resilient conditions, which would mitigate climate change effects.

Through CWPPs there has been an emphasis to treat Forest Service land as well as State lands and private property within the WUI. The efforts identified in all alternatives, in combination with past, current, and future treatments on private and State lands would help to reduce the risk of uncharacteristic wildfire impacts to communities and the national forest. Treatments carried out on the majority of private lands bordering the Colville National Forest are done with grants from the WA-DNR. WA-DNR Landowner Assistance Foresters assist with planning those treatments with the intent of reducing fire hazards, which reduces the risk to both the private lands being treated and the potential of fire moving off private land onto NFS land. Treatments on NFS land would also serve to reduce the potential of fire moving onto private land.

Neighboring land managers (Colville Confederated Tribes, BLM, Okanogan-Wenatchee National Forest, Idaho Panhandle National Forests) are also implementing projects that produce emissions (smoke). There may be additional impacts to Colville National Forest lands in terms of air quality, visibility, and human health. Tribal participation in the Washington Smoke Implementation Plan is voluntary, though the other agencies follow guidance from the State.

There is a direct relationship between the number of snowmobiles and emissions and, consequently, air quality levels. Meteorology also plays an important role in that cold, stable atmospheric conditions with low wind speeds hinder the dispersion of air pollutants and allow pollutants to accumulate in the immediate area of their release (USDI National Park Service 2000). No alternative is expected to significantly alter current levels of snowmobile use, and air quality across the forest would not be altered due to snowmobile use.

Invasive Plants

Invasive plants are recognized as a major threat to native vegetation and wildlife, as well as to social and economic conditions. Invasive plants are defined as “non-native plants whose introduction does, or are likely to, cause economic or environmental harm or harm to human health” per E.O. 13112. The Chief of the Forest Service declared invasive species as one of the four main threats to ecosystem health (USDA Forest Service 2004). The threat is considered serious because invasive plants have the potential to displace or change native plant communities and can increase wildfire hazard, degrade fish and wildlife habitat, eliminate rare and endangered plants, impair water quality and watershed health, and adversely affect a wide variety of other resource values, such as recreational opportunities.

Introduction

Language concerning why forest plans need to consider invasive plants is contained within Forest Service Handbook (FSH) 2150 and 2109 which state that: “All pesticide-use activities on NFS lands must be consistent with the standards and guidelines and other management direction in applicable Forest Land and Resource Management Plans (forest plans). Forest plans generally mandate the use of Integrated Pest Management (IPM) for management of forest pests such as insects, diseases, animals, and invasive or unwanted vegetation. Forest Plans should also contain relevant language relating to the management of areas as diverse as wilderness, research natural areas, botanical areas, other reserved areas such as wild and scenic rivers, seed orchards, and nurseries, in addition to general forest and multiple-use areas.” Other Direction is found in Forest Service Manual (FSM) 2900 at 2903.2 which states that: When applicable, invasive species management actions and standards should be incorporated into resource management plans at the forest level, and in programmatic environmental planning and assessment documents at the regional or national levels.”

The area affected by invasive plant species has increased throughout the Interior Columbia Basin during the last 100 years. The same trend has occurred in northeastern Washington during the last 30 years. Invasive plant populations are increasing at a rate of 8 to 12 percent per year on NFS lands (USDA Forest Service 2005a and 1999b). Vegetation types that are most susceptible to invasive plant infestation are dominated by dry forest, dry grass, dry shrub, and cool shrub types.

Invasive plants are spread by natural vectors (such as birds, wildlife, insects, wind and water) as well as human-related vectors (such as contaminated hay, vehicles, equipment, riding stock, pack stock, hiking and livestock grazing). While transportation vectors are important in the spread of invasive plants, soil disturbance also plays a critical role. Invasion and dominance by invasive plants is highly correlated with soil disturbance, but are not limited to disturbed areas (Cox 1999). Invasive plants can readily invade, occupy, and/or dominate conifer plantations, road prisms, trail heads, trails, mined sites, gravel pits, river corridors, wildlife wallows and bedding areas and rangelands, but they can also establish in naturally occurring disturbances and small forest openings. Recognized human management activities that have some potential to influence invasive plant establishment and spread are; timber and other vegetation management, road construction, road decommissioning, road maintenance, livestock grazing, fire and fuels management, recreation and recreation management and mining. Prevention measures are assumed to slow the rate of spread (assumed to slow by half to 4 to 6 percent; R6 2005 FEIS).

Affected Environment

Invasive plants occupy approximately 20,000 acres within the Colville National Forest. Most infested acres occur along roads and on dry south facing slopes in low elevations, but there are infestations known to exist in areas of past timber harvest, forest openings, recreation sites, trails, and shorelines of lakes, ponds, rivers and streams. Thirty-five different invasive plants are known to exist on the Forest with all but three being broadleaf herbaceous plants. The average annual amount of acres treated for invasive plants is 2,152 acres per year and was based on efforts for years 2012 through 2014.

Currently, the Colville National Forest uses an integrated approach in managing invasive plants, which includes prevention measures, inventory, treatment, and monitoring. Integrated pest management is the coordinated use of multiple tactics to assure stable ecosystem function and maintain pest damage below economic levels, while minimizing hazards to human, animals, plants and the environment. The Forest uses a variety of treatment methods to control invasive plants and treatment methods are determined by plant attributes and site-specific conditions found at treatment locations. The different treatment methods used by the Colville National Forest and some examples of each method include:

- Releasing approved biological control agents – Host-specific organisms
- Cultural – Using fertilizer
- Manual Removal – Hand pulling and digging
- Mechanical Treatment – Mowing
- Chemical – Applying herbicide

These approaches to managing invasive plants would be continued in the no action alternative and all action alternatives.

In 2005, the regional forester amended the 1988 forest plan with the record of decision (ROD) for the Preventing and Managing Invasive Plants FEIS (USDA Forest Service 2005a). This amendment added management direction for invasive plants to the 1988 forest plan, including goals, objectives, standards and a monitoring framework, which guide the Forest in responding to Invasive Plant management challenges. The 1988 forest plan direction for managing invasive plants would continue for the no action alternative.

In addition to the invasive plant direction contained in the 2005 FEIS and ROD, the Colville National Forest developed Noxious Weed Prevention Guidelines in 1999, which also guide the Forest. Guidance contained in the Colville National Forest Noxious Weed Prevention Guidelines would continue for the no action alternative and all action alternatives.

All alternatives were assessed for their predicted ability to meet the desired condition and by the degree to which ground disturbance could lead to conditions that would increase the invasive species spread rate.

Current and ongoing management direction has the potential to meet this desired condition. The Preventing and Managing Invasive Plants FEIS (USDA Forest Service 2005a) disclosed that the adopted invasive plant management direction had a “moderate to high potential to reduce rate of spread,” and concluded that effective treatment of the existing populations along with prevention measures applied to land uses and activities could reduce the current 8 to 12 percent rate of spread to about 4 to 6 percent. Thus, to meet the desired condition, both current infestations and new infestations need to be contained, controlled, or eradicated.

Need for Change

The Need for Change is described in chapter 1 of the FEIS. Only information related specifically to the invasive species analysis and the Need for Change is discussed in this section.

Old Forest Management and Timber Production

One factor driving development of alternatives is the recent history of increased levels of disturbance resulting from fire and insect and disease activity and the interaction with increasing risk to viability of old forest-dependent wildlife species. The alternatives designate different areas and objective levels for scheduled timber harvest and types of fuel treatment. The different levels of vegetative treatment could result in different effects to management of invasive plant species.

Motorized Recreation Trails and Access

The alternatives vary in direction for management of motorized roads and trails. The amount of area allowing motorized roads and trails as a suitable use, and the amount of NFS roads could affect management of invasive plant species.

Recommended Wilderness Areas

By law, all NFS lands must be evaluated for possible wilderness recommendation during the plan revision process. The amount of recommended wilderness may change the types of treatments authorized under each alternative for treatment of invasive plant species.

Environmental Consequences

Methodology

Since activities associated with timber management and production create the largest amount of bare soil conditions, the acres of suitable timberlands by alternative would be used as a surrogate to predict the amount of risk for invasive plant spread. Specific locations that are likely to be at risk for invasive plant establishment and spread through vegetation and fuels management are roads, landings and skid trails because of the high levels of use which occur and result in bare soils.

Potential changes to access on the Colville National Forest through the various alternatives will also be discussed in this section to evaluate how invasive plants could be influenced by management activities. OHV routes will not be considered separately because they generally overlap existing motorized access routes, are considered part of the Forest's motorized access system, and none of the alternatives include designation of any specific roads or motorized trails.

This section will not consider livestock grazing in evaluating the effects of the various alternatives since allotment status and stocking rates would not change as a result of the forest plan revision effort or the alternatives considered.

Assumptions

- The 1998 Environmental Assessment for the Colville National Forest Integrated Noxious Weed Treatment (USDA Forest Service 1998a) analyzed and approved the use of manual, biological, and chemical control agents (herbicides) for the treatment of noxious or invasive species. This document and Decision made to implement alternative C would continue to guide invasive plant management on the Colville National Forest until such time as it is replaced by a newer document/decision.
- The 2005 Pacific Northwest Region Invasive Plant Program Preventing and Managing Invasive Plants Final Environmental Impact Statement (FEIS) and Record of Decision (ROD) along with its standards, goals and objectives would continue to guide the Colville National Forest for the no action alternative. The intent of this direction is brought forward into the action alternatives; however, the management direction has been updated to reduce redundancy with and improve consistency with national policy as codified in FSM 2900.
- Compliance with terms and conditions that implement the reasonable and prudent measures described in applicable biological opinions providing protection for federally listed species.

Methods of Analysis

This analysis relies on the timber suitability analysis and the acres generated for each alternative in it. To compare the different alternatives, they are evaluated against the no action alternative that would continue existing management.

Also considered in this analysis are the desired conditions for road densities because forest roads have the potential to influence rates of spread and acres infested for invasive plants.

Incomplete and Unavailable Information

Numbers of road miles projected to exist through implementation of the revised land and resource management plan.

Spatial and Temporal Context for Effects Analysis

This analysis is completed for all NFS lands within the administrative boundaries of the Colville National Forest. It is assumed that the effective life of the plan would be 15 to 20 years, and this analysis discusses the effects to invasive plants over this time period.

Past, Present, and Foreseeable Activities Relevant to Cumulative Effects Analysis

- Invasive plants on private property that threaten to spread to NFS lands.
- Invasive plants on NFS lands with the potential to affect adjacent private lands
- People driving on roads and motorized trails on NFS lands

- Livestock grazing
- Climate change

Summary of Effects

Given the Colville National Forest's current level of invasive plant occurrence, and a predicted rate of spread equaling 5 percent per year, it is expected that completing approximately 2,000 acres of invasive plant treatments and/or restoration activities relating to restoring native vegetation (including active restoration such as planting, seeding and mulching) would allow the Forest to proceed toward and achieve desired conditions for vegetation and invasive species.

Table 71 demonstrates that effective treatment of an average of 2,000 acres per year would result in a trend toward reducing the density and extent of invasive plants over a 15-year period.

Table 71. Prediction of Colville National Forest acres of invasive plant infestation

Year	Beginning Acres	New Acres	Treated Acres	Ending Acres
1	20,000	1,000	2,000	19,000
2	19,000	950	2,000	17,950
3	17,950	898	2,000	16,848
4	16,848	842	2,000	15,690
5	15,690	784	2,000	14,474
6	14,474	724	2,000	13,198
7	13,198	660	2,000	11,858
8	11,858	593	2,000	10,451
9	10,451	523	2,000	8,973
10	8,973	449	2,000	7,422
11	7,422	371	2,000	5,793
12	5,793	290	2,000	4,083
13	4,083	204	2,000	2,287
14	2,287	114	2,000	401
15	401	20	421	0

The actions and activities resulting from the various alternatives have the potential to create conditions conducive to the spread of invasive plants, but management direction would be in place to limit the potential extent of spread and infestation. However, since invasion and dominance by invasive plants is highly correlated to soil disturbances (Cox 1999), the greater the potential extent and intensity of timber harvest, fuels reductions, road maintenance and prescribed fire, the greater the potential for indirect effects from soil disturbances (e.g., conditions favorable to invasive plants).

Average fire regime condition class percent departure by forest type, over the life of the revised land and resource management plan, only decreases by 2 to 3 percent in the Douglas-fir dry forest type under the action alternatives. Mechanical and prescribed fire treatments in the Douglas-fir dry forest type would focus on reducing fire severity, but due to the stands missing multiple fire returns, the relatively high mean fire return interval continues to keep this vegetation type severely departed from historic conditions (Curtis 2017). Since there is little change in the potential for wildfire as a result of forest management under the action alternatives, there is no anticipated additional effects to invasive plant populations from wildfire.

To compare alternatives, an index was created to display the relative amount of soil-disturbing activities related to timber harvest and associated actions for each alternative. The index relies upon the timber suitability analysis completed for the forest plan revision effort. The amount of suitable acres for the no action alternative would be the base line and would have a coefficient value of 1. It is assumed that the risk for invasive plant establishment and spread would be associated with suitable forestland and that the amount of potential soil disturbance would change equally with the change in acres suitable.

The index values for the proposed action and alternatives R, P, B, and O are displayed relative to the no action alternative in table 72. There is no standard for measuring soil disturbance as a predictor of nonnative plant invasion, either as an observable measurable value or as a percent of managed lands. The index serves only to compare alternatives and suggest which alternatives are more or less likely to create conditions favorable to the invasion of nonnative invasive plants. The higher the index value, the greater the risk for invasive plant establishment. In fact, management direction for the Invasive Plants program requires that each project prevent or minimize potential for invasive species introduction, establishment, and/or spread.

Table 72. Index values for soil-disturbing actions that favor invasion by invasive plants for each alternative of the forest plan revision

	No Action	Proposed Action	Alternative R	Alternative P	Alternative B	Alternative O
Suitable Forest Lands (acres)	535,700	653,200	129,400	656,600	384,500	347,500
Index Values	1	1.22	0.24	1.23	0.72	0.65

Compared to the no action alternative, the proposed action and alternative P would represent a greater risk for invasive plant establishment and spread by creating opportunities for invasive plants, while alternatives R, B, and O represent less risk. At the project level, all management activities would be designed to include measures that would help prevent invasive plant spread.

No Action Alternative

The no action alternative would result in the same level of risk for invasive plants as has been experienced under the 1988 forest plan. This is because the amount of suitable forestlands does not change in this alternative from the 1988 forest plan.

Timber Production

An index value rating of 1 found in table 72 for the no action alternative equates to the risk of invasive plant establishment and spread from timber production, and associated road and fuels reduction work, being equal to the current risk. The costs associated with treating invasive plants and the acres needing treatment are predicted to be the same as it is currently.

Motorized Recreation Trails

The no action alternative would result in the same level of risk from motorized recreation trails, and use of these trails, as current management. Therefore, there is no change.

Access

The no action alternative would result in the same level of risk from access as current management. Therefore, there is no change.

Wildlife

The quality of wildlife habitat resulting from invasive plant establishment and spread for this analysis is influenced by the amount of risk present. Since the largest risk factor is related to timber production, and associated management practices, risks to wildlife habitat would be in alignment with the risks from timber management.

The no action alternative would result in the same level of risk to the quality of wildlife habitat from invasive plants as current management. Therefore, there is no change.

Riparian and Aquatic Resource Management

The no action alternative would result in the same level of risk to riparian and aquatic resource management as current management. Therefore, there is no change at the forestwide level.

Proposed Action

The proposed action alternative would result in an elevated level of risk for invasive plants compared to the no action alternative and that which has been experienced under the 1988 plan. This is because the amount of suitable forestlands is predicted to increase, and proposed road density limits are not likely to have an appreciable change.

Timber Production and Management

An index value rating of 1.22 found in table 72 for the proposed action equates to the risk of invasive plant establishment and spread from timber production, and associated road and fuels reduction work, being 22 percent greater than the risk in the 1988 plan. This 22 percent increase in risk has the potential to result in a need to treat more acres of invasive plants than experienced currently. This potential need to treat more acres could also result in increased costs for invasive plant treatment, increased monitoring and inspection efforts, and increased coordination efforts around invasive plant issues.

Motorized Recreation Trails

The proposed action could experience a slightly higher level of risk from motorized recreation trails, and use of these trails, to invasive plants spread when compared to current management. While the management area identified as backcountry motorized is projected to increase by approximately 4 percent, it cannot be said with any level of certainty that the actual presence of motorized trails would increase under this alternative.

Access

The proposed action would not likely result in a substantial change in risk to invasive plant spread from access compared to current management. With road density limits of 2 miles per square mile for focused restoration areas and 3 miles per square mile for general restoration areas, there would not be an appreciable change in open road miles.

Wildlife

The quality of wildlife habitat resulting from invasive plant establishment and spread for this analysis is influenced by the amount of risk present. Since the largest risk factor is related to timber production, and associated management practices, risks to wildlife habitat would be in alignment with the risks from timber management.

The proposed action would result in a 22 percent increase in risk to the quality of wildlife habitat from invasive plants compared to current management.

Riparian and Aquatic Resource Management

The proposed action would result in a similar level of risk to riparian and aquatic resource management from invasive plant establishment and spread as current management. Therefore, there would be little change.

Alternative R

Alternative R would result in a substantially reduced level of risk for invasive plants compared to the no action alternative and that which has been experienced under the 1988 forest plan. This is because the amount of suitable forestlands is predicted to decrease as a myriad of protections are proposed in this alternative.

Changes to road density are likely to result in fewer roads on the Forest. Having fewer open roads would reduce the amount of bare soil associated with roads and human-related vectors of spread through vehicles would be decreased.

Timber Production and Management

An index value rating of 0.24 found in table 72 for alternative R equates to the risk of invasive plant establishment and spread from timber production, and associated road and fuels reduction work, being 76 percent less than the risk in the 1988 forest plan. This 76 percent decrease in risk has the potential to result in a need to treat fewer acres of invasive plants than experienced currently. This potential need to treat fewer acres could also result in decreased costs for invasive plant treatment and decreased monitoring and inspection efforts.

Motorized Recreation Trails

Alternative R would experience a reduced level of risk from motorized recreation trails, and use of these trails, to invasive plants spread when compared to current management. The Backcountry Motorized Management Area in this alternative would only comprise approximately 1 percent of the Colville National Forest. This is 60 percent less than the area identified in the no action alternative (1988 forest plan.)

Assuming that actual miles of motorized recreation trails would be reduced as a result of the change in the amount of backcountry motorized acres, the trail system would have a lower risk to invasive plant establishment and spread by there being fewer miles of trail available for use.

Access

Alternative R would result in a reduction in the risk to invasive plant spread from access compared to current management. With road density limits of 1 mile per square mile for focused restoration areas and 2 miles per square mile for general restoration areas, there would be fewer roads available to be driven. Therefore, potential for invasive plants to be spread from the road system would be less.

Since this alternative would result in a reduction in the amount of road miles over the life of the plan, there would be less bare soil associated with the maintenance and use of these roads. It is expected that decommissioned roads would have permanent vegetative cover, which would naturally deter invasive plants by not providing available niches to occupy in the future.

Wildlife

The quality of wildlife habitat resulting from invasive plant establishment and spread for this analysis is influenced by the amount of risk present. Since the largest risk factor is related to timber production, and associated management practices, risks to wildlife habitat would be in alignment with the risks from timber management.

The proposed action would result in a 76 percent decrease in risk to the quality of wildlife habitat from invasive plants compared to current management.

Riparian and Aquatic Resource Management

Through implementation of alternative R, there would be a similar risk to riparian management, compared to the no action alternative, because similar strategies would be used in regard to limiting ground disturbance within riparian management areas. Following the guidance in the Aquatic Riparian Conservation Strategy Modified (ARCS-Mod) concerning aquatic invasive species (AIS), the risk of infestation and spread of these plants would be reduced by the efforts to clean equipment and avoid contaminating new sites.

Alternative P

Alternative P would result in an elevated level of risk for invasive plants compared to the no action alternative and that which has been experienced under the 1988 forest plan. This is because the amount of suitable forestlands is predicted to increase. The increase is likely curbed to some degree by the reduction in road miles that should be expected over the life of the plan for this alternative.

Timber Production and Management

An index value rating of 1.23 found in table 72 for alternative P equates to the risk of invasive plant establishment and spread from timber production, and associated road and fuels reduction work, being 23 percent greater than the risk in the 1988 forest plan. This 23 percent increase in risk has the potential to result in a need to treat more acres of invasive plants than experienced currently. This potential need to treat more acres could also result in increased costs for invasive plant treatment, increased monitoring and inspection efforts, and increased coordination efforts around invasive plant issues.

Motorized Recreation Trails

Alternative P could experience a slightly higher level of risk from motorized recreation trails, and use of these trails, to invasive plants spread when compared to current management. While the management area identified as backcountry motorized is projected to increase by approximately 3 percent, it cannot be said with any level of certainty that the actual presence of motorized trails would increase under this alternative.

Access

Alternative P would result in a reduction in the risk to invasive plant spread from access compared to current management. With road density limits of 1 mile per square mile for focused restoration areas and 2 miles per square mile for general restoration areas, there would be fewer roads available to be driven. Therefore, potential for invasive plants to be spread from the road system would be less.

Since this alternative would result in a reduction in the amount of road miles over the life of the plan, there would be less bare soil associated with the maintenance and use of these roads. It is expected that decommissioned roads would have permanent vegetative cover, which would naturally deter invasive plants by not providing available niches to occupy in the future.

Wildlife

The quality of wildlife habitat resulting from invasive plant establishment and spread for this analysis is influenced by the amount of risk present. Since the largest risk factor is related to timber production, and associated management practices, risks to wildlife habitat would be in alignment with the risks from timber management.

The proposed action would result in a 23 percent increase in risk to the quality of wildlife habitat from invasive plants compared to current management.

Riparian and Aquatic Resource Management

Through implementation of alternative P, there would be a similar risk to riparian management, compared to the no action alternative, because similar strategies would be used in regard to limiting ground disturbance within riparian management areas. Following the guidance in the Aquatic and Riparian Conservation Strategy (Colville ARCS) concerning AIS the risk of infestation and spread of these plants would be reduced by the efforts to clean equipment and avoid contaminating new sites.

Alternative B

Alternative B would result in a reduced level of risk for invasive plants compared to the no action alternative and that experienced under the 1988 forest plan. This is because the amount of suitable forestlands is predicted to decrease.

Timber Production and Management

An index value rating of 0.72 found in table 72 for alternative B equates to the risk of invasive plant establishment and spread from timber production, and associated road and fuels reduction work, being 24 percent less than the risk in the 1988 forest plan. This 24 percent decrease in risk has the potential to result in a need to treat fewer acres of invasive plants than experienced currently. This potential need to treat fewer acres could also result in decreased costs for invasive plant treatment and decreased monitoring and inspection efforts.

Motorized Recreation Trails

Alternative B would experience a reduced level of risk from motorized recreation trails, and use of these trails, to invasive plants spread when compared to current management. The Backcountry Motorized Management Area in this alternative would comprise less than 1 percent of the Colville National Forest. This is 60 percent less than the area identified in the no action alternative (1988 forest plan).

Assuming that actual miles of motorized recreation trails would be reduced as a result of the change in the amount of backcountry motorized acres, the trail system would have a lower risk to invasive plant establishment and spread by there being fewer miles of trail available for use.

Access

Alternative B would result in the same level of risk from access as current management since the number of road miles is expected to stay the same. Therefore, there is no change.

Wildlife

The quality of wildlife habitat resulting from invasive plant establishment and spread for this analysis is influenced by the amount of risk present. Since the largest risk factor is related to timber production, and associated management practices, risks to wildlife habitat would be in alignment with the risks from timber management.

Alternative B would result in a 24 percent decrease in risk to the quality of wildlife habitat from invasive plants compared to current management.

Riparian and Aquatic Resource Management

Alternative B would result in the same level of risk to riparian and aquatic resource management as current management. Therefore, there is no change.

Alternative O

Alternative O would result in a reduced level of risk for invasive plants compared to the no action alternative and that which has been experienced under the 1988 forest plan. This is because the amount of suitable forestlands is predicted to decrease.

Timber Production and Management

An index value rating of 0.65 found in table 72 for alternative B equates to the risk of invasive plant establishment and spread from timber production, and associated road and fuels reduction work, being 35 percent less than the risk in the 1988 forest plan. This 35 percent decrease in risk has the potential to result in a need to treat fewer acres of invasive plants than experienced currently. This potential need to treat fewer acres could also result in decreased costs for invasive plant treatment and decreased monitoring and inspection efforts.

Motorized Recreation Trails

Alternative O could experience a slightly higher level of risk from motorized recreation trails, and use of these trails, to invasive plants spread when compared to current management. While the management area identified as backcountry motorized is projected to increase by approximately 3 percent, it cannot be said with any level of certainty that the actual presence of motorized trails would increase under this alternative.

Access

Alternative O would result in the same level of risk from access as current management since the number of road miles is expected to stay the same. Therefore, there is no change.

Wildlife

The quality of wildlife habitat resulting from invasive plant establishment and spread for this analysis is influenced by the amount of risk present. Since the largest risk factor is related to timber production and associated management practices, risks to wildlife habitat would be in alignment with the risks from timber management.

Alternative O would result in a 35 percent decrease in risk to the quality of wildlife habitat from invasive plants compared to current management.

Riparian and Aquatic Resource Management

Alternative O would result in a similar level of risk to riparian and aquatic resource management from invasive plant establishment and spread as current management. Therefore, there would be little change.

Cumulative Effects (Common to all alternatives)

Cumulative effects may arise from the introduction of invasive species from lands adjoining the plan area. These lands consist of other Federal (BLM), Tribal, State, county, or privately owned lands. The plant invasion process occurs in three phases: introduction, establishment, and spread. Invasive species are introduced via vectors, such as wind, water, or wildlife, in addition to the actions of people, which move seeds or plant fragments from one location to another. Wind and water, in particular, are major natural dispersal agents. For example, windblown seed of rush skeleton weed can be carried up to 20 miles (USDA Forest Service 2005a). Water is a primary aid in the dispersal of many species, including Japanese knotweed. Rivers and waterways have been identified as one of the biggest spread mechanisms for invasive plants (Sheley et al. 1995).

Various wildlife species can contribute to the spread of invasive plant species by dispersing seeds in their dung, on their coats or feathers, or between their hooves. Ants have even been identified as one of the dispersal agents for the seeds of Scotch broom (Parker et al. 1998). Though invasive plant propagules (seeds or plant fragments capable of establishing) may originate from outside sources, there is potential for them to affect the Colville National Forest. Therefore, the cumulative effects analysis area is considered northeastern Washington, and it includes lands of all ownership.

People traveling to the Colville National Forest may transport invasive plant propagules from adjacent or even distant lands. This may be done through a variety of means: motor vehicles, clothing and footwear, pets, stock, etc. Motor vehicles, in particular, have been shown to pick up and move invasive species seeds that can be deposited along roads (Schmidt 1989, Hodkinson and Thompson 1997). Roadside habitats are particularly susceptible to plant invasions for a number of reasons. Roads eliminate some of the physical and environmental barriers that help prevent invasion by increasing available light and dispersal opportunities. Disturbances associated with the use and maintenance of roads provide habitat easily exploited by invasive species, which can then seed themselves relatively swiftly along roadsides or be transported by animals or people (vehicles). Roads are primary vectors for the spread of invasive plants and the most likely vector for human transport of invasive plant propagules from outside the plan area.

Cumulative effects may be incurred from the transport and establishment of nonnative invasive plants from sources adjacent to the plan area. Likewise, weeds from NFS lands could spread to adjacent areas. However, these effects are expected to be small compared to the anticipated spread from invasive plants sites within the plan area. While the land and resource management plan addresses invasive plant spread via prevention standards, invasive plants would continue to move freely across borders, to and from ownerships, because the movement of seeds and propagules via wind, water, or wildlife are largely beyond the control of the Forest Service.

An effect associated with mechanical treatments and livestock grazing is the potential to spread invasive species from adjacent lands. New weed populations could occur from vehicle-transported seeds, disturbed soils and increased light availability following mechanical treatments or creation of seedbeds by livestock use. Livestock and wildlife can spread weed seeds, but livestock and wildlife use results in fewer new weed populations than those established along roads and trails by seeds spread from vehicle tires, equipment tracks, and/or attached soil (Tyser and Worley 1992, Tyser and Key 1988, Gelbard and Harrison 2003). This circumstance is attributed to the higher amount of biotic and below ground biotic resistance experienced in areas other than roads and trails (Gelbard and Harrison 2003). All alternatives would contribute similarly to the control, treatment, and eradication of invasive plant species introduced from outside the forests.

Cumulative effects may also result from climate change. Much of the research on invasive species interactions with climate change has contributed to the growing body of evidence that global warming has enabled invasive species to expand to areas where they were not previously able to persist (Dukes and Mooney 1999, Weltzin et al. 2003, Thuiller et al. 2007, Walther et al. 2009). Some researchers have modeled range expansions for some invasive species (*Centaurea solstitialis* and *Tamarix*) while predicting reduced invasion risk and significant range contractions for others (*Bromus tectorum, Euphorbia esula,* and *Centaurea biebersteinii*) by the year 2100 (Bradley et al. 2009). As the climate changes, the ranges of invasive plant species would change; some species may become less invasive, and others may become more invasive. Given their adaptive traits, invasive plants may be able to out-compete native species in the migration process to new suitable habitat (Hellmann et. al. 2008). Compared to a stable climate, the degree to which climate change has contributed to the current spread of invasive plants is unclear.

The revised forest plan responds to the challenges of increased risk of invasion from invasive plants, whether introduced from external sources and whether climate change may influence their spread, by incorporating standards to prevent the transport and establishment of invasive plant propagules and including objectives to reduce the area infested by invasive plants over time. The cumulative effects do not add significantly to effects expected from this alternative.

By the Colville National Forest implementing invasive plant control measures and prevention strategies through the forest plan revision, a positive cumulative effect would be realized when considered in light of the control and prevention measures being used on adjacent ownerships, which include the Idaho Panhandle National Forests, Okanogan-Wenatchee National Forest, private lands under the control of county weed boards, State lands and Canadian lands to the north managed by the Ministry of Forestry.

The intent of the Inventory and Monitoring Plan Framework contained as appendix M of the 2005 Preventing and Managing Invasive Plants EIS is updated in the action alternatives by (1) aligning measures with revised plan objectives, accomplishment reporting criteria and definitions in our data bases of record, (2) removing redundancy with Water Quality Best Management Plan monitoring for chemical uses, and (3) removing redundancy with programmatic and site-specific Endangered Species Consultation.

Fisheries

This section discusses effects to fisheries and aquatic habitat from the related specialist report (MacDonald et al. 2018), with special emphasis on the issues of riparian and aquatic resource management, access, and old forest management and timber production.

Affected Environment

Riparian Habitat

Riparian zones are found adjacent to streams, rivers, lakes and wetlands, providing a transitional zone between terrestrial and aquatic components of the landscape (Gregory et al. 1991). Although riparian zones occupy a small part of the overall Forest land base, they support a diverse vegetation community not found in the upland areas. Riparian zones provide important foraging, cover, travel corridors, and nesting habitat for birds, small and large mammals, reptiles, and amphibians. Healthy riparian zones with an abundance of trees and other native woody species and forbs provide for channel and floodplain stability and integrity. Healthy riparian vegetation adjacent to streams and on floodplains slow flood waters and reduce the likelihood of downstream flooding.

Riparian zones improve water quality by filtering runoff, sediment, and nutrients from adjacent upland slopes. Riparian zones provide stream cover and shade, which helps keep the summer water temperatures cool for salmonids and other aquatic species, and are a source of large woody debris to stream channels. Riparian zones also contribute to the aquatic food base as a source of terrestrial insects that fall into channels and by providing detritus input used by myriad of macroinvertebrate species, which in turn are forage for fish and certain bird species such as the American dipper (*Cinclus mexicanus*). Healthy, functioning riparian zones are vital for providing good water quality and diverse aquatic habitat (Naiman et al. 1992, FEMAT 1993).

Riparian conditions on the Forest are highly variable. Overall, some riparian zones on the Forest are functioning at or near their potential or are considered to be improving. However, there are many areas where they are functioning below their potential. Degraded riparian conditions have primarily resulted from livestock grazing, mining, timber harvest, fire management, road development, and water diversions. On forested landscapes, silviculture, road building, and fire suppression have altered riparian conditions by changing the riparian vegetation composition and structure; reducing the amount of large trees that provide large woody debris and shade; and altering channel morphology. To a lesser degree, disturbances associated with developed and dispersed recreation have impacted riparian habitat. Additional information regarding the current condition of riparian habitat is contained in the watershed section of FEIS chapter 3, in Day (2018), and later in this section.

Stream Channel Conditions

There are a variety of aquatic and riparian ecosystems on the Forest: streams, rivers, ponds, reservoirs, wetlands, and riparian areas. These ecosystems support complex communities of vertebrate and invertebrate aquatic life along with an assortment of riparian and aquatic plants. The Forest includes approximately 6,670 miles of stream including approximately 2,480 miles of perennial stream and 4,190 miles of intermittent stream. Approximately 500 stream miles are fish-bearing. All streams within the Forest eventually flow into the Columbia River. There are no anadromous fish (i.e., salmon and steelhead) on the Forest, as passage onto the Forest was blocked with the construction of Grand Coulee Dam.

Stream channel morphology responds to the flow of water and soil and vegetative inputs from adjacent land forms creating distinctive patterns such as pools, riffles, glides, and side channels. Different channel characteristics during varying flows provide a diverse range of aquatic habitats.

In 1989, the Forest began using stream surveys as the dominant inventory/monitoring tool to assess stream function and condition. By the end of 2012, greater than 95 percent of fish-bearing streams have been inventoried on the Forest, and many have been inventoried twice. The results of the surveys show that many of the reaches surveyed are not meeting the riparian management objectives (RMOs) as defined by INFISH.

A limiting factor for understanding the individual potential of most streams on the Forest has been the lack of reference conditions from similar stream reaches in unmanaged or lightly managed watersheds. However, many stream reaches are not meeting the RMOs and the aquatic habitat is judged to be functioning at risk or not properly functioning as described in the following Species Status, Watershed

Condition, and Foundation for Effects Assessment discussion. Based on the existing stream inventory data, common deficiencies in stream habitat conditions on the Forest include:

- Pools per mile are limited and large pools (greater than 3 feet in depth) even more so, thus, limiting overwintering, spawning and rearing habitat for salmonids.
- Large woody debris per mile is limited along many reaches. Large wood can be an important channel structural component that helps create pools and provide cover for fish.
- Watersheds in the eastern half of the forest, particularly in the south half of the Pend Oreille River subbasin are composed of predominately sensitive, decomposed granitic land types making them at greater risk for increased erosion from land management activities.
- Watersheds with active livestock grazing and heavy dispersed recreation use are more likely to have some reaches with excessive bank disturbance resulting in reduced stream bank cover and widening stream channels due to localized bank erosion and sediment deposits. Increases in channel width result in decreased stream depths and more surface area exposed to solar radiation making the streams more susceptible to increased water temperatures.
- Watersheds with high road densities and with roads located within riparian areas are more likely to have some reaches displaying stream bank alteration with reduced stream bank cover and accelerated sediment delivery to the channels from road surfaces.

More recent work that has been completed to describe the stream channel and watershed conditions will be discussed later in this section.

Lakes

There are 102 lakes, ponds and reservoirs on the Forest, the largest of which is Sullivan Lake. Most lakes are low-elevation. There are very few high-elevation lakes on the Forest. The lakes range from 0.6 acre to large reservoirs. A majority of the lakes and reservoirs are stocked with salmonids for sport fishing. The riparian habitat around many of the lakes has been affected by both dispersed and developed recreational use. Activities such as dispersed recreational camping and fishing result in limited, isolated damage, particularly along near-shore areas. Fluctuating reservoir levels due to hydropower energy production affects near-shore aquatic and wetland plant and animal communities, and the success of near-shore fish spawning. The impacts due to hydropower are or will be addressed during hydropower project relicensing and will be highlighted later in this section.

Some shallow-water lakes and large reservoirs are presently being affected by the spread of invasive aquatic plants such as Eurasian water-milfoil (EWM), yellow flag iris (YFI), flowering rush (FR), curly pondweed (CP), and invasive aquatic animals such as northern pike (NP) and American bullfrogs (AB) are also present on the Forest.

Table 73. Lakes and reservoirs occupied by invasive aquatic species

Lake or Reservoir Name	Invasive Aquatic Species
Boundary Reservoir	EWM,CP, NP
Box Canyon Reservoir	EWM,CP, NP, YFI, FR
Sherry Lake	EWM, YFI
Gillette Lake	EWM, YFI
Thomas Lake	EWM, YFI
Heritage Lake	EWM, YFI
Nile Lake	EWM

Lake or Reservoir Name	Invasive Aquatic Species
Bead Lake	EWM
Marshall Lake	EWM
Pierre Lake	YFI

Water Quality

Streams and lakes on the Forest generally have good quality water. Where water quality is impaired, as defined by Clean Water Act standards, the primary pollutants are fecal coliform, high stream temperature, low dissolved oxygen and pH. Approximately 3 miles of stream are listed as water quality impaired for fecal coliform, 15 miles for temperature, 15 miles for pH and 22 miles for dissolved oxygen. A more complete discussion of the current water quality on the Forest and actions to improve water quality is included in the watershed section of this chapter and in Day (2018).

Species Status, Watershed Condition and Foundation for Effects Assessment

Background

The objective of this evaluation (starting in 2010) was to refine the current "ecological sustainability" model where appropriate to ensure the evaluation approach addresses "species viability" criteria of the 1982 planning, while meeting the intent of the 2012 planning rule. The remainder of this section will describe the status of aquatic species on the Forest and the condition of watersheds on the Forest.

Watershed hierarchy is a key concept to understand. Watersheds are natural divisions of the landscape and the basic functioning unit of hydrologic systems and processes. Watersheds can be described or analyzed in a variety of scales ranging from large river basins to individual streams.

Watersheds are hierarchical (smaller ones are nested within larger ones) making them an appropriate context for considering many ecological processes. Physical processes such as rainfall, runoff, erosion, and sedimentation interact within the watershed boundaries to shape the landscape. Biological processes also occur within watershed boundaries. Environmental changes commonly culminate and appear at the watershed scale. Changes in soil, vegetation, topography, and chemicals change the quantity and quality of water, sediment, and organic material that flow through a watershed, influencing the characteristics of stream channels and aquatic habitat. The different watershed scales are identified through a numbering system called the Hydrologic Unit Code (HUC). The hydrologic unit system is a standardized watershed classification developed by the U.S. Geological Survey. Hydrologic units are watershed boundaries organized in a nested hierarchy by size. They range in size from regions to smaller units.[24] For this analysis, three scales of watershed will be discussed in order of decreasing hierarchy: subbasin (HUC 8), watershed (HUC10), and subwatershed (HUC 12). Additional information and explanation of the watershed hierarchy is contained in the watershed section of this document and in Day (2018).

The Forest includes five subbasins that provide the framework for describing the fish species status and subsequently assessing the effects of different alternatives, as shown in the following table.[25]

[24] See http://water.usgs.gov/GIS/huc.html

[25] The Forest includes a small portion of the Upper Spokane subbasin but there are no fish-bearing streams within the subbasin on Forest so the Upper Spokane subbasin is not discussed.

Table 74. Major subbasin hydrologic unit code (HUC) and size

Subbasin Name (8th level HUC*)	HUC	Total Subbasin Size (Acres)	Colville National Forest Acres
Sanpoil River	17020004	627,732	105,291
Kettle River	17020002	659,201	321,743
Upper Columbia River-Lake Roosevelt	17020001	1,327,733	212,863
Colville River	17020003	650,712	145,579
Pend Oreille River	17010216	698,349	557,449

To meet the sustainability requirements of the 2000 planning rule, the Forest (with the Okanogan-Wenatchee National Forest and Blue Mountain National Forests), participated in a Region 6 pilot effort to develop a process to address the contribution of NFS lands to the "sustainability of aquatic species." The result of the regional pilot process is a paper titled, *Process for Evaluating the Contribution of National Forest System Lands to Aquatic Ecological Sustainability* (Reiss et al. 2008). Reiss et al. (2008) developed the Aquatic Ecological Condition (AEC) model to evaluate the status of local populations of surrogate species and their habitat at the HUC 12 or sub-watershed scale. The results are then aggregated to produce an ecological sustainability or viability outcome for each surrogate species at the subbasin (HUC 8) scale.

The following describes process used for assessing the current status of aquatic species, watershed and habitat condition. More detail, including the complete scientific basis for the AEC, is provided in Reiss et al. (2008).

Aquatic Species Assessment and Current Status

The process developed by Reiss et al. (2008) relies on the use of "focal species" to assess current aquatic species status and later to assess the potential effects of alternatives on species viability. There are many aquatic native and non-native species that inhabit streams and rivers on the Forest. It is not possible to analyze viability for all the aquatic species present in subbasins within NFS lands. The focal species serve as surrogates for other aquatic vertebrate and invertebrate species. For this analysis, the term surrogate is used in place of focal to be consistent with the 1982 planning rule.

There are limitations to the surrogate species approach. The assumption that the condition and needs of one species will overlap completely with other species, even those with the same habitat association, is inherently problematic. The intent is that by analyzing and assessing the viability of surrogate species that utilize a variety of habitats at different temporal and spatial scales, and designing conservation strategies that address the results of the analysis, other aquatic species will benefit. Species that should not be selected as surrogate species include those about which very little is known and those that are dependent exclusively or primarily on habitat that is not substantially affected by management of NFS lands (FSH 1909.14 Chapter 43.22d, as cited in Reiss et al. 2008).

The process to determine surrogate species includes four steps following the process outlined in Reiss et al. (2008):

- Step 1(a) - Create a list of all known fish species and other aquatic species found on lands managed by the Forest and adjacent to the Forest.
- Step 1(b) - Determine species of concern
- Step 2 - Identify applicable spawning and rearing habitat associations for each species
- Step 3 - Categorize the species-at-risk identified above into habitat associations

- Step 4 - Choose species from each association as surrogate to serve as indicators of other species occupying the same habitat.

Colville National Forest Surrogate Species

Step 1(a) – Create a list of all known fish species and other aquatic species found on lands managed by the Forest and adjacent to the Forest.

The following species and associated narratives are from Reiss et al. (2008) unless otherwise cited.

Family ACIPENSERIDAE

White sturgeon (*Acipenser transmontanus*) occur predominantly in the mainstem Columbia River and are identified in the Lake Roosevelt subbasin plan as present, though all records are downstream of the Forest boundary. The white sturgeon is a long-lived, large-bodied species that inhabits deep water, using fast-moving tributaries for spawning. The only known spawning site in the Lake Roosevelt subbasin is near the confluence of the Pend Oreille and Columbia Rivers.

Family SALMONIDAE

Westslope cutthroat trout (WSCT) (*Oncorhynchus clarki lewisi*). WSCT are the native cutthroat trout within the Forest (Behnke 2002). WSCT are estimated to currently occupy approximately 59 percent of the species' total historic range and 58 percent of the historic range in Washington state (May 2009). WSCT are presently found in all five subbasins on the Forest; however, distribution of this species is extremely limited. Historically, fluvial or adfluvial populations existed within the Kettle River, Sanpoil, Pend Oreille, and Colville subbasins.[26] The native adfluvial and fluvial life history is nearly extirpated with most remaining native populations exhibiting a resident life history form. WSCT is a Forest Service Region 6 sensitive species.

With the exception of annually stocked lowland lakes, WSCT are generally found in headwater streams where stream temperatures are cold and human impact is limited. The conversion of riverine habitat on the Pend Oreille and Columbia Rivers into reservoirs without providing fish passage as well as dams and dikes on major tributaries have possibly eliminated the migratory life-history forms of WSCT.

Historic land management practices including logging, grazing, and road construction has impacted WSCT habitat. Additionally, the introduction of the coastal rainbow (*O. mykiss irredius*) Yellowstone cutthroat (*O.clarki bouvieri*) have led to hybridization of WSCT populations. The WSCT historic distribution on the Forest may have been reduced through the introduction of non-native brook trout (*Salvelinus fontinalis*), as brook trout have been found to displace cutthroat trout (Benjamin and Baxter 2010, Peterson et al. 2004). Most genetically pure WSCT populations are located behind either dams or natural falls or are found in high gradient headwaters.

Trotter et al. (2001) conducted a genetic analysis from 19 stream trout populations on the Forest. The populations were ranked from A to F depending upon the level of genetic introgression. A population received an A ranking – Pure stock if all individuals carried genetic markers of the species or subspecies of interest, and there was no history of stocking the water with hatchery fish of the same species or subspecies. A population received a B ranking if 1 to 9 percent of the individuals sampled carried evidence of genetic influence from another species or subspecies, but appearance-wise are all "good"

[26] In general terms, a fluvial life history refers to a species that exhibits a migratory life history where spawning and early rearing occur in tributary streams and then juvenile fish migrate to larger streams to rear and mature before returning to the natal stream to spawn. An adfluvial life history is similar to fluvial, but the juvenile fish migrate to a lake to rear and mature before returning to the natal stream to spawn. A resident life history refers to fish that spawn and rear in the same stream, although they may move throughout the stream during their life cycle

representatives of the species or subspecies of interest. The B ranking also applied to populations with no detectable hybridization, but there was a history of stocking the water with hatchery fish of the same species or subspecies. Trotter et al. (2001) concluded that the WSCT populations in the South Fork Sanpoil, Rocky Creek, Silver Creek, and East Fork Smalle Creek merited an A rating. Additionally, the populations in Fourth of July Creek, Harvey Creek, North Fork Sullivan Creek, Upper Sullivan Creek, Slate Creek, Cedar Creek, and East Branch LeClerc Creek were given B ratings.

The re-licensing terms for the Boundary Hydroelectric Project include the construction and operation of a hatchery to produce native salmonids to outplant into tributaries draining into Boundary Reservoir. Initially, the priority species would be WSCT, but could include bull trout or other native salmonids. The terms of the re-licensing also include establishing population goals to establish self-sustaining populations of the native fish. Seattle City Light is monitoring the success of the outplanting program until the population goals are met.

Interior redband trout ***(O. mykiss gairdneri)*** are a form of rainbow trout native to the east side of the Cascade Mountain crest (Behnke 2002). Redband trout are distributed within the Kettle, Sanpoil, Upper Columbia, and Colville subbasins. The interior redband trout is a Forest Service Region 6 sensitive species. Naturally occurring pure WSCT and interior redband usually do not inhabit the same streams on the Forest.

On March 3, 2013, the Regional Forester for USDA Forest Service Region 6 signed the *Rangewide Conservation Agreement for the Conservation and Management of Interior Redband Trout* (available at: https://www.fws.gov/pacific/fisheries/sphabcon/species/Interior%20Redband%20Trout%20%28Color%29.pdf. Accessed 2/22/2017). The agreement outlines a process of cooperation, coordination, and data sharing among the entities with either management responsibility or interest for the conservation of interior redband trout. The intent of the agreement is to enhance the cooperation and coordination of interior redband trout conservation efforts. Other signatories include the Regional Foresters of Forest Service Regions 1, 4, and 5; the states of California, Idaho, Nevada, Oregon and Washington, the USDI Bureau of Land Management, the Fish and Wildlife Service; five Indian Tribes and Trout Unlimited. In November 2016, the *Conservation Strategy for Interior Redband (Oncorhynchus mykiss subs) in the States of California, Idaho, Montana, Oregon and Washington* was completed (IRCT 2016). This strategy provides goals and objectives for redband conservation across its range, and specific stepwise goals, objectives, and actions for each of the eight redband geographic management units (GMUs). The intent of the strategy is to implement actions that significantly reduce or eliminate threats to redband populations and their ecosystems, and thus, substantially reduce the likelihood of its future listing under the ESA (IRCT 2016).

The Forest’s redband populations have been placed in the Upper Columbia-Spokane GMU. Historically, the Forest, below natural barriers, was occupied by both resident and anadromous redband trout. The anadromous life history within the GMU was permanently blocked in 1945 by Grand Coulee Dam on the Columbia River (IRCT 2016). The current distribution of redband trout within the Forest has been significantly reduced from the historic distribution. The historical redband populations within the Upper Columbia GMU subbasins included within the Forest: Lake Roosevelt-Columbia, Kettle, Colville, Sanpoil, (redband trout are not believed to be native to the Pend Oreille subbasin) were distributed over 7,228 stream kilometers (km), compared to a current distribution of 1,655 km. There has been a large loss of occupied lake habitat within the Colville subbasins, but a large increase in occupied lake habitat due to Lake Roosevelt (table 5 IRCT 2016).

Threats to redband trout across the range include introduction of non-native salmonids and non-salmonids (e.g., smallmouth bass); lost degraded and fragmented habitat (e.g., agricultural and grazing practices, dam construction, water diversions, logging, road building, etc.); non-point pollution, sediment and runoff due to urban development; reduced stream flows; altered thermal regimes due to drought and/or climate change. A growing concern is habitat disturbance due to uncharacteristically large forest fires (IRCT 2016).

Fish and game agencies have stocked coastal rainbow trout in lakes and streams on the Colville National Forest for over 80 years. The past stocking has led to introgression between the two subspecies in 14 sub-watersheds. All local populations appear to exhibit only the resident in life history form although historically migratory life history forms were likely present. Trotter et al. (2001) found pure redband trout in Lone Ranch and Canyon Creeks. The Kettle subbasin has pure redband trout populations in Deadman Creek and tributaries, Trout Creek and tributaries, Little Boulder Creek, South Fork Saint Peters Creek, Tonata Creek and tributaries, Lone Ranch, and Pierre Creek. The Upper Columbia subbasin has populations in Canyon Creek, Lane Creek, Hall Creek, Nancy Creek, and Barnaby Creek. South Fork Obrien Creek has the only population in the Sanpoil subbasin. The Colville subbasin has two small populations in the South Fork of Chewelah Creek and Strauss Creek (Trotter et al. 2001).

Coastal rainbow trout *(O. m. irredius)* are not native to the Forest, but have been planted widely across the state as a game fish. Pure populations that have not interbred with native rainbow have been identified via genetic testing in three of five subbasins on the Forest: Colville, Pend Oreille, and Lake Roosevelt. Coastal rainbow trout commonly hybridize with interior redband trout or WSCT.

Kokanee *(O. nerka kennerlyi)*. Kokanee salmon, a landlocked form of sockeye salmon are a very desirable sport fish. Historically, anadromous sockeye salmon were found in northeastern Washington and southern British Columbia. The anadromous sockeye life history ended with the construction of Grand Coulee Dam on the Columbia River. The presence of kokanee on the Forest appears to have originated through stocking programs. Kokanee are annually stocked by WDFW in Lake Roosevelt. Kokanee spawn in Sullivan and Pierre Lakes on the Forest.

Kokanee from Lake Roosevelt attempt to spawn in the Sanpoil River tributaries on the Forest, although success has not been documented. With the exception of the Lake Roosevelt adfluvial population, kokanee are generally found in oligotrophic lakes, where water temperatures are cold. The species provides an important subsistence fishery for the Colville Tribe and a sport fishery for local communities.

Pygmy whitefish *(Prosopium coulteri)* Sullivan and Bead Lakes are two of only nine lakes in Washington state thought to support remnant pygmy whitefish populations. In 2004, the species was also found in Mill Pond Reservoir, which is downstream of Sullivan Lake. Pygmy whitefish sometimes use tributary streams to spawn, but can also spawn in shallow lakebed habitat. The main threats that have been identified for pygmy whitefish are introduced predatory species, silting of spawning streams and lake eutrophication.

Mountain whitefish *(P. williamsoni)* are found in two subbasins on the Forest, the Kettle and Pend Oreille. Whitefish display seasonal movements from streams for spawning and feeding to deep, slow water for over-wintering habitat. Spawning occurs in late fall as females broadcast adhesive eggs over a gravel substrate. Mountain whitefish are not found in the small streams on the Forest, but are found in the larger systems that primarily do not flow through the Forest.

Brown trout *(Salmo trutta)* are an introduced fish originating in northern Europe. Reproducing, self-sustaining populations exist in four subbasins on the Forest. In the Pend Oreille subbasin brown trout are abundant in tributaries to Boundary and Box Canyon Reservoirs. Substantial populations exist in Sullivan, LeClerc, Cee Cee Ah, Skookum, and Indian Creeks. Brown trout are also found in the Colville River subbasin, primarily in Chewelah Creek. In the Kettle River subbasin, brown trout are annually stocked in Renner Lake for recreational fishing. Large adult brown trout have been found in the main

Sanpoil River; however, no spawning activity has been observed on NFS lands. With the exception of a population in Renner Lake, all other populations appear to exhibit adfluvial or fluvial life histories.

Brown trout tend to be an effective predator in lakes, rivers and streams. Brown trout are abundant in the large rivers and reservoirs. The bull trout recovery plans for north central Washington recommend removal of brown trout and other non-native fish as a strategy for recovery.

Bull trout *(Salvelinus confluentus)* are a native char species in the Interior Columbia Basin. Bull trout exhibit a variety of life history strategies in the inland Columbia Basin: fluvial, adfluvial, and resident and all three life history strategies may be found within the same population (USFWS 2015b). Bull trout have the most specific habitat requirements of the native salmonids: requiring colder water temperatures compared to other salmonids; the cleanest substrates; complex stream habitat including deep pools, overhanging banks and large woody debris; and connectivity between spawning and rearing areas and downstream foraging, migration, and overwintering habitats (USFWS 2015b).

Bull trout were listed as a Threatened Species under the ESA in 1998 (63 FR 31647). Bull trout were once widely distributed in four of the five subbasins that overlay the Forest, but are currently considered to be extirpated in the Sanpoil, Kettle River, and Lake Roosevelt subbasins and are now only found in the Pend Oreille subbasin (USFWS 2015b). Native Americans historically fished for bull trout in the Sanpoil River and LeClerc Creek.

Waters draining the Forest are in the Mid-Columbia Recovery Unit and the Columbia Headwaters Recovery Unit as defined in the recovery plan. Within the recovery units, core areas have been identified. A core area represents the closest approximation of a biologically functioning unit consisting of habitat that could supply all the necessary elements for every life stage (e.g., spawning, rearing, migratory, and adult) and include one or more groups of bull trout (USFWS 2015b). The Forest contains only one core area within the Mid-Columbia Recovery Unit, South Salmo River. The South Salmo River originates on the Forest within wilderness, but primarily flows through Canada. Bull trout historically populated several streams flowing into Lake Roosevelt. These streams are included in the Northeast Washington Research Needs Area (USFWS 2015b). There are currently no spawning populations within the Northeast Washington Research Needs Area, although there is suitable spawning habitat in several tributaries including the Sanpoil River (USFWS 2015c). Fewer than 25 bull trout have been documented at the mouths of tributaries to Lake Roosevelt or in Lake Roosevelt/Columbia River since 2011, usually near the Canadian border. In 2012, a single bull trout was observed in the lower Sanpoil River. The bull trout recently observed in the Northeast Washington Research Needs Area are thought to come from local populations in the Coeur d’ Alene/Spokane River or Pend Oreille River basins or from tributaries to the Columbia River in Canada, which have been entrained over dams (USFWS 2015b).

Most recent bull trout observations, and all bull trout critical habitat on the Forest, are on tributaries to the Pend Oreille River. These tributaries lie within the Lower Clark Fork Geographic Region, Pend Oreille core area. The large Pend Oreille core area has been divided into three parts. The streams tributary to the Pend Oreille River flowing off the Forest are in LPO-C, which includes the Lower Pend Oreille basin downstream of Albeni Falls Dam to Boundary Dam (1 mile upstream from the Canadian border) and bisected by Box Canyon Dam; including portions of Idaho, eastern Washington, and the Kalispel Reservation (USFWS 2015b).

While, overall, the bull trout populations in the Pend Oreille core area are considered stable with a moderate, but not imminent risk of extinction in the last status review (USFWS 2008), local bull trout population numbers on the Forest, if present, are very low and spawning populations likely do not currently exist (USFWS 2016). Even if a small remnant population exists, the very low numbers puts the population at high risk of extirpation (Rieman and McIntyre 1993). There have been few recent observations of bull trout on the Forest. The most recent observations include:

- Cedar Creek (Stevens County) - the watershed is primarily in the United States, but the lower reaches are in British Columbia. Two juvenile bull trout were found in the lower portion of Cedar Creek in Canada by British Columbia biologists in 1996. There are numerous road crossings with the potential to block fish passage in the lower part of the drainage. Day snorkeling the East Fork Cedar Creek on NFS lands in 1996 did not find bull trout presence. Environmental DNA[27] samples were taken in 2015. There were no detections of bull trout in Cedar Creek and East Fork Cedar Creek.
- South Fork Salmo River - over 90 percent of the larger Salmo River watershed is in British Columbia. The Salmo River has a relatively healthy population of bull trout. Juvenile bull trout were observed while snorkeling in the Canadian portion of the South Fork in 1998. Juvenile and adult bull trout were captured as early as 1975, and as late as 1995, in the portion of the watershed within the United States. This portion is within the Salmo-Priest Wilderness. Most of the Salmo River bull trout habitat is in Canada, so the Salmo River system was not included within the core area.
- Slate Creek - Five individual bull trout (four adults and one juvenile) were caught in the mouth of this creek between 1994 and 1997. One individual was caught twice.
- Sullivan Creek - one adult bull trout was found poached in lower Sullivan Creek in 1994, below Mill Pond Dam, an impassable blockage to fish approximately 3.25 miles from the mouth. Environmental DNA samples were taken in 2015. There were no detections of bull trout in Sullivan Creek.
- Cedar Creek (Ione Creek) (Pend Oreille County) - one adult bull trout observed while snorkeling in 1995, above the old municipal dam for Ione. The dam was removed in 2005. Environmental DNA samples were taken in 2015. There were no detections of bull trout in Cedar Creek.
- LeClerc Creek - three juvenile bull trout were found while electrofishing in the East and West Branches in 1993. Two juvenile bull trout were observed during snorkeling in the East Branch in 1995. One juvenile bull trout was observed while snorkeling in the East Branch in 1998. According to the USFWS (2012b), there has been no recent documentation of bull trout juveniles or spawning since 2001, when a bull trout was observed on a redd, and the population likely no longer exists. In 2014, a single adult bull trout was observed in West Branch LeClerc Creek (USFWS 2016). Environmental DNA samples were taken in 2015. There was a detection of bull trout in the West Branch of LeClerc Creek.
- Mill Creek (Pend Oreille County) - One adult bull trout was observed during snorkeling within the lowest mile of the creek in 1995. Environmental DNA samples were taken in 2015. There were no detections of bull trout in Mill Creek.
- Indian Creek - One bull trout was observed while snorkeling on the lowest mile of this creek on private lands in 1997.

The primary threats to bull trout recovery, as identified in USFWS 2015b are:

[27] Environmental DNA (eDNA) is DNA extracted from an environmental sample, such as soil, water, or air, without directly sampling the target organism. In 2015, the Colville National Forest took eDNA samples from all streams with bull trout critical habitat (Carim 2016).

- Upland/Riparian Land Management including sediment from forest roads, logging, and livestock grazing cause riparian and instream degradation, loss of large woody debris, and loss of pools.
- Instream impacts from transportation, flood control, and utility corridors along riparian areas contribute to degradation through loss of large woody debris, pool reduction, and increased sedimentation in some tributaries (e.g., Sullivan creek, Indian creek, Calispell Creek and Tacoma Creek. Historic placer mining significantly changed the hydrology, created sediment sources, and caused passage issues (e.g., Sullivan Creek), the effects of which are still present.
- Water temperatures in the lower Pend Oreille River and reservoirs, and the lower reaches of most tributaries are marginally high for bull trout survival in the summer and conditions are worsening. Artificial pools created by operation of Albeni Falls, Box Canyon, and Boundary Dams warm and perpetuate high water temperatures in summer, delaying or hindering movement of bull trout to spawning tributaries.
- Feeding, migration, and over-winter habitat is fragmented by Albeni Falls and Box Canyon Dams, leading to low population size and extinction risk on now isolated spawning and rearing habitat.
- Non-native northern pike (*Esox lucius*), smallmouth bass (*Micropterus dolomieui*), walleye (*Sander vitreus*), and to a lesser extent, brown trout and occasional lake trout (*S. namaycush*) occupy the artificially created habitat downstream of Albeni Falls Dam. These highly piscivorous species may prey on bull trout, especially migrating juveniles. Brook trout (*S. fontinalis*) occur in high numbers in some streams especially in lower elevations. Hybridization is frequently observed due to low bull trout populations (e.g., LeClerc Creek)

The presence of brook trout, which are widespread on the Forest, pose a particular threat to bull trout. Bull trout and brook trout would hybridize resulting in hybrid offspring that are often, but not always sterile. Where hybridization occurs declines in the bull trout population or even local extirpations have occurred (USFWS 2015b). Brook trout may have a competitive advantage over bull trout and displace bull trout into higher elevation streams, especially at warmer water temperatures (Rieman et al. 2006, McMahon et al. 2007, Rodtka and Volpe 2007).

Watershed and stream habitat conditions on the Forest are generally “impaired” compared to reference conditions; however, there appear to be improving trends in habitat conditions under 1988 forest plan direction. Each alternative considered in detail includes a strategy developed to improve watershed and habitat conditions for bull trout and other aquatic species (see Riparian and Aquatic Resources sections in the alternative descriptions in chapter 2). The re-licensing terms for the Boundary Hydroelectric Project include programs to improve conditions for bull trout and aid recovery of the population. The programs identified include improving passage for fish both upstream and downstream of the dam; riparian and stream channel habitat improvement; improving road conditions; and non-native trout suppression and eradication programs (USFWS 2012b). However, the USFWS (2012b, page 160) acknowledges that it may take 14 years before benefits of the programs result in slow but steady increases in bull trout numbers.

Bull trout critical habitat on the Forest has been designated in Cedar Creek, Slate Creek, Sullivan Creek, LeClerc Creek, Mill Creek and Indian Creek, Ruby, Tacoma, Smalle, and Winchester Creeks (75 FR 63898).

Brook trout are an introduced char species from the eastern United States that have been planted widely across the state as a game fish for the last 80 to 90 years, becoming widely distributed in all five subbasins that overlay the Forest. The species is abundant in most subwatersheds within the subbasins.

Brook trout seem to be limited by natural or unnatural barriers and very high gradients found in most headwaters on the forest. Most populations exhibit only a resident in life history. Presently, brook trout are only stocked on the Forest in lakes without inlets or outlets. The brook trout is a desirable sport fish. Brook trout have been found to interbreed with and out-compete native bull trout. Brook trout are also known to have negative impacts on native WSCT populations through inter-specific competition and predation. Though there is little research on the effect of brook trout stocking on native rainbow populations, habitat overlap would likely create competition between these species as well. Under the terms of the Federal Energy Regulatory Commission (FERC) re-licensing for the Boundary Hydroelectric Project, Seattle City Light will be sponsoring non-native trout, particularly brook trout, suppression and eradication projects.

Lake trout are an introduced species found only in Bead Lake on the Forest. Lake trout are a popular sport fish. The species is occasionally caught in Lake Roosevelt, and Box Canyon and Boundary Reservoirs when the fish become entrained out of Priest or Pend Oreille Lake. Lake trout live in lakes and have a piscivorous diet. Lake trout compete with bull trout and are considered one of the biggest threats to bull trout populations in the Lake Pend Oreille Core Area. Efforts to control the lake trout population in Lake Pend Oreille include angler incentive programs, and trap and gill netting programs (see USFWS 2012b, page 113). Spawning takes place in the fall in shoals, but no redds are created.

Family CYPRINIDAE

Tench (*Tinca tinca*) are an introduced species that is found on the Forest in the Pend Oreille and Colville subbasins. They inhabit the Little Pend Oreille Lakes, Parker, and Sullivan Lakes on the Forest. Tench inhabit the shallow areas of lakes and ponds in dense vegetation. Spawning occurs from late May through late June.

Chiselmouth (*Arcocheilus alutaceus*) inhabit lakes and slow streams east of the Cascade Range and are considered “common to abundant” in the upper Columbia River. The species is found in waters adjacent to the Forest in the Pend Oreille, Lake Roosevelt, and Sanpoil subbasins. This species is also present on the Forest in Cusick Creek, a tributary to Box Canyon Reservoir in the Pend Oreille subbasin.

Peamouth (*Mylocheilus caurinus*) is found on the Forest only in Bead Lake in the Pend Oreille subbasin. The species is also found in Lake Roosevelt and Box Canyon and Boundary Reservoirs adjacent to the Forest. Peamouth primarily inhabit lakes and reservoirs. They occupy the deeper habitat during the day and move to shallows at night. Spawning occurs from late May through early June in streams and among lake shores on a gravel or rubble bottom.

Northern pikeminnow (*Ptychocheilus oregonensis*) are a native species that have increased in numbers on the mainstem Columbia and Pend Oreille Rivers as dams have created large, slow-water systems. Most pikeminnow are found adjacent to the Forest in Lake Roosevelt, Box Canyon and Boundary Reservoirs and the lower Sanpoil River. Presence on the Forest has been documented in one body of water, Bead Lake. Pikeminnow inhabit lakes and slow water areas of streams. As juveniles, they consume aquatic insects, but in adult form they are highly piscivorous.

Longnose dace (*Rhinichthys cataractae*) are a common stream species that are found in the Lake Roosevelt and Pend Oreille subbasins adjacent to the Forest. They mainly inhabit fast water portions of cool streams, though they may move to slower water refuges during the winter months.

Speckled dace (*R. osculus*) presence has only been documented on the Forest in Sullivan Lake in the Pend Oreille subbasin, but the species also occurs in the Colville River subbasin adjacent to the Forest. This species is a generalist and inhabits streams and lakes.

Redside shiner (*Richardsonius balteatus*) are found in lakes and slow-water habitat. The species is found in the Sanpoil River, Cottonwood Creek, and Sullivan Lake in the Colville, Pend Oreille, and Sanpoil subbasins, respectively on the Forest. Shiners have the potential to compete with juvenile trout and kokanee for food resources where habitat overlaps and are also important as a forage fish for larger trout.

Umatilla dace (*R. umatilla*) are found in the Columbia River Basin east of the Cascade Mountains from Umatilla, Oregon to British Columbia, Canada. In Washington state, Umatilla dace specimens have been reported from the Columbia, Yakima, Okanogan, Similkameen, Kettle, and Colville Rivers. It is not known if Umatilla dace inhabit waters within the Forest boundary.

Lake chub (*Couesius plumbreus*) Lake chub are distributed across the northern half of North America from Quebec westward to Alaska, south to Washington, and east to northern New England. Lake chub inhabit the Columbia River system north through British Columbia. Lake chub inhabit both lakes and streams, but appear to have a preference for lakes, with lake populations reported to migrate to streams for spawning (Wydoski and Whitney 2003). The lake chub is a Regional Forester's sensitive species due to an apparent limited distribution and unknown status within Washington.

Family CATOSTOMIDAE

Longnose sucker (*Catostomus catostomus*) are found on the Forest only in the Pend Oreille subbasin in both Bead and Sullivan Lakes. This species is also found in Lake Roosevelt and Box Canyon and Boundary Reservoirs adjacent to the forest. Primary habitat is coldwater lakes and streams, with early spring spawning and only short migrations recorded.

Bridgelip sucker (*C. columbianus*) lives in pools and backwaters of larger rivers, primarily on the east side of the Cascade Range. This species is present in the Lake Roosevelt and Sanpoil subbasins adjacent to or downriver from the Forest.

Largescale sucker (*C. macrocheilus*) are found throughout waters adjacent to the Forest, but have only been documented on the Forest in the Pend Oreille subbasin. These are the most common of all sucker species inhabiting both lakes and streams. Larger, slow-moving systems are favored.

Family GADIDAE

Burbot (*Lota lota*) is the only freshwater species of cod found in North America. Burbot are found in Sullivan and Bead Lakes in the Pend Oreille subbasin on the Forest. This species is also found in Lake Roosevelt adjacent to the Forest. Burbot feed on other lake fish species, foraging more actively in the summer. Spawning takes place in late winter. It is presently unclear whether burbot was native to the Forest or introduced.

Family CENTRARCHIDAE

Largemouth bass (*Micropterus salmoides*) is an introduced species from the eastern United States. The species is found in Pierre, Ellen, and Pepoon Lakes on the Forest, in the Lake Roosevelt and Kettle subbasins. Largemouth bass is tolerant of warm water and does best in shallow weedy lakes and the backwaters of rivers.

Smallmouth bass (*Micropterus dolomieu*) is an introduced species from the eastern and midwestern United States. The species is found in Boundary and Box Canyon Reservoirs in the Pend Oreille subbasin. Smallmouth bass is tolerant of warm water, but usually inhabits cool, clear streams or lakes with some current.

Black crappie (*Pomoxis nigromaculatus*) is also an introduced species from the eastern United States. The species is found in Pierre Lake, Kettle subbasin, on the Forest. Black crappie is generally found in the clear waters of large streams or in reservoirs and medium-sized lakes.

Family COTTIDAE

Slimy sculpin (*Cottus cognatus*) is found in riffles in stream systems. It is found in 10 subwatersheds in the subbasins of the Colville (Chewelah Creek), and the Pend Oreille (Big and Little Muddy Creeks, Jim Creek, Lost Creek, Sullivan Creek, Smalle Creek, Ruby Creek, Skookum Creek, and Winchester Creek).

Columbia sculpin (*Cottus hubbsi*) is found in riffles in stream systems. It has been documented in two subwatersheds in the subbasins of the Sanpoil and the Kettle River (Deadman Creek) (R6 Aquatic Survey database) .

Torrent sculpin (*Cottus rhotheus*) is found in riffles in stream systems. It has been documented in one subwatershed in the Colville subbasin (Mill Creek) (R6 Aquatic Survey database).

Aquatic Invertebrates

California floater (*Anodonta californiensis*) is a native mussel that is found from Mexico to southern British Columbia. It is known to occur near the mouth of the Kettle River and in Curlew Lake in the Kettle subbasin, near the mouth of the Colville River in the Colville subbasin and in Cusick Creek in the Pend Oreille subbasin. The California floater requires clean fresh water. In the larval stage, the mussel is parasitic to specific minnow hosts in the *Gila* genus. Maintaining healthy native populations is important to ensure suitable hosts are available. Juvenile clams fall from fish where they attach to gravel or rocks in clean, well-aerated waters. After growing for some time, young clams are washed downstream where they settle in sandy or soft muddy bottoms in the slower waters of lakes or large rivers where they mature. This species is a State candidate species.

Order ODONATA (dragonflies and damselflies)

Delicate emerald (*Somatochlora franklini*) (the following is from Foltz 2008a). The delicate emerald, is widely distributed across Canada and the northeastern United States, usually found in sphagnum bogs and very shallow, well-vegetated waters in mountainous regions. The species prefers sedge and moss-filled fens at the foot of hillsides. Threats to the species include activities that alter fen-habitat including peat mining, wetland grazing, manipulation of water levels, recreational development and aquatic vegetation management. Climate-related changes may threaten southern populations and shift the species' distribution northward. The only known habitat for the species is Bunchgrass Meadows on the Colville National Forest. The delicate emerald is a Regional Forester's sensitive species.

Whitehouse's emerald (*Somatochlora whitehousei*) (the following is from Foltz 2008a). The uncommon but widely distributed Whitehouse's emerald is found across Canada. Within the United States, the species has only been found in one site in Montana and in Bunchgrass Meadows on the Colville National Forest. Whitehouse's emeralds are found in moderate-sized open ponds and bogs with abundant vegetation (mosses, sedges, buckbean and algae). The species prefers clean water with soft mud substrates. Threats to the species include activities that alter fen-habitat in Washington including peat mining, wetland grazing, manipulation of water levels, recreation, recreational development, and management of aquatic vegetation. Climate-related changes may threaten southernmost populations and shift the species' distribution northward. Other potential climate change-related impacts projected that could adversely impact the species' habitat include increased frequency and severity of seasonal droughts and flooding, reduced snowpack to feed river flow, increased siltation, and increased air and water temperatures. The Whitehouse's emerald is a Regional Forester's sensitive species.

Zigzag darner (*Aeshna sitchensis*) (the following is from Foltz 2010). The zigzag darner is distributed across Canada and most of the northern United States. The species is found in Washington, primarily on NFS lands at high elevations in Ferry, Okanogan, Pend Oreille, Chelan, and Skamania Counties. Most observations and collected specimens have been from Bunchgrass Meadows on the Colville National Forest. The species has also been observed on the Forest at Davis Lake. Habitat for this boreal species is reported to include wet sedge meadows, fens, bogs, and very shallow peaty bogs. Threats to this species are similar to those described for the delicate emerald and Whitehouse's emerald. Drought is considered the primary threat to the species. Habitat alteration and degradation, specifically activities that alter fen-habitat may also threaten the species. The zigzag darner is a Regional Forester sensitive species.

Subarctic bluet (*Coenagrion interrogatum*) (the following is from Foltz 2011a). The subarctic bluet belongs to a family known as pond damsels. The species is distributed throughout Canada and in several northern and northeastern states including most of New England. The species is found in boreal fens and bogs, usually associated with sphagnum and other aquatic mosses, but often occurs in shrubs. The two documented locations of the species in Washington are on the Colville National Forest in Davis Lake and Bunchgrass Meadows. The greatest immediate threats to the species in Washington state are considered to be drought and associated water-level changes. Managing aquatic vegetation may also be problematic for the species, as the larvae are dependent on vegetation for foraging and protection from predators. The subarctic bluet is a Regional Forester's sensitive species

Subarctic darner (*Aeshna subarctica*) (the following is from Foltz 2011b) This large-bodied dragonfly is widespread across Canada, south to Oregon, Wyoming, Minnesota, Michigan, and New York. The species is found in four locations in Washington state, three of which are on the Colville National Forest; Davis Lake, Bunchgrass Meadows, and Granite Meadows. The species is found in fens, wet meadows, and bogs with abundant sphagnum and other mosses. Submerged vegetation is required for the larvae due to their clinging-type predation behavior. The species is widely distributed in Canada and considered to be secure, but the species' status is ranked as imperiled or unranked in most states. Drought and associated water-level changes are considered to be the greatest immediate threats to the species in Washington. The subarctic darner is a Regional Forester sensitive species.

There are numerous aquatic insects for which we have no inventory or population information. Due to the lack of information, these species cannot be discussed at a population level. As will be discussed later, there is monitoring information regarding the status of aquatic macroinvertebrate communities on the Forest.

Step 1 (b) – Determine species of concern.

Establishing a list of species of concern is an important element in the process of selecting surrogate species. Species of concern are those plant and animal species whose long-term persistence within the plan area is of known conservation concern and are known to occur in the plan area (36 CFR 21162). For the Colville forest plan revision, species of concern included species listed as threatened or endangered (TE), Regional Forester sensitive species, and additional species that may require plan components established for them, such narrow endemic species and species of public interest including hunted, fished, and other species identified cooperatively with State fish and wildlife agencies consistent with the Sikes Act. The species of concern are recognized as potentially sensitive to management actions from which surrogate species are chosen to serve as surrogates for assessing current conditions and potential effects of alternatives to other aquatic vertebrate and invertebrate species.

The species of concern are listed in the following table.

Table 75. Summary of species of concern

Species	ESA Listing	MIS (M) /Surrogate (S)	R6 Sensitive Species	Management Interest/ Conservation Concern	Present on the Forest?
Bull trout *Salvelinus confluentus*	Threatened	M/S			Yes
California floater *Anodonta californiensis*				Washington state candidate	Yes
Delicate emerald *Somatochlora franklini*			X		Yes
Kokanee *Oncorhynchus nerka*				Tribal and sport fishing importance	Yes
Lake chub *Couesius plumbeus*			X		Unknown
Pygmy Whitefish *Prosopium coulteri*			X	Washington state candidate	Yes
Redband/rainbow trout *Oncorhynchus mykiss gairdneri*		M/S	X		Yes
Subarctic bluet *Coenagrion interrogatum*			X		Yes
Subarctic darner *Aeshna subarctica*			X		Yes
Umatilla dace *Rhinichthys umatilla*			X		Unknown
Westslope cutthroat *Oncorhynchus clarkii lewisi*		M/S	X	Washington state candidate	Yes
Zigzag darner *Aeshna sitchensis*			X		Yes

Management Indicator Species (MIS) –The 36 CFR 219.19 (1982 planning rule) directs forests to establish objectives for the maintenance and improvement of MIS' habitat (see further MIS discussion below). Species are selected as MIS because their population changes may indicate the effects of land management activities (36 CFR 219.19 (a) (1)). There is only one aquatic MIS in the 1988 forest plan: "Trouts," with no specific species or subspecies indicated. "Trouts" were selected to represent species utilizing lacustrine, riverine, and riparian habitat.

Step 2 – Identify Applicable Spawning and Rearing Habitat Associations for Each Species. Habitat associations are defined as the type of habitat that a particular species primarily uses for spawning and rearing. By choosing to focus on spawning and rearing habitat, we identify a potential limiting factor for the species' survival. Though foraging areas and migratory corridors are important, without access to suitable spawning and rearing habitat, the species will not survive (Reiss et al. 2008).

Habitat associations are categorized as headwaters, minor tributaries, major tributaries, main-stem rivers, and lakes and reservoirs. From a hydrologic standpoint, these categories may be general and potentially difficult to define. For the purposes of this assessment general stream habitat associations are headwaters (1st and 2nd order fish-bearing streams), minor tributaries (3rd order), major tributaries (4th order), main-stem rivers (5th order and higher), and lakes and reservoirs (Reiss et al. 2008).

Step 3 – Categorize the species of concern into Habitat Associations and

Step 4 – Choose Species from each Association as Surrogate Species to serve as indicators of other species occupying the same habitat type.

The following table provides the results from both Steps 3 and 4 in a one-reference table (Reiss et al. 2008).

Table 76. Habitat associations (spawning and rearing) for species of concern

Headwaters	Minor tributaries	Major tributaries	Mainstem Rivers	Lakes and Reservoirs
Bull Trout	**Bull Trout**	**Bull Trout**	**Bull Trout**	**Bull Trout**
Westslope Cutthroat	**Westslope Cutthroat**	**Westslope Cutthroat**	**Westslope Cutthroat**	**Westslope Cutthroat**
Interior Redband	**Interior Redband**	**Interior Redband**	California Floater	Pygmy Whitefish
		Lake chub	Umatilla dace	Lake chub
			Lake chub	Kokanee

Note: Species in bold text are Colville National Forest selected MIS/surrogate species.

The Forest selected "surrogate species" to assess current aquatic species status and later to assess the potential effects of alternatives on species viability. There are many aquatic native and non-native species that inhabit streams and rivers on the Forest. It is not possible to analyze viability for all the aquatic species present in subbasins within Colville National Forest. The surrogate species serve as surrogates for other aquatic vertebrate and invertebrate species. The surrogate species also act as the management indicator species, so the selected species are referred to as MIS/surrogate species. The MIS/surrogate species are bull trout, interior redband trout, and the westslope cutthroat trout. These species were given priority as surrogate species because:

- Bull trout are federally listed under the ESA, and WSCT and interior redband trout are Regional Forester's sensitive species. All three species fall under the MIS category of Trouts.
- There are available information and data for these species through various subbasin plans, recovery plan (USFWS 2015b), Colville National Forest monitoring, FERC re-licensing, etc.
- The life history strategies of these species, their presence in a wide range of watersheds across the Forest, and the multiple habitat types these species are associated with.
- These species are dependent on habitat that is substantially affected by management of NFS lands.

The California floater was not selected, as it is known to occur in only one stream on the Forest. The Umatilla dace was not considered as a surrogate species, as it is not known or suspected to be found on the Forest. Pygmy whitefish were not selected, as they are found in only two lakes and are not suspected to be substantially affected by management on the Forest. The lake chub was not chosen as a surrogate species for much the same reason as the pygmy whitefish and Umatilla dace. Lake chub are known to be present in the Box Canyon Reservoir and Kettle River adjacent to the Forest, but the species distribution on the Forest is unknown. Forest management activities designed to meet the needs of the surrogate species are expected to provide for the necessary habitat quality for these species.

The five sensitive species in the order Odonata were not chosen as surrogate species, again due to limited known distribution and current riparian management direction appears to be protective of their habitat, especially in Bunchgrass Meadows, which is a research natural area (Foltz 2008a, 2008b, 2010, 2011a and 2011b). Riparian habitat management direction in the plan is expected to be at least as protective of riparian-dependent resources as the current direction. Additional potential impacts to all sensitive species are addressed at the project level.

Kokanee salmon, brown trout, and brook trout fall under the MIS “Trouts” category. However, while popular sport fish, they are not native to the Forest. Management designed to meet the needs of the surrogate species is expected to provide habitat conditions for any desired non-native species. In fact, the non-native fish are not necessarily good surrogate species as the re-licensing for the Boundary Hydroelectric Project includes terms for non-native fish suppression and eradication programs.

Colville Forest Plan Revision Management Indicator Species

The 1982 planning rule (36 CFR 219.19) directs forests to establish objectives for maintenance and improvement of habitat for MIS. Species are selected as MIS because their population changes may indicate the effects of land management activities (36 CFR 219.19 (a) (1)). Each forest plan alternative is to establish objectives for the maintenance and improvement of habitat for the MIS. The MIS are to be used to estimate the effects of each alternative on fish and wildlife populations. Alternatives are to be evaluated in terms of both the amount and quality of habitat and of the population trends for the MIS. The selection of MIS are to represent, where appropriate (36 CFR 219.19 (a) (1)):

- Endangered and threatened plant and animal species identified on State and Federal lists for the planning area.
- Species with special habitat needs that may be influenced significantly by planned management programs.
- Species commonly hunted, fished or trapped.
- Non-game species of special interest.
- Additional plant or animal species selected because their population changes are believed to indicate the effects of management activities on other species of selected major biological communities or on water quality.

There is only one aquatic MIS identified for the 1988 forest plan: Trouts, with no specific species or subspecies indicated. Trouts were selected to represent species utilizing lacustrine, riverine, and riparian habitat. For the Colville National Forest, the Trouts may include native bull trout, WSCT, and interior redband trout; as well as non-native trouts; brook trout, coastal rainbow trout, brown trout, lake trout, and kokanee salmon that have been introduced for sport fishing. Without identifying any particular species, Trouts could also include the mountain whitefish and pygmy whitefish, which are in the same family (*Salmonidae*) as the aforementioned Trouts.

When the 1988 forest plan was written, no fish species were listed as threatened or endangered under the ESA. Since then, one species, the bull trout, has been listed as Threatened with critical habitat designated on the Forest. WSCT, interior redband, pygmy whitefish and Umatilla dace, lake chub, delicate emerald, Whitehouse's emerald, subarctic bluet, subarctic darner, and zigzag darner are now Forest Service, Region 6 sensitive species.

The surrogate species were chosen to assess current aquatic species status and to assess the potential effects of alternatives on species viability. In a sense, the surrogate species, bull trout, WSCT, and interior redband trout, are used in a similar manner as the MIS under 1982 planning rule in the development of the FEIS and subsequent revised forest plan.

The three surrogate species will be carried forward as both surrogate and MIS (hereafter referred to as MIS/surrogate species) because the bull trout are a threatened species, the three species have special habitat needs that may be influenced significantly by planned management programs; the interior redband, and WSCT are species of concern and game fish; and because population changes could be indicators of the effects of management activities on other species, biological communities, or on water quality.

The native mountain whitefish, lake chub, and pygmy whitefish were not selected as surrogate species or considered to be identified as MIS. The mountain whitefish are not generally found in the small streams on the Forest, but in the larger systems that primarily do not flow through the Forest. Pygmy whitefish are only found in two lakes on the Forest. The main threats that have been identified for pygmy whitefish are introduced predatory species, silting of spawning streams and lake eutrophication. The Umatilla dace is not known to occur on the Forest. Lake chub distribution on the Forest is also unknown. Providing for the habitat needs of the MIS/surrogate species through the plan components (Desired Conditions, Objectives, Key Watersheds, Riparian Management Areas, and Standards and Guidelines) (see the revised forest plan, chapter 4) is expected to reduce the potential for adverse amounts of sediment or silt being deposited in spawning streams and reduce the potential for Forest management programs contributing to lake eutrophication. In addition, the Forest would collaborate with the State of Washington, Tribes, and Fish and Wildlife Service on projects to decrease predators impacting mountain pygmy whitefish and potentially lake chub on the Forest. As discussed previously, the five Odonata species were not chosen as surrogate species because the limited distribution and riparian management direction in the revised forest plan is expected to be at least as protective as the 1988 forest plan management direction under INFISH, and the potential impacts to sensitive species are assessed at the project level.

The non-native brook trout, brown trout, lake trout, kokanee salmon, and coastal rainbow trout were not considered as MIS. Although these species are popular sport fish, they are also threats to the native MIS/surrogate species through competition for food and habitat, predation on the surrogate species, and hybridization with the surrogate species. Lake trout compete with bull trout and are considered one of the biggest threats to bull trout populations in the Lake Pend Oreille core area. Efforts to control the lake trout population in Lake Pend Oreille including angler incentive programs, and trapping and gill netting programs. The terms for the Boundary Hydroelectric Project re-licensing include implementing non-native fish population suppression and eradication efforts in streams tributary to the Boundary Reservoir. It would not make sense to select a non-native fish species as an MIS when some populations may be actively suppressed or eradicated.

Land management activities such as timber harvest, the transportation system (both roads and trails), grazing, and recreation can adversely impact the habitat for native aquatic species. The three MIS/surrogate species were selected based upon the rationale presented in the selection of surrogate species discussion. The habitat requirements for the ESA Threatened bull trout including: requirements for cold water temperatures, clean substrates; complex stream habitat including deep pools, overhanging banks and large woody debris; and connectivity between spawning and rearing areas and downstream foraging, migration, and overwintering habitats, make the species the potentially the most susceptible of the surrogate species to impacts from the management programs identified in the land and resource management plan. Monitoring the status of bull trout habitat may, therefore, be expected to be a good indicator of the status of habitat for other aquatic species on the Forest.

