
Okanogon and Wenatchee National Forests Roads Analysis: Entiat and Chelan Sub-Basins

April 2004

Core Team Members

Marge Hutchinson	Team Leader, South Zone Engineer
Carl Davis	Forest Soil Scientist
Andrea Gold	Wildlife Biologist
Ken MacDonald	Forest Fisheries Biologist
Tom Robison	Forest Hydrologist
Jennifer Zbyszewski	District Environmental Coordinator

District Team Members

Rick Acosta	Recreation Planner
Phil Archibald	District Fish Biologist
Troy Corn	Fire Management
Rick Edwards	District Hydrologist
Tom Graham	Resource Management
Mallory Lenz	District Wildlife Biologist
Barry Marsh	Road Engineer
Claudia Narcisco	District Geologist
Jack Rainford	GIS Specialist
Bridget Ranne	District Wildlife Biologist
Ernie Stutzman	Road Management

For more information, contact

*Chelan Ranger District
428 W. Woodin Avenue
Chelan, WA 98816*

*Entiat Ranger District
2108 Entiat Way, PO Box 476
Entiat, WA 98822*

Contents

Contents.....	i
List of Figures	iv
List of Tables	iv
Introduction	5
Entiat and Chelan Sub-Basins Analysis Area	6
I. Existing Conditions and Situation	9
General Conditions	9
A. Roads	9
B. Aquatics.....	10
C. Wildlife.....	13
Entiat Watershed	16
A. Human Use	17
B1. Aquatics	19
B2. Aquatics: Transitional and Transport Zone.....	21
C. Wildlife	24
Mad River Watershed	25
A. Human Use	26
B. Aquatics.....	26
C. Wildlife.....	28
Columbia Breaks Watershed	29
A. Human Use	30
B. Aquatics.....	31
C. Wildlife.....	31
Chelan Watershed	32
A. Human Use	33
B1. Aquatics: Railroad Creek Zone.....	34
B2. Aquatics: Lower Chelan Zone	35
C. Wildlife.....	36
II. Analysis	38
General Analysis	38
A. Human Use	38
B. Aquatics.....	38
C. Wildlife.....	39
Entiat Watershed	40
A. Human Use	40
B1. Aquatics: Depositional Zone.....	41
B2. Aquatics: Transport and Transitional Zone	42
C. Wildlife.....	42
Mad River Watershed	43
A. Human Use	43
B. Aquatics.....	44
C. Wildlife.....	44
Columbia Breaks Watershed	45

A. Human Use	45
B. Aquatics	45
C. Wildlife.....	45
Chelan Watershed	46
A. Human Use	46
B. Aquatics.....	47
C. Wildlife.....	47
Recommendations.....	48
Minimum Affordable Road System	49
Entiat Watershed	50
Mad River Watershed	52
Columbia Breaks Watershed	52
Chelan Watershed	53
Watershed Analysis Priority	54
Works Cited.....	56
Appendices	59
Appendix A: Human Use Rating Criteria.....	61
Factor 1: Required by Law, Agreements, and Permits	61
Questions Addressed	62
Ratings.....	62
Data Sources	62
Factor 2: Resource Management	62
Ratings.....	63
Data Sources	64
Factor 3: Public Access and Level of Use	64
Questions Addressed	64
Ratings.....	65
Data Sources	65
Factor 4: Economics.....	65
Questions Addressed	66
Ratings.....	66
Data Sources	66
Appendix A Works Cited	66
Appendix B: Aquatic Rating Criteria.....	69
Development of Aquatic Impact, At-Risk Criteria	69
Criterion 1: Geologic Hazard	69
Questions Addressed	70
Ratings.....	70
Criterion 2: Road-Related Fine Sediment.....	70
Questions Addressed	70
Ratings.....	71
Criterion 3: Flood Plain Function, Off-Channel Habitat, and Riparian Reserves	71
Questions Addressed	73
Ratings.....	73
Criterion 4: Flow Effects	74
Questions Addressed	74

Ratings	74
Criterion 5: At-Risk Fish Populations	75
Questions Addressed	75
Ratings	75
Criterion 6: Wetlands and Wet Meadows	76
Questions Addressed	77
Ratings	77
Appendix C: Wildlife Rating Criteria	82
Definitions	82
Criterion 1: Wide-Ranging Carnivores	83
Questions Addressed	84
Ratings	84
Criterion 2: Late-Successional Associated Species	85
Questions Addressed	85
Ratings	85
Criterion 3: Riparian-Dependent Species	86
Question Addressed	86
Ratings	86
Criterion 4: Ungulates	86
Questions Addressed	86
Ratings	87
Criterion 5: Unique Habitats	87
Question Answered	87
Ratings	87
Appendix C Works Cited	88
Appendix D: Recommended Management Actions	92
Appendix E: Public Input Summary	101
Public Input to Roads Analysis, Entiat Ranger District	101
Public Input to Roads Analysis, Chelan Ranger District	101
Appendix F: Definitions	102
Definitions	102
Terms Used in Wildlife Rating Criteria	103

List of Figures

Figure 1. Chelan and Entiat Districts vicinity map	7
Figure 2. Geographic area analyzed on the Entiat and Chelan Districts	8

List of Tables

Table 1. Sub-Watersheds in the Entiat Sub-Basin	11
Table 2. Road-associated factors--Negatively affecting habitat or populations of wildlife species (based on Wisdom et al. 1999) and the wildlife species group for which effects of the road-associated factor has been documented	14
Table 3. Major roads and travel routes within the Entiat Watershed	16
Table 4. Annual sediment sampling data, Entiat Ranger District, 1993-1998	23
Table 5. Road density of Lynx Analysis Units within the Entiat Watershed	25
Table 6. Road density of Lynx Analysis Units within the Mad River Watershed.....	28
Table 7. Major roads and travel routes within the Columbia Breaks Watershed	29
Table 8. Road density of Lynx Analysis Units within the Chelan Watershed	37
Table 9.	40
Table 10.	40
Table 11. Entiat minimum affordable road system options.....	50
Table 12. Chelan minimum affordable road system options.....	50
Table 13. Recommended management actions: Entiat Watershed	51
Table 14. Recommended management actions: Mad River Watershed	52
Table 15. Recommended management actions: Columbia Breaks Watershed	53
Table 16. Recommended management actions: Chelan Watershed	54
Table 17. Watershed ratings	55
Table A-1. Human Uses, Entiat, and Chelan Sub-Basins	67
Table B-1. Aquatic impact, at-risk, Entiat and Chelan Sub-Basins.....	79
Table C-1. Relative ranking scheme: determining the priority of watersheds for watershed scale analysis within each sub-basin for each species group or habitat	82
Table C-2. Road-associated factors negatively affecting habitat or populations of wildlifespecies (based on Wisdom et al. 1999) and the species group for which effects of the road-associated factor has been documented	83
Table C-3. Road density of each Lynx Analysis Unit (LAU) on the Entiat and Chelan Sub-Basins	84
Table C-4. Wildlife impact, at-risk, Entiat and Chelan Sub-Basins	90
Table C-5. Results of roads analysis, rating and notes, for wildlife habitat on Entiat and Chelan Sub-Basins.....	90
Table D-1. Ratings and recommended management actions, alternatives	93
Table D-2. Recommended management actions, Entiat and Chelan Sub-Basin.....	94

Introduction

Over the past decade, because of a national shift in environmental awareness, roads and road issues have become points of controversy. Roads are being scrutinized for their impact on ecosystems. Also, the funding available to maintain roads has decreased significantly. There is an urgent need to find a balance between the need for access and the potential environmental risks of a deteriorating road system. To meet this goal, the Okanogan and Wenatchee National Forests conducted a forest-wide roads analysis.

The objective of the roads analysis was “to provide line officers with critical information to develop road systems that are safe and responsive to public needs and desires, are affordable and efficiently managed, have minimal negative ecological effects on the land, and are in balance with available funding for needed management actions.” (USDA FS, 1999a) This analysis is not a decision-making process. It will develop strategies and recommendations that will be incorporated into future project-level decision-making analysis.

The following analysis is a science-based interdisciplinary process using existing information and inventories. The analysis addresses the effects of roads on biological, social, and economic factors. The condition of the current road system was analyzed in terms of desired conditions, which includes amount and type of access, and impact and risks to the ecosystem. This analysis identifies opportunities and strategies for moving toward the goal of an affordable, efficient road system that meets the needs of the public and the Forest Service with minimal impact to the environment. The analysis includes previously completed plans, analysis, and decisions.

This analysis is based on the objectives and guidelines in “Roads Analysis: Informing Decisions about Managing the National Forest Transportation System,” developed by the Forest Service Chief’s Office in Washington, D.C. (USDA FS 1999a). The guidelines present six steps that each analysis should complete. The six steps are:

- Step 1: Setting up the analysis
- Step 2: Describing the situation
- Step 3: Identifying issues
- Step 4: Assessing benefits, problems and risks
- Step 5: Describing opportunities and setting priorities
- Step 6: Reporting

The analysis of the Entiat and Chelan Sub-Basins is a modified version of a process developed by the Umpqua National Forest and presented in “Upper Steamboat Creek Watershed Analysis: Access and Travel Management Planning Process and Results.” The process was modified to reflect characteristics and situations present on the Okanogan and Wenatchee National Forests and incorporates the six steps listed above.

This is the first of a three-phase process to analyze all the roads on the Okanogan and Wenatchee National Forests. The second phase will be at the watershed scale: all roads within the watershed will be considered. The third, final phase will be at the specific project scale. The first two phases (sub-basin level and watershed level) develop recommendations, and are not decision documents. The final

phase, at the project scale, will be at the decision-and-implementation level.

The analysis process examines the major arterial and collector roads within the sub-basin. The roads were segmented according to their maintenance level and the watershed in which they are located. After the roads were segmented, they were rated on criteria in three modules: Human Use, Aquatics, and Wildlife. The Aquatic and Wildlife modules document the effects of roads on biological factors; the Human Use module addresses the effects of roads on the social and economical factors. The specific criteria in each module are described in the appendices; the five maintenance levels are described in Appendix F.

Each module developed a “High,” “Moderate,” or “Low” rating for each road segment. The three ratings were used to develop a recommended management strategy for that road segment. The management strategy options ranged from major improvements to some form of decommissioning.

Each watershed within the sub-basins was given an overall rating for each module. This rating was used to develop the recommended priorities and sequence for conducting the watershed scale of the roads analysis process.

1. Information from the completed sub-basin roads analysis will be used in several ways: The compilation of the sub-basin level analyses will contribute to the comprehensive forest-wide road management strategy.
2. More detailed watershed-scale analyses will tier to the sub-basin data and recommendations.
3. Scheduled Land and Resource Management Plan (Forest Plan) revisions will use the analyses results in setting long-term management direction for the road system across the three forests. The Forest Plan revision is scheduled to begin in the spring of 2003.

Entiat and Chelan Sub-Basins Analysis Area

This analysis focuses on the major arterials and collectors (roads opened and maintained for passenger car use) within the Entiat and Chelan River Sub-Basins. The sub-basin boundaries closely correspond to the northern and eastern boundaries of Chelan Ranger District and the southern and western boundaries of Entiat Ranger District on the Okanogan and Wenatchee National Forests (see Figure 1).

The Entiat Sub-Basin is made up of three watersheds: Mad River, Entiat River, and a portion of the Columbia Breaks Watershed. The area of the sub-basin that was analyzed is 258,000 acres, of which approximately 125,000 acres (48 %) are in wilderness or inventoried roadless areas. The area contains approximately 1,100 miles of classified Forest Service roads (FSR), of which 201 miles will be analyzed. The 201 miles are the main arterial and collector roads within the sub-basin; these are maintained for passenger cars. The remaining miles are roads maintained for high clearance vehicles (maintenance level 2 roads) or are closed roads (maintenance level 1). Unclassified roads were not considered in this analysis, but will be included in the future watershed scale analyses.

The Chelan Sub-Basin is made up of the Chelan Watershed and a portion of the Columbia Watershed. The area of the sub-basin that was analyzed is 377,000 acres; approximately 252,000 acres (66%) of these are in wilderness and inventoried roadless areas. The area contains approximately 332 miles of classified FSRs; 133 miles of these will be analyzed. The 133 miles accounts for the main arterial and collector roads within the sub-basin that are maintained for passenger cars. The remaining miles are

roads maintained for high clearance vehicles (maintenance level 2 roads) or are closed roads (maintenance level 1). Unclassified roads were not considered in this analysis, but will be included in the future watershed scale analyses.