The historic range of WSCT and interior redband trout has been greatly reduced due to degraded habitat and stocking non-native species, especially non-native forms of cutthroat trout, coastal rainbow trout, and brook trout. However there are sub-watersheds that still support genetically pure WSCT or interior redband trout populations. While neither bull trout, WSCT, nor interior redband populations are widely distributed across the Forest, the three species, their habitat, and populations are found across the range physical and biological watershed conditions on the Forest.

The Forest Service contribution to the three species' population viability will be assessed for each alternative. The potential for the alternatives to cause a trend toward an ESA listing of the other Regional Forester's Sensitive Species will be discussed. The habitat conditions for the three MIS/surrogate species will be assessed through the aquatics and watershed land and resource management plan monitoring program. The monitoring program, discussed in chapter 4 of the revised forest plan, has been incorporated into all alternatives to determine if land management actions implemented in accordance with the plan components are improving watershed conditions, riparian and stream habitats toward the desired conditions. PACFISH/INFISH Biological Opinion Monitoring (PIBO) (discussed later in this document), is expected to continue to provide information regarding the trends in aquatic habitat condition.[28] The Forest annually conducts stream habitat surveys on approximately 17 miles of stream using a standard Region 6 stream survey protocol. The surveys also collect information of fish distribution at the time of the survey, although the surveys are not designed to provide a population estimate. Monitoring information that is described in the Watershed portion of the FEIS will provide valuable information regarding the status of aquatic habitat. The watershed monitoring includes periodically updating the Watershed Condition Framework (WCF) (Potyondy and Geier 2010) and the Regional Best Management Practice (BMP) monitoring program.

Programs implemented by other agencies are expected to provide information regarding fish population trends, especially in the Pend Oreille subbasin. For example, the terms for re-licensing the Boundary Hydroelectric Project include a conservation hatchery program to re-build the populations of native fish. The terms for the hatchery program include establishing population goals for self-sustaining populations of the native fish. Seattle City Light is to monitor the success of the out-planting program until the population goals are met.

Aquatic Species Viability Evaluation/ Aquatic Ecological Condition Model

The 2012 planning rule, 36 CFR 219.19(a)(7)(ii)(A-B & D), states "Evaluations of species diversity must include, as appropriate, assessments of the risks to species *viability* and the identification of ecological conditions needed to maintain species *viability* over time based on the following: The *viability* of each species listed under the Endangered Species Act (ESA) as threatened, endangered, candidate, and proposed species must be assessed. Individual species assessments must be used for these species. For all other species, including other species-at-risk and those species for which there is little information, a variety of approaches may be used, including individual species assessments and assessments of MIS/surrogate species or other indicators used as surrogates in the evaluation of ecological conditions needed to maintain species *viability.* In analyzing *viability*, the extent of information available about

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[28] See Appendix1 page 15 in the April 18, 2014, letter from the Deputy Regional Directors to FS Pacific Northwest and Rocky Mountain Research Station Director, NOAA Fisheries Branch Chiefs (West Coast Region), BLM District/Field Managers (Oregon, Washington, Idaho, and Montana), FWS Field Supervisors (Pacific Region), EPA Office of Water Directors (Regions 8, 9, and 10), EPA Operations Office Directors (Idaho, Oregon, Montana, and Washington), EPA Region Forest/Range Manager (Region 10) Updated Interior Columbia Basin Strategy: A Strategy for Applying the Knowledge Gained by the Interior Columbia Basin Ecosystem Management Project to the Revision of Land Use Plans and Project Implementation

species, their habitats, the dynamic nature of ecosystems and the ecological conditions needed to support them must be identified. Species assessments may rely on general conservation principles and expert opinion. When detailed information on species habitat relationships, demographics, genetics, and risk factors is available, that information should be considered."

To meet the above direction, the AEC model was developed to assess the current condition of aquatic habitat and MIS/surrogate species population status and to inform the species viability assessment. Reiss et al. (2008) utilized a decision-support model to formalize the assessment procedures, assumptions, and factors that would contribute to healthy, ecologically sustainable aquatic species populations and their habitat. The decision support model (DSM) is a computer-based model (Netweaver) that applies a consistent evaluation process across time and space.[29] This type of model was chosen because it uses an explicit process for assessing condition and documents the data and relations between attributes assumed in the assessment. DSMs use data to evaluate a conclusion. For the AEC model, the conclusion being analyzed is: Subwatersheds (HUC 12) on the Forest provide aquatic ecological conditions that are properly functioning and support viable populations of aquatic MIS/surrogate species. Data used in the assessment lend varying levels of support to this conclusion, ranging from full support (+1) to no support (-1). The HUC 12 AEC assessment depends on two topics; MIS/surrogate species local population condition and habitat condition within each sub-watershed on the Forest. Both of these topics are dependency networks composed of aggregated evaluation scores from other attributes (shown below). These scores may be interpreted as strength of evidence, where +1 indicates strong evidence of the conclusion and -1 indicates no evidence of the conclusion.

- A score of 0 is assigned by the model when the strength of evidence lies midway between the +1 and -1 scores and/or does not provide evidence for or against the conclusion.
- Scores from -1 to -0.34 were considered *NOT PROPERLY FUNCTIONING* for a model attribute or total AEC;
- Scores from -0.33 to +0.33 are considered *FUNCTIONING AT RISK* for viability;
- Scores from +0.33 to +1.0 are considered *FUNCTIONING APPROPRIATELY* for viability.

The AEC model was originally run for the Forest in 2008. The Forest decided not to use the 2008 AEC model results due to a variety of factors including: (1) Subwatershed boundaries have changed since the original assessment; (2) Documentation of the 2008 AEC modeling process for the Forest is not clear and the personnel who developed and ran the model have moved to other agencies or retired; thus it is difficult to analyze the model results without better understanding the model inputs. This concern was further highlighted as the model results seem to over-estimate the number of watersheds in a "poor" condition, given the 2010 watershed condition framework (WCF) effort;[30] (3) Existing information on in-stream habitat was not utilized in the 2008 model. Updating the 2008 analysis allowed the Forest to integrate the available stream habitat information and the WCF exercise to provide a more complete assessment of the current AEC across the Forest; and (4) Current fish distribution and status information is more robust than what was available in 2008.

A second exercise to assess the AEC was undertaken in 2014. For the 2014 AEC modeling, the Forest followed the basic procedures outlined in Reiss et al. (2008), but the information and analysis described below used Excel spreadsheets instead of the DSM.[31]

[29] Documentation including the scientific rationale used to develop the AEC model can be found in Reiss et al. (2008)
[30] A description of the WCF effort and results are included in the chapter 3 Hydrology section of the FEIS and in Day 2018
[31] Kate_Aqautic_Function_9_22-14 and KeyWatershedSpreadsheet_9-29-2014-Excel

HUC 12s (sub-watersheds averaging 10,000 to 40,000 acres) were chosen to evaluate viability due to the configuration of the HUC 12 boundaries being considered the best surrogate for local populations of MIS/surrogate species in the Interior Columbia Basin (Reiss et al. 2008). MIS/surrogate species local population condition was evaluated using data on fish distribution, population status and abundance, habitat and genetic connectivity, and impact of non-native species. These attributes were selected to evaluate the health, diversity, resilience, and distribution of populations of MIS/surrogate aquatic species within the planning area.

Distribution - The distribution of MIS/surrogate species was primarily evaluated using “expert opinion” derived from biologists (and/or hydrologists) familiar with local conditions and studies.

The *status* assessment includes two attributes: status and abundance. Local spawning populations were characterized as strong or depressed based on current versus historic abundance, full expression of life history traits, and population trends. When information was not sufficient to apply the criteria, “unknown status” was assigned. Some HUC 12s were identified as exclusively non-spawning/rearing areas (i.e., migratory corridor, over-wintering, or foraging). We included an additional attribute: genetically pure population. This attribute was evaluated based on assumptions about populations, and information from genetic studies.

The *abundance* attribute of the HUC 12 MIS/surrogate species assessment describes local population status by addressing the average number of adults spawning annually. In many cases, abundance was unknown, so a score of 0 was applied.

Connectivity also includes two attributes: habitat barriers and genetic connectivity. Habitat barriers evaluates the degree to which access to habitat is limited by barriers to upstream and downstream fish movement within the HUC 12. Only human-made barriers within the boundary of the HUC 12 are considered in this attribute, though natural barriers may limit access as well. Barriers that protect resident fish populations from an invasive species are scored as beneficial.

Genetic connectivity describes the degree of connectivity between local populations within the HUC 8, and thus, the potential for a functioning meta-population. Although data for this attribute were determined at the HUC 8 scale, the impact of isolation was assessed for each local population. Connectivity was primarily evaluated through expert opinion.

Non-native effects assesses the effects of non-native species on MIS/surrogate species. We focused on threats via introgression and not competition because the effects of introgression are more direct and thus quantifiable. However, we did consider competition where it appears non-native fish may have displaced a MIS/surrogate species population.

HUC 12-Scale Model: Habitat Condition

The habitat condition component of the HUC 12 AEC model was designed to assess ecological processes and watershed function, rather than evaluate the specific habitat needs of any particular species (see Reiss et al. 2008 for scientific rationale used to develop the model). Aquatic and riparian resources, water quality and species viability are dependent on the protection of naturally occurring processes. Processes such as, wildfire, flooding, sediment delivery to streams, natural flow regimes and retention of riparian vegetation (provides shade, moderates stream temperatures, provides recruitment of downed trees, etc.) are essential to the proper functioning of the stream channel and habitat that provides for the viability of aquatic species. Attributes were selected to serve as indicators of the routing of water, sediment, wood, and nutrients through the watershed—the processes that create and maintain the habitat conditions necessary to sustain healthy populations of aquatic- and riparian-dependent species. Channel shape and function, and the large woody debris attributes are included as indicators of current stream channel and overall aquatic habitat condition.

The Forest followed a process similar to and consistent with Reiss et al. (2008). The following model and attributes and attribute weights were developed by the Forest based on Reiss et al. (2008), and with input from Forest Service Region 6 Regional Office fish biologist, hydrologist, and planning staff.

The road density attribute is used in the habitat condition model not only as an indicator of the potential risks roads present to aquatic habitat and watershed processes, but as an indicator of the intensity of anthropogenic disturbances in a watershed, not just those risks due directly to effects of the roads themselves. Roads have been shown to affect the routing of water, sediment, wood, and nutrients to stream channels resulting in accelerated erosion and sediment delivery to stream channels; altered channel structure and lateral migration of the channel in the flood plain; reduced large wood recruitment into the stream channel and shorter residence times of wood in the stream; and altered flow paths leading to diversion or extension of channels onto un-channeled portions of the landscape.

Roads are also associated with activities, past and present, that create negative effects on watershed and aquatic conditions beyond those solely attributable to the road, such as fishing, fish stocking (particularly non-native species), disease introduction, beaver removal, timber harvest, splash-damming, permanent dams for water storage and power production, recreation (particularly dispersed recreation camping next to streams), livestock grazing, irrigation withdrawals, fire suppression and ignition, and mining.

The road density (miles per square mile) attribute was calculated by subwatershed by dividing the total miles of road under all jurisdictions within the Forest proclaimed boundary by the area of the proclaimed Colville National Forest boundary.

Roads in proximity to water attribute is similar to the channel constriction attribute described in Reiss et al. (2008), recognizing that roads near aquatic habitat can have additional effects to the habitat. Streamside roads can reduce stream shade and increase water temperatures, simplify channel form (cut off side channels, straighten streams through confinement), and create impediments to the movement of aquatic species. The rationale given in Reiss et al. (2008) is further supported by recent work specific to the Interior Columbia Basin. Meredith et al. (2014) found the presence of roads adjacent to streams resulted in significant reductions of in-channel wood. The proximity to water attribute by subwatershed was calculated by dividing total road miles of all roads under all jurisdictions in the riparian habitat conservation areas (RHCA) designated by INFISH (USDA Forest Service 1995a) by the square mile of RHCAs.

The road attributes were categorized or "scored" consistent with the WCF, where a score of 1 is considered to be "good" condition, a score of 2 representing "fair" and a score of 3 is considered "poor" condition. The following table displays how the road density and proximity to water attributes were categorized.

Table 77. Road attributes categories

Road Density (mile per square mile)	Road Density Risk category	Riparian Road Density category
less than 1	1	1
1-2.4	2	2
>2.4	3	3

The roads attributes were further evaluated for erosion and sedimentation risk. High road densities in sensitive HUC 12s can more severely disrupt watershed processes and potentially have more serious impacts to water quality, aquatic habitat, and the species themselves than the same densities in less sensitive HUC 12s. The weight that the road density evaluation score receives in the model varies according to a HUC 12's sensitivity to soil disturbance.

The roads in landtype associations (LTA) with high erosion and sedimentation potential attribute is similar to the road density by sensitive soils attribute in Reiss et al. (2008). LTAs are ecological land units delineated based on similarities in landform pattern, geomorphic processes, regolith and bedrock features and their influence on physical and biological processes, climate, and potential vegetation (Davis et al. 2004).[32] Both the hydrology and soils sections in this document include additional discussion of LTAs. The LTAs were rated based on erosion risk using the following factors:

- Sediment delivery efficiency
- Surface runoff from snowpack
- Surface runoff from summer storms
- Deep-seeded landslide risk
- Shallow, rapid landslide risk
- Soil erosion

The erosion risk factors were put into three categories that were weighted equally.

Table 78. Erosion risk categories

Category	Points
Low	1
Moderate	2
High or Flashy	3

The points for the six factors were summed to determine the "final" erosion risk score. Therefore, the highest total score is 18, the lowest is 6.

Table 79. Final erosion risk categories

Total Points	Final Erosion Risk
6-8	Low
9-12	Moderate
12-18	High

The following table displays how subwatersheds with roads in LTAs with high erosion and sedimentation risk were categorized.

[32] Landtype Associations are defined for the Colville National Forest in Davis (2004)

Table 80. Erosion and sedimentation risk categories

Miles of Road in LTAs with high erosion and sedimentation risk	Road Erosion and Sedimentation Risk Category
0-8	1
8.1-15	2
>15	3

Two upslope vegetation attributes were included in the AEC model: fire condition class, and insects and disease. The definitions, rating, and scoring for the two attributes were obtained from the 2010 WCF database. These two attributes were chosen to help describe the health of forest vegetation as a component of a healthy watershed and to assess the potential risk of historically uncharacteristic wildfire, and insect and disease outbreaks.

The fire regime condition class (FRCC) measures the degree vegetation conditions have departed from a reference condition expected with natural fire frequency intervals. The departure from reference conditions may result in changes to key ecosystem components, such as vegetation characteristics (species composition, structural stage, stand age, canopy closure, and mosaic pattern); fuel composition; fire frequency, severity, and pattern; and other associated disturbances, such as insect and disease mortality, grazing, and drought. The degree of departure may be due to (but are not limited to) fire suppression, timber harvesting, livestock grazing, introduction and establishment of exotic plant species, and introduced insects and disease. The FRCC is a measure of ecological trend and the potential for uncharacteristic disturbance to the ecosystem from fire. There are three fire regime condition classes described below:

> *FRCC 1* represents ecosystems with low (less than 33 percent) departure and that are still within the estimated historical range of variability during a specifically defined reference period.
>
> *FRCC* 2 indicates ecosystems with moderate (33 to 66 percent) departure.
>
> *FRCC 3* indicates ecosystems with high (greater than 66 percent) departure from reference conditions.

Insects and disease along with fire are important regulators of forest change. Insects and disease can negatively affect resource values and ecosystem functions including reducing the ability of forest canopies to intercept snow and prevent excessive runoff. Recent increases in forest area affected by insect outbreaks and possible links to fire suppression have created a resurgence of interest in their possible effects to water quantity, quality, and risks.

The riparian wetland vegetation attribute addresses riparian vegetation condition. Important functions of riparian vegetation include (FEMAT 1993, Gregory et al. 1991): (1) The input of fine organic matter and nutrients to aquatic habitat; (2) Providing for bank stability; (3) Filtering sediment due to surface erosion thus controlling the amount reaching the aquatic system; (4) A source of large woody debris; (5) Shading the aquatic habitat thus helping to control water temperature; and (6) Controlling the microclimate within the riparian zone and adjacent to the aquatic habitat

The riparian wetland vegetation attribute scores were obtained from the WCF database.

Reiss et al. (2008) recognized the importance of including in-stream attributes as indicators of aquatic habitat condition; however, did not, due to lack of data on non-Federal lands. Reiss et al. (2008) did recognize the value of including stream channel attributes if available. Since the Forest had assessed all subwatersheds within the Forest administrative boundary in 2010, with a consistent framework through the WCF exercise, the decision was made to include attributes that would help describe the current condition of stream habitat. The previously discussed attributes assess factors that influence aquatic habitat, but do not specifically describe current aquatic habitat condition for the MIS/surrogate species. Therefore, the Forest decided to include attributes to describe aquatic habitat conditions which, when combined with the upslope and riparian attributes and MIS/surrogate species status scores, were determined to provide a more complete picture of the AEC. Channel shape and function, and large woody debris were the in-channel attributes chosen to describe in-stream habitat conditions.

Stream channels are formed and shaped in response to the timing and quantity of flow and sediment delivery over time. Short-term changes in water or sediment delivery due to a disturbance such as a fire or flood may cause a channel response resulting in a changed condition. However, if the channel forming processes are intact and allowed to recover, the stream channels and aquatic habitat are usually resilient (Montgomery and Buffington 1998, Leopold 1994, Rosgen 1996).

Allowing stream channels to interact with floodplains and preserving the lateral, longitudinal, and temporal variability between stream channels, floodplains and riparian habitats are paramount to maintain natural heterogeneity and complexity of aquatic habitat (Naiman et al. 1992). In-stream large woody debris, where it is a natural part of the aquatic system, is an important feature that creates complex channel structure and fish habitat by collecting sediment, forming riffles and pools, providing cover, and facilitating biological productivity (Naiman et al. 1992). Complex habitats that are resilient to disturbance are important for the survival and productivity of aquatic species populations (Reeves et al. 1995)

The scores for the habitat portion of the AEC were obtained by multiplying the score for each attribute by its weight and summing the scores for each subwatershed. The properly functioning, functioning at risk, and not properly functioning scores were then converted to a +1 to -1 scale and combined with the MIS/surrogate species status to obtain the AEC score for a subwatershed.

Table 81. Total possible score by attribute

Attribute	Total Score Possible
Large Woody Debris	0.3
Channel Shape and Function	0.3
Riparian Wetland Veg Condition	0.3
Road Density	0.45
Proximity to Water	1.2
Roads in LTAs with high erosion and sedimentation potential	0.15
Fire Condition Class	0.15
Insects and Disease	0.15
Total	3

Table 82. Final aquatic habitat condition rating

Final Aquatic Habitat Condition Rating	Final Habitat Score	Score Included in the AEC Model
Properly Functioning	1.0-1.4	+0.33 to +1.0
Functioning at Risk	1.5-2.4	-0.33 to +0.33
Not Properly Functioning	2.5-3	-1 to -0.34

AEC Results – Current Watershed Condition and Species Status on the Colville National Forest

Kettle Interior Redband

The total AEC scores for interior redband in the Kettle subbasin range from a high of 0.4 (functional) in the Sand Creek-Kettle River subwatershed to -0.6 (*not properly functioning*) in the West Deer Creek subwatershed. The MIS/surrogate species scores are within the *properly functioning* range in eight subwatersheds; in five subwatersheds the population is rated functioning at risk; and the local population score is *not properly functioning* in two subwatersheds. The low local population scores are generally due to unknown redband abundance, abundant brook trout and a past history of stocking non-native rainbow trout. The habitat scores are considered *not properly functioning* in 10 of the 15 subwatersheds occupied by interior redband. No subwatershed habitat scores fall within the *properly functioning* range. A lack of large woody debris in the stream channels, high road densities and riparian road densities are commonly driving the low habitat scores. In all subwatersheds, the channel shape and function attribute is rated *functioning at risk*. The fire regime indicator is rated *functioning at risk* in many of the subwatersheds and the riparian vegetation indicator is rated as *not properly functioning* in the Trout Creek, Tonata Creek, Saint Peter Creek, Little Boulder Creek, and West Deer Creek subwatersheds.

Table 83. Kettle Interior Redband Subbasin AEC scores

HUC 12 Number	HUC 12 Name	HUC 12 MIS/Surrogate Species Score	Watershed Condition Score	Final AEC Score
170200021301	Trout Creek	0.75	-0.60	0.1
170200021701	Tonata Creek	0.81	-0.60	0.1
170200022002	North Fork Deadman Creek	0.44	-0.50	0.0
170200022003	Deadman Creek	0.44	-0.40	0.0
170200021904	Sand Creek-Kettle River	0.50	0.20	0.4
170200021706	Lone Ranch Creek	0.50	-0.30	0.1
170200022004	Hodgson Creek-Kettle River	0.00	0.20	0.1
170200021304	Saint Peter Creek	0.19	-0.60	-0.2
170200021905	South Fork Boulder Creek	0.34	-0.40	0.0
170200021906	North Fork Boulder Creek-Boulder Creek	0.34	-0.50	-0.1
170200021902	Deep Creek	-0.25	-0.40	-0.3
170200021903	Little Boulder Creek	-0.19	-0.20	-0.2
170200022001	Toulou Creek	0.00	-0.40	-0.2
170200021302	Lambert Creek	-0.53	-0.30	-0.4
170200021705	West Deer Creek	-0.75	-0.50	-0.6

Kettle WSCT

Westslope cutthroat trout inhabit six subwatersheds within the Kettle River subbasin. Only the Sand Creek-Kettle River has a *properly functioning* AEC score, the remaining five subwatersheds are rated functioning at risk. The MIS/surrogate species population is rated *not properly functioning* in the East Deer Creek-Kettle River, *functioning at risk* in four subwatersheds, and within the *properly functioning* range in Sand Creek-Kettle River. The low population scores are driven by low or unknown abundance, barriers and presence of non-native fish including possible presence of introduced non-native cutthroat trout. The *functioning at risk* watershed condition scores are due to ratings for channel function and shape, low amounts of woody debris, road and riparian road densities. The riparian vegetation attribute is *functioning at risk* in the South Fork Boulder Creek subwatershed. The fire regime indicator is *functioning at risk* in the North Fork Boulder-Boulder Creek and South Fork Boulder Creek subwatersheds.

Table 84. Kettle Subbasin WSCT AEC scores

HUC 12 Number	HUC 12 Name	HUC 12 MIS/Surrogate Species Score	Watershed Condition Score	Final AEC Score
170200021907	East Deer Creek-Kettle River	-0.63	0.30	-0.2
170200021904	Sand Creek-Kettle River	0.50	0.20	0.4
170200021906	North Fork Boulder Creek-Boulder Creek	0.21	-0.50	-0.1
170200022001	Toulou Creek	0.31	-0.40	0.0
170200021902	Deep Creek	-0.25	-0.40	-0.3
170200021905	South Fork Boulder Creek	-0.29	-0.40	-0.3

Sanpoil WSCT

Within the Forest only the North Fork Sanpoil River-Sanpoil subwatershed is inhabited by WSCT. The local population is *functioning at risk* due to unknown abundance and a lack of connectivity with other WSCT populations. The watershed condition within the North Fork Sanpoil River-Sanpoil subwatershed is *functioning at risk* due to poor riparian vegetation conditions and high riparian road densities. Channel shape and function, fire regime, insects and disease and road densities are all rated *functioning at risk*. Only the large wood attribute and sediment risk from roads on sensitive soils are considered *properly functioning*.

Table 85. Sanpoil Subbasin WSCT AEC scores

HUC 12 Number	HUC 12 Name	HUC 12 MIS/Surrogate Species Score	Watershed Condition Score	Final AEC Score
170200040101	North Fork Sanpoil River-Sanpoil River	-0.31	-0.30	-0.3

Sanpoil Interior Redband

Interior redband trout are found in four subwatersheds within the Sanpoil subbasin. Two subwatersheds have a total AEC within the *functioning at risk* category and two are rated *not properly functioning*. All local populations are rated *not properly functioning* except O’Brien Creek which is *functioning at risk*. Brook trout predominate and interior redband trout may no longer be present in all but the O’Brien Creek subwatershed. The O’Brien Creek population is at risk due to unknown abundance, reduced range, and lack of connectivity with other redband populations. Habitat is *functioning at risk* in O’Brien and Thirteenmile-Sanpoil River subwatersheds and rated as *not properly functioning* in the Scatter Creek and

Ninemile Creek subwatersheds. Only the insect and disease and road on sensitive soils attributes are rated as *properly functioning* in O'Brien Creek, riparian road densities are *not properly functioning*. Thirteenmile Creek-Sanpoil River subwatershed is *functioning at risk* due to impaired channel shape and function, road densities and high riparian road densities. High road and riparian road densities, and a lack of large woody debris primarily drive the low watershed condition rating for Scatter Creek-Sanpoil River subwatershed. The Ninemile Creek watershed condition is degraded due to high road and riparian road densities combined with all other indicators except the road on sensitive soils indicator are rated *functioning at risk*.

Table 86. Sanpoil Subbasin interior redband AEC scores

HUC 12 Number	HUC 12 Name	HUC 12 MIS/Surrogate Species Score	Watershed Condition Score	Final AEC Score
170200040102	O`Brien Creek	-0.13	-0.30	-0.2
170200040108	Thirteenmile Creek-Sanpoil River	-0.50	0.00	-0.3
170200040106	Scatter Creek-Sanpoil River	-0.75	-0.40	-0.6
170200040107	Ninemile Creek	-0.75	-0.50	-0.6

Pend Oreille Bull Trout

Bull trout local population status and overall AEC scores are generally rated as *not properly functioning*. Only the Headwaters South Salmo River received a positive population score, although population status is *functioning at risk*. The local populations in North Fork Sullivan Creek,-Sullivan Creek, Slate Creek, West Branch LeClerc Creek and East Branch LeClerc Creeks were rated *at risk*. The low population scores are due to low or unknown abundance, competition with non-native trout, and barriers.

As with the population status ratings, the watershed condition scores are also generally *not properly functioning*. Watershed condition is rated as *properly functioning* only in the Headwaters South Salmo River subwatershed, North Fork Sullivan Creek-Sullivan Creek, and Slate Creek subwatersheds. The *functioning at risk* and *not properly functioning* ratings are due to *at risk* or *not properly functioning* ratings for large woody debris (16 subwatersheds), channel shape and function (17 subwatersheds), riparian vegetation condition (18 subwatersheds), insects and disease (four subwatersheds), road densities (19 subwatersheds) riparian road densities (19 subwatersheds) and roads on sensitive soils (eight subwatersheds). Additionally all subwatersheds were rated *functioning at risk* for the fire regime attribute.

Table 87. Pend Oreille Subbasin bull trout AEC scores

HUC 12 Number	HUC 12 Name	HUC 12 MIS/Surrogate Species Score	Watershed Condition Score	Final AEC Score
170102160702	Headwaters South Salmo River	0.16	0.90	0.5
170102160403	North Fork Sullivan Creek-Sullivan Creek	-0.29	0.70	0.2
170102160903	Slate Creek	-0.16	0.40	0.1
170102160201	Exposure Creek-Pend Oreille River	-0.56	-0.20	-0.4
170102160302	West Branch LeClerc Creek	-0.24	-0.10	-0.2
170102160303	East Branch LeClerc Creek	-0.24	-0.50	-0.4
170102160902	Sweet Creek-Pend Oreille River	-0.35	-0.20	-0.3
170102160102	Winchester Creek	-0.63	-0.50	-0.6
170102160103	Smalle Creek	-0.69	-0.40	-0.5

HUC 12 Number	HUC 12 Name	HUC 12 MIS/Surrogate Species Score	Watershed Condition Score	Final AEC Score
170102160206	Tacoma Creek	-0.53	-0.50	-0.5
170102160304	Ruby Creek	-0.63	-0.70	-0.7
170102160402	Headwaters Sullivan Creek	-0.94	-0.50	-0.7
170102160401	Harvey Creek	-0.75	-0.20	-0.5
170102160101	North Fork Calispell Creek	-0.88	-0.70	-0.8
170102160104	Calispell Creek	-0.50	0.00	-0.3
170102160202	Skookum Creek	-0.63	-0.50	-0.6
170102160207	Cusick Creek-Pend Oreille River	-0.53	-0.60	-0.6
170102160306	Lost Creek	-0.63	-0.40	-0.5
170102160901	Big Muddy Creek	-0.53	-0.50	-0.5
170102160904	Flume Creek-Pend Oreille River	-0.75	-0.10	-0.4
170102160905	Pewee Creek-Pend Oreille River	-1.00	-0.70	-0.9
170102160204	Cee Cee Ah Creek	-0.38	-0.40	-0.4
170102160307	Maitlen Creek-Pend Oreille River	-0.63	-0.50	-0.6

Pend Oreille WSCT

Of the 24 Pend Oreille subwatersheds rated for WSCT, only the Headwaters South Salmo River received a functional AEC. The AEC for the Winchester Creek, North Fork Calispell Creek, Skookum Creek, Cusick Creek-Pend Oreille River and Maitlen Creek-Pend Oreille River is rated as *not properly functioning*. All other subwatersheds received a *functioning at risk* score. Local species population status is rated as *properly functioning* in the Headwaters South Salmo River, West Branch LeClerc Creek, East Branch LeClerc Creek, and Harvey Creek. Twelve local populations are rated as *functioning at risk* and eight local populations are rated as *not properly functioning*. The *functioning at risk* and *not properly functioning* scores are due to a combination of unknown or low abundance, competition with non-native trout and lack of connectivity with other WSCT populations due to barriers.

The watershed condition is rated as *properly functioning* in Headwaters South Salmo River, North Fork Sullivan Creek-Sullivan, and Slate Creek. The watershed condition is rated as *functioning at risk* in seven subwatersheds and *not properly functioning* in 14 subwatersheds. Factors contributing to the *at risk* and *not properly functioning* ratings include; diminished amounts of large woody debris (17 subwatersheds), impaired channel shape and function (20 subwatersheds), riparian vegetation condition (17 subwatersheds), insects and disease (nine subwatersheds), high road densities and riparian road densities (21 subwatersheds) and roads on soils sensitive to erosion (nine subwatersheds). Additionally all subwatersheds are rated *functioning at risk* for the fire regime indicator.

Table 88. Pend Oreille Subbasin WSCT AEC scores

HUC 12 Number	HUC 12 Name	HUC 12 MIS/Surrogate Species Score	Watershed Condition Score	Final AEC Score
170102160702	Headwaters South Salmo River	0.50	0.90	0.7
170102160403	North Fork Sullivan Creek-Sullivan Creek	-0.13	0.70	0.3
170102160903	Slate Creek	0.13	0.40	0.3
170102161003	Cedar Creek	-0.25	0.20	0.0
170102160302	West Branch LeClerc Creek	0.43	-0.10	0.2
170102160303	East Branch LeClerc Creek	0.36	-0.50	-0.1
170102160103	Smalle Creek	0.06	-0.40	-0.2
170102160206	Tacoma Creek	0.27	-0.50	-0.1
170102160401	Harvey Creek	0.44	-0.20	0.1
170102160402	Headwaters Sullivan Creek	0.06	-0.50	-0.2
170102160902	Sweet Creek-Pend Oreille River	0.01	-0.20	-0.1
170102160304	Ruby Creek	0.01	-0.70	-0.3
170102160201	Exposure Creek-Pend Oreille River	-0.38	-0.20	-0.3
170102160102	Winchester Creek	-0.53	-0.50	-0.5
170102160905	Pewee Creek-Pend Oreille River	0.06	-0.70	-0.3
170102160101	North Fork Calispell Creek	-0.41	-0.70	-0.6
170102160204	Cee Cee Ah Creek	0.05[33]	-0.40	-0.2
170102160306	Lost Creek	0.01	-0.40	-0.2
170102160901	Big Muddy Creek	0.11	-0.50	-0.2
170102160104	Calispell Creek	-0.50	0.00	-0.3
170102160202	Skookum Creek	-0.75	-0.50	-0.6
170102160207	Cusick Creek-Pend Oreille River	-0.41	-0.60	-0.5
170102160904	Flume Creek-Pend Oreille River	-0.50	-0.10	-0.3
170102160307	Maitlen Creek-Pend Oreille River	-0.63	-0.50	-0.6

Colville WSCT

The subwatersheds with WSCT in the Colville subbasin, include the Little Pend Oreille Lakes, Cottonwood Creek, and South Fork Mill Creek. Cottonwood Creek received an overall AEC score in the *functioning at risk* range while the Little Pend Oreille lakes and South Fork Mill Creek subwatersheds are rated as *not properly functioning*. The local population scores are all in the *functioning at risk* range due to low abundance, a predominance of brook trout, and isolation due to man-made barriers preventing connectivity with other populations. The Cottonwood Creek subwatershed condition is *functioning at risk* while both Little Pend Oreille Lakes and South Fork Mill Creek are rated as *not properly functioning*. The Cottonwood rating is due to large woody debris amounts scored as *not properly functioning*. The channel shape and function, road densities and riparian road density attributes are *functioning at risk*. The *not properly functioning* watershed condition ratings for Little Pend Oreille Lakes and South Fork Mill Creek

[33] Since the current status of the MIS/surrogate species were assessed the Kalispel Tribe of Indians has eradicated non-native trout within the Cee Cee Ah subwatershed and reintroduced WSCT. At this time, the status of the reintroduced population is not known, but it is likely the MIS/surrogate species and total AEC scores have improved.

subwatersheds are due to *functioning at risk* or *not properly functioning* scores for all the watershed condition attributes except insects and disease and for roads on soils sensitive to erosion.

Table 89. Colville Subbasin WSCT AEC scores

HUC 12 Number	HUC 12 Name	HUC 12 MIS/Surrogate Species Score	Watershed Condition Score	Final AEC Score
170200030106	Cottonwood Creek	0.20	0.20	0.2
170200030201	Little Pend Oreille Lakes	-0.25	-0.50	-0.4
170200030301	South Fork Mill Creek	-0.26	-0.60	-0.4

Colville Interior Redband Trout

The Colville subbasin includes four subwatersheds with interior redband trout. The total AECs for the South Fork Chewelah Creek-Chewelah Creek and North Fork Mill Creek are rated *functioning at risk*, while the AEC for the South Fork Mill Creek and North Fork Chewelah Creek is rated as *not properly functioning*. The local populations are considered to be *functioning at risk* due to low abundance, isolation by barriers, high numbers of brook trout or hybridization with non-native trout. The watershed condition is considered *not properly functioning* in all four subwatersheds due to *at risk* or *not properly functioning* scores for all watershed condition attributes except insects and disease, roads on soils sensitive to erosion, and the fire regime attribute in the North Fork Mill Creek and North Fork Chewelah Creek watersheds.

Table 90. Colville Subbasin interior redband AEC scores

HUC 12 Number	HUC 12 Name	HUC 12 MIS/Surrogate Species Score	Watershed Condition Score	Final AEC Score
170200030109	South Fork Chewelah Creek-Chewelah Creek	-0.18	-0.50	-0.3
170200030301	South Fork Mill Creek	-0.26	-0.60	-0.4
170200030302	North Fork Mill Creek	-0.01	-0.60	-0.3
170200030108	North Fork Chewelah Creek	-0.25	-0.70	-0.5

Lake Roosevelt Interior Redband

Interior redband trout populations are found in nine subwatersheds. No subwatersheds received a *properly functioning* AEC score, four are rated as *functioning at risk* and five received a *not properly functioning* rating. Six local populations are *functioning at risk* and three are *not properly functioning*. Factors contributing to the low scores include limited distribution, low population numbers, isolation due to barriers, competition with non-native brook trout, and hybridization with non-native trout. Isolation above barriers are protecting small populations of interior redband from hybridization with non-native rainbow trout in the South Fork Sherman Creek, Upper Sherman Creek, and Lower Sherman Creek subwatersheds.

No subwatersheds received a *properly functioning* watershed condition score. Five received a *functioning at risk* rating and the remaining four are rated as *not properly functioning*. All subwatersheds were *functioning at risk* or *not properly functioning* for riparian road densities and channel shape and function. Seven subwatersheds were rated *functioning at risk* or *not properly functioning* for large woody debris, five for the riparian vegetation condition attribute, three for fire regime, three for insects and disease, seven for total road densities, and two for roads on soils sensitive to erosion.

Table 91. Lake Roosevelt Subbasin interior redband AEC scores

HUC 12 Number	HUC 12 Name	HUC 12 MIS/Surrogate Species Score	Watershed Condition Score	Final AEC Score
170200011401	Upper Hall Creek	0.09	0.20	0.1
170200011301	South Fork Sherman Creek	0.03	-0.40	-0.2
170200011302	Upper Sherman Creek	-0.31	-0.50	-0.4
170200011303	Lower Sherman Creek	0.00	-0.50	-0.3
170200011306	Barnaby Creek	-0.25	-0.50	-0.4
170200011304	Nancy Creek-Franklin D Roosevelt Lake	0.25	0.20	0.2
170200011207	Flat Creek-Franklin D Roosevelt Lake	-0.53	-0.30	-0.4
170200011307	Quillisascut Creek-Franklin D Roosevelt Lake	-0.75	0.00	-0.4
170200011205	Crown Creek	-0.53	-0.20	-0.4

Lake Roosevelt WSCT

The Lake Roosevelt subbasin includes five subwatersheds with WSCT populations. Four of the five subwatersheds received a *functioning at risk* AEC while Meadow Creek was rated *not properly functioning*. All the local populations are rated as *functioning at risk* except Meadow Creek, which is *not properly functioning*. The watershed condition scores for North Deep Creek, American Fork and Lower Big Sheep Creek are rated as *functioning at risk*. Rocky Creek and Meadow Creek are *not properly functioning*. The local population scores are influenced by low abundance, isolation due to barriers and the apparent displacement of WSCT populations by brook trout. The watershed condition scores are due to all subwatersheds receiving a *functioning at risk* rating for the large woody debris, channel shape and function, road density, and riparian road density attributes. Three of the five subwatersheds are rated as *functioning at risk* or *not properly functioning* for the riparian vegetation attribute; three are *functioning at risk* for fire regime and one for the insect and disease indicator.

Table 92. Lake Roosevelt Subbasin WSCT AEC scores

HUC 12 Number	HUC 12 Name	HUC 12 MIS/Surrogate Species Score	Watershed Condition Score	Final AEC Score
170200011004	North Fork Deep Creek	-0.38	-0.30	-0.3
170200011105	American Fork	-0.25	-0.30	-0.3
170200011107	Lower Big Sheep Creek	-0.25	-0.10	-0.2
170200011001	Rocky Creek	-0.09	-0.50	-0.3
170200011002	Meadow Creek	-0.22	-0.60	-0.4

Summary

The AEC for most subwatersheds on the Forest is rated as *functioning at risk* or *not properly functioning*. The local population's MIS/surrogate species status is rated as *functioning at risk* or *not properly functioning* in most subwatersheds. Subwatersheds with local populations rated as *properly functioning* include eight redband populations and one WSCT population in the Kettle subbasin, and four WSCT populations in the Pend Oreille subbasin. The poor local population status ratings are generally due to low abundance of the MIS/surrogate species, hybridization, apparent displacement or competition from non-native fish, especially brook trout, barriers, and a lack of connectivity between populations.

As with the local population status, the watershed condition is rated as *functioning at risk* or *not properly functioning* in most subwatersheds. Only the Headwaters South Salmo River, North Fork Sullivan Creek-Sullivan Creek and Slate Creek subwatersheds in the Pend Oreille subbasin were rated as *properly functioning*. Factors influencing the watershed condition scores commonly include low ratings for large woody debris and channel shape and function, high road and riparian road densities. Degraded riparian vegetation conditions also influenced the ratings in a number of subwatersheds. Many watersheds were considered *functioning at risk* for the fire regime attribute, while the insect and disease attribute did not receive a *properly functioning* rating in a few subwatersheds. Road densities within LTAs sensitive to erosion were identified as a potential problem in some subwatersheds in the Pend Oreille, Colville, and Lake Roosevelt subbasins.

PIBO Surveys

The AEC assessment provides information on the current status of MIS/surrogate species populations and watershed and stream channel condition. That assessment of current aquatic habitat condition on the Forest is further informed through habitat trend information provided by the PACFISH/INFISH Biological Opinion Effectiveness Monitoring Program (PIBO). PIBO began implementation in 2001 (while the Forest only comes under the INFISH strategy, the PIBO program includes areas managed under both the PACFISH and INFISH strategies).[34] The monitoring program was designed to answer the question: “Are key biological and physical components of aquatic and riparian communities being improved, degraded, or restored within the range of steelhead (*O. mykiss*) and bull trout?” As the program has progressed, PIBO is using an “index” approach to answer the question.[35] The index approach to assessing status of habitat conditions outlined in Al-Chokhachy et al. (2010) was developed to account for some natural variability among sites due to geoclimatic and disturbance regimes. The PIBO approach (Archer et al. 2016), based upon Al-Chokhachy et al. (2010), compares the status of stream habitat conditions at sites in ‘managed’ subwatersheds (subwatersheds disturbed by various management activities) to habitat conditions at sites within ‘reference’ or relatively pristine subwatersheds. Since all streams are affected by natural disturbance, status is determined by assessing how the range of habitat conditions at managed sites compares to what would be expected if the stream had only experienced natural disturbance. The PIBO approach compares five in-channel habitat attributes; residual pool depth, percent pools, D50,[36] fines in pool tails, and large wood frequency. The individual attribute index scores are combined into a total index and there is an additional index for the aquatic macroinvertebrate community (observed/expected). The index scores for the individual attributes and the final index are then compared to scores from reference stream reaches, in reference subwatersheds within the same ecoregion, and across the PIBO monitoring area.

PIBO also evaluated the data to determine if habitat trends on reaches where they had repeat surveys (often three) were improving (moving in a direction considered to be favorable habitat for salmonids). For the trend analysis, the attributes bank stability (percent bank covered with plants or rock) and percent undercut bank were added to the five used to assess status. The index approach is felt to be good for determining status but may not be as useful for determining trends in habitat conditions over time as it

[34] PIBO PACFISH INFISH Biological Opinion Monitoring http://www.fs.fed.us/biology/nsaec/index.html)
[35] Personal communication, telephone conversation between Ken MacDonald and Erik Archer, PIBO (March 20, 2014) and email Erik Archer to Ken MacDonald (Preliminary Colville Results) (March 21, 2014)
[36] D50 is a measure of the stream substrate median particle size of the stream substrate. Definitions for all the stream habitat attributes can be found in Kershner et al. (2004).

averages conditions of several attributes that may be more responsive individually. Trends are therefore estimated by measuring the changes in the individual stream attributes over time (Archer et al. 2016).

In addition to the sites sampled to determine whether the “key biological and physical components of aquatic and riparian communities are being improved, degraded, or restored” (deemed PIBO effectiveness monitoring), PIBO samples sites in Designated Monitoring Areas (DMAs). The DMAs are located at sites within grazed subwatersheds that are representative of typical grazing impacts for the pasture (Archer et al. 2016).

In order to account for differences in stream types and geographic location, predictor variables were developed to provide the ‘expected’ stream habitat conditions (Al-Chokhachy et al. 2010, Archer et al. 2016). The predictor variables are:

- Catchment Area (square kilometers; km^2)
- Average precipitation (meters; m)
- Slope of valley along reach (%)
- Percent forested along reach (%)
- Drainage density in catchment (kilometers/square kilometer; km/km^2)
- Reach gradient (%)
- Elevation (m)
- Dominant geology type

The following summarizes the results from Archer et al. (2016) on a forestwide basis and within the individual subbasins on the Forest. In all cases below, the “managed” stream results are compared to the results from similar reference streams, based on the landscape predictor variables, in the same ecoregion and through PIBO sampling area. The term significant refers to statistical significance (p less than 0.10).

Colville National Forest

The overall index scores as well as the “scores” for most of the habitat attributes are significantly lower (‘impaired’ condition) than what is expected compared to reference sites within the ecoregion and reference sites across the PIBO sampling area. Only the residual pool depth index score is not significantly different than reference sites within the ecoregion, but there is a relatively large confidence interval. The large wood attribute score is significantly higher than the reference sites. While the observed/expected index is significantly lower than reference sites, the score is still within the range that would be considered “good” as described in Archer et al. (2016). While the scores for most all the attributes are lower than reference sites, there are statistically significant positive trends in the overall index scores, and the bank stability, percent undercut bank, large wood frequency, bank angle, residual pool depth and percent pool attributes.

Similarly, the overall index scores within the sampled DMAs are significantly lower than reference reaches as are the median substrate size, fines in pool tail-outs, and bank angle habitat attributes. There appear to be significant positive trends in the bank stability and percent pool indices within the sampled DMAs across the Forest, although sample size is low.

Kettle Subbasin

The total index score for sampled streams in the Kettle subbasin is significantly lower than observed in reference streams within the ecoregion and overall. The percent pools, median substrate size (D50), pool-tail fines, and bank angle attributes are all significantly lower than observed in reference streams. The large woody debris scores are statistically greater than in the references. There are no significant trends in the condition of the habitat attributes in the Kettle subbasin other than a significant positive trend for the large wood and residual pool depth attributes. There are no significant differences in the overall index score within DMAs in the Kettle subbasin or individual habitat attributes other than the median substrate score is significantly lower than either reference and large wood is significantly higher than either reference. Again sample size is low. There are not enough samples at this time to determine trends within the DMAs.

Sanpoil Subbasin

Only four managed streams in the Sanpoil subbasin were available for comparison, therefore, the statistical significance of differences in attribute and final scores and trends could not be determined

Pend Oreille Subbasin

Within the Pend Oreille subbasin, the overall index and the percent pool attribute scores are not significantly different than reference sites within the ecoregion, but are significantly lower when compared to all reference sites. However, the lack of a significant difference between managed and reference sites within the eco-region may be due to a large confidence interval around the mean values within the Pend Oreille subbasin (27 percent) and a larger sample size with smaller confidence interval across all reference sites compared to the eco-region reference sites. The median substrate size and pool tail fine attributes are both significantly lower (‘impaired’) compared to either reference. There are no significant differences in the status of the other attributes compared to the references. There are significant positive trends in the bank stability, large wood, pool-tail fines and residual pool depth attributes. There are not enough samples to determine either status or trend within the DMAs.

Colville Subbasin

The overall habitat index score is significantly lower for the sampled streams in Colville subbasin than the expected condition based upon reference stream conditions. Pool fines, the macroinvertebrate community and median substrate size (D50) scores are significantly lower compared reference streams. In the Colville subbasin, the bank stability, pool-tail fines, and percent pools showed a significant, positive trend. There are not enough samples within DMAs to establish either status or trend.

Upper Columbia-Lake Roosevelt Subbasin

The overall index score for streams sampled are significantly lower than either reference. The median substrate size and pool-tail fines attributes are significantly lower than the reference sites and wood frequency is significantly higher than the references. Only the wood frequency attribute shows a significant positive trend. Within DMAs in the subbasin, the wood frequency scores are significantly higher than either reference but the overall habitat index, the median substrate, and pool fines are significantly lower than either reference. There are not enough samples to determine trend in the habitat attributes in the DMAs at this time.

Need for Change

The Need for Change is described in chapter 1 of the FEIS. Only information related specifically to the fisheries analysis and the Need for Change is discussed in this section.

Wildlife

There is a need to maintain or restore ecological conditions that contribute to the recovery and viability of terrestrial plant and wildlife species. The 1988 forest plan needs to be updated to reflect new species listings, designated critical habitat, and current science relating to plant and animal species and their habitats. Some wildlife species have been added to the Federal Threatened and Endangered Species List and some have included a new designation of critical habitat (woodland caribou). A considerable body of information is now available concerning the viability of terrestrial wildlife and plant species of management focus. This includes viability assessments for the Interior Columbia Basin and for northeastern Washington. Key factors that influence viability of many of the species assessed include habitat alteration due to timber harvest, wildfire, and other vegetation management activities; restoration of riparian and wetland habitats; and reduction of habitat effectiveness and connectivity due to the potential impacts of roads. Climate change may alter how water systems function and it is projected to exacerbate the loss of old forest habitat due to increased fire rates. This creates a need to restore watershed conditions to be more resilient to disturbances to provide for the recovery and viability of wildlife and plant species.

Riparian and Aquatic Resource Management

The 1988 forest plan includes riparian management direction from the Inland Native Fish Strategy (INFISH) (USDA Forest Service 1995a). This approach appears to have either maintained or improved riparian and aquatic habitat conditions at the watershed and larger scales.

Objectives for riparian management areas would give emphasis to maintaining or restoring the riparian and aquatic structure and function of intermittent and perennial streams, confer benefits to riparian-dependent plant and animal species, enhance habitat conservation for organisms that are dependent on the transition zone between upslope and riparian areas, contribute to improved water quality and flows, and contribute to a greater connectivity of the watershed for both riparian and upland species.

Desired conditions for riparian management areas within any given watershed are to have compositions of native flora and fauna and a distribution of physical, chemical, and biological conditions commensurate with natural processes.

Environmental Consequences

Methodology

A 2-step process for the environmental consequences assessment was used for fish and aquatic habitat for each alternative. First, the key indicators for the issues were assessed providing the framework to describe the relative conservation value to aquatic species of the alternatives based upon an assessment of the relative risks and protections the alternatives are judged to provide (table 93).

Table 93. Issues and key indicators for the aquatic habitat and species environmental consequences

Issue	Key Indicators
Old Forest Management and Timber production	The number of acres that have focused restoration (or late forest structure), general restoration, and a timber production emphasis.
Motorized Trails and Access	Desired Conditions for road densities Acres allocated to motorized access.
Recommended Wilderness	Total acres in recommended wilderness.
Riparian and Aquatic Resource Management	Aquatic Conservation Strategy Direction, RMA delineation and RMA direction. Key Watershed Acres, Management Direction for Key Watersheds, MIS/Surrogate Species, Key Watershed and Restoration Objectives. Change in distribution of aquatic invasive species. Improvement in riparian vegetation conditions within grazing allotments.

Once the environmental consequences of an alternative were determined based upon the key indicators, the Forest Service contribution to providing for the viability of the MIS/surrogate species was modeled based on the procedures outlined in Reiss et al. (2008).

Viability Model and Forest Service Contribution to Viability

The viability as described in Reiss et al. (2008) utilizes a DSM, similar to what was used in the AEC to determine the current status of the MIS/surrogate species. The viability model, however, evaluates the conclusion that the MIS/surrogate species populations at the subbasin scale are sustainable or viable based on their current status. The HUC 12 AEC results are aggregated to the subbasin (HUC 8) scale to provide a broader assessment of population and habitat status to better capture the distribution and ability of the local populations to interact across a broader landscape. The subbasin scale assessment allows a broader assessment of natural and human-made disturbance that may be missed if only the AEC results are considered alone (Reiss et al. 2008).

After the viability of the MIS/surrogate species populations on the Forest was estimated, the Forest Service contribution to the ecological viability of the MIS/surrogate species' populations was assessed by alternative. This assessment was also performed at the subbasin scale (Reiss et al. 2008). The viability and Forest Service Contribution to Viability models was explained further in the Methods section below.

Assumptions

- Forest budgets would remain relatively constant at current levels, recognizing there may be increases or decreases in any one year.
- The MIS/surrogate species approach to determining the AEC, viability analysis and the Forest Service Contribution to Viability truly captures the conservation requirements for other species that are not analyzed.
- Alternatives with more reliance on standards than guidelines are more conservative (from an aquatic perspective) compared to guidelines.
- Where identified, the desired condition road densities are attainable.

Methods of Analysis

Acres displayed for effects to fish habitat discussion are approximate and based on GIS modeling.

Rationale for Key Indicators Addressing the Issues

The following describes the rationale for selecting the key indicators for each key issue. The rationale was developed based upon the literature regarding the potential effects of land management activities on aquatic habitat and fish populations; and management direction based upon work completed for the Interior Columbia Basin Ecosystem Management Project (Quigley and Arbelbide 1997), The Interior Columbia Deputy Team Strategy and Framework documents (discussed below), and the Forest Service Region 6 Aquatic and Riparian Conservation Strategy (ARCS; USDA Forest Service 2008a, 2016a).

Old Growth Forest Management and Timber Production

The key indicator for assessing the effects of vegetation management and timber production is: the number of acres that have a focused restoration, general restoration, or timber production emphasis.

Vegetation management through timber sales for timber production or as a fuel treatment (e.g., thinning, prescribed fire) to reduce the potential for uncharacteristically severe wildfires can adversely affect watershed processes, aquatic and riparian habitat (Spence et al. 1996, Meehan 1991, Day 2017). The potential for adverse effects is greatest on lands specifically allocated for timber production due to the emphasis on commodity production; potentially resulting in intense vegetation manipulation and more ground disturbance due to logging and roads than is expected where vegetation management emphasizes the restoration of forest vegetation. However, managing vegetation to provide a vegetation composition and structure that is more characteristic of the natural fire regime and to promote late forest structure appropriate to the biophysical environment is a component of managing for natural watershed function and may result in terrestrial and aquatic ecosystems that are more resilient to disturbance from fires or insects and disease.

Historically, fires were a natural disturbance on the landscape. Since European man settled the West, logging, grazing, fire suppression, and the introduction of exotic plants has changed the natural plant structure and composition of terrestrial ecosystems resulting in the potential for larger and more severe fires in many landscapes (Hessburg and Agee 2003). Large fires can result in accelerated erosion due to surface erosion or debris slides increasing the sediment supply to streams and changing channel structure (Wondzell and King 2003, Benda et al. 2003). However, disturbances such as fires and the resulting erosion processes also help create diverse fish habitat through the introduction of large woody debris and coarse substrates that maintain productive fish habitat (Reeves et al. 1995).

Fires can cause direct mortality to fish resulting in local extirpations. However, fish populations, especially salmonids, have been observed to rapidly recover after an episodic disturbance such as a wildfire; as long as the population and habitat are connected to adjoining populations, (Sestrich et al. 2011, Rieman et al. 2003, Rieman et al. 1995). As discussed in the Affected Environment section, a number of the local populations for the MIS/surrogate species are isolated above barriers or in streams with little connectivity to adjacent populations and are, therefore, more susceptible to extirpation by a large disturbance.

The AEC results show that a number of subwatersheds are *functioning at risk* or *not properly functioning* for the fire regime and insects and disease attributes. Management that emphasizes late forest structure and terrestrial vegetation conditions, as may be expected under the natural or historic disturbance regime, may be beneficial to overall watershed health and reduce the potential for uncharacteristically severe wildfires. For the potential benefits to watershed conditions and aquatic species to be realized the other attributes of watershed condition would need to be improved as well, or at least maintained.

Motorized Trails and Access

The key indicators for the Motorized Recreation Trails and Access issues are the desired conditions for road densities and acres allocated to motorized access.

Roads can have numerous adverse effects on fish and fish habitat including the interruption or alteration of geomorphic and hydrologic processes. Geomorphic impacts of roads include chronic and long-term sediment delivery to aquatic habitat, accelerated mass failures of cuts and fills depositing large quantities of sediment, and altered channel morphology if the roads confine streams and prevent access to the floodplain. Roads constructed in riparian areas damage or remove vegetation thus reducing stream shade and large woody debris input. Roads constructed in the floodplain may inhibit natural stream channel migration processes (Gucinski et al. 2001). Meredith et al. (2014) found that in the Interior Columbia Basin, the presence of near-stream roads resulted in reduced amounts of large woody debris in streams.

The effects of roads on hydrologic processes include the interception of rainfall directly on the road surface and road cutbanks affecting subsurface water moving down the hillslope; concentrating flow on the surface or in an adjacent ditch or channel; and diverting or rerouting water from normal flow paths were the roads not present. Roads can deliver pollutants to aquatic habitat as the chemicals applied to roads or from vehicles runs off a road into a stream (Gucinski et al. 2001). Additional discussion regarding the effects of roads on geomorphic and hydrologic processes is contained in the watershed section of the FEIS and in Day (2018).

Roads can influence fish populations by creating passage barriers at culverts at road/stream crossings. Blocking passage is a serious issue as maintaining connectivity between populations of a species and providing access to blocked habitat are important factors in a species' long-term persistence, such connectivity to adjacent populations and habitat may be an important strategy for species to persist in a changing climate (ISAB 2007).

In addition to the effects of the roads on the physical environment and passage, roads are an indicator of the level of potential human uses or management intensity that may affect fish population. Lee et al. (1997) found strong fish populations in the Interior Columbia Basin were more frequently found in areas of low road density than high road density. Similarly, Al-Chokhachy et al. (2010) found reference watersheds generally provided higher quality physical stream habitat than managed watersheds with higher road densities. Following Lee et al. (1997), the USFWS (1999) considers watersheds with road densities less than 1 mile per square mile and no valley bottom roads as one measure of properly functioning watersheds for bull trout recovery. The USFWS considers road densities of 1 to 2.4 miles per square mile to be functioning at risk, and road densities greater the 2.4 miles per square mile to be not properly functioning.

OHV trails that are not designed or maintained properly, including the drainage system, can be sources of chronic and long-term sediment delivery to streams. Negative impacts of soil and watershed functions from OHV activities include soil compaction, reduced water infiltration capacity, increased erosion, and damage to vegetation. Extensive networks of OHV routes across a landscape, especially on steep slopes, can direct or alter the direction of surface flows forming gullies that channel sediment and contaminants into aquatic systems (Ouren et al. 2007).

The effects of roads and trails on watershed function can be reduced by considering the location, design, and employing design or maintenance methods to disperse runoff (Furniss et al. 1991). Road removal or decommissioning creates a short-term disturbance that may temporally increase sediment, but over the long-term, decommissioning can reduce chronic erosion and the threat of landslides.

Recommended Wilderness

The key indicator for the recommended wilderness area issue is the total acres in recommended wilderness. As mentioned above, fish populations and aquatic habitat are generally in better condition on lands with less management impact; especially low road densities. Although some management activities such as non-motorized recreation and grazing can occur in recommended wilderness, and in some alternatives mechanized recreation can continue on the current trail system, and active vegetation management to restore forest structure to be more resilient to disturbance would not occur, it assumed that overall these areas would be protective of watershed function and fish habitat.

Riparian and Aquatic Resource Management

The key indicators used to assess the alternative approaches to riparian and aquatic resource management are: the Aquatic Conservation Strategy (ACS) direction, the definition of RMAs and management direction for RMAs; the acres of key watersheds, MIS/surrogate species habitat and bull trout designated critical habitat within key watersheds; objectives for key watersheds and watershed restoration; the change in distribution of AIS; and the potential for improvement in riparian vegetation conditions within grazing allotments due to RMA standards and guidelines. The alternatives do not change grazing allotments; however, the management direction for grazing within RMAs will be discussed. All alternatives will then be assessed for the potential Forest Device Contribution to viability of the MIS/surrogate species.

The protection of riparian ecosystems is central to all salmonid conservation efforts (FEMAT 1993, Spence et al. 1996, and Quigley and Arbelbide 1997). As national forest land and resource management plans (forest plans) and Bureau of Land Management resource management plans were about to be revised, the Interior Columbia Deputy Team[37] issued in 2003, *the Interior Columbia Strategy, A Strategy For Applying The Knowledge Gained By The Interior Columbia Ecosystem Management Project To The Revision Of Forest and Resource Management Plans And Project Implementation*. Direction for using the *Strategy* was clarified in August 21, 2008, when the Deputy Team issued further direction through a memo titled *A Framework for Incorporating the Aquatic and Riparian Component of the Interior Columbia Basin Strategy into BLM and Forest Service Plan Revisions* (hereafter referred to as Framework). The intent of the Framework was to include the information generated in the Interior Columbia Basin Ecosystem Management Project (Quigley and Arbelbide 1997) to facilitate consistency among plans in terms of the structure of riparian and aquatic components while providing for a high level of agency decision discretion in the substance of individual plan revisions.

Consistent with the aquatic conservation strategies of the Northwest Forest Plan, PACFISH and INFISH Strategies, and suggested by Quigley and Arbelbide (1997), the Framework includes six components:

1. Riparian Conservation Areas, Riparian Management Areas or other land use allocations to provide direction regarding aquatic and riparian conservation. These special management areas are not “no management” zones, but areas where riparian-dependent species receive management emphasis. The riparian management and delineation of these areas needs to recognize the important functions they are established for including:
    a. The input of fine organic matter and nutrients to aquatic habitat.
    b. Providing for bank stability.
    c. Filtering sediment due to surface erosion, thus controlling the amount reaching the aquatic system.
    d. A source of large woody debris.
    e. Shading the aquatic habitat thus helping to control water temperature.
    f. Controlling the microclimate within the riparian zone and adjacent to the aquatic habitat.
    g. Recognition of small and intermittent streams and managing unstable lands to account for aquatic function and values.
2. Protection of Population Strongholds for Listed or Proposed Species and narrow endemics. The revised plans should identify watersheds (HUC 10 or HUC 12) to be managed for the protection of ESA listed or proposed species. The intent is to identify habitat networks of existing strongholds with robust populations and high quality habitat for the species to support expansion and recolonization to adjacent watersheds.

[37] The Interior Columbia Deputy Team includes the Assistant Regional Director for the U.S. Fish and Wildlife Service; the EPA Deputy Regional Administrator; the Deputy Regional Foresters for Forest Service Regions 1, 4, 6; the BLM Idaho Deputy State Director for Resource Services; the BLM Oregon/Washington Deputy State Director for Resource Planning, Use and Protection; the National Marine Fisheries Service Assistant Regional Administrator, the Pacific Northwest and Rocky Mountain Research Station Deputy Station Directors.

3. Multiscale Analysis. Recognizing the hierarchical nature of watersheds, plans should describe how multiscale analysis was used in plan revisions and how multiscale analysis will be used in subsequent project-level decisions.
4. Restoration Priorities and Guidance. The plans should identify restoration priorities by general types and geographic areas.
5. Management Direction (desired conditions, objectives, management actions). The plans should provide management direction that identifies desired outcomes or future conditions (conditions and objectives) for aquatic resources.
6. Monitoring/Adaptive Management to:
    a. Determine if a plan is being implemented correctly and is achieving desired results
    b. Provide a mechanism for accountability and oversight,
    c. Evaluate the effectiveness of recovery and restoration efforts
    d. Provide a feedback loop so that management direction may be evaluated and modified.

And, a seventh component, Climate Change. The discussion of climate change was added by the Columbia Basin Deputy Team to account for the effects of climate change on the success or failure of management actions to achieve an aquatic/riparian conservation strategy.

Region 6 of the Forest Service includes lands managed under the Northwest Forest Plan, PACFISH and INFISH. Based on broad-scale monitoring programs, the aquatic conservation strategies of INFISH, PACFISH and the Northwest Forest Plan appear to have been effective in improving aquatic habitat and watershed condition (Archer et al. 2009, Lanigan et al. 2012, Meredith et al. 2012). As forest plans were to be revised, Region 6 wanted a regionally consistent approach to the management of watersheds, and riparian and aquatic habitat. The ARCS (USDA Forest Service 2008a) was developed based upon the lessons learned implementing the Northwest Forest Plan, PACFISH and INFISH, and new information that had become available since the earlier strategies were developed; especially the roll of disturbance and the dynamic nature of watersheds, riparian and aquatic systems (Reeves et al. 1995). The ARCS was revised in 2016 (USDA Forest Service 2016a), although the two versions are similar.

The ARCS is designed to maintain and restore the ecological health of watersheds, and aquatic and riparian ecosystems on NFS lands. Naiman et al. (1992) define the components ecologically healthy watersheds as the basin geomorphology, hydrologic pattern, water quality riparian vegetation characteristics, and habitat characteristics; and the management of ecologically healthy watersheds requires the preservation of the interactions between these components and accounting for spatial and temporal variability (Naiman et al. 1992). Another purpose of the ARCS is to develop networks of properly functioning watersheds that support populations of fish and other aquatic and riparian-dependent resources across the Region. The intent of the ARCS is to maintain and restore the dynamic ecological processes responsible for creating and sustaining habitats over broad landscapes, as opposed to just at the individual project or small watershed scale (USDA Forest Service 2008a). The ARCS is intended to provide a core set of desired conditions, suitability, objectives, standards and guidelines for aquatic and riparian management for national forests to design the land and resource management plan direction (USDA Forest Service 2008a).

Consistent with the Interior Columbia Deputy Team Framework the ARCS includes five elements:

1. Riparian management areas (RMAs) along permanently flowing stream, ponds, lakes, wetlands, seeps, springs, intermittent streams and unstable sites where management activities are to maintain, restore or enhance the ecological health of aquatic and riparian ecosystems and dependent resources.

2. Key watersheds. Key watersheds are a network of watersheds selected to serve as strongholds for important aquatic resources or having the potential to do so. Management emphasizes minimizing risk and maximizing restoration or maintaining ecosystem health. Key watersheds are selected based upon the requirements of the MIS/surrogate species. The key watershed concept has been found to be an effective strategy as in the Northwest Forest Plan area the watershed condition of key watersheds appears to be improving at a faster rate than non-key watersheds (Lanigan et al. 2012.)
3. Mid-Scale Analysis of Watersheds. Watershed or mid-scale analysis provides a basis for development of watershed-scale restoration strategies and provides the basis for defining desired conditions, management objectives and monitoring.
4. Watershed Restoration. Watershed restoration is defined as an integrated set of actions and treatments designed to facilitate the recovery of watersheds and related aquatic ecosystem structure and function.
5. Monitoring. Monitoring is a strategic assessment of the implementation and effectiveness of management activities and the ecological trends toward desired conditions.

Each alternative includes an ACS that is either based upon INFISH, the ARCS, or a revised version of the ARCS as will be discussed for each alternative . The direction in INFISH, the ARCS and the revised ARCS includes goals or desired conditions, objectives including restoration objectives, RMAs, key watersheds and standards and guides. Two types of Mid-Scale Analysis were completed for the FEIS. The AEC is a broad, mid-scale analysis at the subwatershed scale. The viability assessment and the Forest Service Contribution to Viability Assessment are subbasin-scale analyses. Each alternative will include a brief discussion of the direction or role of subsequent mid-scale or watershed analyses (the terms are synonymous and the term used in an alternative discussion depends upon the ACS direction for the alternative). The aquatic monitoring component of the revised plan is common to all alternatives.

Aquatic Conservation Strategy Direction, Desired Conditions, Riparian Management Areas (RMAs), Key Watersheds and Standards and Guidelines. The environmental consequences for an alternative will be assessed in terms of the relative effectiveness of the ACS components; desired conditions, the definition of RMAs, standards and guidelines, the size of the key watershed network, and the overlap of the key watersheds with important habitat for MIS/surrogate species, to meet the desired conditions and contribute to the viability of the MIS/surrogate species.

Objectives for Key Watersheds and Watershed Restoration. There is a need to accelerate improvement in watershed condition across the Forest. The 1988 forest plan and amendments do not adequately provide integrated management direction to maintain and restore properly functioning watersheds that provide a range of benefits on and off the national forest within a timeframe that is meaningful. This is supported by new science, the listing of bull trout under the ESA, designation of bull trout critical habitat, information in the bull trout recovery plan (USFWS 2015b), and the results of new assessment tools such as the National Watershed Condition Framework (WCF). Properly functioning watersheds provide ecological systems that are resilient to disturbance, and allow for habitat conditions that support aquatic species, contribute to the recovery and de-listing of threatened and endangered species, and restore waters listed as impaired under the Clean water Act (303(d) listed waters). All alternatives include objectives for watershed restoration.

Aquatic Invasive Species (AIS). Invasive species are a threat to aquatic and terrestrial ecosystems. AIS include invasive plants, invertebrates, pathogens, and non-native fish[38]. Invasive species may disrupt the food web, compete with native species for food and space, may be predators on native fish, or introduce

[38] Non-native fish introduced by state agencies in the past as sport fish are not considered invasive, although it may now be understood that they can be a threat to native species and management actions may be implemented to reduce their numbers

diseases. The management direction for controlling and managing to prevent AIS will be discussed for each alternative.

Potential Improvement of Riparian Vegetation within Grazing Allotments. The potential effects of livestock grazing on fish habitat have been well documented (e.g., Platts 1991, Spence et al. 1996). Al-Chokhachy et al. (2010) found the presence of cattle in watersheds sampled across the Interior Columbia Basin and the Missouri River Basin often resulted in degraded physical aquatic habitat conditions, especially where grazing occurred in watersheds with high road densities. The potential adverse effects of grazing include soil erosion and sediment delivery to streams; soil compaction; alteration or removal of riparian vegetation that provides shade, cover, a terrestrial food source and stabilizes stream banks; altered channel morphology including channel widening, increased bank instability and loss of undercut banks. The alternatives do not change grazing allotments however the anticipated effectiveness of the management direction for grazing within RMAs for each alternative will be discussed.

Viability and Forest Service Contribution to Viability Assessment

MIS/Surrogate Species Viability Assessment (see Reiss et al. 2008 for further description and rationale)

The viability assessment evaluates the conclusion that the current MIS/surrogate species' populations are viable. The viability of individual MIS/surrogate species populations is evaluated at the subbasin scale where the species is currently present. Ecosystems are dynamic over time so not all habitat within a subbasin will be in good condition all the time and even natural, undisturbed population numbers will be variable. MIS/surrogate species are judged to be viable when a large enough proportion of habitat is in good ecological condition, habitat forming processes are functional, and the local populations of a MIS/surrogate species (subwatershed scale) are not isolated; having access to other habitat and local populations (Reiss et al. 2008).

The AEC analysis assessed the status of local populations within the subwatersheds. However, the AEC does not capture the ability of the local populations to interact with other local populations or assess the distribution of local populations across the broader landscape. Similarly, the AEC assesses the watershed and habitat conditions at the subwatershed scale, but may miss natural and human-made disturbance patterns that become apparent at a larger scale. It should be noted that this viability assessment is addressing the MIS/surrogate species viability on the Forest only, primarily assessing national forest lands. While factors that may influence the larger population of a MIS/surrogate species are considered, this assessment is not as broad or inclusive as a viability assessment that the USFWS may undertake for an ESA status review.

The two attributes assessed to determine the population viability of the MIS/surrogate species within a subbasin on the Forest are: the subbasin condition and connectivity within the subbasin. The viability was assessed in the manner described in Reiss et al. (2008) only instead of using a DSM, the information was put into an Excel spreadsheet. The attributes discussed below are aggregated to attain an overall subbasin viability score for the MIS/surrogate species ranging from +1 (high support for the conclusion that the MIS/surrogate species populations on the Forest are viable) to -1 (low support for the conclusion that to populations are viable). Unlike Reiss et al. (2008), we did not estimate the historic viability, assuming that before development by European man all the MIS/surrogate species were viable at the subbasin scale.

Condition

The subbasin condition is assessed with three attributes; distribution, patch and the AEC. The distribution attribute assesses the percentage of the potential spawning and rearing habitat in the subbasin currently occupied by the MIS/surrogate species. The distribution reflects the impact of fragmentation and includes populations isolated by natural barriers. The patch attribute assesses the connected length of stream available to the MIS/surrogate species. Habitat patches within the subbasin are delineated by aggregating all connected stream kilometers of occupied habitat. If there are no barriers, the entire subbasin is one large patch. Where natural or man-made barriers exist, the occupied habitat above the barrier is its own patch. It is generally assumed that large, connected patches provide a better chance for a viable population over time than small isolated patches. Finally, the AEC attribute is the area-weighted average of the subwatershed scores within the subbasin.

Connectivity

The connectivity of river systems is a major factor determining the potential for viable populations. Where streams are connected, local populations have the potential to function as a meta-population with some degree of genetic exchange over generations. Connectivity also allows an adjacent population to re-found a local population that becomes extinct due to a disturbance such as a fire or flood. There are two connectivity attributes; population connectivity and habitat connectivity. Population connectivity evaluates the overall connectivity of each local population within the subbasin. The habitat connectivity evaluates the ability of MIS/surrogate species to access unoccupied, potential habitat in the subbasin (Reiss et al. 2008).

Colville National Forest Contribution to MIS/Surrogate Species' Ecological Viability (see Reiss et al. 2008 for further description and rationale)

The extent to which the different alternatives may contribute to the viability is assessed at the subbasin scale as well. This is a relative risk assessment based upon the risk different management allocations may pose to the MIS/surrogate species, the current condition of the MIS/surrogate species populations and habitat, and the amount of habitat on NFS lands. The emphasis of this assessment is on management of NFS lands, in other words management that the Forest has control over. There are numerous actions and conditions of other lands that affect the MIS/surrogate species future viability; residential development, road systems; hydroelectric projects; etc., over which the Forest has more limited management authority. Hence, this a relative assessment of how well Forest management as described for each alternative may be expected to contribute to the viability of the MIS/surrogate species.

The contribution to viability assessment includes three attributes; protection, the percent of habitat occupied by a MIS/surrogate species on the Forest, and the AEC of the subbasin. As with the AEC and Viability assessments, Reiss et al. (2008) used a DSM to estimate the level of protection or conservation value of an alternative toward MIS/surrogate species viability. We again used an Excel spreadsheet to inform our analysis. The Forest Service contribution is assessed by MIS/surrogate species in each occupied subbasin, by alternative. The scores of the attributes are averaged resulting in a +1 (high support for the conclusion that that an alternative would contribute to MIS/surrogate species' ecological viability) to -1 (low support for the conclusion).

Protection

The management areas (MAs) described in the alternatives are assessed for the level of protection the allocation is expected to provide for aquatic habitat and watershed condition. A basic premise is allocations with no or few roads are more protective than allocations with higher road densities. Lands where terrestrial vegetation will be managed with a restoration emphasis is more protective or less risky to aquatic habitat and watershed condition than lands with a timber production emphasis.

The MAs that informed the aquatic effects portion of the FEIS, based upon the four issues; old forest management and timber production, motorized trails and access, recommended wilderness, riparian and aquatic resource management, were assessed for their relative protection afforded aquatic resources and watershed condition. The MAs included in the assessment are: recommended wilderness, backcountry motorized, backcountry non-motorized, focused restoration, general restoration (including late forest structure in alternative R), active management, and responsible. The current designated wilderness was also included. Within each MA, the following management activities that relate to the key indicators in the aquatics effects analysis were assessed based on the level of protection (or inversely the level of risk to the aquatic habitat); non-motorized trails, motorized trails, timber harvest, and roads. At the beginning of the analysis, each allocation starts with a protection value of +1 and then points are subtracted based upon the potential intensity of an activity within the MA. If an activity is not allowed in an MA, there is zero deduction. For example roads, motorized use and timber harvest are not allowed in wilderness so there are no deductions for those activities within the Wilderness MA.

<u>Non-Motorized Trails</u>. If non-motorized trails are present, -0.1 is deducted for the MA. The reason is that the presence of the trails does affect a watershed to a small degree and use of the trail does pose a risk to riparian habitat by trampling vegetation, may increase fishing pressure and possible introduction of AIS or a non-native fish.

<u>Motorized Trails</u>. If motorized trails are present, but the use is no longer permitted, -0.1 was deducted. If motorized trail use is allowed, the deduction is -0.2.

<u>Timber Harvest</u>. Timber harvest deductions are based on the potential intensity of the activity. While the restoration MAs often emphasize terrestrial vegetation restoration, which may help improve watershed condition, vegetation management activities do pose some risk to aquatic resources. It is assumed the intensity of vegetation management will be higher in General Restoration MAs than Focused Restoration MAs where there is more emphasis on aquatic resources and wildlife. The most risk or least protection is on those MAs that have greater timber production emphasis and allow even-aged management. Focused restoration areas therefore received a -0.1 deduction; general restoration a -0.2 deduction and the Responsible Management and Active Management MAs a -0.3 deduction.

The no action alternative MAs are based on the 1988 forest plan, so for timber harvest we “lumped” the MAs based upon the intensity of timber management. The Caribou, Old Growth, Recreation/Wildlife, Scenic/Winter Range, Winter Range MAs received a -0.2 deduction for timber harvest based on current management. The Private Lands Originally, Recreation, Scenic/Timber and Wood/Forage MAs received a -0.3 deduction.

<u>Roads</u>. The road deductions were based upon whether roads are allowed or not, and if allowed the desired road densities. If roads are allowed and the road density desired condition is up to 1.0 mile per square mile then -0.2 was deducted. Even low road densities affect hydrologic processes and can affect aquatic habitat. The 1.0 mile per square mile density is at the upper range of road densities that in general watersheds may be *properly functioning* and potentially support strong fish populations. If the road density desired condition is no greater than 2 miles per square mile there is a -0.3 deduction. The 2.0 miles per square mile road density is within the range where watersheds are generally considered *functioning at risk* for road density as is the potential for the presence of strong fish populations. Road densities of 3.0 miles per square miles are considered *not properly functioning* for watershed condition and strong fish populations and received a -0.4 deduction. Alternatives that have no road density desired condition received a -0.5 deduction as these alternatives keep the current road mileage on the Forest where most watersheds are already *functioning at risk* or *not properly functioning* for road densities in the AEC assessment.

The total score for an MA is obtained by subtracting the deductions for a total protection value. So wilderness with only a -0.1 deduction is considered highly protective (0.9), while an MA with even-age timber management, and high road densities gets a low protection score. All MAs were assumed to have non-motorized trails and motorized trails unless they are specifically not allowed.

The total protection scores for the MAs for an alternative is the area-weighted average of the score for each land use allocation by subbasin. In this assessment, the score was determined by assessing the subbasin as a whole as opposed to doing the same assessment by subwatershed and aggregating the results together as described in Reiss et al. (2008). Another difference between this assessment and Reiss et al. (2008) is the treatment of key watersheds. Key watersheds, other than no action and alternative B, are primarily in the Focused Restoration MA, although there may be some backcountry, wilderness and recommended wilderness. Instead of assessing the protection value of key watersheds based on allowed activities in the key watersheds, it is assumed the key watersheds have an added protection value of their own as management within key watersheds emphasizes minimizing risk and maximizing restoration or retention of ecological health (see previous key indicator rationale). Therefore the percent area of key watershed within a subbasin was added to the protection score. Finally, grazing and RMAs are not specifically discussed. The grazing allotments are not changed in the different alternatives so grazing is just discussed as a key indicator in the Aquatic effects. The RMAs for different alternatives is also discussed as a key indicator.

Percentage of Occupied Habitat on the Colville National Forest

This attribute quantifies the proportion of the total occupied spawning and rearing habitat of a MIS/surrogate species on the Forest within a subbasin.

Aquatic Ecological Condition

The AEC attribute is the area-weighted average of the habitat condition AEC scores of the NFS lands within the subbasin to help determine the “Forest Service” contribution to viability.

The final protection score for an alternative by subbasin and MIS/surrogate species is the average of protection, percent of occupied habitat on NFS lands, and the AEC. The viability assessment and the Forest Service Contribution scores represent an interpretation of the relative role of Colville National Forest lands to provide for the viability of a MIS/surrogate species in a subbasin by alternative. It should be noted that when the Forest Service contribution to ecological viability scores is low, this does not necessarily indicate that Forest Service management direction is insufficient, but rather that management is not addressing all factors that contribute to species ecological viability. Much of the other management not addressed may be off NFS lands, such as roads managed by other entities. A low Forest Service contribution may also be due to presence of non-native fish and isolation due to natural barriers and man-made barriers off the national forest.

Incomplete and Unavailable Information

Incomplete or unavailable information includes: (1) The rate and magnitude of restoration activities would depend upon budgets social and technical constraints, therefore, for estimating a rate for changing watershed condition is unknown; (2) The use of the MIS/surrogate species concept is assumed to provide for the viability of other aquatic species including invertebrate species for which little is known on the Colville National Forest; (3) Although the locations of the land allocations is known the actual level of management activity within a subbasin overtime is not known; and (4) The actual effects of climate change (see below).

Spatial and Temporal Context for Effects Analysis

The analysis of the effects of the alternatives on the MIS/surrogate species and aquatic habitat is completed at several scales. First the current status of the MIS/surrogate species’ populations and the watershed/aquatic habitat condition was assessed at the subwatershed (HUC 12) scale to determine the AEC. The current viability of the species was then assessed at the subbasin scale (HUC 8). The effects of the alternatives based upon the plan components is assessed at the scale of the Forest and the final estimate of the potential effects to MIS/surrogate species' viability on the Forest, or the Forest Service contribution to viability is assessed at the subbasin scale. The temporal context for the assessment is the current time period, with the relative benefits or risks to the species due to implementation of an alternative estimated through the life of the revised forest plan as defined by the alternative.

Summary of Effects

Focus Watersheds and Priority Watersheds

All alternatives include key watersheds (including the INFISH priority watersheds) and focus watersheds. While the key watersheds vary by alternative, the focus watersheds are common to all alternatives.

Forest Service Region 6 developed the Region 6 Aquatic Restoration Strategy (ARS) in 2005 to provide guidance for watershed and aquatic and riparian improvement at a regional scale (see Hydrology section in the FEIS). As the ARS is scaled down for implementation at the forest level, the national forests are to work with partners to identify focus watersheds (HUC 10). The idea of the focus watersheds is to take a whole watershed approach to restoration to meaningfully affect change in watershed condition as opposed to practicing "random-acts-of-kindness" by scattering restoration efforts over a broad landscape (Roni et al. 2010). Working with the partners, forests are to then develop a watershed action plan (WAP) that identifies the needed restoration work that is technically and socially feasible. The current Forest focus watersheds are the LeClerc-Pend Oreille River (HUC 171021602), the Upper Sanpoil River (HUC 1702000401), and Chewelah Creek-Colville River (HUC 1702000301). WAPs have been prepared for the Upper and West Forks Sanpoil River, and LeClerc Creek. A WAP has not been completed to date for the Chewelah Creek-Colville River.

National forests throughout the United States were mandated in 2010 to implement the WCF, which was discussed for the AEC model. The results of the assessment were used to identify priority subwatersheds to focus management to improve impaired watershed function (see Hydrology section of the FEIS for more information on Focus Watersheds and Priority subwatersheds).

Monitoring

Watershed conditions, stream and riparian habitat would be monitored through the life of the revised forest plan to determine (1) If plan implementation is achieving the watershed and aquatic objectives; and (2) The effects of various resource management activities on watershed, riparian and aquatic resources.

The Forest would continue to cooperate with the PIBO monitoring program to determine current habitat conditions and to track the trends of aquatic habitat condition.[39] Additionally, the Forest would continue assessing aquatic habitat condition using the Region 6 Level II stream survey protocol, or future versions. Currently, the Forest surveys about 17 stream miles annually. The Level II surveys also collect information on fish distribution at the time of the survey, but are not designed to estimate population size. Changes in watershed condition would be determined through periodic updates of the WCF and the effectiveness the protection of watershed, riparian and aquatic resources during the implementation of land management projects would be monitored through BMP monitoring. For more information regarding the WCF, BMP, and additional water quality monitoring, see the Watershed section of the FEIS.

[39] See Appendix1 page 15 in the April 18, 2014 letter from the Deputy Regional Directors to Forest Service Pacific Northwest and Rocky Mountain Research Station Director, NOAA Fisheries Branch Chiefs (West Coast Region), BLM District/Field Managers (Oregon, Washington, Idaho, and Montana), FWS Field Supervisors (Pacific Region), EPA Office of Water Directors (Regions 8, 9, and 10), EPA Operations Office Directors (Idaho, Oregon, Montana, and Washington), EPA Region Forest/Range Manager (Region 10) *Updated Interior Columbia Basin Strategy: A Strategy for Applying the Knowledge Gained by the Interior Columbia Basin Ecosystem Management Project to the Revision of Land Use Plans and Project Implementation*

The Forest would continue to cooperate and coordinate with monitoring programs implemented by other entities, such as those associated with the Boundary Hydroelectric Project. For example, the Boundary Project re-licensing terms include a hatchery program to re-build the populations of native fish, initially focusing on WSCT. The terms for the hatchery program include establishing population goals for self-sustaining populations of the native fish. Seattle City Light is to monitor the success of the out-planting program until the population goals are met.

Current Viability of MIS/Surrogate Species

The assessment of the current MIS/surrogate species viability on the Forest (bull trout, WSCT and interior redband trout) evaluates the conclusion that the MIS/surrogate species' populations are viable at the subbasin scale. MIS/surrogate species are judged to be viable when a large enough proportion of habitat is in good ecological condition, habitat forming processes are functional, and the local populations of a MIS/surrogate species (subwatershed scale) are not isolated; having access to other habitat and local populations. The inputs to the viability assessment include the distribution of the MIS/surrogate species within the subbasin, the patch size, the weighted average of the AEC scores (that describe the habitat and population and habitat connectivity. The MIS/surrogate species viability score for a subbasin species status can range from +1 (high support for the conclusion that the MIS/surrogate species populations on the Forest are viable) to -1 (low support for the conclusion that the populations are viable). The following table displays the final viability model scores for the MIS/surrogate species by subbasin.

Table 94. MIS/surrogate species viability scores

Subbasin	Pend Oreille		Columbia		Kettle		Colville		Sanpoil	
Species	WSCT	BT	WSCT	IRT	WSCT	IRT	WSCT	IRT	WSCT	IRT
Viability	-0.22	-0.42	-0.70	-0.43	-0.73	-0.09	-0.40	-0.53	-0.89	-0.61

WSCT=westslope cutthroat, IRT=interior redband, BT=bull trout

As displayed in table 94, in no subbasin, for any MIS/surrogate species, is there support for the conclusion the populations are currently viable. If one were to categorize the scores as +1 to +0.33 is viable, 0.33 to -0.33 as viability is at risk and greater than -0.33 as not viable, the viability of the WSCT in the Pend Oreille subbasin and interior redband in the Kettle subbasin would be considered at risk. All other populations would be considered not currently viable at the subbasin scale. This is not surprising as in the AEC assessment the status of most local populations was rated as *functioning at risk* or *not properly functioning*, as were the habitat condition scores. There were no positive scores for patch size other than for bull trout in the Pend Oreille, meaning most populations occupy or have access to a stream network smaller than what is considered beneficial for long-term viability. The overall scores reflect the threats to the MIS/surrogate species due to: the overall poor population status; impaired watershed functions and aquatic habitat generally in a "poor" condition compared to reference streams; and poor distribution of the MIS/surrogate species within the subbasins due to natural isolation above waterfalls, man-made barriers including those off the Forest; and the abundance of non-native fish, especially brook trout. In some cases, the natural barriers are protecting the WSCT and interior redband populations from invasion by the non-native trout.