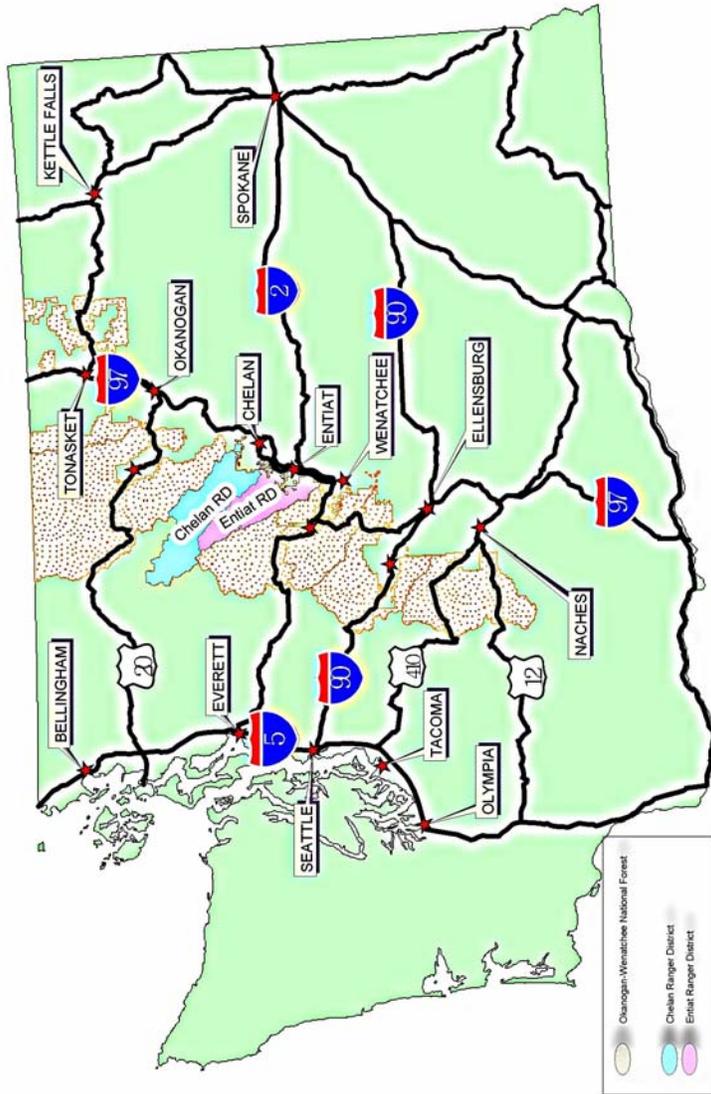


Figure 1. Chelan and Entiat Districts vicinity map

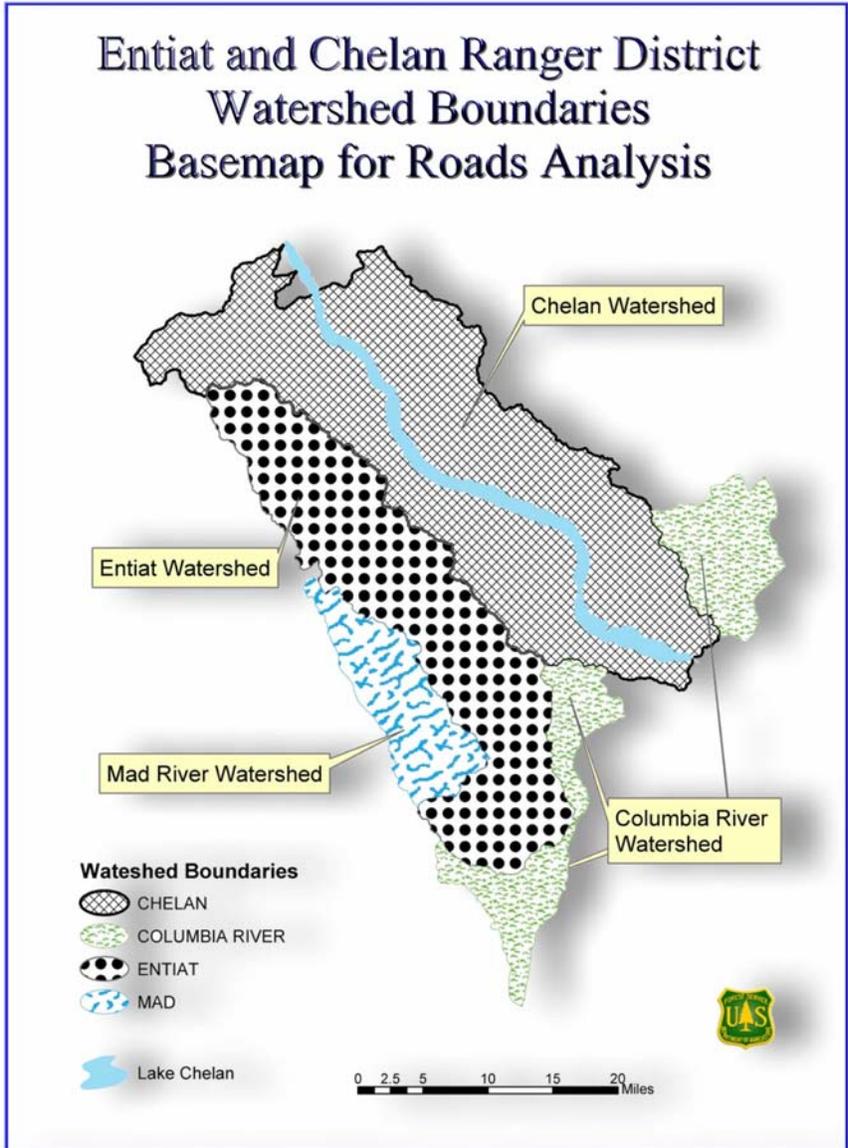


Figure 2. Geographic area analyzed on the Entiat and Chelan Districts

I. Existing Conditions and Situation

General Conditions

A. Roads

The entry of non-indigenous peoples to the Entiat Valley and Chelan Watershed before the mid- to late 1800s was largely related to exploration and the fur trade. Travel was by foot or horseback and probably followed established native trails. Settlement at the mouth of the Entiat River was well established by the late 1800s and centered around livestock grazing and timber harvest. The first sawmill and dam, located approximately one mile up the Entiat River, were operating by 1888. The town of Chelan was established near the turn of the century. The Grade Creek road, which provides access to the north shore of Lake Chelan, was constructed in 1889 for maintenance of a Bureau of Reclamation pipeline.

By the 1950s new roads were being constructed for timber harvest. In time, the demand for forest products increased, as did the need for additional roads. Equally as important as an economic element was the increasing interest in recreation and the recreation opportunities forest roads provided. Among these recreation opportunities are access to trails, boating activities, developed campgrounds, dispersed camping sites, and access to motorized recreation activities for off-highway vehicles, motorcycles, all-terrain vehicles (ATVs), and snow machines. Access to the area was increased by roads constructed by the public (“user-built roads”) and termed “unclassified” by the U.S.D.A. Forest Service.

Road-associated effects to the environment are also included in this analysis. Throughout the sub-basin the combination of road location, road surface type, and high public-use patterns in the wetter times of the year produce a greater potential for increased road surface damage and sediment production. This is particularly evident on the native-surfaced roads that are extensively used during hunting season. In many cases, this combination of conditions results in rutted or wheel-track damaged roads.

For the purposes of this roads analysis, the Forest Transportation Management System (INFRA Roads database) describes each system road or road segment by assigning values that describe the way the road serves resource management needs and the specific maintenance required, consistent with management objectives and maintenance criteria. In the past few years, the emphasis has been on gathering road-related data within projects, such as inventorying and mapping unclassified roads, identifying the backlog of deferred maintenance work, and surveying road culverts which may be a problem for fish passage. Information provided by these and other projects will be included at some level of the roads analysis process. A summary of forest roads miles in each watershed, grouped by road type and maintenance level, is available in the analysis file. For a description of the five maintenance levels, see Appendix F.

Main access to the Entiat Sub-Basin is by the Entiat River Road (5100), which follows the Entiat River up the valley. It provides access to several campgrounds, dispersed recreation sites, and resource management activities within the valley. The Tillicum Road (5800) and the Tyee Road (5700) provide the main access to the southern portion of the sub-basin (Mad River Watershed). The main access to

the northern portion of the Entiat Sub-Basin is provided by the Mud Creek Road (5300), Preston Creek Road (5501), and Shady Pass Road (5900). These roads provide for resource management, particularly wildfire suppression and recovery activities, as well as recreation activities such as snowmobiling and hunting.

Boat travel up Lake Chelan provides the only access to the upper two-thirds of the sub-basin. Shady Pass Road (5900), Slide Ridge Road (8410), and State Route 971 along the south shore provide road access to the southeastern portion of the drainage. On the north side of the sub-basin Grade Creek Road (8200) provides access to the lower third of the lake for wildfire suppression activities and other resource management needs.

B. Aquatics

Current conditions are described and watershed scores developed using the following roads analysis rating factors (See the Aquatic Assessment):

1. Geologic hazard
2. Fine sediment
3. Floodplain function, off-channel habitat, and riparian reserves
4. Flow effects
5. At-risk fish populations

Because the Wetland and Wet Meadows rating factor is used only at the road segment level it is not discussed in the watershed condition section.

Section 7(a)(2) of the Endangered Species Act requires all federal agencies to review actions authorized, funded, or carried out by federal agencies to ensure such actions do not jeopardize the continued existence of listed species. Furthermore, federal agencies must consult with the National Marine Fisheries Service (pertaining to anadromous fish) and the U.S. Fish and Wildlife Service (pertaining to inland fish) on on-going and new activities that may affect a listed species. The Okanogan and Wenatchee National Forests prepare biological assessments to assess potential impact of management activities. The biological assessments and subsequent consultation are conducted at the watershed scale. The basis for the biological assessment is “A Framework to Assist in Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Bull Trout Subpopulation Watershed Scale”, (U.S. Fish and Wildlife Service (USFWS) (adapted from the National Marine Fisheries Service), (US FWS 1998). An important portion of the biological assessment is establishing the environmental baseline for the watershed. In the baselines, various habitat and watershed features are rated as “functioning appropriately,” “functioning at risk,” or “functioning at unacceptable risk.” The fine sediment, floodplain function, off-channel habitat, riparian reserve, and flow effects ratings in the roads analysis are based on the latest watershed biological assessment for a watershed, which is cited at the beginning of each watershed section. When available, new information from monitoring was also used. The watershed score for each rating element is shown next to the element and the narrative gives the rationale for the score.

Entiat Sub-Basin

The Entiat Sub-Basin is tributary to the Columbia River. It enters the Columbia River at the town of

Entiat, approximately river mile 483 of the Columbia. Fish species protected under the Endangered Species Act are Upper Columbia steelhead (endangered), Upper Columbia spring chinook salmon (endangered) and Columbia River bull trout (threatened). Other native salmonid species of management emphasis include summer chinook salmon, redband/rainbow trout, west slope cutthroat trout, and a small riverine sockeye population. The term “at-risk fish populations,” as used in this analysis, refers to the spring chinook salmon, steelhead, and bull trout populations protected under the Endangered Species Act.

The 258,000 acre Entiat Sub-Basin includes three watersheds: Entiat River, Mad River, and the minor Columbia River tributaries. The Minor Columbia River tributary watershed includes small sub-watersheds that drain directly into the Columbia River and are for the most part non-fish bearing waters.

For watershed analysis purposes the Entiat Watershed has been stratified into three zones based on land types, sediment delivery, and sediment loading. These zones are the Sediment Transport Zone, Transitional Zone, and the Sediment Depositional Zone. For the purposes of this analysis, the Depositional Zone is considered a watershed, and the Transport and Transitional Zone will be considered a watershed. Therefore the “watersheds” to be discussed are: the Mad River, the Depositional Zone (including the minor Columbia tributary sub-watersheds), and the Transport/Transitional Zone described in Table 1.

The Entiat River originates in a glacial cirque basin near the crest of the Cascade Mountains, then descends through a U-shaped glaciated valley (Transport and Transitional Zones) and then continues to flow through a moderately V-shaped non-glaciated valley (Depositional Zone) before terminating at the Columbia River on a moderately broad alluvial fan. “The Entiat Watershed Analysis” (USDA FS, 1996) stratified the Entiat Sub-Basin into three zones, with the Transport Zone defined by glacial processes and the Depositional Zone defined by fluvial and hill slope processes. The Transitional Zone, while largely influenced by glacial processes, encompasses processes and functions of both landscapes.

Table 1. Sub-Watersheds in the Entiat Sub-Basin

Sediment transport zone (source)	Transitional zone (source, transport, and depositional)	Sediment depositional zone (response)
Upper Entiat ¹	Upper-Mid Entiat ¹	Lower Entiat ^{1*}
Headwaters Entiat	Lake-Silver-Pope ¹	Lower-Mid Entiat ¹
North Fork Entiat ¹	Brennegan-Preston	Mud Creek
Three Creek-Tommy ¹	Upper Mad ^{1 2}	Stormy-Potato ¹
Headwaters Mad ^{1 2}	Middle Mad ^{1 2}	Roaring-Tamarack ¹
		Mills-Dinkelman
		Swakane-Spencer
		Ribbon Mesa
		Navarre-Coulee
		Lower Mad ^{1 2}

¹ Sub-watersheds that provide habitat for steelhead, spring chinook, bull trout.

² The sub-watersheds of the Mad River are discussed in the Mad River Watershed section.

Significant sub-watersheds for a species are as defined in MacDonald et al. (1996). The original mapping in MacDonald et al. (1996) has been updated periodically with new information; in the case of the Entiat Sub-Basin the update occurred as part of Washington State Salmon Recovery work. Sub-watersheds are defined in MacDonald et al. (1996) as significant if they meet any one of the following criteria:

1. The sub-watershed was identified as a stronghold in the Interior Columbia Basin Ecosystem Management Plan Assessment.
2. The sub-watershed provides the primary spawning or rearing habitat for the species within the sub-basin.
3. The sub-watershed represents the only known occupied habitat within a fifth-field watershed and is fairly isolated from populations in other watersheds, and thus is significant from a distribution standpoint.
4. The sub-watershed contributes to the genetic integrity of a species.
5. The sub-watershed is known, or strongly suspected, to support a stable, strong population.

For the roads analysis process, sub-watersheds in the Entiat Sub-Basin that are significant for spring chinook salmon, steelhead, or bull trout have the greatest influence on the ranking of a road segment because these species are protected under the Endangered Species Act and therefore are a priority for consideration. Because the range of most of the salmonid species greatly overlap, road management activities that have a positive or negative impact on habitat for at-risk species should, in general, have a similar effect on habitat for other native salmonids.

Lake Chelan Sub-Basin

The Lake Chelan Sub-Basin is located along the eastern slopes of the Cascade Mountains between the Entiat and Methow Sub-Basins. The sub-basin drains into the Columbia River via the Chelan River approximately 35 miles upstream from Wenatchee. The watershed is oriented primarily in a northwest to southeast direction along the deeply glaciated valley. Lake Chelan is made up of approximately 50 miles of the 75-mile long basin. The drainage area is approximately 588,000 acres with 63 percent within the Wenatchee National Forest, 27 percent within the North Cascades National Park, and 10 percent in private ownership.