The sensitive pygmy whitefish, lake chub, and the Odonata species are widely distributed across their range, but have a limited distribution on the Forest. The limited distribution and unknown population size hinders any ability to determine their viability on the Forest. It is not expected that lake chub or pygmy whitefish population status would trend toward listing under the ESA due to implementation of any alternative, as all alternatives include an ACS equal to or more protective and restorative of watershed conditions and riparian and aquatic habitats as the current management direction; which appears to be resulting in some improving aquatic habitat trends on the Forest. The alternatives that present the greatest benefit to the MIS/surrogate species are also expected to provide the greatest potential benefits to the pygmy whitefish and lake chub.

Implementation of any alternative, other than the no action alternative, is not expected to diminish the viability, due to Forest management, of the five sensitive dragonflies and damselflies on the Forest or cause a trend toward ESA listing. Not only is the ACS for each alternative equal to or more protective and restorative of watershed conditions and riparian and aquatic habitats as the current management direction, the management direction for the Bunchgrass Meadows Research Natural Area will be maintained. Bunchgrass Meadows should also benefit as the Harvey Creek subwatershed, which includes Bunchgrass Meadows will remain a priority or key watershed. Additionally, the effects of the alternatives for wetlands, moist meadows and riparian habitats as described in the Botany discussion in chapter 3 of this FEIS states plan components proposed for all but the no action alternative are expected to maintain habitat effectiveness for species associated with the riparian habitats.

The following summarizes the current viability of the MIS/surrogate species populations by subbasin.

Pend Oreille

The MIS/surrogate species in the Pend Oreille subbasin are WSCT trout and bull trout. The WSCT populations are well distributed geographically, but their viability is at risk due to the presence of non-native trout, culvert barriers, and habitat degradation. The bull trout populations have also been affected by non-native trout, culvert barriers and habitat degradation. Bull trout have not been recently observed on the Forest, hence, the species has a poor distribution score. The bull trout migratory life history and connectivity between populations is also impaired due to hydroelectric dams on the mainstem rivers.

Upper Columbia/Lake Roosevelt

The WSCT and redband trout are MIS/surrogate species in the Lake Roosevelt subbasin. The WSCT populations are mainly found in watersheds flowing into the eastside of Lake Roosevelt and are isolated from the lake and other populations by natural barriers. The interior redband trout populations are mainly found in watersheds draining into the west side of the lake and are also isolated by natural barriers. The isolated populations of both species have small patch sizes and the AEC scores reflect degraded habitat conditions. Non-native trout are probably preventing the two MIS/surrogate species from expanding their ranges, but the barriers are also preventing the non-native trout from invading the currently occupied WSCT and interior redband trout habitat.

Kettle

WSCT and interior redband trout inhabit the Kettle subbasin. The WSCT populations are isolated in two subwatersheds by natural barriers resulting in a low distribution and patch score. The AEC scores are low due to low or unknown population numbers and degraded habitat conditions. The distribution of the WSCT populations is likely restricted by the presence of non-native trout, but as with the Lake Roosevelt populations, the natural barriers are preventing the non-native trout from invading the currently occupied WSCT habitat.

Interior redband trout are distributed across 15 subwatersheds, although many populations are probably hybridized with non-native coastal rainbow trout. Pure populations are isolated from the Kettle River by man-made and natural barriers, resulting in small patch sizes. The MIS/surrogate species population status is relatively healthy in eight subwatersheds, but the isolated populations combined with some degraded habitat conditions and non-native trout below the barriers are threats to the interior redband populations.

Colville

The small interior redband trout and WSCT populations in the Colville subbasin are isolated by natural and man-made barriers. The population viability of both species is threatened due to small, isolated populations, degraded habitat conditions and the wide distribution of non-native trout.

Sanpoil

There is a small WSCT population within one subwatershed in the Sanpoil subbasin. The population is isolated from the rest of the subbasin by a natural barrier. The limited distribution, small population number, small patch size, and lack of connectivity with other WSCT populations, combined with watershed conditions rated as functioning at risk are threats to the population viability.

Small populations of interior redband trout are distributed in only four subwatersheds within the Sanpoil subbasin. The populations are isolated due to natural barriers resulting in small patch sizes and poor population and habitat connectivity. Widely distributed non-native trout are likely preventing both WSCT and interior redband trout from becoming more widely distributed.

No Action Alternative

The 1988 forest plan delineates broad management areas (MAs) where the general management intent is similar. Table 95 displays the MAs that share the same management direction in all alternatives.

Table 95. Management areas that share the same direction across all action alternatives

Management areas with direction that remains the same across alternatives	Management direction and comparison to 1988 forest plan direction
Administrative and Recreation Sites (Includes permitted and developed recreation sites)	The sites are established as separate management areas rather than overlays or inclusions in other management areas. The management direction remains unchanged from the 1988 forest plan.
Wild and Scenic Rivers (Includes all rivers identified in the 1988 forest plan and those additional proposed eligible rivers)	Plan direction emphasizes maintaining the eligibility of the areas. Overarching management direction from legislation, policy, and directives bounds the direction.
Research Natural Areas	Emphasizes maintaining the research values of the areas. Boundaries of these areas remain unchanged from current. Overarching management direction from policy, directives, and establishment records bounds the direction.
Scenic Byways	Emphasizes maintaining the scenic values and functions of the area and remains unchanged across alternatives. Overarching management direction from policy and directives bounds the proposed plan revision direction.
Wilderness – Congressionally Designated	Congressionally designated wilderness boundaries do not change across alternatives. Management direction within wilderness also does not change across alternatives. A notable change from management under the 1988 plan is a proposal to allow the Forest to authorize use of prescribed fire within wilderness areas.

Management areas specific to the 1988 forest plan are displayed in the following table.

Table 96. No action management areas by subbasin (acres)

Management Area	Colville	Franklin D. Roosevelt Lake	Kettle	Pend Oreille	Sanpoil	Total
Caribou Habitat				30,300		30,300
Downhill Skiing				2,000		2,000
Old Growth Dependent Species Habitat	4,674	6,772	7,097	10,335	4,290	32,900
Private Lands Originally	91	77	20	1025		1,300
Recreation	8,511	9,722	9,158	11,146	4,642	43,200
Recreation/Wildlife		2,248	978		9,235	13,200
Research Natural Area		401		2269	2350	5,300
Scenic Timber	22,595	42,961	46,498	89,594	14,472	217,100
Scenic/Winter Range	8,101	7,588	11,736	47,067	1,861	76,100
Semi-Primitive, Motorized Recreation		3,449	10,118			13,600
Semi-Primitive, Non-Motorized Recreation		29,942	16,824	33,696	7,534	86,900
Wilderness Management				31,400		31,400
Winter Range	16,422	16,877	37,483	34,506	20,396	126,500
Wood/Forage	48,082	74,556	158,418	109,254	32,601	424,000
Total	108,477	194,593	298,330	404,099	97,381	1,103,200

Note: Acres are approximate and may vary slightly in other resource sections due to GIS methodology

Old Forest Management and Timber Production

Key Indicators

The number of acres that have focused restoration (or late forest structure), general restoration, and a timber production emphasis—32,900 acres (about 3 percent of the Forest) is allocated to old growth dependent species habitat. The areas allocated to old growth dependent species habitat are “fixed reserves,” that is the location on the landscape is not expected to change.

Number of acres where management to produce timber is allowed—about 891,000 (about 81 percent of the Forest). However, vegetation management in the Caribou, Old Growth Dependent Species, Recreation/Wildlife, Scenic/Winter Range and Winter Range MAs is more likely to be similar to vegetation management in the Focused Restoration or Late Forest Structure MAs in the proposed action and alternatives R and P, and the Restoration MA in alternatives B and O. These no action MAs include about 25 percent of the Forest (approximately 279,000 acres), which is similar to the proposed action. More intense timber production is expected in the Recreation, Scenic/Timber and Wood/Forage MAs totaling about 684,300 acres (about 62 percent of the Forest), which is more than the Active Management MA of alternative B and Responsible MA included in alternative O. The risks to watershed processes and aquatic habitat associated with timber production would occur over more of the Forest than any other alternative.

Motorized Recreation Trails and Access

Key Indicators

Desired conditions for road densities—No desired conditions that specifically address watershed condition or aquatic habitat.

Acres allocated to Motorized Recreation—in total, approximately 931,221 acres, about 85 percent of the Forest is available for off-road motorized use. Off-road vehicle use would continue to be allowed in designated areas and trails over approximately 698,575 acres (about 65 percent of the Forest); allowed but subject to seasonal closures or other restrictions on approximately 232,646 acres (about 21 percent of the Forest; and discouraged or not allowed on about 168,370 acres (15 percent of the Forest).

There are approximately 4,000 miles of NFS roads on the Forest and another approximately 2,500 miles of roads owned by other jurisdictions within the boundaries of subwatersheds that include the Forest. The AEC assessment found most subwatersheds on the Forest to be *functioning at risk* or *not properly functioning* for the road density and riparian road density attribute. The no action alternative, along with alternatives B and O do not include desired conditions for road densities and cap the road system at 4,000 miles. While some MAs within the no action alternative have desired conditions limiting open road densities, primarily to benefit wildlife, roads that are closed to use but still on the landscape continue to impact watershed processes and are considered "open" from a watershed and aquatic habitat perspective. The no action alternative, along with alternatives B and O, present the most risk to aquatic resources and watershed conditions due to roads.

Off-road vehicle use would continue to be allowed in designated areas and trails over approximately 698,575 acres (about 65 percent of the Forest); allowed but subject to seasonal closures or other restrictions on approximately 232,646 acres (about 21 percent of the Forest; and discouraged or not allowed on about 168,370 acres (15 percent of the Forest). Off-road use increases the potential for accelerated sediment delivery to streams and damage to riparian vegetation and stream banks. These risks may increase if recreation use increases as expected and budgets to manage and maintain the system as described in appendix 3 of the Fisheries Specialist Report do not keep pace.

Recommended Wilderness Areas

The 1988 forest plan has no areas recommended for wilderness.

Riparian and Aquatic Resource Management

Key Indicator – ACS direction, RMA delineation and RMA direction

Under the no action alternative, the 1988 forest plan direction for watershed, aquatic and riparian resources would remain as defined by INFISH.

INFISH includes eight riparian goals (similar to desired conditions) establishing the expectation for providing the characteristics of healthy, functioning watersheds, riparian areas and fish habitat; riparian management objectives (RMOs) that are numeric descriptors for good fish habitat[40]; riparian habitat conservation areas (RHCAs) (similar to RMAs) where riparian-dependent resources receive primary emphasis and specific standards and guides for land management activities are to be applied; priority watersheds designated to protect and conserve inland native fish habitat and populations; watershed analysis, a systematic procedure for determining how a watershed functions in relation to its physical and biological components; watershed restoration to improve the current condition of watersheds to restore degraded habitat and to provide long-term protection to riparian and aquatic resources (although no

[40] The specific measurable RMOs are for the following in-stream features; pool frequency; water temperature; large woody debris; bank stability; lower bank angle and width/depth ratio The RMOs are to remain in place unless they are revised through watershed or site-specific analysis

restoration strategy was originally included); and Monitoring (USDA Forest Service 1995a) (see appendix 1 of the Fisheries Specialist Report for a complete description of the ACS for each alternative).

The delineation of riparian management areas, where riparian-dependent ecosystems receive primary emphasis would continue under the INFISH RHCA definitions (table 97). Standards and guidelines direct management within the RHCAs to meet the numeric RMOs.

The INFISH standards and guidelines for RHCAs constrain management activities (timber, roads, livestock grazing, recreation, minerals, fire/fuels, lands, general riparian, watershed and habitat restoration, fisheries and wildlife restoration) to achieve the Riparian Goals and RMOs and ensure protection of physical and biological resources.

The results of stream surveys conducted by the Forest show that many of the reaches surveyed are not meeting the RMOs as defined by INFISH, although recent analysis of habitat trends show conditions may be slowly improving.

Key Indicator – Key Watershed; acres, management direction, MIS/surrogate species and objectives

There are currently 13 priority watersheds that cover 214,283 acres or about 19 percent of the Forest.

The RHCA widths for intermittent streams are wider in priority watersheds than in non-priority watersheds (100 feet versus 50 feet); however, there are no other specific goals, desired conditions, or other direction specific to the priority watersheds. The priority watersheds are located in the Pend Oreille subbasin. Most priority watersheds support both bull trout critical habitat and WSCT populations. There are no Key or priority watersheds in the other subbasins within the Forest.

Key Indicator – Improvement in riparian vegetation conditions within grazing allotments

Managing grazing allotments would continue under INFISH riparian goals and the four INFISH grazing standards and guidelines that focus on attainment of RMOs and the direction in the 1988 forest plan, which may or may not be appropriate to site-specific hydrologic, geomorphic, and riparian vegetation conditions. There are no other specific physical or biological indicators specified. Allotments with bull trout critical habitat would continue to be governed by biological opinions issued by the USFWS, and may include more specific measures to limit impacts on bull trout and bull trout habitat.

Stream habitat conditions as determined by the index scores generated by PIBO on the Forest and within the sampled DMAs are significantly lower than reference reaches, as are the median substrate size, fines in pool tail-outs, and bank angle habitat attribute. There appear to be significant positive trends in the bank stability and percent pool attributes within the DMAs across the Forest, although sample size is low. Not enough DMAs have had repeat samples to date to determine trends within DMAs at an individual subbasin scale.

Table 97. Riparian habitat conservation area width

Stream and water body classification	Riparian habitat conservation area width
Fish-bearing streams	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

Stream and water body classification	Riparian habitat conservation area width
	slope distance (600 feet, including both sides of the stream channel), whichever is greatest.
Permanently flowing non-fish-bearing streams	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.
Ponds, lakes, reservoirs and wetlands greater than 1 acre	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.
Seasonally flowing or intermittent streams and the area to the top of the inner gorge, wetlands less than 1 acre, and the extent of landslides and landslide-prone areas	At a minimum the RHCAs must 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. 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.

Key Indicator – Change in distribution or aquatic invasive species (AIS)

There is no INFISH direction specific to dealing with the threat of AIS. There is one standard and guideline. AIS and preventing their distribution is indirectly addressed in the INFISH riparian goals.

Forest Service Contribution to Viability

Although there is some indication aquatic habitat is improving with implementation of INFISH, the AEC for most subwatersheds on the Forest are *functioning at risk* or *not properly functioning* and current pace of slow improvement would be expected given there are no road desired conditions, no extra protection to aquatic and riparian resources from recommended wilderness, and the more of the land base is open to intensive timber production under the no action alternative than any other alternative. The no action alternative provides the least Forest Service contribution to improve the viability of the MIS/surrogate species than any other alternative (table 98).

Table 98. Forest Service contribution to viability

Forest Service Contribution*	Pend Oreille		Roosevelt		Kettle		Colville		Sanpoil	
Species	WSCT	BT	WSCT	IRT	WSCT	IRT	WSCT	IRT	WSCT	IRT
No Action	0.01	-0.26	-0.34	-0.34	-0.36	-0.10	-0.29	-0.49	-0.46	-0.41
Proposed Action	0.10	-0.17	-0.20	-0.19	-0.21	0.04	-0.26	-0.46	-0.39	-0.34
Alternative R	0.14	-0.13	-0.03	-0.02	-0.13	0.13	-0.15	-0.35	-0.37	-0.32
Alternative P	0.14	-0.13	-0.06	-0.05	-0.17	0.09	-0.22	-0.43	-0.37	-0.32

Forest Service Contribution*	Pend Oreille		Roosevelt		Kettle		Colville		Sanpoil	
Species	**WSCT**	**BT**	**WSCT**	**IRT**	**WSCT**	**IRT**	**WSCT**	**IRT**	**WSCT**	**IRT**
Alternative B	0.04	-0.23	-0.30	-0.30	-0.29	-0.03	-0.28	-0.48	-0.41	-0.35
Alternative O	0.07	-0.20	-0.11	-0.10	-0.21	0.05	-0.27	-0.48	-0.40	-0.34

* The higher the score the greater the Forest Service Contribution
WSCT=westslope cutthroat trout, IRT-interior redband trout, BT=bull trout

As mentioned in the Methods section, the final score for an alternative is the average of the relative protection to watershed and aquatic resources afforded by the MAs, the percent of occupied habitat on the national forest lands, and the AEC (which includes watershed and habitat condition and the species status). The Forest Service Contribution scores represent an interpretation of the relative role of NFS lands to provide for the viability of a MIS/surrogate species in a subbasin by alternative. It should be noted that when the Forest Service contribution to ecological viability scores are low, it does not necessarily indicate that Forest Service management direction is insufficient, but rather that Forest Service management is not addressing all factors that contribute to species' ecological viability. Much of the other management issues not addressed may be off NFS lands, such as roads managed by other entities and hydroelectric dams. A low Forest Service contribution may also be due to presence of non-native fish and isolation due to natural barriers and man-made barriers off the National Forest as well as the current status of the MIS/surrogate species and habitat conditions as reflected in the AEC. As has been discussed, the viability of the MIS/surrogate species is currently threatened because: many MIS/surrogate species are isolated above natural as well as anthropogenic barriers and population status is affected by both low population numbers on the Forest and the widespread distribution and abundance of non-native trout; and impaired habitat conditions both on and off the Forest.

The no action alternative may pose the greatest risk to the viability of the five sensitive dragonflies and damselflies on the Forest, but is still not expected to lead to a trend toward ESA listing. While the five species are widely distributed across their range, their distribution is limited in Washington state and on the Forest. The potential risk to the viability of the sensitive plants described in the Botany section of the FEIS describes a downward trend in habitat conditions in some wetlands, moist meadows and riparian habitats that may result in a trend toward Federal listing or a loss of viability of the sensitive plant species associated with the habitats. The negative trends in habitat may contribute to impaired habitat for the dragonflies and damselflies, if those species are found in those locations. However, the potential risk to the viability of the dragonfly and damselfly species is mitigated because they are widely distributed across their range, management direction for RHCAs, and the management direction for the Bunchgrass Meadows Research Natural Area, a hotspot for the Odonata species would be maintained. Further benefits to the dragonfly and damselfly species is the Harvey Creek subwatershed, which includes Bunchgrass Meadows, would remain a priority watershed.

The no action alternative provides a current baseline from which to judge the relative potential change in the Forest Service contribution to MIS/surrogate species viability between alternatives.

Old Forest Management and Timber Production

Old forest management in the 1988 forest plan occurs in old growth fixed reserves and is also guided by the Eastside Screens. The fixed reserves cover 32,900 acres or about 3 percent of the Forest. The Eastside Screens direct that no tree over 21 inches in diameter be harvested. Timber production is allowed in the Recreation, Scenic/Timber, Scenic/Winter Range, Wood/Forage and Winter Range MAs that cover almost 81 percent of the Forest. However, vegetation management in the Caribou, Old Growth Dependent Species, Recreation/Wildlife, Scenic/Winter Range and Winter Range MAs is more likely to be similar to vegetation management in the Focused Restoration or Late Forest Structure MAs of the proposed action and alternatives R and P, and the Restoration MA in alternatives B and O. The aforementioned no action MAs include about 25 percent of the Forest, which is similar to the proposed action.

More intense timber production is expected in the Recreation, Scenic/Timber and Wood/Forage MAs totaling about 684,300 acres (about 62 percent of the Forest). The area with a timber production emphasis is more than the Active Management MA of alternative B and the Responsible MA included in alternative O. The watershed condition and AEC for most subwatersheds on the Forest are rated as *functioning at risk* or *not properly functioning* and little improvement may be expected over the current baseline conditions. The risks to watershed processes and aquatic habitat associated with timber production continue to occur over more of the Forest than any other alternative. While past timber harvest may have degraded the riparian vegetation attribute of the AEC, the transportation system needed to support the timber program is a bigger impact on watershed processes. Recent work completed by PIBO shows, that after almost 20 years of implementing INFISH, stream habitat conditions may be improving but the rate of improvement is slow, and habitat conditions on the Forest are in “poor” condition compared to reference streams. Therefore aquatic habitat may continue to show slow improvement but most watersheds would likely continue to *function at risk* or be *not properly functioning*.

Motorized Recreation and Access

Roads are allowed on over 80 percent of the Forest. Currently, there are approximately 4,000 miles of NFS roads. There are approximately 2,500 miles of roads owned by other jurisdictions within the boundaries of subwatersheds that include the Forest. Roads not only disrupt watershed processes, but their presence can have an impact on fish populations as well. Generally, watersheds that exhibit properly functioning watershed condition and support strong fish populations have road densities less than 1.0 mile per square mile and no valley bottom roads. Watersheds with road densities of 1 to 2.4 miles per square mile are generally considered to be functioning at risk for maintaining watershed processes and strong fish populations, and watersheds with road densities greater the 2.4 miles per square mile are considered to be not properly functioning. The AEC assessment found most subwatersheds on the Forest to be functioning at risk or not properly functioning for the road density and riparian road density attributes. The impaired watershed conditions are expected to continue under the no action alternative. While some MAs include desired conditions limiting open road densities at least seasonally there are no specific desired conditions for watersheds function or fish habitat. A road that is closed to access, such as for deer winter range, but still existing on the landscape has an imprint on watershed processes, and therefore, such roads are considered “open” in our road density calculations unless these roads have been hydrologically stabilized.

The Forest currently decommissions about 4 miles of road per year and completes three to five fish passage improvement projects annually and it is assumed this rate would continue under the no action alternative. Road decommissioning should help improve watershed conditions, especially when concentrated in “focus” watersheds and may be expected to reduce fine sediment delivery to streams over the long term. However, with an emphasis on timber production, the overall road densities are not expected to be significantly reduced on the Forest as a whole.

Motorized vehicle use would continue to be allowed in designated areas and trails over approximately 698,575 acres (about 65 percent of the Forest); allowed but subject to seasonal closures or other restrictions on approximately 232,646 acres (about 21 percent of the Forest; and discouraged or not allowed on about 168,370 acres (15 percent of the Forest). Off-road use increases the potential for accelerated sediment delivery to streams and damage to riparian vegetation and stream banks. These risks may increase if recreation use increases as expected and budgets to manage and maintain the system do not keep pace.

Recommended Wilderness

The 1988 forest plan includes no lands recommended for wilderness. The no action alternative is the only alternative that does not include recommended wilderness.

Riparian and Aquatic Resource Management

Watershed, riparian, and aquatic habitat direction is provided by INFISH. The 1988 forest plan and amendments focus heavily on Goals, Objectives and Standards and Guidelines to implement the watershed, aquatic, and riparian direction (see appendix 1 of the Fisheries Specialist Report for INFISH plan direction and comparison to action alternatives). Under the no action alternative the 1988 forest plan direction for watershed, aquatic and riparian resources would remain as amended by INFISH.

INFISH includes eight riparian goals (similar to desired conditions) establishing the expectation for providing the characteristics of healthy, functioning watersheds, riparian areas and fish habitat; RMOs that are numeric descriptors for good fish habitat, RHCAs (similar to RMAs) where riparian-dependent resources receive primary emphasis and specific standards and guides for land management activities are to be applied; priority watersheds designated to protect and conserve inland native fish habitat and populations; Watershed Analysis, a systematic procedure for determining how a watershed functions in relation to its physical and biological components; watershed restoration to improve the current condition of watersheds to restore degraded habitat and to provide long-term protection to riparian and aquatic resources (although no restoration strategy was originally included); and Monitoring (USDA Forest Service 1995a). INFISH only requires a watershed analysis to change the RMOs or RHCA widths.

The delineation of riparian management areas would continue under the INFISH RHCA definitions (table 99). RHCA widths may be increased or decreased when necessary to attain RMOs when site-specific data or watershed analysis supports the change. Standards and guidelines direct management within the RHCAs to meet the numeric RMOs although there is no distinction between a standard and a guideline.

Table 99. Riparian habitat conservation area width

Stream and water body classification	Riparian habitat conservation area (RHCA) width
Fish-bearing streams	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.
Permanently flowing non-fish-bearing streams	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.
Ponds, lakes, reservoirs and wetlands greater than 1 acre	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.
Seasonally flowing or intermittent streams and the area to the top of the inner gorge, wetlands less than 1 acre, and the extent of landslides and landslide-prone areas	At a minimum the RHCAs must include the extent of landslides and landslide prone areas; the intermittent stream channel and the area to the top of the inner gorge; the intermittent stream channel or wetland and the area to the outer edge of riparian vegetation; for priority watersheds the area from the edges of the stream channel, wetland, landslide or landslide prone area to a distance of one site potential tree or 100 feet slope distance, whichever is greatest; 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 the height of one-half site potential tree or 50 feet, whichever is greatest.

INFISH designated what are termed priority watersheds. Within priority watersheds, inland native fish are to receive special attention and treatment (USDA Forest Service 1995a). The criteria to designate priority watersheds include:

- Watersheds with excellent habitat of strong assemblages of inland native fish, with a priority on bull trout populations
- Watersheds that provide for meta-population objectives
- Degraded watersheds with a high restoration potential

Watersheds in good condition are to serve as anchors for the potential recovery of depressed populations, and provide colonists for adjacent areas where habitat had been degraded by land management or natural events. Those watersheds with lower quality habitat and high potential for restoration would become future sources of good habitat through focused restoration. The RHCA widths for intermittent streams are wider in priority watersheds than in non-priority watersheds (100 feet versus 50 feet); however, there are no other specific goals, desired conditions, or other direction specific to the priority watersheds.

The results of stream surveys conducted by the Forest show that many of the reaches surveyed are not meeting the RMOs as defined by INFISH. Deficiencies were noted in pool frequency and the number of large pools, large woody debris, bank conditions and stream widths riparian vegetation and sediment.

However, given the natural variability in stream habitat conditions due to weather, disturbance and the physical environment a “one-size-fits-all” approach, such as the use of RMOs may not adequately describe habitat conditions (Al-Chokhachy et al. 2011, Kershner and Roper 2010).

Archer et al. (2009) and Meredith et al. (2012) found that the PACFISH and INFISH strategies appeared to be working although streams within managed watersheds are generally in a more degraded condition than more unmanaged or reference watersheds (Al-Chokhachy et al. 2010). Using an index approach, PIBO data were assessed for sampled streams on the Forest. After almost 20 years implementing INFISH, a number of individual components of aquatic habitat and overall habitat scores on the Forest tended to be (but not universally) less (impaired habitat condition) than would be expected compared to reference streams. However, the results indicate positive trends for a number of the stream habitat indicators, suggesting that habitat may be slowly improving under current management. The bank angle and fine sediment indicators, D50 and percent fines, appear to be most commonly in what might be considered an impaired condition. These reference conditions would replace the current INFISH RMOs.

There are currently 13 priority watersheds where inland native fish are to receive special emphasis. The priority watersheds cover 214,283 acres or about 19 percent of the Forest. Watersheds in good condition would serve as anchors for the potential recovery of depressed populations, and provide colonists for adjacent areas where habitat had been degraded by land management or natural events. Those watersheds with lower quality habitat and high potential for restoration would become future sources of good habitat through focused restoration. The RHCA widths for intermittent streams are wider in priority watersheds that in non-priority watersheds (100 feet versus 50 feet), however, there are no other specific goals, desired conditions, or other direction specific to the priority watersheds.

The priority watersheds are only located in the Pend Oreille subbasin. Most of the priority watersheds support both bull trout and WSCT populations. Table 100 displays the priority watersheds including all designated bull trout critical habitat on the Forest.

Table 100. INFISH priority and alternative B key watersheds

Subwatershed Number	Subwatershed Name	Total Subwatershed Acres	Colville National Forest Ownership Acres	Species/CH
170102160201	Exposure Creek-Pend Oreille River	41,224	14,463	BT, WSCT
170102160202	Skookum Creek	31,811	14,192	BT, WSCT
170102160301	Middle Creek-Pend Oreille River	23,209	5,066	BT
170102160302	West Branch LeClerc Creek	21,672	15,099	WSCT, CH
170102160303	East Branch LeClerc Creek	26,663	11,145	WSCT,CH
170102160401	Harvey Creek	32,999	27,554	WSCT
170102160402	Headwaters Sullivan Creek	45,516	45,417	WSCT,CH
170102160403	North Fork Sullivan Creek-Sullivan Creek	12,709	11,259	WSCT,CH
170102160702	Headwaters South Salmo River	20,697	12,472	BT, WSCT
170102160704	Outlet South Salmo River	14,013	3,460	BT, WSCT
170102160902	Sweet Creek-Pend Oreille River	41,832	28,890	WSCT
170102160903	Slate Creek	20,195	19,907	WSCT,CH
170102161003	Cedar Creek	17,209	5,359	WSCT,CH
	Total Acres	**349,747**	**214,283**	

WSCT=Westslope Cutthroat Trout, IRT=Interior Redband, BT=Bull Trout, CH=Bull Trout Critical Habitat

While native fish are to receive special management emphasis within priority watersheds, there is no additional management direction provided such as specific desired conditions, objectives, or standards and guides specific to the priority watersheds.

There is no INFISH direction specifically addressing the threat of AIS. There is one standard and guideline:

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

AIS and preventing their distribution is indirectly addressed in the INFISH riparian goal to maintain or restore the: diversity and productivity of native and desired non-native plant communities in riparian zones; riparian and aquatic habitats necessary to foster the unique genetic fish stocks that evolved within the specific geo-climatic region; and 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.

Currently, the Forest AIS strategy includes a milfoil weed control project in the Little Pend Oreille Lakes and using preventive measures such as disinfecting field gear to reduce the accidental spread of AIS. These activities are expected to continue.

Active grazing allotments overlap with RHCAs, including those that provide habitat for MIS/surrogate species. Managing grazing allotments would continue under INFISH riparian goals and the four INFISH grazing standards and guidelines that focus on attainment of RMOs and the direction in the 1988 forest plan. The RMOs may or may not be appropriate to site-specific hydrologic, geomorphic and riparian vegetation conditions. Allotments with bull trout critical habitat would continue to be governed by biological opinions issued by the Fish and Wildlife Service and may include more specific measures to limit impacts on bull trout and bull trout habitat. Since during project planning, indicators would be developed based on monitoring and current science to move the RMOs toward attainment, this alternative offers similar protections to the other alternatives. Aquatic habitat tends to be of impaired quality on the Forest compared to reference streams, but after almost 20 years of implementing INFISH, there is indication that aquatic habitat conditions on the Forest are slowly improving. Similarly, the aquatic habitat within the sampled DMAs are in “poor” condition compared to reference reaches, as are the habitat attributes median substrate size, fines in pool tail-outs, and bank angle habitat. There appear to be significant positive trends in the bank stability and percent pool attributes within the DMAs across the Forest although sample size is low.

Cumulative Effects

A general discussion of cumulative effects common to all alternatives is included in the section; Past Present and Foreseeable Activities Relevant to the Cumulative Effects Analysis. The watershed condition and status of most of the MIS/surrogate Species’ local populations are functioning at risk or not properly functioning, although there is some indication of slow improvement in aquatic habitat condition. Road densities and riparian road densities which are two major attributes causing the poor watershed condition scores may not significantly improve, despite restoration, due to the amount of land available for timber production, the current Forest road system, and the 2,500 miles of road managed by other entities, which is not expected to change.

The Forest would continue with actions as described in the Northeast Washington Forest Vision 2020 project. Such actions, especially when they are implemented in a whole watershed restoration approach, should help restore watershed condition to some degree. However, given the road system and the fact that after 20 years of implementing INFISH on the Forest stream habitat is only slowly improving, watershed condition and stream habitat may not be expected to significantly improve forestwide. The magnitude of the improvement within a subwatershed would depend upon the amount of work that is socially acceptable and technically feasible to implement. The MIS/surrogate species' population status are significantly affected by high numbers and wide distribution of non-native fish, isolation above barriers and low MIS/surrogate species numbers, and problems in the migratory corridors on the larger rivers. The terms associated with relicensing of hydroelectric dams on mainstem rivers adjacent to the Forest should have beneficial impacts to native fish, especially bull trout and WSCT.

Climate Change

The overall effects of climate change were presented in the Summary of Effects Common for all Alternatives section. Under the no action alternative, Colville National Forest aquatic resource management direction for managing for stronghold populations that may contribute to the MIS/surrogate species persistence under different climate change scenarios is contained in the INFISH direction for priority watersheds. The priority watersheds are Exposure Creek-Pend Oreille River, Skookum Creek, Middle Creek Pend Oreille River, West Branch LeClerc Creek, East Branch LeClerc Creek, Harvey Creek, Headwaters Sullivan Creek, North Fork Sullivan Creek-Sullivan Creek, Headwaters South Salmo River, Outlet South Salmo River, Sweet Creek-Pend Oreille River, Slate Creek, and Cedar Creek. The Priority watersheds may provide the potential to rebuild populations and improve habitat, especially in the East Fork and West Fork LeClerc Creeks, which are focus watersheds. Where implemented, habitat restoration projects, improved aquatic passage, road decommissioning should help protect MIS/surrogate species populations and improve connectivity for bull trout populations in those streams, especially in the East and West Branch LeClerc Creek and Ninemile Creek where restoration actions are to be focused in the near-term. The threat to the MIS/surrogate species due to the high abundance and broad distribution of non-native fish may be exacerbated in a warming climate.

Monitoring

The monitoring program was previously described in the Summary of Effects Common for all Alternatives section.

Proposed Action

The proposed action reflects current management policies of the Forest. The proposed action provides for a mix of wilderness, motorized and non-motorized recreation opportunities to address the increase in visitor uses due to population growth and changing demographics. Similar to the 1988 forest plan, the proposed action allows the existing level of authorized road access with approximately 80 percent of the Forest in a roaded recreation setting. Some key differences between the proposed action and the 1988 plan include; a dynamic approach to managing old forests rather than fixed reserves, more area emphasizing backcountry motorized use, and approximately 101,400 acres identified as recommended wilderness.

In addition to including the Recommended Wilderness MA, two restoration management areas are proposed, focused restoration and general restoration. Focused restoration areas are defined by key watersheds, and grizzly bear and caribou recovery areas that are not included in Backcountry and Backcountry Motorized MAs. General restoration areas spatially include all areas not already included in another MA.

The road density desired conditions for focused and general restoration areas vary between the proposed action, and alternatives R and P. Road density is defined as the miles of all NFS roads per square mile of

NFS land. The total NFS road density is averaged over the whole MA (focused or general restoration) within a watershed (HUC 10).

Table 101. Proposed action management area acres by subbasin pertinent to aquatics discussion

Management Area	Colville	Franklin D. Roosevelt Lake	Kettle	Pend Oreille	Sanpoil	Total*
Focused Restoration	0	31,073	46,989	179,079	0	257,200
General Restoration	101,808	99,151	166,104	106,538	62,348	536,300
Backcountry	5,270	13,627	20,448	32,907	18,587	90,800
Backcountry Motorized	1,357	11,807	40,459	5,259	2,844	61,700
Wilderness Recommended	0	30,002	24,009	38,876	8,498	101,400
Wilderness-Congressionally Designated	0	0	0	31,400		31,400

*Acres are approximate and may vary slightly in other resource sections due to GIS methodology.

The proposed action addresses the need for updated, integrated direction for watershed, aquatic and riparian management. Riparian and aquatic resource direction included in the proposed action is based on the ARCS (USDA Forest Service 2008a). The ARCS includes designation of riparian management areas (RMAs), designation of a key watershed network, and a core set of desired conditions, goals, objectives, and standards and guidelines designed to provide ecological conditions conducive to maintaining, restoring, and enhancing habitat necessary to sustain aquatic and riparian-dependent species on NFS lands.

Old Forest Management and Timber Production

Key Indicator – The number of acres that have focused restoration, general restoration, and a timber production emphasis.

- Active Restoration B MA (focused restoration) includes 257,200 acres.
- Active Restoration C MA (general restoration) includes 536,300 acres

The proposed action implements a landscape approach using active management to move forest structure toward HRV. The proposed action and alternative P utilize a landscape approach to manage forest structure, allowing structure to be better managed because there is no reliance on fixed reserves, which may or may not contain the desired structure type. All future actions that affect forest vegetation would be assessed and compared to HRV, with the goal of moving the overall landscape toward HRV. Approximately 72 percent of the Forest is available for timber harvest in the restoration MAs with the intent to restore forest vegetation conditions. The Focused Restoration MA includes about 23 percent of the Forest and the general restoration area about 49 percent of the Forest. The amount of land in these two MAs is almost reversed in alternative R. Alternative P has similar amounts of land in the two MAs; about 28 percent in focused restoration and about 44 percent in general restoration.

The intent of timber harvest and other vegetation management activities is to create vegetation conditions that are more resilient to disturbances such as wildfire, drought and insect infestations. Management to restore vegetation to conditions, including old forests or late forest structure that are more resilient to disturbances such as fire, drought and insects and disease may help improve watershed conditions. The restoration management approach would likely have fewer risks to aquatic habitat and watershed condition than management with a timber production emphasis. It is assumed that there would be more active management within the General Restoration MA, and therefore, potentially more risk to aquatic resources due to vegetation management activities, as the Focused Restoration MA has a greater emphasis to provide habitat for wildlife and key watersheds. However, the potential increased risks due to vegetation management in the General Restoration MA compared to the focused restoration areas is small as the intent in both areas is to improve upslope vegetation conditions. The potential benefits to watershed condition and aquatic habitat due to terrestrial vegetation management may not be fully realized due to the desired road densities (see below).

Motorized Recreation Trails and Access

Key Indicators

- Desired conditions for road densities – Road density desired conditions are 2.0 miles per square mile in Focused Restoration MA and 3.0 miles per square mile in General Restoration MA.[41]
- Acres allocated to motorized use – Approximately 854,600 acres or 78 percent of the Forest.

Watershed conditions would continue to be impaired as road densities above 2.4 miles per square mile are generally considered indicative of a *not properly functioning* watershed and are not conducive to supporting strong fish populations. The 2.0 miles per square mile road density desired conditions still falls in the range where watershed conditions and the ability of a watershed to support strong fish populations is *at risk*.

Motorized trail use on existing trails, within 300 feet of designated roads and trails for dispersed camping, is permitted over most of the Forest. The continued motorized trail use increases the potential for accelerated sediment delivery to streams and damage to riparian vegetation and stream banks. The level or magnitude of the risks would depend in part, whether the Forest can maintain the trail system to keep pace with the expected growing demand.

Recommended Wilderness Areas

Key Indicator - Total area in recommended wilderness – 101,400 acres

The 101,400 acres allocated to recommended wilderness would be protective of streams within those lands. No roads can be constructed within recommended wilderness and motorized recreation would not be allowed. Some existing uses that do not usually conform to wilderness designations, such as the use of chainsaws for trail maintenance and mountain bikes, would still be allowed. No new mountain bike trails would be permitted.

Riparian and Aquatic Resource Management

Key Indicator – ACS direction, RMA delineation and RMA direction

The proposed action ACS, based upon the Region 6 ARCS (USDA Forest Service 2008a) includes desired conditions, standards and guidelines, and a key watershed network designed to provide the ecological conditions conducive to maintaining, restoring, and enhancing habitat necessary to sustain aquatic and riparian-dependent species on NFS lands. Watershed, aquatic, and riparian direction address both ecosystem and species diversity at watershed and landscape scales by providing the core set of desired conditions, objectives, and standards and guidelines for general water resources, key watersheds, and riparian management areas.

The proposed action includes RMAs, similar to the RHCAs in the no action alternative. Two notable differences between the proposed action RMAs and the existing INFISH RHCA definitions are: (1) a

[41] Total road density for the proposed action and alternative R is calculated as miles of open and closed NFS road per square mile of NFS lands at the HUC 10 scale. This does not include roads under another jurisdiction.

300-foot RMA for lakes and natural ponds, compared to INFISH riparian width of 150 feet; and (2) the proposed riparian width of 100 feet for all seasonally flowing or intermittent streams, wetlands, seeps and springs less than one acre; compared to the existing direction of 100 feet in Priority watersheds, and 50 feet in non-priority watersheds. The increase in RMAs, compared to the INFISH direction contained in the no action alternative, recognizes the importance of these areas for maintaining watershed function and protecting downstream aquatic habitat as well as associated riparian-dependent species (USDA Forest Service 2008a).

Direction for managing RMAs to benefit riparian-dependent resources, includes two desired conditions. Direction for managing other resource programs within the RMAs is provided by 13 standards and 28 guidelines. In the 1988 forest plan, there is no distinction between standards and guidelines within the INFISH RHCAs. The inclusion of specific standards and guidelines provides clear direction for resource management within RMAs.

The proposed action also includes six key watershed and RMOs for improving riparian and aquatic habitat. The objectives address grazing concerns, restoring riparian processes at dispersed recreation sites and on user-constructed trails, and restoring fish passage in key watersheds.

Key Indicator – Key watersheds, management direction, MIS/surrogate species and objectives

The proposed action carries forward the concept of key watersheds as a primary element to maintain and improve aquatic conditions for the MIS/surrogate species' populations, other aquatic species, and to provide high water quality. Management in key watersheds emphasizes minimizing risk and maximizing restoration or retention of ecological health.

The proposed action identifies 22 HUC 12 subwatersheds as key watersheds covering 371,943 acres or almost 34 percent of the Forest; compared to the 13 priority watersheds in the no action alternative that include 214,283 acres (about 19 percent of the Forest). In the no action alternative, all the priority key watersheds are located in the Pend Oreille Subbasin. The proposed action includes a broader network that not only benefits bull trout and includes bull trout critical habitat, but expands the key watershed network for WSCT and includes subwatersheds with interior redband trout populations.

Management direction is provided through three desired conditions that address key watershed contribution to the conservation and recovery of threatened and endangered fish species, watershed integrity, and minimizing the risk due to roads. Unlike INFISH which has no standards specific to key watersheds, the proposed action includes three. There is to be no net increase in roads in a key watershed and there are two standards for hydroelectric development. The proposed action includes six objectives for key watersheds, emphasizing that management within key watersheds is to focus on; the restoration or protection of watershed, aquatic and riparian function; reducing the impacts of roads on watershed function; improving aquatic organism passage at road/stream crossings, range management actions; enhancing late forest structure in upland plant communities within RMAs and improving stream channel and floodplain function. Additional, specific objectives have also been developed to guide restoration activities. The expansion of key watersheds to include more subwatersheds supporting WSCT and interior redband trout is expected to better protect those populations than under the current key watershed network, as experience within the Northwest Forest plan area has shown key watershed designation generally results in improved watershed conditions (Lanigan et al. 2012). The improved conditions observed within key watersheds is due to the overall management direction provided by desired conditions and standards, but also focused restoration.

Key Indicator – Change in distribution of aquatic invasive species (AIS):

There is no specific direction within the proposed action that addresses AIS prevention, control, or eradication other than a desired condition, "Native assemblages of riparian dependent plants and animals are free of persistent non-native species." There is also indirect direction for managing AIS risk in the overall and riparian desired conditions for healthy watersheds and aquatic systems, maintaining and recovering native species.

Improvement in riparian vegetation conditions within grazing allotments

Grazing management within RMAs is guided by watershed and RMA desired conditions and RMA standards and guidelines. The proposed action includes one standard addressing livestock handling, management and watering facilities, and four guidelines. One guideline specifically addresses streambank alteration, and utilization of herbaceous and woody vegetation. The guideline provides a starting point for managing grazing within RMAs to protect riparian and aquatic habitat.

The Forest Service Contribution to MIS/Surrogate Species Viability

The proposed action is expected to contribute to the viability of the MIS/surrogate species to a greater degree than the no action alternative. Compared with the no action alternative, the proposed action includes more lands allocated to MAs that are felt to be "protective" of watershed processes and aquatic habitat (wilderness, recommended wilderness, backcountry and backcountry motorized), more lands that have a "moderate" level of protection (focused restoration); and while timber is expected to be an output from both the focused and general restoration areas, there is more emphasis of restoring forest vegetation conditions than timber production in the proposed action than the no action alternative. There is also a significantly larger key watershed network that expands the key watersheds to include more subwatersheds with bull trout and WSCT in the Pend Oreille subbasin; and subwatersheds with interior redband trout in the Lake Roosevelt and Kettle subbasins. The Forest's contribution to viability is improved as well by road density desired conditions for the focused and general restoration areas, but the overall contribution compared to alternatives R and P is reduced because the desired road densities, especially for the General Restoration MA, are higher than the road densities generally found in functioning watersheds that provide habitat for strong fish populations. The RMAs in the proposed action are expanded, compared to the no action alternative, to included extra consideration for all intermittent streams, recognizing the importance of these small streams for providing high quality water to downstream aquatic habitat.

Table 98 in the no action alternative discussion displays the relative Colville National Forest contribution to viability in the subbasins for the MIS/surrogate species by alternative. The proposed action increases the Forest Service contribution to the species viability in all subbasins for all the MIS/surrogate species. If the ratings for the MIS/surrogate species are averaged across the subbasins, the Forest Service contribution to MIS/surrogate species' viability under the proposed action is greater for all species than in the no action alternative and alternative B, but less than in alternatives R and P, and less than, but somewhat similar to alternative O.

Old Forest Management and Timber Production

Approximately 71 percent of the Forest is available for timber harvest in the Focused and General Restoration MAs. The intent of timber harvest and other vegetation management activities is to create vegetation conditions that are more resilient to disturbances such as wildfire, drought, and insect infestations. Although endemic levels of insects and diseases create snags, which in turn, provide woody debris to streams, and low-severity fires can deliver wood and nutrients to aquatic system, many of the subwatersheds are functioning at risk for the fire regime indicator and a few are not properly functioning in the AEC assessment. A few subwatersheds are functioning at risk for insects and disease. Epidemic insect population levels and/or high-severity fire can lead to vegetation losses or sediment increases above desired levels for native fish populations.

Management to restore vegetation to conditions, including late forest structure, as may be expected under historical and anticipated environmental conditions is a component of managing for healthy, resilient watersheds and may help improve watershed conditions. There are likely less risks to aquatic resources due to vegetation management in the Focused Restoration MA than in the General Restoration MA, as the focused restoration includes a greater emphasis for wildlife habitat and key watersheds. The restoration management approach for both the MAs would likely have fewer risks to aquatic habitat and watershed condition than management with a timber production emphasis; however, the potential benefits of terrestrial vegetation management may not be fully realized due to the desired road densities (see below).

Motorized Recreation and Access.

Motorized trails are not authorized in research natural areas, recommended wilderness, wilderness, or on national scenic trails. Wilderness designation further precludes mechanized use with minor exceptions. Motorized trails may be authorized in specified locations at recreation or administrative sites.

The proposed action has two Backcountry MAs, motorized and non-motorized. In the proposed action, approximately 6 percent of the Forest is allocated to backcountry motorized (BCM) management and approximately 8 percent is allocated to backcountry non-motorized (BC). Motorized trail use and off-trail over-snow use is allowed in the BCM management areas, but not in BC areas. Summer and winter motorized use would be authorized within the Focused and General Restoration MAs.

Roads are currently allowed on about 80 percent of the Forest and the proposed action continues to allow road access in those areas. Road access would not be allowed within recommended or designated wilderness areas, BCM and BC MAs, or research natural areas. Road density desired conditions are identified for the Focused and General RAs. The desired road density in the focused restoration areas is 2.0 miles per square mile averaged over the focused restoration areas within watershed and 3.0 miles per square mile in the general restoration areas.

Most subwatersheds on the Forest are functioning at risk or not properly functioning for the AEC road density and riparian road density attributes. The road attributes are a prime reason for impaired watershed function. Roads are currently allowed on 80 percent and the proposed action would continue to allow access to these areas. Road access is not allowed in Wilderness, Recommended Wilderness, Backcountry Motorized and Non-Motorized Management Areas or research natural areas; about 26 percent of the Forest.

The proposed action identifies desired road densities for the focused restoration and general restoration areas. The Focused Restoration MA, approximately 23 percent of the Forest, has a road density desired condition of 2.0 miles per square mile. The General Restoration MA, about 49 percent of the Forest, has a desired road density of 3.0 miles per square mile. Watersheds with road densities of 1.0 to 2.4 miles per square mile are generally considered functioning at risk for watershed condition and for providing the conditions necessary to support strong fish populations. Road densities greater than 2.4 miles per square mile are generally considered not properly functioning. The Forest’s ability to achieve the desired road densities would be depend upon budgets and in some cases public acceptance. Implementation of the proposed action may improve watershed conditions in focused restoration areas that currently exceed 2.0 miles per square mile, with the greatest improvements likely to occur as restoration objectives are met in key watersheds. However, approximately 71 percent of the Forest watersheds may be expected to remain functioning at risk or not properly functioning for road densities.

The desired conditions, standards and guides for aquatic resources provide direction for minimizing the effects of roads especially in key watersheds and RMAs.

Motorized trail use is allowed over most of the Forest where the trails currently exist, within 300 feet of designated roads and trails for dispersed camping, and within 30 feet of designated roads and trails. The continued motorized trail use increases the potential for accelerated sediment delivery to streams and damage to riparian vegetation and stream banks. The level or magnitude of the risks would depend in part if budgets to manage the system keep pace with the expected growing demand.

Some improvement to impaired watershed condition due to roads and motorized trail use may occur due to the aquatic and riparian management plan components, including overall desired conditions, RMA standards and guidelines, and key watershed direction (see Riparian and Aquatic Resource Management). The Forest currently decommissions about 4 miles of road a year and completes 3 to 5 fish passage improvement projects annually, and it is assumed the activities would continue at the present rate. Road decommissioning should improve watershed function, especially in focus and Key watersheds but the overall effectiveness at improving watershed condition may be constrained by the desired road densities. Implementation of the objectives for restoration, Key watersheds and RMAs may help reduce the impacts of roads and trails that are left on the landscape.

Recommended Wilderness

The proposed action identifies 101,400 acres, about 9 percent of the Forest, to be managed as recommended wilderness. The wilderness character of these areas is to be maintained until Congress either designates them as wilderness or releases an area from consideration. While there may be some impacts to watershed processes and fish habitat associated with the existing trails, overall, the recommended wilderness areas, with no roads or management other than recreation, should be protective of aquatic habitat.

Riparian and Aquatic Resource Management

The proposed action ACS is based upon the Region 6 ARCS (USDA Forest Service 2008a). The ARCS, and subsequently, the Forest’s ACS includes desired conditions, standards and guidelines, and a key watershed network designed to provide the ecological conditions conducive to maintaining, restoring, and enhancing habitat necessary to sustain aquatic and riparian-dependent species on NFS lands. Watershed, aquatic and riparian direction address both ecosystem and species diversity at watershed and landscape scales by providing the core set of desired conditions, objectives and standards and guidelines for general water resources, key watersheds, and riparian management areas.

Overall, direction is provided by plan components that include 11 desired conditions that apply to all watersheds, aquatic and riparian systems. These are similar to the riparian goals of INFISH. Desired conditions apply to all watersheds and are intended to provide a comprehensive description of the characteristics of healthy functioning water, fisheries, and riparian resources toward which land management should be directed. The 11 desired conditions direct NFS lands to contribute to: the distribution, diversity, and resiliency of watershed and landscape-scale features; uninterrupted physical and biological processes within and between watersheds; habitat and ecological conditions that are capable of supporting self-sustaining populations of native and desired non-native aquatic and riparian-dependent plant and animal species; the physical integrity of aquatic systems and riparian habitat; water quality necessary to support healthy riparian, aquatic and wetland ecosystems; the sediment regime within the natural range of variation; 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, variability and duration of floodplain inundation; the timing, variability and water table elevation in wetlands, seeps and springs; the species composition and structural diversity of plant communities in riparian management areas (including wetlands); and native assemblages of riparian-dependent plants and animals.

The ACS identifies RMAs similar to the INFISH RHCAs except additional consideration is given to the riparian areas adjacent to intermittent streams, wetlands less than 1 acre, seeps and springs and unstable and potential unstable areas in all watersheds. The increase in RMAs provides additional protection to these areas, recognizing their importance for maintaining watershed function and protecting downstream aquatic habitat as well as associated riparian-dependent species (USDA Forest Service 2008a).

Table 102. Riparian widths for the proposed action and alternatives R, P, and O

Stream and Water body Classification	Riparian Management Area (RMA) Widths
Fish-bearing streams	RMAs consist of the stream and the area on each 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 total, including both sides of the stream channel), whichever is greatest.
Permanently flowing non-fish-bearing streams	RMAs consist of the stream and the area on each 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 one site-potential tree, or 150 feet slope distance (300 feet total, including both sides of the stream channel), whichever is greatest.
Constructed ponds and reservoirs and wetlands greater than 1 acre	RMAs consist of the body of water or wetland and the area to the outer edges of the riparian vegetation, or to the extent of seasonally saturated soil, or the extent of unstable and potentially 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 wetland greater than 1 acre or the maximum pool elevation of constructed ponds and reservoirs, whichever is greatest.
Lakes and natural ponds	RMAs consist of the body of water and the area to the outer edges of the riparian vegetation, or to the extent of seasonally saturated soil, or to the extent of unstable and potentially unstable areas, or to a distance equal to the height of two site-potential trees, or 300 feet slope distance, whichever is greatest.
Seasonally flowing or intermittent streams, wetlands, seeps and springs less than 1 acre and unstable and potentially unstable areas	The stream channel or wetland and the area from the edges of the stream channel or wetland to the outer edges of the riparian vegetation, extending from the edges of the stream channel to a distance equal to the height of one site-potential tree, or 100 feet slope distance, whichever is greatest. A site-potential tree height is the average maximum height of the tallest dominant trees for a given site class.

Desired conditions for RMAs include:

- RMAs within any given watershed reflect a natural composition of native flora and fauna and a distribution of physical, chemical and biological conditions appropriate to natural disturbance regimes.
- Key riparian processes and conditions (slope stability, vegetative root strength, wood delivery, etc.) are operating consistently with local disturbance regimes.

Standards and guidelines provide direction for management activities within RMAs.

Direction for managing RMAs to benefit riparian-dependent resources, including direction for managing other resource programs within the RMAs, is provided by 14 standards and 26 guidelines. In the 1988 forest plan, there is no distinction between standards and guidelines within the INFISH RHCAs. The inclusion of specific standards and guidelines in the proposed action provides clear direction for resource management within RMAs.

The direction for RMAs also include four riparian management objectives specifically addressing improving riparian processes and function in grazing programs, restoring dispersed recreation sites and user-constructed trails, and restoring fish passage in the key watersheds. The riparian objectives are different than the RMOs in INFISH and the no action alternative. The INFISH RMOs were considered to be general descriptors of good fish habitat that could be changed by a Forest with more site-specific information. The RMO “one-size-fits-all” approach is somewhat problematic and may not adequately describe habitat conditions due to the natural variability in stream habitat conditions caused by weather, disturbance and the physical environment (Al-Chokhachy et al. 2011, Kershner and Roper 2010).

The 2008 ARCS, and thus, the proposed action includes mid-scale analysis of watersheds as an element of the aquatic strategy. Mid-scale or watershed analysis is a systematic analytical procedure for characterizing watershed physical and ecological processes. Watershed analysis identifies and analyzes dominant ecological and geomorphic characteristics and processes influencing riparian and aquatic ecosystems within a watershed. Decision makers may use the results of a watershed analysis to diagnose the condition and trend of watershed and riparian-dependent resources and determine appropriate activities to attain revised forest plan desired conditions. Watershed analysis serves as the basis for determining restoration needs, developing project-specific proposals, may help in defining objectives for management within RMAs, identify the most useful indicators for diagnosing existing and potential conditions and provide a context for multi-scale monitoring programs (USDA Forest Service 2008a). However, there are no objectives or other plan components for watershed analysis other than some form of watershed analysis will be needed to determine attainment of desired conditions

Key watersheds are defined as a network of watersheds selected to serve as strongholds for important aquatic resources or having the potential to do so. They are areas crucial to TES and areas that provide high quality water important for downstream aquatic habitat. The protocol for developing key watersheds is provided by Reiss et al. (2008). The proposed action designates an expanded network of key watersheds compared to the no action alternative by identifying 22 HUC 12 subwatersheds as key watersheds covering 371,943 acres, or almost 34 percent of the Forest; compared to the 13 priority watersheds in the no action alternative that include 214,283 acres (about 19 percent of the Forest). In the no action alternative, all the priority key watersheds are located in the Pend Oreille Subbasin. The proposed action includes a broader network that not only benefits bull trout and includes bull trout critical habitat, but expands the key watershed network to other subbasins benefiting additional WSCT populations and includes subwatersheds with interior redband trout populations. Watershed and aquatic habitat condition is expected to improve within key watersheds as found by Lanigan et al. (2012) over time. The improved watershed conditions are due to the management direction for the key watersheds, the management intent to minimize risks to watershed condition and aquatic habitat within key watersheds, and the emphasis on restoration (discussed below).

Table 103. Proposed action key watersheds

Subwatershed Number	Subwatershed Name	Total Subwatershed Acres	Colville National Forest Ownership Acres	MIS/ Surrogate Species CH
170102160102	Winchester Creek	10,482	5,627	WSCT, CH
170102160103	Exposure Creek-Pend Oreille River	41,223	14,462	BT, WSCT
170102160106	Smalle Creek	17,753	11,058	BT, WSCT, CH
170102160109	Tacoma Creek	39,519	27,182	BT, WSCT, CH
170102160202	West Branch LeClerc Creek	21,671	15,098	BT, WSCT, CH
170102160203	East Branch LeClerc Creek	26,662	11,145	BT, WSCT, CH
170102160204	Ruby Creek	19,597	18,385	BT, CH
170102160302	Sweet Creek-Pend Oreille River	41,831	28,890	WSCT
170102160303	Harvey Creek	32,998	27,553	WSCT
170102160304	Headwaters Sullivan Creek	45,516	45,417	BT, WSCT, CH
170102160305	North Fork Sullivan Creek-Sullivan Creek	12,708	11,258	BT, WSCT, CH
170102160306	Slate Creek	19,911	19,907	BT, WSCT, CH
170102160307	South Salmo River	22,271	15,932	BT, WSCT
170200010104	North Fork Deep Creek	49,256	26,633	WSCT
170200010306	Barnaby Creek	23,107	14,299	IRT
170200010401	Upper Hall Creek	31,648	13,785	IRT
170200010402	Sitdown Creek	14,484	0	
170200010403	Middle Hall Creek	15,480	1,927	IRT
170200020401	Trout Creek	23,434	14,121	IRT
170200020501	Tonata Creek	14,453	13,780	IRT
170200020608	North Fork Deadman Creek	13,449	13,185	IRT
170200020609	Deadman Creek	26,518	22,299	IRT
	Total	**563,971**	**371,943**	

WSCT=Westslope Cutthroat Trout, IRT=Interior redband, BT=Bull Trout, CH=Bull Trout Critical Habitat

Management activities in key watersheds are to emphasize minimizing risk and maximizing restoration or retention of ecological health. Three desired conditions are identified for key watersheds:

- Networks of watersheds with good habitat and functionally intact ecosystems that contribute to and enhance conservation and recovery of threatened and endangered fish species
- Roads do not present risk to aquatic resources;
- Key watersheds have high watershed integrity.

The proposed action includes three standards for management within key watersheds:

- There shall be no net increase at any time in the mileage of Forest roads in any key watershed unless doing so results in a reduction in road-related risk to watershed condition.
- Hydroelectric and other water development authorizations shall include requirements for in-stream flows and habitat conditions that maintain or restore native fish and other desired aquatic species populations, riparian-dependent resources, favorable channel conditions, and aquatic connectivity.

- New hydroelectric facilities and water developments shall not be located in a key watershed unless it can be demonstrated they have minimal risks and/or no adverse effects to fish and water resources for which the key watershed was established.

The proposed action also includes six objectives for restoration for key watersheds.

1. Management in key watersheds focuses on restoration or preservation of watershed, aquatic, and riparian function and recovery of threatened and endangered species. The East Branch LeClerc Creek, West Branch LeClerc Creek, Deadman Creek, Barnaby Creek, Harvey Creek, North Fork Deadman Creek, North Fork Sullivan Creek-Sullivan Creek, Tonata Creek, and Ruby Creek subwatersheds are priorities for active restoration. Additional key watersheds that are priorities for restoration would be identified as priority work is completed.
2. Reduce road hydrologic connectivity and sediment delivery through storm damage risk reduction, full hydrologic decommissioning, and other acceptable treatment measures;
3. Restore or maintain aquatic organism passage at road/stream crossings for all species, seasons, flows, and life stages within 15 years of plan implementation, through culvert replacement or installation and improvement of hydrologic and aquatic habitat function and resiliency to a range of flows thorough natural channel design and other acceptable treatment measures;
4. Improve hydrologic and aquatic function through range infrastructure improvements, including riparian fencing, movement and improvement of watering troughs, and other acceptable treatments;
5. Enhance late forest structure in upland vegetation within riparian management areas;
6. Restore hydrologic, geomorphic, and riparian process and function through streambank stabilization, restoration of lateral and vertical hydrologic connectivity and improvement of stream channel and floodplain function.

Additionally, there are objectives for key watersheds that identify restoration activities specific to the individual key watersheds. The objectives identify treating 68 miles of road to reduce impacts on water quality and watershed processes; improving aquatic organism passage at 36 road/stream crossings; improving range infrastructure to reduce the potential for detrimental impacts to riparian and aquatic habitat due to grazing on 240 acres; improving the structure and composition of upland vegetation within RMAs on between 450 and 950 acres; and restoring 70 miles of stream. The combined direction for key watersheds should improve watershed condition as roads are decommissioned and riparian vegetation is improved. The benefits may improve watershed conditions the most where the actions are focused in a watershed.

Table 104. Proposed action — objectives and projected improvements in key watersheds that are active priorities for restoration

Key Watershed Prioritization	Road Treatments Road Improvement (miles)	Road Treatments Aquatic Organism Passage Improvement (# of crossings)	Range Infrastructure Improvement (acres)	Riparian Vegetation Structure Improvement (acres)	Stream Restoration (miles)
East Branch LeClerc Creek	3	1	20	0	10
West Branch LeClerc Creek	3	5	20	0	10
Deadman Creek	5	1	30	75-150	3
Barnaby	5	5	30	75-150	4
Harvey Creek	10	2	0	0	4
North Fork Deadman Creek	5	1	30	75-150	3
North Fork Sullivan-Sullivan Creek	15	7	0	0	20
Tonata Creek	4	4	50	75-150	3
Ruby Creek	3	4	30	75-150	3
Treatments in additional key and/or priority watersheds (estimate addition 3 subwatersheds)	15	6	30	75-150	10
Total for the life of the plan (essential projects completed for 12 key watersheds)	**68 miles**	**36 crossings**	**240 acres**	**450-950 acres**	**70 miles**

All key watersheds are in the Focused Restoration MA. The intent to restore terrestrial vegetation should help improve the resiliency of watersheds to disturbance, although the actual benefit would depend upon the amount of terrestrial restoration activity that actually occurs in a watershed or subwatershed. Key watershed and riparian management objectives to reduce road-related sediment should help improve water quality and fish habitat, but changing watershed conditions to full functioning may be limited by the road density desired condition of 2.0 miles per square mile that is considered a risk to watershed processes and strong fish populations.

There is no specific direction within the proposed action that addresses AIS prevention, control, or eradication other than a desired condition: “Native assemblages of riparian dependent plants and animals are free of persistent non-native species.” There is also indirect direction for managing AIS risk in the overall and riparian desired conditions for healthy watersheds and aquatic systems, maintaining and recovering native species. The threat AIS pose to native species is discussed in the 2008 ARCS (USDA Forest Service 2008a) as a need for a comprehensive aquatic and riparian restoration strategy.

A number of subwatersheds are functioning at risk or not properly functioning for the AEC riparian vegetation attribute. Aquatic habitat tends to be of poor quality on the Forest compared to reference streams, but after almost 20 years of implementing INFISH, there is indication that aquatic habitat conditions on the Forest are slowly improving. The bank stability, percent undercut bank, and bank angle attributes of aquatic habitat are showing some improving trends on the Forest. Similarly, the aquatic habitat conditions within the sampled DMAs across the Forest are significantly lower than reference reaches, as are the median substrate size, fines in pool tail-outs, and bank angle habitat attributes. There appear to be significant positive trends in the bank stability and percent pool attributes within the DMAs across the Forest, although sample size is low.

Grazing management within RMAs is guided by watershed and RMA desired conditions and RMA standards and guidelines. The proposed action includes one standard addressing livestock handling, management and watering facilities, and four guidelines. One guideline describes utilization within the RMA, stating: Within green-line vegetation area adjacent to all watercourses[42]

- do not exceed 20 percent streambank alteration;
- do not exceed 40 percent utilization of mean annual vegetative production on woody vegetation; and
- maintain at least 4 to 6 inches or do not exceed 40 percent utilization of mean annual vegetative production on herbaceous vegetation.[43]

Streambank alteration is an indicator of damage to streambanks that can lead to bank instability, accelerated delivery of sediment to stream channels, loss of undercut banks and increasing bank angles with an associated loss of cover for fish and contributing to channel widening. When discussing standards or guidelines for streambank alteration it is important to identify the protocol to be used as the allowable percent alternation would depend upon the protocol (different protocols may have different results for the same level of bank alteration (Archer 2014)). It is assumed that the Forest would continue to use the Multiple Indicator Monitoring protocol (Burton et al. 2011). Bengeyfield (2006) suggested bank alteration of 20 percent or less should be protective of streambanks; however, Bengeyfield (2006) used a different protocol. A standard of 20 percent bank alteration using the Multiple Indicator Monitoring protocol is consistent with the recommendations of Archer (2014) based upon the PIBO monitoring information. Not exceeding 40 percent utilization of mean annual vegetative production on woody vegetation should protect riparian shrubs and bushes from excessive grazing (Winward 2000).

Maintaining 4 to 6 inches stubble height is designed to protect the health of riparian vegetation. Clary and Leininger (2000) suggest that a 4-inch stubble height is a starting point for improved riparian grazing, but raising the stubble height to 6 to 8 inches may be required to protect willows and limit bank trampling. Clary and Webster (1990) also state that greater than 6-inch stubble heights may be required in riparian systems where threatened, endangered, or sensitive species are present or where streambanks are highly erodible. Bengeyfield (2006) found where riparian areas were grazed to a 4-inch stubble height there were no upward trends in stream channel morphology. Pelster et al. (2004) found that 25 to 50 percent of steer diets were comprised of willow during late-summer and fall grazing and suggested stubble heights of about 8 inches were needed to reduce willow consumption during these critical periods. Therefore,

[42] National forests can modify the numeric values in these guidelines to more effectively achieve desired conditions. Rationale for these changes should be documented.

[43] Sampling and assessment of these parameters is intended to portray the general condition of banks and riparian vegetation along an individual stream reach within each pasture. It is assumed that there will be some variability in conditions within the reach, including occasional, limited area of concentrated animal use, such as water gaps or crossings.

*Numeric values in this standard represent minimum levels of what cannot be exceeded and should be more conservatively modified where determined necessary to effectively achieve desired conditions. Rationale for these changes must be documented. Standards can be applied solely or in combination as appropriate to site-specific conditions. Sampling and assessment of these parameters is intended to portray the general condition of banks and riparian vegetation along an individual stream reach within each pasture after the grazing season. It is assumed that there will be some variability in geomorphic, hydrologic and vegetation conditions within designated monitoring areas, including occasional, limited area of concentrated animal use, such as water gaps or crossings.

depending upon the conditions at a site, grazing to a 4-inch, or even a 6-inch residual stubble height may not be sufficient for improving riparian vegetation conditions and protecting aquatic habitat. Root strength is important for maintaining stable streambanks, preventing bank erosion, and for the development of undercut banks that provide cover for fish. Overall utilization of herbaceous vegetation can result in slow or diminished root growth, thus, potentially affecting the health of riparian vegetation and reducing the root strength. The standard for not exceeding 40 percent utilization of the mean annual vegetative production of herbaceous vegetation is at the upper end of the recommendations of Archer (2014). The guideline establishes the upper limits for bank alteration, utilization, and stubble height as the starting point for identifying grazing management strategies within RMAs.

The other guidelines address considering the removal of existing livestock handling or management facilities form RMAs, avoidance of livestock trailing, bedding, loading and other handling activities, and avoiding trampling threatened or endangered fish species' redds. The specific direction to avoid redd trampling is important as redd trampling can cause direct mortality to the eggs or alevins.

The grazing guidelines, when used in total, should help manage livestock grazing to protect riparian and aquatic habitat. The bank alteration and utilization standards may be more protective and actually be reached before the stubble height is grazed down to 4 to 6 inches. The bank alteration standard, however, needs to be measured very soon after the cattle are removed from an allotment and before the fall rains that may wash away signs of alteration (Archer 2014).

Collectively, the desired conditions, standards and guidelines, and objectives are designed to provide management direction to ensure forest management activities will help attain and maintain aquatic and riparian desired conditions over time; maintain or improve vegetative and stream conditions; contribute to the aquatic species viability on the Forest; and provide important contributions to the recovery of ESA-listed species.

Cumulative Effects

Information regarding cumulative effects that are common for all alternatives is included in the Past, Present, and Foreseeable Activities Relevant to Cumulative Effects Analysis section. The activities outside the influence of the proposed action, such as the aquatic habitat improvement work associated with hydroelectric projects are common for all alternatives. The activities associated with the Northeast Washington Forest Vision 2020 project would continue and be guided by the proposed action direction.

The ACS for the proposed action is based on the Region 6 ARCS, which was based upon the lessons learned through implementation of the Northwest Forest Plan, PACFISH and INFISH, as well as science that came to light after those plans were written. The ACS clarifies standards and guidelines for RMAs and key watersheds as well as restoration objectives that should provide more direction for improving watershed, aquatic and riparian habitat conditions that may result in those conditions improving at a faster rate than has occurred under the no action alternative.

However, over the Forest, most subwatersheds may remain functioning at risk or not properly functioning due to the road density desired conditions for the Focused Restoration (2.0 miles per square mile) and General Restoration (3.0 miles per square mile) MAs and the transportation system managed by other entities. Actual achievement of the road density desired conditions would be dependent upon budgets for restoration and social acceptance.

Restoration work and attaining the ACS desired conditions may be greatest where Colville National Forest actions are coordinated with the actions of other entities, such as those associated with the Boundary Hydroelectric Project.

Climate Change

The general description of the potential effects of climate change remain the same as discussed in the Effects Common to All Alternatives section. The increased overall direction of the ACS including forestwide desired conditions, riparian and key watershed standards and guidelines; the key watershed network covering approximately 34 percent of the Forest; desired conditions for and management to improve the vegetative structure and composition of Forests; and objectives for improving riparian and watershed conditions may remove human stressors to the environment and provide a somewhat better opportunity for aquatic species to adjust to climate change. Specific key watershed objectives to improve aquatic organism passage should help improve the habitat and MIS/surrogate species population connectivity as the projects are implemented. However, the road density desired conditions may continue to pose a risk to MIS/surrogate species' persistence in the face of climate change.

A particular risk to the MIS/surrogate species would remain the presence of non-native fish, low MIS/surrogate species population numbers, and isolated and fragmented populations. In addition to the Forest actions described above, the non-native fish population suppression or eradication, habitat improvement and improved passage at the hydroelectric project dams may be key factors in conserving the MIS/surrogate species.

Monitoring Recommendations

The monitoring program was previously described in the Summary of Effects Common for all Alternatives section.

Alternative R

Riparian and aquatic resource direction in alternative R is based on the proposed action direction, but incorporates additional desired conditions, objectives, and standards and guidelines that address contemporary issues specific to the Forest raised by the public, regulatory agencies, and internally during scoping.

Table 105. Alternative R management area acres by subbasin pertinent to aquatics discussion

Management Area	Colville	Franklin D. Roosevelt Lake	Kettle	Pend Oreille	Sanpoil	Total
Late Forest Structure	84,792	123,294	160,189	195,907	3,990	568,200
General Restoration	17,023	13,434	59,628	93,241	61,205	244,800
Backcountry	0	0	7,570	12,214	437	20,200
Backcountry Motorized	1,357	63	0	5,279	0	7,000
Wilderness Recommended	5,339	49,262	70,928	55,951	27,409	209,000
Wilderness-Congressionally Designated	0	0	0	31,400	0	31,400

*Acres are approximate and may vary slightly in other resource sections due to GIS methodology

Old Forest Management and Timber Production

Key Indicator – The number of acres that have late forest structure, general restoration, and a timber production emphasis.

- Late Forest Structure (focused restoration) – 568,200 acres
- General Restoration – 244,800 acres

Alternative R retains the two restoration MAs introduced in the proposed action. The late forest structure management area includes about 51 percent of the Forest and the general restoration area about 22 percent of the Forest. Alternative R includes more land in the late forest structure MA and less in the General Restoration MA than either the proposed action or alternative P. In addition, approximately 568,200 acres within the Late Forest Structure MA are to be managed with an emphasis on late forest structure. This alternative implements an expanded late forest structure reserve network. Late forest structure management under alternative R would primarily be passive, where structural changes would be the result of successional process, insect and disease interactions, wildfire, and prescribed burning. All future actions that affect forest vegetation would be assessed and compared to HRV, with the goal of moving the overall landscape toward HRV. Some treatments may occur to reduce fire risk by fuels reduction or manipulation of structure and species composition to increase tree vigor to maintain old structure for a longer period of time.

Under alternative R, the majority of acres treated through vegetation management would occur with the use of prescribed fire (75 percent), followed by timber harvest (15 percent), and mechanical fuels treatments (10 percent). Vegetation management to restore vegetation to conditions, including late forest structure that may be more expected under historic and anticipated disturbance regimes, is a component of managing for healthy watersheds. Modeling results (see Forest Vegetation section) show alternative R creates less late structure than no action, the proposed action, and alternative P, but more than alternatives B and O.

Motorized Recreation Trails and Access

Key Indicator - Desired conditions for road density

- Late Forest Structure Areas – 1.0 mile per square mile
- General Restoration Areas – 2.0 miles per square mile

Road density desired condition for Late Forest Structure MA is 1.0 mile per square mile. Road density indicator for general restoration is 2.0 miles per square mile. Most subwatersheds on the Forest are not properly functioning or functioning at risk for the AEC road density and riparian road density attributes. Implementing alternative R would potentially help improve watershed condition more than the proposed action. If the road density desired conditions are attained watershed conditions may be expected to improve. The Late Forest Structure MA, with a desired average road density of 1.0 mile per square mile covers about one-half percent of the Forest. In general, road densities of 1.0 mile per square mile are the upper bounds of what are considered properly functioning watersheds, conducive to providing habitat for strong fish populations. The General Restoration MA with a desired average road density of 2.0 miles per square mile includes a little less than one-quarter of the Forest. Watersheds with 2.0 miles per square miles are generally considered to be functioning at risk for watershed condition and supporting strong fish populations. The extent to which the road density desired conditions would be attained will depend upon budgets and social acceptance.

Key Indicator - Acres allocated to motorized recreation - approximately 837,401 acres, about 76 percent of the Forest.

Alternative R includes 209,000 acres of recommended wilderness (second most of the alternatives), where new roads would not be built, and no motorized recreation is permitted, reducing the risk of accelerated sediment delivery from motorized trails, compared to the proposed action. Motorized recreation is allowed on existing trails, within 300 feet of designated roads and trails for dispersed camping, and within 30 feet of designated roads and trails on approximately 837,401 acres; 76 percent of the Forest.

Recommended Wilderness

Key Indicator – Recommended wilderness areas

Alternative R allocates approximately 19 percent of the Forest to recommended wilderness, second highest amount of all the alternatives. Inconsistent uses such as the use of chainsaws and current levels of mountain bike use would not be allowed.

Riparian and Aquatic Resource Management

Riparian and aquatic resource direction in alternative R is based on direction in the proposed action, but incorporates additional desired conditions, objectives, and standards and guidelines that address contemporary issues specific to the Forest raised by the public, regulatory agencies, and internally during scoping.

Key Indicator – ACS direction, RMA delineation, and RMA direction

Watershed direction within alternative R incorporates the desired conditions for watersheds, aquatic and riparian systems that were described in the proposed action with clarifying language added to several of the desired conditions. Alternative R also includes the addition of desired conditions for TES species, one for roads, and five additional standards to decrease the spread of AIS and to minimize the disruption of hydrologic processes due to roads and trails.

The alternative R definition of RMAs and the associated widths are the same as in the proposed action. The management direction for RMAs includes 16 standards and 23 guidelines. Several of the RMA guidelines in the proposed action are standards in alternative R, some additional standards have been added, and specificity has been added to the language describing some standards and guidelines. Changing guidelines to standards may add clarity and certainty to expectations concerning how management actions are to be implemented within RMAs. An additional desired condition is also added regarding livestock grazing. Mid-scale or watershed analysis is included as described for the proposed action.

Key Indicator – Key watershed acres, management direction for key watersheds, MIS/surrogate species, key watershed and restoration objectives

The alternative R key watershed network includes 25 subwatersheds covering 451,525 acres, compared to 22 key watersheds covering about 371,943 acres in the proposed action. Three subwatersheds were removed from the proposed action key watershed network because they had less than 25 percent NFS ownership. The key watershed network includes the bull trout critical habitat and expands the network to include subwatersheds with interior redband trout and additional subwatersheds with WSCT. Alternative R, along with alternatives P and O (discussed later), provide the greatest benefit to the MIS/surrogate and aquatic species due to the key watershed network.

Alternative R includes the three key watershed desired conditions as in the proposed action with some clarifying language added and the three key watershed standards. The key watershed objectives are similar to those as described for the proposed action (see appendices 1 and 2 of the Fisheries Specialist Report) with additional objectives to improve range infrastructure to protect riparian habitat, restore the structure and composition of upland vegetation within RMAs and for stream restoration.

Key Indicator – Change in the distribution of aquatic invasive species (AIS)

Alternative R includes standards developed specifically for prevention, control, and eradication of AIS. Such plan components provide more clear and urgent direction to implement appropriate AIS management actions than the proposed action and no action alternatives, and thus, alternative R may provide more protection from AIS invasion than no action and the proposed action.

Key Indicator – Improvement in riparian conditions within grazing allotments.

Alternative R includes three standards and two guidelines for grazing within RMAs. The guideline in the proposed action that refers to maintaining 4- to 6-inch stubble height and no more than 20 percent bank alteration is changed to maintaining at least 8-inch stubble height and to not exceed 25 percent bank alteration.

Forest Service Contribution to MIS/Surrogate Species Viability

Alternative R provides the greatest Colville National Forest contribution to MIS/surrogate species viability of all alternatives. The Forest contribution for alternative R is the highest for WSCT and interior redband trout of any alternative and equal to alternative P for bull trout. The reason that alternative R exhibits the greatest potential contribution is the expanded key watershed network that includes the bull trout critical habitat and has an increased key watershed area for WSCT and interior redband trout compared to no action, the proposed action, and alternative B. Alternative R includes the second greatest amount of recommended wilderness of all alternatives and the greatest amount of land within the late forest structure MA. The potential benefits of the amount of land within the Late Forest Structure MA is the 1.0 mile per square mile road density desired condition compared to the 2.0 miles per square mile desired condition included in the proposed action.

Although not included in the “scoring,” alternative R maintains the definition for RMAs that is included in the proposed action, extending the amount of lands within RMAs around intermittent streams. Alternative R, compared to the no action alternative, relies more on standards than guidelines to provide management direction and includes standards for the prevention, control and eradication of AIS. The distinction between standards and guidelines is mentioned, as standards may add more clarity and expectations concerning how management actions are to be implemented within RMAs than a guideline may offer.

Old Forest Management and Timber Production

Alternative R uses a fixed reserve management approach to maintain old forest habitats and late forest structure. The reserves are called “late forest structure emphasis areas” and overlay other management areas, guiding the vegetation management emphasis for the area. The desired conditions, standards, and guidelines in the old forest emphasis areas are the same as the proposed action’s plan direction for old forests and direction for goshawk habitat. The key difference between the proposed action and alternative R for late forest structure is that these areas in the proposed action are managed dynamically at the landscape scale, whereas, in alternative R they are managed in a static reserve system.

Old forest emphasis areas emphasize habitat for key watersheds and wildlife species including grizzly bear and goshawk. Road density direction is a desired condition of 1.0 mile per square mile on average. Alternative R allocates about 51 percent of the Forest to late forest structure and about 22 percent of the Forest to general restoration.

Timber harvest is permitted in the late forest structure and General Restoration MAs. On approximately 484,000 of those acres the goal is to provide late forest structure appropriate to the vegetation community. Other than in the approximately 484,000 acres reserved for late forest structure, vegetation management within the Restoration MAs is to emphasize providing the vegetation structure and composition to provide for forest communities that are resilient to disturbances such as wildfire, drought and insect infestations, similar to the proposed action. Many of the subwatersheds on the Forest are functioning at risk for the fire regime indicator in the AEC assessment, and a few are not properly functioning. Vegetation management to restore vegetation to conditions including, late forest structure, that may be more expected under historic and anticipated disturbance regimes may help improve watershed conditions. Vegetation management including timber harvest as outlined for alternative R may be more beneficial toward improving watershed conditions due to the road density desired conditions compared to the proposed action. The potential risks to aquatic resources due to vegetation management projects, especially timber sales would likely be greatest in the general restoration area due to the higher desired conditions for road density and an expected greater amount of active vegetation management than in the late forest structure area.

Motorized Recreation and Access

Alternative R provides one percent of the Forest for summer motorized trail opportunities in a backcountry, unroaded setting and two percent of the Forest for summer non-motorized trail opportunities in a backcountry, unroaded setting. Summer and winter motorized trails may be authorized in administrative and recreation sites and are not authorized on national scenic trails or in research natural areas, recommended wilderness, or wilderness. Seasonal restrictions and closures may apply to areas such as deer and elk winter range. Summer and winter motorized use would be authorized within the Late Forest Structure and General Restoration Management Areas, providing a roaded recreation setting.

The alternative includes 209,000 acres of recommended wilderness (second most of the alternatives). The recommended wilderness allocation combined with the Backcountry MA and current wilderness comprise about 24 percent of the Forest where no motorized recreation is permitted, reducing the risk of accelerated sediment delivery from motorized trails. However, motorized use is still allowed on most of the Forest where some accelerated erosion and potential damage to riparian and aquatic habitat may occur, especially if management is not able to maintain the trail system given the expected increase in use.

Roads are currently allowed on about 80 percent of the Forest and alternative R would continue to allow roads in those areas. Like all other alternatives, new road access would not be allowed in Recommended or designated Wilderness, Backcountry Motorized and Non-Motorized Management Areas, or research natural areas.

Alternative R includes desired condition for road density in the Late Forest Structure and General Restoration MAs. Desired road density in the late forest structure MA is no greater than 1.0 mile per square mile averaged over late forest structure areas within the 5th field watershed. The desired road density in the General Restoration MA is no greater than 2.0 miles per square mile averaged over general restoration areas within the 5th field watershed.

Most subwatersheds on the forest are not properly functioning or functioning at risk for the AEC road density and riparian road density attributes. Implementing alternative R would potentially help improve watershed condition more than the proposed action. The majority of lands within key watersheds are within the late forest structure MA, which includes a desired average road density of 1.0 mile per square mile, or other MAs that restrict road development including backcountry non-motorized, recommended wilderness, and wilderness. The benefits of the alternative to watershed and aquatic resources is extended to the plan area as a whole, compared to the proposed action and no action alternatives, as the late forest structure MA includes about one-half of the Forest. In general, road densities of 1.0 mile per square mile are the upper bounds of what are considered properly functioning watersheds, conducive to providing habitat for strong fish populations. The General Restoration MA with a desired average road density of 2.0 miles per square mile includes only about one-quarter of the Forest. Watersheds with 2.0 miles per square mile are generally considered to be functioning at risk; however, between the two MAs there should be some improvement in watershed conditions and fish habitat if the desired road densities are attained. As with the proposed action and alternative P, the ability of the Forest to attain the desired road densities would depend upon budgets and social acceptance. Achieving the desired road densities is most likely in the key watersheds due to focused restoration.

Recommended Wilderness

Alternative R includes approximately 209,000 of recommended wilderness, second highest amount of all the alternatives, where no new roads or motorized use is allowed. The restriction on motorized use of all kinds provides benefit to watershed conditions and aquatic habitat by reducing the risk of sediment delivery to streams and aquatic habitat due to the use of existing motorized trails, and the construction of new roads or trails.

Riparian and Aquatic Resource Management

Watershed direction in alternative R contains plan components (desired conditions, objectives, and standards and guidelines) for general watershed resources; key watersheds and RMAs. Watershed, aquatic and riparian forest plan direction is designed to maintain and restore the ecological health of watersheds and aquatic and riparian ecosystems on NFS lands.

Watershed direction within alternative R incorporates the desired conditions for watersheds, aquatic and riparian systems that were described in the proposed action; adds clarifying language to several of the desired conditions, and incorporates an additional desired condition regarding TES fish: *National Forest lands contribute to the recovery of Threatened and Endangered fish species and conservation of Regional Foresters sensitive fish species. Aquatic habitat supports spawning, rearing and other key life history requirements*.

Five additional standards were added that apply not only to overall watershed management, but to RMAs as well. These standards include direction to decrease the potential spread of AIS when working in water; including during fire suppression activities, utilizing Early Detection and Rapid Response principles to respond to a potential introduction of an AIS, and an overall standard to minimize the disruption of hydrologic processes due to roads and trails.

The alternative R definition of RMAs and the associated widths are the same as in the proposed action. The management direction for RMAs includes 16 standards and 23 guidelines. Standards may add more clarity and expectations concerning how management actions are to be implemented within RMAs than a guideline.

Table 106. Alternative R– objectives and projected improvements in key watersheds that are active priorities for restoration

Key Watershed Objective 6: Key Watershed Prioritization	Key Watershed Objective 7: Road Treatments		Key Watershed Objective 8: Range Infrastructure Improvements	Key Watershed Objective 9: Riparian Vegetation Structure	Key Watershed Objective 10: Stream Restoration
Management in key watersheds focuses on restoration or preservation of watershed, aquatic, and riparian function and recovery of threatened and endangered species. Improve watershed condition class in key watersheds that are a priority for restoration. Key watersheds that are a priority for restoration include:	Reduce road-hydrologic connectivity and sediment delivery on roads through storm damage risk reduction treatments, full hydrologic decommissioning, and other accepted treatment measures on hydrologically connected road (miles)	Restore or maintain aquatic organism passage at road/stream crossings for all native species, seasons, flows, and life stages through culvert replacement or installation and improvement of hydrologic and aquatic habitat function and resiliency to a range of flows through natural channel design and other acceptable treatment measures (# of crossings)	Improve hydrologic and aquatic function through range infrastructure improvements, including riparian fencing, movement and improvement of watering troughs, and other acceptable treatments(acres)	Move upland vegetation in riparian management areas toward HRV (acres)	Restore hydrologic, geomorphic, and riparian process and function through activities including streambank stabilization, restoration of lateral and vertical hydrologic connectivity, and improvement of stream channel and floodplain function (miles)
East Branch LeClerc Creek	3 miles	1	20	0	10
West Branch LeClerc Creek	3 miles	5	20	0	10
Deadman Creek	5 miles	1	30	75-150	3
Upper Sherman Creek	5 miles	5	0	75-150	2
South Fork Sherman Creek	5 miles	9	0	75-150	4
Barnaby	5 miles	5	30	75-150	4
Harvey Creek	10 miles	2	0	0	4
Tonata Creek	4 miles	4	50	75-150	3
North Fork Deadman Creek	5 miles	1	30	75-150	3
North Fork Sullivan-Sullivan Creek	18 miles	7	0	0	20
Ruby Creek	3 miles	4	30	75-150	3
Treatments in additional key and/or priority watersheds (estimate addition 3 subwatersheds over 15 years)	12 miles	6	30	75-150	10
Total for the life of the plan (essential projects completed for 14 subwatersheds)	**78 miles**	**50 crossings**	**240 acres**	**600-1,200 acres**	**76 miles**

Alternative R includes additional key watersheds than are included in the proposed action. The key watershed network includes 25 subwatersheds covering 451,525 acres. The key watershed network was expanded in alternative R based on updated fish distribution data and improved data on aquatic habitat function since designation of the proposed action key watershed network. Five subwatersheds were added to the key watershed network included in the proposed action and three subwatersheds were removed from the proposed action key watershed network because they had less than 25 percent NFS ownership. The alternative R key watersheds include bull trout critical habitat and expand the key watersheds providing habitat for WSCT and interior redband trout. Alternative R, along with alternatives P and O (discussed in the following sections) provides the greatest potential benefit to the MIS/surrogate and other aquatic species due to the key watershed network.

Table 107. Key watersheds for alternatives R and O

Subwatershed Number	Subwatershed Name	Total Subwatershed Acres	Colville National Forest Ownership Acres	MIS/Surrogate Species/ CH
170102160102	Winchester Creek	10,482	5,628	WSCT, CH
170102160103	Smalle Creek	17,754	11,058	BT, WSCT, CH
170102160201	Exposure Creek-Pend Oreille River	41,224	14,463	BT, WSCT
170102160206	Tacoma Creek	39,519	27,182	BT, WSCT,CH
170102160302	West Branch LeClerc Creek	21,672	15,099	BT, WSCT, CH
170102160303	East Branch LeClerc Creek	26,663	11,145	BT, WSCT, CH
170102160304	Ruby Creek	19,597	18,385	BT, CH
170102160401	Harvey Creek	32,999	27,554	WSCT
170102160402	Headwaters Sullivan Creek	45,516	45,417	BT, WSCT, CH
170102160403	North Fork Sullivan Creek-Sullivan Creek	12,709	11,259	BT, WSCT, CH
170102160702	Headwaters South Salmo River	20,697	12,472	BT, WSCT
170102160902	Sweet Creek-Pend Oreille River	41,832	28,890	WSCT
170102160903	Slate Creek	20,195	19,907	BT, WSCT, CH
170102161003	Cedar Creek	17,209	5,359	BT, WSCT, CH
170200011004	North Fork Deep Creek	49,257	26,634	WSCT
170200011301	South Fork Sherman Creek	22,004	21,899	IRT
170200011302	Upper Sherman Creek	26,381	26,260	IRT
170200011303	Lower Sherman Creek	20,987	15,98	IRT
170200011306	Barnaby Creek	23,108	14,299	IRT
170200011401	Upper Hall Creek	31,648	13,786	IRT
170200021301	Trout Creek	23,435	14,122	IRT
170200021701	Tonata Creek	14,453	13,781	IRT
170200021907	East Deer Creek-Kettle River	23,385	15,443	WSCT
170200022002	North Fork Deadman Creek	13,450	13,185	IRT
170200022003	Deadman Creek	26,518	22,300	IRT
	Total	**642,692**	**451,525**	

The alternative R key watershed direction carries over the key watershed desired conditions in the proposed action with some clarifying language added and includes the proposed action's three key watershed standards. The key watershed objectives are similar to those as described for the proposed action with additional objectives to improve range infrastructure to protect riparian habitat, restore the structure and composition of upland vegetation within RMAs and for stream restoration. Additionally, the objectives identify the amount and type of actions expected within the key watersheds to move watershed and stream channels toward the desired conditions. Over the life of the plan the objectives identify:

- Reducing road-hydrologic connectivity and sediment risk on 78 miles of road.
- Restoring or passage at road/stream crossings for all life stages of native aquatic species and improving the hydrologic and aquatic habitat function at 50 crossings.
- Improving range infrastructure over 240 acres.
- Restoring between 600 to 1,200 acres of upland vegetation conditions within RMAs.
- Restoring 76 miles of stream.

Alternative R includes standards developed specifically for prevention, control, and eradication of AIS. Such plan components provide more clear and urgent direction to implement appropriate AIS management actions, and therefore, may be more protective against AIS becoming established than the proposed action and no action alternatives.

A number of subwatersheds are functioning at risk or not properly functioning for the AEC riparian vegetation attribute. As mentioned in the proposed action discussion, aquatic habitat tends to be of poor quality on the Forest in general and within the DMAs compared to reference streams, but there appears to be slow improvement in aquatic habitat after 20 years of implementing INFISH. The extent to which grazing is or is not contributing to the current habitat conditions is not determined at this time. Alternative R includes three standards and two guidelines for grazing within RMAs. The one guideline in the proposed action for streambank alteration and woody vegetation utilization and stubble height is revised to read:

Within green-line vegetation area adjacent to all watercourses:

- do not exceed a 25 percent streambank alteration;
- do not exceed a 40 percent utilization of available mean annual vegetative production on woody vegetation;
- maintain at least 6 to 8 inches residual stubble height and utilize no more than 40 percent of mean annual vegetative production on deep-rooted herbaceous vegetation.

The rationale for the guideline was presented in the discussion of the grazing guideline in the proposed action. As discussed for the proposed action, the 6- to 8-inch stubble height may be more protective of riparian and aquatic habitat, especially the protection of woody species such as willow (Clary and Leininger 2000, Pelster et al 2004, Bengeyfield 2006) than a guideline for maintaining 4 to 6 inches residual stubble height. The combination of no more than 25 percent bank alteration combined with the 6- to 8-inch stubble height and no more than 40 percent utilization should be allowed for the maintenance and improvement of riparian vegetation conditions, and thus, be protective of streambanks and stream channel conditions. While the allowable 25 percent streambank alteration is greater than the 20 percent allowed in the proposed action, the 8-inch residual stubble height plus the 40 percent utilization limits should be protective of riparian vegetation, and thus, streambanks. The guideline reflects the recommendations of Archer (2014), based on PIBO results, for improve riparian habitat and stream channel conditions while allowing livestock grazing. The bank alteration stubble height and utilization guidelines set a starting point for designing grazing strategies that are potentially more protective of riparian vegetation and stream habitat than the no action and proposed action alternatives.

Cumulative Effects

The information regarding cumulative effects common to all alternatives was discussed in the Past, Present, and Foreseeable Activities Relevant to Cumulative Effects Analysis section. The activities outside the influence of alternative R, such as the aquatic habitat improvement work associated with hydroelectric projects and the transportation system managed by other entities are common for all alternatives. The activities associated with the Northeast Washington Forest Vision 2020 project would now be guided by the alternative R key watershed objectives and restoration direction.

The watershed condition of most subwatersheds and the subbasins as a whole on the Forest are not properly functioning or functioning at risk with the road systems appearing to be a primary driver. Alternative R road density desired conditions in Late Forest Structure and General Restoration MAs are more within the range considered supportive of good watershed conditions and strong fish populations. The desired conditions for roads, plus vegetation management to improve the composition and structure of forests, should help make watersheds and stream channels more resilient to disturbance. It would be less likely for watersheds within the General Restoration MA to become properly functioning for watershed condition due to the desired road density of 2.0 miles per square mile. The realized benefit, however, would depend upon the timeframe the road density desired conditions can be met and the amount of terrestrial management that occurs in any watershed or subwatershed.

Watershed conditions may improve through the implementation of the ACS. The desired conditions; standards and guides; and objectives are designed to provide for and restore watershed riparian and aquatic habitat conditions. The benefits may be greatest where watershed and riparian restoration, especially in key watersheds, is coordinated with vegetation management and road management to attain the desired conditions. The ACS with an increase in the area covered by RMAs, additional standards and guides and a larger key watershed network with specific restoration actions identified than has occurred under INFISH and may be expected under the other alternatives except alternative P.

The status of many MIS/surrogate species' local populations is likely to remain at risk due to the presence of non-native fish, isolation above natural and man-made barriers to migration. Coordinating restoration actions on Forest with the work of other entities, such as work tied to hydroelectric project relicensing, provide the most potential for improving the population status of MIS/surrogate species.

Climate Change

The general description of the potential effects of climate change remains the same as discussed in the Past, Present, and Foreseeable Activities Relevant to Cumulative Effects Analysis section. The increased overall direction of the ACS, including forestwide desired conditions, riparian and key watershed standards and guides; the key watershed network covering approximately 41 percent of the Forest; desired road densities more in the range of what is considered beneficial to aquatic species and watershed function; desired conditions for and management to improve the vegetative structure and composition of Forests; and objectives for improving riparian and watershed conditions may remove human stressors to the environment to provide a better opportunity for aquatic species, including the MIS/surrogate and sensitive species, to adjust to climate change. A particular risk to the MIS/surrogate species would remain the presence of non-native fish, low MIS/surrogate species population numbers and isolated and fragmented populations. In addition to the Colville National Forest actions described above, the actions associated with hydroelectric project re-licensing including, the non-native fish population suppression or eradication, habitat improvement and improved passage at the hydroelectric project dams may be key factors in conserving the MIS/surrogate species.

Monitoring Recommendations

The monitoring program was previously described in the Summary of Effects Common for all Alternatives section.

Alternative P

Similar to the proposed action, alternative P includes a whole landscape approach to providing late forest structure, including about 6 percent of the Forest as recommended wilderness, and includes the Focused and General Restoration MAs. Desired road densities for the Focused and General Restoration MAs are the same as for alternative R, although how the road densities would be calculated is slightly different. Alternative P also proposes to allocate about 12 percent of the Forest to backcountry non-motorized recreation versus about 8 percent in the proposed action.

Table 108. Alternative P management area acres by subbasin pertinent to aquatics discussion

Management Area	Colville	Franklin D. Roosevelt Lake	Kettle	Pend Oreille	Sanpoil	Total
Focused Restoration	3	61,397	58,742	192,379	3	312,500
General Restoration	101,801	69,128	159,056	93,737	65,193	489,200
Backcountry	5,338	20,770	44,425	34,032	24,534	129,100
Backcountry Motorized	1,357	11,893	36,071	5,255	0	54,600
Wilderness Recommended	0	22,311	0	36,847	2,512	61,700
Wilderness-Congressionally Designated	0	0	0	31,400	0	31,400

*Acres are approximate and may vary slightly in other resource sections due to GIS methodology

The definition of RMAs, plan components for watersheds, and RMAs are the same as alternative R. Alternative P includes one additional key watershed, Cee Cee Ah, that is not included in alternative R.

Old Forest Management and Timber Production

Key Indicator – The number of acres that have focused restoration (or late forest structure), general restoration, and a timber production emphasis.

- Focused Restoration – 312,500 acres
- General Restoration – 489,200 acres

Alternative P implements a landscape approach to managing forest structures by using active management to improve adaptability and resilience and move the landscape toward HRV. The main difference between the proposed action and alternative P is the number of acres recommended for wilderness. The landscape approach to forest structure management proposed in this alternative and the proposed action alternative allows active management across larger areas than other alternatives. This, in turn, allows structure to be better managed because there is no reliance on fixed reserves, which may or may not contain desired structure classes. All future actions that affect forest vegetation would be assessed and compared to HRV, with the goal of moving the overall landscape toward HRV. Restoring forest structure would result in also moving species composition, process, and spatial pattern toward more resilient conditions. Alternative P allocates more land to the General Restoration MA (about 489,200 acres; 44 percent of the Forest) than the Focused Restoration MA (about 312,500 acres; 28 percent of the Forest). Timber harvest is allowed in both restoration MAs. The objective for vegetation management, including timber harvest, is to improve the resiliency of forests to disturbance. Many subwatersheds on the Forest are considered to be functioning at risk for the fire regime attribute of the AEC, so vegetation management within the restoration areas may help improve watershed condition. The risks to watershed processes and aquatic habitat associated with vegetation management is probably greater in the General Restoration MA, as the Focused Restoration MA includes more management emphasis for wildlife habitat and key watersheds.

Motorized Recreation Trails and Access

Key Indicator – Desired conditions for road densities

- Focused restoration – 1.0 mile per square mile. Road densities vary across the management area; however, there are no more than 1 mile of NFS road per square mile within the focused restoration management area within each subwatershed. Total road density is calculated as miles of open and closed NFS road per square mile of NFS lands. This road density calculation does not include roads under another jurisdiction, or roads that have been hydrologically stabilized and effectively closed to vehicular traffic, or decommissioned.
- General restoration – 2.0 miles per square mile. Road densities vary across the management area; however, there are no more than 2 miles of NFS road per square mile within the General Restoration Management Area within each subwatershed. Total road density is calculated as miles of open and closed NFS road per square mile of NFS lands. This road density calculation does not include roads under another jurisdiction, or roads that have been hydrologically stabilized and effectively closed to vehicular traffic, or decommissioned.

Most subwatersheds on the Forest are not properly functioning or functioning at risk for the road and riparian road density attributes of the AEC. Alternative P, with desired road densities of 1.0 mile per square mile in the Focused Restoration MA and 2.0 miles per square mile in the General Restoration MA may result in improved watershed conditions compared to the no action alternative, alternative B and alternative O; but the potential improvement is less than alternative R due to more lands within the General Restoration MA. One difference in the road density desired conditions between alternatives R and P is the way road densities are calculated. In alternative P, the road density calculation is at the subwatershed scale, as opposed to the watershed scale. The major expected difference is actual changes to road densities due to project implementation should be better reflected at the subwatershed scale. New roads cannot be constructed in Recommended Wilderness, Backcountry Motorized or Backcountry Non-Motorized MAs.

Key indicator – Acres allocated to motorized use

Motorized recreation is allowed on approximately 856,297 acres in the restoration MAs and Backcountry Motorized MA which is about 78 percent of the Forest.

Recommended Wilderness Areas

Key Indicator – Total acres in recommended wilderness

Alternative P only proposes to allocate 61,700 acres or about 6 percent of the Forest to recommended wilderness. Therefore, the protection afforded to watershed condition and aquatic habitat is less than the recommended wilderness in the proposed action (9 percent of the Forest), alternative R (19 percent), and alternative B (about 20 percent of the Forest). Alternative P does recommend more recommended wilderness than no action and alternative O.

Riparian and Aquatic Resource Management

Key Indicator – Key watershed acres, management direction for key watersheds, MIS/surrogate species, key watershed and restoration objectives

The alternative P aquatic conservation strategy incorporates the ARCS strategy that was described for alternative R plus additional plan components based upon the ARCS 2016 (USDA Forest Service 2016a) and is referred to as the Colville ARCS. The Colville ARCS also includes additional direction for watershed analysis that is not contained in alternative R. As such, the direction for watershed, riparian, and aquatic management is expected to be more comprehensive and protective than alternative R (see appendix H of the FEIS for the final Colville ARCS).

Key Indicator – Change in the distribution of aquatic invasive species (AIS)

In addition to standards developed specifically for prevention, control, and eradication of AIS, alternative P include two specific objectives for controlling AIS and non-native aquatic species. The specific objectives would provide even more direction to control undesired non-native species than in alternative R. Therefore, alternative P may provide the greatest protection against AIS than any other alternative.

Key Indicator – Improvement in riparian conditions within grazing allotments.

Management direction for grazing within RMAs is similar to that in alternative R except utilization, stubble height and bank alteration as well as woody browse utilization is governed by the ecological status of the RMA within a pasture. Alternative P includes an additional standard to manage livestock grazing to attain aquatic and riparian desired conditions. The grazing management direction is likely as protective of riparian habitat as alternative R, but may provide more flexibility toward meeting desired conditions than provided in alternative R.

Forest Service Contribution to MIS/Surrogate Species Viability

Alternatives R and P are similar in their respective contributions to MIS/surrogate species viability. Alternative R may provide a slightly greater contribution to the viability of WSCT and interior redband in the Lake Roosevelt, Kettle, and Colville subbasins. Alternatives P and R provide similar contributions to the viability of bull trout and WSCT in the Pend Oreille subbasin and WSCT and Redband in the Sanpoil subbasin.

Although alternative P includes the alternative R key watershed network with one additional key watershed added, Cee Cee Ah, alternative P includes more lands within the General Restoration MA and the associated desired road density of 2.0 miles per square mile.

Effects – Alternative P

Old Forest Management and Timber Production

Alternative P uses the whole landscape approach to provide late forest structure. Like the proposed action and alternative R, the roaded portion of the Forest is divided into two vegetation restoration areas, the Focused Restoration 312,500 acres (about 28 percent of the Forest) and General Restoration 489,200 acres (about 44 percent of the Forest) MAs. The major difference between the two restoration MAs are the desired road densities and the Focused Restoration MA also emphasizes habitat for key watersheds, and wildlife species. Timber harvest is allowed in both restoration MAs.

Similar to the proposed action, timber harvest is allowed on about 72 percent of the Forest in the Focused and General Restoration MAs. These areas are to be managed to provide the vegetation structure and composition, including late forest structure, for forest communities that are resilient to disturbances such as wildfire, drought and insect infestations. Many of the subwatersheds on the Forest are functioning at risk for the fire regime indicator in the AEC assessment, and a few are not properly functioning. As with alternative R, vegetation management to restore vegetation to conditions as may be expected under historic and anticipated disturbance regimes, may improve watershed condition, especially in the Focused Restoration MAs if the desired road densities are attained.

Watersheds in the General Restoration MA may not become fully functioning due to the desired road densities, although there may be some improvement from the current conditions, as the road densities in not properly functioning watersheds are reduced toward the desired levels The potential risks to aquatic resources due to vegetation management projects, especially timber sales, would likely be greatest in the General Restoration MA due to the higher desired conditions for road density and a likely higher level of vegetation management than in the focused restoration area. Management direction for RMAs should minimize the potential adverse impacts to riparian-dependent resources due to timber sales. Vegetation management including timber harvest as outlined for alternative P may be more beneficial toward improving watershed conditions due to the road density desired conditions compared to the proposed action, but less so than alternative R. As with alternative R and the proposed action, achieving the desired road densities is most likely in the key watersheds due to focused restoration, and would depend upon budgets and social acceptance.

Motorized Recreation Trails and Access

Similar to all other alternatives, new roads are not allowed in Recommended Wilderness, Backcountry Motorized, or Backcountry Non-Motorized MAs, or research natural areas. The desired road density in Focused Restoration MA is no greater than 1.0 mile per square mile and in the General Restoration MA no greater than 2.0 miles per square mile. About 5 percent of the Forest is allocated for backcountry motorized recreation.

Similar to alternative R, watershed conditions and the AEC for the MIS/surrogate species may improve as the desired road densities are attained, but watersheds in the General Restoration MA would likely remain functioning at risk even if the desired road densities are attained. Alternative P allocates the second most amount of area to backcountry recreation. The recommended wilderness, current wilderness, and backcountry recreation areas combine to comprise 20 percent of the Forest where roads are not allowed. However, motorized use is still allowed over most of the Forest where some accelerated erosion and potential damage to riparian and aquatic habitat may occur, especially if management is not able to maintain the trail system, given the expected increase in use.

Recommended Wilderness

Alternative P proposes to add 61,700 acres or about 6 percent of the Forest. Therefore, the protection afforded to watershed condition and aquatic habitat is less than the recommended wilderness in the proposed action (9 percent of the Forest), alternative R (19 percent), and alternative B (about 20 percent of the Forest). Alternative P does recommend more recommended wilderness than no action and alternative O. Existing uses that are usually inconsistent with wilderness designation, specifically the use of chainsaws for maintenance of existing trails and existing levels of mountain bike use, would continue in recommended wilderness until Congress designates wilderness. However, the recommended wilderness would be monitored to ensure that these inconsistent uses do not increase.

Riparian and Aquatic Resource Management

The alternative P aquatic conservation strategy incorporates the strategy that was described for alternative R with some re-wording of the alternative R plan components to add clarity, and with additional desired conditions, standards, and guidelines based on the ARCS 2016. Alternative P also includes more restoration objectives than were included in alternative R. The key watershed network is the same as alternative R except the Cee Cee Ah subwatershed is added. The additional plan components included in alternative P should provide additional benefit to watershed conditions, riparian and aquatic habitats than described for alternative R.

Alternative P includes two additional desired conditions for forestwide water resources than was included in alternative R:

- *FW-DC-WR-10. Water Production for Downstream Uses*. NFS lands produce high-quality water for downstream ecological communities (including human communities) dependent upon them. Watershed scale is used for both Forest and project planning
- *FW-DC-WR-14. Resiliency to Climate Change*. Aquatic and riparian ecosystems are resilient to the effects of climate change and other major disturbances. Subbasin scale is used for Forest planning and 5th field watershed scale is used for project planning.

Desired condition, FW-DC-WR-04 expands upon the same desired condition in alternative R by stating: "National Forest System lands provide aquatic habitats in which the distribution of conditions (e.g., bank stability, substrate size, pool depths and frequencies, channel morphology, large woody debris size and frequency) in the population of watersheds on the Forest is similar to the distribution of conditions in the population of similar, reference condition watersheds. Reference conditions can be drawn from the Forest or Provincial scales." The new language clarifies how progress toward attaining the desired condition is to be assessed.

Alternative P includes two forestwide standards and one guideline not included in alternative R. They provide additional management direction and expectations for projects implemented over the life of the revised forest plan. The additional forestwide standards and guidelines are:

- *FW-STD-WR-01. Properly Functioning Watersheds* - When aquatic and riparian desired conditions are being achieved and watersheds are functioning properly, projects shall maintain those conditions. When aquatic and riparian desired conditions are not yet achieved or watersheds have impaired function or are functioning-at-risk and to the degree that project activities would contribute to those conditions, projects shall restore or not retard attainment of desired conditions. Short-term adverse effects from project activities may be acceptable when they support long-term recovery of aquatic and riparian desired conditions. Exceptions to this standard include situations where Forest Service authorities are limited. In those cases, project effects toward attainment of desired conditions shall be minimized and not retard attainment of desired conditions to the extent possible within Forest Service authorities.
- *FW-STD-WR-02. Best Management Practices* - All projects shall be implemented in accordance with best management practices, as described in national and regional technical guides.
- Alternative R guideline *FW-GDL-WR-02* is now *FW-STD-WR-04. Aquatic Invasive Species – Aquatic Resource Sampling* - Aquatic sampling equipment should be disinfected prior to use in new stream or lake locations.
- *FW-GDL-WR-05* - Chemical Fire Suppression has been added stating whenever practical, as determined by the fire incident commander, use water or other less toxic wildland fire chemical suppressants for direct attack or less toxic approved fire retardants in areas occupied by riparian and aquatic-dependent threatened, endangered, proposed, candidate, or sensitive species, or their habitats.

The definition of RMAs in alternative P is the same as alternative R and the proposed action. Alternative P includes two additional desired conditions that are not included in alternative R. The two additional desired conditions further clarify the Forest's desired expectations for the condition of riparian and aquatic habitat, similar as described above for FW-DC-WR-10 and FW-DC-WR-14.

The 25 standards and 21 guidelines (versus 16 standards and 23 guidelines in alternative R), including four new standards for minerals management, provide additional management direction. One key revision to the alternative P standards for RMAs to further clarify how management actions within RMAs are to be implemented is MA-STD-RMA-01. Aquatic and Riparian Conditions, which now states:

> *Riparian Management Areas include portions of watersheds where aquatic and riparian-dependent resources receive primary management emphasis. When RMAs are properly functioning and aquatic and riparian desired conditions are being achieved, projects shall maintain those conditions. When RMAs have impaired function or are functioning-at-risk or if aquatic and riparian desired conditions are not yet being achieved and to the degree that project activities would contribute to those conditions, projects or permitted activities shall restore or not retard attainment of desired conditions. Short-term adverse effects from project activities may be acceptable when they support long-term recovery of aquatic and riparian desired conditions. Exceptions to this standard include situations where Forest Service authorities are limited. In those cases, project effects toward attainment of RMA desired conditions shall be minimized and not retard attainment of desired conditions to the extent possible within Forest Service authorities.*

Table 109. Alternative P – Objectives and projected improvements in key watersheds that are active priorities for restoration

Key Watershed Prioritization	Road Treatments		Range Infrastructure Improvement (acres)	Riparian Vegetation Structure Improvement (acres)	Stream Restoration (miles)
	Road Improvements (miles)*	Aquatic Organism Passage Improvement (# of crossings)			
West Branch LeClerc Creek	3	5	20	0	10
East Branch LeClerc Creek	3	1	20	0	10
Deadman Creek	5	1	30	75-150	3
Upper Sherman Creek	5	5	0	75-150	2
South Fork Sherman Creek	5	9	0	75-150	4
Barnaby Creek	5	5	30	75-150	4
Harvey Creek	15	4	0	75-150	8
Tonata Creek	4	4	50	75-150	3
North Fork Deadman Creek	5	1	30	75-150	3
North Fork Sullivan Creek	1	2	0	0	1
Sullivan Creek	15	6	0	75-150	20
Ruby Creek	20	4	30	75-150	3

Key Watershed Prioritization	Road Treatments		Range Infrastructure Improvement (acres)	Riparian Vegetation Structure Improvement (acres)	Stream Restoration (miles)
	Road Improvements (miles)*	Aquatic Organism Passage Improvement (# of crossings)			
Treatments in additional key and/or priority watersheds (estimate addition 3 subwatersheds over 15 years)	30	6	30	75-150	10
Total for the life of the plan (essential)	**116 miles**	**53 crossings**	**240 acres**	**600-1,500 acres**	**81 miles**

The alternative P key watershed network is the same as for alternative R except the Cee Cee Ah (HUC 170102160404) subwatershed is added. The subwatershed includes 6,500 acres within the Forest boundary, primarily benefiting WSCT.

Alternative R includes FW-STD-WR-03. Road Construction and Decommissioning in Key Watersheds, which states there shall be no net increase (i.e., for each mile of new road constructed, at least one mile of road must be decommissioned) at any time in the mileage of NFS roads in any key watershed unless doing so results in a reduction in road-related risk to watershed condition. This standard is replaced in alternative P with FW-STD-WR-06. In key watersheds and in subwatersheds with ESA critical habitat for aquatic species that are functioning properly with respect to roads, there would be no net increase (at least one mile of road-related risk reduction for every new mile of road construction) in system roads that affect hydrologic function. In key watersheds and in subwatersheds with ESA critical habitat for aquatic species that are functioning-at-risk or have impaired function with respect to roads, there would be a net decrease (for every mile of road construction there would be greater than one mile of road-related risk reduction) in system roads that affect hydrologic function to move toward proper function. Treatment priority shall be given to roads that pose the greatest relative ecological risks to riparian and aquatic ecosystems. Road-related risk reduction would occur prior to new road construction unless logistical restrictions require post-construction risk reduction. The standard makes it clearer that the management intent is to improve, not just maintain, conditions in key watersheds, especially those with bull trout critical habitat.

Table 110. Alternative P key watersheds

Subwatershed Number	Subwatershed Name	Total Subwatershed Acres	Colville NF Ownership Acres	MIS/Surrogate Species/ CH
170102160102	Winchester Creek	10,482	5,628	WSCT, CH
170102160103	Smalle Creek	17,754	11,058	BT, WSCT, CH
170102160201	Exposure Creek-Pend Oreille River	41,224	14,463	BT, WSCT
170102160206	Tacoma Creek	39,519	27,182	BT, WSCT,CH
170102160302	West Branch LeClerc Creek	21,672	15,099	BT, WSCT, CH
170102160303	East Branch LeClerc Creek	26,663	11,145	BT, WSCT, CH
170102160304	Ruby Creek	19,597	18,385	BT, CH
170102160401	Harvey Creek	32,999	27,554	WSCT

Subwatershed Number	Subwatershed Name	Total Subwatershed Acres	Colville NF Ownership Acres	MIS/Surrogate Species/ CH
170102160402	Headwaters Sullivan Creek	45,516	45,417	BT, WSCT, CH
170102160403	North Fork Sullivan Creek-Sullivan Creek	12,709	11,259	BT, WSCT, CH
170102160404	Cee Cee Ah Creek	12,063	6,500	WSCT
170102160702	Headwaters South Salmo River	20,697	12,472	BT, WSCT
170102160902	Sweet Creek-Pend Oreille River	41,832	28,890	WSCT
170102160903	Slate Creek	20,195	19,907	BT, WSCT, CH
170102161003	Cedar Creek	17,209	5,359	BT, WSCT, CH
170200011004	North Fork Deep Creek	49,257	26,634	WSCT
170200011301	South Fork Sherman Creek	22,004	21,899	IRT
170200011302	Upper Sherman Creek	26,381	26,260	IRT
170200011303	Lower Sherman Creek	20,987	15,998	IRT
170200011306	Barnaby Creek	23,108	14,299	IRT
170200011401	Upper Hall Creek	31,648	13,786	IRT
170200021301	Trout Creek	23,435	14,122	IRT
170200021701	Tonata Creek	14,453	13,781	IRT
170200021907	East Deer Creek-Kettle River	23,385	15,443	WSCT
170200022002	North Fork Deadman Creek	13,450	13,185	IRT
170200022003	Deadman Creek	26,518	22,300	IRT
	Total	**654,755**	**457,886**	

WSCT=Westslope Cutthroat Trout, IRT=Interior redband, BT=Bull Trout, CH=Bull Trout Critical Habitat

Alternative P includes more restoration objectives than any of the other alternatives considered in detail. The objectives for improving conditions in key watersheds are increased compared to alternative R.

- *FW-OBJ-WR-05. Key Watershed Restoration Prioritization* - Management in key watersheds focuses on restoration or preservation of watershed, aquatic, and riparian function and recovery of threatened and endangered species. Improve watershed condition class in key watersheds that are a priority for restoration within 15 years of forest plan implementation. Key watersheds that are a priority for restoration include:
    - ♦ East Branch LeClerc Creek, West Branch LeClerc Creek, Deadman Creek, Barnaby Creek, Harvey Creek, North Fork Deadman Creek, North Fork Sullivan Creek, Sullivan Creek, Ruby Creek, Tonata Creek, Upper Sherman Creek, and South Fork Sherman Creek subwatersheds. Additional key watersheds that are a priority for restoration would be identified, as appropriate, through the life of the plan, through the WCF process.
- *FW-OBJ-WR-06* seeks to reduce road-hydrologic connectivity and sediment risk on 116 miles of road, versus 78 miles in alternative R, and restore aquatic organism passage and improve hydrologic and aquatic habitat function at road/stream crossings for all life stages of native aquatic species at 53 crossings versus 50 crossings in alternative R.
- *FW-OBJ-WR-07* would improve range infrastructure over 240 acres (the same as alternative R).

- *FW-OBJ-WR-08* would improve 1,500 acres of upland vegetation conditions within RMAs. The objective for alternative R would improve 1,200 acres.
- *FW-OBJ-WR-09* would restore hydrologic, geomorphic and riparian process and function on 81 miles of stream within key watersheds versus 76 miles of stream in alternative R.

The objectives for improving conditions within RMAs are also increased compared to alternative R.

- *MA-OBJ-RMA-01* would restore riparian processes and balance the need for occupancy and access to water at 75 dispersed and developed recreation sites over the next 15 years; compared to 50 sites in alternative R.
- *MA-OBJ-RMA-02* would restore hydrologic and riparian habitat function within RMAs in non-key watersheds by reducing road-related impacts on 80 miles of road within 15 years; compared to 30 miles in alternative R.
- *MA-OBJ-RMA-03* would move upland vegetation within RMAs outside key watersheds toward the historical range of variability on 500 acres within 15 years; which is the same as alternative R.

Forestwide objectives for general watershed restoration, fish habitat improvement and watershed restoration in focus and priority watersheds are the same as alternative R.

Similar to alternative R, alternative P includes standards for the prevention, control, and eradication of AIS and non-native species. Alternative P also includes objectives to treat and reduce the potential impacts of AIS:

- *FW-OBJ-WR-01. Aquatic Invasive Species* - Within the next 15 years, implement aquatic invasive species prevention measures at all developed recreation sites providing direct and/or indirect access to water bodies, such as boat ramps, campgrounds, and day use areas that provide portal zones for hand carried watercraft. Implement aquatic invasive species prevention measures as part of all aquatic survey and inventory procedures and other management activities that pose high potential for invasion vectors to occur.
- *FW-OBJ-WR-02. Aquatic Invasive and Non-Native Species* – Within the next 15 years, implement aquatic invasive species control and eradication at 15 waterbodies (streams and lakes) (versus 10 sites in alternative R) where such invasions have become established and prevent attainment of listed fish recovery plan goals and/or effects to social, economic, and ecological systems are determined to be unacceptable.

By providing not only standards for the prevention, control, and eradication of AIS and non-native species, the specific objectives for controlling such species make alternative P the most aggressive of the alternatives to control the threats of such species to riparian and aquatic habitat and the MIS/Surrogate species.

A number of subwatersheds are functioning at risk or not properly functioning for the AEC Riparian Vegetation attribute. As mentioned in the proposed action discussion, aquatic habitat across the Forest and within DMAs tends to be of poor quality on the Colville National Forest compared to reference streams, but there appears to be slow improvement in aquatic habitat after 20 years of implementing INFISH. The extent to which grazing is or is not contributing to the current habitat conditions is not determined at this time. Alternative P includes standards and guidelines for grazing within RMAs similar to those in alternative R with two significant changes. MA-STD-RMA-09 established that livestock grazing is to be managed to move toward aquatic and riparian desired conditions. The other significant change is alternative R guideline MA-GDL-RMA-09 is replaced with guideline MA-GDL-RMA-11. The guideline in alternative R includes specific values for streambank alteration, utilization of woody vegetation, stubble height, and utilization of deep-rooted herbaceous vegetation. The alternative P guideline was originally developed based on the 2016 ARCS (USDA Forest Service 2016a) and the rationale for the guideline is included in Regional ARCS Guideline for Annual Livestock Use and Disturbance Indicators (GM-3) (USDA Forest Service 2017b). The guideline is based upon discussions between Regional Office and Colville National Forest watershed, fisheries and grazing specialists, and integrates the current science with their management experience.

The suggested values in MA-GDL-RMA-11 for stubble height, bank alteration, and utilization are based more upon the ecological condition of an RMA within a pasture. As such, the grazing direction in alternative P, when used in total with the forestwide water resources standards and guidelines and RMA standards and guidelines, is felt to be at least as protective of aquatic and riparian resources as the direction in alternative R, while allowing more flexibility in developing grazing management strategies based upon the conditions present at a site.

Alternative P includes more specific direction for watershed analysis than the other alternatives. Watershed analysis is an essential component of alternative P. Similar to the watershed analysis discussion for the proposed action, watershed analysis is described as an interdisciplinary analysis of status and trends of watershed and aquatic ecosystem conditions, key State-designated beneficial uses of water (e.g., municipal water supply) and the hydrologic, geomorphic, and biological processes that strongly influence them. Watershed analysis provides consistent mid-scale information that serves as the foundation for plan implementation through the development of strategic and integrated programs and projects that protect and restore aquatic resources, while enabling informed and sustainable resource management.

Watershed analysis is intended to guide plan implementation by providing decision-makers and others (1) information to identify activities that would maintain watershed and aquatic and riparian ecological conditions or move them toward desired conditions; and (2) the context for developing projects and evaluating their consistency, via the NEPA process, with plan direction (i.e., desired conditions, objectives, standards, and guidelines associated with watershed and aquatic resources).

Generally, watershed analysis should be conducted or updated prior to developing and implementing Watershed Restoration Action Plans as well as prior to:

- proposing changes to RMA widths,
- timber salvage or construction of facilities in RMAS,
- construction of permanent system roads in RMAs.

Unlike any other alternative, alternative P includes one objective specific to watershed analysis, FW-OBJ-WR-11 Watershed Analysis, which states: Within 15 years of plan implementation complete or update watershed analyses for 5 subwatersheds. Criteria for selecting subwatersheds for watershed analysis include: Key Watersheds, Priority Watersheds, watersheds that support designated critical habitat, or support listed species, and watersheds where management activities are likely to occur that may affect aquatic resources (due to their inherent nature, location, timing, or scale).

Cumulative Effects

The information regarding cumulative effects common to all alternatives was discussed in the Past, Present, and Foreseeable Activities Relevant to Cumulative Effects Analysis section. The activities outside the influence of alternative P, such as the aquatic habitat improvement work associated with hydroelectric projects and the transportation system managed by other entities, are common for all alternatives. The activities associated with the Northeast Washington Forest Vision 2020 project would now be guided by the alternative P restoration direction.

The watershed condition of most subwatersheds and the subbasins as a whole on the Forest are not properly functioning or functioning at risk with the road systems appearing to be a primary driver. A number of subwatersheds are also functioning at risk or not properly functioning for the fire regime and insect indicators of the AEC. The alternative P road density desired conditions in focused restoration areas covering about 28 percent of the Forest are more within the range considered supportive of good watershed conditions and strong fish populations. The desired conditions for roads plus vegetation management to improve the composition and structure of forests in the Focus Restoration MAs may help make watersheds more resilient to disturbance and reduce the adverse impacts to aquatic habitat. The realized benefit, however, would depend upon the timeframe the road density desired conditions can be met and the amount of terrestrial management that occurs in any watershed or subwatershed. It would be less likely for watersheds within the General Restoration MA to become properly functioning for watershed condition due to the desired road density of 2.0 miles per square mile.

Watershed conditions may improve through implementation of the ACS. The desired conditions, standards and guidelines, and objectives are designed to provide for and restore watershed riparian and aquatic habitat conditions. The benefits may be greatest where watershed and riparian restoration, especially in key watersheds, is coordinated with vegetation management and road management to attain the desired conditions. The ACS with an increase in the area covered by RMAs, additional standards and guidelines and a larger key watershed network, with restoration objectives, than the no action or proposed action alternatives may be expected to improve aquatic habitat at a faster rate than has occurred under INFISH. Alternative P also includes additional desired conditions, standards, guidelines, and objectives for restoration than alternative R.

Many populations of the MIS/surrogate species are likely to remain at risk due to the presence of non-native fish, isolation above barriers, and other barriers to migration. Coordinating restoration actions on Forest with the work of other entities, such as work tied to hydroelectric project relicensing, provide the most potential for improving the population status of MIS/surrogate species.

Climate Change

The general description of the potential effects of climate change remain the same as discussed for the Past, Present, and Foreseeable Activities Relevant to Cumulative Effects Analysis. The increased overall direction of the ACS including forestwide desired conditions, riparian and key watershed standards and guides; the key watershed network covering over 41 percent of the Forest; the Focus Restoration MA with desired road densities more in the range of what is considered beneficial to aquatic species and watershed function; desired conditions for and management to improve the vegetative structure and composition of Forests; and objectives for improving riparian and watershed conditions, may remove some human stressors to the environment to provide a better opportunity for aquatic species to adjust to climate change, especially if actions are concentrated in key watersheds. A particular risk to the MIS/surrogate species would remain the presence of non-native fish, low MIS/surrogate species population numbers, and isolated and fragmented populations. In addition to the Colville National Forest actions described above, the non-native fish population suppression or eradication, habitat improvement and improved passage at the hydroelectric project dams may be key factors in conserving the MIS/surrogate species.

Monitoring Recommendations

The monitoring requirements are common for all alternatives.

Alternative B

Two MAs focus on forest vegetation: the Restoration MA, which emphasizes old forests or late forest structure on 31 percent of the landscape; and the Active Management MA, which emphasizes timber production on 44 percent of the Forest. The Restoration and the Active Management MAs are similar to Focused or General Restoration MAs in the proposed action and other alternatives. Active management to restore late forest structure is limited to only dry plant association groups. Also, unlike the proposed action, in alternatives R and P, the Active Management MA emphasizes even-aged management for timber production.

Table 111. Alternative B management area acres by subbasin pertinent to aquatics discussion

Management Area	Colville	Franklin D. Roosevelt Lake	Kettle	Pend Oreille	Sanpoil	Total
Restoration	17,301	59,902	103,416	140,786	17,123	338,500
Active Management	84,491	76,902	116,645	152,619	48,200	479,200
Backcountry	0	0	0	4,835	0	4,800
Backcountry Motorized	1,357	0	0	5,249	0	6,600
Wilderness Recommended	5,356	49,640	78,278	59,275	27,761	220,300
Wilderness-Congressionally Designated	0	0	0	31,400	0	31,400

*Acres are approximate and may vary slightly in other resource sections due to GIS methodology

Old Forest Management and Timber Production

Key Indicator – The number of acres that have a focused restoration (or late forest structure), general restoration, timber production emphasis.

- The Restoration MA (focused restoration) includes 338,500 acres
- The Active Management MA (general restoration) includes 479,200 acres. Even-aged management for timber production is allowed.

Timber harvest is allowed in both the Restoration and Active Management MAs.

Vegetation management within the Restoration MA emphasizes enhancing the ecological integrity and ecosystem function by restoring late forest structure, natural processes, and the resiliency of forests. Within the Active Management MA, the focus is to provide a stable flow of forests products to the local economy, maintain the infrastructure necessary to provide forest products while increasing the Forest’s resilience to insects, disease, and uncharacteristic fire. Alternative B allocates less land to a focused restoration type of management than alternative R, but more than is allocated in the proposed action; and similar amount as in alternatives P and O. Unlike the proposed action and alternatives R and P, the emphasis on timber production in the Active Management MA increases the risk to watershed processes and aquatic habitat compared to vegetation management in the proposed action and alternatives R and P and the Restoration MA of this alternative. Any potential benefit to watershed conditions that may be accrued by managing for more resilient forests is likely to be diminished as the current level of 4,000 road miles is to be retained across the Forest.

Motorized Recreation Trails and Access

Key Indicator – Desired conditions for road densities.

There are no road density desired conditions that would potentially improve watershed conditions. There may be some reduction in road densities within the Restoration MA, but access would be maintained within the Active Management MA to facilitate the flow of forest products. Overall, the current level of 4,000 road miles on the Forest is to be maintained, and therefore, watershed conditions are not expected to be greatly improved.

Key Indicator – Acres allocated to motorized access.

Alternative B allocates the least amount of lands to Backcountry Motorized and Backcountry MAs. Motorized access including motorized trails is allowed on 824,300 acres in the Active Management, Restoration, and Backcountry Motorized MAs, approximately 75 percent of the landscape.

Recommended Wilderness Areas

Key Indicator – Total acres in recommended wilderness.

Alternative B recommends 220,300 acres as proposed wilderness, more than any other alternative.

Riparian Aquatic and Resource Management

Alternative B continues current riparian and aquatic management under INFISH. The RMA widths do not provide extra consideration to intermittent streams as in the other alternatives. As in the proposed action, the priority watersheds are only located in the Pend Oreille subbasin benefiting bull trout, a few WSCT populations, and no interior redband trout populations. Stream habitat on the Forest may be slowly improving in the 20 years INFISH has been implemented, but most subwatersheds and aquatic habitat condition is still considered impaired. The trends in watershed condition and stream habitat are expected to be similar as would be expected under the no action alternative.

Forest Service Contribution to MIS/Surrogate Species Viability

Implementation of alternative B is expected to contribute the least to MIS/surrogate species viability compared to all alternatives except the no action alternative (table 98 in the no action alternative). The relatively low contribution is due to maintaining the current amount of road mileage on the Forest, a significant amount of the Forest in the Active Management MA and the relatively small number of key watersheds. Alternative B also maintains the INFISH ACS, which after 20 years is showing some slow improvement in stream habitat, but most subwatersheds and stream habitat is, and may be expected to continue to be, in a functioning at risk or not properly functioning state with watershed conditions not generally considered conducive for strong fish populations.

Effects – Alternative B

Old Forest Management and Timber Production

Alternative B includes two MAs that emphasize vegetation management, the Restoration MA and the Active Management MA. Both MAs allow use of timber harvest, prescribed fire, and thinning of stands to meet vegetation management objectives. Vegetation management in the 338,500-acre Restoration MA emphasizes enhancing ecological integrity by restoring late forest structure and natural processes and resiliency of the terrestrial vegetation landscape. Standards limit management for late forest structure objectives to dry plant associations only, as forests in these plant associations are likely to be highly departed from historical conditions due to past management and fire suppression, although moist mixed conifer forests may require some restoration as well.

The Active Management MA includes 44 percent of the Forest. The emphasis in this MA is to provide a stable flow of forest products to the local economy and sustain forest products infrastructure, while increasing the Forest's resilience to insects, disease, and uncharacteristic fire. Even-aged management is allowed subject to guidelines for timber production. The risks to watershed, riparian, and aquatic resources due to vegetation management are expected to be greater in the Active Management MA compared to the Restoration MA, due to the greater emphasis on timber production.

The fire regime and insect indicators of the AEC are functioning at risk or not properly functioning in most subwatersheds on the Forest. Vegetation management to improve the resiliency of forests to disturbance, such as uncharacteristically severe wildfire, may help improve the fire regime and insect and disease attributes of watershed condition especially in the Restoration MA. However, overall watershed conditions are unlikely to improve in the either the Restoration or Responsible MAs as any benefit accrued by improving the Forest's resiliency to disturbance would be off-set by maintaining the transportation system at current levels.

Motorized Trails and Access

Alternative B provides the least amount of summer and winter motorized and non-motorized recreation opportunities in a backcountry, unroaded setting, with less than 1 percent of the Forest allocated to backcountry motorized trail recreation.

Motorized recreation is allowed on about 75 percent of the Forest. Like all other alternatives, new road access would not be allowed in Recommended or designated Wilderness, Backcountry Motorized (trail access only) and non-motorized Management Areas, or research natural areas. Motorized recreation increases the risk for accelerated sediment delivery to streams from the trails and use of the trails as well as the potential for degrading riparian areas and stream habitat by off-trail use. The level to which the potential adverse impacts occur would depend upon the Forest's ability to manage the trail system, given the expected increase in recreation use.

Alternative B does not include desired road densities as in the proposed action and alternatives R and P. Alternative B caps the total miles of NFS roads at the current level, about 4,000 miles, and uses a standard that would require at least one mile of road to be decommissioned when adding a mile to the system. Most subwatersheds are already functioning at risk or not properly functioning for road and riparian road densities with road densities above those generally supporting strong fish populations. While there may be some reduction in road density within the Restoration MA due to watershed improvement activities, the overall forestwide watershed condition is not expected to improve.

Recommended Wilderness

Alternative B allocates 220,300 acres to recommended wilderness, the most of any alternative. Motorized vehicle use is not permitted in the recommended wilderness prior to their potential designation by Congress. The restriction on motorized vehicle use means there would be no roads or motorized trails to deliver sediment to aquatic habitat in the recommended wilderness.

Riparian Aquatic and Resource Management

Alternative B continues current riparian and aquatic management under INFISH and effects of the ACS are the same as described for the no action alternative. The RHCA widths, the priority watershed network, and riparian and aquatic resource goals, objectives, standards, and guidelines are the same as no action. The RHCAs do not extend the same consideration to intermittent streams as the other alternatives, so may not be as protective of watershed processes. The potential benefits of key watershed designation only occurs in the Pend Oreille subbasin. The key watersheds include bull trout critical habitat and some WSCT populations, but fewer WSCT populations than the other alternatives, except no action, and no interior redband trout populations are included in the key watersheds. Stream habitat on the Forest may be slowly improving in the 20 years INFISH has been implemented, but most subwatersheds and aquatic habitat is considered impaired. The trends in watershed condition and stream habitat are expected to be similar as would be expected under the no action alternative.

Cumulative Effects

The information regarding cumulative effects common to all alternatives was discussed in the Past, Present, and Foreseeable Activities Relevant to Cumulative Effects Analysis section. The activities outside the influence of the Forest, such as the aquatic habitat improvement work associated with hydroelectric projects and the transportation system managed by other entities are common for all alternatives. The activities associated with the Northeast Washington Forest Vision 2020 project would now be guided by the alternative B restoration direction.

The watershed condition and status of most of the MIS/surrogate species' populations are functioning at risk or not properly functioning, although there is some indication of slow improvement in aquatic habitat condition. Road densities and riparian road densities, which are two major attributes causing the poor watershed condition scores, may not significantly improve despite restoration due to the amount of land available for timber production, maintaining the current miles of NFS roads and the 2,500 miles of road managed by other entities, which is not expected to change.

The Forest would continue with actions as described in the Northeast Washington Forest Vision 2020 project. Such actions, especially when they are implemented in a whole-watershed restoration approach, should help restore watershed condition to some degree. The magnitude of the improvement within a subwatershed would depend upon the amount of work that is socially acceptable and technically feasible to implement. However, given the current road system and the fact that after 20 years of implementing INFISH on the Forest, stream habitat is only slowly improving, watershed condition and stream habitat may not be expected to significantly improve forestwide. The MIS/surrogate species' population status is significantly affected by the high numbers and wide distribution of non-native fish, isolation above barriers and low MIS/surrogate species numbers, and problems in the migratory corridors on the larger rivers.

Climate Change

The overall effects of climate change were presented in the Past, Present, and Foreseeable Future Activities Relevant to Cumulative Effects Analysis section. Under alternative B, the Forest aquatic resource management direction for managing for stronghold populations that may contribute to the MIS/surrogate species persistence under different climate change scenarios is contained in the INFISH direction for priority watersheds. The priority watersheds may provide the potential to rebuild populations and improve habitat to allow bull trout and WSCT the opportunity to adapt to climate change, especially in the East Fork and West Fork LeClerc Creeks and Ninemile Creek. As mentioned in the cumulative effects section, the actual benefits to fish habitat and populations from such work is likely to be limited due to maintaining the current number of roads on the Forest. The potential effects of climate change may be greatest for this alternative and the no action alternative as the amount of subwatersheds and populations expected to be functioning at risk or not properly functioning is expected to remain as is. The threats to MIS/surrogate species viability due to population isolation and fragmentation, combined with the wide distribution of non-native fish and poor habitat conditions may be exacerbated in a warming climate.

Monitoring Recommendations

Monitoring recommendations are common to all alternatives.

Alternative O

Alternative O emphasizes summer and winter non-motorized opportunities in a backcountry, unroaded setting and minimizes recommended wilderness. Late forest structure is managed with a fixed reserve system. Alternative O includes two management areas to address vegetation management: the Restoration MA to restore the historical range of variation, and the Responsible MA that emphasizes timber production. The management zones are very similar to those proposed in alternative B. The total percentage of the Forest allocated to vegetation management is similar to alternative B, though alternative O has a greater percentage in the Restoration MA than alternative B.

Table 112. Alternative O management area acres by subbasin pertinent to aquatics discussion

Management Area	Colville	Franklin D. Roosevelt Lake	Kettle	Pend Oreille	Sanpoil	Total
Restoration	23,993	63,245	110,389	140,463	31,419	369,500
Responsible	77,809	67,266	108,242	146,071	33,763	433,400
Backcountry	5,354	42,856	44,448	53,382	27,068	174,300
Backcountry Motorized	1,356	11,878	35,241	5,259	0	53,700
Wilderness Recommended	0	0	0	15,900	0	15,900
Wilderness-Congressionally Designated	0	0	0	31,400	0	31,400

*Acres are approximate and may vary slightly in other resource sections due to GIS methodology

The plan components for watershed, riparian and aquatic management; desired conditions, standards and guides, and the definition of RMAs is the same as the proposed action. Alternative O, however, incorporates the same key watershed network as in alternative R.

Old Forest Management and Timber Production

Key Indicator – The number of acres that have a focused restoration (or late forest structure), general restoration, timber production emphasis.

- The Restoration MA (focused restoration) includes 369,500 acres
- The Responsible MA (general restoration) includes 433,400 acres. Even-aged management for timber production is allowed.

Timber harvest is allowed in both the Restoration and Responsible MAs.

Vegetation management and timber production as described for alternative O is very similar to alternative B. Vegetation management within the Restoration MA emphasizes enhancing the ecological integrity and ecosystem function by restoring late forest structure, natural processes, and the resiliency of forests. The emphasis for vegetation management in the Responsible MA is for sustainable active management to provide a steady flow of forest products to the local economy and maintain the infrastructure necessary to provide forest products, while increasing the Forest’s resilience to insects, disease, and uncharacteristic fire.

Alternative O allocates approximately 34 percent to a focused restoration type of management in the Restoration MA. The amount of land in the Restoration MA is less than the Focused Restoration MA in alternative R, more than the Focused Restoration MA in the proposed action and alternative P, and the Restoration MA in alternative B. Similar to alternative B, the emphasis on timber production in the Active Management MA increases the risk to watershed processes and aquatic habitat compared to vegetation management within the General Restoration MA in the proposed action and alternatives R and P. Any potential benefit to watershed conditions that may be accrued by managing for more resilient forests is likely to be diminished as the current level of 4,000 road miles is to be retained across the Forest.

Motorized Recreation Trails and Access

Key Indicator – Desired conditions for road densities.

As in alternative B, there are no road density desired conditions that would potentially improve watershed conditions. There may be some reduction in road densities within the Restoration MA, but access would be maintained within the Responsible MA to facilitate the flow of forest products. Overall, the current level of 4,000 road miles on the Forest is to be maintained, and therefore, watershed conditions are not expected to be greatly improved.

Key Indicator – Acres allocated to motorized access.

Alternative O allocates the most lands to the Backcountry MA and approximately 5 percent of the Forest is allocated to motorized recreation in a backcountry setting. Motorized recreation is allowed in the Backcountry Motorized, Restoration, and the Responsible MAs, resulting in approximately 78 percent of the landscape being available to motorized recreation.

Recommended Wilderness Areas

Key Indicator – Total acres in recommended wilderness.

Alternative O recommends 15,900 acres as proposed wilderness, the least amount of any action alternative. Motorized vehicle use is not permitted in recommended wilderness prior to their potential designation by Congress. The restriction on motorized vehicle use means there would be no roads or motorized trails to deliver sediment to aquatic habitat in the recommended wilderness.

Riparian and Aquatic Resource Management

The alternative O plan components for watershed, riparian and aquatic resource management; desired conditions, the definition of RMAs, standards and guidelines, and objectives are the same as the proposed action. The primary difference between alternative O and the proposed action compared to alternatives R and P is a greater reliance on guidelines than standards; there is not an additional desired condition for TES fish, there is no specific direction for managing AIS species, or a standard for minimizing the disruption of hydrologic processes due to roads and trails. Alternative O incorporates the same key watershed network and key watershed objectives as alternatives R and P, which encompasses more land than the proposed action.

Forest Service Contribution to MIS/Surrogate Species Viability

Implementation of alternative O contributes to the MIS/surrogate species viability to a greater degree than the no action alternative and alternative B. The alternative O contribution to viability for the three MIS/surrogate species is less than alternatives R and P, and similar to the proposed action (table 98 in the no action alternative).

A positive aspect of alternative O is the same key watershed network as in alternatives R and P. Alternative O is not expected to contribute to MIS/surrogate species viability to the same degree as alternative R, due to no road density desired conditions and little land allocated to recommended wilderness. Most subwatersheds on the Forest are functioning at risk or not properly functioning for watershed condition. Little overall improvement would be expected under alternative O by maintaining the transportation system at the current levels resulting in watershed conditions that generally do not support strong fish populations.

Effects – Alternative O

Old Forest Management and Timber Production

Alternative O includes two MAs that emphasize vegetation management, the Restoration MA and the Responsible MA. The two MAs are very similar to the Restoration and Active Management MAs in alternative B, as are the anticipated affects to watershed, aquatic and riparian resources. Both the Responsible MA and the Restoration MA allow use of timber harvest, prescribed fire, and thinning of stands to meet vegetation management objectives. Vegetation management in the Restoration MA emphasizes enhancing the ecological integrity of forests by restoring late forest structure and natural processes and resiliency of the terrestrial vegetation landscape.

The emphasis in the Responsible MA is to provide a stable flow of forest products to the local economy and sustain forest products infrastructure, while increasing the Forest’s resilience to insects, disease, and uncharacteristic fire. Even-aged management is allowed subject to guidelines for timber production. The road system would be retained in the active management areas to facilitate the flow of forest products. The risks to watershed, riparian and aquatic resources due to vegetation management are expected to be greater in the Responsible MA compared to the Restoration MA due to the greater emphasis on timber production.

The fire regime and insect indicators of the AEC are functioning at risk or not properly functioning in many subwatersheds on the Forest. Vegetation management to improve the resiliency of forests to disturbance, such as uncharacteristically severe wildfire, may help improve watershed condition especially in the Restoration MA. The potential risks of adverse impacts on watershed and aquatic habitat are greater in the Responsible MA than the Restoration MA and the Focused and General Restoration MAs in the proposed action, alternative R, and alternative P, due to the emphasis on timber production. Also, unlike the proposed action and alternatives R and P, overall watershed conditions are unlikely to improve in the either the Restoration or Responsible MAs as any benefit accrued by improving the Forest’s resiliency to disturbance may be offset by maintaining the transportation system at current levels.

Motorized Trails and Access

Alternative O allocates the greatest amount of land to backcountry recreation where motorized use is not allowed and there would be no new roads. While some minor disruption of watershed processes may occur on hiking trails, there would be no potential for accelerated sediment delivery or damage to riparian and aquatic habitat due to motorized recreation in the 174,300-acre Backcountry MA.

Like all other alternatives, new road access would not be allowed in Recommended or designated Wilderness, Backcountry Motorized (trail access only) and non-motorized Management Areas, or research natural areas. Motorized recreation would be allowed on approximately 78 percent of the Forest, with the associated risk for accelerated sediment delivery to streams from the trails and use of the trails, as well as the potential for degrading riparian areas and stream habitat by off-trail use. The level to which the potential adverse impacts occur would depend upon the Forest’s ability to manage the trail system, given the expected increase in recreation use.

Alternative O includes no road density desired conditions that would potentially improve watershed conditions. There may be some reduction in road densities within the Restoration MA, but access would be maintained within the Active Management MA to facilitate the flow of forest products. Most subwatersheds are functioning at risk or not properly functioning for the road and riparian road density attributes of the AEC. Overall, the current level of 4,000 road miles on the Forest would be maintained, and therefore, little improvement in watershed conditions would be expected.

Recommended Wilderness

Alternative O recommends 15,900 acres as potential new wilderness. Recommended wilderness is considered to protect watershed processes, aquatic, and riparian habitat, as no roads would be built or other management activities occur other than recreation.

Riparian and Aquatic Resource Management

Alternative O incorporates the same ACS as the proposed action with a greater reliance on guidelines than standards than in alternatives R and P. Like the proposed action, alternative O does not include the desired conditions for TES fish or the standards for managing AIS that are included in alternatives R and P. Unlike the proposed action, alternative O does include the same key watershed network as alternatives R and P that includes 25 subwatersheds compared to 22 in the proposed action, primarily providing extra protection for interior redband trout. The riparian and aquatic resource effects are the same as described in the proposed action, other than the effects of the key watershed network. While there may be some reduction in road density and the effects to watershed and aquatic habitat from the existing roads may be reduced due to focused watershed restoration efforts, the benefits of key watershed designation are expected to be less than either alternative R or P, as there are no desired conditions for road densities.

Cumulative Effects

The information regarding cumulative effects common to all alternatives was discussed in the Past, Present, and Foreseeable Activities Relevant to Cumulative Effects Analysis section. The alternative O cumulative effects are similar to alternative B. The activities outside the influence of the Forest, such as the aquatic habitat improvement work associated with hydroelectric projects and the transportation system managed by other entities are common for all alternatives. The activities associated with the *Northeast Washington Forest Vision 2020* project would now be guided by the alternative B restoration direction.

The watershed condition and status of most of the MIS/surrogate species' populations are functioning at risk or not properly functioning, although there is some indication of slow improvement in aquatic habitat condition. Even with the same key watershed network as alternatives R and P, the ACS that is felt to be more complete than INFISH in alternative B, and the continued implementation of the Northeast Washington Forest Vision 2020 project watershed conditions and fish population status are not expected to significantly improve. Maintaining the current miles of road on the Forest combined with the 2,500 miles of road managed by other entities would result in road densities that would keep most subwatersheds in a functioning at risk or not properly functioning status. Such road densities generally do not provide the conditions for strong fish populations.

Climate Change

The overall effects of climate change applicable to all alternatives were presented in the Past, Present, and Foreseeable Activities Relevant to Cumulative Effects Analysis section. Under alternative O, the Forest aquatic resource management direction for managing for stronghold populations that may contribute to the surrogate species persistence under different climate change scenarios is contained in the ACS direction including key watersheds. Although alternative O includes a more comprehensive ACS, including a broader key watershed network than alternative B, the effects of climate change are expected to be similar to those described for alternative B. The key watershed network may provide some potential to rebuild populations and improve habitat to allow the MIS/surrogate species the opportunity to adapt to climate change, especially in the East Fork and West Fork LeClerc Creeks and Ninemile Creek, which are priority watersheds.

The viability of the MIS/surrogate species on the Forest is threatened by low population numbers, population isolation, and fragmentation. The high road densities that would result in subwatersheds to continue to be functioning at risk or not properly functioning and would probably not provide the habitat conditions necessary for strong fish populations to recover. The status of the fish populations, combined with degraded watershed and habitat conditions and the wide distribution of non-native fish may exacerbate the effects of a warming climate.

Monitoring Recommendations

The monitoring program is common to all alternatives.

Summary of the Effects of the Alternatives on Aquatic Resources

The current viability of the three MIS/surrogate species, WSCT, interior redband trout, and bull trout is at risk within all subbasins on the Forest. The viability of the MIS/surrogate species on the Forest is generally threatened by poor watershed conditions, low abundance of the species, and a lack of connectivity between habitats and populations both on and off the Forest. The MIS/surrogate species are also threatened by the widespread distribution of non-native fish including brook trout, coastal rainbow trout and past introductions of non-native subspecies of cutthroat trout. The no action alternative would continue current management programs, including the INFISH aquatic strategy. There are indications that aquatic habitat conditions may be slowly improving under current management; however, the overall AEC for most subwatersheds on the Forest would likely continue to be functioning at risk or not properly functioning as little change in overall road densities on the Forest is expected, there is no additional protection afforded to aquatic resources through recommended wilderness, and more of the land base is open to relatively intense timber harvest than under the action alternatives. Of all alternatives, the no action alternative provides the least Forest Service contribution to the viability of the MIS/surrogate species.

The proposed action is expected to contribute to the viability of the MIS/surrogate species to a greater extent than continued management under the no action alternative. Compared to the no action alternative, the proposed action includes more lands in recommended wilderness, backcountry, and backcountry motorized allocations that are generally considered to be “protective” of watershed processes and aquatic habitat. The proposed action includes more lands that are considered to have a “moderate” level of protection in the Focused and General Restoration MAs. While timber harvest is allowed as a tool in the two MAs, the emphasis for vegetation management is to restore terrestrial vegetation structure and composition. The proposed action also includes a significantly larger network of key watersheds than the no action alternative, providing greater potential benefits to not only bull trout, but also WSCT and interior redband. RMAs are also expanded to give extra consideration to intermittent streams than in the no action alternative. The contribution to MIS/surrogate species viability is less than alternatives R and P; however, primarily due to desired road densities in the General Restoration MA that are higher than the road densities generally associated with properly functioning watersheds capable of supporting strong fish populations.

Alternative R and P are similar in their respective contributions to MIS/surrogate species viability. Alternative R may provide a slightly greater contribution to the viability of WSCT and interior redband in the Lake Roosevelt, Kettle, and Colville subbasins. Alternative P, compared to alternative R, may provide a greater contribution to the viability of bull trout and WSCT in the Pend Oreille subbasin and to WSCT and interior redband in the Sanpoil subbasins; however, the modelling results are very similar between the two alternatives.

Alternative R also includes the second largest amount of land allocated to recommended wilderness of all alternatives. Both alternatives R and P include the Focused and General Restoration MAs, where the desired road densities of 1.0 mile per square mile and 2.0 miles per square mile are more within the range of road densities generally associated with strong fish populations and properly functioning watersheds. The major difference between alternative R and P is that alternative P includes more land within the General Restoration MA, but alternative P includes one additional key watershed. Both alternatives R and P include aquatic conservation direction similar to the proposed action, but include more standards and guidelines to direct management within RMAs. Alternative P, based upon both the ARCS 2008 and ARCS 2016, includes the most comprehensive direction for managing watersheds, aquatic and riparian habitat and includes the most watershed, riparian and aquatic habitat restoration objectives of all alternatives.

Alternative B is expected to contribute the least toward the MIS/surrogate species viability than any action alternative as the alternative includes the same key watershed network as the no action alternative, hence, significantly less than the other action alternatives. Alternative B also maintains the current road network. The watershed and stream channel conditions within most subwatersheds on the Forest are currently considered to be functioning at risk or not properly functioning and would likely remain so under alternative B.

Similar to the proposed action, alternative O may be expected to contribute toward the viability of MIS/surrogate species to a greater degree than alternative B and the no action alternative, but less so than alternatives R and P. While alternative O includes the same key watershed network as alternative R, alternative O does not include the alternative R road density desired conditions.

Cumulative Effects (Common to all Alternatives)

Past, Present, and Foreseeable Activities Relevant to Cumulative Effects Analysis

The future status of fish populations, aquatic and riparian habitats on the Forest would be influenced not only by management on the Forest, but also by the management of surrounding lands and actions implemented by other entities within the subbasins. The potential effects to aquatic habitat due to timber harvest, roads and recreation management would continue on the Forest. The potential risks to aquatic habitat would vary depending upon the timber production emphasis, road desired conditions and recreation emphasis; motorized versus non-motorized recreation. The grazing program remains the same through all alternatives. The magnitude and severity of cumulative effects would depend upon; the management direction for the land allocations, the amount of land within the different land allocations, the ACS for an alternative, and the location and timing of management activities. The ACS plan components including: the desired conditions, key watersheds, RMAs, the number of key watersheds, and management direction provided by standards and guidelines would be important to mitigating potential cumulative effects. The future design of land management projects including the location, design criteria, and incorporation of BMPs at the project level would be important factors in determining the potential cumulative effects, either positive or negative, to fish populations, aquatic and riparian habitat. Fish habitat quality on the Forest appears to be slowly improving. The improvement in habitat conditions is expected to continue. The potential rate and magnitude of improvement would depend upon the alternative.

Projected human population growth would continue to put demands to forest resources, especially recreation. Recreational use of the Forest is projected to increase due to population growth as more people seek outdoor activities. The anticipated increase in recreation may put demands on infrastructure such as roads and trails. The degree to which the Forest can attain the desired conditions for road densities and OHV use, and maintain the infrastructure to improve watershed conditions may be challenging. Increased recreation use may also increase impacts on riparian habitat. As development of private land continues, the Forest Service anticipates a greater dependence on the Forest for nature-based activities and experiences that are becoming less accessible elsewhere. In many locations, resource impacts and crowding associated with recreation use are growing, with damage to riparian areas and unauthorized trail development being of particular concern. The Forest has been and would continue to aggressively manage OHV use through monitoring and restoration of user-built trails similar to what is described in appendix 3 of the Fisheries Specialist Report. The extent to which recreation and especially OHV use would contribute to cumulative effects that are adverse to fish populations and habitat would depend on the Forest having the resources to manage the program.

The road system on both the Forest and adjacent lands is an important watershed condition attribute resulting in the current, impaired watershed condition in most subwatersheds. The transportation system managed by other jurisdictions is not expected to change in the future, resulting in approximately 2,500 miles of road within the subwatersheds over which the Forest has no management authority. Roads would continue to contribute to the cumulative effects that have resulted in the impaired watershed and stream channel conditions on the Forest. The degree to which the road system contribution to cumulative effects may be reduced would depend upon achieving restoration objectives and the Forest’s ability to maintain the desired road system.

The AEC analysis found that few subwatersheds on the Forest have watershed conditions or MIS/surrogate species populations that are considered to be properly functioning. Improving watershed conditions would depend on the Forest’s ability to manage the expected increased demands for use of the Forest and continue to implement the current watershed restoration programs, in addition to the restoration objectives described for the alternatives. The Forest, in the Northeast Washington Forest Vision 2020 project, is planning to accomplish the following by the year 2020 to improve upslope and watershed conditions:

- Establish forest vegetation on 35,000 acres
- Improve forest vegetation on 13,600 acres,
- Treat 2,000 acres to manage noxious weeds and invasive plants
- Protect maintain or improve 100 acres of water or soil resources.
- Restore or enhance 20 miles of stream habitat.
- Restore or enhance 45,600 acres of terrestrial habitat.
- Improve maintenance on 1,840 miles of high clearance system roads and 165 miles of passenger car system roads receiving maintenance.
- Decommission 52 miles of road
- Improve aquatic organism passage at 31 stream crossings.
- Improve to standard 785 miles of trail.
- Utilize timber sales to treat 42,500 acres of forestlands and treat hazardous fuels on 136,000 acres to reduce the risk of stand-replacing wildfire.

The activities identified in the Northeast Washington Forest Vision 2020 Project are expected to contribute to achieving both desired conditions and objectives. A whole watershed restoration strategy where restoration is focused on meeting the objectives for specific watersheds should help restore watershed condition to some degree and potentially improve the resiliency of watersheds and aquatic habitat to disturbance.

The ability to restore healthy native fish populations on the Forest would be challenged by the past introduction, and resulting established populations, of non-native trout. Restoring the populations of the MIS/surrogate species on the Forest would be greatly influenced by actions implemented by other entities both on and off the Forest. The hydroelectric projects on the mainstem rivers would continue to impact migratory fish populations including WSCT and bull trout. Riverine habitats have been converted to reservoir habitat and the dams impede fish passage. The mitigation measures included in the re-licensing for the hydroelectric dams on mainstem rivers adjacent to the Forest should provide some beneficial impacts to MIS/surrogate species populations and aquatic habitat on the Forest. Some actions to be implemented include (USFWS 2012b):

- Removing Mill Pond Dam on Sullivan Creek.
- Providing upstream fish passage at Boundary Dam
- Eradicating non-native fish and supplementing the native WSCT and bull trout populations.
- Habitat improvement projects both on and off the Forest.

Additionally, Pend Oreille PUD under actions associated with the Box Canyon license would be providing upstream and downstream fish passage at Box Canyon Dam, restoring 164 miles of tributary habitat, eradicating non-native fish and supplementing with natives, controlling aquatic invasive weed species and controlling erosion on NFS lands along Box Canyon Reservoir.[44]

Uncharacteristic fire may affect both watershed conditions and MIS/surrogate species populations. While disturbances such as fire and subsequent erosion events can be beneficial for long-term productive habitat, significant fish mortality can also occur. The MIS/surrogate species' populations can often recover quickly from such disturbances if the populations are connected to other populations, or have a migratory life history where some individuals are not present at the time of the disturbance. On the Forest, however, a number of the MIS/surrogate species' local populations are isolated and no longer appear to express the historic migratory life history type. Severe fires in subwatersheds with the isolated populations could result in the extirpation of a local population. The degree to which these populations become more resilient to such disturbances would depend upon improvement in the different attributes of the AEC and restoration actions to be implemented off the Forest by other entities.

Climate Change

Climate change is the largest unknown factor that would influence long-term cumulative effects. There is a wide range of climate change models that give an equally wide range of future trajectories. There is general agreement that climate will warm, but no certainty on rate. Major shifts in several tree species are expected by the end of the century as is a doubling of fire acres by 2040, and a tripling of fire acres by 2080 (see Forest Vegetation section).

In addition to the potential changes to terrestrial vegetation and the resulting potential for increased wildfires, climate change may also produce profound impacts to fish and aquatic habitat. As summarized by Staab et al. (2014), climate change across the Pacific Northwest is expected to result in declines in snowpacks; increased streamflow and associated flooding in the winter and early spring; decreased streamflow in the late spring, summer and fall; increased stress on scarce summer water supplies; and

[44] Email Brian Peck, Colville National Forest, to Ken MacDonald (FW: Project Operations Compliance Report submitted in FERC P-2144-000 by Seattle City Light, et al.) (March 21, 2014). Terms of Seattle City Light's license are available at: http://elibrary.ferc.gov/idmws/file_list.asp?accession_num=20140318-5216 (March 25, 2014)

increased stress on salmon and other cold-water species due to declining summer streamflows and rising stream temperatures.

Streamflow patterns are expected to change in northeastern Washington with decreasing snowpacks in mid-elevation and wetter locations. Most subbasins on the Forest have a mixed rain and snow winter precipitation pattern, with only the Pend Oreille considered to be a snow dominated subbasin as a whole; however, it may transition to a more mixed pattern by 2040 (Snover et al. 2013). In the mountains of northeastern Washington, snowpacks are expected to persist at higher elevations, but at diminished levels, with large portions of the mountains of northeastern Washington possibly losing their April 1 snow-water equivalent (see Staab et al. 2014),[45] which may result in lower summer flows and potentially an increase in stream temperatures that are stressful for native salmonids (Mantua et al. 2010). Additional changes in streamflow regimes that may be expected include peak streamflows occurring earlier in the spring, a slight increase in the 20-year recurrence interval flood, and some reduction in low flows (Mantua et al. 2010).

Although many biotic and abiotic factors interact to determine suitable habitats for different fish species at a specific location, warming streams, declining summer flows, and increasing flood risk are, in general, all expected to negatively affect coldwater fish populations such as trout. Bull trout are especially vulnerable given that spawning and rearing are constrained by their location in upper watersheds and the species' requirement for cold water temperatures. Warming water temperatures may reduce the miles of stream suitable for bull trout spawning and rearing (Rieman et al. 2007, Wenger et al. 2011). Increased water temperatures may also put bull trout at a competitive disadvantage with brook trout where the two species overlap (Rodtka and Volpe 2007, McMahon et al. 2007). Williams et al. (2009), hypothesize that WSCT populations in northeastern Washington are at high risk due to warming temperatures; however, Wenger et al. (2011) felt WSCT distribution may not be strongly influenced by climate change where brook trout are not present. The potential for WSCT populations to hybridize with the non-native rainbow trout is greater in streams with higher mean summer water temperatures (Muhlfield et al. 2009).

While climate change may give brook trout a competitive advantage over bull trout, climate change would also influence brook trout distribution. Like bull trout, Wenger et al. (2011) feel brook trout populations would be negatively affected by climate change, which may be an advantage to WSCT, whose distribution appears to be negatively influenced by the presence of brook trout. Rainbow and redband trout may not be as susceptible to warmer water temperatures as they generally are more tolerant of higher water temperatures (Bjornn and Reiser 1991). Issak et al. (2010) found that over a 13-year period increased stream temperatures, primarily driven by climate and to a lesser degree wildfires, minimally affected the thermal habitat for rainbow trout, but reduced bull trout habitat.

Climate change would influence the distribution of non-native fishes as well. Warming water temperatures may increase the range of non-native predators such as smallmouth bass and northern pike (*Esox lucius*) from large rivers into tributaries, which is not only a potential threat to the MIS/surrogate species, but also to the sensitive lake chub.

The Fish and Wildlife Service (2012b) in their biological opinion for the Boundary Hydroelectric Project felt that if the current climate change models and predictions for Pacific Northwest aquatic habitats are relatively accurate, bull trout in the Pend Oreille River basin are likely to be impacted through at least one or more of the following pathways:

[45] Snow Water Equivalent (SWE) is a common snowpack measurement. It is the amount of water contained within the snowpack. It can be thought of as the depth of water that would theoretically result if you melted the entire snowpack instantaneously (USDA Natural Resources Conservation Service, March 22, 2014)
http://www.nrcs.usda.gov/wps/portal/nrcs/detail/or/snow/?cid=nrcs142p2_046155 (March 2

- Changes in distribution of bull trout within the core area, such as reduced spawning habitat, and/or seasonal thermal blockage in the migratory corridors associated with increased stream temperatures
- Disturbance or displacement of eggs, alevins, juveniles, and adults of resident and/or migratory adults during winter flooding events
- Short- or long-term changes in habitat and prey species due to stochastic events during winter floods
- Changes in flow/out-migration timing in the spring for bull trout and their prey species
- Increased migration stressors from lower stream flows and high stream temperatures during spawning migrations

The Fish and Wildlife Service (2012b) also judged some specific habitat effects may include:

- Changes in flows in Sullivan Creek due to altered snowpack and snowmelt, which may change the timing of higher flows in lower Sullivan Creek, resulting in a barrier to bull trout migration in July and August.
- Changes in temperature and flows within Sullivan and Slate Creeks may alter the species composition and abundance of the macroinvertebrate and fish populations with adverse consequences to bull trout food base.
- Increased temperatures in Boundary Reservoir would decrease the amount of time that the reservoir is suitable for bull trout migration. Increased temperatures could alter the migratory pattern of bull trout for times entering tributary streams to spawn as well as migration times to and from the Lake Pend Oreille system. Warmer temperatures within Boundary Reservoir would improve conditions for non-native predators.

Few MIS/surrogate species fish populations on the Forest are judged to be properly functioning as described in the AEC. The negative effects caused by the widespread distribution of the non-native fish may be exacerbated by climate change. In the face of climate change, efforts to conserve native fish species should focus on restoring degraded habitat, improving riparian vegetation, providing habitat and population connectivity, providing flows in stream for ecosystem purposes, and providing for a network of intact habitats to support large populations (ISAB 2007, Haak and Williams 2012). Climate change is also an identified threat to the sensitive Odonata species. Protecting watershed processes that maintain their riparian habitat may the best strategy to maintain those species on the Forest.

Hydrology

This section summarizes effects related to hydrology from the specialist report, with special emphasis on the publicly identified issues of riparian and aquatic resource management, access, and old forest management and timber production (Day 2018). While other issues, including recommended wilderness, and motorized recreation trails are tangentially applicable to water resources, public concerns on these issues are not specific to the hydrologic resource. Analysis of the riparian and aquatic resource management, access, and old forest management and timber production issues would indirectly address the potential effects of recommended wilderness and motorized recreation trails to water resources, and how these effects vary across alternatives. Acres displayed for watershed size and for effects to the hydrologic resource discussion are approximate and based on GIS modeling.

Affected Environment

Setting

Physiography

The Forest is located in the foothills of the Rocky Mountains and is bisected from west to east by Lake Roosevelt on the Columbia River, impounded by the Grand Coulee Dam, and the Kettle and Selkirk mountain ranges in the western and northeastern sections of the Forest, respectively. Average elevation is 3,800 feet and ranges between 1,394 feet near Lake Roosevelt to 7,200 feet in the high ridges of the Selkirk Range. The Selkirk Range includes the Salmo-Priest Wilderness—the only designated wilderness on the Forest.

Climate

Climate is consistent with both maritime and continental regimes, with air masses from both the Pacific Ocean and interior North America crossing the region. Climate is influenced primarily by latitude, topography, proximity to the Pacific Ocean, prevailing westerly winds, and development and movement of weather systems over the North Pacific (Phillips and Durkee 1972). The majority of precipitation falls between October and April as snow. Summers are usually dry, with most precipitation associated with thunderstorms. Humidity is low throughout the year.

Annual precipitation varies between 10 to 55 inches per year and increases with elevation. The western-most section of the Forest is in the rain shadow of the North Cascades and has annual precipitation levels of 10 to 15 inches per year. The eastern portion of the Forest has a moist near-maritime climate caused by the forcing of westerly air flow over the 5,000- to 7,000-foot peaks of the Kettle River and Selkirk ranges. Throughout the year, maritime air from the Pacific exerts a moderating influence on temperatures with more extreme summer and winter temperatures caused by drier air from the interior. The greatest precipitation levels occur in the Selkirk Mountains, where uplifting of prevailing winds results in increased precipitation (Baldwin 2006).

Geomorphology

The Forest is located in the Okanogan Highlands Section of the northern Rocky Mountain forest-steppe-coniferous forest-alpine meadow province, delineated through the national hierarchical framework of ecological units (ECOMAP 1993). This framework provides a nationally standardized method for the classification, mapping, and description of ecological units at multiple scales based on similarity in potential vegetation, climate, and geomorphology. The Okanogan Highlands are characterized by moderate slopes with broad, rounded summits weathered from repeated continental glaciation. Ice sheets covered the areas during the Pleistocene, and their retreat formed the Columbia and Pend Oreille valleys

(WA DNR 2015a). Glacial scour has exposed rock outcrops on many slopes. Most of the area is covered with glacial till, outwash, and debris. Glacial lakes, rivers and streams are common, as well as mountains with both narrow and broad valleys (McNab and Avers 1994). The history and effects of continental glaciation on the Forest is discussed in greater detail in the Soil Resources Specialist Report (Farr et al. 2017).

Geology

The Okanogan Highlands is divided into two geographic regions divided by the Columbia River; the Selkirk, Chewelah, and Huckleberry Mountains to the east, and the Kettle, and Sanpoil Mountains to the west. The eastern Okanogan Highlands contains the oldest sedimentary and metamorphic rocks in Washington formed from the deposition of sediments with metasedimentary rocks overlain by layers of marine rocks including sandstone (metamorphosed into quartzite), shales, and limestones. The western Okanogan Highlands is less complex geologically than the eastern section, and contains metasedimentary rocks formed from the deposition of volcanic sediments (Lasmanis 1991). The western Okanogan Highlands is an important mineral-producing area with gold, silver, magnetite, pyrite, molybdenum, and cobalt mineral deposits (WA DNR 2015a).

Land Use History

Historical disturbances and management practices (such as the Interior Columbia Basin Ecosystem Management Project) affect water quantity and quality and the physical processes within a stream system, including erosion and sedimentation and the distribution of organic material. The combined impacts of past land uses and disturbance patterns as well as current management and development have shaped and continue to affect hydrologic function and physical stream characteristics.

Abundant salmon runs attracted the first humans to northeastern Washington, and evidence exists that people lived in the region as early as 9,000 to 12,000 years ago (Holstine 1987). Based on the availability of salmon, the area became one of the most important prehistoric trading sites in the Pacific Northwest; however, effects to the physical environment from early inhabitants were minor and diffuse (Holstine 1987). Early uses affecting hydrologic systems increased as European settlers moved into the area. The remnants of these activities including mining, logging, homesteading, livestock grazing, and road building can be found across the landscape.

Beginning in the mid-1800s, fur trapping was one of the most widespread uses, resulting in significant declines in beaver populations. Beaver dams in small streams alter hydrology, geomorphology, and habitat, increasing water and sediment storage (Pollack et al. 2003). Beaver dams also dissipate stream energy, provide channel stability, and create diverse aquatic habitat (Gurnell 1998). Loss of beaver populations has affected hydrology and sediment dynamics and has contributed to channel incision and lowering of groundwater levels (Pollack et al. 2003) across the Forest.

Fires burned across 160,000 acres of the Forest in 1910. Historical accounts suggest that as late as 1916, areas that had burned to the ground were still bare. In 1917, fires again swept through the area, burning 23,000 acres in the western portion of the Forest. Fires in the 1920s burned over half of the timber land on the Forest (Holstine 1987). The effects to stream channels of increased erosion, sedimentation, and peak flows from these fires can still be observed. Channel incision common in streams across the Forest was likely accelerated following the fires of the early 1900s.

Placer mining of gold began in 1855 and ended by the 1870s when prospectors began upland “hard rock” mining for gold, silver, and lead, which continues today (Holstine 1987).

Changes in hydrologic and erosional and depositional processes from land uses including homesteading, logging agriculture, grazing, mining, road construction, and hydro-developments (dams, irrigation, and flood control) have altered flow and sediment regimes, floodplain and riparian function, and resulted in loss and fragmentation of aquatic habitat (Wissmar 2004). Current land uses including maintenance and construction of roads, fire exclusion, silvicultural practices, planned and unplanned wildland fire, mining, livestock grazing, and alteration of hydrologic regime and stream morphology through dams and diversions, and stream and watershed restoration are discussed in greater detail throughout this section.

Surface Water Characteristics

Climate, geology, and physiography are large-scale drivers of hydrologic processes, and control hydrologic regime and stream channel characteristics. Most streams across the Forest flow through glacial outwash within narrow valleys. Present-day glacial lakes and wet valleys are associated with the last retreat of glaciers across the region (McNab and Avers 1994).

Streamflow Regime

Most streams have a snowmelt flow regime with a peak in flow from April through June during spring snowmelt and no discernable peaks in discharge from fall/winter rains. The annual hydrograph from 84 years of gauge data on the Kettle River near Laurier shows the typical seasonal discharge pattern for unregulated streams across the Forest.

There are approximately 20 stream gauges on or near the Forest, however, many of these gauges are on regulated systems and have variable years of data available. Therefore, streamflow data from these gauges does not necessarily represent all streamflow regime types on the Forest. Reidy Lierman et al. (2012) classified flow regimes for ungauged streams and rivers across Washington using gauge data and climactic and physical drainage basin characteristics. Across the Forest, 97 percent of streams are categorized as either snowmelt, ultra-snowmelt, or snow-rain systems. Only 3 percent of streams are hydrologically classified as groundwater systems. Characteristics of these different systems are described in the following table (Reidy Lierman et al. 2012).