For analysis purposes, the Chelan sub-basin has been divided into three zones based on landform: the Upper Chelan zone, the Middle Chelan zone, and the Lower Chelan zone.

The Upper Chelan zone includes:

- The tributaries to Lake Chelan up-lake from and including Railroad Creek on the south shore.
- Up-lake but not including Fish Creek on the north shore.
- The Stehekin River.

The Middle Chelan zone includes:

- Drainages down-lake from Railroad Creek and up-lake of Twenty-Five Mile Creek on the South Shore.
- Drainages between and including Fish Creek and Safety Harbor Creek on the north shore.

The Lower Chelan zone is that part of the lake down-lake of and including Twenty-Five Mile Creek on the south shore and Falls Creek on the north shore.

There are no at-risk fish populations in the Chelan Sub-Basin. Anadromous fish are found only in the lower reaches of the Chelan River well below the National Forest boundary. A series of falls prevented anadromous fish access to the Lake Chelan basin since the end of the last Ice Age. Bull trout were native to Lake Chelan but appear to have been extirpated. Lake Chelan does provide popular sport fisheries primarily for introduced fish including kokanee salmon, chinook salmon, lake trout, and rainbow trout. Historically the only salmonids found in the lake basin were bull trout, west slope cutthroat trout (still present), and mountain whitefish.

Several small sub-watersheds that are on the Chelan Ranger District but not within the Chelan Sub-Basin are also included in this analysis. These small non-fish bearing streams, such as Antoine Creek, Washington Creek, and Navarre Coulee, are either intermittent or have very little perennial flow with no surface connection to the Columbia River. These will be grouped together as Columbia River tributaries.

Virtually all the roads are in the lower Chelan watershed. The only roads on National Forest land within the Upper Chelan zone are in the Railroad Creek Sub-Watershed. A few roads are located in the middle Chelan zone; these are located on ridge tops with little potential impact to fish habitat. The Middle Chelan zone roads are considered in the Lower Chelan portion of the analysis, because that is where the potential impact occurs. The Middle Chelan Zone will not be discussed further; only the Railroad Creek Sub-Watershed will be discussed for the Upper Chelan Zone.

C. Wildlife

This section describes the current wildlife conditions on the Entiat and Chelan Sub-Basins in order to develop an information base for making decisions about the road management and the effects of roads on wildlife. The sub-basin analysis will identify maintenance level 3-5 roads for management, prioritize watersheds for further analysis at the watershed scale based upon potential restoration needs for wildlife habitats, identify issues within watersheds, and establish the context for watershed scale roads analysis.

Roads definitions are from the grizzly bear core analysis process and have been used for wildlife analyses for several years. These analyses can be used to address wide-ranging carnivores, late-successional associated species, riparian-dependent species, ungulates, and unique habitats. Table X summarizes road-associated factors that affect wildlife habitats or populations (Wisdom et al. 1999). The analyses address the terrestrial wildlife (TW) roads analysis questions, TW-1, TW-2, TW-3, TW-4, and ecosystem functions (EF) question EF-2 identified in “Roads Analysis: Informing Decisions about Managing the National Forest Transportation System,” published by the U.S.D.A. Forest Service in 1999. The analyses described in this document are an adaptation of the TW questions to better address the issues and conditions on the Entiat and Chelan Sub-Basins.

C1. Wide-Ranging Carnivores

The wide-ranging carnivores covered in this assessment that are known or suspected to occur within the sub-basin include the gray wolf (endangered), wolverine (petitioned for listing), lynx (threatened)

and grizzly bear (threatened). The entire Lake Wenatchee-Leavenworth Sub-Basin is located within the North Cascades Grizzly Bear Recovery Zone. Several studies have documented the effects of road-associated factors on carnivores; these are summarized in Table 2. No conservation strategies or recovery plans currently exist for wolverines or gray wolves. A conservation strategy for lynx has been completed (Ruediger et al. 2000) but does not address potential indirect effects of roads on habitat quality. For all of these species, areas that are relatively free of human access provide refugium that is important for their long-term viability (Weaver et al. 1996). The availability of these areas is based on the amount of core area using the assessment process and definitions provided in Puchlerz and Servheen (1998).

C2. Late-Successional Associated Wildlife Species

Over 100 wildlife species on the Okanogan and Wenatchee National Forests are associated with late-successional forest (USDA FS 1997). The road-associated factors that have been identified to affect these species are shown in Table 2. These species include the northern spotted owl (threatened) and are managed through a network of late-successional reserves (LSRs) and managed late-successional areas (MLSAs) (USDA FS 1997). The Wenatchee National Forest’s Late-Successional Reserve Assessment (USDA FS 1997) identified a goal of providing a high level of habitat effectiveness within LSRs and MLSAs.

Levels of habitat effectiveness:

High: open road densities <1 mile/square mile of habitat and >70% security habitat (areas >500 miles from an open road or motorized trail)

Moderate: open road densities of 1-2 miles/square mile of habitat and 50-70% security habitat

Low: open road densities >2 miles/square mile of habitat and <50% security habitat.

C3. Riparian Dependent Wildlife Species

This group of wildlife species includes about 285 vertebrate species that are either directly dependent on riparian habitat or use these habitats far more than others (Thomas et al. 1979). Current management direction includes managing riparian areas and influence zones through a network of riparian reserves (USDA FS 1994). Riparian reserves provide habitat for wildlife species and are also important in providing habitat connectivity between areas managed for late-successional habitats. Within the dry surrounding area, riparian zones are wet, productive, well-defined microclimates and are used disproportionately by wildlife (Thomas et al. 1979). The road-associated factors that can affect riparian-dependent wildlife species are summarized in Table 2.

Table 2. Road-associated factors--Negatively affecting habitat or populations of wildlife species (based on Wisdom et al. 1999) and the wildlife species group for which effects of the road-associated factor has been documented

Road-associated factor	Effect of the factor	Wildlife group affected
Hunting	Non-sustainable or non-desired legal harvest by hunting facilitated by road access	Wide-ranging carnivores; Ungulates
Poaching	Increased illegal take of animals, as facilitated by roads	Wide-ranging carnivores; Ungulates

Road-associated factor	Effect of the factor	Wildlife group affected
Collisions	Death or injury resulting from a motorized vehicle running over or hitting an animal	Wide-ranging carnivores; Late-successional; Riparian dependent; Ungulates; Unique Habitats
Chronic negative human interactions	Increased mortality of animals (e.g. euthanasia or shooting) due to increased contact with humans, as facilitated by road access	Wide-ranging carnivores
Movement barrier	Interference with dispersal or other movements as posed by a road itself or by human activities on or near a road or road network	Wide-ranging carnivores; Late-successional; Riparian dependent; Ungulates; Unique habitats;
Displacement or avoidance	Spatial shifts in populations or individual animals away from a road or road network in relation to human activities on or near a road or road network	Wide-ranging carnivores; Late-successional; Riparian dependent; Ungulates; Unique habitats
Habitat loss and fragmentation	Loss and resulting fragmentation of habitat due to the establishment of roads, road networks, and associated human activities	Wide-ranging carnivores; Late-successional; Riparian dependent; Ungulates; Unique habitats

C4. Ungulates

These species include mule deer, elk, big horn sheep, and mountain goats. Current management is focused on maintaining or restoring habitat effectiveness within areas designated as winter range (Northwest Forest Plan Land Allocation EW-1). The road-associated factors that affect these species are summarized in Table 2. An important issue addressed in this assessment is the access that roads provide on winter ranges for snowmobiling and other winter activities. Winter is an important time for ungulates because food resources are limited and energy reserves are at or below maintenance levels (McCorquodale 1991). This assessment was based on the assumption that the road density on the winter ranges provides an index to the amount of winter human activity occurring. Should there be discrepancies between Forest Plan mapped winter range and actual winter range, this portion of the analysis will be conducted based on actual known winter range.

C5. Unique Habitats

Unique habitats include wetlands, talus slopes, caves, cliffs, snag patches, hardwood forests, meadows, etc., which provide important habitat for a wide variety of wildlife species. Unique habitats such as wetlands have special protection under the Northwest Forest Plan (USDA FS and USDI BLM 1994) and are managed by retaining buffers around them. Other unique habitats are managed on a site-specific basis through project design. The road-associated factors that can affect unique habitats are summarized in Table 2.

Road-associated factors that negatively affect habitat or populations of wildlife species (based on Wisdom et al. 1999) and the wildlife species group for which effects of the road-associated factor has been documented.

Entiat Watershed

The head of the Entiat River is a glaciated basin near the crest of the Cascade Mountains and flows southeasterly. It meets the Columbia River near the town of Entiat, about 20 miles upstream from Wenatchee. Topography is extremely steep and dissected. Vegetative cover is primarily forest but also includes a shrub/steppe component on the lower end and an alpine meadow component in the upper reaches.

The two major tributaries to the Entiat River are (1) the North Fork Entiat which joins the Entiat at river mile 33.0 and (2) the Mad River, which enters at river mile 10.5. The Entiat Watershed includes 10.3 miles of maintenance level 5 roads, 7.9 miles of maintenance level 4 roads, and 20.9 miles of maintenance level 3 roads. The major roads and travel routes in the watershed are listed in the following table.

Table 3. Major roads and travel routes within the Entiat Watershed

Road name	Road #	Maint. level	Description	Length (miles)
Entiat River	5100	10 miles—level 5; remaining—level 3	Major access road up the Entiat River; seven campgrounds, five trailheads.	
Entiat Ridge	5200	2	Branches off Entiat River Road, travels along Entiat Ridge.	
Dinkelman Ridge	5210	2	Together create 16-mile travel route between Dinkleman Ridge & Entiat Ridge Road.	
Dinkleman Tie	5210215	2		
Old Camp	5212	2		
Mud Creek	5300	3	Branches off Entiat River Road, follows Mud Creek for 4.5 miles, continues into the Columbia Breaks Watershed.	
	5310		Steliko Lookout located along this road.	
Murdock Road	5320	2	6.5 miles, travel route between Potato Creek & Mud Creek, passes over McKenzie Ridge.	6.5
Potato Creek	5380	2	Branches off Entiat River Road, follows Potato Creek, intersects with Slide Ridge Road.	5.5
Preston Creek	5501		Leaves Entiat River Road at	

Road name	Road #	Maint. level	Description	Length (miles)
			Brennegan Creek; provides 2.3 miles of mid-slope access to the south-facing slope below four-Mile Ridge.	
Tommy Creek	5605	1 st 6.3—level 4 Last 0.8 miles—level 3	Branches off the Entiat River Road follows Tommy Creek. Road 5605112 accesses M. Tommy Trailhead.	
Shady Pass Road	5900	4.2 miles—level 3 6.9 miles—level 2	Major travel route between Entiat River Road & Twenty-five Mile Creek in Chelan Watershed. 11 miles in Entiat Watershed. Road 5900112 branches off at Sandy Pass, accesses Big Hill.	
Slide Ridge	8410	2	Branches off Mud Creek, passes into Chelan Watershed near Baldy Mountain 10.5 miles beyond Mud Creek Road intersection.	

A. Human Use

A1. Public Use

The Entiat River and Mad River Watersheds provide visitors diverse recreation opportunities, including developed fee campgrounds in the lower valley, dispersed camps along roads and trail systems, and primitive camps in the Glacier Peak Wilderness areas near the Entiat River the headwaters. An extensive system of forest single-track trails provides recreationists with such opportunities as the highly-developed asphalt barrier-free trail within the Silver Falls Complex and numerous miles of multiple-use trails to more primitive trails in wilderness setting such as the 45-mile sheep drive along Borealis Ridge.

Recreational use throughout the Entiat valley has increased with the continued development in the valley and the proximity of the area to other population centers. Use of recreation facilities, such as developed campgrounds, declined slightly following the large fires of 1994 but has returned to levels typical of the mid-1990s. Based on trends in other developed recreation sites on the Wenatchee National Forest and local population trends, use is expected to show a steady increase over the next decade.

Developed recreation facilities are confined mostly to the main stem of the Entiat River; the one exception is the Pine Flats Campground along the Lower Mad River. Within the Entiat River Watershed are eight developed campgrounds, making a total of 103 individual campsites.

Dispersed camping is popular throughout the Entiat and Mad River Watersheds. These dispersed camps provide opportunities that are very different from those in developed campgrounds. Users of these areas seek privacy, lack of development, lower use levels, and the freedom to pursue activities that would not be appropriate at developed sites, such as the use of firearms and operation chainsaws. There are approximately 200 dispersed sites in the Entiat and Mad River Watersheds, 151 of which are mapped. Only camps within the Glacier Peak Wilderness Area have extensive conditions surveys on record. The majority of the camps are in the vicinity of water: near a lake, stream, river, or adjacent to a developed campground. Although these sites tend to be near water sources, less than half of the mapped sites are actually within a riparian reserve area. Some general geographic areas with known concentrations of camps are: Entiat Meadows, Larch Lakes, Ice Lakes, Mad Lake, and Tommy Creek. During the last five years several dispersed campsites in the Lower Mad River riparian area have been closed and rehabilitated.

Dispersed recreation activities also include hunting, fishing, hiking, photography, mushroom and berry gathering, firewood cutting, transplant digging, and Christmas tree cutting. These activities occur throughout the watershed at varying intensity levels depending on the time of year.

The Entiat and Mad River Watersheds have approximately 292 miles of maintained recreation trails. This extensive trail system is divided into four primary use categories: wilderness, multiple-use, non-motorized, and hiker only.

In the Entiat Ranger District one primary outfitter operates horse-packing trips in the Entiat and Mad River watersheds. The special-use permit for this outfitter is technically issued and administered by the Leavenworth Ranger District. Entiat Ranger District personnel review and approve the annual operating plan and trip itinerary and perform on the ground inspections of camps and outfitter activities.

For the 2000 summer packing season, 28 trips were included in the itinerary. Twelve trips were in the main stem of the Entiat River and twelve were in the North Fork Entiat drainage. Both of these areas are in the Transport Zone of the Entiat Watershed.

The primary winter recreation activity in the Entiat Watershed is snowmobiling. Snowmobile use continues to increase in popularity. We do not currently have any basis for estimating use, but a typical weekend day attracts more than 20 vehicles to the snow-parks. Within the Entiat Watershed, approximately 33 miles of trails are groomed for snowmobile use. Five miles of these groomed trails are in the Entiat Transport Zone and 28 are in the Transition Zone. In addition, all Forest Service roads that are not plowed for highway vehicle use are open as ungroomed routes. Open areas, such as meadows and existing clear-cut harvest units adjacent to both groomed and ungroomed routes, are frequently used as “play areas” by some snowmobilers.

The Entiat Watershed has one snow-park located 24 miles up the Entiat River Road #51. The Entiat Snow-Park is the only access point in the Entiat watershed for groomed snowmobile route access. Because this snow park also functions as a school bus turnaround, the Chelan County road maintenance crew plows the snow at the site. The Entiat Valley Road groomed route connects via Shady Pass Road groomed route to Twenty-Five Mile Snow-Park on the Chelan Ranger District.

Other winter recreation activities are cross-country skiing and winter camping. There are no groomed ski routes. The majority of use occurs on unplowed roads that intersect the Entiat Valley Road. A few users venture into the backcountry on skis for winter camping and mountaineering-type experiences.

A2. Resource Management

Vegetation in the watershed falls into five groups: shrub/steppe, open forest, closed forest, closed subalpine forest, and open subalpine forest/parkland-alpine meadows. Fire exclusion has influenced all these groups and has allowed the bitterbrush and sagebrush to increase in the shrub/steppe type. The more open, park-like forest communities were maintained by fire. Recently fire exclusion has allowed vegetation succession to change open forest to the closed, mid-elevation forest areas. These areas seldom experienced large-scale stand-replacement fires. However, the large fires of recent years (from 1988 to today), often catastrophic, have killed most trees and some understory plants. Historically, these stands were open and park-like with large, widely-scattered, fire-resistant trees. Now many of these stands are essentially devoid of any living trees; intense soil heating may have altered succession for many years from historical post-fire succession.

Noxious weeds are growing in the watershed, including cheatgrass, diffuse knapweed, oxeye daisy, and Dalmation toadflax. The Potato Creek Cattle Allotment and the Mosquito Ridge Sheep and Cattle Allotment fall within the watershed. Grazing is expected to continue on both allotments.

The information for this Human Use section was obtained from “Watershed Assessment, Entiat Analysis Area, Version 2.0,” (USDA FS 1996).

B1. Aquatics

The Depositional Zone (excluding the Columbia Breaks sub-watersheds) makes up 99,168 acres (37%) of the Entiat Watershed. Approximately 65,612 acres (68.0%) are publicly owned. Publicly-owned lands are administered by the Wenatchee National Forest, the U.S. Department of the Interior Bureau of Land Management, U.S. Department of the Interior Fish and Wildlife Services, and by the Washington Departments of Natural Resources and Fish & Wildlife. Approximately 31,660 acres (32.0%) are privately owned either by Longview Fibre Company or by individual landowners. Effects of public and private ownership on the Depositional Zone of the Entiat River include channelization, confinement by roads, timber harvest, stream cleanout, fire suppression, agricultural and private development, and hatchery operations within the riparian zone and grazing disturbances. All three at-risk populations utilize the Depositional Zone to some degree. Sub-watersheds include Lower Entiat, Lower-Mid Entiat, Mud Creek, Stormy-Potato, Roaring-Tamarack, Mills-Dinkleman.

B1a. Geologic Hazard - Score 6

Rating is elevated because of wildlife effects triggering debris slides. The response to these slides has created an exceptionally high level of in-channel sediment in this segment.

The Entiat River originates from the Entiat Glacier, descends through a relatively broad U-shaped glacial valley then continues to flow through a V-shaped non-glaciated valley before terminating at the Columbia River on a broad alluvial fan. The prominent terminal moraine near Decker Canyon (upstream from Potato Creek) represents a distinct boundary between the alpine glaciated reaches and the reaches cut by fluvial and hill slope processes.

The Depositional Zone extends from the mouth of the Entiat River to the terminal moraine at Decker Canyon. The reaches of the Entiat River from the mouth to the terminal moraine at Decker Canyon, are characterized by non-glaciated, Mountain (a Landtype Association) and strongly Dissected Mountain Slopes (a Landtype Association) formed by fluvial erosion, with secondary influences of mass wasting, primarily as shallow rapid debris slides. Side slopes commonly range from 30-60% but slopes exceeding 60% are typical along higher order rivers. Hill slopes are dissected by relatively high density, low order tributary streams forming a dendritic drainage pattern. Subsurface water storage capacity is low and surface runoff is collected and delivered rapidly to tributary streams. These landforms deliver sediment very efficiently. The Depositional Zone has a relatively high fine sediment loading.

B1b. Road-Related Fine Sediment - Score 6

The riparian sediment-buffering capacity of the Depositional Zone has been detrimentally altered due to high road densities, high riparian road densities, highly erodible soils, frequent wildfires, post-fire salvage logging. In the Stormy-Potato and Mud Creek Sub-Watersheds of the Depositional Zone, increased surface erosion, debris slides and mass wasting have occurred on some hill slope areas where vegetative ground cover is not adequate due to fire and roads, resulting in increased sediment delivery to those tributary streams. Periodic localized events (for example, debris/mud torrents from Potato Creek, 1997 and Stormy Creek, 1997) can temporarily raise sediment levels in downstream reaches of the Entiat River. The increases of fines in 2000 were the largest observed during the eight-year history sediment has been sampled in the Entiat River.

B1c. Floodplain Function, Off-Channel Habitat and Riparian Reserves - Score 10

Floodplain Function, and Off-Channel Habitat are functioning at risk and Riparian Reserves are functioning at unacceptable risk due to roads, logging, and channelization. Roads within riparian reserves, orchards, large woody debris removal, flooding, wildfire, grazing, and logging have all contributed to degraded riparian habitat.

B1d. Flow Effects - Score 6

The Depositional portion of the watershed is considered to be functioning at risk for road density and location. All sub-watersheds have more than 2.7 miles of road/sq.mi., with the Mills-Dinkleman sub-watershed containing almost 5 miles/sq.mi. Peak/base flows are functioning appropriately with no apparent change in flow magnitude or timing from the historical record.

B1e. At-Risk Fish Populations - Score 10

The Lower Entiat and Lower Mid-Entiat Sub-Watersheds are considered significant for steelhead, spring chinook salmon, and summer chinook salmon. Bull trout migrate through and may reside in the watershed but there is no known significant spawning or rearing. Habitat degradation prevents the depositional zone from being a refugia for the species but restoration is a priority and the watershed is important for long term persistence and recovery of the at-risk species and summer chinook within the sub-basin.

The existing habitat conditions information was obtained from the most recent environmental baseline. The baseline was established in the "Draft Biological Assessment for Steelhead, Spring and Summer

Chinook, Bull Trout and Cutthroat Trout in the Depositional Zone of the Entiat Watershed, Chelan County, Washington. Baseline Conditions and Effects of the Proposed Bockoven Land Interchange” (USDA FS 2001a). This draft was completed in spring 2001 and has yet to be finalized through consultation.

B2. Aquatics: Transitional and Transport Zone

B2a. Geologic Hazard - Score 6

The reaches of the Entiat River from the terminal moraine at Decker Canyon to the upper watershed segment are characterized primarily by Scoured Glacial Trough and Glacial Trough landforms along the Entiat Valley and Glaciated Mountain Slopes within tributary drainages.

Multiple advances of the Entiat glacier formed the upper slopes, ridges and headwalls within the Transitional and Transport Zone. Side slopes are extremely steep ($\geq 60\%$), rocky and irregular, with numerous ridges, cliffs and ledges. Boulder talus accumulates on ledges on lower slopes, glacial till is usually absent along upper trough walls but forms fairly continuous deposits along lower slopes. Trough walls are dissected by high gradient, poorly defined, low order parallel tributary stream patterns. Debris slides often originate from the tributary streams and form alluvial fans/debris cones in the Entiat Valley.

Glacial till deposits on lower trough walls intercept runoff and seepage from upper slopes and are important sources of stream flow regulation. These lower glacial till deposits also have frequent seeps and springs, which can buffer stream temperature. Surface runoff is concentrated in the tributary streams and delivers sediment efficiently. The landforms in this zone contribute and deliver a high level of coarse sediment (coarse sand to boulder size alluvium) to the Entiat River.

Nearly level terraces and floodplains characterize valley bottom landforms upstream of the Decker Moraine. A fair amount of uniform coarse sandy sediment has accumulated upstream of the moraine suggesting that at one time this was an impoundment reach. The Entiat River channel in this segment is meandering. Upstream of the suspected impoundment reach, the Entiat River alluvium consists of larger sized material, and stream sinuosity reduces dramatically.

B2b. Road-Related Fine Sediment - Score 9

The Wenatchee National Forest has been monitoring sediment annually in the Entiat River using McNeil Core sampling since 1993. Sampling sites located in the Transition Zone are noted in Table X.

The riparian sediment-buffering capacity of the Transport and Transition Zones is mostly intact except for minor localized areas at developed campgrounds. Periodic localized events (such as debris/mud torrent from Preston Creek, June 1972) can temporarily raise sediment levels in downstream reaches of the Entiat River. Although fines appear to be in a declining trend for the Entiat River, overall there is still a high level of concern regarding fine sediment in the Depositional Zone where the majority spring chinook spawning occurs.

Table 4. Annual sediment sampling data, Entiat Ranger District, 1993-1998

Sample site	1999 % Fines <1.00mm	1999 % Fines <0.85mm	1998 % Fines <1.0mm	1998 % Fines <0.85mm	1997 % Fines <1.0mm	1997 % Fines <0.85mm	1996 % Fines <1.0mm	1995 % Fines <1.0mm	1994 % Fines <1.0mm	1993 % Fines <1.0mm
Reach 2 Entiat River										
@ Burnes Cr.	13.51	11.44	18.30	16.68	13.12	10.47				
@WNF Boundary	11.69	9.96	13.42	11.80	8.28	7.03				
@Fox Cr.	15.06	13.77	15.26	13.74	22.11	20.62				
Reach Mean	13.42	11.72	15.39	14.07	14.50	12.71	15.28	15.06	14.95	17.42
Reach 3 Entiat River										
@Box Canyon	11.77	7.67	8.72	7.23	13.89	8.93				
@Silver Falls	13.80	11.89	11.67	9.94	9.25	6.87				
@Entiat Falls	13.50	11.56	9.84	7.61	9.56	6.59				
Reach Mean	13.02	10.37	10.07	8.26	10.90	7.47	14.42	12.48	16.24	14.98

Values reported are sample means ($n=12$ per reach).

For the Entiat Watershed Analysis (WNF 1996), sub-watersheds were placed in one of three categories based on a comparison of fine sediment in the sub-watershed with current Forest Plan Standard for percent fine sediment in channel substrate:

Red = >20 percent fine sediment (unacceptable risk)

Yellow = 15 to 20 percent fine sediment (at risk)

Green = <15 percent fine sediment (appropriate)

These determinations were based on percent fines in the mainstem Entiat River as measured by core sampling, visual evaluation of the level of embeddedness determined as part of stream surveys, and professional judgment based on knowledge of field conditions. The Transport Zone was rated as green and the Transition Zone overall was rated as yellow with two of the five sub-watersheds having a high slope delivery efficiency. Based on the results of six years of sediment sampling, the Entiat River transitional area is considered to be functioning at risk for spring chinook, steelhead, cutthroat and bull trout. Roads are accelerating sediment delivery, especially in some sub-watersheds within the Transition Zone and road density and location are considered to be functioning at unacceptable risk.

B2c. Floodplain Function, Off-Channel Habitat, Riparian Reserves - Score 6

While most off-channel habitat appears to be intact and functioning appropriately in the Transport and Transitional Zones, riparian roads and development have impinged on the floodplain. Floodplain connectivity is judged to be functioning at risk because of development and roads in the lower Transition Zone.

B2d. Flow Effects (Score 6)

Road density and location are not a major concern in the Transport Zone, but due to extensive road development, the Drainage Network Indicator and road density/location indicators are judged to be functioning at risk and functioning at unacceptable risk respectively in the Transitional Zone. The peak/base flow indicator is rated as functioning at risk primarily due to evidence of increased peak flow. The extent to which the apparent change is due to fire, above normal snow pack, the elimination of beaver, and development within riparian areas and roads, is not known.

B2e. At-Risk Fish Populations (Score 6)

The Upper Mid-Entiat is significant for bull trout, and spring chinook salmon. Steelhead are also present in the Upper-Mid Entiat. Some road crossings prevent fish from accessing all potential habitats but for the most part natural connectivity between streams is maintained. Natural falls prevent access to a number of tributaries from the Entiat River and Entiat Falls is a natural barrier that prevents migratory fish access to the Transport Zone.

The existing habitat condition information was obtained from the most recent environmental baseline. The baseline was established in the “Draft Biological Assessment for Steelhead, Spring and Summer Chinook, Bull Trout and Cutthroat Trout, Preston/Fox Analysis Area” (Wenatchee National Forest, Entiat Ranger District, Chelan, WA, draft 2001b). Information was also obtained from more recent monitoring data and discussions with Phil Archibald, Entiat District Fish Biologist (Archibald 2002).