Table 113. Hydrologic stream classification for the Colville National Forest

Stream Hydrologic Classification*	Description	Percent of Streams on the Colville National Forest
Snowmelt	Peak in flow during spring snowmelt, with little discernable winter rain influence	84%
Ultra Snowmelt	Higher-elevation streams that exhibit a peak at spring slightly later in spring than snowmelt-regime streams	12%
Snow-Rain	Mixture of spring snowmelt and winter rain	1%
Groundwater	Predictable annual minimum and base flow values, exhibit a slight increase at snowmelt, but no increase from winter rains	3%

*Reidy Lierman et al. 2012

Water Yield

Water yield refers to the runoff from a drainage basin and is calculated as precipitation minus evapotranspiration. Physiography, geology, and spatial variation in the magnitude and timing of precipitation are controls of water yields for streams and rivers across the Forest. Water yield at low-flow was calculated for select gauges across the Forest based on average streamflow (cubic feet per second (cfs)) in July and August divided by the drainage area upstream of the stream gage (square miles) for the development of the Total Maximum Daily Load (TMDL) for the Forest (discussed later in this section). In the drier, western section of the Forest, water yields are less than in the wetter, eastern portion of the Forest.

Colville National Forest Contribution to Water Supply

Brown and Froemke (2009) estimated the annual contribution of water supply for all national forests in the contiguous United States based on data from 1953 to 1994. Water supply estimates were calculated as "precipitation minus natural evapotranspiration," with the assumption that water that infiltrates into the soil is not evaporated or transpired is eventually available as surface water (Brown and Froemke 2009). Estimated annual contribution to the water supply from lands within the Forest administrative boundary is 65,121 million cubic feet per year. Estimated annual contribution from lands within the Forest ownership boundary is 51,525 cubic feet per year.

Watershed Hierarchy and Spatial Bounds of Analysis

Major Drainage Basins

The Forest is located entirely in the Columbia River basin, which originates in Canada and flows southwest through Washington, forming the border between Washington and Oregon to its mouth at the Pacific Ocean. Major river basins include the Pend Oreille, Sanpoil, Kettle, and Colville. The Pend Oreille River originates in Montana, flows through Idaho into Washington, where it flows north into Canada to its mouth at the Columbia River. The Pend Oreille River is the fourth largest contributor of streamflow to the Columbia River. The Forest east of the Selkirk Mountain Crest drains into the Pend Oreille River. The Sanpoil River drains the southwest portion of the Forest west of the Kettle Crest and flows directly into Lake Roosevelt downstream of the Forest administrative boundary. The Kettle River receives most of the runoff from the northwestern portion on the Forest. It flows north into Canada, and south to its confluence with Lake Roosevelt (Columbia River) west of the community of Kettle Falls. The Colville River drains the central portion of the Forest east of the Selkirk Range, and west of Lake Roosevelt. The Colville River drains into the eastern side of Lake Roosevelt near Kettle Falls.

Watershed Hierarchy

A watershed is an area of land where all the water drains into a particular water body. Watersheds occur at various scales and are appropriate boundaries for hydrologic analysis because physical processes including rainfall, precipitation, runoff, erosion, and sedimentation interact within watershed boundaries to shape the landscape (MacDonald et al. 2018), affecting hydrologic function, stream condition, water quality, and water uses.

Watershed boundaries are delineated for this analysis using the hydrologic unit (HU) system. Hydrologic units are delineated and classified by the U.S. Geological Survey based on size using a standard nested-hierarchical system with six levels of classification of successively smaller watersheds (FGDC 2005). Individual hydrologic units are denoted both numerically by a unique hydrologic unit code, and name. Classification and general size of hydrologic units within the system are shown in table 114. The table also includes an example of both the name and number of the hydrologic hierarchy of the Ninemile subwatershed.

Table 114. Classification, naming conventions, and average size of hydrologic units in the hydrologic unit code system

HU name	# of digits in HUC	HU Level	Average Size (mi^2)	Example Name	Example Number
Region	2	1st	180,000	Pacific Northwest Region	17
Subregion	4	2nd	17,000	Upper Columbia Subregion	1702
Basin	6	3rd	10,000	Upper Columbia Basin	170200
Subbasin	8	4th	700	Sanpoil Subbasin	17020004
Watershed	10	5th	227 (40,000-250,000 acres)	Upper Sanpoil Watershed	1702000401
Subwatershed (SWS)	12	6th	4 (10,000-40,000 acres)	Ninemile Subwatershed	170200040107

The Forest is located in the Pacific Northwest region, two subregions, and the Pend Oreille, Upper Columbia, and Spokane basins.

Table 115. Region, subregions, and basins on the Colville National Forest

Region	Region Number	Subregion	Subregion Number	Basin	Basin Number
Pacific Northwest Region	17	Kootenay, Pend Oreille, and Spokane River Basins Subregion	1701	Pend Oreille Basin Spokane Basin	170102 170103
		Upper Columbia; Columbia River above the confluence with the Snake River, excluding the Yakima River Subregion	1702	Upper Columbia	170200

The administrative forest boundary of the Forest is located within six subbasins, all within the Columbia River drainage. A small portion of the administrative forest (15,826 acres) falls within the Upper Spokane subbasin. Although a portion of the Forest administrative boundary falls within the Upper Spokane subbasin, there is no Forest Service ownership within the subbasin. Therefore, streams, riparian areas, roads, and other features affecting hydrologic function are generally not analyzed in the Upper Spokane subbasin. Subbasins on the Forest and the percentage of each subbasin within the Forest administrative boundary are shown in the following table.

Table 116. Subbasins and approximate acreages within the Colville National Forest administrative boundary

HUC 8 Number	Subbasin Name	Colville National Forest Administrative Acres	Total Acres (in US only)	% subbasin within Colville National Forest Administrative Forest
17020001	Upper Columbia River (FDR Lake)	212,863	1,327,733	16
17020002	Kettle River	321,743	659,201	49
17020003	Colville River	145,579	650,712	22
17020004	Sanpoil River	105,291	627,732	17
17010216	Pend Oreille River	557,449	698,349	80
17010308	Little Spokane	15,826	453,912	3

There are 27 fifth-field watersheds within greater than 1 percent of land area within the Forest administrative boundary. The hierarchy of these watersheds within their respective subbasins and percent acres of the Forest administrative boundary within each watershed are shown in table 117.

There are 109 subwatersheds with acreage in the Forest administrative boundary. There are 104 subwatersheds with greater than 5 percent of total area in the Forest administrative boundary, and 75 subwatersheds with greater than 25 percent of total area in the Forest boundary. There have been several changes to subwatershed names and numbers since the forest plan revision process began. Subwatersheds and 5th field watersheds used in this analysis reflect the most current acreages, names, and numbers at the time this analysis was originally completed in 2014. There have been nominal changes in subwatershed acreages since 2014, which have not been updated in this analysis.

The terms subbasin, watershed, subwatershed, priority watershed, focus watershed, and key watershed are used throughout this section. While the term watershed can refer specifically to a 5th field watershed designated in the hydrologic unit system, the term also refers to the drainage area that contributes runoff to a specific stream. Throughout this section priority and key watersheds are delineated at the subwatershed scale, and focus watersheds are delineated at the 5th field watershed scale.

Existing condition is analyzed at different watershed scales depending on the type of analysis, quality and extent of data, and the scale that best fits the intent of the analysis. Existing condition is primarily analyzed at the scale of the Forest administrative boundary. Where appropriate, existing condition is analyzed at the smaller subwatershed scale. The Watershed Condition Framework (WCF) described in detail later in this document analyzed data for subwatersheds with greater than 25 percent Forest administrative ownership. The spatial and temporal bounds for effects analysis are described under Environmental Consequences in this section.

Table 117. Watersheds and approximate acreages within the Colville National Forest administrative boundary

Subbasin	Watershed Name	HUC 10	Total Acres (in US and Canada)	Colville National Forest Administrative Acres	% Watershed within Colville National Forest Administrative Forest
Upper Columbia River (FDR Lake)	Deep Creek	1702000110	122,290	66,529	54
	Big Sheep Creek	1702000111	143,633	15,060	10
	Onion Creek-Franklin D Roosevelt Lake	1702000112	186,401	19,895	11
	Sherman Creek-Franklin D Roosevelt Lake	1702000113	211,509	94,641	45
	Hall Creek-Franklin D Roosevelt Lake	1702000114	110,157	16,741	15
Kettle River	Boundary Creek	1702000210	147,279	1,844	1
	Rock Creek-Kettle River	1702000211	152,801	1,829	1
	Toroda Creek	1702000212	104,125	7,698	7
	Curlew Creek	1702000213	98,976	43,232	44
	Vulcan Mountain-Kettle River	1702000217	154,221	71,280	46
	Boulder Creek-Kettle River	1702000219	180,245	131,405	73
	Deadman Creek-Kettle River	1702000220	102,133	64,423	63

Subbasin	Watershed Name	HUC 10	Total Acres (in US and Canada)	Colville National Forest Administrative Acres	% Watershed within Colville National Forest Administrative Forest
Colville River	Chewelah Creek-Colville River	1702000301	273,840	72,981	27
	Little Pend Oreille River	1702000302	117,703	19,537	17
	Mill Creek	1702000303	90,809	45,556	50
	Stensgar Creek-Colville River	1702000304	168,840	7,508	4
Sanpoil River	Upper Sanpoil River	1702000401	181,184	99,663	55
	West Fork Sanpoil River	1702000402	198,987	4,828	2
	Middle Sanpoil River	1702000403	120,607	802	1
Pend Oreille River	Calispell Creek	1701021601	91,577	64,144	70
	Tacoma Creek-Pend Oreille River	1701021602	195,073	125,202	64
	LeClerc Creek-Pend Oreille River	1701021603	159,801	145,116	91
	Sullivan Creek	1701021604	91,224	91,203	100
	South Salmo River	1701021607	62,989	15,944	25
	Slate Creek-Pend Oreille River	1701021609	127,186	105,844	93
	Cedar Creek-Pend Oreille River	1701021610	59,488	10,007	17
Little Spokane	Upper Little Spokane River	1701030801	178,244	15,826	9

Existing Condition

Watershed Function

Watershed hydrologic function includes the processes that convert precipitation to streamflow, including canopy interception, snowmelt, surface runoff, infiltration, subsurface flow, and groundwater flow. Hydrologic function is influenced by upland physical and vegetation condition, ground cover, soil properties and function, stream channel condition, and riparian vegetation condition, all of which affect the rate and timing of water, nutrients, and sediment into streams. Watershed function is a component of ecosystem function where ecosystems are dynamic and resilient to perturbations to structure, composition, and processes of their biological and physical components (USDA Forest Service 1998b), and includes hydrologic, vegetative, aquatic, and riparian biological characteristics, physical structure, and water quality.

Watershed Condition

A fundamental goal of the Forest Service is “To protect NFS watersheds by implementing practices designed to maintain and improve watershed condition, which is the foundation for sustaining ecosystems and the production of renewable natural resources, values, and benefits” (FSM 2521). Watershed condition is defined as “The state of the physical and biological characteristics and processes within a watershed that affect the hydrologic and soil functions supporting aquatic ecosystems” (Potyondy and Geier 2010). Properly functioning watersheds have five characteristics (Williams et al. 1997, Potyondy and Geier 2010):

1. Provide for high biotic integrity, and support adaptive animal and plant communities that reflect natural processes;
2. Resilient and recover rapidly from natural and human disturbances;
3. Exhibit a high degree of connectivity along the stream both laterally across the floodplain and valley bottom, and vertically between surface and subsurface flows;
4. Important ecosystem services including high water quality, recharge of streams and aquifers, maintenance of riparian communities, and resiliency to climate variability and change;
5. Maintain long-term soil function.

The WCF was conceptualized at the national scale to change the Forest Service’s approach to landscape and watershed restoration. The WCF established a nationally consistent approach to classify watersheds based on underlying ecological, hydrological, and geomorphic functions and targets implementation of focused restoration activities in priority subwatersheds. The WCF provides outcome-based performance measures for documentation of improvement in watershed condition at Forest, regional, and national scales (Potyondy and Geier 2010) through prioritization, and active and passive restoration.

National forests throughout the United States implemented the WCF process in 2010. Subwatersheds on the Forest were classified into three categories through the WCF based on classes described in FSM 2521.1 and Potyondy and Geier (2010):

- Class 1: Functioning Properly—SWSs that exhibit high geomorphic hydrologic, and biotic integrity relative to natural potential conditions. The watershed is functioning similar to natural wildland conditions (Karr and Chu 1999, Lackey 2001). There are minimal adverse human impacts on natural physical or biological processes, and the watershed is able to naturally recover to previous condition in response to natural and human disturbance (Yount and Neimi 1990);
- Class 2: Functioning at Risk—SWSs exhibit moderate integrity as described above;
- Class 3: Impaired Function—SWSs exhibit low integrity as described above. Adverse human impacts have caused a threshold to be exceeded where the watershed is no longer as resilient to physical and biological processes.

Subwatersheds are classified by the watershed condition framework based on geomorphic, hydrologic, and biotic integrity relative to potential natural condition, which relates to geomorphic, hydrologic, and biological watershed function. Integrity is evaluated in the context of the natural disturbance regime and geoclimatic setting and includes aquatic and terrestrial components because water quality and aquatic habitat are related to the integrity and functionality of the upland and riparian areas across the watershed (Potyondy and Geier 2010).

The watershed condition framework classification process includes four process categories including “aquatic physical,” “aquatic biological,” “terrestrial physical,” and “terrestrial biological.” These process categories are represented by 12 indicators comprised of attributes that represent underlying ecological function and processes that affect soil and hydrologic function (Potyondy and Geier 2010). Each indicator attribute receives a rating that is summed and averaged to produce an indicator score. The indicator scores within each process category are averaged, and the final watershed condition score is computed as a weighted average of the four process category scores.

The results of the WCF for the Forest with data compiled in 2010 and updated in 2016 are used throughout this analysis to describe the existing condition of attributes and indicators that affect watershed function for subwatersheds across the Forest. Results of the WCF by subwatershed are shown in table 118.

Table 118. Results of the watershed condition framework summarized by number of subwatersheds within each condition class

Process Category	Indicator	Attribute	Class 1 Functioning Properly (# of Subwatersheds)	Class 2 Functioning at Risk (# of Subwatersheds)	Class 3 Impaired Function (# of Subwatersheds)
Aquatic Physical			65	22	2
	Water Quality		70	18	1
		Impaired Waters	56	31	2
		Water Quality Problems	63	25	1
	Water Quantity	Flow Characteristics	79	9	1
	Aquatic Habitat		12	56	21
		Habitat Fragmentation	51	18	20
		Large Woody Debris	18	50	21
		Channel Shape and Function	7	78	4
Aquatic Biological			13	37	39
	Aquatic Biota		12	26	51
		Life Form Presence	12	26	51
		Native Species	12	26	51
		Exotic and/or Invasive Species	12	26	51
	Riparian Wetland Vegetation	Vegetation Condition	34	23	32
Terrestrial Physical			41	48	0
	Roads and Trails		3	41	45
		Open Road Density	13	50	26
		Road Maintenance	18	49	22
		Proximity to Water	3	32	54
		+Mass Wasting	n/a	n/a	n/a
	Soils		87	0	2
		Soil Productivity	87	2	2
		Soil Erosion	87	2	2
		Soil Contamination	79	10	0
Terrestrial Biological			82	7	0
	Fire Regime	Fire Condition Class	11	67	11
	Forest Cover	Loss of Forest Cover	89	0	0
	*Rangeland Vegetation	*Vegetation Condition	83	2	0
	Terrestrial Invasive Species	Extent and Rate of Spread	85	4	0
	Forest Health		87	2	0
		Insect and Disease	24	62	3
		Ozone	89	0	0

Process Category	Indicator	Attribute	Class 1 Functioning Properly (# of Subwatersheds)	Class 2 Functioning at Risk (# of Subwatersheds)	Class 3 Impaired Function (# of Subwatersheds)
Final Score			25	63	1

+Mass wasting was not assessed in this analysis, but is addressed elsewhere in this document.
*Attribute and indicator assessed only in subwatersheds with range allotments

Composite results of the WCF for the Forest indicate that 70 percent (63 SWSs) of subwatersheds are “functioning at risk.” Only 1 SWS was rated as “not functional,” and 25 SWSs are “functioning properly.” Scores in the aquatic physical process category are generally good, with 71 percent of SWSs functioning properly. Both water quality and water quantity attributes show the majority of SWSs “functioning properly.” Aquatic habitat conditions are the primary driver of reduced function within the aquatic physical process category; 86 percent of SWS were rated as either functioning at risk or not functional for the aquatic habitat indicator.

Scores are low across the aquatic biological process category, with scores of functioning at risk and not functional for most indicators and attributes. Riparian wetland condition scores are higher than other indicators and attributes in this process category. Aquatic habitat is discussed in greater detail in the fisheries section of this chapter (MacDonald et al. 2018).

Within the terrestrial physical process category, roads attributes, and indicators are the primary driver of low scores. Fifty percent of SWSs received not functional scores in all road attributes and indicators, with only 3 subwatersheds receiving a “functioning properly” rating. Roads are discussed in greater detail in the roads section of this analysis. Soil attributes and indicators were rated functioning properly across most SWSs.

Most indicators and attributes within the Terrestrial Biological process category are rated functional, with a greater percentage of SWSs falling within the functional at risk category in the fire condition class and insect and disease attributes.

Select indicators and attributes from the WCF were used in the Aquatic Ecological Condition (AEC) model to assess the function of aquatic ecological conditions and its ability to support viable populations of aquatic surrogate species. The AEC model was used to determine key watersheds in the forest planning process and to assess aquatic species viability. The AEC process and results are discussed in the fisheries section of this chapter (MacDonald et al. 2018).

Streams

Approximately 2,483 miles of perennial streams flow throughout the year within the Forest administrative boundary. And, approximately 4,191 miles of intermittent streams across the Forest flow either seasonally or spatially (flow subsurface in some reaches). The intermittent stream category for purposes of this analysis also includes ephemeral channels, which flow for a short period following precipitation or snowmelt. Ephemeral streams generally do not have the surface groundwater interaction to support riparian or wetland vegetation and do not show evidence of yearly scour. Other water features on the Forest include lakes, ponds, reservoir, and seeps and springs.

Stream Channel Condition and Function

Stream channel condition and function is affected by processes occurring throughout a watershed. Stream channel condition is often discussed in terms of the habitat it provides for fish; however, channel conditions also affect how stream system responds to changes in inputs of water, nutrients and sediment from natural or anthropogenic disturbance. Although stream systems are variable, functional streams are generally more resilient to disturbance and recover faster than non-functional systems.

The “channel shape and function” attribute was assessed for WCF using stream channel condition data collected using the level II Region 6 stream inventory protocol (USDA Forest Service 2012c) for most named streams across the Forest. Streams in most SWSs are functioning at risk (80) with four SWSs functioning properly, and five SWSs with impaired function.

Data collected on stream channel variables that are indicators of channel shape and function under the PACFISH INFISH Effectiveness Monitoring Program (width to depth ratio, pool quality, streambank stability, and large woody debris) collected on selected reaches across the Forest since 2001 indicate that channel conditions in reaches in managed watersheds are poorer than in reference reaches located in watersheds with minimal disturbance. See MacDonald et al. (2018) for further discussion of the PACFISH INFISH Effectiveness Monitoring Program and results of monitoring.

Riparian and Wetland Function

Although riparian and wetland ecosystems comprise a small portion of lands on the Forest, they provide important ecological function and habitat for plants and aquatic and terrestrial wildlife (Wissmar 2004). Riparian areas and wetlands provide ecological, economic, and social benefits and are valued for recreation, livestock grazing, mining, transportation corridors, and water supply for cropland and irrigation (Kovalchik and Clausnitzer 2004). They provide a linkage between upland and stream habitats and are important habitat for aquatic and terrestrial wildlife and a variety of plants. Vegetation production is generally higher in wetland and riparian ecosystems than in the uplands, and riparian structure and function influence the rate, amount, and timing of discharge of water, sediment, nutrients, and other potential pollutants (Kovalchik and Clausnitzer 2004).

Historical and current uses in riparian areas have influenced structure, composition, and function of these ecosystems, and conservation, rehabilitation, and restoration of function is a high priority on the Forest. Riparian, aquatic, and wetland ecosystems are diverse in eastern Washington, with 163 recognized aquatic, wetland, and riparian plant associations or community types (Kovalchik and Clausnitzer 2004).

Riparian Areas

Riparian areas act as a filtration system for overland water and sediment runoff before it enters the stream system. This function is especially important where watersheds have experienced disturbance or management that alters the routing of water and sediment upslope of the riparian area. Trees and shrubs in riparian areas create shade, regulate air, soil, and water temperature, and provide inputs of downed trees and woody debris to the stream system (Wissmar 2004).

Roots of riparian vegetation provide bank stability and slow the rate of erosion and potential channel migration (Gregory et al. 1991). Riparian vegetation also slows flowing water during high flow events, trapping sediment within the floodplain (Platts et al. 1985), resulting in a reduction in the sediment load in flood water (Wondzell 2001).

INFISH (USDA Forest Service 1995a) designates riparian habitat conservation areas (RHCAs) to be managed for the benefit of aquatic and riparian-dependent species. Since RHCAs are designated by width rather than riparian function or existence of riparian vegetation, there is often upland vegetation on the outer width of RHCAs. RHCA widths designated by INFISH vary based on stream/wetland type and are wider in priority watersheds (designated by INFISH). Acres of RHCA across the Forest by stream type are shown in table 119. These widths and acreages were calculated using the default distances. However, RHCAs are delineated on the ground based on characteristics such as the inner gorge, outer edges of the 100-year floodplain, the outer edges of riparian vegetation, some distance equal to the height of site-potential trees, the extent of the seasonally saturated soil, or to the extent of moderately and highly unstable areas and using the width that is greatest. Table 119 lists the definitions of RHCA widths. Since RHCA widths only apply to management on lands owned by the Forest, RHCA acreage is calculated for lands owned by the Forest rather than lands within the Colville National Forest administrative boundary.

Table 119. Existing riparian habitat conservation areas (RHCA) acreage on the Colville National Forest within the administrative boundary

RHCA Designation/Description	RHCA Width (feet)	RHCA Acres across the Colville National Forest
Fish Bearing Perennial	300	35,427
Non-fish Bearing Perennial	150	49,075
INFISH Natural Waterbody; ponds, lakes, reservoirs	150	6,091
INFISH Non-fish Bearing Intermittent	50	25,987
INFISH Wetland less than 1 acre	50	805
INFISH Wetland >1 acre	150	14,736
Priority Watershed No Fish Intermittent	100	15,904
Priority Watershed Wetlands less than 1 acre	100	233
Priority Watershed Wetlands > 1 acre	150	2,434
Total		150,692

Riparian Wetland Vegetation Condition

Conditions across riparian areas on the Forest vary across subwatersheds. Thirty-four subwatersheds are rated as properly functioning; these riparian areas have native mid to late seral vegetation in dynamic equilibrium with the stream or wetland system in greater than 80 percent of riparian areas. Twenty-one subwatersheds are rated as functioning at risk with native vegetation showing a moderate loss of vigor, with a lesser component of mid to late seral vegetation occupying 25 to 80 percent of riparian areas. Thirty-four subwatersheds are rated as “not functional,” with native vegetation displaying a loss in vigor and cover and composition are mostly early seral. Riparian areas in SWSs rated not functional are generally disconnected from surface water and shallow groundwater, and reflect the loss of available soil water (Potyondy and Geier 2010).

Degraded riparian conditions are influenced by livestock grazing, mining, timber harvest and associated infrastructure, fire suppression, and road construction and use. Riparian conditions are also affected by stream channel function and the ability of the stream system to provide water to support persistence of riparian vegetation. Channel incision can lower the water table, making the water table too low to support riparian vegetation (Wondzell and Swanson 1999).

Wetlands

Wetlands are critical for water storage and slowing the release of flood water and snow melt, recharge groundwater, and recycle nutrients (Keddy 2010). The National Wetlands Inventory is a detailed spatial inventory of wetland data mapped across the lower 48 states completed by the Fish and Wildlife Service. Wetland type and acreage across the Forest are shown in table 120.

Table 120. Riparian and wetland acreage for the Colville National Forest (National Wetlands Inventory)

Wetland Type	General Description	Total Acres
Freshwater Emergent Wetland	Herbaceous marsh, fen, swale, or wet meadow, palustrine emergent	5,001
Freshwater Forested/Shrub Wetland	Forested swamp or shrub bog wetland, palustrine forested/shrub	6,767
Total		**11,768**

Groundwater-dependent Ecosystems

Groundwater is the portion of precipitation that infiltrates into soil and bedrock and flows subsurface until it reaches the surface in streams, lakes, springs, seeps, and wetlands (USDA Forest Service 2014f). Ground and surface water are interconnected, with groundwater contributing to flow, chemistry, and temperature of streams, lakes, springs, and wetlands, providing the water to support terrestrial and aquatic plants and animals. Groundwater is also critical to water supply and provides drinking water to communities across the country (USDA Forest Service 2007b).

Groundwater-dependent ecosystems (GDEs) are areas that require access to groundwater to maintain the community of plants, animals, and physical processes. Examples of GDEs include, springs, seeps, and groundwater-fed wetlands. Groundwater-fed wetlands are particularly important biophysical features on the Forest due to their water storage capability, the disproportionately large numbers of rare and uncommon plant species they support, and the susceptibility of their generally wet, peaty soils to negative physical alteration due to certain management practices. Proper hydrologic function is critical to maintaining conditions in GDEs that support wetland plants and animals. Management activities with the potential to impact GDEs include grazing, road building and maintenance, recreation, vegetation management, large wildfires, and climate change. Impacts to GDEs from these activities are mitigated through standards, guidelines, and BMPs, which are discussed in the effects analysis of this section.

Inventories of GDEs on the Forest have primarily been completed at the project level. The national hydrography dataset shows mapped springs and seeps and provides a basis for quantifying springs and seeps across the Forest; however, this dataset underrepresents the actual number of springs, seeps, and other groundwater-dependent ecosystems. A summary of the number of springs and seeps across the Forest from national hydrography dataset data is shown in table 121. Location of GDEs can also be approximated using the National Wetland Inventory’s categorization of palustrine emergent wetlands which occupy only 12 acres on the Forest. Data from the National Wetlands Inventory also underrepresents GDEs and underscores the need for project-level analysis of location and condition of GDEs during planning.

The Forest Service released a draft groundwater management directive in 2014, to amend its internal direction to establish comprehensive direction for management of groundwater resources on NFS lands (FSM 2560 (draft)). The intent of the proposed directive was to clarify roles and establish new processes and procedures for special uses involving withdrawal of groundwater resources. The proposed directive was withdrawn on June 19, 2015, because concerns were raised through collaboration with Tribes, conservation organizations, states, and other organizations that the proposed directive may exceed the Agency’s authorities and infringe on State authorities to allocate water (Federal Register, USDA Forest Service 2015d). The intent of any new groundwater directive would be to establish a clear and consistent approach for evaluation and monitoring of the effects of different actions on groundwater resources on NFS lands through a collaborative process (Federal Register, USDA Forest Service 2015d).

Groundwater Aquifers

The Forest is underlain by aquifers that occur in pre-Miocene rocks including igneous, metamorphic, volcanic, and marine and non-marine sedimentary rocks that vary in permeability and water yield. Higher water-yielding aquifers in unconsolidated deposits consisting of primarily of sand and gravel with lesser components of clay and silt occupy less than 25 percent of the Forest land base (Whitehead 1994). Aquifers occurring in unconsolidated deposits occur primarily in the eastern portion of the Forest.

Surface and Groundwater Interaction

The interaction between surface and groundwater is a function of climate, geology and aquifers, and soils. Soil affects how water moves across the landscape, and the quantity and timing of stream discharge. Soil water movement was modeled across the Forest using soil erodibility, soil runoff potential, and soil available water storage (Farr et al. 2017). Soil water flow categorization and description, and springs and seeps (from national hydrography dataset) are shown in table 121.

Table 121. Soil water flow category acreage across the Colville National Forest administrative forest and number of springs and seeps within each soil water flow category

Soil Water Flow Category	Description	Total Acres	Number of Seeps and Springs
Runoff	Primary water movement is on the surface of the soil	393,297	61
Storage	Water primarily infiltrates and is stored in the soil	693,438	116
Lateral Flow	Water infiltrates and water movement is primarily subsurface	180,149	29
No Category	n/a	0	5
Total		**1,266,884**	**211**

Over half (54 percent) of the area of the Forest have soils that support infiltration and storage. Thirty-one percent of the soils support runoff of water across the soil surface; however, runoff potential is also affected by vegetation and litter cover, and precipitation intensity. Lateral flow is the primary soil water flow mechanism on 14 percent of soils across the Forest. Springs and seeps are most prevalent in areas where storage is the primary soil water flow mechanism.

Land Uses and Disturbances Affecting Watershed Function

Climate, topography, geology/soils and topography interact to affect runoff, erosion, and ultimately water quality and quantity, and stream channel function (Elliot 2010). The primary land uses that affect watershed function addressed in this section include vegetation management, wildland fire, insect and disease outbreaks, grazing, roads, and watershed restoration.

The Role of Upland Vegetation Condition in Hydrologic Processes

Forest vegetation plays a significant role in hydrologic processes (Hubbart 2007). In an intact forest ecosystem when precipitation falls as rain, vegetation intercepts a percentage of water that evaporates back into the atmosphere. Un-intercepted precipitation falls to the forest floor, where uncompacted soils and the vegetative litter layer allow water to slowly infiltrate into the soil. Infiltrated water enters the groundwater system where it is used by plants and other organisms, and transpired back into the atmosphere through plant photosynthesis. Infiltrated groundwater eventually flows back to the surface, feeding streams, lakes, rivers, springs, and other surface waters. A small percentage of precipitation may not be intercepted or infiltrated and may travel overland in a process known as overland flow. Overland flow is limited on forested lands with little disturbance to locations where precipitation intensity exceeds infiltration capacity (Horton overland flow), when soils are saturated and precipitation continues to fall (saturation excess overland flow), or disturbance results in soil compaction or loss of ground cover.

Precipitation falling as snow is associated with climatic processes, but is also dependent on forest cover. In winter, trees intercept significant amounts of snow that often sublimates (changes directly from solid to gas state) and never reaches the ground, reducing the amount of precipitation available to infiltrate or run off the landscape (Elliot 2010). Creation of canopy openings can alter rates of snow accumulation and alter the timing of snowmelt (Troendle and King 1985). Troendle et al. (2001) report that in coniferous forests in cold snow zones, 25 to 35 percent of snow would be intercepted and sublimated or evaporated. Studies have shown that snow water equivalent and snow melt rates are higher in open areas than in forested areas (McCaughey and Farnes 2001, Skidmore et al. 1994). In a study in northern Idaho, measured snow water equivalent was 200 millimeters less under a canopy than in an open area (Hubbart 2007).

The effect of changes in upland vegetation on hydrologic function is dependent on the processes through which changes in vegetation cover affect water cycle components, including evapotranspiration, snow accumulation and melt rates, infiltration, and overland flow (Chamberlin et al. 1991). Removal of canopy cover through timber harvest, insect and disease outbreaks, or wildland fire alters the hydrologic cycle by reducing interception by vegetation, altering evaporation and transpiration, and potentially increasing snow accumulation rates. Removal of vegetation and organic matter from the forest floor can also increase watershed runoff, erosion, and sedimentation. Removal of leaf litter and other vegetation material from the forest floor also increase runoff and erosion and sedimentation processes (Robichaud et al. 1993). Removal of forested vegetation can also affect water yield and peak flows. Reduction in canopy cover interception and evapotranspiration can increase the amount of precipitation available and the timing of runoff and recharge to surface water systems (Goodell 1965, Woods 1966). Changes in snow accumulation and timing and rate of snowmelt from changes in vegetation canopy cover also affect runoff, water yield, and peak flows. Effects to hydrologic process and function for timber harvest, die-off from insect and disease, and wildland fire are shown in table 122.

Table 122. Effects to hydrologic processes from timber harvest, die-off from insect and disease outbreaks, and wildland fire*

Associated Change	Die-off	Harvest	Fire
Canopy Cover Loss	X	X	X
Soil Compaction from Vegetation Removal Activities	X (if salvaged)	X	X (if salvaged)
Heat-induced soil water repellency			X
Litter layer/understory burning			X
Water yield	X	X	X
Increased peak flows	X	X	X

*Adams et al. 2012

Timber Harvest

Direct removal of vegetation through timber harvest can affect watershed processes including runoff, erosion, and sedimentation, water yield, and peak flows; however, the infrastructure to support vegetation removal has the greatest impact to hydrologic processes and function. Furniss et al. (1991) concluded that forest roads contribute more sediment than all other forest activities combined on a per-unit area basis (Meehan 1991). The majority of sediment from timber harvest activities is related to road construction and increased use of existing roads (Lee et al. 1997, Chamberlin et al. 1991, Dunne and Leopold 1978).

Removal of trees through timber harvest can also affect water yield. Studies on the effects of vegetation removal on water yield show highly variable effects, and generally have not been undertaken on a scale greater than small watersheds (Ziemer 1987). At small scales, changes in water yield are easier to measure, while changes in runoff per unit area are hard to measure directly for larger areas because changes are too small for direct measurement (Huff et al. 2000). In conifer forests a reduction in forest cover less than 20 percent, resulted in no detectable increase in water yield (Bosch and Hewlett 1982, Stednick 1996). Megahan et al. (1995) found no significant increase in either annual or monthly streamflow in a paired catchment study in Idaho, where 23 percent of one watershed was clearcut through helicopter logging and burned. A study on a clear-cut in 25 percent of the study basin in the Uinta Mountains of Utah found up to a 147 millimeters (52 percent) increase in annual water yield with the largest increases in May to August. Increases in water yield persisted for the 20 years data was collected after harvest (Burton 1997). A 30-year study of watershed response to timber practices at the High Ridge evaluation area in the Northern Blue Mountain showed low-magnitude, short-term increases in water yield after clear cutting (Helvey et al. 1995).

The greatest relative increases in water yield and streamflow from vegetation removal in the Pacific Northwest are observed in the summer low-flow season; however, larger overall increases occur during snowmelt (Harr 1979, Troendle et al. 2001, Brown et al. 2005). In a study in northwestern California, Keppeler and Ziemer (1990) found that relative water yields were greater during summer low-flow, than annual flows, with increases diminishing 5 years post-harvest.

Generally, water yield increases in proportion to forest vegetation removed, with lower magnitude in response in dry regions (Stednick 1996, Brown et al. 2005). Water yield typically increases in the first year following fire or logging, but slowly decreases to pre-disturbance levels as vegetation reestablishes (Hibbert 1967, Peterson et al. 2009). The magnitude of increases in water yield is dependent on precipitation patterns 2 to 3 years after disturbance as vegetation begins to recover. The duration of water yield and peak flow increases following vegetation removal or mortality is dependent on timing and intensity of precipitation and snowmelt rates (MacDonald 2000), and rate of vegetation recovery. Areas with high precipitation generally have vegetation regenerate, resulting in the rapid return of streamflow to pre-disturbance state. However, these same higher-precipitation watersheds also have the most pronounced, yet short-lived increase in water yield (Stanley and Arp 2002). Therefore, short-term increases in water yield may be more pronounced on the wetter eastern side of the Forest. Smaller magnitude increases in water yield would be expected in the drier western section of the Forest, however these effects may be longer in duration, as vegetation may take longer to reestablish.

While small-scale studies show that water yield can be increased through focused forest management, the scale of treatment needed to increase water yield on NFS lands is constrained by a variety of factors. Only portions of areas on NFS lands can be economically treated based on physical, environmental, and political constraints (Ziemer 1987). Although it has not been studied locally, a 1983 study for NFS lands in the Sierra Nevada Mountains of California found that if multiple use/sustained yield guidelines were followed, water yield could be increased by 1 percent above current levels (Kattelman et al. 1987). This increase would likely be undetectable from a water use perspective; U.S. Geological Society stream gages usually have up to a 5 percent error (Rothacher 1970). In addition, most of the projected increases would occur during snowmelt in wetter years, rather than during summer low-flow and in drought years.

Vegetation removal also affects peak flows. In a compilation of paired and modeled watershed studies in western North America, the largest increases in peak flows were reported for small storms (less than 1 year recurrence interval), with increases in peak flows diminishing with higher magnitude storms (Grant et al. 2008). The largest peak flow increases were in watersheds that had been 100 percent clearcut, but there was no pattern between treatment type and magnitude of peak flow increase (Grant et al. 2008).

While vegetation treatment type affects peak flow, other management treatment considerations including road density, hydrologic connectivity, and drainage efficiency (Wemple et al. 1996), and riparian buffer widths also influence peak flows (Grant et al. 2008). Increased erosion and runoff from forest roads generally have a greater influence on peak flows than vegetation removal (Wemple et al. 2001).

Potential effects of timber harvest and vegetation removal to hydrologic function and water quality are mitigated through BMPs and implementation of land and resource management plan standards and guidelines, including limiting the temporal and spatial scale of treatments, limiting vegetation treatment in riparian areas and other unstable areas, and properly locating skid trails, landings, and temporary roads to limit erosion. While implementation of BMPs is included in all alternatives, standards and guidelines for timber harvest and other vegetation management activities vary by alternative, and are discussed in the effects analysis section.

Differences in land available for timber harvest, and the primary types of vegetation management activities and their potential effects are discussed in the Environmental Consequences section. In addition, timber harvest and other vegetation treatments generally require additional access through roads (either temporary or system), therefore potential effects of increased creation and use of roads for vegetation management activities are also discussed in the effects analysis section of this section.

Wildland Fire

Wildland fire includes both unplanned and planned initiations (prescribed fire). Prescribed fire is initiated to achieve resource management objectives, primarily to reduce the risk of high-severity fires and improve forest health. Wildland fire was once a common occurrence in forest lands across the Forest, however fire exclusion since the early 1900s has resulted in changes in forest structure and species composition resulting in increased risk of higher severity and intensity wildfires when they do occur (Hessburg and Smith 1999). Fire severity describes the effects of a fire to soil structure, infiltration capacity and biotic components and affects runoff and soil erosion potential from fire effects. Fire intensity describes fire effects to vegetative characteristics including tree mortality and consumption of understory vegetation and down wood (DeBano et al. 1998) and affects runoff rates, peak flows, water yield, and riparian canopy cover.

Fire kills trees and decreases canopy cover, partially or completely burns ground cover, and may form water-repellant soils (hydrophobic), depending on burn intensity. Soil water storage, interception, and evapotranspiration are reduced when vegetation is removed or killed by fire and when organic matter on the soil surface is consumed by fire (DeBano et al. 1998, Neary et al. 2005). Fire consumption of ground vegetation and hydrophobic soils increase overland flow and erosion and sedimentation risk. Burned areas are vulnerable to accelerated soil erosion, which can increase post-fire sediment yield (Neary et al. 2005). Increases in surface erosion following wildfire have been well documented (Helvey 1980, Robichaud and Hungerford 2000, Wondzell and King 2003, and Neary et al. 2005); however, effects are spatially variable based on soil condition, burn severity, and timing and magnitude of precipitation (Robichaud and Hungerford 2000). Helvey et al. (1985) found that annual sediment yield increased as much as 180 times above pre-fire levels following a high-mortality wildfire in the Entiat experimental forest in the eastern Cascades of Washington. Water yields and peak flows can also increase from large fires due to loss of canopy cover and reduction in evapotranspiration (Helvey 1980). Effects of vegetation removal through timber harvest on water yield discussed in the previous section are similar to the effects of wildland fire.

Prescribed fire is used as a management tool by itself or in conjunction with thinning to reduce fuel loading and the risk of uncharacteristically large fires (Mitchell et al. 2009). The most effective way to reduce fire severity is forest thinning in conjunction with prescribed burning (Covington et al. 1997, Graham et al. 1999). Most prescribed fires are ignited under conditions that limit the potential for high-severity fires (Wondzell 2001), they have less of an effect on vegetative litter and soil organic structure, and result in a lower risk of erosion and changes in water yield and peak flows (DeBano et al. 1998). A study of the effect of fuels treatment on modeled water yield in the 12,402-acre East Deer Creek subwatershed on the Forest was completed as part of a PhD dissertation in 2013 (Srivastava 2013). This study used the Watershed Erosion Prediction Project simulations to obtain modeled water yield pre-treatment (undisturbed forest) and post-treatment (thinning and prescribed burning), and found that implementation of thinning prescribed burn treatments would have a slight increase on water yield (0.69 percent) over pre-treatment conditions.

Climate change is expected to alter fire return intervals and exacerbate potential effects from increasingly large, severe fires. There is a close correlation with climate conditions and severity and extent of wildfires in the western United States, and projected changes in temperatures and precipitation in the interior Pacific Northwest are expected to increase the risk of larger, more severe fires (Littell et al. 2010, Westerling et al. 2003).

Potential effects to hydrologic processes from prescribed fire are mitigated through BMPs and standards and guidelines that limit fire intensity and severity, ground-disturbing activities (including firelines), and retain adequate groundcover. While more difficult to mitigate, effects from unplanned ignitions are mitigated through burned area emergency response activities, and post-fire rehabilitation of firelines and other infrastructure. In addition, forest vegetation management in all alternatives focuses on increasing landscape resiliency to large-scale wildland fire.

Insects and Disease

Large-scale insect and disease outbreaks can have similar effects to hydrologic function as large-scale wildland fire in the scale of disturbance and mortality of overstory vegetation (Wondzell 2001). Increases in stand mortality may increase fuel loading and increase susceptibility to large fires (Hessburg et al. 1994). There are limited studies on the effects of die-off from insect and disease outbreaks on erosion and sedimentation, but indirect effects include increased inputs of litter to the forest floor, and increased large woody debris to the stream system and upland environment (Wondzell 2001). Die-off from insects and disease can also alter water yield and peak flows through the same processes discussed in the Timber Harvest and Wildland Fire sections. Adams et al. (2012) hypothesize that in snowmelt-dominated watersheds, there would be decreases in evapotranspiration and increased flows if canopy cover from die-off exceeds 20 percent.

Vegetation Condition

The structure and composition of forest vegetation on the Forest has changed since Euro-American settlement (Wondzell 2001). Historical range of variability (HRV) analysis was used to evaluate existing forest structure condition for 5 vegetation types across the Forest and is discussed in detail in the Forest Vegetation Report (Day 2017). HRV describes the dynamic behavior and functioning of ecosystems before European settlement and provides a framework to determine changes between historical and current conditions (Aplet and Keeton 1999). When forest conditions move beyond the limits of HRV, they move into a state of disequilibrium, making them more susceptible to disturbances, including insect and disease outbreaks, changes in climate, and stand-replacing fires (Kaufmann et al. 1994). As discussed above, these large-scale episodic disturbances affect hydrologic and watershed function and processes and water quality. Historical range of variability percentage by vegetation type for 5 structure classes compared to current conditions are shown in table 123.

Table 123. Historical range of variability percentages by vegetation type for each structure class compared to 2012 conditions. Shaded cells are within HRV

		Early	Mid Open	Mid Closed	Late Open	Late Closed
Douglas-fir dry	2012	12	7	57	5	19
	Historical	6-16	2-8	4-13	38-78	1-32
Northern Rocky Mountain mixed conifer	2012	19	4	65	1	11
	Historical	9-25	1-3	18-30	4-6	44-60
Western hemlock / Western red cedar	2012	35	0	52	0	13
	Historical	4-24	0	7-27	0	55-83
Subalpine fir / Lodgepole pine	2012	33	4	49	2	13
	Historical	45-65	0	33-53	0	3
Spruce / Subalpine fir	2012	21	0	60	0	19
	Historical	14-46	0	13-41	0	29-57

There is an abundance of mid-structural and a lack of late-stage structure across 4 of 5 vegetation types on the Forest. These stands have smaller tree sizes and greater canopy cover than would be expected historically, which is consistent with fire suppression and other changing land use patterns (Day 2017). The overabundance of stands in the mid-closed structural class makes them more susceptible to large-scale disturbance and increases the risk of effects to hydrologic and watershed function.

Livestock Grazing

Livestock grazing is one of the most widespread uses in the interior Northwest; however, grazing on the Colville National Forest is less widespread and intensive than on other forests east of the Cascades in Oregon and Washington. Livestock effects include trampling of vegetation, soil compaction, and loss of vegetative cover (Platts 1991), which can increase stream and channel instability and result in unstable banks and incised and widened stream channels (Marston 1994). However, the impact of grazing depends on timing, intensity and frequency, as well as type of animals (Heitschmidt and Stuth 1991). Although grazing can affect upland conditions, effects to hydrologic and aquatic function are most pronounced in riparian areas and areas with active water because these areas are most sensitive to livestock disturbance, and they are often where use is concentrated.

Livestock concentrate in riparian areas and trampling and overutilization of riparian vegetation by livestock has contributed to the decline of riparian ecosystem structure and composition across the interior Pacific Northwest (Lee et al. 1997, Johnson 1992). Riparian areas in the western United States comprise approximately 1 to 2 percent of summer range, but provide 20 percent of forage available for livestock (Clary and Webster 1990).

The impacts of historical grazing practices across the West have been well-documented (Al-Chokhachy et al. 2010, Rieman et al. 2003); however, aquatic conditions have improved since the mid-1990s through implementation of existing aquatic conservation practices. The effects of grazing can be mitigated with proper management and implementation of practices that keep livestock out of streams and other aquatic features as well as riparian areas. Additional grazing protections were implemented following the establishment of INFISH guidelines in 1995. These guidelines were intended to provide protection for riparian areas to protect resident fish and water quality and move conditions toward attainment of riparian management objectives (RMOs). Analysis of status and trend of stream channel variables and RMOs is discussed in detail in MacDonald et al. 2017.

Monitoring of stream channel attributes through the PACFISH/INFISH Biological Opinion Effectiveness Monitoring Program indicate that since implementation of INFISH on the Forest, several stream habitat attributes have improved, with macroinvertebrate communities, bank stability, bank angle, pool tail fines, and percent pools showing positive, but not statistically significant trends. Substrate size (D50) has shown a negative, though not statistically significant, trend. Increases in large woody debris, pool depth, and percent undercut banks show a statistically significant improving trend in most subbasins (Archer 2015). At most sites, PACFISH/INFISH Biological Opinion trend data was calculated for two years of sampled data over a 10-year period (each site sampled once every 5 years). Two data points generally do not provide enough data to make conclusions regarding long-term trends.

The timeframe for measureable changes in stream channels may be decades or centuries and is often related to larger scale disturbance, such as floods and fires, making it difficult to isolate the effects of management on stream channel adjustments. With a longer record of data, trends may be detected. Other studies on changes in channel morphology following livestock exclusion support this conclusion. These studies have shown mixed improvement in stream channel condition and function because morphological change is often on a timescale longer than conducted studies, and is sensitive to processes at the watershed rather than reach scale (McDowell and Magilligan 1997, Medina and Martin 1988, Kondolf 1993).

Approximately 363,845 acres (33 percent) of the Forest are classified as suitable for cattle grazing, and 448,160 acres (41 percent) are suitable for sheep grazing. There are a total of 58 allotments on the Forest; 42 are active, and 16 are not currently grazed. Of the 16 vacant allotments, 7 are likely to be used again in the foreseeable future. An animal unit month (AUM) is the amount of forage used by a cow and a calf pair, one horse, or five sheep or goats for one month. AUMs have fluctuated between approximately 28,000 and 33,000 over the past 10 years (Fletcher 2017), and land and resource management plan alternatives do not propose changes to allotment boundaries, use, or AUMs. However, standards and guidelines pertaining to range management differ by alternative and are analyzed in the Environmental Consequences section.

Roads

Roads have wide-ranging effects on hydrologic processes and watershed function. The compacted surface of roads lowers infiltration capacity, which alters and concentrates overland flow and increases erosion and delivery of sediment to the stream system, degrading water and habitat quality (Furniss 1991). Roads can also intercept subsurface flow and convert it to rapid surface runoff, extending channel networks and increasing watershed efficiency (Wemple et al. 1996). Roads reduce vegetative cover in streamside areas and accelerate delivery of water and increase erosion and sedimentation into streams (Megahan 1983). Accelerated erosion, runoff, and sediment delivery from roads increases streambed fine sediment, which affects aquatic habitat and macroinvertebrates, and makes streambeds and banks more susceptible to erosion during high flow events (Cover et al. 2006). At crossings, excessive flow velocities and undersized culverts can alter stream channel function and increase the risk of channel and crossing instability at high flows (Furniss et al. 1998). Other road-related impacts include reduced potential large wood available for in-channel wood and shade from riparian areas. Meredith et al. (2014) found the presence of roads adjacent to streams reduced adjacent in-channel wood.

Slope position of roads is a critical factor in the interaction between roads and streams. Ridge-top roads can influence watershed hydrology by channeling flow into small headwater swales, accelerating channel development. Mid-slope roads can intercept subsurface flow, extend channel networks, and accelerate erosion (Gucinski et al. 2001). Roads adjacent to and crossing streams, or hydrologically connected to streams have the greatest influence on streamflow, streamside shade, and accelerated sediment delivery to the stream system (Croke et al. 2005). Hydrologically connected roads (portions of roads that route water and/or sediment directly to the stream system) increase flow routing efficiency and can increase peak flows and sedimentation (Wemple et al. 1996). Roads also simplify adjacent channels and riparian and in-stream habitat, and prevent natural channel adjustments (Spence et al. 1996).

Several road metrics provide a means to assess the potential effects and risk of roads. Road density is often used as a measure of risk, particularly in areas of active timber harvest (Lee et al. 1997, Sharma and Hilborn 2001). However, road density does not adequately assess the varying effects of roads across the landscape that are dependent on geology, precipitation, and location of roads in relation to the stream system (Lee et al. 1997). McCaffery et al. (2007) found a significant positive correlation between total road density, open road density, number of stream crossings, and fine sediment in streams. Traffic density on open roads can also present a larger erosion and sedimentation risk than closed roads. Reid and Dunne (1984) found that a heavily used road segment contributes 130 times as much sediment as a closed road.

The road indicator in watershed condition framework was calculated using open road density (road maintenance levels 2 to 5, and maintenance level 1 roads that have not been effectively hydrologically stabilized), proximity of roads to water, and the degree of road maintenance (Potyondy and Geier 2010). Results of the watershed condition framework for the roads and trails indicator show that roads are affecting hydrologic function across most of the Forest, with most subwatersheds rated as impaired for road indicators. In these subwatersheds, the density and distribution of roads and trails indicate that there is a high probability that the timing, magnitude, duration, and spatial distribution of flows is altered by the road system.

Additional metrics to assess the existing condition of the road system on the Forest are presented here. Total miles of road on the Forest, road density, riparian road density by subwatersheds, estimates of hydrologic connectivity, and number and relative risk of stream crossings are presented in this analysis. Calculations in this analysis were performed using all open and closed roads (maintenance levels 1-5) regardless of jurisdiction within the Forest administrative boundary. Decommissioned roads were also included in this analysis because spatial data does not include detail on the level of hydrologic decommissioning completed on decommissioned roads. Therefore, decommissioned roads are assumed to have a continued effect on the hydrologic system. Since they are used for one-time access as needed in a single timber sale or associated project, temporary roads were not included in this analysis. However, temporary roads can have an impact on hydrologic and aquatic function if they are not properly removed and stabilized following use.

Road density and mileage numbers presented here use the metrics that best represent the effects of roads and relative risk to the hydrologic system, and provide a more focused analysis of road condition and relative risk than the road and trails indicator ratings from the watershed condition framework. Road mileage and densities presented here may be different from those contained in other forest plan revision documents. Additional calculations of road density using different criteria are presented by management area and watershed in the effects analysis section. Calculation methodology for this road density metric is described when the data are presented.

Total miles of road on the Forest are shown in table 124. There are total of 5,221 miles of roads under all jurisdictions within the Forest administrative boundary. Fifty-seven percent of roads are open, and 19 percent are non-forest system roads. Approximately 15 percent of the roads are located in RHCAs and two-thirds of the roads in RHCAs are open.

Table 124. Miles of road on the Colville National Forest

Road Type	Miles	% of Total Road Miles	Miles in RHCAs	% of Total Road Miles
Total Existing Roads	5,221	100%	797	15%
Open	2,957	57%	547	10%
Closed	2,263	43%	250	5%

Road density of open and closed roads was computed at the subwatershed scale for all subwatersheds with greater than 25 percent of land within the Forest administrative boundary. Road density and riparian road density in each subwatershed was categorized based on relative risk, where less than 1 mile per square mile is good, 1 to 2.4 miles per square mile is fair, and greater than 2.4 miles per square mile is poor condition (Potyondy and Geier 2010). Road density and road density in riparian areas is shown in table 125. Road densities across subwatersheds on the Forest are generally in the fair to poor categories; only 5 subwatersheds have road density of less than 1 mile per square mile, and 57 percent of subwatersheds have road densities greater than 2.4 miles per square mile. Road densities in riparian areas are higher than general road densities; 73 percent of subwatersheds have riparian road densities greater than 2.4 miles per square mile, and only 4 subwatersheds have riparian road densities less than 1 mile per square mile.

Table 125. Subwatersheds categorized by road density and riparian road density

Road Density Category		Number of subwatersheds in each road density category	
Road Density	Road Density Condition Rating	Total Road Density	Riparian Road Density
less than 1 mi/mi^2	Good	5	4
1-2.4 mi/mi^2	Fair	27	16
>2.4 mi/mi^2	Poor	43	55
Total		75	75

Hydrologically connected roads and crossings are a higher risk to the stream system than mid-slope and ridgetop roads because they deliver water and sediment directly to the stream system. Several tools and models can be used to assess the relative hydrologic risk of the road system, and determine the location of roads were risk could be minimized through focused restoration and road improvements. One tool is the empirical and model based Geomorphic Road Analysis and Inventory Package (GRAIP). Road sediment delivery data collected across four watersheds in the Pacific Northwest using GRAIP, including the North Fork Siuslaw and North Fork John Day watersheds in Oregon and the Bear Valley and the MF Payette watersheds in Idaho, found that 2 to 10 percent of road drain points (depending on watershed) deliver 90 percent of sediment from the road to the stream system (GRAIP 2014). Results of this analysis suggest that when the location and relative sediment production and delivery of high-risk roads is known, treatments can focus on a relatively small percentage of the road system to reduce hydrologic impacts.

There are an estimated 2,285 road/stream crossings across the Forest. Relative risk of sediment delivery to the stream system from the crossings was assessed using length and gradient of road on each side of the crossing approach. Number of crossings and relative risk are shown in table 126. Fifty-four percent of crossings on the Forest are at high risk for sediment delivery.

Table 126. Number of crossings and relative risk of sediment delivery

Number of Crossings	Crossing Risk
350	Low
694	Medium
1,241	High
2,285	**Total**

Crossings and roads within RHCAs were used to estimate hydrologic connectivity of the road system. There are an estimated 862 miles of hydrologically connected road across the Forest (17 percent of the road system). These roads have the highest risk of sediment delivery and other impacts to the stream system and are the primary focus of road treatments to improve hydrologic function and aquatic habitat across the Forest in Plan Objectives.

Some of the effects of roads to watershed function can be mitigated through road design and location (Furniss et al. 1991), implementation of BMPs, and treatments to reduce erosion and hydrologic connection of roads to the stream system. Treatments including road surfacing, improvement of road drainage through construction of waterbars or drainage dips, and seasonal closures to prevent road damage during wet weather can reduce erosion and sedimentation (Burroughs and King 1989, Bilby et al. 1989). Hydrologic road decommissioning through full road prism recontour is also an effective method to restore hydrologic function on roads that are no longer needed for access or forest management. While road decommissioning treatments have been found to reduce erosion and sedimentation, the technique does not eliminate all road-related sediment delivery to streams (Madej 2001), and erosion and sedimentation may increase in the first 2 to 3 years after treatment (Luce et al. 2001). Hydrologic stabilization of roads is an appropriate treatment when the road is needed for long-term management activities, but will be kept in storage for an extended period. Hydrologic stabilization minimizes hydrologic risk from the road system and includes culvert removals, installation of water bars, and outsloping. Other road maintenance activities can increase short-term sediment routing to streams through the exposure of additional soil, alteration of slope stability in cut and fill areas, removal of vegetation, and alteration of drainage patterns (Reid and Dunne 1984, Luce and Black 2001).

Effectiveness of road treatments is dependent on type of treatment, erosion rates, and timing and amount of precipitation. While road decommissioning is usually the most effective method to reduce road hydrologic risk, simply closing the entrance to a road does not reduce hydrologic risk. Hydrologic decommissioning, or stabilization (depending on long-term access needs) including removal of culverts, de-compaction of road surface, and return to natural land contour (if needed) are the most effective treatments to reduce road hydrologic risk.

Effectiveness of hydrologic road decommissioning and storm damage risk reduction treatments was evaluated across the Pacific Northwest using GRAIP (Nelson et al. 2012, Cissel et al. 2014). Road decommission was monitored on 68 km of road and hydrologic connectivity was reduced by 58 percent, and sediment delivery was reduced by 64 percent. Storm damage risk reduction treatments were monitored on 86 km of road and hydrologic connectivity was reduced by 9 percent, and sediment delivery was reduced by 51 percent. Post-storm inventories of decommissioned and control roads found that connectivity was reduced by 44 percent and fine sediment delivery was reduced by 80 percent. Roads treated through storm damage risk reduction showed a 67 percent reduction in fine sediment delivery, but an 11 percent increase in hydrologic connectivity post storm.

While there are numerous treatments to mitigate the hydrologic effects of roads, not all effects of roads are preventable. A 1983 study in northwestern California showed that 24 percent of road-related erosion could have been prevented from conventional engineering techniques, with the remaining 76 percent of erosion caused by site condition and road location (McCashion and Rice 1983). This study on 344 miles of road, illustrates the concept that the mere existence of roads increases erosion and sedimentation and supports the practice of full decommissioning of the road prism to minimize risk. GRAIP effectiveness monitoring shows that decommissioning treatments were more effective in reducing sediment delivery and road hydrologic connectivity than storm damage risk reduction treatments (Nelson et al. 2012).

Watershed Restoration and Monitoring

Over the last two decades, watershed restoration has become a larger focus of land management across the National Forest System. New direction on watershed restoration since the 1988 forest plan is a primary need for change addressed in this forest plan revision.

INFISH

The 1988 Colville Forest Plan was amended by the Inland Native Fish Strategy (USDA Forest Service 1995a), which provides additional direction intended to restore and maintain the ecological health of watersheds and aquatic ecosystems on National Forest System lands for native resident fisheries. INFISH was implemented in response to the potential listing of resident fish species under the Endangered Species Act (ESA). INFISH prescribed riparian management objectives (RMOs) and designated priority watersheds. RMOSs are discussed in greater detail in the fisheries analysis section. INFISH designated priority watersheds as those “Watersheds having excellent habitat or strong assemblages of inland native fish, particularly bull trout, or watersheds that provide for population distribution goals, or watersheds having a high restoration potential” (INFISH, USDA Forest Service 1995a). Priority watersheds under INFISH are a long-term, strategic network of watersheds that serve as strongholds for native fishes and provide high-quality water. Priority watersheds under INFISH were originally designated in 1995, and were amended in 2001. INFISH-designated priority subwatersheds for the Colville National Forest are shown in the following table.

Table 127. INFISH priority watersheds on the Colville National Forest designated at the subwatershed scale

Subwatershed Name	Subwatershed Number
Cedar Creek	170102161003
East Branch LeClerc Creek	170102160203
Exposure Creek-Pend Oreille River	170102160103
Harvey Creek	170102160303
Headwaters Sullivan Creek	170102160304
Headwaters South Salmo River*	170102160702
Middle Creek-Pend Oreille River	170102160301
North Fork Sullivan Creek-Sullivan Creek	170102160305
Outlet South Salmo River*	170102160704
Skookum Creek	170102160202
Slate Creek	170102160306
Sweet Creek-Pend Oreille River	170102160302
West Branch LeClerc Creek	170102160202

Riparian habitat conservation areas (RHCA) widths in INFISH priority watersheds under INFISH are wider than RHCA widths in non-priority watersheds for non-fish-bearing intermittent streams and wetlands less than 1 acre (table 128). INFISH did not specify additional more-restrictive standards or guidelines for priority watersheds. Table 119 contains a more complete definition of the RHCA widths.

Table 128. Differences in RHCA widths for INFISH priority and non-priority watersheds

	INFISH RHCA Designation for non-priority watersheds	INFISH Priority Watershed RHCA designation
Non-fish-bearing intermittent	50	100
Wetland less than 1 acre	50	100

Aquatic Restoration Strategy

The Forest Service Region 6 Aquatic Restoration Strategy (ARS) was originally developed in 2005 to provide guidance for watershed and aquatic and riparian condition improvement at a regional scale through both passive and active restoration techniques (USDA Forest Service 2005b). Passive restoration is the broad-scale natural recovery of the aquatic ecosystem and includes coordination, analysis, planning, and design activities to maintain or improve habitat conditions while implementing projects across multiple resource areas (USDA Forest Service 2005b). Examples include implementation of best management practices (BMPs), designation of riparian habitat conservation areas (or riparian management areas), compliance with laws, regulations, permits, and plans, interagency coordination, monitoring, and adaptive management. Active restoration includes management actions with the specific goal of restoring the processes that improve aquatic and riparian habitat function. Active restoration is focused on a more limited scale than passive restoration.

ARS prioritized basins for aquatic restoration based on modeling of aquatic resource condition, watershed sensitivity, and sensitivity to management (USDA Forest Service 2005b). Through the basin prioritization process, the Upper Columbia basin was designated as high priority and the Pend Oreille and Spokane basins were designated as low priority basins. Since the prioritization of these basins, there is recognition that the basin scale is meaningful for planning at the regional scale, but it may not reflect restoration goals at the scale of individual forests (MacDonald 2014e).

Through the ARS, the Forest identified 3 focus watersheds to focus active restoration (table 131). Focus watersheds were identified in 2008 based on the need for watershed restoration to improve aquatic habitat condition, function, and water quality, the presence or potential presence of native fish populations, partnership potential and planned or completed NEPA documentation for restoration.

Table 129. Focus 5th field watersheds on the Colville National Forest

Watershed Name	Watershed Number
LeClerc Creek-Pend Oreille River	1701021602
Upper Sanpoil River	1702000401
Chewelah Creek-Colville River	1702000301

In partnership with the Okanogan National Forest and the Colville Confederated Tribes, the Forest completed a watershed action plan (WAP) for the Upper and West Forks of the Sanpoil River in 2012 (SWAP 2012). The LeClerc Creek Watershed Action Plan (Hickenbottom et al. 2009) was completed in 2009. These watershed action plans describe limiting factors to structural and biological aquatic function and prioritize aquatic restoration projects for the improvement of water quality, watershed function, aquatic habitat, riparian function and structure (Hickenbottom et al. 2009, SWAP 2012). A WAP for the Chewelah Creek-Colville River watershed has not yet been completed.

Watershed Condition Framework

In 2010, national forests throughout the United States implemented the Watershed Condition Framework process, with the goal of identification of current conditions of subwatersheds on NFS lands. The results of the assessment were used to identify priority subwatersheds where focused management over a 5- to 10-year period could improve constituent elements that impair watershed function. The watershed condition framework process and results are discussed in greater detail in the Existing Condition section. The Forest identified 3 priority watersheds through this process (table 131), and completed watershed action plans outlining essential project to improve watershed condition for 3 priority watersheds, in 2011 and 2012, including West Branch LeClerc Creek, East Branch LeClerc Creek, and Ninemile Creek (USDA Forest Service 2011b, 2012f and i). Completion of essential projects within these subwatersheds is currently in progress, and has been completed in the East Branch LeClerc Creek subwatershed. Once essential projects in existing subwatersheds are completed, additional priority subwatersheds would be identified through the life of the plan.

Table 130. Priority watersheds on the Colville National Forest

Subwatershed Name	Subwatershed Number
West Branch LeClerc Creek	170102160202
Ninemile Creek	170200040107

Summary of Existing Priority Watersheds

The watershed hierarchy of existing focus and priority watersheds for restoration is shown in table 131.

Aquatic and Riparian Conservation Strategy (2008)

The Aquatic and Riparian Conservation Strategy (ARCS) was developed by Forest Service Region 6 in 2008 to consolidate management direction from the Northwest Forest Plan, PACFISH, INFISH, and ARS into a framework document to be used in forest plan revision. ARCS includes five elements including; designation of riparian management areas (RMAs), designation of a key watershed network, mid-scale analysis of watersheds, watershed restoration, and monitoring. The interaction of these five elements forms the basis for watershed, aquatic, and riparian ecosystem management and restoration (USDA Forest Service 2008a).

Scientific studies completed after the initiation of the Northwest Forest Plan, PACFISH, and INFISH support their assumptions and general framework; however, there was a need for a unified aquatic conservation strategy that incorporated new science and addressed and clarified issues identified through more than a decade of field-level implementation (Naiman et al. 2000, Spence et al. 1996, Reeves et al. 2006, Heller and McCammon 2004). Providing refinement to earlier strategies is the primary basis for the development of the original version of ARCS. ARCS-2008 includes better recognition of the role of disturbance in building ecosystem resiliency, consideration of scale effects on ecosystem processes, confirmation of the value of watershed-scale analysis, the need for better monitoring, and better establishment of the linkage between management intent and aquatic strategy.

Most alternatives in this forest plan revision use ARCS as the framework for management of hydrologic and aquatic resources, however each alternative uses different versions of ARCS. The proposed action and alternative O include plan components from the original 2008 version of ARCS. ARCS-modified plan components are included in alternative R and are described below. As described below, the Colville

ARCS included in alternative P is a synthesis of the 2008-ARCS, ARCS-modified, and the 2016 version of ARCS.

Table 131. Summary of existing priority and focus watersheds

Focus Watershed Name (Designated through ARS)	Priority Subwatershed Name (Designated by INFISH and watershed condition framework)	INFISH Priority Subwatershed	Watershed Condition Framework Priority Subwatershed
Chewelah Creek-Colville River	N/A		
Upper Sanpoil River	Ninemile Creek		X
LeClerc Creek-Pend Oreille River	West Branch LeClerc Creek	X	X
	East Branch LeClerc Creek	X	*
	Cedar Creek	X	
	Exposure Creek-Pend Oreille River	X	
	Harvey Creek	X	
	Headwaters Sullivan Creek	X	
	Headwaters South Salmo River	X	
	Middle Creek-Pend Oreille River	X	
	North Fork Sullivan Creek-Sullivan Creek	X	
	Outlet South Salmo River	X	
	Skookum Creek	X	
	Slate Creek	X	
	Sweet Creek-Pend Oreille River	X	

*The East Branch LeClerc subwatershed was previously a priority watershed, however all essential projects for restoration were completed in 2016 and the subwatershed is no longer a priority, per the Watershed Condition Framework process.

ARCS-Modified

The 2008-ARCS supports forests adding specificity and local detail to tailor management of watersheds and riparian resources to local systems and conditions. As forests work through a public and internal collaborative process, plan components may be added to those provided in ARCS that are forest-specific and science-based (USDA Forest Service 2008a).

Based on public and internal comments, best available science, and new policies on Forest Service management of aquatic and riparian resources, including the Watershed Condition Framework, discussions with the forest plan interdisciplinary team, resource specialists in the Pacific Northwest regional office, and other reviewers of the revised land and resource management plan, components in ARCS were updated in alternative R. The updated plan components are referred to as ARCS-modified in the FEIS.

Most of the updates made to ARCS plan components ARCS-modified add clarity to individual plan components (i.e., guidelines worded properly as guidelines, standards worded as standards). The interdisciplinary team also considered operational constraints in the evaluation of each standard and guideline within ARCS. Specific differences between ARCS and ARCS-modified are discussed in the environmental consequences section. ARCS-modified is included in Alternative R.

During the forest plan revision process, the terms ARCS, ARCS-modified, 2016 ARCS, and Colville ARCS are used to distinguish differences in aquatic and riparian direction between alternatives. Once a revised land and resource management plan decision is signed, these terms would no longer be used. The plan components and aquatic direction within ARCS would become part of the revised land and resource management plan and are encompassed in the Colville ARCS.

2016-ARCS

Since 2008, the Forest Service Region 6 Office worked to integrate recent policy direction, best available science, and better align ARCS with the 2012 planning rule into ARCS-2016 (USDA Forest Service 2016a). While ARCS-2016 is tailored specifically for forest plan revisions completed under the 2012 planning rule, certain aspects of ARCS-2016 were incorporated into the Colville Plan in alternative P. Primarily, plan components incorporated from ARCS-2016 provided greater clarity than what was contained in ARCS-modified and respond to issues raised both by the public and the Forest Service interdisciplinary team with regard to operation flexibility and assurances of protection and improvement of aquatic resources.

Colville ARCS

The overall strategy to maintain and restore the ecological health of watersheds and aquatic and riparian ecosystems on the Colville National Forest is incorporated throughout the land and resource management plan (primarily in the Water Resources and Riparian Management Area sections). The Colville Aquatic and Riparian Conservation Strategy (Colville ARCS) is outlined in a stand-alone document (appendix H) that includes plan components (desired conditions, objectives, standards, guidelines), designation and discussion of riparian management areas and key watersheds, and a discussion of how aquatic protection and restoration would be prioritized, completed, and monitored.

Water Quality, Quantity, and Uses

Water quality and water uses on the Forest are managed cooperatively with other State and Federal agencies responsible for preservation and management of water quality, and quantification and management of water rights and uses. In Washington, Water Resources Inventory Areas (WRIAs) are the administrative and planning boundaries used by State agencies as the basis and scale for management of water quality, water uses and rights, and management of fish and wildlife. WRIAs were formalized under WAC 173-500-040 and authorized under the Water Resources Act of 1971, RCW 90.54. The Washington Department of Ecology (Ecology) has the responsibility for development and management of designation and management of WRIA administrative and planning boundaries (WADoE 2014d). There are seven WRIAs that contain the Forest administrative boundary. Generally, WRIAs follow subbasin boundaries, however, the Franklin D. Roosevelt subbasin is divided into the Upper Lake Roosevelt and Middle Lake Roosevelt WRIAs (table 132).

Table 132. Crosswalk between subbasins and WRIAs on the Colville National Forest administrative forest

Subbasin	WRIA Name	WRIA Number
Pend Oreille River	Pend Oreille	62
Upper Columbia River—FDR Lake	Upper Lake Roosevelt	61
	Middle Lake Roosevelt	58
Colville River	Colville	59
Kettle River	Kettle	60
Sanpoil River	Sanpoil	52
Upper Spokane	*Little Spokane	55

*There is no Colville National Forest ownership within the Little Spokane WRIA.

Water Quality

Water produced on the Forest is generally of high quality; research on the effects of land management has shown that water quality in undisturbed forests is usually good. In managed watersheds, water quality is affected by land-use practices (USDA Forest Service and USDI Bureau of Land Management 2000). The most widespread pollutants of concern on the Forest are fecal coliform bacteria and temperature. High summer air temperatures during summer low-flows and reduction in stream shading can increase summer stream temperature. Fecal coliform levels are elevated from both native mammals and livestock grazing both on and off NFS lands. Dissolved oxygen and pH are also pollutants of concern, but are not as widespread as fecal coliform and temperature.

Sediment is also considered a pollutant if high levels of fine sediment accumulation are affecting aquatic habitat and channel function. Fine sediment accumulation is a natural channel function and varies based on geology, streamflow, and channel gradient (Montgomery and Buffington 1997). Accumulation of fine sediment is evident in some streams on the Forest from localized bank erosion and roads.

Best Management Practices

Preventing water quality impacts is more effective than restoring damage from management activities. Implementation and monitoring of BMPs is the fundamental basis of the Forest Service water quality management program to protect, restore, or mitigate water quality impacts from activities on NFS lands (USDA Forest Service 2012d). BMPs are methods, measures, or practices to reduce or eliminate the introduction of pollutants into receiving waters (36 CFR 219.19). Site-specific BMPs are required and implemented at the project level using Washington forest practices rules (222 WAC), regional guidance (USDA Forest Service 1988d), forest plan direction, and national BMP guidance.

Implementation and effectiveness monitoring of BMPs has been completed across project activities on the Forest since the development of regional BMPs; however, monitoring completed at the project scale was not integrated into a larger program of consistent BMP monitoring and reporting. The Forest Service's national BMP program was established in 2012 to establish consistent direction for BMP implementation to control non-point source pollution on NFS lands to avoid, minimize, or mitigate adverse effects to soil, water quality, and riparian resources and meet the intent of State and Federal water quality laws and regulations, executive orders, and USDA and Forest Service directives. The national BMP program also establishes a consistent process to monitor, evaluate, and report implementation and effectiveness of BMPs in the protection of water quality at multiple scales (USDA Forest Service 2012d), and provides a strong feedback loop to address shortcomings in BMP effectiveness and/or implementation.

BMP implementation and effectiveness has been systematically monitored across NFS lands in California since 1992, using protocols similar to the more recent national BMP protocols. From 2008 to 2010, randomized monitoring showed 91 percent of BMPs were implemented, and 80 percent of implemented BMPs were rated effective. BMPs for timber harvests, fuels treatments, and vegetation management were consistently highly effective, while BMPs for other activities, including roads, range management, recreation, and mining, were less effective (USDA Forest Service 2013c). At sites where BMPs were not implemented or effective, the monitoring program includes a strong feedback loop to take corrective action on non-compliance scenarios.

BMP monitoring completed on the Forest since 2012, using the national BMP protocol indicates that most projects monitored were implemented correctly, and that BMPs were generally effective in protecting water quality. When BMPs were not implemented correctly, monitoring provided the feedback to implement corrective actions where needed to improve future BMP implementation and effectiveness (USDA Forest Service 2013a).

Water quality across streams in the Forest has improved in recent years as a result of changes in management from INFISH direction, implementation of BMPs, direction from the Regional Aquatic Restoration Strategy, fish recovery plans, and increased emphasis on watershed restoration and partnerships. The Forest has been working on grazing allotments to implement BMPs including off-stream watering, riparian exclusion fencing, and adjusting grazing timing and numbers (where appropriate). In addition, the Forest has worked to restore riparian areas, stabilize stream banks, and implemented measures to prevent off-highway vehicle use near streams and wetlands (USDA Forest Service 2013a).

Beneficial Uses and the Clean Water Act

The principal law governing pollution in the Nation's streams, lakes, and estuaries is the Federal Water Pollution Control Act (P.L. 92-500, enacted in 1972), commonly known as the Clean Water Act (CWA). The CWA is the primary Federal law that protects the Nation’s waters, including lakes, rivers, aquifers and coastal areas from point and non-point source pollution. The main objective of the CWA is to restore and maintain the integrity of the Nation's waters through regulation of point and non-point source water pollution.

Through the CWA, each state is required to provide guidance and direction for the protection and restoration of water bodies (40 CFR 131.12). In Washington, the U.S. Environmental Protection Agency (EPA) has designated authority for compliance with the CWA to the Washington Department of Ecology (WADoE). As required under the CWA, Ecology identified beneficial uses and developed water quality standards to protect beneficial uses. Water quality standards for the primary pollutants on streams and rivers across the Forest are shown in table 133. Designated beneficial uses established for national forests, wilderness areas, and national parks in Washington include (WAC 173-201A-200, Baldwin 2006):

- Salmon and trout spawning, core rearing and migration
- Extraordinary primary contact recreation
- Domestic, industrial, and agricultural water supply
- Stock watering
- Wildlife habitat
- Harvesting (fish, etc.)
- Commerce and navigation
- Boating
- Aesthetic values

Section 303(d) of the CWA and EPA regulation (40 CFR 130.2(J), and 130.7), delegates the authority to list waters that do not meet water quality standards or beneficial uses to individual states. Washington determines its 303(d) list through the water quality assessment process. Once a water body is listed as impaired on the 303(d) list, it is Ecology’s responsibility to develop a Total Maximum Daily Load (TMDL) for each pollutant of concern. A TMDL is a quantitative plan and analysis procedure for attaining and maintaining water quality standards and specifies the total load of pollutant a waterbody can carry and still meet beneficial uses. The TMDL and associated Water Quality Implementation Plan (WQIP) outline the process through which beneficial uses can be met through the identification of sources of pollutants, and actions that lead to improved water quality (40 CFR 130.2(H)).

Table 133. Water quality standards for waters of the Colville National Forest (WAC 173-201A-200)

Parameter	Standard
Temperature	16 °C (60.8 °F), 12 °C (53.6 °F) in bull trout critical habitat (7 day average of daily maximum temperature)
pH	6.5-9.0*

Parameter	Standard
Fecal Coliform	geometric mean above 50 colonies per 100 milliliters with the 90th percentile of the samples not exceeding 100 colonies per 100 milliliters
Dissolved Oxygen	9.5 mg/L (lowest 1-day minimum)
Total Dissolved Gas	Shall not exceed 110% of saturation at any point of sample collection
+Turbidity	5 NTU over background when background is 50 NTU or less. A 10% increase in turbidity when background turbidity is more than 50 NTU.

*Based on naturally occurring dissolved calcite from regional limestone geology, the upper range of the standard for pH was raised from 8.5 to 9.0 (Whiley and Baldwin 2005).

+ Sediment in water bodies fits into two categories: suspended sediments (measured and regulated by the turbidity standard), and bedded sediments. There is no approved water quality standard for sediment in Washington. Bedded sediments are difficult to regulate and implement without site specificity on background erosion rates (Seeds and Foster 2010).

A 2000 Memorandum of Agreement (MOA) between Ecology and Region 6 of the U.S. Forest Service designates the Forest Service as the management agency for meeting CWA requirements on NFS lands. Through this MOA, the Forest Service is responsible for ensuring that all waters on NFS lands meet or exceed water quality laws and regulations and that activities on NFS lands are consistent with protections provided in the Washington Administrative Code and relevant State and water quality requirements (USDA Forest Service and WADoE 2000). The MOA recognizes the contribution of existing Forest Service direction, including the Interior Columbia Basin Ecosystem Management Project, INFISH, and BMPs in meeting water quality laws and regulations, and states that the Forest Service and Ecology will collaborate to address 303(d) listings through the development of TMDLs and WQIPs (USDA Forest Service and WADoE 2000). While the 2000 MOA has not been updated, the Forest Service and Ecology continue to manage CWA compliance under the MOA.

While the Forest Service has made progress under MOA implementation, the agency is challenged by budget constraints that make treatment of all road-related risk difficult. The Forest Service continues to prioritize and treat roads that are the greatest risk to aquatic and riparian systems. The Forest uses a science-based roads analysis procedure to evaluate road risk and uses this information to prioritize road treatments based on beneficial uses and conditions. In addition, the Forest minimizes the construction of new roads, especially those located near streams or unstable areas, and decommissions or hydrologically stabilizes high risk roads.

The 2008 Water Quality Assessment and 303(d) list was approved by the EPA December 21, 2012 (US EPA 2012). The 2008 Water Quality Assessment and 303(d) list is considered the ‘2012 Water Quality Assessment’ to reflect when the assessment was approved rather than when the assessment was scheduled for completion (WADoE 2014a, b). The 2012 Water Quality Assessment 305(b) list and 303(d) list contains 42 stream reaches on the Forest that do not meet water quality standards and includes all impaired stream segments added to the 303(d) list since 2004 that are not under an approved TMDL (WADoE 2014a, b, and e). Impairment pollutants include fecal coliform bacteria, dissolved oxygen, pH and temperature. Portions of Big Muddy Creek, Brown’s Creek, Buck Creek, Middle and North Fork Calispell Creek, Cedar Creek, Cee Ah Creek, Cottonwood Creek, East Deer Creek, Exposure Creek, Fisher Creek, Halfmoon Creek, Harvey Creek, Lambert Creek and an unnamed tributary, East, West, Middle, and main stem LeClerc Creek, North Fork and main stem Lone Ranch Creek, Lost Creek, McGahee Creek, Meadow Creek, Mill Creek, Pend Oreille River, Ruby Creek, Sandwich Creek, North Fork, South Fork, and main stem Sherman Creek, South Fork and main stem Skookum Creek, Slate Creek, Smackout Creek, North Fork St. Peter Creek, North Fork and main stem Sullivan Creek, Tacoma Creek, and Wilson Creek are on the 2008 303(d) list. Bead Lake is the only lake on the Forest on the 303(d) list and is listed for PCBs and dioxins found in fish tissue samples.

To meet the goals outlined in the MOA and comply with the CWA, Ecology began working with the Forest in 2002 on a TMDL for temperature, bacteria, pH, and dissolved oxygen and WQIP (WADoE 2006) for waters across the Forest on the 1998 303(d) list. The EPA approved the TMDL and WQIP for fecal coliform on 8 waterbody segments and temperature on 4 segments from the 1998 303(d) list as well as 41 temperature-impaired waterbody segments added to the 303(d) list during the TMDL development process in 2005 (US EPA 2005a, Whiley and Baldwin 2005). The TMDL for pH and dissolved oxygen was not approved at this time because the submittal report lacked some of the required components in the dissolved oxygen and pH analysis (Baldwin 2006). The EPA also approved a TMDL for the Colville River and its tributaries for fecal coliform in 2003 (Coots 2002, Murray and Coots 2003, Baldwin 2005). There are also several stream segments on the Forest included in the Colville River TMDL.

Although water bodies added to the 303(d) list since TMDLs and WQIPs were finalized are not included in the TMDLs, they are included in monitoring plans on the Forest (discussed below). Miles of stream by pollutant by subbasin covered under TMDLs and WQIPs, and not covered under TMDLs and WQIPs are shown in table 134.

Table 134. Miles of stream by pollutant by subbasin on the Colville National Forest under an approved TMDL and WQIP, and miles of stream on the current 303d list not specifically covered under at TMDL and WQIP+

	Pollutant (*Category 4a)		Pollutant (*Category 5)			
Subbasin	**Bacteria**	**Temperature**	**Bacteria**	**Temperature**	**pH**	**DO**
Colville	8.5	2	0.2	1.4	0	0
Franklin D Roosevelt Lake	2.0	0	0	7.5	2.4	0.6
Kettle	2.0	0.8	0.8	2.8	1.4	1.3
Pend Oreille	0	2.2	2.2	3.3	11.0	20.1
Sanpoil	0	0	0	0	0	0
Little Spokane	0	0	0	0	0	0

* Category 4a waters have known pollution problems that have an approved TMDL being actively implemented. Category 5 waters are classified as polluted waters that require a TMDL or WQI plan and are traditionally known as the 303(d) list.

+ WADoE 2014a

The Forest is working to reduce fecal coliform bacteria from varied sources, including recreation and livestock grazing. Outhouses in developed campgrounds have been replaced and sealed vault toilets have been installed at select dispersed recreation sites farther from surface waters (Baldwin 2005). Work also continues to improve BMPs on active grazing allotments, including installation of off-stream watering and fencing (WADoE 2013a). In compliance with the WQIP, the Forest has monitored 13 streams annually for fecal coliform bacteria following procedures described in the Quality Assurance Project Plan in the TMDL (Baldwin 2006). A 2013 assessment of 10 years of fecal coliform monitoring results determined that six streams continually met the fecal coliform standard, and one stream met standards most years. These seven streams were removed from the monitoring program, and a 2014 request was made to remove these streams from the TMDL. Nine additional monitoring sites were added across the Forest in 2013 (WADoE 2013a).

In 2013, Ecology concluded that the Forest has made significant progress in the last 8 years toward meeting the requirements of the bacteria TMDL and improving water quality on the Colville National Forest. Based on monitoring and restoration progress toward meeting fecal coliform standards, the final target date to reduce bacteria concentrations to meet water quality standards has been extended from October 2013 to October 2018 (USDA Forest Service 2014a). Monitoring and restoration activities will continue with the goal of meeting the fecal coliform standard by 2018.

The Forest is also working to monitor and improve temperature in impaired stream reaches. The WQIP and TMDL require temperature monitoring and compliance at 37 sites by 2056. The Forest has temperature data for 78 streams with varying years of data. A subset of these 78 temperature monitoring sites are on temperature-impaired streams. Progress continues to increase temperature monitoring sites and to improve the processes that impair stream temperature through active and passage restoration.

The majority of waterbodies across the Forest meet water quality standards and support designated beneficial uses; however, the current 303(d) list and TMDLs do not necessarily include all the streams across the Forest where water quality may be impaired. Many streams do not have the monitoring data to determine if water quality is impaired. Protection measures for activities with the potential to impact water quality, including BMPs and land and resource management plan standards and guidelines that focus on riparian areas and other vulnerable areas ensure that waters of the Forest will continue to be high quality. Focused restoration activities to improve hydrologic processes will continue to preserve and improve water quality where needed. Those waterbodies that do not meet these goals are monitored, and WQIPs and TMDLs are in place to improve conditions.

Water Quantity and Uses

In the Columbia River basin, an estimated 38 percent of water yield originates from NFS lands (Sedell et al. 2000). This water is valued from ecological, economic, social, and cultural purposes. Water from national forests is used for both consumptive and non-consumptive uses for defined purposes recognized by Federal and state agencies. This section describes both consumptive and non-consumptive water uses across the Forest.

Instream Flows

The Washington Department of Fish and Wildlife (WDFW) is responsible for recommending instream flows for watershed planning, administration of water rights, and protection of fish and wildlife (WAC 75), and Ecology is required to maintain instream flows sufficient to protect and preserve beneficial uses (RCW, 90.54 and 90.22). Instream flows are defined by Ecology as a specific streamflow level (cfs) at a specific location on a given stream. Instream flows change from month to month and protect a quantity of streamflow for instream resources (WADoE 2013b). WDFW more narrowly describes instream flow as flows needed to protect stream habitat (Wald 2009). Generally, instream flow requirements are set only when a potential or existing project affects flow in a river system, the impacts of altered flow on instream resources is evaluated using accepted instream flow study guidelines (WDFW and WADoE 2004). WDFW recommends, requests, or requires, as applicable minimum instream flows that:

A. Protect full fish and wildlife potential;
B. Maintain riparian and instream wildlife habitat;
C. Manage water use and allocation to provide channel forming and maintaining flows;
D. Protect hyporheic flows;
E. Maintain fish passage and safe downstream fish migration;
F. Provide mitigation for, or enhancement of adversely affected fish and wildlife habitat to ensure “no net loss” of function and value;
G. Provide habitat for desirable aquatic non-game wildlife species, even in streams without populations of fish;
H. Preserve future enhancement and/or compensation options where potential fish habitat is unused because of barriers to immigration;

I. Avoid adverse impacts on estuarine and marine habitats; and

J. Provide connectivity of channel processes such as movement of sediment and debris.

WDFW also recognizes the importance of high flows for providing geomorphic conditions for fish migration and spawning, including transport of sediment and organic matter, maintenance of channel geometry, formation of new channels, and creation of meanders, and side channels (Wald 2009).

Municipal Supply Watersheds

Municipal supply watershed provide water for human consumption where Forest Service management could have a significant impact upon the quality of water at the intake point and that provide water used by a community or other public water system regularly serving at least 25 individuals at least 60 days out of the year or providing at least 15 service connections (FSM 2542). Three municipal watersheds were designated in the 1988 plan 2 of which are carried forward as municipal supply watersheds in the revised plan. Municipal watersheds on the CNF include East Deer Creek and North Fork Sullivan Creek. These watersheds provide water to the communities of Orient, Metaline Falls, respectively. Cedar Creek (referred to as Ione Creek in certain sections of the 1988 plan) provided water to the community of Ione. The water supply dam and water diversion infrastructure on Cedar Creek were removed in the early ‘90s, and Ione now uses a well for municipal water. Municipal supply watersheds in the Revised Forest Plan are included in the Key Watershed network and plan direction applying to Key Watersheds provides protection to municipal supply watersheds to protect water quality.

Source Water Protection Areas

Source water is untreated water from streams, rivers, lakes, or underground aquifers that is used to provide public drinking water, and to supply private wells used for human consumption (US EPA 2012). A source water protection area is the land area contributing to a public water system where potential contamination could affect drinking water supply.

Many communities in northeastern Washington rely on water from the Forest for drinking. The Safe Drinking Water Act is the 1974 Federal law that sets standards for drinking water quality. The law requires actions to protect drinking water and its sources, and sets national standards for drinking water to protect against naturally occurring and man-made contaminants (US EPA 2012). A 1996 amendment to the Safe Drinking Water Act requires each state to implement Source Water Assessment Programs (SWAP). The SWAP program in Washington is administered by the state Department of Health Office of Drinking Water. There are four requirements under the SWAP program: (1) delineate source water protection areas that serve greater than 25 individuals for each source, (2) inventory each source water protection area for potential contaminant sources, (3) conduct a susceptibility assessment for each drinking water source, and (4) make the findings available to interested parties (WA Dept. of Health 2005).

The SWAP program designates both surface and groundwater source water protection areas and classifies water systems as Group A or B. Group A is a designation specific to Washington and includes public use water systems large enough to be regulated by the Safe Drinking Water Act (those serving over 25 individuals). Group B public water systems serve fewer than 25 individuals (WA Dept. of Health 2005).

Surface sourcewater protection areas

Surface source water protection areas are delineated by the upstream watershed that contributes to the point of use (WA Dept. of Health 2005). Waters of the Forest are upstream of surface water systems that service Cusick, Grand Coulee, Kettle Falls, Metaline, Metaline Falls, Orient, and Riverbend. Designated surface source water protection areas have also been delineated for water systems for Grand Coulee Dam, Forty Nine Degrees North Ski Resort, and Columbia Cedar (Surface Water Protection spatial data). All surface water protection areas on the Forest provide water to Group A water systems.

Groundwater sourcewater protection areas

There are 31 Group A and 51 Group B water systems that are groundwater-sourced within the Forest administrative boundary. One, 5, and 10-year time of travel wellhead protection areas are delineated by WA Dept. of Health for all group A groundwater systems, and a 600-foot fixed radius is used as the wellhead protection boundary for group B systems.

Forest Service Drinking Water Systems

The Forest manages 15 drinking water systems across the Forest at campgrounds and administrative sites. These include Noisy Creek, Lake Leo, Mill Pond, Swan Lake, Pierre Lake, Gillette, Panhandle, Sullivan Lake, Edgewater, Long Lake, South Skookum Lake, Pioneer Park, and Sherman Overlook campgrounds, Batey-Bould trailhead, and the Bead Lake boat launch..

Water Rights

A water right is a legal authorization to use a certain amount of water for a specific purpose of use. Water rights in Washington are managed by Ecology. There are three types of water rights documents:

1) A “claim” is a claim to use water that predates the State’s water permitting system, the validity of which must be confirmed through judicial processes;
2) A “permit” is permission by the State to develop a water right and gives the permit-holder permission to proceed with construction of a water system to put water use;
3) A “certificate” is issued when all conditions of the permit have been met—and is a legal record of the water right. Certificates are appurtenant to the land on which the water is used (WADoE 2013c).

Data on water rights was summarized from spatial data obtained from Ecology. Figures presented in this analysis are estimates only. There are approximately 115 certificated water rights and 356 points of diversion in the name of the USDA Forest Service on the Forest. The Forest does not have any current claims, applications, or permits for which a certificate has not been issued. The primary purpose of use for consumptive rights on the Forest is livestock (table 135), with only 8 certificates for other uses. Total certificated storage volume is 477 acre-feet per year; certificated diversion volume is 4.55 cfs. A total of 17 irrigated acres also have certificated water rights. Water rights are concentrated in the drier western portion of the Forest.

Table 135. Certificated water rights and points of diversion in the name of the Colville National Forest* by purpose of use and volume

Purpose of Use	# of Certificates	# of points of diversion	Certificated storage volume (acre-feet)	Certificated diversion (cfs)	Irrigated Acres
Livestock	107	348	447	3.7	
Domestic single/Irrigation	1	1		0.01	1
Domestic multiple	1	1		0.05	
Domestic multiple/irrigation	2	2	19	0.54	15
Domestic multiple/recreation beautification	1	1	1	0.01	
Domestic multiple/fire protection/recreation beautification	1	1		0.1	
Domestic multiple/fire protection/irrigation	1	1	4	0.1	1
Domestic multiple/fire protection	1	1	6	0.035	
Total	115	356	477	4.55	17

*Several certificates are in the name of the Kaniksu National Forest, but are located within and managed by the Colville National Forest.

There are approximately 536 certificated water rights in the name of others within the Forest administrative boundary. The largest consumptive uses within the Forest administrative boundary by volume are for domestic use, municipal use, irrigation, and power generation. Storage rights in the name of others within the Forest administrative boundary total 111,193 acre-feet. A total of 6,114 irrigated acres also have certificated water rights.

Table 136. Certificated water rights within the Colville National Forest administrative boundary in the name of others

	Applications	Claims	Permits	Certificates
Total Number	11	712	61	536
Storage Volume (acre-feet) unless otherwise noted	1,700 gpm	316,314	33,802	111,193
Irrigated Acres	480	36,327	98	6,114

Certificated water rights for consumptive uses in the name of the Forest Service within the Forest administrative boundary constitute less than 1 percent of both storage volume and irrigated acres of total certificated rights. The majority of water volume certificated for consumptive uses within the Forest boundary are in the name of others. Certificated water rights within the Forest administrative boundary are small in comparison to water yield from the Forest and consumptive uses downstream of the Forest. Water availability on lands off-forest are discussed in the Cumulative Effects section.

Dams

The Forest currently administers four dams including the West Branch LeClerc Creek Dam, Little Twin Lakes Dam, Big Meadow Lake Dam, and Bayley Lake Dam. An additional five dams within the administrative boundary of the Forest are owned by public utilities or local governments. Additional details about dams on the Forest are shown in table 137. Management of these dams does not vary by land and resource management plan alternative, and management and mitigation of effects of these dams is expected to continue under all alternatives.

Table 137. Dams on the Colville National Forest

Dam Name	Owner	Subbasin	Stream/River Name	Notes
Little Twin Lakes Dam	Colville National Forest (NF)	Colville	Camp Creek	70-acre reservoir maintained for recreation and fish and wildlife
Big Meadow Lake Dam	Colville NF	Franklin D Roosevelt Lake	Meadow Creek	83-acre reservoir maintained for recreation and fish and wildlife
Bayley Lake Dam	Colville NF	Colville	Bayley Creek	Impounds Bayley Lake, a 17-acre reservoir, located on the Little Pend Oreille Wildlife Refuge. Lake is maintained for recreation, fish, and wildlife. Dam is on the Colville National Forest.
West Branch LeClerc Creek Dam	Colville NF	Pend Oreille	West Branch LeClerc Creek	Log crib dam that does not create impoundment; filled with fine sediment. Removal is an essential project in the WB LeClerc Watershed Action Plan
Metaline Falls Municipal Water Dam	Metaline Falls	Pend Oreille	Tributary to Sullivan Creek	Diversion dam supplying water to the Community of Metaline Falls
Boundary Dam	Seattle City Light	Pend Oreille	Pend Oreille	See text
Mill Pond Dam	Pend Oreille PUD	Pend Oreille	Sullivan Creek	Scheduled for removal in 2017
Sullivan Lake Dam	Pend Oreille PUD	Pend Oreille	Harvey Creek/ Outlet Creek	Dam enhances the natural lake. Managed by Pend Oreille PUD for recreation, and water supply for interbasin transfers.
Box Canyon Dam	Pend Oreille PUD	Pend Oreille	Pend Oreille	See text

Hydroelectric Dams

There are three hydropower projects on the Forest, including Boundary Dam, the Sullivan Creek Water Supply Project, and Box Canyon Dam. In addition, though not within the Forest administrative boundary, all of the waters of the Forest eventually drain into Lake Roosevelt, on the Columbia River. Lake Roosevelt is impounded by the Grand Coulee dam—the largest power-supplying dam in the United States. The Grand Coulee Dam generates 21 billion kilowatt-hours of electricity per year, supplying power to Washington, Oregon, Idaho, Montana, Wyoming, Colorado, California, Nevada, New Mexico, Utah, Arizona, and Canada (USBR 2014a).

The Federal Energy Regulatory Commission (FERC) regulates all operating non-Federal dams that generate electrical energy. FERC licenses these projects and permits the dam owner to use public waters for energy generation. The license specifies the conditions for construction, operation, and maintenance of the project, is enforceable by FERC through fines or injunctions, and may be revoked for non-compliance (FERC Licensing 2014). Settlement agreements signed in conjunction with issuance of FERC licenses for Box Canyon Dam, Boundary Dam, and the surrender of the hydropower license for the Sullivan Creek Water Supply project, provide funds and comprehensive plans for restoration of hydrologic and aquatic resources on the Forest to mitigate effects from hydropower production

Box Canyon Dam

Opened in 1956, the Box Canyon Dam is a gravity-type hydroelectric dam on the Pend Oreille River operated by the Pend Oreille PUD. The dam is 62 feet high, 160 feet long, and creates the Box Canyon Reservoir, which stretches 55 miles to Albeni Falls Dam near the Idaho border. The dam impounds water draining an area of 24,900 mi^2 and has a surface area between 7,000 and 9,000 acres depending on pool elevation. The dam is capable of producing 62 MW of power. The Box Canyon Dam operates “run of river”—flows released from the project approximate the flows released upstream from the Albeni Falls Dam (PUD No. 1 of Pend Oreille County). The Box Canyon Dam project occupies 190 acres on the Forest (PUD No. 1 of Pend Oreille County).

The Box Canyon Dam was relicensed in 2005. Under the settlement agreement signed in 2010, the Pend Oreille PUD committed to a variety of treatments to improve hydrologic and aquatic function, and fisheries in Box Canyon Reservoir and its tributaries. Most of these tributaries are on the Forest, and projects under this settlement agreement on Forest lands will be completed in collaboration with the PUD and other state and Federal partners (PUD No. 1 of Pend Oreille County).

Since the 2010 settlement agreement, the PUD has begun an active program of stream restoration and fisheries improvement in 160 miles of Box Canyon Reservoir tributaries under the Trout Habitat Restoration Program. Initial efforts in Box Canyon tributaries are focused in the East and West Branches of LeClerc Creek and tributaries, and Calispell Creek and its tributaries. Treatments include wood placement, pool improvement, removal or replacement of barriers to aquatic organism passage, brook trout eradication, fence construction, and installation of hardened cattle crossings. The Trout Habitat Restoration Program will continue through the life of the 50-year Box Canyon License, with work focused in the Mill Creek, Cee Cee Ah, Skookum Creek, and Ruby Creek drainages.

Restoration in Box Canyon Reservoir has and will continue to focus on monitoring and treatment of erosion, removal of invasive aquatic weeds, suppression of non-native invasive fish species, improvement of riparian habitat, and fish passage improvement at Box Canyon Dam (upstream passage facility construction planned completion in 2017).

Sullivan Creek Water Supply Project

The Sullivan Creek Water Supply Project includes the Sullivan Dam, and Mill Pond Dam and is operated by the Pend Oreille PUD. The Pend Oreille PUD purchased the project in 1959 including water rights (FERC 2011). The Sullivan Dam enhances the existing Sullivan Lake to a surface area of 1,240 acres. The area impounded by Mill Pond Dam covers a 63-acre area. The project occupies 522 acres on the CNF. The FERC license for the Sullivan Creek project was surrendered in 2013 because the PUD determined that the project was not economically viable for hydropower generation. The settlement agreement for the project, negotiated with multiple resource management agencies, representatives from the public, and the PUD includes changes in the timing of flow release of Sullivan Lake, an increase in lake elevation, installation of a cool water release pipe to allow colder water from the bottom of the lake to discharge into Sullivan Creek and the removal of Mill Pond Dam in partnership with Seattle City Light (WADoE 2014c). Once mitigations in the settlement agreement for surrender of license are complete, the Sullivan Lake dam will be operated under a special use permit with the CNF. Mill Pond Dam was removed in 2017, with additional restoration at the site continuing through 2019.

Boundary Dam

The Boundary Dam on the Pend Oreille River is a concrete arch gravity-type hydroelectric dam that supplies more than one-third of Seattle City Light’s Power, which began operations in 1967. The dam is 340 feet high from its bedrock foot and is 740 feet long. The reservoir created by the dam is 17.5 miles long and extends to the base of the Box Canyon Dam. The reservoir created by the dam is 1,794 acres and drains an area of 25,200 mi^2 (FERC 2011). The dam has the capacity to produce 1040MW at peak output—40 percent of Seattle City Light's electricity demands (Seattle City Light 2014a). The Boundary Dam project occupies 609 acres on the Forest (City of Seattle).

The application to relicense the Boundary Project was filed in 2009. In 2010, a joint offer of settlement for the Boundary Dam and Sullivan Creek water supply project was filed, which proposed consolidation of the relicensing of the Boundary project and Pend Oreille PUD's surrender of license for the Sullivan Creek Project. The joint settlement agreement was signed by the City of Seattle, Pend Oreille PUD, the Kalispel Tribe of Indians, several State and Federal agencies (including the Colville National Forest), and two non-governmental organizations. The FERC issued a 42-year license for the Boundary Project in 2013. As part of the settlement agreement, Seattle City Light committed $60 million to a 42-year program of watershed improvements including evaluation and improvement of passage for resident salmonids, improvement of aquatic habitat, fish stocking, groundwater well decommissioning, acquiring and managing land for wildlife, recreation enhancement, and enhancement and protection of cultural resources (FERC 2011, Seattle City Light 2014b).

Since 2013, Seattle City Light has worked collaboratively with the Forest and other settlement agreement parties to complete aquatic restoration in Boundary Reservoir and its tributaries. Work and planning to date has focused on Sullivan Creek and its tributaries and includes treatment of dispersed recreation sites on Sullivan Creek to reduce erosion and sanitation issues, brook trout suppression and eradication, stream restoration through wood placement and floodplain and side channel reconnection, replacement or removal of barriers to aquatic organism passage, road improvement projects, and landslide stabilization.

Need for Change

This analysis addresses the following needs to revise the 1988 forest plan:

- Accelerate improvement in watershed condition across the Forest. The 1988 forest plan and amendments do not adequately provide integrated management direction to maintain and restore properly functioning watersheds that provide a range of benefits on and off the Colville National Forest within a meaningful timeframe. This is supported by best available science, the listing of bull trout (*Salvelinus confluentus*) under the Endangered Species Act (1988), designation of critical habitat for bull trout (2010), information provided by the bull trout recovery plan (USFWS 2015b), and the results of new assessment tools such as the national Watershed Condition Framework. Properly functioning watersheds provide stable and productive ecological systems and allow for conditions that support aquatic species viability and self-sustaining populations, contribute to the recovery and de-listing of threatened and endangered species, and restore stream systems that do not meet Washington State water quality standards (WADoE 2014f). In addition, properly functioning watersheds prevent degradation of water quality, and are more resilient to disturbance, including climate change.
- Integrate watershed and aquatic strategies across the Forest. The 1988 forest plan was amended by the Inland Native Fish Strategy (INFISH) (USDA Forest Service 1995a) in 1995. Since 1988, the Aquatic Restoration Strategy (ARS) (USDA Forest Service 2005b), the Aquatic and Riparian Conservation Strategy (ARCS) (USDA Forest Service 2008a, 2016a) and the Watershed Condition Framework (WCF) (Potyondy and Geier 2010) have been developed to reflect management direction recommended by current research and supported by regional and national policy. The ARS is a Forest Service Pacific Northwest Regional operational strategy that reinforces the foundation of existing forest plan strategies, including broad-scale passive restoration, and strategically focused active restoration and guides implementation through establishment of specific goals and objectives and a formal process for near-term active restoration. The 2010 National Watershed Condition

Framework process evaluated current conditions at the subwatershed scale and identified priority subwatersheds where focused restoration could improve watershed condition on NFS lands. ARCS is a refinement of previous forest plan strategies (including the Northwest Forest Plan, PACFISH, and INFISH) incorporating key concepts from the ARS and WCF, and is intended to provide the core set of desired conditions, suitability, objectives, standards and guidelines for aquatic and riparian management. ARCS provides additional watershed direction intended to restore and maintain watershed conditions and processes that sustain a full range of ecosystem services and support beneficial uses of water, with a focus on protection and restoration of native anadromous and non-anadromous fisheries. The original 2008 version of ARCS was updated in 2016, and provides greater emphasis on watershed function, water quality, and providing water from NFS lands for downstream communities and other uses. Consistency and integration of new research and regional and national direction on restoration and protection of watershed and aquatic habitat and function would contribute to the restoration and maintenance of riparian and aquatic habitats and beneficial uses of water and increase resilience to disturbance.

- Address climate change implications and vulnerabilities. The 1988 forest plan does not address the potential effect of climate change. Recent scientific findings on climate change (Intergovernmental Panel on Climate Change (IPCC) 2014) have improved our understanding of how ecosystems have changed and are likely to change in the future. Changing climate conditions have affected ecosystem composition, structure, process, and spatial pattern, altering the character and distribution of habitats for key surrogate plant and animal species. In addition, climate change has altered, and will continue to alter disturbance regimes, including forest insects and diseases, fire, and hydrologic regimes. Future conditions may be more favorable to some undesired non-native plant, wildlife, and aquatic species (IPCC 2014). The full impact of climate change on ecosystems is uncertain, but an integrated management direction that provides flexibility to respond to a changing environment is needed to maintain or restore the resilience of the national forests in the face of these changes.

Environmental Consequences

Methodology

This section describes the analysis process to determine the environmental consequences to watershed function, water quality, and water uses from implementation of six land and resource management plan alternatives. Environmental consequences are not site-specific at the broad-scale of forest planning, therefore, several indicators will be discussed in qualitative terms based on best available science and professional judgment. Quantitative analysis of potential effects is presented where appropriate and applicable. This section discusses the broad-scale environmental consequences and relative trends and provides a means to compare the potential effects of alternatives.

Assumptions

- In estimation of effects of alternatives at the revised forest plan level, it is assumed that the kinds of management activities allowed under the prescriptions will occur to achieve the goals and objectives of each alternative. The actual location and design of treatments is not known, and will be determined through project-level, site-specific NEPA decisions. Therefore, this analysis refers to potential effects that could occur, but cannot be applied to specific locations. Effects analysis at the revised forest plan scale is useful for comparing alternatives, but cannot be applied to specific locations other than at the broad scale of management areas and ecological regions.

- Data representing forestwide conditions may not represent site-specific water quality, quantity, or watershed function. Additional site-specific analysis is needed at the project scale during implementation of this land and resource management plan.
- Measurable objectives for water resources, key and priority watersheds, and RMAs identify priority treatment activities, extent (i.e., miles, acres, number of crossings improved), and timing of completion were developed in the forest plan revision process. Effects of meeting these objectives through the life of this land and resource management plan are based on the assumption that Forest budgets will remain relatively constant, but will vary from year to year. The actual rate of improvement of watershed condition is dependent on internal and partner financial contributions, and staffing levels.
- Land and resource management plan guidelines provide guidance for carrying out projects and activities to achieve desired conditions and objectives. Guidelines do not force action, but provide design criteria that should apply when an action is being taken. Standards are mandatory constraints on project activities and are established to achieve desired conditions, mitigate or avoid undesirable effects, and meet applicable legal requirements. Standards provide strict design criteria, allowing no variation, whereas guidelines allow variation if the result would be equally effective to move toward achievement of desired conditions. Therefore, standards provide a greater assurance of specific protections than guidelines.
- Issues addressed in this analysis are those identified through the scoping process for the forest plan revision, and issues specific to hydrologic resources.
- Previously decommissioned roads were included in road calculations because full hydrologic closure of these roads is not certain. At the scale of the Forest, total mileage of previously decommissioned road makes up less than 1 percent of NFS roads.
- Estimates of primary vegetation management tools used in all alternatives are based on modeling of treatment by vegetation type (described in Day 2017). For each alternative, an estimated acres of treatment type per year by vegetation type is presented based on modeling. These figures are used to compare alternatives and are not assumed to represent actual acres that will be treated. Vegetation management is not authorized under this document, and treatments will be evaluated in subsequent project-specific treatment. Differences in primary vegetation management tools used in each vegetation type vary by alternative and potential effects are broadly discussed by alternative. Since there is little variation in treatment type by alternative, potential indirect effects of vegetation treatments by alternative are discussed in terms of estimated (modeled) acres of treatment, and the acreage within each management area where vegetation treatment is authorized.

Spatial and Temporal Context for Effects Analysis

The spatial boundary for analysis of indirect effects is all lands within the Forest ownership boundary, and within the five subbasins with Forest ownership for cumulative effects. The temporal boundary of indirect and cumulative effects is 15 years, the estimated amount of time management would continue under the revised land and resource management plan. Vegetation condition was modeled for 100 years. Climate change analysis to inform cumulative effects analysis uses projections for the 2040s and 2080s

Summary of Effects

Restoration Priority and Focus Watersheds

Priority and focus watersheds are the same across alternatives. Essential projects outlined in watershed action plans in priority and focus watershed would continue in all alternatives; however, restoration activities would be prioritized based on key watershed objectives in the proposed action and alternatives R, P, and O.

Water Quality

The Forest would continue to comply with the Clean Water Act in all alternatives at the project level. The Forest would continue to work with Ecology to implement the Colville National Forest TMDL and the TMDL for the Colville River through monitoring of fecal coliform and water temperature, and projects to improve water quality. As new streams on the Forest are added to the 303(d) list, they would be included, as funding and strategic project planning allows in the Forest's fecal coliform and temperature monitoring program. The MOA between Ecology and the Forest recognizes the contribution of existing Forest Service direction, including the Interior Columbia Basin Ecosystem Management Project, INFISH, and BMPs in meeting water quality laws and regulations, and states that the Forest Service and Ecology will collaborate to address 303(d) listings through the development of TMDLs and Water Quality Management Plans (USDA Forest Service and WADoE 2000), which would continue under all alternatives.

Potential indirect effects of implementation of this land and resource management plan on water quality vary by alternative, based on differences in goals, objectives, standards, and guidelines and are discussed in effects analysis by alternative.

Grazing

There are no proposed changes in the location or boundaries of permitted range allotments or type of livestock across alternatives. Boundaries, AUMs, and management of allotments are expected to change over time, based on site-specific analysis through the NEPA and allotment management planning process; however, this does not vary by alternative. Grazing standards and guidelines differ by alternative and grazing practices may vary based on differences in standards and guidelines in each alternative. Potential differences are discussed in the effects analysis section.

Best Management Practices

Implementation of BMPs would continue to be one of the primary mechanisms to ensure that aquatic and hydrologic function are preserved in all alternatives. Project-level monitoring of implementation and effectiveness of BMPs using nationally consistent protocols would continue under all alternatives. BMP monitoring would be used to identify and implement corrective actions to address site-scale problems with BMP implementation and effectiveness. Adaptive management would be used to correct systematic, programmatic-level issues (i.e., lack of transfer of BMPs from planning to project implementation, project design criteria specified in NEPA not included into contract provisions, etc.). Accountability for addressing lack of effectiveness and implementation of BMPs is a critical component of water resource protection and compliance with the CWA.

Water Uses

Water uses across the Forest are expected to be the same across all alternatives. Standards protecting key watersheds from certain uses differ by alternative and are discussed in effects analysis.

No Action Alternative

Riparian and Aquatic Resource Management

Acres of RHCAs and management and protection of RHCAs

Present management of riparian areas under INFISH (USDA Forest Service 1995a) includes designation of riparian habitat conservation areas (RHCAs) where riparian-dependent resources receive primary emphasis and additional standards and guidelines apply to management. RHCAs overlay approximately 150,692 acres (14 percent) of the Forest. RHCAs are mapped, but actual locations of RHCAs may be changed and updated based on project-level planning and reconnaissance. RHCA widths vary by water body type and intermittent streams and wetlands less than 1 acre receive a wider RHCA width in INFISH priority watersheds than these features in non-INFISH priority watersheds. RHCA widths and acreages are shown in table 138.

RHCAs are intended to protect desired riparian functions, including sediment filtration, stream temperature moderation, production of fine organic matter and large woody material, and stream bank stability. Research on the effectiveness of riparian protection measures suggests that a width of one site-potential tree is sufficient to protect riparian function in most systems (Wenger 1999). Pollock and Kennard (1998) found that buffer widths of 50 to 250 feet were sufficient to preserve riparian function in eastern Washington, with differences in effective widths dependent on soils, slope, and vegetation.

Table 138. Riparian habitat conservation areas width and acreages on the Colville National Forest in no action and alternative B

Stream and water body classification	Riparian habitat conservation area width	Total Acres
Fish-bearing streams	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.	35,427
Permanently flowing non-fish-bearing streams	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.	49,075
Ponds, lakes, reservoirs and wetlands greater than 1 acre	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.	23,261

Stream and water body classification	Riparian habitat conservation area width	Total Acres
Seasonally flowing or intermittent streams, wetlands less than 1 acre	At a minimum the RHCAs must 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 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.	42,929
Total		150,692

Riparian and Aquatic Plan Components

Riparian and aquatic plan components including objectives, standards, and guidelines in the no action alternative are from INFISH (see part II of appendix H for a comparison of plan components across all alternatives). INFISH includes riparian goals rather than desired conditions, and riparian management objectives (RMOs) that define numeric stream habitat objectives for width to depth ratio, bank stability, bank angle, large woody debris, stream temperature, percent fine sediment , dominant substrate, and pool frequency, that describe high quality habitat. RMOs were developed from existing stream habitat data and were designed to provide benchmarks for evaluation of current stream conditions. Although RMOs have been widely applied, analysis of their usefulness or applicability across ecoregions has not been widely researched. Criticisms of numeric stream habitat objectives including the failure to account for variability and recognition of the difficulty of separation of land use effects from natural disturbance. (Kershner and Roper 2010). RMOs are discussed in greater detail in the fisheries section of this FEIS (MacDonald et al. 2018).

INFISH includes standards and guidelines (with no differentiation between standards and guidelines) for RHCAs that constrain management within RHCAs to achieve RMOs. Standards and guidelines address activities including timber management, livestock grazing management, recreation management, mineral management, fire and fuels management, lands, general riparian area management, watershed and habitat restoration, and fisheries and wildlife restoration. RHCA widths may be increased or decreased when necessary to attain RMOs when site-specific data and watershed analysis supports the change.

Acres in INFISH Priority Watersheds

INFISH priority watersheds on the Forest were originally designated in 1998 and updated in 2001. INFISH designated as “priority” watersheds “having excellent habitat or strong assemblages of inland native fish, particularly bull trout, or watersheds that provide for population distribution goals, or watersheds having a high restoration potential” (USDA Forest Service 1995a). There are 214,283 acres (19 percent total NFS ownership) in INFISH priority watersheds under NFS ownership in the no action alternative (table 139).

Table 139. INFISH priority watersheds (designated at the subwatershed scale)

Subwatershed Number	Subwatershed Name	Total Subwatershed Acres	Administrative Forest Acres	Colville National Forest Ownership Acres
170102160201	Exposure Creek-Pend Oreille River	41,224	23,376	14,463
170102160202	Skookum Creek	31,811	31,728	14,192
170102160301	Middle Creek-Pend Oreille River	23,209	21,760	5,066
170102160302	West Branch LeClerc Creek	21,672	21,672	15,099
170102160303	East Branch LeClerc Creek	26,663	26,651	11,145
170102160401	Harvey Creek	32,999	32,991	27,554
170102160402	Headwaters Sullivan Creek	45,516	45,510	45,417
170102160403	North Fork Sullivan Creek-Sullivan Creek	12,709	12,703	11,259
170102160702	Headwaters South Salmo River	20,697	12,475	12,472
170102160704	Outlet South Salmo River	14,013	3,469	3,460
170102160902	Sweet Creek-Pend Oreille River	41,832	33,477	28,890
170102160903	Slate Creek	20,195	19,911	19,907
170102161003	Cedar Creek	17,209	7,074	5,359
Total Acres		349,747	29,2795	**214,283**

There are no standards, guidelines, goals, or measurable objectives specific to INFISH priority watersheds in the no action alternative. However, the intent of INFISH is for priority watersheds in good condition to serve as anchors for the potential recovery of depressed aquatic populations, and provide colonists for adjacent watersheds with degraded habitat. Priority watersheds with lower habitat are the focus of restoration activities to improve habitat quality and function.

Watershed and Aquatic Restoration

Based on the original intent of the short time period for implementing INFISH, a restoration strategy was not included in this amendment. The intent of INFISH was for forests to use watershed analysis to determine restoration strategies and projects, with INFISH priority watersheds being the highest priority for restoration. Historically, aquatic restoration across the INFISH priority network has not accelerated since this watershed network was designated in 1995 (and expanded in 2001) on the Forest, except in a select number of subwatersheds. Instead, the pace of restoration was increased through designation of focus watersheds identified through ARS and priority subwatersheds identified through WCF. Investment in watershed restoration to improve aquatic habitat and hydrologic function has and would continue to occur in several subwatersheds within the INFISH priority network, including the East and West Branches of LeClerc Creek, and the Headwaters and North Fork of Sullivan Creek, but there are no specific plans to accelerate the pace of restoration in other subwatersheds in the INFISH priority network under the no action alternative. Therefore, restoration in INFISH priority watersheds would continue at the current pace under the no action alternative.

Watershed and aquatic restoration would focus on completion of essential projects outlined in watershed action plans in focus (Sanpoil, LeClerc, and Chewelah Creek watersheds) and national priority watersheds (West Branch LeClerc Creek, and Ninemile Creek subwatersheds). In addition, opportunistic restoration would continue across the Forest based on partnerships, funding from FERC relicensing, Vision 20/20 (see MacDonald et al. 2018 for specific projects), and completed NEPA for vegetation management, grazing, and recreation projects.

Based on current restoration plans in place under the no action alternative for the next 15 years, treatment is expected on 51 miles of road, 15 crossings to improve aquatic organism passage, 54 miles of stream channel, 70 acres of rangeland infrastructure, and 75 to 150 acres in RHCAs to move toward HRV. Improvement in watershed condition class is estimated in seven subwatersheds.

Roads/Access

Acres of management areas where road-building activities are permitted

Approximately 218,300 acres (20 percent of Colville National Forest) in the no action alternative are in management areas where construction of new roads is prohibited.

Summer and Winter Motorized Recreation Opportunities Suitable Uses

Summer and winter motorized recreation is authorized in all MAs with the exception of research natural areas, wilderness, and semi-primitive non-motorized recreation. Several MAs allow motorized recreation use if suitable habitat integrity is maintained within standards and guidelines. Approximately 980,200 acres (89 percent of the Forest) are within MAs where summer and winter motorized recreation are authorized. Standards and guidelines, implementation of BMPs, and adaptive management are the primary mechanisms through which watershed function and water quality are maintained. Suitability of an area for summer or motorized recreation opportunities is guidance for project activity decision making and is not a resource commitment or final decision approving projects and activities. Use would not occur over an entire suitable area; locations of potential motorized use would be determined at the project level through site-specific analysis.

Road density desired conditions

Road density desired conditions range from 0.4 to 2 miles per square mile of open road (maintenance levels 2-5) and are dependent on species or resource in need of protection. Since road density desired conditions do not consider closed maintenance level 1 roads, they do not adequately address the potential impacts of the road system on hydrologic and aquatic function and habitat.

Road management plan components

Standards and guidelines, and BMPs specific to road construction focus on minimizing erosion and sediment risk from the road system to attain RMOs and minimize adverse effects to inland native fish. In INFISH priority watersheds, watershed analysis is required before certain road activities and construction of new recreation facilities are permitted in RHCAs, and there are specific protections against increased sedimentation through prioritization of road treatments in priority watersheds.

Old Forest Management, Timber Production, and Upland Vegetation Condition

Active Vegetation Management

Existing management areas (MAs) and authorization of road building and timber harvest by MA are shown in chapter 2 (table 21). Timber harvest is allowed in MA-3A (Recreation), MA-5 (Scenic/Timber), MA-6 (Scenic/ Winter Range), MA-7 (Wood/ Forage), and MA-8 (Winter Range) (however, not all lands within these management areas are “suitable” for timber production). These management areas cover 80.7 percent of the Forest, the largest land base available for active vegetation management of all alternatives. Actual acres treated per year are constrained by timber suitability, Forest budgets, and additional constraints at the project level.

Primary Vegetation Management Tools

Partial harvest would be the primary vegetation management tool in the Douglas-fir dry MAs where timber harvest is authorized with 500 acres of treatment estimated per year. Thinning, regeneration harvest, and mechanical fuels treatments are used in the northern Rocky Mountain mixed conifer vegetation type. Regeneration harvest would be the primary tool in the subalpine fir/lodgepole pine vegetation type with 388 acres of treatment per year estimated. Mechanical fuels treatments would also be used in this vegetation type. Prescribed fire would be used in Douglas-fir dry, northern Rocky Mountain conifer, and subalpine fir/lodgepole pine vegetation types, and is estimated on 4,879 acres. A total of 1,096 acres of mechanical fuels treatments per year are estimated under the no action alternative.

Historical Range of Variability

Eight out of 25 structure classes are within HRV after 100 years of land management under the no action alternative, which has the least number of structure classes within HRV (table 140). Ten structure classes are below HRV, and seven are above. Late open and closed structure conditions show the greatest departure from HRV. Levels of disturbance and management do not occur across enough acres over 100 years under the no action alternative to create open structure conditions that existed historically. Areas that would historically have contained large trees with open canopy conditions, and greater resistant to wildfire and insect and disease outbreaks would be in a closed canopy condition with greater susceptibility to disturbance (Day 2017). Greater susceptibility of forest stands to disturbances including large fires and insect and disease outbreak increases the risk to hydrologic function from disturbance.

Vegetation Management Plan Components

INFISH provides stricter standards and guidelines for vegetation management activities than the forest plan it amended. Timber harvest and fuelwood cutting in RHCAs is prohibited under INFISH except in the event of safety, catastrophic events, or to acquire desired vegetation characteristics where needed to attain riparian management objectives. Silvicultural practices should be applied in a manner that does not retard attainment of riparian management objectives and that avoids adverse effects on inland native fish. In addition, INFISH includes standards and guidelines that minimize roads and landings in RHCAs. Standards and guidelines and BMPs are the primary mechanisms to protect water quality and riparian function from vegetation management activities under the no action alternative.

Grazing Plan Components

Current allotment boundaries and AUMs would continue under the no action alternative. INFISH provides stricter standards and guidelines than the forest plan it amended on grazing to move toward attainment of RMOs. These standards and guidelines apply primarily in RHCAs and would continue to be implemented under the proposed action. It is assumed that allotment management under the proposed action would meet guidelines for grazing in RHCAs, and that changes in grazing management to attain RMOs would be implemented through project-level NEPA, and allotment management plans. There are no specific numeric guidelines for grazing in RHCAs in INFISH and the no action alternative. Standards and guidelines and BMPs are the primary mechanisms to protect water quality and riparian function from grazing under the no action alternative. PIBO monitoring indicates that stream conditions across the Forest are improving (see MacDonald et al. 2018 and discussion of PIBO data discussed previously in this section) under INFISH standards and guidelines, however most stream channel parameters are outside of reference conditions.

Table 140. Modeled forest structure levels at 100 years compared to HRV for all vegetation types in the no action alternative

Structure Class	HRV	No Action
Early Structure		
Douglas-fir dry	6-16	5
Northern Rocky Mountain mixed conifer	9-25	4
Western hemlock / western red cedar	4-24	0
Subalpine fir / lodgepole pine	45-65	38
Spruce / subalpine fir	14-46	4
Mid Open		
Douglas-fir dry	2-8	2*
Northern Rocky Mountain mixed conifer	1-3	0
Western hemlock / western red cedar	0	0
Subalpine fir / lodgepole pine	0	21
Spruce / subalpine fir	0	0
Mid Closed		
Douglas-fir dry	4-13	7
Northern Rocky Mountain mixed conifer	18-30	14
Western hemlock / western red cedar	7-27	0
Subalpine fir / lodgepole pine	33-53	26
Spruce / subalpine fir	13-41	34
Late Open		
Douglas-fir dry	38-78	49
Northern Rocky Mountain mixed conifer	4-6	0
Western hemlock / western red cedar	0	0
Subalpine fir / lodgepole pine	0	5
Spruce / subalpine fir	0	0
Late Closed		
Douglas-fir dry	1-32	37
Northern Rocky Mountain mixed conifer	44-60	83
Western hemlock / western red cedar	55-83	100
Subalpine fir / lodgepole pine	3	11
Spruce / subalpine fir	29-57	63
Total Structure Classes Within HRV		**8**

*Shaded cells are within HRV.

Summary of Effects and Comparison to Other Alternatives

The no action alternative provides less protection to the processes that improve or preserve hydrologic function than the proposed action and alternatives R, P, and O. The no action alternative would provide a slower pace of recovery of hydrologic function through passive and active restoration than the proposed action and alternatives R, P, and O. Effects of the no action alternative in relation to other alternatives include:

- The no action alternative does not address the need for change in this forest plan revision; the pace of watershed restoration is not increased from current levels, watershed and riparian direction is not integrated. Specific watershed and riparian objectives in the proposed action, and alternatives R, P, and O should increase the pace and scale of watershed restoration, and improve resiliency to the potential hydrologic effects of climate change more effectively than the plan components in the no action alternative and alternative B.
- Narrower RHCA widths along intermittent streams, lakes, and ponds are less restrictive than RMA widths in the proposed action, and alternatives R, P, and O and may not improve or preserve hydrologic and riparian function as well as wider RMA widths.
- There are fewer acres of priority watersheds in the no action alternative than in the key watershed network in the proposed action and alternatives R, P, and O. While restoration activities are not expected on every acre within key watersheds, the larger key watershed network in the proposed action and alternatives R, P, and O and specific restoration objectives in key watersheds would accelerate the pace of restoration of hydrologic function than in the smaller INFISH priority network.
- The no action alternative does not accelerate improvement in watershed condition as much as the proposed action and alternatives R, P, and O. The INFISH priority network would remain and there are no specific plans to accelerate the pace of restoration across the INFISH priority watershed network. Watershed analysis forms the basis for project effects analysis and defining restoration needs. There are no measureable objectives for the INFISH priority watershed network other than essential projects outlined in watershed action plans for focus watersheds designated through ARS, and priority watersheds designated through WCF.
- RMOs would continue to be used as benchmarks for evaluation of current stream conditions, even though they may not adequately account for natural variability or separate land use effects from natural disturbance.
- The no action alternative manages toward eight riparian goals, the proposed action and alternatives R, P, and O focus on the attainment of desired conditions for aquatic and riparian function and watershed condition.
- Approximately 20 percent of Colville National Forest land base is in management areas where construction of new roads is prohibited. Construction of new roads is prohibited in a higher percentage of the Forest in all other alternatives including the proposed action. Road density desired conditions range from 0.4 to 2 miles per square mile of open road (maintenance level 2-5) and depend on species or resource in need of protection. Unlike the proposed action and alternatives R, P, and O, road density desired conditions include maintenance level 1-5 roads. Inclusion of maintenance level 1 (closed) roads in road density calculations provides a better metric for improvement in aquatic and riparian function because closed roads have an effect on hydrologic processes.
- Approximately 89 percent of the Forest is within management areas where summer and winter motorized recreation are authorized. This is the most acreage of all alternatives.
- Approximately 80 percent of the Colville National Forest land base is in management areas that allow timber harvest; all other alternatives have less land open to these activities.
- Standards and guidelines in the no action alternative do not as effectively address contemporary issues of watershed function, including protection of streambank and floodplain integrity from livestock grazing, and reduction of erosion and sedimentation and disruption of hydrologic processes from roads and trails. Standards and guidelines in the no action alternative may not

protect watershed function and water quality as effectively as the proposed action, and alternatives R, P, and O.

- Standards for development of hydroelectric and other water use developments are less stringent in the no action alternative than the proposed action and alternatives R, P, and O.
- Eight out of 25 vegetation structure classes are within HRV after 100 years of land management under no action. Forests that are departed from HRV generally are at greater risk for large fires and insect and disease outbreaks, which can impact hydrologic function and aquatic ecosystems.
- The no action alternative does not increase the pace of increasing resiliency of infrastructure and water uses to potential effects of climate change; infrastructure upgrades would continue at the current pace.

Proposed Action

The proposed action was released to the public in June 2011. It reflects current management policies of the Forest and meets the intent of recovery plans for terrestrial and aquatic threatened and endangered species, based on science that has evolved since the existing Colville Forest Plan was published in 1988. An emphasis on management that applies landscape ecology concepts to provide for ecological resilience to disturbances, including the effects of climate change, has also been added based on current scientific knowledge. Management areas in the proposed action are designated where management intent is similar.

Direction for management of aquatic resources is based on the 2008 Region 6 ARCS (USDA Forest Service 2008a) and provides a comprehensive core set of plan components (desired conditions, objectives, standards, and guidelines) to maintain and restore the ecological health of watersheds and aquatic ecosystems across the Forest. ARCS also designates riparian management areas (RMAs) and a key watershed network, and includes watershed analysis as the basis for assessment of status and trend of watershed conditions.

Riparian and Aquatic Resource Management

Riparian Management Areas

Riparian and aquatic resource direction included in the proposed action is based on the 2008 Region 6 ARCS (USDA Forest Service 2008a), which is a refinement of earlier strategies including the Northwest Forest Plan (USDA Forest Service and USDI BLM 1994a), PACFISH (USDA and USDI 1995), INFISH (USDA Forest Service 1995a), and the R6 ARS (USDA Forest Service 2005b). The proposed action includes designation of riparian management areas (RMAs), which include portions of watersheds where aquatic and riparian-dependent resources receive special management and have specific standards and guidelines. RMAs overlay approximately 179,236 acres (16 percent) of the Forest, compared to 14 percent under the no action and B alternatives. RMAs are mapped, but actual locations of RMAs may be changed and updated based on project-level planning and reconnaissance. These widths were calculated using the default distances. However, RHCAs are delineated on the ground based on characteristics such as the inner gorge, outer edges of the 100-year floodplain, the outer edges of riparian vegetation, some distance equal to the height of site-potential trees, the extent of the seasonally saturated soil, or to the extent of moderately and highly unstable areas and using the width that is greatest. Table 119 lists the definitions of RHCA widths.

Table 141. RMA widths and total acreage for the proposed action and alternatives R, P, and O

Stream and water body classification	Riparian Management Area (RMA) width	Acres
Fish-bearing streams	RMAs consist of the stream and the area on each 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 total, including both sides of the stream channel), whichever is greatest. A site-potential tree height is the average maximum height of the tallest dominant trees for a given site class.	34,840
Permanently flowing non-fish-bearing streams	RMAs consist of the stream and the area on each 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 one site-potential tree, or 150 feet slope distance (300 feet total, including both sides of the stream channel), whichever is greatest.	48,791
Lakes and natural ponds	RMAs consist of the body of water and the area to the outer edges of the riparian vegetation, or to the extent of seasonally saturated soil, or to the extent of unstable and potentially unstable areas, or to a distance equal to the height of two site-potential trees, or 300 feet slope distance, whichever is greatest.	10,138
Constructed ponds and reservoirs, and wetlands greater than 1 acre	RMAs consist of the body of water or wetland and the area to the outer edges of the riparian vegetation, or to the extent of seasonally saturated soil, or the extent of unstable and potentially 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 wetland greater than 1 acre or the maximum pool elevation of constructed ponds and reservoirs, whichever is greatest.	15,844
Seasonally flowing or intermittent streams; wetlands, seeps, and springs less than 1 acre, and unstable or potentially unstable areas	Seasonally flowing or intermittent streams, wetlands, seeps and springs less than 1 acre, and unstable and potentially unstable areas - This category applies to features with high variability in size and site-specific characteristics. At a minimum, the RMAs will include: • The extent of unstable and potentially unstable areas (including earthflows). • The stream channel and extend to the top of the inner gorge. The stream channel or wetland and the area from the edges of the stream channel or wetland to the outer edges of the riparian vegetation, extending from the edges of the stream channel to a distance equal to the height of one site-potential tree, or 100 feet slope distance, whichever is greatest. A site-potential tree height is the average maximum height of the tallest dominant trees for a given site class. Intermittent streams are defined as any non-permanent flowing drainage feature having a definable channel and evidence of annual scour or deposition. This includes what are sometimes referred to as ephemeral streams if they meet these two physical criteria. Including intermittent streams, springs, and wetlands within RMAs is important for full implementation of the ARCS. Accurate identification of these features is critical to the correct implementation of the strategy and protection of the intermittent stream and wetland functions and processes. Identification of these features is difficult at times due to the lack of surface water or wet soils during dry periods. The extent of intermittent channels are also difficult to identify due to lack of continuity in bedform features. Fish-bearing intermittent streams are distinguished from non-fish-bearing intermittent streams by the presence of any species of fish for any duration. Many intermittent streams may be used as spawning and rearing streams, refuge areas during flood events in larger rivers and streams, or travel routes for fish emigrating from lakes. In these instances, the guidelines for fish-bearing streams would apply to those sections of the intermittent stream used by the fish.	69,623
Total		179,236

An increase in total acres of RMAs from the total area of RHCAs in the no action alternative gives greater protection to riparian function and structure than the no action alternative and alternative B at lakes and natural ponds (where riparian distance is increased from 150 to 300 feet), and intermittent streams and wetlands, seeps, and springs less than 1 acre (where riparian distance is increased from 50 feet in non-INFISH priority watersheds to 100 feet across the Forest). There is no research to indicate that riparian reserve widths under the Northwest Forest Plan provide more protection than necessary to meet riparian desired conditions and objectives (Everest and Reeves 2007). This finding supports the expansion of RMA widths from INFISH RHCA widths to be more consistent with Riparian Reserve widths from the Northwest Forest Plan.

Riparian and Aquatic Resource Plan Components

The proposed action includes objectives, standards, and guidelines specific to RMAs. Objectives for RMAs include:

- Modification of grazing practices in RMAs to move toward desired conditions
- Restoration of riparian processes at dispersed recreation sites
- Consolidation of user-created access routes in RMAs
- Provide upstream fish passage at road stream crossings

Standards address activities including chemical application, fuel containment, fuel wood cutting, road and stream crossing construction and reconstruction, location of livestock handling and watering facilities, location of mine waste, pump screening, fire suppression, fuel chipping, new and existing special uses, and development of new hydroelectric facilities. Guidelines address activities including, RMA function, water drafting, hazard tree retention, harvest and thinning, road and stream crossing construction and re-construction, livestock grazing, recreation facilities, mineral development, fire suppression, and watershed restoration project design. There are 28 guidelines and 17 standards for RMAs in the proposed action. These standards and guidelines and BMPs form the primary mechanisms of protection of riparian and aquatic function under the proposed action.

Key Watersheds

Key watersheds are one of the primary elements within the proposed action that maintain and improve hydrologic and aquatic function. Key watersheds are a network of watersheds that serve as strongholds for important aquatic resources or have the potential to do so through focused restoration (USDA Forest Service 2008a). Key watersheds are designated at the subwatershed scale and were selected based on population condition of surrogate aquatic species (interior redband trout, westslope cutthroat trout, and bull trout), and aquatic habitat condition and function (see Fisheries Specialist Report for description of this methodology). Management in key watersheds minimizes risk and maximizes restoration of preservation of ecological health. The key watershed network in the proposed action was identified in 2011, and expands the INFISH priority network in the proposed action with the addition of 13 additional subwatersheds. Four subwatersheds in the INFISH priority network were not included in the key watershed network for the proposed action because they did not have the aquatic habitat conditions or surrogate species population necessary for designation as a key watershed under Reiss et al. (2008).

There are 371,900 acres of key watersheds under NFS ownership (34 percent of total Colville National Forest ownership) in the proposed action (table 142). Existing miles and road density of NFS roads in RHCAs within the Forest ownership boundary in key watersheds are shown in table 142. Key watersheds are included in the Focused Restoration, Backcountry, Backcountry Motorized, Research Natural Area, Recommended Wilderness, and Wilderness Management Areas. The Winchester Creek SWS is the only key watershed located in the General Restoration MA in the proposed action. Subwatershed names, numbers, and boundaries have changed since the creation of management areas in the proposed action, and inclusion of Winchester Creek in the General Restoration MA is a legacy of these changes.

Table 142. Key watersheds in the proposed action

Key Watershed Number	Key Watershed Name	Total Subwatershed Acres	Colville National Forest Ownership Acres	Riparian Road Miles	Riparian Road Density
170102160102	Winchester Creek	10,482	5,627	10.7	4.2
170102160103	Exposure Creek-Pend Oreille River	41,223	14,462	9.7	1.7
170102160106	Smalle Creek	17,753	11,058	9.9	1.9
170102160109	Tacoma Creek	39,519	27,182	25.1	2.7
170102160202	West Branch LeClerc Creek	21,671	15,098	5.6	0.9
170102160203	East Branch LeClerc Creek	26,662	11,145	11.0	2.7
170102160204	Ruby Creek	19,597	18,385	13.1	2.2
170102160302	Sweet Creek-Pend Oreille River	41,831	28,890	16.5	2.1
170102160303	Harvey Creek	32,998	27,553	17.6	1.9
170102160304	Headwaters Sullivan Creek	45,516	45,417	45.1	3.9
170102160305	North Fork Sullivan Creek-Sullivan Creek	12,708	11,258	1.8	0.6
170102160306	Slate Creek	19,911	19,907	10.5	2.3
170102160307	South Salmo River	22,271	15,932	0.1	0
170200010104	North Fork Deep Creek	49,256	26,633	15.7	2.2
170200010306	Barnaby Creek	23,107	14,299	9.1	2.4
170200010401	Upper Hall Creek	31,648	13,785	3.7	1.0
170200010402	Sitdown Creek	14,484	0	0	0
170200010403	Middle Hall Creek	15,480	1,927	0.9	0.8
170200020401	Trout Creek	23,434	14,121	10.7	3.6
170200020501	Tonata Creek	14,453	13,780	16.2	5.9
170200020608	North Fork Deadman Creek	13,449	13,185	8.8	1.1
170200020609	Deadman Creek	26,518	22,299	10.7	2.6
Total		563,971	**371,943**		

Watershed and Aquatic Restoration

The proposed action prioritizes watershed restoration through measureable objectives in key watersheds, and additional RMA objectives to improve aquatic and hydrologic condition and function and move toward desired conditions. Plan components specific to key watersheds, including measureable objectives are discussed in this section.

Key watersheds where restoration would be prioritized were identified based on limiting factors to hydrologic and aquatic function that could be improved through focused restoration projects identified in the WCF and AEC processes (MacDonald et al. 2018). Measurable objectives for key watersheds that are priorities for active restoration would contribute to the maintenance and restoration of desired conditions in key watersheds. Desired conditions for key watersheds include:

- Key watersheds are networks of watersheds with good habitat and functionally intact ecosystems that contribute to and enhance recovery of threatened and endangered species;

- Roads do not present risk to aquatic resources;
- Key watersheds have high watershed integrity

Future projects in key watersheds would focus on achieving key watershed-specific, RMA, and aquatic and riparian system desired conditions. While watershed improvement treatments are not expected on every acre of key watershed through the life of this land and resource management plan, specific measurable objectives for key watersheds where restoration is focused are expected to accelerate the pace of aquatic restoration across the key watershed network.

Specific objectives for key watersheds were developed that are intended to achieve desired conditions. Objectives for the key watershed network under the proposed action include:

- **Key watershed objective 1 Watershed Restoration Prioritization:** Management in key watersheds focuses on restoration or preservation of watershed, aquatic, and riparian function and recovery of threatened and endangered species. Improve watershed condition class in key watersheds that are a priority for restoration within 15 years of land and resource management plan implementation. Key watersheds that are a priority for restoration include East Branch LeClerc Creek, West Branch LeClerc Creek, Deadman Creek, Barnaby Creek, Harvey Creek, North Fork Deadman Creek, North Fork Sullivan Creek, Sullivan Creek, Ruby Creek, and Tonata Creek subwatersheds. Additional key watersheds that are a priority for restoration would be identified, as appropriate through the life of the plan.
- **Key watershed objective Road Treatments:** Reduce road-hydrologic connectivity and sediment delivery on roads through storm damage risk reduction treatments, full hydrologic decommissioning, and other accepted treatment measures on 68 miles of hydrologically connected road within 15 years of land and resource management plan implementation.
- Restore or maintain aquatic organism passage and improve hydrologic and aquatic habitat function at 36 road/stream crossings for all native aquatic species, seasons, flows, and life stages within 15 years of land and resource management plan implementation through culvert replacement or crossing improvement and natural channel design or other acceptable treatment measures that provide for natural stream channel function at all flows.
- **Key watershed objective Range Infrastructure Improvements:** Improve hydrologic and aquatic function through range infrastructure improvements, including riparian fencing, movement and improvement of watering troughs, and other acceptable treatments on 240 acres within 15 years of plan implementation.
- **Key watershed objective Riparian Vegetation Structure:** Move upland vegetation within riparian management areas in key watersheds toward HRV on 450-950 acres within 15 years of plan implementation.
- **Key watershed objective Stream Restoration:** Restore hydrologic, geomorphic, and riparian process and function on 70 miles of stream within 15 years of land and resource management plan implementation through activities including streambank stabilization, restoration of lateral and vertical hydrologic connectivity and improvement of stream channel and floodplain function.

Objectives for key watersheds and estimates of restoration work that would be completed through the life of the revised forest plan in key watersheds that are priorities for active restoration are shown in the following table.

Table 143. Objectives for key watersheds that are a priority for restoration

Key Watershed Prioritization	Road Treatments Road Improvement (miles)*	Road Treatments Aquatic Organism Passage Improvement (# of crossings)	Range Infrastructure Improvement (acres)	Riparian Vegetation Structure Improvement (acres)	Stream Restoration (miles)
West Branch LeClerc Creek	3	5	20	0	10
East Branch LeClerc Creek	3	1	20	0	10
Deadman Creek	5	1	30	75-150	3
Barnaby	5	5	30	75-150	4
Harvey Creek	10	2	0	0	4
North Fork Deadman Creek	5	1	30	75-150	3
North Fork Sullivan Creek	3	1	0	0	0
Sullivan Creek	15	6	0	0	20
Tonata Creek	4	4	50	75-150	3
Ruby Creek	3	4	30	75-150	3
Treatments in additional key and/or priority watersheds (estimate addition 3 subwatersheds)	12	6	30	75-150	10
Total for the life of the plan (essential projects completed for 12 key watersheds)	**68 miles**	**36 crossings**	**240 acres**	**450-950 acres**	**70 miles**

The following standards were developed for key watersheds in the proposed action:

- There shall be no net increase at any time in the mileage of Forest roads in any key watershed unless doing so results in a reduction in road-related risk to watershed condition;
- Hydroelectric and other water development authorizations shall include requirements for instream flows and habitat conditions that maintain or restore native fish and other desired aquatic species populations;
- New hydroelectric facilities and water developments shall not be located in a key watershed.

Through the life of the revised forest plan, completion of essential projects in 12 key watersheds is estimated. Treatments to achieve this goal include: 68 miles of reduction in road hydrologic connectivity through decommissioning and storm damage risk reduction treatments, improvement of aquatic organism passage at 36 crossings, 240 acres of range infrastructure improvements, 450 to 950 acres of riparian vegetation improvements to move upland vegetation in riparian areas toward HRV, and 70 miles of improvement of hydrologic and geomorphic channel function through in-stream channel improvements.

Roads/Access

Acres of Management Area Where Road Building Activities are Permitted

Approximately 291,100 acres (26 percent of Colville National Forest) in the proposed action are in management areas where construction of new roads is prohibited, including backcountry, backcountry motorized, research natural areas, and both designated and recommended wilderness.

Summer and Winter Motorized Recreation Opportunities Suitable Uses

Summer and winter motorized recreation use is authorized in the Active Restoration B and C, Backcountry Motorized (winter use is limited by wildlife restrictions), and Scenic Byways Management Areas; 874,800 acres (79 percent of the Forest) are within MAs where summer and winter motorized recreation are authorized. Standards and guidelines, implementation of BMPs, and adaptive management are the primary mechanisms through which watershed function and water quality are maintained. Suitability of an area for summer or motorized recreation opportunities is guidance for project activity decision making and is not a resource commitment or final decision approving projects and activities. Use would not occur over an entire suitable area; locations of potential motorized use would be determined at the project level through site-specific analysis.

Road Density Desired Conditions

Road densities of less than 1 mile per square mile with no valley bottom roads are considered low enough to support proper watershed and aquatic function (Potyondy and Geier 2010). Road densities of 1 to 2.4 miles per square mile are considered functional at risk, and road densities greater than 2.4 miles per square mile are considered not functional. While road density provides a broad-scale metric to assess watershed condition, the location, type, and condition of roads provides a better approximation for potential effect of the road system on hydrologic and aquatic function.

While road densities vary across the management areas, a road density desired condition of no greater than 2 miles per square mile of maintenance level 1-5 roads is included in the Active Restoration B MA (257,200 acres, 23 percent of Colville National Forest), and no greater than 3 miles per square mile in the Active Restoration C MA (536,300 acres, 49 percent of Colville National Forest). Existing road densities calculated by management area at the 5th field watershed scale for the Focused and General Restoration MAs are shown in table 144. There are no watersheds within the Focused Restoration MA where existing condition meets the road density desired condition of 2 miles per square mile. There are 8 watersheds within the General Restoration MA that meet the road density desired condition of 3 miles per square mile, and 9 watersheds that do not meet road density desired conditions.

Road Management Plan Components

A specific objective for reduction in road hydrologic connectivity and sediment delivery through treatment of an estimated 68 miles of hydrologically connected road through the life of the plan would improve hydrologic and aquatic function and reduce road risk and density. Roads that are hydrologically connected to the stream system are the focus of restoration activities because watershed-scale road analyses across the Pacific Northwest have shown that less than 10 percent of road segments deliver 90 percent of road-generated sediment to the stream system. Therefore, treatment of the highest risk hydrologically connected road has the greatest potential to reduce the risk of roads to aquatic habitat and hydrologic function (GRAIP 2014).

In addition to specific road density desired conditions for the General and Focused Restoration Management Areas, desired conditions for aquatic and riparian systems, RMAs, and key watersheds focused on minimizing hydrologic interruption, erosion, and sedimentation from the road system are included in the proposed action. Projects implemented under the proposed action would be designed with the goal of achieving these desired conditions.

Table 144. Existing road density by 5th field watershed for the focused and general restoration management areas under the proposed action

5^{th} field Watershed Name	Road Density (mi/mi^2)	Meets Road Density Desired Condition of 2 mi/mi^2?
Focused Restoration MA		
Boulder Creek-Kettle River	3.3	N
Curlew Creek	2.6	N
Deep Creek	3.7	N
Hall Creek-Franklin D Roosevelt Lake	5.3	N
LeClerc Creek-Pend Oreille River	2.1	N
Sherman Creek-Franklin D Roosevelt Lake	2.8	N
Sullivan Creek-Pend Oreille River	3.7	N
Tacoma Creek-Pend Oreille River	3.1	N
Vulcan Mountain-Kettle River	3.9	N

5^{th} field Watershed Name	Road Density (mi/mi^2).	Meets Road Density Desired Condition of 3 mi/mi^2?
General Restoration MA		
Boulder Creek-Kettle River	3.0	Y
Chewelah Creek-Colville River	4.3	N
Curlew Creek	3.6	N
Deep Creek	3.4	N
Hall Creek-Franklin D Roosevelt Lake	4.3	N
LeClerc Creek-Pend Oreille River	2.6	Y
Little Pend Oreille River	3.3	N
Mill Creek	2.7	Y
Onion Creek-Franklin D Roosevelt Lake	2.8	Y
Sherman Creek-Franklin D Roosevelt Lake	2.8	Y
Stensgar Creek-Colville River	3.0	Y
Sullivan Creek-Pend Oreille River	3.0	Y
Tacoma Creek-Pend Oreille River	4.1	N
Toroda Creek	2.5	Y
Upper Sanpoil River	3.2	N
Vulcan Mountain-Kettle River	4.6	N
West Fork Sanpoil River	3.7	N

The proposed action includes standards for sidecasting, fill placement, and avoidance of hydrologic flow paths during road construction, maintenance, and reconstruction. Also included in the proposed action is a standard for reconstructing stream crossings to accommodate 100-year flows, avoid diversion of streamflow onto roads in the event of crossing failure, and provide fish passage for all species and life stages. Guidelines in the proposed action include avoidance of road construction in RMAs, wetlands, and unstable areas, construction or reconstruction of stream crossings to allow for riparian-dependent species passage, and retention of fish passage barriers where they restrict access by non-native fish species.

Standards, guidelines, BMPs, and restoration objectives to minimize hydrologic impacts from the road system are the primary mechanisms to protect water quality and riparian function from roads under the proposed action.

Old Forest Management, Timber Production, and Upland Vegetation Condition

Active Vegetation Management

Timber harvest is allowed (however, not all lands within these management areas are "suitable" for timber harvest) in both Active Restoration B and C MAs, which cover 793,500 acres (71 percent of the Forest). This is less acreage available for timber harvest than no action and alternative B, similar to alternatives P and O, and more than alternative R. Acres treated are constrained by timber suitability, Forest budgets, and project-level considerations. BMPs are the primary mechanism to limit the potential effects of vegetation management activities on water quality and hydrologic function.

Primary Vegetation Management Tools

Variable density thinning would be the primary tool for active commercial vegetation management in the Focused and General Restoration MAs in the proposed action in the Douglas-fir dry and northern Rocky Mountain mixed conifer vegetation types in the proposed action with an estimated (modeled) treatment of 4,050 acres per year. Mechanical fuels treatments are estimated on 5,000 acres per year in these vegetation types. Mixed and light-severity prescribed fire would be used in open-canopy stands on a 20-year rotation to maintain open conditions in the Douglas-fir dry and northern Rocky Mountain mixed conifer vegetation types with treatment modeled for 3,839 acres per year. Shelterwood harvest with reserves would be the primary commercial vegetation management tool in the subalpine fir and lodgepole pine vegetation type with an estimated (modeled) 950 acres of treatment per year. Stand-replacing prescribed fire would be used in the subalpine fir and lodgepole pine vegetation type with an estimated treatment of 1,040 acres per year. There are no modeled vegetation treatments in the Western red cedar/Western hemlock and spruce/subalpine fir vegetation types.

Acres of Colville National Forest lands by management area and activities authorized in each are shown in chapter 2 (table 21).

Historical Range of Variability

Twelve out of 25 structure classes are within HRV after 100 years of land management under the proposed action (table 145). The same number of structure classes are within HRV for no action, the proposed action, and alternative P. The late closed forest structure would be above HRV in four of five vegetation types. Levels of disturbance and management do not occur across enough acres over 100 years under the proposed action to create open structure conditions that existed historically. Areas that would historically have contained large trees with open canopy conditions, and greater resistant to wildfire and insect and disease outbreaks would be in a closed canopy condition with greater susceptibility to disturbance (Day 2017).

Table 145. Modeled forest structure levels at 100 years compared to HRV for all vegetation types in the proposed action

Structure Class	HRV	Proposed Action
Early Structure		
Douglas-fir dry	6-16	8*
Northern Rocky Mountain mixed conifer	9-25	2
Western hemlock / western red cedar	4-24	0
Subalpine fir / lodgepole pine	45-65	56
Spruce / subalpine fir	14-46	3
Mid Open		
Douglas-fir dry	2-8	6
Northern Rocky Mountain mixed conifer	1-3	1
Western hemlock / western red cedar	0	0
Subalpine fir / lodgepole pine	0	11
Spruce / subalpine fir	0	0
Mid Closed		
Douglas-fir dry	4-13	4
Northern Rocky Mountain mixed conifer	18-30	12
Western hemlock / western red cedar	7-27	0
Subalpine fir / lodgepole pine	33-53	22
Spruce / subalpine fir	13-41	32
Late Open		
Douglas-fir dry	38-78	59
Northern Rocky Mountain mixed conifer	4-6	7
Western hemlock / western red cedar	0	0
Subalpine fir / lodgepole pine	0	3
Spruce / subalpine fir	0	0
Late Closed		
Douglas-fir dry	1-32	22
Northern Rocky Mountain mixed conifer	44-60	77
Western hemlock / western red cedar	55-83	100
Subalpine fir / lodgepole pine	3	9
Spruce / subalpine fir	29-57	65
Total Structure Classes Within HRV		**12**

*Shaded cells are within HRV.

Vegetation Management Plan Components

Standards for fuel wood cutting, application of herbicides and other pesticides, and fuel chipping are included in the proposed action. Guidelines are included for hazard tree felling, timber harvest and thinning in RMAs, location of landings, skid trails, and staging, decking, and yarding activities in RMAs. Standards, guidelines, and BMPs are the primary mechanisms to protect water quality and riparian function from vegetation management activities under the proposed action.

Grazing Plan Components

Current allotment boundaries and AUMs would continue under the proposed action. Plan components in the proposed action provide stricter guidelines than INFISH to attain goals, objectives, and desired conditions. A guideline with stricter criteria for minimizing streambank alteration, decreasing vegetation utilization, and increasing stubble height should move toward desired conditions in a shorter timeframe than the no action alternative. Specific guidelines within greenline vegetation area adjacent to all watercourses include:

- do not exceed 20 percent streambank utilization;
- do not exceed 40 percent utilization of mean annual vegetation production on woody vegetation; and
- maintain at least 4 to 6 inches or do not exceed 40 percent utilization of mean annual vegetative production of herbaceous vegetation.

Standards, guidelines, BMPs, and restoration objectives to mitigate the impact of grazing on hydrologic function and water quality are the primary mechanisms to preserve water quality and hydrologic function under the proposed action.

Summary of Effects and Comparison to Other Alternatives

The proposed action provides more protection for preservation and restoration of hydrologic function, water quality, and water uses than the no action and B alternatives. The proposed action does not provide as much protection for preservation and restoration of hydrologic function, water quality, and water uses as alternatives R, P, and O. Effects of the proposed action in relation to other alternatives include:

- The proposed action addresses the need for change more effectively than no action and alternatives B and O. Through plan components and principles from ARCS, including watershed analysis, and specific objectives for restoration in key watersheds, the pace and scale of watershed restoration and resiliency to potential hydrologic effects of climate change are increased in the proposed action. The proposed action does not address the need for change as effectively as alternatives P and R.
- Wider RMA widths along intermittent streams, lakes, and ponds than no action and alternative B would improve and preserve hydrologic and riparian function better than narrower RHCA widths in no action and alternative B.
- There are more acres of key watersheds in the proposed action than in the INFISH priority network in no action and alternative B. There are fewer acres of key watersheds in the proposed action than in alternatives R, P, and O. While restoration activities are not expected on every acre within key watersheds, the larger key watershed network in the proposed action would accelerate the pace of restoration of hydrologic function than in the smaller INFISH priority network in no action and alternative B.
- The proposed action would accelerate improvement in watershed condition faster than no action and alternative B. Measurable objectives in key watersheds would accelerate restoration and preservation of hydrologic function. There are fewer subwatersheds in the proposed action key watershed network than in the key watershed network for alternatives R, P, and O.
- Desired conditions are identified for general aquatic riparian and watershed condition; no action and alternative B focus on general riparian goals rather than desired conditions.
- Approximately 26 percent of Colville National Forest land base is in management areas where construction of new roads is prohibited. Twenty-three percent of the Colville National Forest land

base is within the Focused Restoration MA where desired condition for road density is 2 miles per square mile.

- Approximately 79 percent of the Forest is within management areas where summer and winter motorized recreation is authorized. This is the same percentage as alternatives P and O, less than no action, and more than alternatives R and B.
- Approximately 71 percent of Colville National Forest land base is in management areas where timber harvest is authorized, though lands in these management areas may not be suitable for timber harvest. This is less than no action and alternative B, similar to alternatives P and O, and greater than alternative R.
- Twelve out of 25 vegetation structure classes are within HRV after 100 years of land management under the proposed action. Departure from HRV in the proposed action is the same as no action and alternative P.
- Standards and guidelines address watershed function, including protection of streambank and floodplain integrity from livestock grazing, reduction of erosion and sedimentation and disruption of hydrologic processes from roads and trails. Standards and guidelines in the proposed action should protect watershed function and water quality more effectively than no action and alternative B. Standards and guidelines in the proposed action are less restrictive than in alternatives R and P.
- There is a greater emphasis on grazing standards and guidelines in the proposed action; a guideline with numeric criteria for streambank alteration, herbaceous and woody utilization, and stubble height should be more effective in moving toward desired conditions in RMAs in grazing allotments than no action and alternative B. Standards and guidelines for grazing in the proposed action are not as restrictive as in alternatives R and P.
- Standards for development of hydroelectric and other water use developments are more stringent in the proposed action and alternatives R, P, and O than in no action and alternative B.
- Measureable objectives and focused restoration activities in key watersheds in the proposed action would increase the pace of increasing resiliency of infrastructure and water uses to potential effects of climate change. Since the key watershed network is smaller in the proposed action than in alternatives R, P, and O, the proposed action would be less effective in increasing resiliency to climate change than alternatives R, P, and O.

Alternative R

Alternative R responds to public comments that the proposed action does not provide watershed, aquatic, and riparian resource protections that are as effective as 1988 forest plan direction. Aquatic direction and plan components in alternative R are based on a modified version of ARCS (referred to throughout this FEIS as ARCS-modified), which adds clarification to desired conditions, objectives, standards, and guidelines in the 2008 version of ARCS to address issues specific to the Forest. Changes from ARCS-2008 to ARCS-modified were based on public and internal comments, best available science, and new policies on Forest Service management of aquatic and riparian resources, including the Watershed Condition Framework. ARCS-modified plan components were updated based on discussions with the land and resource management plan interdisciplinary team, resource specialists in the Pacific Northwest regional office, and other reviewers of the revised land and resource management plan.

Most of the updates made to ARCS plan components in ARCS-modified add clarity to individual plan components. Operational constraints were also considered in the evaluation of each standard and guideline within ARCS.

Alternative R includes three new guidelines related to aquatic invasive species (AIS), one new guideline addressing fuel storage in RMAs, a new standard to limit hydrologic impacts from roads, trails, and developed recreation sites, and five standards that were guidelines in the proposed action. RMAs are the same as the proposed action and alternatives P and O. There are more subwatersheds within the key watershed network than in the proposed action in alternatives R and O. The key watershed network in alternative P is larger than in alternatives R and O. Similar to all other alternatives, alternative R includes watershed analysis as a means to assess the status and trend of watershed and ecological conditions; however, there are no specific objectives for watershed analysis.

Riparian and Aquatic Resource Management

Acres of RMAs

RMA widths and acreages are the same as the proposed action and alternatives P and O.

Riparian and Aquatic Plan Components

Alternative R includes desired conditions, objectives, standards, and guidelines for general water resources and RMAs. Desired conditions for general water resources, key watersheds, and RMAs have been updated and clarified in alternative R. An additional desired condition addressing roads in RMAs is included in alternative R. A desired condition was also added to alternative R to address the existing condition in focus and priority watersheds. RMA and general water resources objectives address limiting factors to hydrologic, aquatic, and riparian function, and focus on improving watershed condition through the life of the plan and are discussed in detail in the watershed and aquatic restoration section.

Standards in alternative R address activities including chemical application, fuel containment, fuel wood cutting, road and stream crossing construction and reconstruction, location of livestock handling and watering facilities, location of mine waste, pump screening, fire suppression, fuel chipping, new and existing special uses, and development of new hydroelectric facilities. Guidelines under the proposed action that address activities including RMA function, water drafting, hazard tree retention, harvest and thinning, road and stream crossing construction and re-construction, livestock grazing, recreation facilities, mineral development, fire suppression, and watershed restoration project design are standards in alternative R. Alternative R has a greater emphasis on standards than the proposed action; there are 27 guidelines and 21 standards for general water resources, key watersheds, and RMAs in the proposed action. Standards, guidelines, and BMPs are the primary mechanisms to protect hydrologic, aquatic, and riparian function in alternative R.

Key Watersheds

The key watershed network is expanded from the proposed action in alternative R based on updated fish distribution data, improved data on aquatic habitat function, and changes in boundaries, names, and numbers of subwatersheds since designation of the key watershed network for the proposed action. Five subwatersheds were added to the key watershed network in the proposed action. Additionally, three subwatersheds were removed from the proposed action key watershed network because they contain less than 25 percent NFS ownership.

There are approximately 451,500 acres of key watersheds under NFS ownership (41 percent of total Colville National Forest ownership) in alternative R. Under alternative R, key watersheds are included in the Late Forest Structure, Backcountry, Backcountry Motorized, Research Natural Area, Recommended Wilderness, and Wilderness MAs. While watershed improvement treatments are not expected on every acre of key watershed through the life of the revised forest plan, specific measurable objectives for key watersheds are expected to accelerate the pace of aquatic restoration across the key watershed network.

Water quality and hydrologic function are expected to improve from restoration projects to meet specific objectives outlined in the revised forest plan.

Table 146. Key watersheds (subwatershed scale) for alternatives R and O

Key Watershed Number	Key Watershed Name	Total Subwatershed Acres	Colville National Forest Ownership Acres	Riparian Road Miles	Riparian Road Density
170102160102	Winchester Creek	10,482	5,628	10.7	4.2
170102160103	Smalle Creek	17,754	11,058	9.9	1.9
170102160201	Exposure Creek-Pend Oreille River	41,224	14,463	9.7	1.7
170102160206	Tacoma Creek	39,519	27,182	25.1	2.7
170102160302	West Branch LeClerc Creek	21,672	15,099	5.6	0.9
170102160303	East Branch LeClerc Creek	26,663	11,145	11.0	2.7
170102160304	Ruby Creek	19,597	18,385	13.1	2.2
170102160401	Harvey Creek	32,999	27,554	17.6	1.9
170102160402	Headwaters Sullivan Creek	45,516	45,417	45.1	3.9
170102160403	North Fork Sullivan Creek-Sullivan Creek	12,709	11,259	1.8	0.6
170102160702	Headwaters South Salmo River	20,697	12,472	0.1	0
170102160902	Sweet Creek-Pend Oreille River	41,832	28,890	16.5	2.1
170102160903	Slate Creek	20,195	19,907	10.5	2.3
170102161003	Cedar Creek	17,209	5,359	1.4	1.2
170200011004	North Fork Deep Creek	49,257	26,634	15.7	2.2
170200011301	South Fork Sherman Creek	22,004	21,899	11.6	2.3
170200011302	Upper Sherman Creek	26,381	26,260	15.4	2.8
170200011303	Lower Sherman Creek	20,987	15,998	6.7	6.7
170200011306	Barnaby Creek	23,108	14,299	9.1	2.4
170200011401	Upper Hall Creek	31,648	13,786	3.7	1.0
170200021301	Trout Creek	23,435	14,122	10.7	3.6
170200021701	Tonata Creek	14,453	13,781	16.2	5.9
170200021907	East Deer Creek-Kettle River	23,385	15,443	4.2	1.5
170200022002	North Fork Deadman Creek	13,450	13,185	8.8	1.1
170200022003	Deadman Creek	26,518	22,300	10.7	2.6
	Total	642,692	**451,525**		

Three desired conditions for key watersheds in alternative R are similar to the proposed action, but have been updated for clarity. These desired conditions address riparian composition, key riparian processes, and livestock grazing, which are the same in alternative R and the proposed action. Standards for key watersheds are similar to the proposed action with clarification in the description of the “no net increase in road miles” standard.

Watershed and Aquatic Restoration

Identification of key watersheds that are a priority for restoration and objectives for key watersheds are the same as the proposed action, except Upper Sherman Creek and South Fork Sherman Creek were added as restoration priorities in alternative R. Key watersheds that are priorities for restoration and projected restoration completed through the life of the revised forest plan are shown in table 147. Key watershed objectives include:

- *FW-OBJ-WR-05. Key Watershed Restoration Prioritization*: Management in key watersheds focuses on restoration or preservation of watershed, aquatic, and riparian function and recovery of threatened and endangered species. Improve watershed condition class in key watersheds that are a priority for restoration within 15 years of plan implementation. Key watersheds that are a priority for restoration include:
    - ♦ East Branch LeClerc Creek, West Branch LeClerc Creek, Deadman Creek, Barnaby Creek, Harvey Creek, North Fork Deadman Creek, North Fork Sullivan Creek, Sullivan Creek, Ruby Creek, Upper Sherman Creek, South Fork Sherman Creek, and Tonata Creek subwatersheds. Additional key watersheds that are a priority for restoration would be identified, as appropriate through the life of the plan.
- *FW-OBJ-WR-06. Key Watershed Road Treatments:* Reduce road-hydrologic connectivity and sediment delivery on roads through storm damage risk reduction treatments, full hydrologic decommissioning, and other accepted treatment measures on 78 miles of hydrologically connected road within 15 years of plan implementation.

  Restore or maintain aquatic organism passage and improve hydrologic and aquatic habitat function at 50 road/stream crossings for all native aquatic species, seasons, flows, and life stages within 15 years of forest plan implementation through culvert replacement or crossing improvement and natural channel design or other acceptable treatment measures that provide for natural stream channel function at all flows.
- *FW-OBJ-WR-07. Key Watershed Range Infrastructure Improvements:* Improve hydrologic and aquatic function through range infrastructure improvements, including riparian fencing, movement and improvement of watering troughs, and other acceptable treatments on 240 acres within 15 years of plan implementation.
- *FW-OBJ-WR-08. Upland Vegetation Structure in RMAs in Key Watersheds:* Move upland vegetation within riparian management areas in key watersheds toward HRV on 600 to 1,200 acres within 15 years of plan implementation.
- *FW-OBJ-WR-09. Stream Restoration in Key Watersheds:* Restore hydrologic, geomorphic, and riparian process and function on 76 miles of stream within 15 years of plan implementation through activities including streambank stabilization, restoration of lateral and vertical hydrologic connectivity and improvement of stream channel and floodplain function.

Table 147. Key watersheds that are priorities for restoration and projected restoration activities based on key watershed objectives that would be completed through the life of alternative R

Key Watershed Prioritization	Road Treatments Road Improvement (miles)*	Road Treatments Aquatic Organism Passage Improvement (# of crossings)	Range Infrastructure Improvement (acres)	Riparian Vegetation Structure Improvement (acres)	Stream Restoration (miles)
West Branch LeClerc Creek	3	5	20	0	10
East Branch LeClerc Creek	3	1	20	0	10
Deadman Creek	5	1	30	75-150	3
Upper Sherman Creek	5	5	0	75-150	2
South Fork Sherman Creek	5	9	0	75-150	4
Barnaby Creek	5	5	30	75-150	4
Harvey Creek	10	2	0	0	4
Tonata Creek	4	4	50	75-150	3
North Fork Deadman Creek	5	1	30	75-150	3
North Fork Sullivan Creek	3	1	0	0	0
Sullivan Creek	15	6	0	0	20
Ruby Creek	3	4	30	75-150	3
Treatments in additional key and/or priority watersheds (estimate addition 3 subwatersheds over 15 years)	12	6	30	75-150	10
Total for the life of the plan (essential projects completed for 14 subwatersheds)	**78 miles**	**50 crossings**	**240 acres**	**600-1,200 acres**	**76 miles**

Objectives for restoration in RMAs are expanded and clarified in alternative R from those included in the proposed action. In addition, alternative R includes an objective for management of upland vegetation in RMAs to move toward HRV. Two RMA objectives apply to subwatersheds outside of key watersheds, since key watershed objectives address the same activities within key watersheds. Objectives for RMAs in alternative R include:

- *MA-OBJ-RMA-01. Improve Riparian Function at Dispersed and Developed Recreation Sites:* Over the next 15 years, restore riparian processes and balance need for occupancy and access to water at 50 dispersed and developed recreation sites, through education, enforcement, and engineering where recreational use results in bank damage, reduction in water quality, and/ or a reduction in stream shade.
- *MA-OBJ-RMA-02. Restoration of Riparian Habitat and Processes on Roads:* Restore hydrologic and riparian habitat function within RMAs in non-key watersheds by reducing road-related impacts on 30 miles of road within 15 years.

- *MA-OBJ-RMA-03. Restoration of Late Forest Structure:* Move upland vegetation within riparian management areas outside of key watersheds toward HRV on 500 acres within 15 years of plan implementation.

Alternative R also includes general water resources objectives, not included in the proposed action:

- *FW-OBJ-WR-01. Aquatic Invasive Species:* Within the next 15 years, implement aquatic invasive species prevention measures at all developed recreation sites providing direct and/or indirect access to water bodies, such as boat ramps and other campgrounds, resorts and day use areas that provide portal zones for hand-carried watercraft. Implement aquatic invasive species prevention measures as part of all aquatic survey and inventory procedures and other management activities that pose high potential for invasion vectors to occur.
- *FW-OBJ-WR-02. Aquatic Invasive and Non-Native Species:* Within the next 15 years, implement aquatic invasive species control and eradication at 10 sites where such invasions have become established and prevent attainment of listed fish recovery plan goals and/or effects to social, economic and ecological systems are determined to be unacceptable.
- *FW-OBJ-WR-03. General Watershed Function and Restoration:* Within the next 15 years, decrease sediment delivery from management activities on 1,000 acres including but not limited to roads, livestock, illegal off-road vehicle use, vegetation management, and dispersed and developed campsites. Restore hydrologic, aquatic and riparian processes through activities that stabilize stream bank erosion, and other accelerated channel destabilizing processes (i.e., headcutting), improve lateral and vertical hydrologic connectivity, and improve stream channel and floodplain function on 10 miles of streams.
- *FW-OBJ-WR-04. Fish Passage Improvement:* Restore aquatic organism passage at 45 road/stream crossings and man-made instream structures including water diversions and dams outside of key watersheds for all native species, seasons, flows, and life stages within 15 years of land and resource management plan implementation, through culvert replacement or installation and improvement of hydrologic and aquatic habitat function and resiliency to a range of flows through natural channel design and other acceptable treatment measures.
- *FW-OBJ-WR-10. Watershed Restoration in Focus and Priority Watersheds:* Over 15 years, implement the watershed condition framework through completion of essential projects outlined in watershed action plans in existing focus and priority watersheds to improve watershed condition class. Focus watersheds designated at the 5th field watershed scale include, Upper Sanpoil, Chewelah Creek-Colville River, and LeClerc Creek-Pend Oreille River watersheds. Priority watersheds designated at the subwatershed scale include Ninemile Creek, East Branch LeClerc Creek, and West Branch LeClerc Creek subwatersheds.

Appendix C of the Hydrology Specialist Report includes details on how water resources and RMA objectives were calculated. The water resources and RMA objectives included in alternative R provide additional direction and a stronger focus on aquatic restoration than the proposed action.

Measurable objectives for key watersheds are similar as the proposed action; however, the specific key watersheds that are priorities for active restoration where these objectives apply are expanded from the proposed action in alternative R. Specific objectives were developed in alternative R for the subwatersheds added to the key watershed network.

Completion of essential projects in 14 key watersheds, and 1 priority watershed is estimated under alternative R. Treatments to achieve this goal include; 78 miles of reduction in road hydrologic connectivity through decommissioning and storm damage risk reduction treatments, improvement of passage at 50 crossings, 240 acres of range infrastructure improvements, 600 to 1,200 acres of riparian vegetation improvements to move upland vegetation in RMAs toward HRV, and 76 miles of improvement of hydrologic and geomorphic channel function through in-stream channel improvements. Completion of projects outside of key and priority watersheds is expected to improve hydrologic, aquatic and riparian function through the treatment of erosion at 50 dispersed recreation sites, 30 miles of road in RMAs, 1,000 acres where erosion problems are identified. In addition, control or eradication of AIS at 10 sites, 500 acres of improvement of upland vegetation in RMAs, improvement of aquatic organism passage at 45 crossings and man-made in-stream structures, and 10 miles of stream restoration would also improve hydrologic, aquatic, and riparian function.

Roads/Access

Acres of Management Area Where Road Building Activities are Permitted

In alternative R, approximately 271,900 acres (25 percent of Colville National Forest) are in management areas where construction of new roads is prohibited, including backcountry, backcountry motorized, research natural areas and both designated and recommended wilderness.

Summer and Winter Motorized Recreation Opportunities Suitable Uses

Summer and winter motorized recreation use is authorized in the Late Forest Structure, General Restoration, Backcountry Motorized (winter use is limited by wildlife restrictions), and Scenic Byways Management Areas (table 21 in chapter 2). Approximately 831,000 acres (75 percent of the Forest) are within MAs where summer and winter motorized recreation are authorized. Standards and guidelines, implementation of BMPs, and adaptive management are the primary mechanisms through which watershed function and water quality are maintained. Suitability of an area for summer or motorized recreation opportunities is guidance for project activity decision making and is not a resource commitment or final decision approving projects and activities. Use would not occur over an entire suitable area; locations of potential motorized use would be determined at the project level through site-specific analysis.