C. Wildlife

The Entiat Watershed is a large watershed that follows the Entiat River. Road densities are extremely high, as this watershed provides high levels of human access to private lands, numerous trailheads and wilderness. This high level of human use has created unsatisfactory habitat conditions and numerous opportunities for improvement.

C1. Wide-Ranging Carnivores

The open road density in the Entiat Watershed is high, at 2.37 mi/mi². Only 30.8% of the watershed is core, for a total of 64,598 acres. This core habitat exists in a patchy distribution across the watershed. The entire area of three Lynx Analysis Units (LAU) (Lake Basin, Pyramid and Upper Entiat) and portions of three other LAUs (Chumstick Mountain., Cougar, and Garland), are found in this watershed. Table 5 describes the road density of those portions within the Entiat Watershed. A description of each LAU in its entirety is available in Appendix C.

C2. Late-Successional Associated Wildlife Species

A 38,495-acre portion of the Shady Pass LSR occupies about 18.4% of the Entiat Watershed. This LSR is in good condition with a moderate security habitat rating and a high habitat effectiveness rating.

C3. Riparian-Dependent Wildlife Species

Riparian reserves occupy approximately 15,833 acres (7.6%) of the Entiat Watershed. The open road density within the riparian reserves is high, at 2.6 mi/mi².

C4. Ungulates

The Entiat Watershed provides mapped winter range (EW-1) within the Entiat Sub-basin. There are 14,364 acres (6.8%) of winter range with a high open road density of 3.1 mi/mi². The Entiat Watershed is also a site of migration, particularly from the Lake Wenatchee-Leavenworth Sub-Basin, and fawning and lambing areas.

Table 5. Road density of Lynx Analysis Units within the Entiat Watershed

LAU	Miles of open road	Area w/in watershed (mi ²)	Road density (mi/mi ²)
Chumstick Mtn.	110.2	20.1	5.5
Cougar	38.8	23.7	1.6
Garland	5.2	30.1	0.2
Lake Basin	198.6	54.3	3.7
Pyramid	37.8	37.0	1.0
Upper Entiat	0	45.2	0

Mean Road Density = 2.0 mi/mi²

C5. Unique Habitats

Unique habitats are not currently mapped within the Entiat Sub-Basin.

Mad River Watershed

The Mad River is a major tributary of the Entiat River, and part of the glaciated basin that begins near the crest of the Cascade Mountains and flows southeasterly. The Mad River meets the Entiat at river mile 10.5. The topography is gentler than that of the Entiat Watershed. Vegetative cover is primarily forest but also includes a shrub/steppe component on the lower end and an alpine meadow component in the upper reaches.

The Mad River watershed is 58,289 acres. Approximately 55,900 acres are in public ownership, primarily managed by the Okanogan and Wenatchee National Forests with a lesser amount managed by the Washington Departments of Natural Resources and Fish and Wildlife (1,450 acres). There are 2,997 acres of private land within the watershed, some of which are classified as prime agricultural land. There are 12.4 miles of maintenance level 4 roads, and 10.8 miles of maintenance level 3 roads within the Mad River Watershed. There are no maintenance level 5 roads.

Mad River Road (5700) is the main road up the Mad River. The first 12.4 miles are a maintenance level 4, and the remaining 1.8 miles are a maintenance level 3. The Pine Flat Campground (road 5700100) is located along this road. Tillicum Road (5800) is another major road in the Mad River Watershed. It branches off the Mad River Road, and follows Tillicum Creek to Entiat Ridge Road at the top of the ridge. It is 9 miles long, and a maintenance level 3 road.

Roaring Ridge Road (5801) loops off Tillicum Road and follows Roaring Ridge for 16.7 miles as a maintenance level 2 road. Rothrock Road (5810) is a travel route between Tillicum Road and Roaring Ridge Road. It passes over Moe and Rothrock Ridge, and accesses a section of Washington State Department of Wildlife land. It is 7.3 miles long, and is a maintenance level 2.

A. Human Use

A1. Public Use

The Mad River Watershed provides users a diverse recreation experience, ranging from a developed campground to undeveloped primitive camps, and primitive and single track trails. The Pine Flats Campground is located along the Mad River Road.

The Upper Mad River area is the most popular destination within the 292-mile trail system on the Entiat District. The gentle topography of this area makes this an attractive recreation area.

A2. Resource Management

Vegetation in the watershed falls into five groups: shrub/steppe, open forest, closed forest, closed subalpine forest, and open subalpine forest/parkland-alpine meadows. Fire suppression has influenced all these groups. Fire suppression has allowed the bitterbrush and sagebrush to increase in the shrub/steppe type. Fire maintained more open, park-like forest communities in most of what was, until recently, the closed, mid-elevation forest areas. These areas seldom experienced large-scale stand-replacement fires. However, the large fires of recent years (going back to 1970) have often been catastrophic and have consequently killed most trees and some understory plants. Historically, these stands were open and park-like with large, widely-scattered, fire-resistant trees. Now many of these stands are essentially devoid of any living trees and intense soil heating may have altered succession for many years from historical post-fire succession.

Noxious weeds are growing in the watershed, including cheatgrass, diffuse knapweed, oxeye daisy, and Dalmation toadflax.

A portion of the Mosquito Ridge Sheep and Cattle Allotment falls within the Watershed. Grazing is expected to continue on the allotment.

B. Aquatics

The Mad River watershed is designated as a Key Watershed under the Northwest Forest Plan. Sub-watersheds are the Headwaters Mad, Upper Mad, Middle Mad, and Lower Mad. All three at-risk fish species inhabit the watershed.

B1. Geologic Hazard - Score 2

The Mad River originates in a rolling glacial highland, descends through a relatively narrow U-shaped glacial valley and then continues to flow through a V-shaped non-glaciated valley before terminating at the Entiat River on a broad alluvial fan. The prominent terminal glacial near the confluence of Cougar Creek represents a distinct boundary between the alpine glaciated reaches and reaches cut by fluvial and hill slope processes. The discussion below provides an explanation why the reaches above and below Cougar Creek are different.

Mad River above Cougar Creek

The Mad River above Cougar Creek is made up mainly of glaciated mountain slopes and glacial cirques landforms. These land-surfaces are basically comprised of smooth, rocky, moderately broad, convex ridges and upper side slopes. Landscapes have varying thickness of glacial till deposits depending upon slope position. The upper Mad River valley consists of relative narrow U-shaped valley bottoms with side slopes commonly greater than 45%. Undifferentiated landslides occur on lower gradient side slopes just down stream of Miners Creek. All of these landforms contribute to relatively high subsurface water storage, which tends to contribute to good regulation of stream flow; fairly frequent seeps and springs on lower slopes.

Mad River below Cougar Creek

The landscape of the lower Mad River is dominated by moderate to steeply Dissected Mountain Slopes formed by fluvial erosion, with secondary influences from mass wasting. Side slopes commonly exceed 45%. This section of the Mad River is deeply incised in a narrow V-shaped valley. Hill slopes are dissected by moderate density, low order tributary streams, forming dendritic pattern. These land-surfaces are relatively efficient at delivery of sediment and contribute low subsurface water storage and limited stream flow regulation. Seeps and springs are not common in this segment. Undifferentiated landslides occur on some lower gradient side slopes in the vicinity of Alma Creek. These landslides contribute to higher water storage capacities, and, depending on size, may be important to base flow regulation in this generally dry landscape.

B2. Road-Related Fine Sediment - Score 3

Sediment in the lower reaches of the Mad River where steelhead and chinook spawn have been monitored since 1995 using McNeil core samples. Yearly mean sediment values have been increasing since 1998, possibly due to a mud/debris torrent that entered the Mad River near river mile 15, below the Miner's Creek confluence, in spring 1999. Fine sediment does not appear to be a problem in the reaches of the Mad where bull trout spawn. The Mad River is considered functioning appropriately for bull trout and functioning at risk for steelhead and spring chinook.

B3. Floodplain Function, Off-Channel Habitat and Riparian Reserves - Score 3

Channelization, County road 119/FS Road 5700, and development in the form of orchards and the town of Ardenvoir have affected the floodplain, off-channel, and riparian habitat in the lowest reach of the Mad River. The lower reaches of Tillicum Creek riparian reserves habitat has been impacted by logging and fire but a strong brush component anchors stream banks and shades the stream. Elsewhere in the watershed the three habitat elements are considered to be functioning appropriately but functioning at risk in the lower reach.

B4. Flow Effects - Score 6

Peak and Base flows are functioning appropriately. Road density in the Mad River watershed as a whole is 3.5 miles/sq.mi. with 0.2 miles/sq.mi. located within riparian reserves. The majority of the road mileage is located within the Lower and Middle Mad Sub-Watersheds making the lower portion of the Mad where salmon and steelhead spawn functioning at unacceptable risk. The Upper and Headwaters Mad Sub-Watersheds are functioning appropriately.

B5. At-Risk Fish Populations - Score 9

The Mad River is the bull trout refugia within the Entiat Sub-Basin with the Middle, Upper and Headwaters Mad Sub-Watersheds considered significant. The Lower and Middle Mad are also considered significant for steelhead. Spring chinook salmon are found in the Lower and Middle Mad, as well.

The existing habitat condition information was obtained from the most recent environmental baseline. The baseline was established in the “Draft Biological Assessment for Steelhead, Spring Chinook, Bull Trout and Cutthroat Trout in the Mad River Watershed Chelan County, Washington. Baseline Conditions and Effects of Mad River Trail Improvement Projects” (USDA FS 2001c).

C. Wildlife

The Mad River Watershed covers a relatively small area on the southwest side of the Entiat Sub-Basin. The Mad River Watershed is a site of high human use, throughout the year, and has moderate potential for improvement.

C1. Wide-Ranging Carnivores

The open road density in the Mad River Watershed is extremely high at 3.5 mi/mi². Core habitat is also extremely limited. Only 12.9% of the watershed is core, for a total of 7,504 acres. Portions of three LAUs fall within the Mad River Watershed. The following table describes the road density of those portions within the Mad River Watershed. A description of each LAU in its entirety is available in Appendix C.

C2. Late-Successional Associated Wildlife Species

A portion of the Chiwawa LSR is found within the Mad River Watershed. The LSR covers approximately 22,232 acres (38.4%) of the watershed. The security habitat rating for the Chiwawa LSR is low while the habitat effectiveness rating is moderate.

Table 6. Road density of Lynx Analysis Units within the Mad River Watershed

LAU	Miles of open road	Area w/in Watershed (mi ²)	Road Density (mi/mi ²)
Chumstick Mtn.	98.9	16.3	6.1
Cougar	95.0	55.2	1.7
Garland	0	1.6	0

Mean Road Density = 2.6 mi/mi²

C3. Riparian-Dependent Wildlife Species

Riparian reserves are limited and occupy only 6,699 acres (11.6%) of the Mad River Watershed. The open road density within the riparian reserves is moderate, 1.8 mi/mi².

C4. Ungulates

The Mad River Watershed contains no mapped winter range; however, there are areas of unmapped winter range used by deer. Roads within this watershed currently allow snowmobile access to winter range areas. The Mad River Watershed also provides areas important to deer fawning.

C5. Unique Habitats

Unique habitats are not currently mapped within the Entiat Sub-Basin, so are not included in this analysis.

Columbia Breaks Watershed

The Columbia Breaks Watershed is made up of a number of small drainages on the Columbia River Breaks, between the Wenatchee River and Knapp Coulee. The topography in the Columbia Breaks is generally very steep and dissected. Cliff and rock features are common, providing not only dramatic scenery but also unique plant and animal habitats. Vegetative cover is primarily shrub/steppe and open forest, but also includes closed forest on north slopes in stringers and in the upper reaches.

The Chelan Watershed includes 12.4 miles of maintenance level 3 roads. There are no maintenance level 5 or 4 roads.

The Columbia Breaks Watershed is comprised of a number of small drainages on the Columbia River Breaks, between the Wenatchee River and the Methow River. The topography in the Columbia Breaks is generally very steep and dissected. Cliff and rock features are common, providing not only dramatic scenery but also unique plant and animal habitats. Vegetative cover is primarily shrub/steppe and open forest, but also includes closed forest on north slopes in stringers and in the upper reaches. The major roads and travel routes in the watershed are listed in the following table.

Table 7. Major roads and travel routes within the Columbia Breaks Watershed

Road name	Road #	Maint. level	Description	Length (miles)
Mud Creek	5300	2	Branches off the Navarre Coulee road,; provides a travel route to Mad Creek in the Entiat Watershed	1.4
Swakane Road	7415	2	Branches off Highway 97A, and follows Swakane Creek through a section of Washington State Department of Wildlife land	7.5
Washington	8021	3	Continues past Echo Ridge to	1 ½

Road name	Road #	Maint. level	Description	Length (miles)
Creek Road			Cooper Mt. Road and Cooper Ridge; continues into the Chelan Watershed once it crosses Cooper Ridge	
Antoine Creek Road	8140	3	Accesses the south-facing slopes above Antoine Creek, and continues for 10.6 miles to Grade Creek at Cooper Corral Spring	10.6

A. Human Use

A1. Human Use

The Columbia Breaks Watershed is the backdrop setting from U.S. Highways 97, 97A, and 971, and for rural communities and summer homes along the Columbia River. Mud Creek Road (5300) provides a travel route between the Entiat River and Navarre Coulee. Road 7415000 (Swakane) comes off the Derby Canyon Road (7400000) on the Leavenworth Ranger District, and travels to Lincoln Rock on the Columbia River.

Echo Ridge Ski Area is located on Road 8021000 (Washington Creek). This road branches off Road 8200000 and loops along Washington Creek, then back to Grade Creek. Most of the recreation use in the Watershed is dispersed, with the exception of Echo Ridge Ski Area.

A2. Resource Management

Vegetation in the watershed falls into five groups: shrub/steppe, open forest, closed forest, closed subalpine forest, and open subalpine forest/parkland-alpine meadows. Fire suppression has influenced all these groups. Fire suppression has allowed the bitterbrush and sagebrush to increase in the shrub/steppe type. Fire maintained more open, park-like forest communities in most of what was, until recently, the closed, mid-elevation forest areas. These areas seldom experienced large-scale stand-replacement fires. However, the large fires of recent years (going back to 1970) have often been catastrophic in nature and have consequently killed most trees and some understory plants as well. Historically, these stands were open and park-like with large, widely-scattered, fire-resistant trees. Now, many of these stands are essentially devoid of any living trees and intense soil heating may have altered succession for many years from historical post-fire succession.

Noxious weeds are growing in the watershed, including cheatgrass, diffuse knapweed, oxeye daisy, and Dalmation toadflax. A portion of the Potato Creek Cattle Allotment falls within the Watershed. Grazing is expected to continue on the allotment.

The information for this Human Use section was obtained from “Watershed Assessment, Entiat Analysis Area, Version 2.0,” (USDA FS, 1996).

B. Aquatics

The Columbia River tributaries are made up of a number of small drainages on the Columbia River Breaks, between the Wenatchee River and Knapp Coulee. These Columbia River tributaries include Swakane Creek, Tenas George Canyon, Spencer Canyon, McKinstry Canyon, Byrd Canyon, Oklahoma gulch, Navarre Coulee and many smaller, unnamed drainages along the Breaks.

The majority of the watersheds are in private ownership, with federal lands occurring in the upper portion of the watershed and in scattered tracts. Topography is generally very steep and dissected. Cliff and rock features are common, providing not only dramatic scenery but also unique plant and animal habitats. Vegetative cover is primarily shrub-steppe and open forest, but also includes closed forest on north slopes in stringers and in the upper reaches. Mean annual runoff is low, with stream flow from these tributaries being strictly intermittent. These streams are not fish bearing other than Swakane, which has been stocked with brook trout in the past.

The confluences of the streams have been permanently and drastically altered by road fill for Highway 97A, railroad grade fill, and the creation of Lake Entiat behind Rocky Reach Dam on the Columbia River.

B1. Geological Hazard - Score 6

Discussion is included in the Depositional Zone discussion.

B2. Fine Sediment - Score 3

Rating is based on streams being non fish bearing and having little effect on downstream habitat since they feed directly into the Columbia. The streams are considered to be functioning appropriately.

B3. Floodplain Function, Off-Channel Habitat, Riparian Reserves (Score 9)

Ratings based on the mouths of streams have been altered with the urbanization of the area and private lands.

B4. Flow Effects - Score 3

Because mean annual runoff is low peak flows are of low concern, flows are considered to be functioning appropriately.

B5. At-Risk Fish Populations - Score 0

Because streams are non fish bearing there are no at-risk populations present.

C. Wildlife

The Columbia Breaks Watershed covers a small area on the eastern side of the Entiat Sub-Basin. This watershed experiences high-level human use by providing access to private land and access from Highway 97A. This watershed has moderate potential for improvement. (Note: In this discussion, numbers presented in (%) are a percentage of the corresponding watershed acreage.)

C1. Wide-Ranging Carnivores

The open road density in the Columbia Breaks Watershed is high at 2.13 mi/mi². Only 28.3% of the watershed is core habitat, for a total of 15,520 acres. A small portion (8.7 mi²) of the Chumstick Mountain LAU falls within the Columbia Breaks Watershed. There are 16.2 miles of open road within this part of the LAU, resulting in a moderate road density of 1.9 mi/mi². A description of this LAU in its entirety is available in Appendix C.

C2. Late-Successional Associated Wildlife Species

No Late-Successional Reserves or Managed Late Successional Areas are located within the Columbia Breaks Watershed.

C3. Riparian Dependent Wildlife Species

Riparian reserves occupy approximately 2,483 acres (5%) of the Columbia Breaks Watershed. The open road density within the riparian reserves is high, 3.7 mi/mi².

C4. Ungulates

The Columbia Breaks Watershed contains the greatest amount of mapped ungulate winter range (EW-1) within the Entiat Sub-Basin. There are 20,874 acres (38.1%) of winter range with a moderate open road density of 1.2 mi/mi². Many areas within the watershed, especially near the Columbia River, are also used by deer and bighorn sheep for spring and summer range, and for fawning and lambing.

C5. Unique Habitats

Unique habitats are not currently mapped within the Entiat Sub-Basin.

Chelan Watershed

The Chelan Watershed is located along the eastern slopes of the Cascade Mountains. The watershed is oriented primarily in a northwest to southeast direction along the deeply glaciated valley. Lake Chelan makes up approximately 50 miles of the 75 mile-long river basin, and is considered a unique geologic feature of North America.

The drainage is approximately 588,000 acres in size with 63% in National Forest, 27% National Park or National Recreation Area, and 10% in private ownership. Precipitation ranges from 150 inches near the Cascade Crest to 10 inches at the Columbia River. Elevation ranges from over 9,000 feet at the Cascade crest to 700 feet at the Columbia River.

The main access routes within the watershed include the following:

Shady Pass Road (5900) leaves Lake Chelan at Twenty-Five Mile Creek, and is a travel route to the Entiat Watershed over Entiat Ridge. There are several developed recreation sites along the 14.8-mile section of this maintenance level 2 road.

Cooper Mountain Road (8020) follows Cooper Ridge for 21.5 miles at a maintenance level 2.

Road 8021000 (Washington Creek) branches off 8020000 at Echo Ridge, and reconnects along Cooper Ridge. There are 4 miles of this road within the Chelan Watershed, at a maintenance level 2.

Grade Creek Road (8200) is the major road through the south-facing slopes of the north shore of Lake Chelan. There are developed and dispersed recreation sites along the road. It is 39.1 miles long, and a maintenance level 2.

Railroad Creek Road (8301) is the 11.5-mile road between Lucerne and Holden Village on the south side of Lake Chelan. It is a maintenance level 3. It can only be reached by boat.

Fields Point Road (8405) is the road in the Fields Point Landing. This half-mile, maintenance level 5 road is in the picnic area, parking lot, and boat launch at the facility. State Route 971 provides the access up to Fields Point Road. Slide Ridge Road (8410) passes between the Chelan and Entiat Watersheds along Slide Ridge. Approximately 19.2 miles are in the Chelan Watershed, with a maintenance level of 2.

A. Human Use

A1. Public Use

Due to its remarkable scenic quality, Lake Chelan has become one of Washington's premier destination resorts. It is a regional and national attraction because it is the main portal to the Lake Chelan National Recreation Area, and the southern portion of North Cascades National Park. The lake is pristine in water quality and offers amazing clarity and a beautiful sapphire hue. Rising directly from its shores are the rugged mountains of the North Cascade Range.

Recreation opportunities are dependent primarily on the topography and the type of access available. Much of the watershed is unroaded, and accessible only by boat, plane, or on foot or horseback. The southeastern portion of the watershed consists of roaded rural and urban areas, unroaded backcountry areas, and a mix of private and public ownerships.

There are approximately 250 miles of system roads in the watershed. These can be divided into two major groups; North shore roads, and South shore roads. The roads allow access to eight developed campgrounds and several dispersed camping areas. Use is heaviest during the holiday weekends, summer weekends, and deer hunting season. Field's Point Landing, on National Forest System Land, is a major point of departure for "Lady of the Lake" boat users. Current facilities include a 400-car parking lot, restrooms, a picnic area, orientation center, and gift shop.

A2. Resource Management

Four natural fire regimes have been identified in the Chelan Watershed: low, moderate, high, and other areas with minimal influence by fire. Approximately 28% of the basin has been classified as having a low fire regime, naturally experiencing frequent, light surface fire (1-25 year fire-free interval). Approximately 18% has a moderate fire regime, with short return interval crown/severe surface fires (25-100 year fire-free intervals). Forty-three percent of the basin has a high fire regime, with long return interval crown/severe surface fires (100-300 year fire-free intervals). Non-forest and riparian areas are distributed throughout the watershed. These areas are classified as experiencing either infrequent, light surface fires, or little fire influence.

The watershed supports approximately 50% forested climax plant communities, and 50% non-forest communities and specialized habitats. Approximately 16% of the forested communities are in the Douglas-fir series. The ponderosa pine series covers approximately 5%, and mountain hemlock series covers another 5%. The rest of the area supports grand fir, western hemlock, silver fir, subalpine fir, white bark pine, and subalpine larch. The non-forest communities include meadow and shrub communities.

Noxious weed species of primary concern, occurring within, on the approach to, or threaten the watershed include common crupina, knapweeds, yellow star thistle, dalmation toadflax, Eurasian water-millfoil, mullien, St. John's wort, and scotchbroom.

The information for this section was obtained from the “Chelan Basin Watershed Assessment” (USDA FS, 1995a), the “North Shore of Lake Chelan Watershed Analysis” (USDA FS, 1998), and the “First/Twenty-Five Mile Creek Watershed Analysis” (USDA FS, 1995b).

B1. Aquatics: Railroad Creek Zone

Railroad Creek Zone

After the Stehekin River, Railroad Creek is the largest tributary to Lake Chelan, contributing about 9% of the annual inflow to the lake, or about one-half the inflow of all other tributaries combined exclusive of the Stehekin. Railroad Creek road runs from Lucerne at the shore of Lake Chelan about 14 miles to Holden Village, a retreat owned by the Lutheran Church.

B1a. Geologic Hazard - Score 2

The Railroad Creek watershed is characterized primarily by scoured glacial trough and glacial trough landforms.

Multiple advances of alpine and continental glaciers scoured the upper slopes, ridges, and headwalls in Railroad Creek. Side slopes are extremely steep ($\geq 60\%$), rocky and irregular, with numerous ridges, cliffs and ledges. Boulder talus accumulates on ledges on lower slopes. Glacial till is usually absent along upper trough walls but forms fairly continuous deposits along lower slopes. Trough walls are dissected by high gradient, poorly defined, low order parallel tributary stream patterns. Debris slides often originate from the tributary streams and form alluvial fans/debris cones in the Railroad Creek Valley.

Glacial till deposits on lower trough walls intercept runoff and seepage from upper slopes and are important sources of stream flow regulation. These lower glacial till deposits also have frequent seeps and springs, which can buffer stream temperature. Surface runoff is concentrated in the tributary streams and delivers sediment efficiently. The landforms in this zone contribute and deliver a high level of coarse sediment (coarse sand to boulder-size alluvium).

Roads in the Railroad Creek watershed are located upslope on alluvial fan benches. Other than naturally-occurring stream diversions on these fans, which can wash over the road, the road system has been fairly stable.

B1b. Road-Related Fine Sediment - Score 3

Railroad Creek has a relatively high sediment load due to the input of glacial sediment. However, the greatest adverse impact to fish habitat including sediment is material from the Holden Mine tailings. There is some erosion off Railroad Creek road especially where the road crosses tributaries.

B1c. Floodplain Function, Off-Channel Habitat and Riparian Reserves - Score 3

The Holden Mine has had the greatest impact on floodplain function, off-channel habitat, and riparian reserves. The mine tailings are located in the historic floodplain of Railroad Creek confining both Railroad and Copper Creeks. Holden Village is located within the Railroad Creek riparian reserve. Railroad Creek has also been confined where it enters its alluvial fan at Lucerne to protect development. Roads themselves have had little impact.

B1d. Flow Effects - Score 1

The 12 miles of Railroad Creek road represent 99% of the roads in the watershed. Roads are not believed to have any significant influence on flow.

B1e. At-Risk Fish Populations - Score 0

There are no at-risk fish in the Chelan basin. Native cutthroat trout are present as are introduced rainbow trout. Introduced kokanee salmon, a very popular sport fish, spawn in lower Railroad Creek but the Railroad Creek Sub-Watershed is not considered significant for either kokanee or west slope cutthroat.

The existing habitat condition information was obtained from the “Chelan Basin Watershed Analysis, March” (USDA FS 1995a), the “Middle Chelan Watershed Assessment” (USDA FS, 1999b) and the “Draft Upper Chelan Watershed Assessment” (USDA FS, 2000a), Additional information was provided from recent monitoring data on file with the Wenatchee National Forest, and the “Fisheries Biological Assessment for First Creek Project” (USDA FS, 2000b).

B2. Aquatics: Lower Chelan Zone

This zone contains most of the roads in the Chelan Sub-Basin. The Lower Chelan zone is that part of the lake down-lake of and including Twenty-Five Mile Creek on the south shore and Falls Creek on the north shore. Virtually all the roads and developments within the sub-basin have occurred in the Lower Chelan watershed. Development around the towns of Chelan and Manson, past grazing, timber harvest, wildfires and the construction of Chelan dam have all had an influence on the current watershed and stream channel conditions. This portion of the Lake Chelan basin is very dry with an annual average precipitation of only eleven inches at the town of Chelan and contributing about one percent of the annual discharge in the basin. Tributary streams include Twenty-Five mile Creek, First Creek, Mitchell Creek, Grade Creek, Coyote Creek, Gold Creek, and Falls Creek.

B2a. Geologic Hazard - Score 6

Elevated rating due to wildfire effects triggering debris slides. The response to these slides has created an exceptionally high level of in channel sediment in this segment.

The Lower Chelan zone is characterized by non-glaciated, strongly dissected mountain slopes formed by fluvial erosion, with secondary influences of mass wasting, primarily as shallow rapid debris slides. Side slopes commonly range from 30-60% but slopes exceeding 60% are typical. Hill slopes are dissected by relatively high density, low order tributary streams forming a dendritic drainage pattern. Subsurface water storage capacity is low; however surface runoff is collected and delivered rapidly to tributary streams. These landforms delivery sediment very efficiently. The depositional zone has a relatively high fine sediment loading. Most valley bottoms in this zone have accumulated fine sediment derived of volcanic ash and weather crystalline bedrock.