Road Density Desired Conditions

While existing road densities vary across the management areas, road density desired condition of maintenance level 1-5 roads is no greater than 1 mile per square mile in the Late Forest Structure MA (568,200 acres, 51 percent of Colville National Forest), and no greater than 2 miles per square mile in the General Restoration MA (244,800 acres, 22 percent of Colville National Forest). Existing road densities calculated by management area at the 5th field watershed scale for the Late Forest Structure and General Restoration MAs are shown in table 148. There are no watersheds within the General Restoration MA, where existing condition meets the desired condition of 2 miles per square mile. There are no watersheds within the Late Forest Structure MA that meet the desired condition of 1 mile per square mile. Objectives for treatment of roads to decrease sediment delivery should move toward meeting road density desired conditions through the life of the revised forest plan.

Table 148. Existing road density by 5th field watershed for the general restoration and late forest structure management areas in alternative R

5th field Watershed Name	Road Density (mi/mi^2)	Meets Road Density Desired Condition of 2 mi/mi^2?
General Restoration MA		
Boulder Creek-Kettle River	4.5	N
Chewelah Creek-Colville River	6.5	N
Curlew Creek	4.0	N
Deep Creek	6.4	N
Hall Creek-Franklin D Roosevelt Lake	9.0	N
LeClerc Creek-Pend Oreille River	4.6	N
Little Pend Oreille River	*14.5	N
Mill Creek	3.8	N
Onion Creek-Franklin D Roosevelt Lake	*36.2	N
Sherman Creek-Franklin D Roosevelt Lake	4.9	N
Sullivan Creek-Pend Oreille River	3.9	N
Tacoma Creek-Pend Oreille River	5.3	N
Toroda Creek	4.5	N
Upper Sanpoil River	3.5	N
Vulcan Mountain-Kettle River	4.0	N
West Fork Sanpoil River	5.3	N

5th field Watershed Name	Road Density (mi/sq. mi)	Meets Road Density Desired Condition of 1 mi/mi^2?
Late Forest Structure MA		
Boulder Creek-Kettle River	3.6	N
Chewelah Creek-Colville River	5.1	N
Curlew Creek	4.2	N
Deep Creek	4.8	N
Hall Creek-Franklin D Roosevelt Lake	6.1	N
LeClerc Creek-Pend Oreille River	4.4	N
Little Pend Oreille River	4.6	N
Mill Creek	3.4	N
Onion Creek-Franklin D Roosevelt Lake	3.6	N
Sherman Creek-Franklin D Roosevelt Lake	3.9	N
Stensgar Creek-Colville River	3.2	N
Sullivan Creek-Pend Oreille River	5.0	N
Tacoma Creek-Pend Oreille River	4.5	N
Toroda Creek	4.8	N
Upper Sanpoil River	7.2	N
Vulcan Mountain-Kettle River	4.6	N

*Low land area included in road density calculation may make road density calculations appear high.

Old Forest Management, Timber Production, and Upland Vegetation Condition

Active Vegetation Management

Timber harvest would be allowed in general restoration areas, comprising 244,800 acres (22 percent of the Forest), however not all acreage in this management area is suitable for timber harvest. Alternative R has the least amount of MAs allocated to active vegetation management. Acres treated are constrained by timber suitability, Forest budgets, and project-level considerations. BMPs, standards, and guidelines are the primary mechanism to limit the potential effects of vegetation management activities on water quality and hydrologic function.

Primary Vegetation Management Tools

Partial harvest, variable density thinning, and shelterwood with reserves would be the primary tools for active commercial vegetation management with an estimated (modeled) treatment of 975 acres per year under alternative R. Mixed-severity prescribed fire would be used in open-canopy stands on a 20-year rotation to maintain open conditions in the Douglas-fir dry and northern Rocky Mountain mixed conifer vegetation types. Stand-replacing prescribed fire would be used in the subalpine fir and lodgepole pine vegetation type.

Acres of Colville National Forest lands by management area and roadbuilding and timber production authorized by management area are shown in chapter 2, table 21.

Historical Range of Variability

Twelve out of 25 structure classes are within HRV after 100 years of land management under alternative R (table 149). This is the same number of structure classes within HRV as the proposed action and alternative P. Late closed structure conditions show the greatest departure from HRV. The late closed forest structure would be above HRV in all five vegetation types. Levels of disturbance and management do not occur across enough acres over 100 years under alternative R to create open structure conditions that existed historically. Areas that would historically have contained large trees with open canopy conditions, and greater resistance to wildfire and insect and disease outbreaks would be in a closed canopy condition with greater susceptibility to disturbance (Day 2017).

Table 149. Modeled forest structure levels at 100 years compared to HRV for all vegetation types under alternative R

Structure Class	HRV	Alternative R
Early Structure		
Douglas-fir dry	6-16	8*
Northern Rocky Mountain mixed conifer	9-25	3
Western hemlock / western red cedar	4-24	0
Subalpine fir / lodgepole pine	45-65	59
Spruce / subalpine fir	14-46	3
Mid Open		
Douglas-fir dry	2-8	3
Northern Rocky Mountain mixed conifer	1-3	1
Western hemlock / western red cedar	0	0
Subalpine fir / lodgepole pine	0	5
Spruce / subalpine fir	0	0
Mid Closed		
Douglas-fir dry	4-13	8

Structure Class	HRV	Alternative R
Northern Rocky Mountain mixed conifer	18-30	13
Western hemlock / western red cedar	7-27	0
Subalpine fir / lodgepole pine	33-53	27
Spruce / subalpine fir	13-41	34
Late Open		
Douglas-fir dry	38-78	45
Northern Rocky Mountain mixed conifer	4-6	4
Western hemlock / western red cedar	0	0
Subalpine fir / lodgepole pine	0	2
Spruce / subalpine fir	0	0
Late Closed		
Douglas-fir dry	1-32	35
Northern Rocky Mountain mixed conifer	44-60	80
Western hemlock / western red cedar	55-83	100
Subalpine fir / lodgepole pine	3	7
Spruce / subalpine fir	29-57	63
Total Structure Classes Within HRV		**12**

*Shaded cells are within HRV.

Vegetation Management Plan Components

Standards for fuel wood cutting, application of herbicides and other pesticides, and fuel chipping are included in alternative R. A guideline is included for hazard tree felling. Three guidelines in the proposed action addressing timber harvest and thinning in RMAs to move upland vegetation toward HRV, location of landings, skid trails, and staging and decking areas, and yarding activities in RMAs were changed to standards in alternative R. Standards, guidelines, and BMPs are the primary mechanisms to protect water quality and riparian function from vegetation management activities under alternative R.

Grazing Plan Components

Current allotment boundaries and AUMs would continue under alternative R. Alternative R includes a stricter guideline for stubble height in greenline areas to reflect best available science, and two guidelines in the proposed action are standards in alternative R. These changes provide the framework to better manage grazing in areas critical to aquatic and riparian function toward attainment of desired conditions. Specific objectives for rangeland improvements in key watersheds that are priority for active restoration should also accelerate the pace of improvement of range infrastructure and management in RMAs. Comparison of grazing components between alternative R and other alternatives are shown in table 150.

Standards, guidelines, BMPs, and restoration objectives to minimize the impact of grazing on hydrologic function and water quality are the primary mechanisms to preserve water quality and hydrologic function under alternative R.

Table 150. Comparison of grazing plan components that are different between alternative R and other alternatives (not under INFISH)

Proposed Action and Alternative O	Alternative R
RMA Guideline GM Within green-line vegetation area adjacent to all watercourses: • Do not exceed 20 percent streambank alteration; • Do not exceed 40 percent utilization of mean annual vegetative production on woody vegetation; • Maintain at least 4 to 6 inches or do not exceed 40 percent utilization of mean annual vegetative production on herbaceous vegetation	MA-GDL-RMA-09 *Recreational and permitted grazing management – green-line vegetation areas* Within green-line vegetation area adjacent to all watercourses: A 25 percent stream bank alteration shall not be exceeded; A 40 percent utilization of available mean annual vegetative production on woody vegetation shall not be exceeded; Maintain at least 6 to 8 inches residual stubble height and utilize no more than 40 percent of mean annual vegetative production on deep-rooted herbaceous vegetation.
RMA Guideline GM During allotment management planning consider removal of existing livestock handling or management facilities from RMAs	**MA-STD-RMA-10** ***Permitted Grazing Management—Allotment Management Planning*** During allotment management planning, negative impacts to water quality and aquatic and riparian function from existing livestock handling or management facilities located within riparian management areas shall be minimized to allow conditions to move toward the desired condition or eliminated.
RMA Guideline GM Generally avoid trampling of federally listed threatened or endangered fish redds by livestock	**MA-STD-RMA-11** ***Recreational and permitted grazing management – fish redds*** Restrict livestock access to federally listed threatened or endangered fish redds.

Summary of Effects and Comparison of Other Alternatives

Alternative R provides the best protection for preservation and restoration of hydrologic function, water quality, and water uses of all alternatives. Effects of alternative R in relation to other alternatives include:

- Alternative R addresses the need for change more effectively than no action, the proposed action, and alternatives B and O. Through plan components and principles from ARCS-modified, and specific objectives for restoration of general watershed function across the forest, and restoration in key watersheds and RMAs, the pace and scale of watershed restoration and resiliency to potential hydrologic effects of climate change are increased in alternative R from the proposed action.
- Wider RMA widths along intermittent streams, lakes, and ponds than no action and alternative B would improve and preserve hydrologic and riparian function better than narrower RHCA widths in no action and alternative B.
- There are more acres of key watersheds in alternative R than in the INFISH priority network in no action and alternative B, and the key watershed network in the proposed action. The key watershed network in alternative R is smaller than in alternative P. While restoration activities are not expected on every acre within key watersheds, the larger key watershed network in alternative R would accelerate the pace of restoration of hydrologic function than in the smaller INFISH priority network in no action and alternative B and the smaller key watershed network in the proposed action.
- Alternative R would accelerate improvement in watershed condition faster than no action, the proposed action, and alternative B. Measurable objectives for water resources, RMAs and the

expanded key watershed network would accelerate restoration and preservation of hydrologic function.

- Similar to other alternatives, watershed analysis would be used to assess the status and trend of watershed and aquatic ecosystem conditions, however there is not a specific objective for completion of watershed analysis.
- Desired conditions are identified for general aquatic riparian and watershed condition; desired conditions are not identified in no action and alternative B.
- Approximately 25 percent of Colville National Forest land base is in management areas where construction of new roads is prohibited. Fifty-one percent of the Colville National Forest land base is within the Focused Restoration MA where desired condition for road density is 1 mile per square mile.
- Approximately 75 percent of the Forest is within management areas where summer and winter motorized recreation are authorized. This is less than all alternatives.
- Approximately 22 percent of the Colville National Forest land base is in areas where active vegetation management is authorized (although not all acres are suitable for timber harvest); this is the least amount of acres designated for this use among all alternatives.
- Twelve out of 25 structure classes are within HRV after 100 years of land management under alternative R. Alternative R has the least number of structure and vegetation types within HRV of all alternatives.
- There is a greater emphasis on grazing standards in alternative R, and stricter numeric criteria for stubble height in MA-GDL-RMA-09 should be more effective in moving toward desired conditions in RMAs in grazing allotments than no action, the proposed action, and alternatives B and O.
- Standards and guidelines address watershed function, including protection of streambank and floodplain integrity from livestock grazing, reduction of erosion and sedimentation and disruption of hydrologic processes from roads and trails. Alternative R has a stronger emphasis on standards than the proposed action, which should protect watershed function and water quality more effectively than no action, the proposed action, and alternatives B and O.
- Standards for development of hydroelectric and other water use developments are more stringent in alternatives R, P, O, and the proposed action than in no action and alternative B.
- Measureable objectives and focused restoration activities in alternative R would increase the pace of increasing resiliency of infrastructure and water uses to potential effects of climate change faster than the proposed action and alternative B. Alternative R does not include an objective for completion of watershed analysis.

Alternative P

Riparian and Aquatic Resource Management

Acres of RMAs

RMA widths and total acreage are the same as the proposed action and alternatives R and O.

Riparian and Aquatic Plan Components

Riparian and aquatic plan components have been refined using ARCS-modified and updates made to the Region 6 ARCS in 2016 to produce the Colville ARCS on which alternative P is based. Referred to as

ARCS-2016 the Regional Office updated the 2008-ARCS to incorporate national and regional policies and best available science, and make the strategy consistent with the 2012 planning rule. Since the revised forest plan is being revised under the 1982 planning rule, certain plan components in ARCS-2016 were not incorporated into the Colville ARCS.

Similar to all other alternatives, alternative P includes watershed analysis as a means to assess the status and trend of watershed and ecological conditions, and includes an objective for completion of watershed analysis.

Alternative P includes desired conditions, objectives, standards, and guidelines for general water resources and RMAs that, along with BMPs, form the basis for protection and improvement of hydrologic, aquatic, and riparian function.

Desired conditions for general water resources, key watersheds, and RMAs have been updated and clarified in alternative P (compared to the 2008 version of ARCS included in the proposed action and alternative O, and ARCS-modified in alternative R) based on guidance provided in the 2016 version of the Region 6 ARCS. For clarity, and to avoid confusion through comparison with multiple versions of plan components, plan components in alternative P are compared to plan components in alternative R (ARCS-modified). Alternative P includes several new plan components, including desired conditions for water production from NFS land for downstream ecological and human communities and t build resiliency to climate change. Several desired conditions have also been updated from alternative R for clarity.

Numeric objectives for reduction in road erosion and sedimentation risk, treatment of aquatic invasive and non-native aquatic species, replacement or removal of culverts to improve aquatic habitat and reduce failure risk, and improvement of dispersed recreation sites have been increased in alternative P.

Standards in alternative P address improving watershed condition and use of BMPs, and provide protection of water quality and function for activities including road, trail, and developed recreation site construction and maintenance, crossing replacement, hydroelectric and other water developments, timber harvest, chemical application, personal fuelwood cutting, grazing, fire and fuels management, special uses, and mineral operations. Minerals standards in alternative P were guidelines in alternative R. Alternative P also includes a standard for suction dredging that was not included in any other alternative. Standards for implementation of BMPs and management of livestock grazing to attain desired conditions were added to alternative P and are not included in any other alternative.

Guidelines in alternative P address activities including RMA function, water drafting, hazard tree retention, harvest and thinning, road and stream crossing construction and re-construction, livestock grazing, recreation facilities, mineral development, fire suppression, and watershed restoration project design are standards in alternative R.

Key Watersheds

The key watershed network in alternative P is expanded from the proposed action key watershed network based on updated fish distribution data, improved data on aquatic habitat function, and changes in boundaries, names, and numbers of subwatersheds since designation of the key watershed network for the proposed action. A total of six subwatersheds were added to the key watershed network in the proposed action to form the alternative P key watershed network. Additionally, three subwatersheds were removed from the proposed action key watershed network because they contain less than 25 percent Forest ownership. The key watershed network was also expanded from the key watershed network presented in alternatives R and O to include the Cee Cee Ah subwatershed. Inclusion of the Cee Cee Ah subwatershed in the alternative P key watershed network was based on ongoing watershed restoration efforts by the

Kalispel Tribe of Indians and the Pend Oreille Public Utility District, resulting in the restoration of westslope cutthroat trout (a surrogate species used to designate the key watershed network) in the subwatershed since the original designation of the key watershed network under the proposed action and alternatives R and O.

Table 151. Key watersheds (subwatershed scale) for alternative P

Key Watershed Number	Key Watershed Name	Total Subwatershed Acres	Colville NF Ownership Acres	Riparian Road Miles	Riparian Road Density
170102160102	Winchester Creek	10,482	5,628	10.7	4.2
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170102160204	Cee Cee Ah Creek	12,063	6,500	11.9	5.3
170102160206	Tacoma Creek	39,519	27,182	25.1	2.7
170102160302	West Branch LeClerc Creek	21,672	15,099	5.6	0.9
170102160303	East Branch LeClerc Creek	26,663	11,145	11.0	2.7
170102160304	Ruby Creek	19,597	18,385	13.1	2.2
170102160401	Harvey Creek	32,999	27,554	17.6	1.9
170102160402	Headwaters Sullivan Creek	45,516	45,417	45.1	3.9
170102160403	North Fork Sullivan Creek-Sullivan Creek	12,709	11,260	1.8	0.6
170102160702	Headwaters South Salmo River	20,697	12,472	0.1	0
170102160902	Sweet Creek-Pend Oreille River	41,832	28,905	16.5	2.1
170102160903	Slate Creek	20,195	19,907	10.5	2.3
170102161003	Cedar Creek	17,209	5,359	1.4	1.2
170200011004	North Fork Deep Creek	49,257	26,634	15.7	2.2
170200011301	South Fork Sherman Creek	22004	21,899	11.6	2.3
170200011302	Upper Sherman Creek	26,381	26,260	15.4	2.8
170200011303	Lower Sherman Creek	20,987	15,998	6.7	6.7
170200011306	Barnaby Creek	23,108	14,299	9.1	2.4
170200011401	Upper Hall Creek	31,648	13,786	3.7	1.0
170200021301	Trout Creek	23,435	14,122	10.7	3.6
170200021701	Tonata Creek	14,453	13,781	16.2	5.9
170200021907	East Deer Creek-Kettle River	23,385	15,443	4.2	1.5
170200022002	North Fork Deadman Creek	13,450	13,187	8.8	1.1
170200022003	Deadman Creek	26,518	22,310	10.7	2.6
	Total	654,757	**457,886**		

Plan components for key watersheds are similar to alternative R; however, several key watershed plan components have been updated in alternative P. Objectives for stream restoration in key watersheds was increased from 76 to 81 miles, restoration of late forest structure in upland vegetation in RMAs was increased from 1,200 to 1,500 acres, reduction in road hydrologic connectivity was increased from 78 to

116 miles, and restoration of aquatic organism passage at road crossings was increased from 50 to 53. Standards for key watersheds are similar to alternative R; however, FW-STD-WR-06 regarding roads in key watersheds is updated based on locations of critical habitat for aquatic species, and condition ratings from the WCF. This standard requires no net increase in system roads that affect hydrologic function in key watersheds and subwatersheds with critical habitat for aquatic species and are functioning properly with respect to roads. In key watersheds and subwatersheds with critical habitat for aquatic species that are functioning at risk or have impaired function with respect to roads, there would be a net decrease in system roads that affect hydrologic function.

Watershed and Aquatic Restoration

Identification of key watersheds that are a priority for restoration and objectives for key watersheds are the same as alternative R. Key watersheds that are priorities for restoration and projected restoration completed through the life of the revised forest plan are shown in table 152. Key watershed objectives include:

- *FW-OBJ-WR-05. Key Watershed Restoration Prioritization:* Management in key watersheds focuses on restoration or preservation of watershed, aquatic, and riparian function and recovery of threatened and endangered species. Improve watershed condition class in key watersheds that are a priority for restoration within 15 years of land and resource management plan implementation. Key watersheds that are a priority for restoration include:
    - ♦ East Branch LeClerc Creek, West Branch LeClerc Creek, Deadman Creek, Barnaby Creek, Harvey Creek, North Fork Deadman Creek, North Fork Sullivan Creek, Sullivan Creek, Ruby Creek, Upper Sherman Creek, South Fork Sherman Creek, and Tonata Creek subwatersheds. Additional key watersheds that are a priority for restoration would be identified, as appropriate, through the life of the plan, through the WCF process.
- *FW-OBJ-WR-06. Key Watershed Road Treatments:* Reduce road-hydrologic connectivity and sediment delivery on roads through storm damage risk reduction treatments, full hydrologic decommissioning, and other accepted treatment measures on 116 miles of hydrologically connected road within 15 years of land and resource management plan implementation.

  Restore or maintain aquatic organism passage and improve hydrologic and aquatic habitat function at 53 road/stream crossings for all native aquatic species, seasons, flows, and life stages within 15 years of plan implementation through culvert replacement or crossing improvement and natural channel design or other acceptable treatment measures that provide for natural stream channel function at all flows.
- *FW-OBJ-WR-07. Key Watershed Range Infrastructure Improvements:* Improve hydrologic and aquatic function through range infrastructure improvements, including riparian fencing, movement and improvement of watering troughs, and other acceptable treatments on 240 acres within 15 years of plan implementation.
- *FW-OBJ-WR-08. Upland Vegetation Structure in RMAs in Key Watersheds:* Move upland vegetation within riparian management areas in key watersheds toward HRV on 600 to 1,500 acres within 15 years of plan implementation.
- *FW-OBJ-WR-09. Stream Restoration in Key Watersheds:* Restore hydrologic, geomorphic, and riparian process and function on 81 miles of stream within 15 years of plan implementation through activities including streambank stabilization, restoration of lateral and vertical hydrologic connectivity and improvement of stream channel and floodplain function.

Table 152. Key watersheds that are priorities for restoration and projected restoration activities based on key watershed objectives that would be completed through the life of alternative P

Key Watershed Prioritization	Road Treatments: Road Improvements (miles)*	Road Treatments: Aquatic Organism Passage Improvement (# of crossings)	Range Infrastructure Improvement (acres)	Riparian Vegetation Structure Improvement (acres)	Stream Restoration (miles)
West Branch LeClerc Creek	3	5	20	0	10
East Branch LeClerc Creek	3	1	20	0	10
Deadman Creek	5	1	30	75-150	3
Upper Sherman Creek	5	5	0	75-150	2
South Fork Sherman Creek	5	9	0	75-150	4
Barnaby Creek	5	5	30	75-150	4
Harvey Creek	15	4	0	75-150	8
Tonata Creek	4	4	50	75-150	3
North Fork Deadman Creek	5	1	30	75-150	3
North Fork Sullivan Creek	1	2	0	0	1
Sullivan Creek	15	6	0	75-150	20
Ruby Creek	20	4	30	75-150	3
Treatments in additional key and/or priority watersheds (estimate addition 3 subwatersheds over 15 years)	30	6	30	75-150	10
Total for the life of the plan (essential projects completed for 14 subwatersheds)	**116 miles**	**53 crossings**	**240 acres**	**600-1,500 acres**	**81 miles**

*Existing riparian road miles and road density are shown in table 142

Objectives for restoration in RMAs are expanded and clarified in alternative P from those included in alternative R. Two RMA objectives apply to subwatersheds outside of key watersheds, since key watershed objectives address the same activities within key watersheds. Objectives for RMAs in alternative P include:

- *MA-OBJ-RMA-01. Improve Riparian Function at Dispersed and Developed Recreation Sites*: Over the next 15 years, restore riparian processes and balance need for occupancy and access to water at 75 dispersed and developed recreation sites, through education, enforcement, and engineering where recreational use results in bank damage, reduction in water quality, and/ or a reduction in stream shade.

- *MA-OBJ-RMA-02. Restoration of Riparian Habitat and Processes on Roads:* Restore hydrologic and riparian habitat function within RMAs in non-key watersheds by reducing road-related impacts on 80 miles of road within 15 years.
- *MA-OBJ-RMA-03. Restoration of Late Forest Structure:* Move upland vegetation within riparian management areas outside of key watersheds toward HRV on 500 acres within 15 years of plan implementation.

Alternative P includes updated general water resources objectives from alternative R:

- *FW-OBJ-WR-01. Aquatic Invasive Species:* Within the next 15 years, implement aquatic invasive species prevention measures at all developed recreation sites providing direct and/or indirect access to water bodies, such as boat ramps and other campgrounds, resorts and day use areas that provide portal zones for hand-carried watercraft. Implement aquatic invasive species prevention measures as part of all aquatic survey and inventory procedures and other management activities that pose high potential for invasion vectors to occur.
- *FW-OBJ-WR-02. Aquatic Invasive and Non-Native Species:* Within the next 15 years, implement aquatic invasive species control and eradication at 15 waterbodies (streams and lakes) where such invasions have become established and prevent attainment of listed fish recovery plan goals and/or effects to social, economic and ecological systems are determined to be unacceptable.
- *FW-OBJ-WR-03. General Watershed Function and Restoration:* Within the next 15 years, decrease sediment delivery from management activities on 1,000 acres including but not limited to roads, livestock, illegal off-road vehicle use, vegetation management, and dispersed and developed campsites. Restore hydrologic, aquatic and riparian processes through activities that stabilize streambank erosion, and other accelerated channel destabilizing processes (i.e., headcutting), improve lateral and vertical hydrologic connectivity, and improve stream channel and floodplain function on 10 miles of streams.
- *FW-OBJ-WR-04. Fish Passage Improvement:* Within 15 years, restore aquatic organism passage for all life stages of native species at 45 road/stream crossings and man-made instream structures such as water diversions and dams outside of key watersheds. Culverts and other passage improvements are to be designed to restore and maintain hydrologic and aquatic habitat function and stream channel resiliency to a range of flows through natural channel design and other acceptable treatment measures.
- *FW-OBJ-WR-10. Watershed Restoration in Focus and Priority Watersheds:* Over 15 years, implement the watershed condition framework through completion of essential projects outlined in watershed action plans in existing focus and priority watersheds to improve watershed condition class. Focus watersheds designated at the 5th field watershed scale include, Upper Sanpoil, Chewelah Creek-Colville River, and LeClerc Creek-Pend Oreille River watersheds. Priority watersheds designated at the subwatershed scale include Ninemile Creek, and West Branch LeClerc Creek subwatersheds.
- *FW-OBJ-WR-11. Watershed Analysis:* Within 15 years of plan implementation, complete or update watershed analyses for 5 subwatersheds. Criteria for selecting subwatersheds for watershed analysis include: key watersheds, priority watersheds, watersheds that support designated critical habitat, or support listed species, and watersheds where management activities are likely to occur that may affect aquatic resources (due to their inherent nature, location, timing, or scale).

Appendix C of the Hydrology Specialist Report includes details on how water resources and RMA objectives were calculated. The water resources and RMA objectives included in alternative P provide additional direction and a stronger focus on aquatic restoration than the proposed action and alternatives R and O.

Measurable objectives for key watersheds are similar to alternative R; however, total restoration accomplished under alternative P is expected to be greater than alternative R, based on increases in total road miles, stream restoration miles, culverts replaced, and dispersed recreation sites stabilized.

Completion of essential projects in 14 key watersheds, and one additional priority watershed (not included in the key watershed network—Ninemile subwatershed) is estimated under alternative P. Treatments to achieve this goal include: 116 miles of reduction in road hydrologic connectivity through decommissioning and storm damage risk reduction treatments, improvement of passage at 53 crossings, 240 acres of range infrastructure improvements, 600 to 1,500 acres of riparian vegetation improvements to move upland vegetation in RMAs toward HRV, and 81 miles of improvement of hydrologic and geomorphic channel function through in-stream channel improvements. Completion of projects outside of key and priority watersheds is expected to improve hydrologic, aquatic and riparian function through the treatment of erosion at 75 dispersed recreation sites, 80 miles of road in RMAs, and 1,000 acres where erosion problems are identified. In addition, control or eradication of AIS at 15 sites, 500 acres of improvement of upland vegetation in RMAs, improvement of aquatic organism passage at 45 crossings and man-made in-stream structures, and 10 miles of stream restoration would also improve hydrologic, aquatic, and riparian function.

Roads/Access

Acres of Management Area Where Road-building Activities are Permitted

Approximately 283,400 acres (25 percent of the Forest) in alternative P are in management areas where construction of new roads is prohibited, including backcountry, backcountry motorized, research natural areas, and both designated and recommended wilderness.

Summer and Winter Motorized Recreation Opportunities Suitable Uses

Summer and winter motorized recreation use is authorized in the Focused, General Restoration, Backcountry Motorized (winter use is limited by wildlife restrictions), and Scenic Byways MAs (table 21 in chapter 2). Approximately 875,600 acres (79 percent of the Forest) are within management areas where summer and winter motorized recreation are authorized. Standards and guidelines, implementation of BMPs, and adaptive management are the primary mechanisms through which watershed function and water quality are maintained. Suitability of an area for summer or motorized recreation opportunities is guidance for project activity decision making and is not a resource commitment or final decision approving projects and activities. Use would not occur over an entire suitable area; locations of potential motorized use would be determined at the project level through site-specific analysis.

Road Density Desired Conditions

While existing road densities vary across management areas, road density desired condition of maintenance level 1-5 roads is no greater than 1 mile per square mile in the Focused Restoration MA (312,500 acres, 28 percent of Colville National Forest), and no greater than 2 miles per square mile in the General Restoration Management Area (489,200 acres, 44 percent of Colville National Forest). Existing road densities calculated by management area at the subwatershed scale for Focused and General Restoration MAs are shown in table 153. Less than 10 percent of subwatersheds in the General Restoration MA currently meet the desired condition of 2 miles per square mile. There are no watersheds within the Focused Restoration MA that meet the desired condition of 1 mile per square mile. Objectives for treatment of roads to decrease hydrologic risk and sediment delivery should move toward meeting road density desired conditions through the life of this land and resource management plan.

Table 153. Existing road density by subwatershed for the focused and general restoration MAs in alternative P

Subwatershed Name	Road Density mi/mi^2	Meets Road Density Desired Condition of 1 mi/mi^2?
Focused Restoration MA		
Barnaby Creek	2.8	N
Calispell Creek	3.2	N
Cedar Creek	4.4	N
Cee Cee Ah Creek	5.0	N
Deadman Creek	2.9	N
East Branch LeClerc Creek	2.0	N
East Deer Creek-Kettle River	2.5	N
Exposure Creek-Pend Oreille River	2.8	N
Flume Creek Pend Oreille River	4.1*	N
Harvey Creek	4.1	N
Headwaters South Salmo River	1.9	N
Headwaters Sullivan Creek	4.7	N
Lower Sherman Creek	2.9	N
Maitlen Creek-Pend Oreille River	3.1	N
Middle Hall Creek	4.6	N
North Fork Deadman Creek	4.0	N
North Fork Deep Creek	3.7	N
North Fork Sullivan Creek-Sullivan Creek	2.7	N
Outlet South Salmo River	3.8	N
Pend Oreille River	2.6	N
Pewee Creek-Pend Oreille River	3.0	N
Ruby Creek	2.2	N
Slate Creek	3.2	N
Smalle Creek	3.3	N
South Fork Sherman Creek	2.4	N
Sweet Creek Pend Oreille River	2.7	N
Tacoma Creek	3.0	N
Tonata Creek	3.9	N
Trout Creek	2.7	N
Upper Curlew Creek	3.4	N
Upper Hall Creek	6.9	N
West Branch LeClerc Creek	1.7	N
Winchester Creek	5.1	N

Subwatershed Name	Road Density mi/mi²	Meets Road Density Desired Condition of 2 mi/mi²?
General Restoration MA		
American Fork	3.0	N
Big Muddy Creek	2.8	N
Calispell Creek	3.3	N
Catherine Creek-Kettle River	3.2	N
Clugston Creek	3.9	N
Cottonwood Creek	2.9	N
Cougar Creek	1.3*	Y
Crown Creek	2.4	Y
Cusick Creek	3.7	N
Deep Creek	3.1	N
Dry Creek-Colville River	2.9	N
East Deer Creek-Kettle River	4.3	N
Emanuel Creek-Kettle River	3.0	N
Fivemile Creek-Franklin D Roosevelt Lake	4.6	N
Flat Creek-Franklin D Roosevelt Lake	3.7	N
Flume Creek-Pend Oreille River	3.9	N
Gillette Creek-Mill Creek	1.3	Y
Golden Harvest Creek	2.1	N
Granite Creek	2.2	N
Hodgson Creek-Kettle River	2.7	N
Independent Creek-Kettle River	2.2	N
Le Fleur Creek-Kettle River	6.5	N
Lambert Creek	4.0	N
Little Boulder Creek	2.7	N
Little Pend Oreille Lakes	3.5	N
Lone Ranch Creek	3.1	N
Long Alec Creek	1.6	Y
Lost Creek	2.2	N
Lower Big Sheep Creek	1.1	Y
Lower Boundary Creek	4.1	Y
Lower Curlew Creek	1.3	Y
Lower Hall Creek	3.8	N
Lower Toroda Creek	1.2	Y
Lower West Fork Sanpoil River	3.7	N
Maitlen Creek-Pend Oreille River	2.7	N
Meadow Creek	4.4	N
Middle Creek-Pend Oreille River	3.3	N
Moran Creek-Colville River	3.0	N
Nancy Creek-Franklin D Roosevelt Lake	2.4	N
Narcisse Creek-Little Pend Oreille River	3.4	N

Subwatershed Name	Road Density mi/mi^2	Meets Road Density Desired Condition of 2 mi/mi^2?
General Restoration MA		
Ninemile Creek	3.6	N
North Fork Boulder Creek	3.2	N
North Fork Calispell Creek	3.4	N
North Fork Chewelah Creek	4.4	N
North Fork Mill Creek	5.5	N
North Fork Sanpoil River-Sanpoil River	3.0	N
O'Brien Creek	2.8	N
Olson Creek-Little Pend Oreille River	2.5	N
Onion Creek	0.5*	Y
Pewee Creek-Pend Oreille River	3.5	N
Prouty Creek	1.5*	Y
Quillisascut Creek-Franklin D Roosevelt Lake	2.7	N
Rattlesnake Creek-Franklin D Roosevelt Lake	3.2	N
Rickey Creek-Franklin D Roosevelt Lake	4.8	N
Rocky Creek	3.1	N
Saint Peter Creek	4.8	N
Sand Creek-Kettle River	2.6	N
Scatter Creek-Sanpoil River	3.5	N
Skookum Creek	4.7	N
South Fork Boulder Creek	3.2	N
South Fork Chewelah Creek-Chewelah Creek	5.0	N
South Fork Deep Creek	3.1	N
South Fork Mill Creek	2.7	N
Squaw Creek-Little Pend Oreille River	1.4*	Y
Thirteenmile Creek-Sanpoil River	2.7	N
Thomason Creek-Colville River	3.4	N
Toulou Creek	4.0	N
Trimble Creek	3.4	N
Upper Curlew Creek	3.4	N
Upper Toroda Creek	4.8	N
West Deer Creek	3.2	N
West Fork Granite Creek	4.0	N
Yocum Lake-Pend Oreille River	2.1	N

*Low land area included in road density calculation may make number less meaningful as a road density indicator.

Road Management Plan Components

In addition to road density desired conditions for the Focused and General Restoration MAs, desired conditions for aquatic and riparian systems, RMAs, and key watersheds focused on minimizing hydrologic interruption, erosion, and sedimentation from the road system are included in alternative P. Road treatment projects through the life of the revised forest plan under alternative P would move toward desired conditions.

Standards and guidelines to protect aquatic and riparian resources are in the RMA standards and guidelines section of the land and resource management plan. Alternative P includes standards for restriction of sidecasting, placement of fill, or plowed snow in RMAs or other hydrologically connected areas, and avoidance of hydrologic flow paths during road construction, maintenance, and reconstruction. Also included in alternative P is a standard for reconstructing stream crossings to accommodate 100-year flows, avoiding diversion of streamflow onto roads in the event of crossing failure, and providing fish passage for all species and life stages at crossings. As discussed in the Key Watershed section above, alternative P also includes a standard for reduction of road hydrologic risk in key watersheds. Guidelines in alternative P include construction or reconstruction of stream crossings to allow for riparian-dependent species passage, and retention of fish passage barriers where they restrict access by non-native fish species. Standards, guidelines, BMPs, and restoration objectives to minimize hydrologic impacts from the road system are the primary mechanisms to protect water quality and riparian function from roads under alternative P.

Old Forest Management, Timber Production, and Upland Vegetation Condition

Active Vegetation Management

Timber harvest would be allowed in the Focused and General Restoration MAs, comprising 801,700 acres (72% of the Forest), however not all acres in these MAs are suitable for timber harvest. This is less than the no action and B alternatives, similar to the proposed action and alternative O and more than alternative R. Acres treated are constrained by timber suitability, Forest budgets, and project-level considerations. BMPs, standards, and guidelines are the primary mechanism to limit the potential effects of vegetation management activities on water quality and hydrologic function.

Primary Vegetation Management Tools

Variable density thinning would be the primary tool for active commercial vegetation management in the Focused and General Restoration MAs in alternative P in the Douglas-fir dry and northern Rocky Mountain mixed conifer vegetation types in the proposed action with an estimated (modeled) treatment of 4,050 acres per year. Mechanical fuels treatments are estimated on 5,000 acres per year in these vegetation types. Mixed and light severity prescribed fire would be used in open-canopy stands on a 20 year rotation to maintain open conditions in the Douglas-fir dry and northern Rocky Mountain mixed conifer vegetation types with treatment modeled for 3,839 acres per year. Shelterwood harvest with reserves would be the primary commercial vegetation management tool in the subalpine fir and lodgepole pine vegetation type with an estimated (modeled) 950 acres of treatment per year. Stand-replacing prescribed fire would be used in the subalpine fir and lodgepole pine vegetation type with an estimated treatment of 1,040 acres per year. There are no modeled vegetation treatments in the Western red cedar/Western hemlock and spruce/subalpine fir vegetation types.

Acres of Colville National Forest lands by management area and roadbuilding and timber harvest authorized by management area are shown in table 21 in chapter 2.

Historical Range of Variability

Twelve out of 25 structure classes are within HRV after 100 years of land management under alternative P (table 154). The same number of structure classes are within HRV for no action, the proposed action, and alternative P. The late closed forest structure would be above HRV in four of five vegetation types. Four out of 5 vegetation types are above HRV in the late closed structure type. Levels of disturbance and management do not occur across enough acres over 100 years under alternative P to create open structure conditions that existed historically. Areas that would historically have contained large trees with open canopy conditions, and greater resistant to wildfire and insect and disease outbreaks would be in a closed canopy condition with greater susceptibility to disturbance (Day 2017).

Table 154. Modeled forest structure levels at 100 years compared to HRV for all vegetation types in alternative P

Structure Class	HRV	Alternative P
Early Structure		
Douglas-fir dry	6-16	8*
Northern Rocky Mountain mixed conifer	9-25	2
Western hemlock / western red cedar	4-24	0
Subalpine fir / lodgepole pine	45-65	57
Spruce / subalpine fir	14-46	3
Mid Open		
Douglas-fir dry	2-8	6
Northern Rocky Mountain mixed conifer	1-3	1
Western hemlock / western red cedar	0	0
Subalpine fir / lodgepole pine	0	11
Spruce / subalpine fir	0	0
Mid Closed		
Douglas-fir dry	4-13	5
Northern Rocky Mountain mixed conifer	18-30	12
Western hemlock / western red cedar	7-27	0
Subalpine fir / lodgepole pine	33-53	21
Spruce / subalpine fir	13-41	33
Late Open		
Douglas-fir dry	38-78	59
Northern Rocky Mountain mixed conifer	4-6	7
Western hemlock / western red cedar	0	0
Subalpine fir / lodgepole pine	0	2
Spruce / subalpine fir	0	0
Late Closed		
Douglas-fir dry	1-32	22
Northern Rocky Mountain mixed conifer	44-60	77
Western hemlock / western red cedar	55-83	100
Subalpine fir / lodgepole pine	3	9
Spruce / subalpine fir	29-57	63
Total Structure Classes Within HRV		**12**

*Shaded cells are within HRV

Vegetation Management Plan Components

Standards for fuel wood cutting, application of herbicides and other pesticides, yarding over stream channels, and fuel chipping are included in alternative P. A guideline is included for hazard tree felling.

Three guidelines in the proposed action address timber harvesting and thinning in RMAs to move upland vegetation toward HRV. Guidelines regarding the location of landings, skid trails, and staging and decking areas, and yarding activities in RMAs were changed to standards in alternative P. Standards, guidelines, and BMPs are the primary mechanisms to protect water quality and riparian function from vegetation management activities under alternative P.

Grazing

Alternative P includes current allotment boundaries and AUMs. Grazing plan components (primarily MA-GDL-RMA-11) in alternative P have been updated and clarified to offer greater protection and management flexibility than the proposed action and alternatives R and O. MA-GDL-RMA-11 (GM-3 in the ARCS-2016) includes an accompanying background document (USDA Forest Service 2017b) that describes the process by which the guideline was adapted, highlights its key characteristics, summarizes the supporting science, and describes how the guideline would be implemented at the Forest scale and for individual allotments through the allotment management planning process.

Alternative P also includes a standard not included in other alternatives regarding management of livestock to attain desired conditions. These changes provide a science-based framework to better adaptively manage grazing in areas critical to aquatic and riparian function toward attainment of desired conditions. Specific objectives for rangeland improvements in key watersheds that are priority for active restoration should also accelerate the pace of improvement of range infrastructure and management in RMAs.

Standards, guidelines, BMPs, and restoration objectives to minimize the impact of grazing on hydrologic function and water quality are the primary mechanisms to preserve water quality and hydrologic function under alternative P.

Summary of Effects and Comparison of Other Alternatives

Alternative P provides the best protection for preservation and restoration of hydrologic function, water quality, and water uses of all alternatives. Effects of alternative P in relation to other alternatives include:

- Alternative P addresses the need for change more effectively than no action, the proposed action, and alternatives R, B, and O. Through plan components and principles from the Colville ARCS (a refinement of ARCS-2008, ARCS-modified, and ARCS-2016), and specific objectives for restoration of general watershed function across the Forest, and restoration in key watersheds and RMAs, the pace and scale of watershed restoration and resiliency to potential hydrologic effects of climate change are increased in alternative P over all other alternatives.
- Wider RMA widths along intermittent streams, lakes, and ponds than no action and alternative B would improve and preserve hydrologic and riparian function better than narrower RHCA widths in no action and alternative B.
- There are more acres of key watersheds in alternative P than in all other alternatives. While restoration activities are not expected on every acre within key watersheds, the larger key watershed network in alternative P would accelerate the pace of restoration of hydrologic function than in the smaller INFISH priority network in no action and alternative B and the smaller key watershed network in the proposed action and alternatives R and O.
- Similar to other alternatives, watershed analysis would be used to assess the status and trend of watershed and aquatic ecosystem conditions. Alternative P also includes a specific objective for completion of watershed analysis.

- Alternative P would accelerate improvement in watershed condition faster than no action, proposed action, and alternatives R, B, and O. Measurable objectives for water resources, RMAs and the expanded key watershed network would accelerate restoration and preservation of hydrologic function over all other alternatives.
- Approximately 25 percent of the Colville National Forest land base is in management areas where construction of new roads is prohibited. Twenty-eight percent of the Colville National Forest land base is within the Focused Restoration MA where desired condition for road density is 1 mile per square mile.
- Approximately 72 percent of the Colville National Forest land base is in areas where active vegetation management is authorized (though not all acreage is suitable for timber harvest and other vegetation management techniques); this is similar to the proposed action, and higher than in alternative R.
- Approximately 79 percent of the Forest is within management areas where summer and winter motorized recreation are authorized.
- Twelve out of 25 structure classes are within HRV after 100 years of management; this is the same number of classes as the proposed action and alternative R.
- Grazing standards and guidelines provide greater protection and allow for better management flexibility than all other alternatives. Grazing plan components in alternative P should be more effective in moving toward desired conditions in RMAs in grazing allotments than all other alternatives.
- Standards and guidelines address watershed function, including protection of streambank and floodplain integrity from livestock grazing, reduction of erosion and sedimentation, and disruption of hydrologic processes from roads and trails. Alternative P has a stronger emphasis on standards than all other alternatives, which should protect watershed function and water quality more effectively than other alternatives.
- Standards for development of hydroelectric and other water use developments are more stringent in alternatives R, P, O, and the proposed action than in no action and alternative B.
- Measureable objectives and focused restoration activities in alternative P would increase the pace of increasing resiliency of infrastructure and water uses to potential effects of climate change faster than no action, the proposed action, and alternative B.

Alternative B

Alternative B combines feedback from diverse interest groups and incorporates management strategies supported by the Northeast Washington Forestry Coalition. Alternative B addresses the concerns of multiple constituencies in one alternative by designating restoration and timber management zones, recommending the highest level of wilderness designation, and the least amount of area for backcountry management and backcountry motorized use.

Land and resource management plan direction for watershed, aquatic, and riparian resources would remain the same as the no action alternative.

Riparian and Aquatic Resource Management

Acres of RHCAs

Acreage, management, and protection of RHCAs are the same as in the no action alternative.

Riparian and Aquatic Resource Plan Components

Riparian goals, riparian management objectives, standards, and guidelines are the same as the no action alternative.

INFISH Priority Watersheds

Acres and management in INFISH priority watersheds are the same as the no action alternative.

Watershed and Aquatic Restoration

The pace and scale of watershed and aquatic restoration is the same as the no action alternative.

Roads/Access

Acres of Management Area Where Road Building Activities are Permitted

Approximately 268,900 acres (24 percent of Colville National Forest) in alternative B are in management areas where construction of new roads is prohibited, including backcountry, backcountry motorized, research natural areas, and both designated and recommended wilderness.

Summer and Winter Motorized Recreation Opportunities Suitable Uses

Summer and winter motorized recreation use is authorized in the Active Management, Restoration, Backcountry Motorized (winter use is limited by wildlife restrictions), and Scenic Byways Management Areas (table 21 in chapter 2). Approximately 841,900 acres (76 percent of the Forest) are within management areas where summer and winter motorized recreation are authorized. Standards and guidelines, implementation of BMPs, and adaptive management are the primary mechanisms through which watershed function and water quality are maintained. Suitability of an area for summer or motorized recreation opportunities is guidance for project activity decision making and is not a resource commitment or final decision approving projects and activities. Use would not occur over an entire suitable area; locations of potential motorized use would be determined at the project level through site-specific analysis.

Road Density Desired Conditions

This alternative caps total miles of NFS roads at the current level, about 4,000 miles, and uses a standard that would require at least one mile of road to be decommissioned when adding a mile to the system. There are no specific road density desired conditions in management areas in alternative B.

Road Management Plan Components

Desired conditions, objectives and standards and guidelines for roads are the same as the no action alternative.

Old Forest Management, Timber Production, and Upland Vegetation Condition

Active Vegetation Management

Timber harvest would be allowed in the Active Management and Restoration areas, comprising 817,700 acres (74 percent of the Forest); however, not all acres are suitable for timber harvest.

Primary Vegetation Management Tools

In alternative B, variable density thinning and shelterwood with reserves would be the primary vegetation management tools in all vegetation types with the exception of the spruce/subalpine fir type, which has no anticipated vegetation management. Prescribed fire of varying intensity is expected in the Douglas-fir dry, northern Rocky Mountain mixed conifer, and subalpine fir/ lodgepole pine (wilderness only) vegetation types. Timber harvest of 2,250 acres per year is estimated (modeled) under alternative B. Mechanical fuels treatments and prescribed fire are estimated (modeled) at 2,501 and 3,839 acres per year, respectively.

Acres of management areas and roadbuilding and timber harvest authorized by management area are shown in table 21 in chapter 2.

Historical Range of Variability

Fifteen out of 25 structure classes are within HRV after 100 years of land management under alternative B (table 155). This is more structure classes within HRV than all other alternatives except for O. The late open forest structure would be at or above HRV in all vegetation types, and the late closed structure class would be above HRV in 4 out of 5 vegetation types. Levels of disturbance and management do not occur across enough acres over 100 years under alternative B to create open structure conditions that existed historically. Areas that would historically have contained large trees with open canopy conditions, and greater resistant to wildfire and insect and disease outbreaks would be in a closed canopy condition with greater susceptibility to disturbance (Day 2017).

Vegetation Management Plan Components

Standards and guidelines for vegetation management are the same as no action.

Grazing Plan Components

Current allotment boundaries and AUMs would continue under alternative B. Standards and guidelines for grazing management and potential indirect effects are the same as no action.

Table 155. Modeled forest structure levels at 100 years compared to HRV for all vegetation types in alternative B

Structure Class	HRV	Alternative B
Early Structure		
Douglas-fir dry	6-16	12*
Northern Rocky Mountain mixed conifer	9-25	8
Western hemlock / western red cedar	4-24	2
Subalpine fir / lodgepole pine	45-65	62
Spruce / subalpine fir	14-46	3
Mid Open		
Douglas-fir dry	2-8	4
Northern Rocky Mountain mixed conifer	1-3	1
Western hemlock / western red cedar	0	0
Subalpine fir / lodgepole pine	0	1
Spruce / subalpine fir	0	0
Mid Closed		
Douglas-fir dry	4-13	10
Northern Rocky Mountain mixed conifer	18-30	10
Western hemlock / western red cedar	7-27	8
Subalpine fir / lodgepole pine	33-53	30

Structure Class	HRV	Alternative B
Spruce / subalpine fir	13-41	32
Late Open		
Douglas-fir dry	38-78	42
Northern Rocky Mountain mixed conifer	4-6	4
Western hemlock / western red cedar	0	0
Subalpine fir / lodgepole pine	0	0
Spruce / subalpine fir	0	0
Late Closed		
Douglas-fir dry	1-32	32
Northern Rocky Mountain mixed conifer	44-60	77
Western hemlock / western red cedar	55-83	90
Subalpine fir / lodgepole pine	3	6
Spruce / subalpine fir	29-57	64
Total Structure Classes Within HRV		**15**

*Shaded cells are within HRV.

Summary of Effects and Comparison of Other Alternatives

Effects to hydrologic function, water quality, and water uses in alternative B are similar to no action and alternative B provides less protection to the processes that improve or preserve hydrologic function than the proposed action and alternatives R, P, and O. Alternative B would provide a slower pace of recovery of hydrologic function through passive and active restoration than the proposed action and alternatives R, P, and O. Effects of alternative B in relation to other alternatives include:

- Alternative B does not adequately address the need for change in this revised forest plan; the pace of watershed restoration is not increased from current levels, and watershed and riparian direction is not integrated. Specific watershed and riparian objectives in the proposed action, and alternatives R, P, and O should increase the pace and scale of watershed restoration, and improve resiliency to the potential hydrologic effects of climate change more than no action and alternative B.
- Narrower RHCA widths along intermittent streams, lakes, and ponds are less restrictive than RMA widths in the proposed action, and alternatives R, P, and O, and may not improve or preserve hydrologic and riparian function as well as wider RMA widths.
- There are fewer acres of priority watersheds in alternative B than the proposed action and alternatives R, P, and O. While restoration activities are not expected on every acre within key watersheds, the larger key watershed network would accelerate the pace of restoration of hydrologic function than in the smaller INFISH priority network in alternative B.
- Alternative B does not accelerate improvement in watershed condition; the INFISH priority network would remain and there are not specific plans to accelerate the pace of restoration in the INFISH priority watershed network. There are no measureable objectives for the INFISH priority watershed network in alternative B.
- RMOs would be used as benchmarks for evaluation of current stream conditions, even though they may not adequately account for natural variability or separate land use effects from natural disturbance.
- Desired conditions are not identified for general aquatic, riparian, and watershed condition.

- Approximately 24 percent of Colville National Forest land base is in management areas where construction of new roads is prohibited. The cap on existing road mileage in alternative B is not as protective as the 1 mile per square mile desired condition for the Focused Restoration MA and the 2 miles per square mile desired condition for the General Restoration MA in alternatives R and P.
- Approximately 76 percent of the Forest is within management areas where summer and winter motorized recreation are authorized. This is more acreage than alternative R, and less acreage than no action, the proposed action, and alternatives P and O.
- Fifteen out of 25 vegetation structure classes are within HRV after 100 years of land management under alternative B. This is more structure classes within HRV than all other alternatives except for O.
- Standards and guidelines would not address contemporary issues of watershed function, including protection of streambank and floodplain integrity from livestock grazing, reduction of erosion and sedimentation, and disruption of hydrologic processes from roads and trails. Standards and guidelines in alternative B may not protect watershed function and water quality as effectively as the proposed action and alternatives R, P, and O.
- Standards for development of hydroelectric and other water use developments are less stringent in alternative B than the proposed action and alternatives R, P, and O.
- Alternative B does not increase the pace of increasing resiliency of infrastructure and water uses to potential effects of climate change.

Alternative O

This alternative comes from a series of public, collaborative meetings run by the Forest Service that focused on motorized recreation, wilderness recommendations, and vegetation management, and reflects areas of general agreement among participants in those meetings. The Forest Service fully developed this alternative using the proposed action to fill in the gaps not addressed in the collaborative process.

Revised forest plan components, including general goals, objectives, and standards and guidelines are the same as the proposed action. RMAs are the same as the proposed action and alternatives R and P. The key watershed network, and objectives specific to key watersheds are the same as alternative R.

Riparian and Aquatic Resource Management

Acres of RMAs

RMA widths and acreages are the same as the proposed action and alternatives R and P.

Riparian and Aquatic Resource Plan Components

Desired conditions, objectives, standards, and guidelines are the same as the proposed action.

Key Watersheds

Acres in key watersheds are the same as alternative R. The priority key watershed network and measureable objectives for key watersheds are the same as alternative R. Standards and guidelines for key watersheds are the same as the proposed action.

Watershed and Aquatic Restoration

The pace and scale of watershed and aquatic restoration in key watersheds is the same as the proposed action. However, like the proposed action, there are no measureable objectives for general water resources, and RMA objectives are the same as the proposed action.

Roads/Access

Acres of Management Areas Where Road Building Activities are Permitted

Approximately 268,900 acres (24 percent of Colville National Forest) in alternative O are in management areas where construction of new roads is prohibited, including backcountry, backcountry motorized, research natural areas, and both designated and recommended wilderness.

Summer and Winter Motorized Recreation Opportunities Suitable Uses

Summer and winter motorized recreation use is authorized in the Responsible, Restoration, Backcountry Motorized (winter use is limited by wildlife restrictions), and Scenic Byways MAs (table 21 in chapter 2). Approximately 876,200 acres (79 percent of the Forest) are within management areas where summer and winter motorized recreation are authorized. Standards and guidelines, implementation of BMPs, and adaptive management are the primary mechanisms through which watershed function and water quality are maintained. Suitability of an area for summer or motorized recreation opportunities is guidance for project activity decision making and is not a resource commitment or final decision approving projects and activities. Use would not occur over an entire suitable area; locations of potential motorized use would be determined at the project level through site-specific analysis.

Road Density Desired Conditions

There are no specific road density desired conditions in management areas in alternative O. Road direction is the same as alternative B; road miles are capped at their current level (approximately 4,000 miles).

Road Management Plan Components

Desired conditions, objectives, and standards and guidelines for roads are the same as the proposed action; however, there are no specific road density desired conditions in management areas in alternative O. Similar to the proposed action and alternatives R and P, alternative O includes FW-STD-WR-03, which states that there would be no net increase in mileage of NFS roads in key watersheds at any time, unless doing so improves watershed condition.

Old Forest Management, Timber Production, and Upland Vegetation Condition

Active Vegetation Management

Timber harvest could occur in both the Responsible and Restoration MAs, comprising 802,900 acres (72 percent of the Forest); however, not all acres are suitable for timber harvest.

Primary Vegetation Management Tools

Anticipated vegetation management tools and estimated (modeled) acres of treatment per year in alternative O are the same as alternative B.

Acres of Colville National Forest by management area and roadbuilding and timber production authorized by management area in alternative O are shown in table 21 in chapter 2.

Historical Range of Variability

Sixteen out of 25 structure classes are within HRV after 100 years of land management under alternative O; this is the most structure classes within HRV of all alternatives (table 156). Late closed structure conditions show the greatest departure from HRV. Levels of disturbance and management do not occur across enough acres over 100 years under alternative O to create open structure conditions that existed historically. Areas that would historically have contained large trees with open canopy conditions, and greater resistance to wildfire and insect and disease outbreaks would be in a closed canopy condition with greater susceptibility to disturbance (Day 2017).

Table 156. Modeled forest structure levels at 100 years compared to HRV for all vegetation types and alternative O

Structure Class	HRV	Alternative O
Early Structure		
Douglas-fir dry	6-16	11*
Northern Rocky Mountain mixed conifer	9-25	6
Western hemlock / western red cedar	4-24	2
Subalpine fir / lodgepole pine	45-65	55
Spruce / subalpine fir	14-46	3
Mid Open		
Douglas-fir dry	2-8	4
Northern Rocky Mountain mixed conifer	1-3	2
Western hemlock / western red cedar	0	0
Subalpine fir / lodgepole pine	0	1
Spruce / subalpine fir	0	0
Mid Closed		
Douglas-fir dry	4-13	8
Northern Rocky Mountain mixed conifer	18-30	11
Western hemlock / western red cedar	7-27	8
Subalpine fir / lodgepole pine	33-53	37
Spruce / subalpine fir	13-41	30
Late Open		
Douglas-fir dry	38-78	45
Northern Rocky Mountain mixed conifer	4-6	5
Western hemlock / western red cedar	0	0
Subalpine fir / lodgepole pine	0	0
Spruce / subalpine fir	0	0
Late Closed		
Douglas-fir dry	1-32	32
Northern Rocky Mountain mixed conifer	44-60	77
Western hemlock / western red cedar	55-83	90
Subalpine fir / lodgepole pine	3	6
Spruce / subalpine fir	29-57	67

Structure Class	HRV	Alternative O
Total Structure Classes Within HRV		**16**

*Shaded cells are within HRV.

Vegetation Management Plan Components

Standards and guidelines for vegetation management are the same as the proposed action.

Grazing Plan Components

Current allotment boundaries and AUMs would continue under alternative O. Standards and guidelines to move streams and RHCAs toward attainment of RMOs and indirect effects are the same as the proposed action. Specific objectives for rangeland improvements in key watersheds that are priority for active restoration are the same as alternatives R and P.

Summary of Effects and Comparison of Other Alternatives

Alternative O is similar to the proposed action in providing protections for preservation and restoration of hydrologic function, water quality, and water uses. Alternative O would be less effective than alternatives R and P, and more effective than no action and alternative B. Effects of alternative O in relation to other alternatives include:

- Similar to the proposed action, alternative O addresses the need for change more effectively than no action and alternative B. Through plan components and principles from ARCS, and specific objectives for restoration in key watersheds, the pace and scale of watershed restoration and resiliency to potential hydrologic effects of climate change are increased in alternative O. Alternative O does not address the need for change as effectively as alternatives P and R.
- Wider RMA widths along intermittent streams, lakes, and ponds than no action and alternative B would improve and preserve hydrologic and riparian function better than narrower RHCA widths in no action and alternative B.
- There are more acres of key watersheds in alternative O than in the INFISH priority network in no action and alternative B, and the key watershed network in the proposed action, and less key watershed acres than in alternative P. While restoration activities are not expected on every acre within key watersheds, the larger key watershed network in alternative O would accelerate the pace of restoration of hydrologic function than in the smaller INFISH priority network in no action and alternative B and the smaller key watershed network in the proposed action.
- Alternative O would accelerate improvement in watershed condition faster than no action, the proposed action, and alternative B. Measurable objectives in the expanded key watershed network would accelerate restoration and preservation of hydrologic function.
- Desired conditions are identified for general aquatic riparian and watershed condition; DCs are not identified in no action and alternative B.
- Approximately 24 percent of the Forest land base is in management areas where construction of new roads is prohibited. The cap on existing road mileage in alternative O is not as protective as the 1 mile per square mile desired condition for the Focused Restoration MA and 2 miles per square mile desired condition for the General Restoration MA in alternatives R and P.
- Approximately 79 percent of the Forest is within management areas where summer and winter motorized recreation is authorized. This is the same percentage as the proposed action and alternative P, less than no action, and more than alternatives R and B.

- Sixteen out of 25 vegetation structure classes are within HRV after 100 years of land management under alternative O. Alternative O has the most structure classes within HRV of all alternatives.
- Standards and guidelines address watershed function, including protection of streambank and floodplain integrity from livestock grazing, reduction of erosion and sedimentation, and disruption of hydrologic processes from roads and trails. Standards and guidelines in alternative O should protect watershed function and water quality more effectively than no action and alternative B. Standards and guidelines in alternative O are less restrictive than in alternatives R, and P.
- Standards for development of hydroelectric and other water use developments are more stringent in alternatives R, P, O, and the proposed action than no action and alternative B.
- Measureable objectives and focused restoration activities in key watersheds in alternative O would increase the pace of increasing resiliency of infrastructure and water uses to potential effects of climate change. Since the key watershed network is expanded from the proposed action in alternative O, this alternative would be more effective in increasing resiliency to climate change than no action, the proposed action, and alternative B.

Comparison of Key Indicators between Alternatives

The six indicators related to riparian and aquatic resource management and predicted effects by alternative are summarized in the following table.

Table 157. Comparison of key indicators between alternatives

Element	No Action	Proposed Action	Alternative R	Alternative P	Alternative B	Alternative O
RHCA/RMA acreage	150,692 acres	179,236 acres	179,236 acres	179,236 acres	150,692 acres	179,236 acres
Acres Colville NF ownership of Priority/Key watersheds	214,300 acres; 19% Colville National Forest ownership	371,900 acres; 34% Colville National Forest ownership	451,500 acres; 41% Colville National Forest ownership	457,900 acres; 42% Colville National Forest ownership	214,300 acres; 19% Colville National Forest ownership	451,500 acres; 41% Colville National Forest ownership
Estimated miles of road treated	51 miles	68 miles	108 miles	196 miles	51 miles	68 miles
Estimated number of crossings where passage is improved	15 crossings	36 crossings	95 crossings*	98 crossings*	15 crossings	36 crossings
Estimated miles of in-stream channel improvements	54 miles	70 miles	86 miles*	91 miles*	54 miles	70 miles
Estimated acres of range infrastructure improvement	70	240	240*	240*	70	240
Estimated acres of treatment of upland vegetation in RMAs to move toward HRV	75-150	450-950	600-1,200*	600-1,500*	75-150	450-950
Number of subwatersheds where conditions are improved	7	12	15*	15*	7	12
Protection and improvement of aquatic and riparian function	Least Protection	Moderate Protection	High Protection	Highest Protection	Least Protection	Moderate Protection
Acres where road building is prohibited	218,300 acres 20% Colville National Forest ownership	291,100 acres; 26% Colville National Forest ownership	271,900 acres; 25% Colville National Forest ownership	283,400 acres; 25% Colville National Forest ownership	268,900 acres; 24% Colville National Forest ownership	268,900 acres; 24% Colville National Forest ownership
Acres where summer and winter motorized recreation uses are authorized	980,200 acres; 89% Colville National Forest ownership	874,800 acres; 79% Colville National Forest ownership	831,000 acres; 75% Colville National Forest ownership	875,600 acres; 79% Colville National Forest ownership	841,900 acres; 76% Colville National Forest ownership	876,200 acres; 79% Colville National Forest ownership

Element	No Action	Proposed Action	Alternative R	Alternative P	Alternative B	Alternative O
Acres with 1 mi/mi^2 road density objective	n/a	n/a	568,200 acres; 51% Colville National Forest ownership	312,500 acres; 28% Colville National Forest ownership	n/a	n/a
Acres with 2 mi/mi^2 road density objective	n/a	257,200 acres; 23% Colville National Forest ownership	244,800 acres; 22% Colville National Forest ownership	489,200; 44% Colville National Forest ownership	n/a	n/a
Acres with 3 mi/mi^2 road density objective	n/a	536,300 acres; 48% Colville National Forest ownership	n/a	n/a	n/a	n/a
Other road restrictions	Road density desired conditions for ML** 2-5 range from 0.4-2 mi/mi^2. No desired conditions for ML 1 roads	No net increase in NFS road mileage in key watersheds	No net increase in NFS road mileage in key watersheds No net increase in NFS road miles in RMAs in a subwatershed	No net increase in NFS road hydrologic risk, and reduction in road hydrologic risk if key watershed is functioning at risk, or not functional in key watersheds No net increase in NFS road miles in RMAs in a subwatershed	Cap on existing road miles	No net increase in NFS road mileage in key watersheds; Cap on existing road mileage
Acres where active mechanical vegetation management is authorized	886,900 acres; 80% Colville National Forest ownership	793,500 acres; 71% Colville National Forest ownership	244,800 acres; 22% Colville National Forest ownership	801,700 acres; 72% Colville National Forest ownership	817,700 acres; 74% Colville National Forest ownership	802,900 acres; 72% Colville National Forest ownership
Number of vegetation structure classes within HRV after 100 years	8	12	12	12	15	16

*Total includes estimates from water resource objectives for both key watersheds, and non-key watersheds.

** ML = maintenance level

Cumulative Effects

Past, Present, and Foreseeable Activities Relevant to Cumulative Effects Analysis

The five subbasins with Forest ownership also have private, Federal, Tribal, state, or county ownership outside of the Forest boundary. Many of the impacts to hydrologic function and water quality on the Forest are from activities occurring on lands under other ownership. Impacts include roads, grazing, mining, development, timber management, dams and diversions, hydropower production and development. All alternatives would maintain or improve hydrologic function, water quality, and water uses, which helps mitigate the effects of off-forest activities.

Past management activities and disturbance on NFS lands including timber harvest, grazing, road building and wildland fire can have cumulative effects on the hydrologic system. Impacts to hydrologic function and water quality from past management includes soil compaction, erosion and sedimentation in stream banks and channels, alteration of riparian vegetation, channel widening and incision, and loss of stream channel complexity and function. Upland and stream channel recovery from disturbance takes decades, and sometimes centuries to recover to a properly functioning condition; however, changes in aquatic management across Region 6 have improved conditions (Archer 2014). Aquatic direction in INFISH was intended to reverse aquatic and riparian degradation from management activities, and significantly changed the management of aquatic resources on NFS lands in the Pacific Northwest (Heller and McCammon 2004).

Active partnerships with State, county, Federal, Tribal and non-profit organizations would continue, and restoration of hydrologic and aquatic function on off-forest lands would continue.

Water Availability

Water availability is discussed at the subbasin scale in this analysis because the water provided by the Forest is an important component of water availability for more intensive downstream uses, and downstream water uses can cumulatively impact water uses and availability on the Colville National Forest. While consumptive uses in the name of the Forest are a small percentage (less than 1 percent) of uses at the subbasin scale, water uses as well as the water supplied from the Forest is upstream of more intensive consumptive uses. Ecology released analyses on the availability of water for the five major subbasins (six WRIAs) on the Forest in 2012 that provide general information on the availability of water for new consumptive uses.

Below is a general discussion of water availability in each subbasin, including adjudications, surface water source limitations, other factors affecting water availability and the issuance of new water rights. Adjudication is a legal process to determine who has a valid water right, how much water can be used, and who has priority during shortages. The adjudication process accounts for water needed for resource use, protection and planning, and transfer of water rights (WADoE 2014e). Surface water source limitations are recommended by the Department of Fish and Wildlife to protect flows to maintain fish populations and can either specify that the limitations apply at low-flow or that waters are closed to new uses (RCW 77.57.020).

Table 158. Adjudications and surface water limitations for WRIAs on the Colville National Forest

WRIA Name and Number	Adjudications*	Low Flow Surface Water Source Limitations (SWSL)	Surface Water Source Limitations Closure
Colville 59	Bulldog Creek, Chewelah Creek, Deer Creek, Hoffman Creek, Jumpoff Joe Creek/Lake, Narcisse Creek, Sherwood Creek, Spring Creek, and Thomason Creek		
Kettle 60	Twin Creek and Myers Creek	All of the WRIA not closed by SWSL	Curlew Creek, Goosmus Creek, Lambert Creek, Little Goosmus Creek, Sand Creek; portions of Tonasket Creek, Toroda Creek, and Toulou Creek
Middle Lake Roosevelt 58	Alder Creek, Corus Creek, Chewelah Creek, Jennings Creek, Harvey Creek, Magee Creek, O-Ra-Pak-En Creek, Quillisascut Creek, Stranger Creek	All of the WRIA not closed by SWSL	Ninemile Creek, North Fork of Hall Creek
Pend Oreille 62	Renshaw Creek, Little Calispell Creek, Marshall Creek/Lake	All of the WRIA not closed by SWSL	Davis Creek, Harvey Creek, Indian Creek, Maitlen Creek, and Skookum Creek and portions of Bracket Creek and East Fork of Smalle Creek
Sanpoil 52		All of the WRIA	
Upper Lake Roosevelt 61	Pingston Creek	All of the WRIA not closed by SWSL	Deep Creek, Onion Creek, and Williams Lake

*Generally, most of the water has been appropriated in adjudicated basins, and new appropriations are not available (WADoE 2012d).

Across subbasins on the Forest, the majority of precipitation occurs during the winter months, when demand is lowest. In summer, rain is infrequent and streams are dependent on groundwater to maintain low or baseflows. Groundwater availability and yield is limited by both climate and geology—only 3 percent of streams across the Forest are considered groundwater systems (Reidy-Liermann et al. 2012), and groundwater-dependent ecosystems including seeps and springs make up considerably less than 1 percent of Forest lands (national hydrography dataset spatial data). Therefore, surface water is least available when demand for water is highest (WADoE 2012a-f).

Within the Pend Oreille WRIA, Ecology is in the process of considering the establishment of streamflow requirements in areas of the WRIA that are restricted or closed to new uses or are expected to experience increased pressure based on population growth and climate change. Flow studies have been initiated on the South Fork of Kalispell and Indian Creek (WADoE 2012d). The Kalispel Indian Reservation is located in this WRIA, and there are Tribal concerns about maintaining flows for fish habitat. Federally Reserved Rights have not been quantified in this WRIA, therefore, the legal availability of this water has not been determined (WADoE 2012d).

The Colville WRIA has an instream flow regulation establishing base flows to protect beneficial uses and protect senior water rights (WAC 173-559-030). Tributaries of the Colville River are closed to further consumptive appropriation except for reservoir storage, from November 1 through May 31, and in-house single domestic supply if an alternative source is not available (WADoE 2012a). The Upper and Lower Colville River is closed to further consumptive appropriation from July 16 to September 30.

The WRIA 59 (Colville River) Water Resource Management Board, which consists of local citizens, local, state, and Federal agencies (including the Forest) has been working on watershed planning activities in the Colville River Watershed over the past 15 years. Key activities of the Water Resource Management Board include development of a watershed implementation plan, an instream flow study, and research on water storage projects to meet future water needs.

While the Middle Lake Roosevelt is not closed to new water uses, the majority of water is appropriated, and new uses are subject to surface water source limitations. Adjudicated basins within this WRIA have annual water shortages (WADoE 2012c).

The Sanpoil WRIA is not closed to new water uses, however, the majority of water is appropriated, and new uses are subject to surface water source limitations. There are no adjudicated watersheds in the Sanpoil WRIA (WADoE 2012e). Federally Reserved Rights are not quantified in the Sanpoil WRIA; however, it is likely new appropriations in the lower Sanpoil River would impact Federal Reserved Water Rights of the Colville Indian Tribe (which owns the majority of the lower subbasin). Future surface water applications for single domestic or stock watering may be approved if there is no alternative source of water supply, and the use would not affect existing Federal reserved rights (WADoE 2012e).

The doctrine of reserved water rights has evolved to ensure that Indian reservations and other Federal lands would have sufficient water to fulfill the purpose for which they were established. Federal reserved rights have a priority date of when the lands were set aside, in contrast to State-based appropriative rights, which have a priority date of when the water was first put to beneficial use.

The revised forest plan addresses water availability primarily through increasing ecological function and resiliency. Forest practices that increase and preserve watershed and riparian function, including BMPs, revised forest plan components (desired conditions, objectives, standards, and guidelines), and vegetation management activities that increase resiliency to disturbance are expected to improve landscape resiliency to low flows.

The revised forest plan includes components to improve and restore hydrologic function, which allows the landscape to hold water longer and release water slower in the summer months when streamflow is low. Desired conditions for water resources provide the framework for hydrologic function, and implementation of the revised land and resource management plan would move the Forest toward these desired conditions. Watershed restoration objectives outline specific activities that would improve landscape function and resiliency. In addition, the revised forest plan includes a robust set of standards and guidelines for protection of water resources and riparian management areas.

Water Rights

Applications, claims, certificates, and permits for WRIAs with Forest administrative forest ownership are shown in table 159. Within the six WRIAs, the majority of consumptive certificated water rights are located off the Forest.

Table 159. Number of applications, claims, certificates, and permits for WRIAs within the Colville National Forest

WRIA Name and Number	Applications	Claims	Permits	Certificates
Colville 59	56	2,728	50	1,495
Kettle 60	13	1,067	21	656
Middle Lake Roosevelt 58	9	742	16	657
Pend Oreille 62	11	1,049	72	691
Sanpoil 52	16	529	5	221
Upper Lake Roosevelt 61	18	548	5	305

Climate Change

The 1988 forest plan does not address the potential effect of climate change. Integrated management direction that provides flexibility and increased resiliency to respond to a changing environment is one of the primary needs for change driving this forest plan revision process. Climate change is expected to affect physical hydrologic processes including the amount, timing, and type of precipitation. Changes in snowpack (Hamlet et al. 2005) and timing of snowmelt are also expected, which can affect streamflow (Mantua et al. 2010) and temperature (Isaak et al. 2011, Luce et al. 2014). Changes in climate would also affect forest vegetation, which may have additional impacts on hydrologic processes and water available for consumptive uses and ecological and biological values (Adams et al. 2012).

A climate change vulnerability assessment of hydrologic resources on the Forest is presented here (Gaines et al. 2012). This analysis identifies key water resource values on the Forest that may be altered through climate change. This analysis focuses on vulnerable infrastructure and water resource values for consumptive uses and analyzes how potential change in hydrologic variables from climate change may impact these resources.

Water Uses

Water uses are a key resource to focus climate change vulnerability assessment for the Forest because changes in timing and quantity of flows could affect multiple uses of water. Consumptive water uses on the Forest are a small proportion of consumptive uses at the subbasin scale. The primary climate change mechanisms with the potential to affect water uses both on and off the Forest are changes in the timing and amount of precipitation falling as snow and the timing of snowmelt.

Snowpack

Loss of snowpack in the Pacific Northwest is one of the most certain aspects of climate change (Kapnick and Hall 2012, Mote et al. 2005). Increasing temperatures across the Pacific Northwest over the last 50 years have caused more precipitation to fall as rain, reduced spring snowpack, and earlier snowmelt. The sensitivity of snowpack across the Forest was assessed using data from Kramer and Snook (2014) that analyzed snowpack data from the Snow Data Assimilation System (NOHRSC 2004). The Snow Data Assimilation System integrates ground, airborne, and satellite snow observations with weather prediction models to produce 1-km resolution daily snow data. Snow water equivalent (SWE) on April 1 (when snowpack is at its peak) Snow Data Assimilation System data from 2003 to 2012 was used to spatially classify and characterize snowpack sensitivity (USDA Forest Service 2014b). April 1 SWE was classified based in differences in snowpack between warmer, drier El Niño and cooler, wetter La Niña years to spatially project potential changes in snowpack under a warmer climate scenario.

Classification of snowpack vulnerability and acres of NFS land in each category are shown in table 160.

Table 160. SWE classification and acres of Colville National Forest within each category*

SWE Category	Description	Acres of Colville NF Administrative Forest	Percentage of Colville NF Administrative Forest Acres
No Snow	No snow on April 1	141,917	10%
Ephemeral Snow	April 1 SWE was less than 1.5 inches during warm dry years, and greater than 1.5 inches in cold wet years.	819,575	60%
Persistent-Most Sensitive	The timing of peak snowmelt in the warmest, driest years occurred more than 30 days earlier that the coldest, wettest years.	249,422	19%
Persistent-Least Sensitive	Timing of peak snowmelt occurred less than 30 days earlier in warm, dry years than cold, wet years.	147,837	11%

*Kramer and Snook 2014

Snowpacks classified as persistent least-sensitive to warmer temperatures are located along the crests of the Kettle and Selkirk mountains. Mountain snowpacks are most sensitive to warmer temperatures in the mid-elevation bands in the Kettle and Selkirk Mountains. The majority of the Forest is in the ephemeral snow zone where April 1 snowpack is generally not large enough to have high inter-annual variability. Snow in this zone is not as critical for sustained runoff during spring snowmelt, because snow generally melts before peak snowmelt. The ephemeral snow zone would likely see the greatest transition from snow to rain in warmer conditions.

Changes in snow accumulation and the timing of snowmelt have potential implications for decreases in summer low flows when flows are critical to satisfy consumptive water uses as well as in-stream flow and habitat requirements.

Low Flow Analysis

Summer low flows are influenced by the timing of snowmelt as well as physical landscape properties including geology, vegetation, and degree of watershed alteration from roads and other disturbances. These factors influence the process of converting precipitation into discharge (Safeeq et al. 2013).

The western United States streamflow metric dataset was developed by Wenger et al. (2010) using daily simulations of the variable infiltration capacity macro-scale hydrologic model Projections of future low flow using the variable infiltration capacity hydrologic model (Wenger et al. 2010) were used to assess potential change in summer low flow on perennial streams across the Forest using the national hydrography dataset plus stream layer.

Percent change in mean summer flow (cfs) from historical data was calculated for the 2040 and 2080 warming scenarios. The magnitude of change in summer low flow is projected to be less than in other regions across the Pacific Northwest east of the Cascade Mountain Range. Miles of stream within each percent change category are summarized in the following table.

Table 161. Percent change in mean summer flow (cfs) from historical data and perennial stream mileage within each category under the 2040 and 2080 warming scenarios

Percent change	Change Category	Vulnerability	Year 2040 Miles	Year 2080 Miles
>(-10)	1	Low	1,879	241
-10-(-20)	2	Moderate	2,220	2,815
>(-20)	3	High	26	1,069

Potential decreases in summer low flows are relatively minor under 2040 projections with increases in low flow vulnerability in 2080. In 2040, the greatest vulnerability is in the Salmo-Priest Wilderness—where elevations are the highest; however, only 26 miles of stream are within this category. Most streams are at moderate risk for reduction in low flows, with lower risk in the western portion of the Forest. In 2080, 1,069 miles of stream are projected to have a high risk decreased summer flow (greater than 20 percent change in low flow) compared to 26 miles in 2040. Low flow vulnerability in 2080 is highest in the Selkirk Range and on the Kettle Crest.

Infrastructure Risk

Hydrologic changes as a result of climate change may impact the infrastructure system on the Forest through reduced and earlier runoff of snowpack resulting in earlier use of roads, higher peak flows and flood risk, and reduced low-flows in summer.

Projected change in bankfull flow magnitude (cfs) was used in this analysis to assess potential risks to roads located near perennial streams. Stream reaches within 300 feet of roads administered by the Forest were used to determine miles of road at risk under the 2040 and 2080 warming scenarios using variable infiltration capacity data (table 162). While there are several factors that affect the vulnerability of infrastructure to high flows, roads near perennial streams were selected for this analysis because roads in valley-bottoms adjacent to the stream network increases infrastructure sensitivity to flooding, channel migration, and bank erosion. Most existing stream crossings are aging culverts that are vulnerable to flood peaks and associated sediment and debris. Bankfull flows are projected to increase in 2040, with greater magnitude changes projected for 2080.

Table 162. Projected vulnerability of roads within 300 feet of perennial streams for 2040 and 2080 categorized by percent increase in bankfull flows from variable infiltration capacity data

Percent change	Change Category	Vulnerability	Year 2040 Miles of Vulnerable Road	Year 2080 Miles of Vulnerable Road
less than 0-10	1	Low	1,081	785
10-20	2	Moderate	372	346
>(-20)	3	High	142	464
Total			**1,595**	**1,597**

Adaption to Climate Change

All alternatives in this analysis have components to adaptively manage hydrologic resources to respond to hydrologic changes in climate. The proposed action and alternatives R, P, and O address climate change through inclusion of desired conditions that address hydrologic and aquatic processes to improve resiliency to climate change. No action and alternative B include riparian goals and RMOs included in INFISH do not address the need for change based on climate change as effectively as the proposed action and alternatives R, P, and O. While riparian goals in INFISH address the function and processes that improve climate change resiliency, the narrow RMOs do not provide the same flexibility for adaptive management as the aquatic and riparian plan components in the proposed action and alternatives R, P, and O. In addition, most aquatic and riparian objectives in alternatives R (ARCS-modified) and P (Colville ARCS), and to a lesser extent in the proposed action and alternative O (ARCS) have prioritized potential restoration treatments of roads, culverts, and recreation sites based on spatial analysis of vulnerability of these resources to changes in peak and low flows. Several other aquatic and riparian objectives respond to climate change vulnerability through increasing resiliency of the landscape through in-stream restoration, improvement of range infrastructure, and treatment of upland vegetation in RMAs. Standards and guidelines under alternatives R and P, and to a lesser extent, the proposed action and alternative O provide the framework to respond to changes in climate, including MA-STD-RMA-07, in which new or replaced culverts would accommodate a 100-year flow with associated bedload and debris. As the magnitude of 100-year flows change over time, calculation of this figure may also change, however, this standard would still remain applicable.

Cumulative Effects by Alternative

No Action

No action would continue to improve hydrologic function and water quality and improve watershed and hydrologic function through restoration activities in focus and priority watersheds (designated through the WCF process), and to a lesser degree in INFISH priority watersheds as funding and partnership opportunities are available. No action would help mitigate potential effects from off-forest activities with the potential to affect hydrologic function, water quality, and water uses. Focused restoration activities would improve resiliency of infrastructure to climate change. When analyzed with past, present, and reasonably foreseeable future activities both on and off the Forest, no action would improve hydrologic function and be responsive to climate change, but may not be as effective as the proposed action and alternatives R, P, and O.

Proposed Action

The proposed action would continue to improve hydrologic function and water quality, and improve watershed and hydrologic function through restoration activities in 11 key watersheds designated as priorities for restoration. The proposed action expands the key watershed network from the INFISH priority network. The proposed action includes wider RMA widths than RHCA widths in the no action alternative, and includes RMA-specific standards and guidelines. Additional desired conditions, goals, objectives, standards, and guidelines in the proposed action would improve and preserve aquatic function and water quality. The proposed action also includes standards for development of hydroelectric and other water use developments that would limit new consumptive water uses. When analyzed with past, present, and reasonably foreseeable future activities both on and off the Forest, the proposed action would improve hydrologic function and be responsive to climate change, but may not be as effective as alternatives R and P.

Alternative R

Alternative R would continue to improve hydrologic function and water quality and improve watershed and hydrologic function through restoration activities in 13 key watersheds designated as priorities for restoration. Alternative R expands the key watershed network from the INFISH priority network and the key watershed network in the proposed action. Alternative R proposes wider RMA widths than RHCA widths in the no action alternative, and includes RMA-specific standards and guidelines. Desired conditions, goals, objectives, standards, and guidelines in alternative R were updated to better preserve and improve aquatic function and water quality. Alternative R includes standards for development of hydroelectric and other water use developments that would limit new consumptive water uses. When analyzed with past, present, and reasonably foreseeable future activities both on and off the Forest, alternative R is the most effective alternative for improvement of hydrologic function and responsiveness to climate change.

Alternative P

Similar to alternative R, alternative P would continue to improve hydrologic function and water quality and improve watershed and hydrologic function through restoration activities in 13 key watersheds designated as priorities for restoration. Alternative P expands the key watershed network from the INFISH priority network and the key watershed network in the proposed action and alternatives R and O. Alternative P proposes wider RMA widths than RHCA widths in the no action alternative, and includes RMA-specific standards and guidelines. Desired conditions, objectives, standards, and guidelines in alternative P were updated and refined from other alternatives based on best available science and direction provided in the 2016-ARCS. Plan components in alternative P better preserve and improve aquatic function and water quality than all other alternatives. Alternative P includes standards for development of hydroelectric and other water use developments that would limit new consumptive water uses. When analyzed with past, present, and reasonably foreseeable future activities both on and off the Forest, alternative P would improve hydrologic function and water quality, and be responsive to climate change more effectively than all other alternatives.

Alternative B

Alternative B would continue to improve hydrologic function and water quality and improve watershed and hydrologic function through restoration activities in focus and priority watersheds (designated through the WCF process), and to a lesser degree in INFISH priority watersheds as funding and partnership opportunities are available. Alternative B would help mitigate potential effects from off-forest activities with the potential to affect hydrologic function, water quality, and water uses. Focused restoration activities would improve resiliency of infrastructure to climate change. When analyzed with past, present, and reasonably foreseeable future activities both on and off the Forest, alternative B would improve hydrologic function and be responsive to climate change, but may not be as effective as the proposed action and alternatives R, P, and O.

Alternative O

Alternative O would continue to improve hydrologic function and water quality, and improve watershed and hydrologic function through restoration activities in 13 key watersheds designated as priorities for restoration. Alternative O expands the key watershed network from the INFISH priority network. Alternative O includes wider RMA widths than RHCA widths in the no action alternative, and includes RMA-specific standards and guidelines. Additional desired conditions, goals, objectives, standards, and guidelines in the proposed action would improve and preserve aquatic function and water quality. Alternative O also includes standards for development of hydroelectric and other water use developments that would limit new consumptive water uses. When analyzed with past, present, and reasonably foreseeable future activities both on and off the Forest, alternative O would improve hydrologic function and be responsive to climate change, but may not be as effective as alternatives R and P.

Summary

Overall, the proposed action provides more protection for preservation and restoration of hydrologic function, water quality, and water uses than the no action and B alternatives. The proposed action does not provide as much protection for preservation and restoration of hydrologic function, water quality, and water uses as the R, P, and O alternatives.

Soil

Soil resource information is a core component of national forest planning. Information about the soil resource provides planning teams with an understanding of the inherent capability of different portions of the landscape to meet a variety of land management objectives. Understanding the inherent soil capabilities and limitations of the landscape also assures that planned activities are both obtainable and sustainable over time. This analysis focuses on the motorized recreation trails and late forest structure issues, since they are the most relevant to soil resources.

Affected Environment

The Colville National Forest has a wide diversity of soil types from the minimally developed, nutrient-poor soil and rock outcrop complexes of the steep mountain slopes and ridges to the deep, fertile soils of the lower valleys. Cooler temperatures, shorter growing seasons, and steep topography are the prime factors behind the lack of soil development in the upper elevations of the Forest. Conversely, warmer temperatures, a longer growing season, and gentle topography found within the lower Forest elevations provide more favorable conditions for soil development.

Soil Development

Soil development is dominated by five major soil formation factors: time, parent material, topography, climate, and biology. The two greatest influences on the development of the soils on the Colville National Forest are continental glaciation and distant volcanic activity.

During the Pleistocene Epoch (approximately 2.4 million to 18 thousand years ago), a continental glacier called the Cordilleran Ice Sheet built up, covering much of western Canada, northern Washington and Idaho and northwestern Montana, including the area covered by the Colville National Forest. The ice sheets advanced and then retreated several times, according to the sequence of sediments that the ice sheets left behind. However, the most completely understood ice sheet advance is the one that occurred most recently, between 200,000 and 18,000 years ago and obscured much of the evidence of the earlier advances.