B2b. Road-Related Fine Sediment - Score 6

Erosion from road fill slopes, and drainage problems on the many native surface roads has accelerated fine sediment delivery to stream channels.

B2c. Floodplain Function, Off-Channel Habitat and Riparian Reserves - Score 9

Streams are predominately high gradient with little floodplain or off-channel habitat potential. Other than a few valley bottom roads such as in First Creek, Twenty-Five Mile Creek and, to a lesser degree, the Grade Creek road system and roads surrounding the developed private lands, most roads are not confining channels. However, the Grade Creek Road crosses seven major tributaries. The crossings are fish passage barriers, are contributing to fine sediment delivery especially at the approaches, and are probably under-sized. Riparian reserves have been heavily affected in the private lands developed for homes and orchards and the valley bottom roads mentioned above.

B2d. Flow Effects - Score 3

No sub-watersheds have two miles of road per square mile of watershed area. The Slide Ridge, Antilon-Joe, Coyote-Camas, and Falls Sub-Watersheds have road densities over one mile per square mile. There is a concern, however, that the roads may be accelerating water and sediment delivery to stream channels during flood events but to what degree over the natural delivery rate is not known, hence the score of 3.

B2e. At-Risk Fish - Score 10

There are no at-risk fish present. However, Falls Creek is inhabited by what appears to be a population of pure west slope cutthroat trout. This population would be the only remaining west slope cutthroat population on the lower north shore and could be a source population for reintroduction to adjacent streams. The Falls Creek culvert is a passage barrier and hence the score of 10.

C. Wildlife

The substantial number of roads in the Chelan Watershed provides high-level motorized human use with potentially great effects on wildlife. The Chelan Watershed occupies most of the Chelan Sub-Basin and is bisected by Lake Chelan, a popular destination of tourists.

C1. Wide-Ranging Carnivores

The Chelan Watershed is in good condition with regard to core habitat. The open road density is low at 0.4 mi/mi². Approximately 51.1% of the watershed is core habitat, for a total of 184,601 acres. Portions of four LAUs (Cooper Mountain., Copper Peak, Fourth of July Basin, Lake Basin) and the entire area of four other LAUs (Ferry Basin, Hungry Ridge, Indianhead Basin, Pyramid) is located within the boundaries of the Chelan Watershed. The following table provides details about the road densities of those portions within the Chelan Watershed. A description of each LAU in its entirety is available in Appendix C.

Table 8. Road density of Lynx Analysis Units within the Chelan Watershed

LAU	Miles of open road	Area w/in watershed (mi ²)	Road density (mi/mi ²)
Cooper Mtn.	17.6	12.1	1.5
Copper Peak	4.2	72.8	0.1
Ferry Basin	25.1	53.3	0.5
Fourth of July Basin	0	24.1	0
Hungry Ridge	7.8	11.3	0.7
Indianhead Basin	0	59.7	0
Lake Basin	39.0	57.0	0.7
Pyramid	0	24.2	0

Mean Road Density = 0.4 mi/mi²

C2. Late-Successional Associated Wildlife Species

Four LSRs are located within the Chelan Watershed. These include: Lucerne (8,533 acres, 2.4%), Sawtooth (15,233 acres, 4.2%), Shady Pass (partial, 37,690 acres, 10.4%), and Slide Peak (1,658 acres, 0.5%). The security habitat and habitat effectiveness ratings are both high for Lucerne, Sawtooth and Slide Peak. Shady Pass has a moderate security habitat and a high habitat effectiveness rating.

C3. Riparian Dependent Wildlife Species

Riparian reserves occupy approximately 18,184 acres (5.0%) of the Chelan Watershed. The open road density within the riparian reserves is low, at 0.7 mi/mi².

C4. Ungulates

The Chelan Watershed provides approximately 8,820 acres (2.4%) of winter range (EW-1). The road density within winter range is moderate at 1.4 mi/mi². The Chelan Watershed also provides areas important to ungulates for calving, fawning, and summer range. There is also a considerable amount of Key Big Game Habitat (EW-3) allocated land adjacent to the Winter Range allocation (EW-1) and the Grade Creek Road. Although EW-3 is a roadless area, any changes to Grade Creek Road could potentially affect the EW-3 land.

C5. Unique Habitats

Unique habitats are not currently mapped within the Entiat and Chelan Sub-Basins, so are not included in this assessment.

II. Analysis

General Analysis

A. Human Use

The objective of the human use portion of the roads analysis is to identify how important the road system is to the human use activities in the particular sub-basin or watershed and to further identify the primary activities or combination of activities the road system is used for. Social values vary greatly among users. Further, users with similar interests will have differing perceptions of what constitutes appropriate access. It is not possible to satisfy every individual or group of individuals, nor is it possible to identify what people will desire tomorrow or into the next decade. It is possible to observe trends and at least make some qualitative estimates of what the future needs may be. However, we generally have sufficient data to make categories of human use that exist today on a broad scale, but will not attempt to make quantitative predications of future needs.

There is a great deal of overlap in social needs, so it is important to keep in mind the scale of population of users being considered: is it small scale/local community, medium scale/multiple community, large scale/regional, or very large scale/national importance? These considerations help the decision maker determine whether the management of a particular road segment will have a direct or indirect effect on the user.

The human use factors are grouped into broad categories relating to the amount of flexibility the decision maker has, whether the value is expected to be of local, regional, or national scale, the current use pattern, and desired future condition. The rating criteria are described in detail in Appendix A. In this analysis, segments with scores of 32 and above were given a high priority, or a high need to maintain some type of passenger car access, 23 to 31 received a moderate priority or need and 22 and below a low priority.

Because letters to the public and information presented at public meetings indicated there would be few changes in levels 3, 4, and 5 roads, there was very minimal public interest expressed for this analysis. All comments centered on keeping currently-open roads open to maintain public access. No written comments were received regarding the specific roads or the process.

B. Aquatics

Road segments were placed into high, medium, or low priority for treatment based upon the Aquatic Analysis. The priorities were determined based upon the aquatic score for the segment and then confirmed by local knowledge (see Appendix B). High priority segments generally were located adjacent to streams in a significant sub-watershed for an at-risk species, are currently delivering sediment to the streams, are on unstable lands, or confine the floodplain.

High priority road segments scored 25 or above. Medium priority streams have some erosion problems delivering sediment into streams or were contributing to riparian degradation, but the problems were either being managed or the potential for adverse affects was not as great as the high risk. These are segments where some work is needed, but are a lower priority than the high risk. Medium priority segments scored between 12 and 23 (no road segment scored a 24). Low priority roads scored under 12 and were low risk because it was felt potential direct delivery of sediment and adverse impact to at-risk species was low due to location and current conditions of the roads.

The high priority road segments are discussed in this narrative. Scores and notes for all road segments are in Appendix B.

C. Wildlife

This section summarizes the wildlife results for the roads analyzed in the Entiat and Chelan Sub-Basins. The wildlife categories that were addressed included: wide ranging carnivores, late successional species, riparian dependent species and ungulates. Road segment priority ratings were determined by summing the category scores derived from the Wildlife Roads Analysis Procedure (Appendix C). Restoration of riparian habitat and connectivity, protection of ungulate habitat and core improvements tend to drive the ratings within the Entiat and Chelan Sub-basins. Because the roads cover a large area and a variety of habitats, the overall ratings frequently consist of various combinations of categories. The following discussion gives a general description of those roads with the greatest potential for improvement within each watershed. More detailed information is available in Appendix C. Unique habitats were not considered during this analysis because they are not mapped in these sub-basins. We recommend the GIS information on unique habitats be updated for the Watershed Level Analysis.

Entiat Sub-Basin

Segments generally scored moderate to high in all four categories. These segments usually offered the greatest potential for restoring riparian habitat and connectivity, improving core habitat for wide ranging carnivores, and enhancing habitat effectiveness of ungulate winter ranges, young rearing areas and migration routes. High priority segments scored at least 20 points, with at least two categories receiving high scores.

Road segments that received a moderate rating usually had one or two elements of strong potential, generally in the same pattern as the high rated segments, but to a lesser degree. Moderate priority segments scored from 6 to 20 points, with only one category receiving a high score.

Low priority segments were often characterized by either excellent habitat conditions or very limited restoration opportunities due to current road conditions, such as pavement and high human use. These road segments scored less than 5 points. There are very few roads in this category because of high watershed road densities.

Chelan Sub-Basin

Road segments that received a high rating generally scored moderate to high in all four

categories. These segments usually offered the greatest potential for enhancing habitat effectiveness of ungulate winter ranges, young rearing areas and migration routes, restoring riparian habitat and connectivity, and improving core habitat for wide-ranging carnivores. High priority segments scored more than 16 points.

Road segments that received a moderate rating usually had one or two elements of strong potential, primarily with the greatest potential to enhance habitat effectiveness of ungulate winter ranges, young rearing areas and migration routes and to improve core habitat for wide ranging carnivores. Moderate priority segments scored from 5 to 16 points.

Low priority segments were often characterized by either excellent habitat conditions or very limited restoration opportunities due to current road conditions, such as pavement and high human use. These road segments scored less than 5 points. There are very few roads in this category because of high human use within the sub-basin.

Entiat Watershed

A. Human Use

The following roads received a high human use rating predominately due to the high scores in resource management needs and economic opportunities.

Table 9.

Road	Road #
Dinkelman Ridge	5210000
Dinkelman Tie	5210215
Entiat River	5100000
Entiat Ridge	5200000
Mud Creek	5300000
Murdock	5320000
Old Camp	5212000
Potato Creek	5380000
Power Line Road	5303000
Roaring Ridge	5801000
South Fork Mud Creek	5340000
Steliko	5310000

The following roads received a moderate human use rating because they generally had a high level of use, moderate resource management and economic opportunities and little or no access requirements.

Table 10.

Road	Road #
Box Canyon	5100115
Cottonwood CG	5100124

Road	Road #
Fox Creek CG	5100113
Lake Creek CG	5100114
North Fork CG	5100120
Shady Pass	5900000
Silver Falls CG	5100116
Tommy Creek	5605000

The following recommendations reflect the human use issues and concerns.

Roads at an appropriate maintenance level but needing major repair to mitigate resource impact:

Entiat Ridge Road 5200000	Dinkleman Ridge Road 5210000
Potato Creek Road 5380000	Shady Pass Road 5900000

Roads at an appropriate maintenance level and needing minor repairs for resource protection:

Entiat River Road 5100000 (segment 2)	Fox Creek Campground Road 5100113
Power Line Road 5303000	Steliko Road 5310000 (segment 20)
Murdock Road 5320000 (segment 22)	North Fork Entiat Road 5606000 (segment 31)
Duncan Hill Road 5608000	Tyee Road 5700000
Tyee Lookout Road 5713000	Rothrock Road 5801000
Slide Ridge Road 8410000	

Roads at an appropriate maintenance level and not needing repairs for resource protection:

Entiat River Road 5100000 (segment 1)	Lake Creek Campground Road 5100114
Box Canyon Road 5100115	Silver Falls Campground Road 5100116
North Fork Campground Road 5100120	Spruce Grove Campground Road 5100122
Three Creek Campground Road 5100123	Cottonwood Campground Road 5100124
Dinkelman Tie Road 5210215	Mud Creek Road 5300000
Steliko Road 5310000 (segment 19)	Potato Creek Road 5320000 (segment 23)
South Fork Mud Creek Road 5340000	Preston Creek Road 5501000
Tommy Creek Road 5605000	North Fork Entiat Road 5606000 (segment 30)
Shamel Creek Road 5702000	Shamel Tie Road 5702710
Big Hill Road 5900112	

Roads that could be decommissioned:

Old Camp Road 5212000

B1. Aquatics: Depositional Zone

Mud Creek Road, # 5300000. The segment of the road within the Entiat Sub-Basin ranked high due to fine sediment delivery and the road severely impinges on the Mud Creek floodplain. Mud Creek is not significant for any at-risk fish but it drains directly into significant sub-watersheds for spring chinook and steelhead as well as summer chinook. Portions of the road should be considered for relocation.

Potato Creek Road, # 5380000. The road needs heavy maintenance to improve drainage and the road surface. Portions of the road within the Potato Creek floodplain should be considered for relocation from the junction with the North Fork upstream. As with Mud Creek, Potato Creek is not significant for any at-risk fish but it drains directly into significant sub-watersheds for spring chinook and steelhead as well as summer chinook.

B2. Aquatics: Transport and Transitional Zone

Tommy Creek Road, # 5605000. The Tommy Creek road from the junction with the Entiat Valley road and the end of the pavement intercepts subsurface flow and has frequent cut-slope failures. Road location is a problem but there may be few alternatives. Consider a geotechnical review and possibly attempt to vegetate slopes. Tommy Creek Sub-Watershed is considered significant for west slope cutthroat trout but also flows directly into waters considered significant for bull trout and spring chinook salmon.

Preston Road, # 550100. In the initial assessment this road rated a low priority. However, in Appendix F-8 Geographic Priorities in the “Entiat Watershed Analysis, Version 2.0” (USDA FS, 1996) the sub-watershed is a priority for restoration work because sediment is delivered to significant chinook and steelhead habitat. The Preston-Fox Sub-Watershed is not a significant sub-watershed but one looks at the proximity and potential impact to significant fish habitat this road and sub-watershed becomes a high priority for restoration and future roads analysis.

C. Wildlife

The road density in the Entiat Watershed (EW) is high at 2.37 mi/mi². Of the 36 road segments analyzed in the watershed; 12 (33%) received a high rating for potential improvement, 23 (64%) received a moderate rating for potential improvement, while one (3%) road segment received a low rating.

Road 5100 (2 segments). Road 5100 is the main access road in the Entiat Watershed. The two segments of road 5100 received high ratings because the road bisects high quality core habitat and high quality habitat in the Shady Pass LSR. The road runs close to the Entiat River, where road modifications provide potential for restoration of riparian areas and connectivity. High levels of human activity along this road may limit opportunities.