In places where the ice sheet flowed across bedrock, such as in eastern Washington, it smoothed the mountains and hills into more streamlined and rounded shapes. The highest peaks on the Colville National Forest remained unglaciated as the ice sheet moved around and not over them. The ice sheet created valley fills and terraces of glacial outwash around its margins in the northern part of eastern Washington. Katabatic winds, driven by the temperature contrasts between the ice and the land, picked up and moved the finer-grained sediments from the outwash both out of and onto the area of the Colville National Forest.

Glacial soils fall into three, general categories: lacustrine, outwash and till. Lacustrine soils are derived from ancient glacial lakebeds. These soils are higher in silt or clay content than other glacial soils, resulting in higher water-holding capacities and higher fertility. Lacustrine soils are more susceptible to hillslope and wind erosion than till or outwash because of their fine texture. Streams flowing from glaciers deposited outwash soils. Water of varying speeds deposits particles of different sizes, sometimes resulting in distinct layers of gravel, sand, and rock in the soil profile. Usually, glacial outwash soils drain rapidly and have low organic matter content. Some glacial outwash soils contain a layer of wind deposited silt (loess) that increases their moisture-retaining capacity and fertility. Glacial till was deposited directly, mixed, deformed, or compressed by glaciers and often results in a mixed particle size soil that is variably drained. Glacial till that was laid down beneath glaciers is known as basal till and has a dense, compacted layer, or densic layer, at a depth of about 18 to 36 inches that can extend more than

10 feet. This densic layer is often impenetrable to both plant roots and infiltrating water, forming a perched water table. Because of this, sites with basal till soils often drain poorly. If the densic layer is very shallow, the soils may not be able to support trees or more deeply rooted plant species by virtue of wetland conditions.

Although lacking volcanoes, younger than 40 million years old within the Forest boundaries, many soils in the Forest owe their productivity to volcanic activity. Volcanic ash from the eruption of Mount Mazama (now Crater Lake) 7,900 years ago has significantly influenced forested soils of the area. Additional volcanic ash and loess influenced by volcanic ash were deposited by eruptions of Mount Rainier, Mount St. Helens, and Glacier Peak. These ash-influenced soils can be found throughout the western United States. Locally, these soils are characterized by a bright brown “cap” of volcanic ash 6 inches or more in thickness. These ash-cap soils, in contrast to other soils, are important to forest management due to their low bulk density, high porosity, high infiltration, high water storage potential, and nutrient retention capabilities. These soil properties reduce drought stress on plants during extended summer dry periods found in the Forest.

Landtypes

Soils of the Colville National Forest can be divided into five landform groups based on similar geomorphic processes (Davis et al. 2004):

- Soils on glaciated and scoured mountain slopes (673,990 acres)

  Soils on glaciated and scoured mountain slopes are formed from metasedimentary, igneous, and pyroclastic geologies that have been shaped by continental glaciation. Scoured areas tend to have thin rocky soils. Lesser areas of deeper soil can be found in glacial till in draws and north-facing slopes.

- Soils on glacial moraines (397,794 acres)

  Glacial deposition is the most common land-forming process in glacial moraines. The most common rock types are metamorphic, intrusive, and volcanic. Springs, seeps, and pothole lakes are common.

- Soils on unglaciated mountains (120,144 acres)

  This landform group consists of dissected and structure controlled mountain slopes and rounded ridge tops. These are the only landforms on the Forest that are not glacially influenced. Moderately deep residual soils can be found on the ridge tops. Erosion and mass wasting are the primary landform drivers on the mountain slopes. These soils are formed from igneous intrusive and metasedimentary geologies.

- Soils on valley bottoms (120,036 acres)

  These landforms are located in valley bottoms of varied size. Glacial meltwater, fluvial flooding, and glacial lake sedimentation are the major land-forming factors. These soils are formed from relatively young surficial deposits of glacial till, alluvium, landslide debris, and glacial outwash. Rock types are mixed and varied in these landforms.

- Soils on glacial troughs and cirques (16,403 acres)

  These landtypes are glacial valleys formed from alpine and continental glaciation. Ridges were scoured and slopes steepened by glacial erosion. Alluvial fans and glacial moraine deposits are found at the lower slopes. The most common rock type is metasedimentary.

Soil Taxonomy

The system of soil classification used by the National Cooperative Soil Survey has six levels. Beginning with the broadest, these categories are order, suborder, great group, subgroup, family, and series. Each level of taxonomy gives more detailed information about the soils. The dominant soil orders found in the Forest are Inceptisols and Andisols followed by Mollisols and Alfisols (table 163).

Inceptisols are soils with poorly developed characteristics. Most Inceptisols occur under forested landscapes in a variety of climatic conditions. They tend to occur on steep slopes where erosion is continuously removing topsoil or convex toeslopes where colluvium is being deposited. Time tends to be the limiting factor of soil development in these soils.

Table 163. Soil orders on the Colville National Forest

Soil Order	Acres	Percentage of Administrative Forest
Inceptisols	666,134	49%
Andisols	477,507	35%
Mollisols	64,416	5%
Alfisols	39,630	3%
Others (including Entisols, Histosols, and Spodosols)	110,462	8%

Andisols form from volcanic ash or other volcanic material. These soils have characteristic chemical and physical properties that include high water-holding capacity and the ability to keep large quantities of phosphorus unavailable to plants. While volcanic ash plays an important role in the soils of the Forest, not all the soils have ash depths that would classify to Andisols. Many soils are within Andic and Vitrandic suborder, great group, or subgroups.

Mollisols are grassland soils with thick dark surface horizons. These dark surface horizons are the result of long-term additions of organic matter primarily through grass roots. These soils were formed in areas with a short fire return interval that prevented the growth of woody vegetation and stimulated the growth of native grasses. Some Mollisols may be relics of periglacial tundra.

Alfisols are soils that have clay-enriched subsoils and high base saturation. These soils have typically formed in forested ecosystems and tend to have high soil fertility.

Soil Quality

Soil is the foundation of the ecosystem. Soil quality is the capacity of a specific kind of soil to function, within natural or managed ecosystem boundaries, to sustain plant and animal productivity, maintain or enhance water and air quality, and support human health and habitation and ecosystem health. Soil productivity is the inherent capacity of the soil resource to support appropriate site-specific biological resource management objectives, which include the growth of desirable plant species, plant communities, or a sequence of plant communities, all to support multiple land uses.

FSM chapter 2550 Soil Management directs soil resource management on NFS lands. The objectives of the national direction are (1) to maintain or restore soil quality on NFS lands, and (2) to manage resource uses and soil resources on NFS lands to sustain ecological processes and function so that desired ecosystem services are provided in perpetuity. Soil function is any ecological service, role, or task that soil performs.

The FSM identifies six soil functions: soil biology, soil hydrology, nutrient cycling, carbon storage, soil stability and support, and filtering and buffering. In order to provide multiple uses and ecosystem services in perpetuity, these six soil functions need to be active and effectively working. These six soil functions are discussed in the following sections. Interpretive maps have been developed to assist in understanding how these functions are operating within different ecosystems. These soil functions and the interpretive maps are also referenced in the discussion of Environmental Consequences.

Soil Biology

Soil biology is the ability to provide habitat for a wide variety of organisms including plants, fungi, microorganisms, and macro-organisms in the upper sections of the soil. Diversity of soil biology is beneficial for several reasons:

The complex process of decomposition and nutrient cycling requires a varied set of organisms.

- An intricate group of soil organisms can compete with disease-causing organisms and prevent a problem-causing species from becoming dominant.
- Several organisms are involved in creating and maintaining the soil structure important to water dynamics in soil.
- Many antibiotics and other drugs and compounds used by humans come from soil organisms.
- Most soil organisms cannot grow outside of soil, so it is necessary to preserve healthy and diverse soil ecosystems to preserve beneficial microorganisms.

The major drivers of soil biological function are presence of organisms and thermodynamics. The organism influences on the soil include plant and animal actions from root growth and distribution to macro pore creation by small mammals. The thermodynamics of the site control moisture and temperature of the soil profile. Vegetation canopy and soil cover (forest floor, fine and coarse woody debris) provide macro and microhabitat and climate conditions on-site to support the soil organisms. Important characteristic soils are formed on unglaciated areas with remnant plant communities; these are typically older, well-developed soils.

Soil Hydrology

Soil hydrology is the ability of the soil to absorb, store, and transmit water, both vertically and horizontally. Soil hydrology is extremely important on the Forest, because the ecosystem productivity is typically limited by water. Soil can regulate the drainage, flow, and storage of water and solutes, including nitrogen, phosphorus, pesticides, and other nutrients and compounds dissolved in the water. With proper functioning, soil partitions water for groundwater recharge and use by plants and animals. Sensitive soils for the hydrologic function are soils with volcanic ash deposits, soils susceptible to drought, and hydric soils (wetlands).

Volcanic Ash Soils

The surficial volcanic ash deposits, or ash cap, of the soils on the Forest are instrumental to the high productivity of the Forest. The ash-cap on the Forest is characterized by a low bulk density, high water-holding capacity, and a high cation exchange capacity that can lead to a concentration of nutrients. The ash-caps found on the Forest are in varying forms from thick mantles of pure ash to layers of ash mixed with weathered mineral soil.

The ash deposited on the Forest tends to be fine particles forming loam and silt loam textured soils. The high water-holding capacity of the ash-cap is arguably the most important feature of the ash-cap locally. The ash was deposited over rocky and sandy coarse-textured soils with relatively low water-holding capacities in northeastern Washington, and therefore, the majority of the plant-available water in this landscape is held in the ash cap.

Ash-caps are extremely susceptible to decreased soil quality due to compaction, erosion, and soil mixing. Ashy soils have low soil-bearing capacity, and therefore, compact very easily within a large range of soil moisture levels. Compaction causes a restriction to plant rooting, lowered water-holding capacity, and lowered infiltration rates. Ashy soils also do not recover from compaction as quickly as other soil types. Several hypotheses exist regarding the slower recovery times, including the low amounts of clay, and therefore, limited natural shrink and swell cycles or the possible physical locking of jagged edge ash particles during compaction.

Ash-cap layers tend to be resistant to erosive forces when fully vegetated due to high infiltration rates and strong soil structure. When vegetation and litter layers are removed, the ashy surface is highly susceptible to severe erosion. Loss of the ash-cap layer would reduce the water-holding capacity and increase the overall soil bulk density. These effects would decrease available soil moisture and tree root penetrability. The effects of mixing the ash-cap with subsoil are similar and would result in comparable productivity decreases. Since volcanic ash is not replaced, the effects of erosional losses of the ash-cap would be long term. Areas with ground disturbance may become more favorable for weed invasion, which could reduce overall soil productivity.

A map of areas and types of ash-cap soils on the Colville Forest was created using the Natural Resources Conservation Service SSUGRO soil data layer. The purpose of this interpretive map is to show where ash-cap soils occur and the relative thickness and makeup of the different volcanic ash soils. Four categories were identified based on whether or not an ash-cap was present and soil taxonomic classification of the ash-caps (Soil Survey Staff 2014). Andisols include soils in the Andisols soil order that have an ash-cap at least 24 inches thick. Ash-cap soils in the Andic subgroup have at least 8 inches of ash-cap and contain minerals weathered from volcanic ash. Ash-cap soils in the Vitrandic subgroup also have at least 8 inches of ash-cap and have higher volcanic glass content compared to Andic subgroups.

Droughty Soils

Drought affects trees directly by slowing or arresting growth, and causing injury or death. It also affects them indirectly, by increasing their susceptibility to wildfire, insect pests, and disease. A drought may be short-lived, perhaps lasting one growth season, but its impact on a tree’s health—and, ultimately, a forest’s—can last much longer. Trees have evolved protective mechanisms to deal with water stress, but there are many external factors that determine the effects of drought, including soil composition and topography, as well as the species mix, age, and density of trees. These soils that are susceptible to drought can inform management as to desired tree density and areas at risk to insect and disease outbreaks.

Oregon State University has created a soil drought index layer for the Pacific Northwest Region of the Forest Service (table 164). This layer represents an initial approximation of the potential for droughty soil conditions in forested landscapes in Washington and Oregon. The index is based upon best available soils data and satellite-derived estimates of actual and potential evaporation. Potential evapotranspiration is an estimate of the evaporation and transpiration that would occur if an adequate supply of moisture were available. Actual evapotranspiration measures the actual loss of moisture from soil and plant surfaces. The degree to which actual evapotranspiration falls below potential evapotranspiration is interpreted as an indicator of moisture limitation. Some studies have found that prolonged periods of low actual evapotranspiration to potential evapotranspiration ratio (actual evapotranspiration/potential evapotranspiration) during a growing season are highly correlated with reduced dryland crop yields.

Actual evapotranspiration/potential evapotranspiration has been used as a broad-scale indicator of potential drought stress.

Table 164. Droughty soil index for the Colville National Forest

Droughty Soil Index	Acres	Percentage of Administrative Forest
April, May, June		
Low	5,915	0%
Low to Moderate	546,751	41%
Moderate	643,988	48%
Moderate to High	147,427	11%
High	840	0%
July, August, September		
Low	7,374	1%
Low to Moderate	464,796	35%
Moderate	644,360	48%
Moderate to High	182,961	14%
High	45,432	3%

Hydric Soils

Hydric soils and wetlands are areas on the landscape that tend to retain moisture and are sensitive to human activities. There are very limited amounts of hydric soils on the Colville National Forest. The Natural Resources Conservation Service classifies map units in the Soil Survey program as to the amount of the map unit that is hydric. There are 2,989 acres of soils mapped as 100 percent hydric on the Forest and 2,247 acres of soils mapped as predominately hydric (66 to 99 percent hydric) (table 165). This combines to less than 1 percent of the Forest land base. Map units that are made up of hydric soils may have small areas, or inclusions, of non-hydric soils in the higher positions on the landform, and map units made up of non-hydric soils may have inclusions of hydric soils in the lower positions on the landform. Map units that are not listed do not meet the definition of hydric soils because the dominant soil component does not have one of the hydric soil indicators. A portion of these map units, however, may include hydric soils. There are inclusions in most map units that can be hydric, therefore, the total land base on the Forest that has hydric soils is likely underestimated due to the level of mapping and classification. In all soil surveys, every map unit includes areas of soil components or miscellaneous areas that are not identified in the name of the map unit. Many areas of these components are too small to be delineated separately. Generally, in these soil surveys, inclusions can make up to 20 percent of a map unit.

Table 165. Map unit hydric ratings on the Colville National Forest

Hydric Class	Acres	Percentage of Administrative Forest
Non Hydric (0%)	1,181,432	87%
Predominately Non Hydric (1-32%)	171,480	13%
Predominately Hydric (66-99%)	2,247	0.17%
Hydric (100%)	2,989	0.22%

Hydric soils are defined as soils formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions within the upper part. A soil is defined as saturated when all pores are filled with water, excluding all air. The saturated soil closest to the soil surface indicates the level of the water table. Anaerobic conditions exist when biologically available oxygen is absent from the soil.

Positions in the landscape that have high water tables are more likely to have wet and potentially hydric soils. The same is true for soils that are prone to flooding or ponding. The following landscape positions are locations that may contain hydric soils, based on the timing and duration of saturation and anaerobic soil conditions.

- Depressional areas collect and store runoff water from the surrounding landscape after rain events. Mineral soils are likely to be present and may or may not be hydric. Vegetation can consist of trees, shrubs, and herbs.
- Floodplains that are seasonally flooded may contain hydric soils. Hydric soils usually form in the backwater area, where water is retained for extended periods. Soils are typically mineral with trees and shrubs being the dominant vegetation.
- Seeps occur at the base of slopes where the groundwater table intersects the soil surface. They are often found where a slope grades into flat land. The high water table in seeps is sustained by groundwater discharge. There can be mineral or organic soils, and the vegetation in and around the seep can consist of trees, shrubs, and herbs.

In hydric soils, soil organic matter accumulates because the microorganisms decompose plant and animal material more slowly than in anaerobic soils. This decrease in decomposition causes organic matter to build up at the surface. As a result, anaerobic soils usually have a dark or almost black surface. Common rates of organic accumulation may average 2 inches every 100 years. A dark surface horizon, underlain by a gray horizon is one common indicator. Another indicator of a hydric soil is a horizon that is predominantly gray with accumulations of iron along root channels or in masses. In the horizons with accumulated iron, there are also areas that are depleted, making them lighter than the main horizon color (Hurt et al. 1996).

The presence of hydric soils is one-third of the requirements needed to meet a jurisdictional wetland. The two other requirements include wetland hydrology and hydrophytic vegetation. Hydrology refers to the movement of water in the environment. However, wetland hydrology specifically implies the soil is saturated to the surface for approximately 5 percent of the growing season, or is frequently flooded or ponded. Hydrophytic vegetation is adapted to survive in saturated and anaerobic soils. Wetlands are universally sensitive to machine traffic due to saturation throughout the growing season and high organic matter content of the soils.

Nutrient Cycling

Nutrient cycling is the movement and exchange of organic and inorganic matter back into the production of living matter. Soil stores, moderates the release of, and cycles nutrients and other elements. In contrast to the annual harvests associated with agriculture, forest harvest—and hence nutrient removal—typically occurs only once per rotation or every 40 to 120 years. This not only reduces the rate of removal, but the long-time interval makes natural additions of nutrients by atmospheric deposition and by weathering of soil minerals very important in maintaining nutrient status. Sensitive soil attributes for nutrient cycling include the forest floor vegetation quantity composition and coarse soil texture subject to leaching. Soils formed on quartzite are problematic in that they are very low in nutrients from parent material and have little capacity for retaining deposited nutrients.

During these biogeochemical processes, analogous to the water cycle, nutrients can be transformed into plant available forms, held in the soil, or even lost to atmosphere or water. Carbon, nitrogen, phosphorus, and many other nutrients are stored, transformed, and cycled through soil. Decomposition by soil organisms is at the center of the transformation and cycling of nutrients through the environment. Decomposition liberates carbon and nutrients from the complex material making up life forms and puts them back into biological circulation so they are available to plants and other organisms. Decomposition also degrades compounds in soil that would be pollutants if they entered ground or surface water. Nutrient cycling can be assessed by considering organic matter composition on a site (forest and rangeland floor, fine and coarse woody material) and the nutrient availability (topsoil horizons and nutrient deficiencies).

Nearly all the nitrogen in forest systems is bound to organic matter. Very little of the total pool of nitrogen is available to plants; only about 2.5 percent of total organic nitrogen is released annually (Grigal and Vance 2000). The rate of nitrogen release from organic matter (mineralization) is controlled by microbial decomposition, which in turn is controlled by environmental factors as well as the amount and chemical composition of organic matter (Grigal and Vance 2000). Rates of nitrogen mineralization are highly spatially variable within stands (Johnson and Curtis 2001). The availability of nitrogen from organic matter has been said to “most often limit the productivity of temperate forests” (Hassett and Zak 2005). Logging residues are a source of nitrogen during early periods of stand growth after harvest (Hyvönen et al. 2000, Mälkönen 1976). Dead woody material left after logging provides carbon-rich material for microbes to feed upon and typically microbial populations increase after forest harvests due to the input of logging residues. Microbes immobilize nitrogen in their tissues and limit losses that could otherwise occur through leaching or volatilization. As dead woody material gradually decomposes during the 15 to 20 years following harvest, microbial populations decline and slowly release the nitrogen to growing vegetation.

One research study found that nearly all the nitrogen and much of the phosphorous that moved down through the litter layer into mineral soil was in organic forms as a result of microbial transformations of organic matter in the forest floor (Qualls et al. 1991). This indicates that some nitrogen and phosphorous can be moved from the litter layer into mineral soil where it may be stable for a longer period. Phosphorus is another essential nutrient that is mainly supplied, in forms available to plants, by the microbial breakdown of organic materials. A deficiency of available phosphorus can limit plant metabolism of nitrogen and some forests may be limited by phosphorus availability (Trettin et al. 2003). Inorganic phosphorus is often present in soil minerals, but under low-pH conditions often found in forest soils soluble aluminum and iron react with inorganic phosphorus to form insoluble compounds that are unavailable to most plants (Pritchett 1979). Sulfur, like nitrogen, occurs in soil primarily as organic compounds and is made available for plant growth through oxidation by microbes to sulfate forms (Fisher and Binkley 2000). Carbonic acid weathering of the feldspathinc, ferro-magnesian igneous rocks, very common on the Forest yields aluminum, iron, calcium, and magnesium ions in low soil pH.

Soil Organic Matter

The soil organic layer is extremely important to all soils on the Forest, especially those formed from low-nutrient geology like granite and quartzite, which weathers slowly. Soil organic matter is fundamentally important to sustaining soil productivity. Soil organic matter is influenced by fire, silviculture activities, and decomposition/accumulation rates. The organic component of soil is a large reserve of nutrients and carbon and is the primary site for microbial activity. Forest soil organic matter influences many critical ecosystem processes, including the formation of soil structure. Soil structure influences soil gas exchange, water infiltration rates, root penetration, and water-holding capacity. Soil organic matter is also the primary location for nutrient recycling and humus formation, which enhances soil cation exchange capacity and overall fertility. Soil organic matter depends on inputs of biomass (e.g., vegetative litter, fine and coarse woody debris) to build and maintain the surface soil horizons, support soil biota, enhance moisture-holding capacity, and prevent surface erosion. Nevertheless, in natural systems organic matter fluctuates with forest growth, mortality, fire, and decay.

Low-nutrient Soils

A rating on soil nutrient availability based on geology types has been developed by the Intermountain Tree Nutrient Cooperative at the University of Idaho (table 166). Tree nutrition value is an interpretation of rock geochemistry and its nutritive status. Soils formed from quartzite geologies tend to be very nutrient poor. This is especially true when the volcanic ash layer is no longer on site. Soil wood loss may alter processes of forest regeneration and growth to favoring species with lower soil moisture and nutrient requirements, and provide for a greater potential for soil erosion. Potential loss or reduction of organic matter can lead to a decline in several key soil and foliar nutrients (Powers et al. 2005). Further effects also include a reduction of habitat for species requiring soil wood as dens or as substrate for invertebrates, bacteria and fungi, which affect food availability for small rodents and their predators.

Table 166. Geology tree nutrition values for the Colville National Forest

Geology Tree Nutrition Value	Acres	Percentage Administrative Forest
High	50,075	4%
Moderate	922,817	68%
Low	278,203	20%
Very Low	104,050	8%

Carbon Storage

The carbon storage function is defined as the ability of the soil to store carbon. The carbon cycle illustrates the role of soil in cycling nutrients through the environment. Globally, more carbon is stored in soil than in the atmosphere and above-ground biomass combined. Limiting factors of soil carbon storage are depth and rockiness. Carbon compounds are inherently unstable and owe their abundance in soil to biological and physical environmental influences that protect carbon and limit the rate of decomposition (Schmidt et al. 2011). Soil organic matter is formed by the biological, chemical, and physical decay of organic materials that enter the soil system from sources aboveground (e.g., leaf fall, crop residues, animal wastes and remains) or belowground (e.g., roots, soil biota). The organic compounds enter the soil system when plants and animals die and leave their residue in or on the soil. Immediately, soil organisms begin consuming the organic matter; extracting energy and nutrients; and releasing water, heat, and carbon dioxide back to the atmosphere. Thus, if no new plant residue is added to the soil, soil organic matter would gradually disappear. If plant residue is added to the soil at a faster rate than soil organisms convert it to carbon dioxide, carbon would gradually be removed from the atmosphere and stored (sequestered) in the soil. Large quantities of soil organic matter accumulate in environments such as wetlands, where the rate of decomposition is limited by a lack of oxygen, and high-altitude sites where temperatures are limiting to decomposition. Most carbon in mineral soil comes from root turnover (Schmidt et al. 2011), although some is moved from the forest floor into upper mineral soil layers (Qualls et al. 1991).

A soil carbon stock was determined for the Forest using data from the soil surveys and local research. The soil carbon stock includes carbon compounds in the forest floor litter layer and the mineral soil to a depth of 1 meter (or depth to bedrock if the soil is shallower than 1 meter). Forest floor carbon numbers were generated using data from the National Cooperative Soil Survey, research data as analyzed by Smith et al. (2006), and regional data collected by Page-Dumroese et al. (2006). Soil organic carbon was estimated for the Colville National Forest using data from the National Cooperative Soil Survey. A modified equation following the methods of Batjes (1996) was used to calculate the total soil organic carbon to a depth of one meter for the mineral soil. This carbon density is within the ranges found in several research projects, as displayed in the table below.

Table 167. Soil carbon densities from research

Environment	SOC* (Mg C/ha)	Source
Cool, conifer forests of United States	403-494	Kern 1994
Cool, temperate forests of Maine	130	Davidson and Lefebvre 1993
Global temperate forests	118	Schlesinger 1977
Cool, temperate forest of north central United States	84-152	Franzmeier et al. 1985

*SOC = soil organic carbon

Support and Stability

Soil stability and support is necessary to anchor plants and structures. Inherent soil properties, like soil texture and particle size distribution, play a major role in physical stability. Soil has a porous structure to allow passage of air and water, withstand erosive forces, and provide a medium for plant roots. Soils also provide anchoring support for human structures and protect archeological artifacts. The need for structural support can conflict with other soil uses. For example, soil compaction may be desirable under roads and houses, but it can be detrimental for the plants growing in these compacted sites. The conflict of stability and support with plant growth capabilities is constant when dealing with roads, skid trails, recreation trails, and forest productivity. Sensitive soils for the support and stability function are soils with high erosion hazards and soils with high mass wasting hazards. Support and stability can be assessed by evaluating risk of erosion and mass wasting and observing soil deposition.

Highly Erosive Soils

The susceptibility of soil to erosion, or the relative loss of exposed soil to erosional forces, is expressed by soil erosion ratings. Surface erosion risk was developed for the Landtype Associations of north central Washington (Davis et al. 2004). This rating represents the susceptibility of the bare, un-vegetated surface to erosion by wind and water. Approximately 37 percent of the Forest has a high risk for surface erosion (table 168). The erosion susceptibility rating applies to bare soil conditions in the absence of vegetative cover. Skid trails, fire lines, machine piles areas, and severely burned areas are examples of practices and conditions that expose soils to erosional forces such as wind and rain.

Table 168. Surface erosion risk

Surface Erosion Risk	Acres	Percentage within Forest Administrative Boundary
Low	220,237	16%
Moderate	629,664	46%
High	507,295	37%

Landslide-prone Soils

Forest soils that have high mass wasting hazards are considered landslide prone. Landslide or mass wasting are terms used to describe the downslope movement of material under the influence of gravity. Water is usually only a minor part of the moving material. A slide is a rapid, planar movement of a large mass of earth and other debris down a hill or a mountainside. Slumps involve a mass of soil or other coherent material sliding along a curved surface (shaped like a spoon). Slumps and planar slides form crescent-shaped cliffs, or abrupt scarps at the top of the slide slope. More than one scarp can exist down the slope. Slumps form a depression or back slope, between the scarp and the mass that moved. Soil creep is a long-term process. The combination of small movements of soil or rock in different directions over time are directed by gravity gradually downslope. Slumping and soil creep result in trees and shrubs curving to maintain their perpendicularity. The surface soil can migrate under the influence of cycles of freezing and thawing, or hot and cold temperatures, inching its way toward the bottom of the slope forming terracettes. Flows are movement of earth materials and vegetative debris that more resemble fluid behavior. Water, air, and ice are often involved in enabling fluid-like motion of the material. Falls, including rockfalls and topples are where rock cascades down a slope, but without fluid or sufficient volume to behave as a flow. The accumulation of fallen rock material residing at the base of the slope is known as talus.

Landslides are likely to occur in areas near where they have occurred in the past or as reactivation of older mass wasting. In many cases, landscape features provide evidence of past and ongoing landslide activity. Mass wasting is part of the evolution of the landscape, delivering material to be carried away by streams. Landslides are triggered by earthquakes, major storms, volcanic activity, or human activities that may cause slopes to become unstable. The additional weight of rains or snow melt can cause slopes to fail or reactivate older landslides. The most significant factors are steepness of the original slope angle, undercutting of the toe of the slope by erosion or excavation, and height of saturation of the slope (Jones et al. 1961).

Landslide hazards ratings for the Colville National Forest were developed for the Landtype Associations of North Central Washington (Davis et al. 2004). (Landslide hazard ratings are currently being developed for Forest Service Region 6, including adjustments for smaller subsets. These ratings would not be available until after the revised plan is finalized.) There are ratings for both deep-seated and shallow rapid landslides. Deep-seated landslides include rotational slumps and other mass movement that is sporadic or slow and involves thick masses of material over a relatively large area. Factors used to assess deep-seated landslide risk were:

- Easily weathered bedrock high in clays
- Geologic structural features such as folding and faulting
- Geomorphic shape features such as escarpments and concave topography
- Fine-textured surficial deposits
- Slope gradients greater than 20 percent
- Indications of concentrated groundwater
- Indications of surface and subsurface water

Approximately 3 percent of the Forest has a high risk for deep-seated landslides, as shown in table 169. The only area on the Forest that was determined to have a high risk at the landtype classification scale is the Pend Oreille River Valley.

Table 169. Deep-seated landslide risk

Deep-seated Landslide Risk	Acres	Percentage within Forest Administrative Boundary
Low	837,452	62%
Moderate	483,928	36%
High	35,817	3%

Shallow rapid landslides include debris slides such as debris avalanches, flows and torrents. These slides are relatively small and shallow. Seven factors were used to develop this risk rating:

- Slope gradients greater than 40 percent
- Convergent drainages and/or catchment basins
- Unconsolidated coarse textured soils
- Interface of materials with discontinuous hydrologic properties
- Sparse vegetation patterns
- Geomorphic features such as debris chutes or alluvial fans
- High low order drainage density especially with parallel patterns

Approximately 1 percent of the Forest has a high risk for shallow rapid landslides (table 170). The only area of the Forest with a high risk of shallow rapid landslides at the landtype scale occurs in the Salmo-Priest area of the Selkirk Mountains. For information on the impacts of these landslides on water quality and fisheries, see the sediment delivery risk analysis discussed in the Fisheries and Hydrology sections.

Table 170. Shallow rapid landslide risk

Shallow Rapid Landslide Risk	Acres	Percentage within Forest Administrative Boundary
Low	581,955	56%
Moderate	759,961	43%
High	15,280	1%

Filtering and Buffering

Soil acts as a filter to protect the quality of water, air, and other resources. Toxic compounds or excess nutrients can be degraded or otherwise made unavailable to plants and animals. The minerals and microbes in soil are responsible for filtering, buffering, degrading, immobilizing, and detoxifying organic and inorganic materials, including industrial and municipal by-products and atmospheric deposits. Soil absorbs contaminants from both water and air. Microorganisms in the soil degrade some of these compounds; others are held safely in place in the soil, preventing contamination of air and water. Wetlands soils especially function as nature's filters. Filtering and buffering on the Forest is impacted by chemical pollutants and industrial contamination at a very small scale. Wetlands are also discussed in the Hydrology section.

Inherent Soil Productivity

Inherent soil productivity can be described as a summation of the six ecological soil functions. The main function drivers of inherent soil productivity on the Colville are soil hydrology and nutrient cycling. Inherent soil productivity influences what plant communities can grow on the Forest and how well they grow. Maintaining soil productivity is an important consideration in determining the level of natural resource extraction, like timber harvest, the Forest can sustain, as well as other forest values, such as wildlife habitat and biodiversity.

Past Management Impacts on Soil Quality and Productivity

Historically (pre-European settlement) and without anthropogenic (man-caused) disturbances, soil loss, soil compaction, and nutrient cycling would probably have been within functional limits to sustain soil function and maintain soil productivity for most soils. The exception to this could be relatively short-term effects of wildfire during times of drought. Since there were no political boundaries historically, soil condition would have been similar on similar soils throughout the range of the vegetation types.

Much of the current soil condition on the Colville National Forest is related to past management. Soil condition is affected by activities that occur or re-occur at the same place over time. Permanent loss of soil productivity has and could affect the level of goods and beneficial use of the forests in the future. Management activities that have affected soil condition include timber harvesting, site preparation, mechanical fuels treatments, prescribed fires, wildfires, road construction and use, recreation facility maintenance and use, grazing, and special uses. Some examples of impacts that have affected current soil condition include:

- Heavily compacted soils from forest vegetation treatments, grazing and recreation activities have caused or may cause reduced productivity for decades (Burger and Kelting 1999).
- Land-disturbing activities caused erosion of topsoil at rates greater than the soils natural ability to replace it, referred to as soil loss tolerance rate. This has resulted in permanent loss of soil productivity, as soils are considered a non-renewable resource.
- During the 19th and 20th centuries, as more livestock numbers and acres were grazed over long seasons, range condition (and soil condition) declined. The effects of this early, heavy livestock use can still be seen on the ground.
- Road corridors that make up the Forest’s road system resulted in loss of soil productivity.
- Mineral extraction pits and mines resulted in permanent loss or reduction in soil productivity.
- Uncharacteristic wildfire resulted in erosion rates well beyond tolerance erosion rates.
- Footprints of administration and recreation sites, such as developed campgrounds, have reduced soil productivity.
- Permanent special use sites, such as communication towers and buildings eliminated soil productivity.

There are activities that have improved soil condition, as well as removing risk to soil productivity such as:

- Prescribed fire has removed fuels and undesirable plant material, which impede vegetation growth and condition.
- Thinning dense forest, woodland, and invaded grassland has increased light and reduced water competition for desired understory grasses and shrubs.
- Channel restoration projects have restored bank and vertical stream bed stability to and have re-established water table levels on floodplains and terraces that result in increased vegetation/soil productivity.
- Decommissioning of unneeded roads has returned old roadbeds back to producing vegetation.
- Implementation of INFISH, Washington State Forest Practice Rules, Washington State Surface Mining Act, and USDA Forest Service Best Management Practices has resulted in decreased erosion and sedimentation from roads and timber harvests.

Need for Change

Change in Forest Service Direction for Soil Management

Soil quality management on the Colville National Forest is guided by national and regional direction found in FSM chapter 2550 Soil Management and chapter 2520 Watershed and Air Management R6 Supplement (1998).

Soil disturbance has been the focus of soil management on NFS lands for many years. The 1988 forest plan places a disturbance cap on management activities to maintain the productivity of the land. The effort was continued with the FSM chapter 2520 Region 6 Supplement, which placed a detrimental soil disturbance cap of 20 percent on management activities including transportation infrastructure. Detrimental soil disturbance is defined as disturbances, including the effects of compaction, displacement, rutting, severe burning, surface erosion, loss of surface organic matter, and soil mass movement that indicate when changes in soil properties and soil conditions would result in significant change or impairment of soil quality.

In 2010, FSM chapter 2550 Soil Management was revised at the national level. The emphasis of soil management was changed to an approach focusing on long-term soil quality and ecological function instead of disturbance tracking. The FSM defines six soil functions: soil biology, soil hydrology, nutrient cycling, carbon storage, soil stability and support, and filtering and buffering. The objectives of the national direction are (1) to maintain or restore soil quality on NFS lands, and (2) to manage resource uses and soil resources on NFS lands to sustain ecological processes and function so that desired ecosystem services are provided in perpetuity. The new planning rule (USDA Forest Service 2012g) broadened the soil management direction, requiring plans to maintain or restore terrestrial ecosystems, put more succinctly in terms of ecosystem services.

Environmental Consequences

The direction for Forest Service management of soil directly tiers to the National Forest Management Act (NFMA, 16 U.S.C. 1604), which stipulates to "ensure…evaluation of the effects of each management system to the end that it will not produce substantial and permanent impairment of the productivity of the land." The past forest plan standards, along with current guidance at the regional and Washington office level, interpret the NFMA's direction to manage for sustained soil productivity.

Methodology

Soil productivity and function and total soil resource commitment are discussed comparatively for the alternatives in the following sections. Site-specific analysis at a project scale will discuss site-specific impacts during subsequent NEPA analysis.

Assumptions

- Current regional soil quality standards apply to all alternatives.
    - ♦ Leave a minimum of 80 percent of an activity area in an acceptable soil quality condition. Detrimental conditions also include landings and system roads. (FSM 2520 R-6 Supplement 2500.98-1)
- The dominant method of mechanical harvest on the Forest is ground-based at approximately 70 percent, with the other 30 percent skyline and helicopter (Day, personal communication). Method of harvest is not anticipated to change across alternatives.

Spatial and Temporal Context for Effects Analysis

Analysis focuses on activities that could have measurable impacts to soils over the next planning cycle, examining direct, indirect, and cumulative effects on the "footprint" of Federal land managed by the Colville National Forest. Management activities that would have the highest potential for affecting soil condition are discussed in this analysis including vegetation treatments (such as timber harvest and fuels management), livestock grazing, and infrastructure/recreation. To address cumulative effects, analysis discusses past and foreseeable future impacts to soil within the Colville National Forest. Activities on adjacent private, State, and Federal ownership were not found to have detectible impacts to soil condition, and therefore, are not discussed in this section.

The time bounding for cumulative effects encompasses previous disturbances from prior wildland fire, timber harvest, and grazing as detailed in the affected environment. Disturbance to soil can last for decades and even centuries (Amundson and Jenny 1997, Jenny 1941).

For reasonably foreseeable future actions, the bounding is known activities to occur within the life of the plan.

Past, Present, and Foreseeable Activities Relevant to Cumulative Effects Analysis

Past management activities and disturbance on Colville National Forest lands including timber harvest, silvicultural activities, grazing, road building and wildland fire can have cumulative effects on the soil resource. Limited mining and special uses have also occurred on the Colville National Forest. Impacts to soils from past management include changes in soil productivity and ecosystem function through inherent and dynamic soil properties as discussed in the previous sections.

There are no foreseeable activities that would vary from present activities. Present activities include timber harvest, fuel reduction (prescribed fire and mechanical), road construction and maintenance, silvicultural treatments, grazing (including llamas), special use permits, and providing recreational opportunities. There is also the potential for wildland fires (suppression and for resource benefit). Foreseeable and present actions also include stream, meadow, and wetland restoration as well as road decommissioning and obliteration.

Summary of Effects

The 1988 forest plan direction for soil management is:

NFS lands will be managed under the principles of multiple use and sustained yield without permanent impairment of land productivity.

a) The total acreage of all detrimental soil conditions should not exceed 20 percent of the total acreage within the activity area including landings and system roads. Consider restoration treatments if detrimental conditions are about 20 percent or more of the activity area. Detrimental soil conditions include compaction, puddling, displacement, and severely burned soil.

b) Skid trail requirements must be specified in timber sale contracts that require tractor yarding.

c) Identify areas of high soil erosion or mass failure potential and evaluate probable impacts of resource development.

d) Retain organic matter to maintain site productivity.

The following proposed forestwide direction for Soil Quality and Productivity is proposed for all alternatives. Current Regional Soil Standards and Guidelines apply to all alternatives.

FW-DC-SOIL-01. Soil Productivity and Function

Soil productivity and function contributes to the long-term resilience of ecosystems. Management activities occur on soils with the inherent capability to support those activities.

Table 171. Soil ecological functions with attributes and indicators for long-term soil productivity

Soil Function	Selected Attributes	Soil Quality Indicator	Desired Condition
Biological	Roots	Root growth and distribution	Root growth, both vertically and laterally, is not impeded by land management actions. Root distribution and depth is at expected levels for vegetation type and successional stage.
	Plant Community Potential and Thermo-dynamics	Plant Community Composition	The soil is capable of supporting a distribution of desirable plant species by vegetative layer (i.e., trees, shrubs, herbaceous) as identified in the potential plant community.
		Canopy Cover and Soil Cover	Soil temperature and moisture is maintained in conditions to support desired floral and faunal communities.
Hydrologic	Infiltration	Surface Structure	Surface structure is as expected for the site (e.g., granular, subangular blocky, single grain).
	Water Absorption and Storage	Available Water	Site water is as expected for the soil type or has been improved.
		Volcanic Ash Cap	Soil ash cap is intact and as expected for the site.
	Water Transmission	Subsurface Flow Connectivity	Maintain subsurface flow connectivity (i.e., subsurface flow is not obstructed or intercepted).
Nutrient Cycling	Organic Matter Composition	Surface Organic Matter	The amount of organic material on top of the mineral soil is maintained at levels to sustain soil microorganisms and provide for nutrient cycling. The size, amount, and distribution of organic matter maintained on the mineral soil on a long term basis is consistent with the amounts that occur given the local ecological type, climate, and normal wildland fire return interval for the area.
		Fine Woody Material	Fine woody material is on site in various stages of decay in amounts appropriate for habitat type.
		Coarse Woody Material	See FW-DC-VEG-04. Snags and coarse woody debris
Nutrient Cycling (cont.)	Nutrient Availability	Surface (A) horizon or mollic layer	The amount of organic matter within the mineral soil, indicated by the color and thickness of the upper soil horizon, is within the normal range of characteristics for the site, and is distributed normally across the area.[46]
		Nutrient Deficiency	Soil nutrients are maintained at levels to support desired vegetation.
Carbon	Carbon Storage Potential		The soil's ability to store carbon is not reduced from current levels.
Support and Stability	Stability	Surface erosion (wind, rill, or sheet)	Erosion is occurring at natural levels or not evident and an adequate level of soil cover is maintained to prevent accelerated erosion.

[46] Soil characteristics are defined by Natural Resources Conservation Service SSUGRO (Soil Survey Geographic Database) soil data layer

Soil Function	Selected Attributes	Soil Quality Indicator	Desired Condition
	Support	Site support (mass erosion, landslide prone)	Site stability potential is unchanged or stability has been improved. Soil stability varies from minor soil creep to active land flows dependent on soil characteristics, soil moisture, and triggers. Management activities avoid or do not accelerate underlying soil movement rates.
	Deposition	Soil deposition	Deposition is at natural levels and recent depositional material is vegetated.
Filtering and Buffering	Filtering	Soil contamination	The soil acts as a filter and buffer to protect the quality of water, air, and other resources by immobilizing, degrading or detoxifying chemical compounds or excess nutrients.

FW-DC-SOIL-02. Detrimental Soil Conditions

Surface erosion rates are within the natural range of variation for a given biophysical setting. There is no degradation of aquatic habitat and water quality from surface erosion rates resulting from permitted uses and management actions. Ecological and hydrologic functions are not impaired by soil compaction.

FW-DC-SOIL-03. Soil Stability

Soil stability varies from minor soil creep to active land flows dependent on soil characteristics, soil moisture, and triggers. Management activities avoid or do not accelerate underlying soil movement rates.

FW-STD-SOIL-01. Effective Ground Cover

Minimum effective ground cover following any soil-disturbing management activity should be as shown in the following table.

Table 172. Minimum effective ground cover following any soil-disturbing activity

	Minimum percent effective ground cover	
Erosion hazard class	1st year	2nd year
Low (very slight-slight)	20-30	30-40
Medium (moderate)	30-45	40-60
High (severe)	45-60	60-75
Very High (very severe)	60-75	75-90

(source for erosion hazard classes: Forest Service Manual 2520)

FW-GDL-Soil-02. Native Topsoil

Native topsoil should be used where practical to meet restoration project objectives.

Soil Productivity and Ecosystem Function

Since attributes of soil productivity and ecosystem function are difficult to measure in the field, associated factors that can be readily observed and measured are used. These are disturbances to dynamic and inherent soil quality (Craigg et al. 2015). The core idea is that maintenance of soil quality provides for ecological services. Most management activities that affect dynamic soil quality can rebound relatively quickly. In contrast, inherent soil quality describes the summation of a site's potential to support growth based on bedrock, climate, and rate of soil development. When management activities impact inherent soil quality a longer recovery term is necessary. Using soil quality terminology, the Colville National Forest desires management actions not lead to permanent impairment on land designated as the productive land base. The productive land base includes all lands that are designated for vegetation or watershed management. Lands in the Total Soil Resource Commitment (discussed later) are not managed for soil productivity. This desired condition maintains or improves dynamic soil quality and conserves inherent soil quality. Timber harvest, prescribed fire and fuels management, livestock grazing, recreation, and other management activities would continue to affect soil condition over the next planning period.

Vegetation Management

Vegetation management, including timber and fuels projects, would continue as the activity having the highest areal impact on soil condition over the next planning period. Annual timber volume harvested from the Colville, excluding fuelwood, has declined dramatically, from a high of almost 135 million board feet per year during the late 1980s to about 46 million board feet in 2010 to 2015. Amount of regeneration harvest cutting has trended downward, and intermediate harvest (thinning) and salvage harvest has trended upward. There has also been increased emphasis on timber harvest in the wildland-urban interface.

The majority of harvest would occur on lands designated as suitable for timber production in the plan. Lands are considered unsuitable for timber for six reasons:

- Statute, Executive Order, or regulation has withdrawn the land from timber production
- The Secretary of Agriculture or the Chief of the Forest Service has withdrawn the land from timber production
- Timber production would not be compatible with the achievement of the desires conditions and objectives established by the plan for those lands
- The technology is not currently available for conducting timber harvest without causing irreversible damage to soil, slope, or other watershed conditions.
- There is no reasonable assurance that such lands can be adequately restocked within 5 years after final regeneration harvest.
- The land is not forested.

Lands unsuitable for timber production include mollic soils, which are typically too hot and dry to produce timber, shallow and rocky soils that would be difficult to regenerate, and soils with the water table at or near the surface year-round or seasonally since harvest operations could produce irreversible soil damage and reforestation is uncertain. Additional harvest could occur on land designated suitable for timber harvest to achieve other management objectives, such as fuel or wildlife habitat treatments. Areas of the Colville National Forest that have been identified as suitable for timber harvest but not timber production from a soils perspective are soils classified as Mollisols and mollic subgrades. These soils were developed in a grassland or savannah type ecosystem and would provide opportunity to restore these ecosystems with the use of timber harvest. The exact location of future timber harvest will depend largely on factors of road access and site-specific forest conditions relative to the desired conditions as outlined in the revised forest plan. However, uncertain disturbance events, such as insect and disease outbreaks and wildfires, influence priority shifts for location and extent of harvest. For example, harvest peaks in the 1970s and 1980s largely responded to outbreaks of mountain pine beetle in lodgepole pine stands.

Fuels treatment would continue as a method to reduce wildfire risk. Prior to the early 2000s, fuels treatments were primarily connected action to silvicultural actions. With the Federal Wildland Fire

Management Policy update in 2001, fuels treatment intensified steadily in tandem with timber harvest as well as a separate treatment. Fuels treatments also involve managing wildfire for resource benefit since many of the habitats on the Forest have not had fire over the last 100 years. For the past 15 years, fuels have been treated across the Forest with a combination of mechanical treatments and prescribed fires.

Harvesting timber requires machinery to cut and yard trees to landings sites that can compact and displace soils (Page-Dumroese et al. 2010, Cambi et al. 2015). Intensity and extent of impacts are managed by project design, mitigation, and BMPs. Using soil monitoring, the Forest Service evaluates the efficacy of forest treatments by comparing disturbance extent against soil quality thresholds. Under the 1988 forest plan, when soil disturbance surpasses these thresholds then long-term impairment could occur and the disturbance is considered detrimental to soil quality. The Colville National Forest forest monitoring has found that harvest methods resulting in the highest disturbance use ground-based harvest (Jimenez, personal communication). Contemporary methods have reduced impacts with lower pressure, wider track, or tread equipment, although economics and advances in mechanization have driven operators to favor ground-based equipment.

Within an activity area, typically defined as a treatment unit, timber harvest over the next planning cycle would likely impact soils at the same disturbance intensity as during the last 15 years. Colville National Forest soil monitoring over this period found ground-based timber harvest methods result in an average detrimental soil disturbance of 19 percent, which is within both 1988 forest plan and regional standards (Jimenez 2014a-c, 2015a-d, 2016). The most pernicious impacts from ground-based harvest mainly occur along high skid trails, landings, and temporary roads. Skyline and helicopter harvest systems result in a much lower level of disturbance similar to that reported in research at 0 to 8 percent detrimental levels (Reeves et al. 2011). In contrast, historical timber harvest and site preparation practices left up to 30 percent of the soil area severely impacted (Klock et al. 1975, Clayton 1990), at least twice the disturbance area of contemporary harvest practices.

Current findings from the Long-term Soil Productivity study suggest that the extent of the impacts can relate to soil texture and organic matter (Powers et al. 2005, Page-Dumroese et al. 2010), but often as confounding variables. For example, coarse-textured soils appear resistant to compaction (Gomez et al. 2002), but also nutrient poor and so particularly at risk to the nominally least risky treatments that remove forest floor (Page-Dumroese and Jurgensen 2006, Page-Dumroese et al. 2010). Forestry research has underscored the importance of organic matter, documenting the soil benefits of downed wood (Harvey et al. 1987, Graham et al. 1994), forest floor, and soil organic matter (Jurgensen et al. 1997).

Coarse wood debris in the form of slash can provide a practical and effective mitigation for reducing harvest impacts on soil physical function and processes (Harvey et al. 1987, Graham et al. 1994). Leaving harvest slash along skid trails can prevent compaction (Han et al. 2009) and enhance soil recovery (Page-Dumroese et al. 2010). It is acknowledged that the coarse wood debris contains very little nutrient value (Laiho and Prescott 1999), but the benefits as groundcover and tempering soil climate promotes soil biologic activity.

For the next planning period, the Forest would continue to treat fuels in the wildland-urban interface using a mixture of pile burning, mechanical treatments, and underburning. Detrimental conditions from fire have been monitored at less than 10 percent of areal extent (USDA Forest Service 2013a). The loss of vegetation by treating fuels is not far removed from natural processes because fire regularly removed vegetation by volatizing biomass. However, the impact may vary by site type. Those areas with organic soils in topsoil that grow abundant grasses and forbs on dry sites likely experienced frequent fire. In these areas, treating fuels aligns with ecological processes and the soils have a higher proportional amount of organic matter in the mineral soils to buffer the removal. For other moist types, the fuels treatment may not directly align with natural cycles. Treating fuels temporarily removes dense growth, but the moist conditions favor quick regrowth. Repeated removal of vegetation to mitigate fire hazard would be out of sequence with the long periods between fires that these vegetation communities typically experienced. These treatments would reduce vegetation leaf and root litter contributions to soil with overall impacts depending on soil fertility. One benefit of re-introduced fire is that the fire can improve soil condition. Burning creates a net increase in available nutrients, both in terms of the products of fire contained in ash residue and the higher decomposition rates after the fire. Almost immediately, burning increases the amount of mineral nitrogen levels for plants and soil organisms (Choromanska and DeLuca 2002, Hart et al. 2005), a limiting nutrient in most forest ecosystems (Binkley 1991). In drier habitats, this increase can be detected as much as 50 years after fire (McKenzie et al. 2004). The burning also increases charcoal production that conditions soils, increasing water-holding capacity and providing exchange sites for plants and soils to acquire nutrients (DeLuca and Aplet 2008).

Vegetation Management by Alternative

The action alternatives vary by annual harvest level as shown in table 173.

The land base allocated to timber production varies by alternative with alternative P having the highest at 63 percent of the land base and alternative R with the lowest at 12 percent. However, since other lands are available for harvest for other resource values, the lands allocated as potential for timber harvest are equal across all alternatives at 78 percent of the land base. The amount of harvest in these additional available acres varies by alternative due to the limitations of the management areas and management direction. The proposed action and alternative P would have the highest on the ground footprint with approximately 10,000 acres treated annually producing 62 MMBF a year. The smallest footprint is found in alternative R with approximately 1,590 acres treated annually producing 14 MMBF. Acres of prescribed fire are estimated to be the same across all alternatives.

Table 173. Vegetation management comparison of alternatives

Alternative	Lands Suitable for Timber Production (acres)	Lands Suitable for Timber Harvest for other Resource benefit (acres)*	Projected Wood Sale Quantity (MMBF)	Mechanical Treatment – Timber and Fuels (annual acres*)	Prescribed Fire (annual acres)*	Estimated Detrimental Soil Condition (acres)
NA	535,700 (52%)	323,050 (31%)	41	3,884	4,879	374
PA	653,200 (63%)	205,550 (20%)	62	9,999	4,879	924
P	656,600 (63%)	202,150 (19%)	62	9,999	4,879	924
R	129,400 (12%)	729,350 (70%)	14	1,590	4,879	167
B	384,500 (37%)	474,250 (46%)	37	4,751	4,879	452
O	347,500 (33%)	511,250 (49%)	38	4,751	4,879	452

*estimated number of acres to be treated, used in modeling

The same relationships between alternatives is true for potential detrimental soil conditions with the proposed action and alternative P having the highest footprint, no action and alternatives B and O have moderate levels of detrimental soil condition, and alternative R has the smallest amount. Standard design features to limit soil damage from vegetation management techniques would be carried forward into this next planning cycle. Soil productivity and ecosystem function is to be maintained or improved in all alternatives through existing and proposed soil quality plan components. Standard practices limit equipment operation on steep slopes and control seasonal operation when soils are more vulnerable to compaction and displacement to achieve the desired conditions (FW-DC-SOIL-01/ FW-DC-SOIL-02) for Soil Productivity and Function and Detrimental Soil Conditions. The revised forest plan, however, does not stipulate operation restrictions to particular conditions. Such limitations would be evaluated on a project basis due to variable soil properties. In addition, the alternatives lower the risk of soil damage outside of these unsuitable areas with guidance that ground-disturbing management activities should not occur on landslide-prone areas (FW-DC-SOIL-03).

The revised forest plan requires varying levels downed coarse wood with guidelines ranging between 3 to 40 tons per acre (FW-DC-VEG-04). Coarse woody debris and organic matter are good indicators of site resiliency and overall forest health. Organic matter including the forest floor and large woody material is essential for maintaining ecosystem function by supporting moderate soil temperatures, improved water availability, and bio diversity (Page-Dumroese et al. 2010). Maintaining coarse woody material on-site after activities provides microsite habitat for soil organisms including mycorrhizae, as well.

To address nutrient cycling, the desired condition states the conservation of the forest floor and fine wood levels appropriate to habitat type (FW-DC-SOIL-01/ FW-DC-SOIL-02). The forest floor can act as a mulch and buffers the soil microclimate to hold water on droughty sites for soil and plant processing in addition to providing a nutrient cache. Cold sites will not have the same water issues, and thus, adequate forest floor can be less constraining for growth. Harvest operations remove biomass and site organic matter, and thus, affect nutrient cycling. Generally, nutrient losses are proportional to the volume of biomass removed from a site. Nutrients are lost during harvesting by removing the stored nutrients in trees, and additional nutrients are lost if the litter layer and woody debris are removed. Whole-tree harvesting, which extracts larger amounts of biomass, especially nutrient-rich foliage, compared to conventional sawlog or thinning operations, removes a larger amount of the nutrients from the site. The exact amount of nutrients lost from a particular site will vary with forest types and particular site conditions (Grier et al. 1989). The amount of nutrients present in the trees will also vary with stand age and development of the humus layer (Grier et al. 1989). Moreover, the greater the proportion of nutrients stored in trees, the greater the potential for site degradation and declines in productivity after harvesting operations. The data suggest that nutrient losses from whole-tree harvesting are considerably greater when compared to conventional sawlog harvesting for all nutrients. Calcium losses were particularly large for whole-tree harvesting due to the high concentrations of calcium present in the wood fiber of twigs, branches, and boles (Mann et al. 1988).

Where new forest treatments have residual effects from past harvest, soil remediation could improve the trajectory of soil recovery. Soil remediation involves actions to obliterate old temporary roads and landing piles, while also conserving organic matter from slash to harness biologic processes for faster soil recovery and overall improved soil quality. Using soil disturbance criteria, the regional soil management policy directs to move toward a net improvement in soil quality where current conditions exceed 20 percent detrimental soil conditions (FSM 2520 R-6 Supplement 2500.98-1).

Old Forest Management

Old forest structure is more sustainable in areas of higher productivity soil types that can sustain the desired structure over the longer term. Soil resource information in combination with a stratification by plant association groupings can be used to better refine assessments of site productivity and the sustainability of old forest management areas. Plant water availability is the resource most limiting productivity within different plant associations groups on the Forest. Information about the soil resource combined with climate can be used to identify different soil drought stress levels and their ability to support dense old forest vegetation structure into the future.

Four classes of suitability for old growth management areas (not suited, low, medium, and high suitability) were developed to assist in analyzing placement of old growth management areas. This analysis was limited to management areas that allow active management.

- Step 1: For each alternative the analysis unit was identified. For example, no action is the fixed old growth management areas, while the proposed action is all actively managed portions of the forest = management areas 3A, 5, 6, 7, and 8.
- Step 2: The droughty soils layer was overlaid to provide an estimate of potential productivity and the percentage of each management area in each productivity class was determined based on the droughty soil index map.

Table 174. Area extent of site productivity ratings for old forest management areas by alternative

Alternative	Management Areas	Acres/ % Area	High	Moderate	Low	Unsuited
NA	Focused and General Restoration	Acres	5,735	15,533	4,165	4,717
		Area	19%	51%	14%	16%
PA	Focused and General Restoration	Acres	189,998	390,736	77,417	90,602
		Area	25%	53%	10%	12%
P	Focused and General Restoration	Acres	189,998	390,736	77,417	90,602
		Area	25%	53%	10%	12%
R	General Restoration and Late Forest Structure	Acres	191,708	397,065	80,121	94,909
		Area	25%	52%	11%	12%
B	Restoration area	Acres	193,154	399,338	80,446	95,105
	Active Management	Area	25%	52%	11%	12%
O	Restoration area	Acres	190,759	394,059	78,872	93,692
	Responsible Management	Area	25%	52%	11%	12%

The 1988 forest plan identifies fixed old growth reserves on about 3 percent of the total Forest land base and the Eastside Screens provide management direction for their management. Approximately 16 percent of the Old Forest Management areas are unsuited for timber production and another 14 percent of these areas have a low site productivity that is likely marginal for supporting Old Forest Management.

The proposed action and alternative P use a “whole landscape” approach for providing late forest structure, allowing late structure forests to shift location in response to ecological process. These types of management enables closer approximation of natural disturbance regimes by allowing closer approximation of natural disturbance regimes that can move around the landscape with disturbance. While under the proposed action, restoring late forest structure can occur within all management areas across the Forest. Alternative R uses a fixed reserve management approach to maintain late forest structure habitats, which covers about 51 percent of the Forest. These reserves are called “late forest structure emphasis areas” and overlay other management areas. Although similar to the proposed action, the key difference between the proposed action and alternative R for late forest structure is that late forest structure areas in the proposed action are managed dynamically at the landscape scale, whereas alternative R proposes management of static reserves for late forest structure areas. Alternative B uses a fixed reserve management approach to maintain late forest structure habitats, which covers about

31 percent of the Forest. These reserves are called “late forest structure emphasis areas” and overlay other management areas. Alternative O uses a fixed reserve management approach to maintain late forest structure habitats, which covers about 34 percent of the Forest. These reserves are called “late forest structure emphasis areas” and overlay other management areas. For all alternatives, within managed land allocations approximately 78 percent of the land base consists of high or moderate site productivity, thus allowing a substantial land base for restoring and maintaining Old Forest Management.

Rangeland Management

An assessment of range capability has been completed for the Forest. As defined in 36 CFR 219.3, capability refers to the potential of an area of land to produce resources, supply goods and services, and allow resource uses under an assumed set of management practices and at a given level of management intensity. Capability depends upon current resource conditions and site conditions, such as climate, slope, landform, soils, and geology, as well as the application of management practices, such as silviculture or protection from fire, insects, and disease. Capable range on the Colville National Forest does not include lands considered rock outcrops, very wet and rubble-land. This category includes lands classified as rock outcrop, rubble-land, lithic, serpentinitic, river-wash, very wet or badlands in the soil resource coverages for the Forest. Lands classified as shallow soils were removed from capable range as well because of inherent productivity limitations. Because slope limits the accessibility of livestock to potential forage, steep slopes need to be withdrawn from the capable land base. A 40 percent slope was determined to be a reasonable threshold for cattle and a 70 percent slope threshold was considered appropriate for sheep on the Forest. Lands steeper than these thresholds were removed from the land base. Approximately 363,845 acres (33 percent) of the Forest are classified as suitable for cattle grazing, and 448,160 acres (41 percent) are suitable for sheep grazing. There are a total of 58 allotments on the Forest; 42 are active, and 16 are not currently grazed. Of the 16 vacant allotments, 7 are likely to be used again in the foreseeable future.

The revised plan proposes no changes in the status, location, or boundaries of permitted range allotments or type of livestock. However, plan components that affect management of livestock grazing would vary by alternative. Changes to site-specific allotment management may be made in the future in response to the revised forest plan at a site-specific allotment management plan level. This section will not consider livestock grazing in evaluating the effects of the various alternatives since allotment status and stocking rates would not change as a result of the forest plan revision effort or the alternatives considered.

Carbon Storage in Soils

The amount of carbon loss varies considerably after timber harvest. Factors include the silvicultural prescription, harvesting method, tree species, amount of debris left after harvest, site preparation techniques, soil characteristics, and climate.

Harmon and Marks (2002) modeled carbon pools in Pacific Northwest forests, finding that the factors critical to optimizing carbon storage were rotation length, amount of wood harvested, and amount of detritus removed by slash burning. In the years following major disturbances, the losses from decay of residual dead organic matter exceed the carbon uptake by regrowth (Nabuurs et al. 2007, USDA Forest Service 2014b). In the years following harvesting and replanting, soil carbon losses may exceed carbon gains in the aboveground biomass. The long-term balance depends on the extent of soil disturbance. Continuous cover forestry with selective harvesting is linked with reduced soil disturbance compared with clear-cut harvesting, which may decrease soil carbon losses (ECCP-Working group on forest sinks 2003, USDA Forest Service 2014b).

Johnson and Curtis (2001) suggest that the amount of woody residue left after harvest is a “dominant control” of the forest floor. The litter layer and woody debris can be partially mixed into mineral soils during some harvests, where decomposition proceeds more slowly (Yanai et al. 2003). Harvest residues left on the soil surface increase the carbon stock of the forest floor, disturbance of the soil structure leads to soil carbon loss. Nave et al. (2010), in a meta-analysis of 432 harvests in temperate forests worldwide, report a statistically significant 8 percent reduction in overall soil carbon (including both forest floor and mineral soil). The forest floor lost an average of 30 percent of carbon following harvest, but coniferous and mixed forests lost less carbon than hardwood forests.

Site preparation techniques include manual, mechanical, and chemical methods and prescribed burning, most of which lead to the exposure of the mineral soil by removal or mixing of the organic layer. The soil disturbance changes the microclimate and stimulates the decomposition of soil organic matter, thereby releasing nutrients (Palmgren 1984, Johansson 1994). A review on the effects of site preparation showed a net loss of soil carbon and an increase in stand productivity (Johnson 1992). The effects varied with site and treatment. Several studies that compared different site preparation methods found that the loss of soil carbon increased with the intensity of the soil disturbance (Johansson 1994, Örlander et al. 1996, Schmidt et al. 1996).

Longer rotation periods have been proposed to foster carbon sequestration in forests. The effect of increased rotation lengths is mainly determined by the current management practice. Longer rotation lengths with more old forests lead to higher carbon pools than short rotations with only young plantations. Old-growth forests have the highest carbon density, whereas younger stands have a larger carbon sink capacity. The theoretical maximum carbon storage (saturation) in a forested landscape is attained when all stands are in old-growth state, but this rarely occurs as natural or human disturbances maintain stands of various ages within the forest (Nabuurs et al. 2007). The accumulation of carbon continues until the carbon gain from photosynthesis is larger than respiration losses. Late-successional species are able to maintain high carbon sequestration rates for longer than pioneer tree species. However, older mature forest stands are not able to close canopy gaps created by natural mortality or thinning. Consequently, the decomposition of soil organic matter is enhanced and decreases the soil carbon pool. Several modelling studies suggest that very long rotation lengths do not necessarily maximize the total C balance of managed forests (Cannell 1999, Liski et al. 2001, Harmon and Marks 2002). In general, aging of forests results in increasing carbon densities in management systems with longer rotation lengths, provided the harvest age is not beyond the age where the forest stand turns from a net sink to a source of carbon (Jandl et al. 2007). The magnitude of the effect of increased rotation lengths depends on the current management practice. At the landscape level, longer rotation lengths with more old forests lead to higher carbon pools than short rotations with only young plantations.

Results from the long term spoil productivity studies suggest that decomposition and carbon release from woody debris after forest harvest varies by climate zones. In warmer and drier climates, carbon is mainly respired and released to the atmosphere rather than being incorporated into the soil. In wetter and cooler climates, much of the carbon may be moved into the soil over time (Powers et al. 2005). Soil taxonomic order predicted much of the variation in carbon storage in mineral soils in the meta-analysis by Nave et al. (2010), which may be related to typical management practices on certain soils, or differences in residue quality. Nave et al. (2010) found that Inceptisols had significant declines in carbon storage after harvests. The rate of woody debris input needed to maintain soil carbon pools is unclear. Jurgensen et al. (1997), in a summary paper on productivity considerations for the Intermountain West, discuss how much woody residue is needed to maintain soil organic matter levels. They note that various guidelines in the region ranged from retaining 4.5 tons per acre after harvest (for all woody debris, including coarse and fine wood) up to 56 tons per acre. The lower values applied to dry conifer sites; based on slow cycling rates for these systems, it was thought that the lower levels of residue retention would be sufficient to maintain soil organic matter. Fire risk was also a consideration. Higher levels of woody residue retention were suggested for mixed conifer forests in the northern Rocky Mountains.

The role of fire in ecosystem carbon changes is not straightforward. Several experiments showed that wildfire had caused increases in soil carbon, which may be driven by the incorporation of charcoal into soils and new carbon inputs via post-fire N_2 fixation (Hirsch et al. 2001, Johnson and Curtis 2001, Johnson et al. 2004, Schulze et al. 1999). Fire oxidizes organic forms of carbon to CO_2, which is rapidly lost to the atmosphere. The degree to which soil and forest floor carbon is affected is variable and site-specific, depending on fire intensity and soil burning temperatures, amount of organic matter on the site, and other environmental conditions during and after the fire. Carbon losses can be large in catastrophic wildfires. Severely burned plots on the 2002 Biscuit Fire lost an average of 22 percent of soil carbon (Erickson and White 2008). Most carbon losses are from the forest floor and surface horizons to about 10 centimeters; fire has little impact on deeper mineral soil layers.

Several strategies can maintain or increase forest soil carbon storage: maintain site productivity, avoid soil disturbance, use forest management practices that store more carbon, and avoid catastrophic mortality by establishing species diversity. Maintaining site quality is essential to ensure that forests continue to capture and store carbon at their maximum capacity (Gough et al. 2007). Factors that impact productivity, such as decreased soil fertility, stressors, or loss of productive area to permanent roads and landings, will reduce the potential to store carbon. Avoiding soil disturbance will limit erosion losses, minimize conditions that lead to increased soil organic matter decomposition, and allow stable organo-mineral complexes to form (Jandl et al. 2007). Recommended forest management practices to store more carbon include increasing average tree diameter and height; allowing forests to become older (i.e., use extended rotations); maintaining full stocking; decreasing the frequency of harvests; and retaining dead woody debris on site (Ray et al. 2009, Nunery and Keeton 2010, Ryan et al. 2010). Avoiding catastrophic mortality and establishing a mixed species forest go hand in hand (Jandl et al. 2007, Ray et al. 2009, Nunery and Keeton 2010). Fuel treatments exchange current carbon storage for the potential of avoiding large carbon losses in wildfire (Ryan et al. 2010). Forest management activities to increase stand-level forest carbon stocks include harvest systems that maintain partial forest cover. These harvest systems also minimize losses of dead organic matter (including slash) or soil carbon by reducing soil erosion, and by avoiding slash burning and other high-emission activities (Nabuurs et al. 2007).

Possible additional strategies, that require further study, are to manipulate forest species to favor those that allocate more carbon belowground (Jandl et al. 2007) and increase the growth rate of existing forests through silvicultural methods, fertilization, water management, and/or the use of different tree species (Jandl et al. 2007, Ryan et al. 2010).

Total Soil Resource Commitment

Total Soil Resource Commitment is the conversion of a productive site to an essentially non-productive site (0 to 40 percent of natural productivity) for a period of more than 50 years. Examples include system roads, administrative sites, developed campgrounds, rock quarries, mine sites, livestock watering facilities. The current total soil resource commitment on the Forest is approximately 2 percent. The main drivers of total soil resource commitment are the road and trail network and developed recreation.

Three broad concerns drove the need to address road density in this revision effort: (1) the Forest is no longer able to afford to properly maintain its road system at current operational maintenance levels, (2) the current road system is not aligned with current and future resource management objectives, and (3) the existing road management direction is confusing and difficult to follow. With the revised forest plan, there is a need to ensure that the Forest continues to have an access system of authorized roads that is safe, affordable, and environmentally sound, that meets obligations to private cooperators, is efficient to manage, and provides adequate access to recreation settings and opportunities. Decisions on road decommissioning would be made at the project level, based on information provided by resource specialists and recommendations contained in the Forest's most recent Travel Analysis Report pursuant to subpart A of the 2005 Travel Management Rule.

The trail network on the Forest consists of both motorized and non-motorized trails. The 1988 forest plan language identifies where motorized recreation use may not be authorized or may be limited for the protection of aquatic, plant and wildlife habitats. In addition, summer motorized recreation use is also restricted to those routes (roads and trails) identified on the Forest's current-year MVUM, which was developed in response to Subpart B of the 2005 Travel Management Rule. OHV use is allowed on designated routes (mixed-use roads and trails) across approximately 82 percent of the Forest. Mixed-use roads open to OHV use includes 684 miles (31 percent) out of the 2,206 miles of road that are open to highway legal vehicles across the Forest. No cross-country OHV use is allowed on the Forest. Non-motorized trails (approximately 319 miles) make up 64 percent of summer trail miles on the Forest and accommodate uses such as hiking, mountain biking, and stock use. While trails may change between motorized and non-motorized uses by alternative, the footprint on the landscape remains in all alternatives. Motorized access in areas of sensitive soils has the potential to affect soil erosion and soil productivity potentials. Some soil types have low bearing strength when wet and would not support motorized access during periods of high soil moisture. Thin ash-cap soils are easily displaced by motorized equipment negatively affecting the functioning of these soils. These sensitive soils would be addressed in site-specific analysis during the designation of new motorized trails.

Developed recreation areas on the Colville National Forest include a suite of opportunities and locations such as: interpretive and historic sites, scenic overlooks, information centers, trailheads, improved dispersed camping areas, rental cabins and lookouts, sno-parks, boat launches, picnic areas, campgrounds, and designated swim areas. In general, a developed recreation site is any place on the Forest where funds have been spent to improve the site for the visitor's convenience and to protect the natural resources associated with the site. The Colville National Forest offers all of the above types of recreation sites, with many of them located along primary scenic byways or recreation lakes. Based on changing demographics, there may be a need to develop additional group use sites, day-use areas, and trailheads closer to Spokane over the next 10 to 20 years. Developed recreation does not vary by alternative.

Total Soil Resource Commitment Effects by Alternative

Under the no action alternative, road density would be managed under 1988 forest plan direction. Under the proposed action, the desired condition for road density on the Colville National Forest would be 2 to 3 miles per square mile, which is close to the existing forestwide road density. In those watersheds already meeting the desired condition, there would be no need to decommission roads to show movement toward the road density desired condition. However, it is still likely that some road decommissioning would occur in those watersheds meeting the desired condition for road density in order to improve resource and habitat conditions on a project-by-project basis. Under alternatives B and O, the Forest's road system would be capped at approximately 4,000 miles for the entire Forest. No roads would be allowed to be added to the Forest's road system unless an equal distance was decommissioned. No action, the proposed action, and alternatives B and O would have comparable effects for the forestwide total soil resource commitment. Alternatives P and R have a desired condition for road density of 1 to 2 miles per square mile and could result in a greater reduction in system roads, especially in key watersheds and watersheds where the existing road densities are above the desired condition. Given that projected Forest funding would allow for approximately 20 miles of decommissioning each year, the magnitude of potential road decommissioning over the 20-year life span of the revised forest plan would be approximately 400 miles, or 10 percent of the Forest's existing road system.

Table 175. Total soil resource commitment by alternative

	No Action	Proposed Action	Alternative P	Alternative R	Alternative B	Alternative O
Desired Road Density	--	2-3 mi/sq. mi	1-2 mi/sq. mi	1-2 mi/sq. mi	Capped at 4,000 miles	Capped at 4,000 miles
Total Forest Acres Open to Motorized Trail Opportunities	906,200	874,700	875,700	838,900	842,000	876,300
Motorized Trails	181	181	181	142	142	181
Non-motorized Trails	342	342	342	382	382	342
Total soil resource commitment	--	No Change, Localized Decrease	Decrease	Decrease	No change	No change

The road decommissioning treatment repurposes the road area back to productive land base and no longer manages these as administrative areas or as part of the total soil resource commitment. The net effect of reallocating more area back to productive purposes would largely be positive. As a means to sustain productivity, the Forest would evaluate not only stabilizing these old road areas, but prescribe treatments to promote soil recovery (FW-DC-SOIL-01/ FW-DC-SOIL-02). The beneficial effects from road decommissioning would depend largely on site potential for recovery (Switalski et al. 2004). For example, droughty slopes with high evaporative loss on sunny aspects would recover more slowly than moist northern aspect slopes. Road treatments would stabilize the surface from erosion, while soil biology, soil chemical and hydrologic properties slowly recover as plants recolonize. Lloyd et al. (2013) quantified road recovery on the Nez Perce-Clearwater National Forests, showing faster soil recovery for treated roads where the road prism was outsloped along with some level of revegetation versus abandoned roads. She found topsoil developed on treated roads three times the depth over one decade than topsoil on roads abandoned for 30 years.

For all alternatives, there would be either a maintenance of the current total soil resource commitment or a decrease over the life of the plan (table 175).

Support and Stability

The support and stability function of soils can be affected by several types of activities anticipated with the next planning cycle including actions both on the productive land base and within the total soil resource commitment. The support and stability function is the only soil ecological function considered for all lands. This function covers both erosion and mass wasting events.

Soil Erosion

Adequate canopy and groundcover is the best protection against soil erosion. Foliage intercepts rainfall, understory vegetation and forest litter reduce the impact and enhance infiltration through rooting. Overland flow, much less surface erosion, is rare in Rocky Mountain forests (Wondzell and King 2003). Using Disturbed Watershed Erosion Prediction Project, a soil erosion model amended for forested environments, soil erosion rarely occurs if groundcover exceeds 85 percent cover (Elliot et al. 1998). Use of slash on disturbed areas during timber harvest is one measure adopted more commonly that increases groundcover and facilitates vegetation regrowth on disturbed soil surfaces. Standard FW-STD-SOIL-01 requires effective groundcover to stabilize soils for erosion control.

Prescribed fire and wildfires pose temporary risk for erosion and deposition during at least 3 years post-fire, depending on fire severity and remaining groundcover. After fire, the blackened ground stabilizes as plant cover and roots secure the surface while loose, exposed soil transports downslope. Across blackened areas, the net effect of the burn residue and surface sealing of soil pores can exacerbate erosion potential by slowing infiltration (Wondzell and King 2003, Larsen et al. 2009). This post burn condition is highly variable spatially and decreases over time (Doerr et al. 2006). All action alternatives would have similar direction for this fire management.

Mass Wasting

Landslides are mostly likely to occur in areas where they have already occurred in the past, on roaded landscapes, and in areas of past wildfire. In many cases, the landscape features surrounding a location where recent landslide catastrophes have occurred and provide evidence of past and ongoing landslide activity. Landslides are part of the processes behind the evolution of the landscape. Landslides are triggered by earthquakes, major storms, volcanic activity, or other natural or human-induced activities that may cause the earth to move. The additional weight of storm rains or snowmelt can cause slopes to fail or reactivate older landslides. All alternatives lower risk of soil damage from human-induced landslides with guidance that ground-disturbing management activities should not occur on landslide-prone areas (FW-DC-SOIL-03).

Many of the landslides documented on the Forest are road-related. Roads can alter water drainage patterns, concentrate runoff, intercept subsurface water flows, and oversteepen slopes. These effects can lead to mass wasting events originating at roads. Since these events happen on the roads, they are also easier to find and quantify compared to other landslides. Slope stability theory identifies the primary underlying cause of these failures as saturation of the fill material by subsurface water and inadequate control of surface water. A common initial condition leading to failure of fills was settlement and incipient rotational movement due to inadequate fill compaction, incorporation of organic materials in the fill, or failure to remove weak material in fill foundations. The settled fills concentrated the uncontrolled surface water into the fill, resulted in saturation, slumping, and erosion of fill material. Modern road and culvert upgrades, maintenance and decommissioning have reduced the overall risk or road-related landslides on the Forest.

Wildfire can have direct long-lasting impacts through initiation of landslides. The two main impacts are (1) an increase in surface runoff because of reduced hydraulic conductivity and evapotranspiration that can lead to debris flows immediately following a wildfire; and (2) a loss of root strength 3 to 5 years after fire, increasing the risk of translational slides. When the wildfire consumes the canopy and soil organic layers, causing the soil to dry out and form hydrophobic layers, rainfall infiltration is decreased leading to an increase of runoff and soil erosion. This increased runoff and erosion can result in loading of channels with the additional water and sediment causing debris flow formation (Cannon et al. 2010).

The second impact from wildfire causing a potential increase of landslides is the loss of root strength (Abe and Ziemer 1991, Hammond et al. 1992, Parise and Cannon 2012). Live roots reinforce the sheer strength of the soil and help protect hillslopes from mass wasting events. After wildfires causing tree mortality, roots begin to decay, and therefore, lose the regolith anchoring properties. Shallow and rotational landslides have been documented to occur up to 30 years post-fire that are hypothesized to be related to this loss of root strength after wildfire (Parise and Cannon 2012).

Cumulative Effects

Effects Common to all Alternatives

Past actions and foreseeable future actions primarily affect soils in the place the actions occur. Influence from adjacent management on private, State, or federally managed areas would have immeasurable effects on site-specific soil conditions. Legacy disturbance from wildfire and timber harvest could affect soil condition where future management is planned.

During the last planning cycle in the 1980s, the footprint of forest management was still expanding into new forest stands. At the same time, rules and guidelines were beginning to take into effect to control soil disturbance and limit offsite transport of sediment (Binkley and Brown 1993). The Forest Service had begun working with the State to adopt BMPs that reduced the adverse effects of timber harvest on soil and water. Within the projected life of the revised forest plan, areas of past vegetation management would likely need retreated. All alternatives include Region 6 soil quality standards with a 20-percent detrimental soil disturbance threshold to limit the cumulative effects to soils if multiple treatments across multiple timeframes are placed on the landscape.

The topography of the Colville National Forest naturally predisposes slopes bared after wildfire to erode and deposit soil materials. Wildfire followed by intense rainfall would continue as a natural geomorphology agent, as it has occurred episodically in Rocky Mountain forests for millenia (Miller et al. 2003, Kirchner 2001). When taking a closer look over a century scale, fire incidence coincides with warm phases of the Pacific Decadal Oscillation (Morgan et al. 2008). This latest warm cycle has continued with periods of dry springs with hot summers. These conditions align with a large-scale fire pattern based on tree-ring research. Climate change predictions suggest a continued increase in monthly temperatures along with longer periods of summer drought that increase wildfire hazard (Curtis 2017). It is uncertain if climate change trends may prevent the cyclic return to cooler conditions (Halofsky et al. 2009).

Fire impacts soils by burning up soil organic matter and producing surface conditions prone to soil erosion and deposition. The impact is described qualitatively as soil burn severity, which conveys the magnitude of energy released from the consumption of fuels and the duration of heating. When fires burn all the aboveground biomass and forest floor, a large portion of the nutrient supply is volatized into the atmosphere, while the residual products of burning creates higher mineral nutrient contents in soil layers (Neary et al. 1999, Erickson and White 2008). The soil inherent quality may remain intact after wildfire because wind-driven fire rarely heats deep into soil (Hartford and Frandsen 1992). However, after the wildfire, the lack of forest canopy and bare soil creates conditions for high erosion hazard. Water and wind erosion transport and deposit soil material incrementally downslope until slopes stabilize. Erosion is highest where fires burn severely on steep hillsides; typical fires result in 0 to 30 percent of the fire area burning with high severity based on Burned Area Emergency Response burn severity maps for the Colville National Forest. Though natural, recovery in these areas depends on available moisture and recolonization from neighboring vegetation and soil patches. Dry southern slopes may recolonize slower from droughty conditions and thin soils.

Based on recent trends in wildfire and more emphasis on prescribed burning for restorative purpose, more fire is expected to occur during this next planning period. Much of this fire may burn through recovering areas that experienced moderate or severe wildfire. Burning through past fire areas with “jackstrawed” dead trees could produce heat that penetrates deeper into soil because of longer burn duration. Research has shown that despite this heating, that reburn rarely sterilizes soil even in re-burn scenarios where concentrated fuels may increase fire severity; rather, the recovery would be controlled by fire severity, tree overstory level, soil texture, and the timing of the burn (Neary et al. 1999, Hebel et al. 2009). The fire may re-organize the soil community where generalist species dominate early on (Egerton-Warburton 2005, Jiménez Esquilín et al. 2008). The soil condition would improve as vegetation recolonizes the site and organic matter stocks rebuild.

Climate Change

Climate is consistent with both maritime and continental regimes, with air masses from both the Pacific Ocean and interior North America crossing the region. Climate is influenced primarily by latitude, topography, proximity to the Pacific Ocean, prevailing westerly winds, and development and movement of weather systems over the North Pacific (Phillips and Durkee 1972). The majority of precipitation falls between October and April as snow. Summers are usually dry, with most precipitation associated with thunderstorms. Humidity is low throughout the year.

Annual precipitation varies between 10 to 55 inches per year and increases with elevation. The western-most section of the Forest is in the rain shadow of the North Cascades and has annual precipitation levels of 10 to 15 inches per year. The eastern portion of the Colville NF has a moist near-maritime climate caused by the forcing of westerly air flow over the 5,000- to 7,000-foot peaks of the Kettle River and Selkirk ranges. Throughout the year, maritime air from the Pacific exerts a moderating influence on temperatures with more extreme summer and winter temperatures caused by drier air from the interior. The greatest precipitation levels occur in the Selkirk Mountains where uplifting of prevailing winds results in increased precipitation (Baldwin 2006).

As the climate continues to warm, the outcome may be difficult to predict because of the interaction of topography and the uncertain dominance of the continental versus maritime climate influence (for more detailed information, see the Climate Change section). Shifts in climate could play out mostly in mid-elevation forests where winter moisture comes as rain rather than snow, and where a decrease in snowpack could result in prolonged periods of soil moisture deficit. A decrease of snowpack could extend soil drought to the mid elevations that is now common to lower-elevation ponderosa pine forests. The seasonal water deficits could stress species that make up the mixed conifer forests. It is possible drought stress would affect mid-elevation forests even more because forest species shift most according to aspect in this zone. Concave slope areas would grow mesic species since these areas have moist deep soils from converging slope water. The upper extent of the timber line would likely move up in elevation as the growing season extends in these normally cold-limited environments.

Any future changes to length of growing season would affect soil and plant respiration. Typically, soils become active where temperatures exceed 44 degrees Fahrenheit and decrease activity when soil moisture declines below 10 percent moisture (Davidson et al. 1998). The combination of adequate temperature for growth is expressed as growing degree days. On areas that could experience longer seasonal drought, the effective growing degree days for soil respiration would decrease, while upper elevations might have a longer growing season. As warming occurs, available soil moisture would be the primary control at mid to lower elevations. In Colorado, a study found that in complex terrain, available water was a limiting factor to soil respiration for ponderosa and lodgepole (Berryman et al. 2015). On finer scales, the outcome becomes complicated by the interaction of the forest canopy and topographic position. Soil water can be maintained by the shading of forest canopy that reduces evaporative losses from wind and sun, but forest transpiration also draws soil water down.

Identification of areas having different levels of resilience to climate change can be used to prioritize vegetation treatments. By looking at the soil hydrologic properties in combination with climatic factors, a risk and resilience to increased soil drought model was developed for the Colville National Forest.

Also, identification of soils and landscapes that store large quantities of water that moderate peak flows and supply water for stream flows later in the summer months can also be used to prioritize vegetation treatments and other restoration activities that improve the functioning of these important areas. Soil affects how water moves across the landscape, and the quantity and timing of stream discharge. Soil water movement was modeled across the Colville National Forest using soil erodibility, soil runoff potential, and soil available water storage. Over half (54 percent) of the area of the Colville National Forest has soils that support infiltration and storage. Thirty-one percent of the soils support runoff of water across the soil surface; however, runoff potential is also affected by vegetation and litter cover, and precipitation intensity. Lateral flow is the primary soil water flow mechanism on 14 percent of soils across the Forest. The areas that are identified as water storage zones could be prioritized for restoration treatments that improve soil water storage.

Action Alternatives (Proposed Action, R, P, B, O) Cumulative Effects

The action alternatives would continue to improve soil conditions on the landscape. Placed within all these alternatives is the restoration of 50 acres of detrimental soil condition per year. This would decrease detrimental soil condition and remediate some of the cumulative effects created from placing multiple treatments across the same activity area. Additional desired conditions, goals, objectives, standards, and guidelines in the action alternatives would improve and preserve soil function and soil quality. When analyzed with past, present, and reasonably foreseeable future activities, the action alternatives would improve soil resilience and lower the risk of damage from high-severity wildfire.

Compliance with Relevant Laws, Regulations, Policies and Plans

The proposed action and the alternatives would meet soil productivity goals and maintenance of soil quality as defined in the National Forest Management Act. The proposed action and alternatives comply with the standards and guidelines described in the Forest Service Manual and Handbook, Region 6 Soil Quality Standards and Guidelines (1998c), and National Best Management Practice for Water Quality Management on NFSs Lands (USDA Forest Service 2012d).

There are approximately 6,500 acres of prime farmland in the planning area. Prime farmland has a specific definition involving soil moisture regime, soil temperature regimes, soil pH, and other soil properties that define highly productive soils for the production of food and fiber. It is described by USDA Department Regulation 9500-003 and defined by the Farmland Protection Policy Act (FPPA) subtitle I of Title XV, Section 1539-1549. Forest management activities would not create loss of prime farmland.

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