Road 5300. Recommendations for the segment of road 5300 that lies in the Entiat Watershed are similar to those of the segment 5300 in the Columbia Breaks Watershed. As such, the most likely opportunities for habitat improvement lie in restoration of riparian areas along the road and protection of ungulate winter range through limiting snowmobile access.

Road 5320 (2 segments). Modifications to these two segments could potentially restore riparian habitat. Limiting snowmobile access in the winter could protect important ungulate winter range. This road serves as a high-use loop road; however, modifications of tributaries to this road should be further analyzed at the watershed level in order to connect islands of core habitat.

Road 5380. Modifications to this road provide potential to improve habitat for many species.

Opportunities exist to restore riparian areas and to improve ungulate winter range through limiting snowmobiling. Although this road accesses private land, the addition of a gate could potentially help increase core habitat.

Road 5605. This road segment begins in a riparian area that could benefit from road modifications designed to restore riparian habitat. This segment accesses an area with quality habitat that could benefit from improvements to core and LSR habitat, however, high human use may limit practical opportunities.

Road 5606 (2 segments). Modifications to this road, including closure of numerous tributaries, could greatly improve core habitat and protection for the Shady Pass LSR, thus requiring further analysis at the watershed level. Areas along this road are also used for fawning.

Road 5608. Habitat associated with this road segment could benefit from recommendations similar to those for Road 5606.

Road 5900 (2 segments). Modifications to this road could greatly improve core habitat; however, it provides access to the Chelan Watershed, thus limiting the opportunities. Modifications to this road also have potential to protect late-successional habitat in the Shady Pass LSR and to restore riparian habitat, primarily at the junction with Road 5100 and at various creek crossings.

In summary, there is great potential to improve habitat in the Entiat Watershed, within all categories. However, the distribution of private and state lands, and the high year round human use in this area may limit opportunities.

Mad River Watershed

A. Human Use

The following roads received a high human use rating predominately due to the high scores in resource management needs and economic opportunities:

Tillicum – 5800000
Roaring Ridge – 5801000
West Tillicum - 5808000

The following roads received a medium human use rating since they generally had a high level of use, moderate resource management and economic opportunities and again little or no access requirements:

Pine Flats CG – 5700100
Indian Creek – 5808410
Rothrock – 5810000

The following recommendations reflect the human use issues and concerns.

Tyee Road 5700000, Pine Flats Campground Road 5700100, Upper Shamel Road 5710000, West Tillicum Road 5808000, and Rothrock Road 5810000 are at an

appropriate maintenance level, and need no repairs for resource protection.

Tyee Lookout Road 5713000 and Roaring Ridge Road 5801000 are at an appropriate maintenance level, but need minor repair for resource protection.

Tillicum Road 5800000 and Indian Creek Road 5808410 need major repairs to mitigate resource impact, then could be decommissioned.

B. Aquatics

Tyee Road, # 5700000. The lower two miles of the road constrict the Mad River to some extent but there is probably little that can be done because there doesn't seem to be an obvious relocation route and it is a major road.

Tillicum Road, # 5800000. From the end of the county road to French Corral, the road is located on an actively moving slope. Suggest a geotechnical review to identify ways to solve drainage problems associated with captured subsurface water. Recommend paving or some other surface improvement from Mad River bridge to Indian Creek. Culvert crossing on the road is 0.2 miles above a barrier.

Indian Creek Road, # 5808410. There are active failures in the road fill, cut slope failures and subsurface water is being captured. Consider a geotechnical review to address failure and subsurface flow issues. Also consider decommissioning the two-mile center segment of the road.

C. Wildlife

The road density in the Mad River Watershed is extremely high at 3.5 mi/mi². Of the nine road segments in this watershed; three (33%) received a high rating for potential improvement, and six (67%) received a moderate rating.

Road 5800. The road density within this watershed is very high with numerous tributaries and alternate routes. Road 5800 runs parallel to the 5800410-road system and they access the same "destination." Closure of one of these systems (from Section 31 to the west) could improve core habitat. Modifications to this road also have potential to restore riparian habitat, protect late-successional habitat and enhance habitat effectiveness for ungulates within winter range, migration and fawning habitat.

Road 5801. This road bisects high-quality core habitat and runs parallel to Road 5810. This road forms a loop and parallel road system with Road 5810, thereby creating great potential to improve core habitat by limiting access on one of the systems. Because Road 5810 accesses private land, Road 5801 may be a better candidate for limits. Deer would benefit from protection during the winter as this road is a high-use snowmobile route running through winter range. Modifying the beginning of this road (junction with Road 5100) could potentially restore riparian habitat.

Road 5810. Road 5810 also provides access to ungulate winter range. Habitat effectiveness could be enhanced by limiting snowmobile access in the winter.

In summary, the ratings within the Mad River Watershed tend to be driven by potential for improvements in core habitat and ungulate winter range.

Columbia Breaks Watershed

A. Human Use

The portions of forest roads Mud Creek – 5300000, South Fork Mud Creek – 5340000, and the Swakane Road - 7415000 in the Columbia Breaks received a high human use rating again due to high scores in resource management needs, economic opportunities, and access requirements.

The following recommendations reflect the human use issues and concerns.

Mud Creek Road 5300000 and Swakane Road 7415000 are at an appropriate maintenance level, but need minor repairs for resource protection.

South Fork Mud Creek Road 5340000 is at an appropriate maintenance level, and does not need repairs for resource protection.

B. Aquatics

All segments received a low or moderate rating.

C. Wildlife

The road density in the Columbia Breaks Watershed is high at 2.13 mi/mi². Both road segments in the watershed received a high rating for potential improvement.

Road 5300. This road provides access from the Navarre Coulee Road (which accesses both the Columbia River Valley and Lake Chelan) to the Entiat River Valley (Entiat Watershed) and private land. As such, the most likely opportunities for habitat improvement lie in restoring riparian areas along the road and protecting ungulate winter range by limiting snowmobile access.

Road 7415. This road runs up Swakane Canyon, accessing state, private and federal land. This road also accesses deer and bighorn sheep winter range. Limits to snowmobile access could be beneficial. Modification of this road could protect fawning and lambing areas, primarily through closure of tributaries, and should be further analyzed at the watershed level. Modifications to this road also have high potential to restore riparian habitat and improve quality core habitat.

In summary, the ratings and potential within the Columbia Breaks Watershed tend to be driven by protection of ungulate habitat and restoration of riparian habitat.

Fields Pooint Road 8405000
Snowberry Campground Road 8410100

Slide Ridge Road 8410000 (segment 66)

Roads that do not need repairs, and could be reduced in maintenance level:
Wash Creek Road 8021000

Could be closed

First Creek Road 8505000 could be closed at Baldy Crossing.

B. Aquatics

From the aquatic perspective, there was only one high priority road on the Chelan Ranger District. While the Chelan District has no at-risk species and as such scored low for species at the watershed and basin scale compared to other sub-watersheds on the Forest, there are some native species present and therefore an aquatic species rating was given for the road segments based upon the relative importance of a road segment, but no segment scored higher than a 5. Even with no score for fish populations, the high priority road, Grade Creek Road, would have scored high because of impact on the other aquatic risk factors.

Grade Creek Road, number 82000. The Grade Creek road has numerous drainage and erosion problems that cause accelerated sediment delivery to Mitchell Creek, Gold Creek, Grade Creek, Little Grade Creek, and Falls Creek. There are active cuts and failures at each drainage crossing and the channels have been constricted. Cut and fill slopes need to be stabilized. The road impacts a number of small wetlands from Coyote Creek to Falls Creek. The crossing at Falls creek is a barrier to west slope cutthroat trout.

C. Wildlife

The road density in the Chelan Watershed is low at 0.4 mi/mi². Of the 17 road segments in the watershed, five (29%) received a high rating for potential improvement, eight (47%) received a moderate rating for potential improvement, and four (24%) received a low rating.

Road 8200. This is the main access road along the north side of Lake Chelan. Modifying this road could positively affect wide-ranging carnivores throughout the year by linking core habitat and protecting wolf prey bases during the winter. This road runs through deer and bighorn sheep winter range. Habitat effectiveness for these species could be enhanced by limiting late season snowmobiling. There is also a considerable amount of EW-3 allocated land adjacent to winter range and Road 8200. Although EW-3 is a roadless area, any changes to Road 8200 should consider potential effects to the EW-3 land. There are also areas important to fawning and migration. Modifying this road also presents potential to restore riparian habitat at numerous crossings.

Road 8200115. This short road segment provides vehicle access into wetland and riparian areas that would greatly benefit from road closure. As a spur road of road 8200, this road also experiences heavy snowmobile use within ungulate winter range and ungulate habitat effectiveness could be enhanced by late season limitations. There is also great potential to protect ungulate fawning areas here through road modifications.

Road 8210. This road bisects core habitat in an area where alternate human routes available. Closure of this road could protect quality spring habitat for grizzly bears and link islands of core habitat. A minimum of a spring closure is suggested. Modifications to this road have the potential to enhance habitat effectiveness for ungulates with regard to winter range, migration and fawning habitat.

Road 8301. This road bisects high quality core habitat within a riparian flood plain in the Lucerne LSR. Although the potential to improve habitat is quite high, this road is the sole access road for the Stehekin Valley, and traffic is limited to busses, therefore opportunities to improve habitat are likely limited.

Road 8505. This road accesses private land. However, from the western boundary of the private land parcel and west, this road has great potential to improve habitat in several categories. Modifications to this road could increase core habitat. The road runs through a flood plain and modifications to the road present opportunities to restore riparian habitat. Modifications to this road also have great potential to enhance habitat effectiveness within ungulate winter range, fawning and migration habitat.

In summary, the ratings within the Chelan Watershed tend to be driven by improvements to core and ungulate habitat. Riparian restoration opportunities are also abundant. Although numerous habitat improvement opportunities exist, high human use in this area may limit modifications.

Recommendations

The range of recommended treatments or strategies fit into five general categories ranging from major improvements to decommissioning. The five categories describing strategies are:

- Major repairs or improvement
- Minor repairs or improvement
- Leave as is
- Lower maintenance requirements
- Stabilize then eliminate maintenance requirements
- Decommission

Major repairs can include but are not limited to relocation, replacing a major culvert, or seasonal closure. Minor repairs can include but are not limited to minor surfacing or grading work, drainage improvements such as adding cross drains or drain dips, or seasonal closures. “Leave as is” means the current maintenance standards would be maintained with no change. The “lower maintenance requirements” strategy would reduce the current maintenance standard to the next lower standard. For example, a maintenance level 3, maintained for passenger cars, would be reduced to a maintenance level 2, which is maintained for high clearance vehicles. The “stabilize then eliminate maintenance” strategy would involve stabilizing the road, for example by out sloping, installing water bars, removing culverts where possible, the just inspecting the road periodically to monitor for any damage. Users will notice little change in the short term on the roads with recommended strategies of “lower the maintenance requirements” or eliminating maintenance after the road stabilized. The road will be allowed to reach the new standard over

time. The “decommissioning” strategy can involve a range of treatments from ripping and seeding the surface to full obliteration. These categories are described in greater detail in Appendix D.

Some type of change in management strategy was recommended for 35 of the 65 road segments that were analyzed. The recommended changes in strategy ranged from improvements to lowering maintenance levels. Of the 35 recommended changes, 14 are to make a major improvement of some type to mitigate resource impact while maintaining passenger car access. This accounts for 74 miles; however, in many cases the repair or treatment is at a specific location and is not the full length of the road. Minor improvements, such as installing additional cross drains, or seasonal closures, are the recommended strategy on 18 segments. Only one segment had the recommended strategy to preserve the access but reduce the level of maintenance applied to the road. However, four segments received the recommendation to raise the maintenance level from a level 2 to a level 3. Only the roads with a recommended change in treatment or strategy are listed in the following tables. A complete listing of all roads analyzed with recommended strategies is included in Appendix D.

If all the recommended strategies were implemented fully, the cost to maintain these roads to full standards would increase about \$70,000 per year from \$204,000 to \$274,000 for the Chelan Ranger District. However, the cost would decrease about \$4,000 per year for the Entiat District, from \$330,000 to \$326,000. Also, a substantial amount would be needed to make all the repairs, improvements, and decommissioning recommended to fully implement all the strategies. The specific projects needed to implement these strategies are not known in enough detail at this time to develop cost estimates. On roads which have Cost Share Agreements, the cost share partner must be consulted and agree to any changes in road management. It is important to note these dollars reflect the needs to maintain only the roads analyzed to the standards defined in the Forest Service Manual. These are not the amounts that are currently being spent. The two districts received a total of approximately \$170,000, which was used to maintain all the roads on the system, not just the major arterials and collectors. This discrepancy of funds needed versus funds received, highlights the need to determine the minimum affordable road system.

Minimum Affordable Road System

The Forest Service defines the minimum affordable road system as the miles of road by maintenance level that can be maintained to full standard with the anticipated maintenance funding. Based on forest averages, it would require approximately \$984,000 annually to maintain all of the system roads in the Entiat Sub-basin, and \$370,000 in the Chelan Sub-Basin. These values do not include the costs for the identified deferred maintenance, the maintenance needed to bring the road back up the standard described in the Forest Service Manual, or the funds needed to improve fish passage by repairing or replacing barrier culverts. In Fiscal Year 2000 just over \$84,000 (9% of the estimated annual need) was expended for maintenance on the roads in the Entiat Sub-Basin and \$84,000 (23% of the estimated annual need) on roads in the Chelan Sub-Basin. However, rather than maintaining this small percentage of the roads to full standard, the work was distributed over a greater mileage to address high priority needs.

Budget projections indicate that funding for road maintenance will continue at current levels for the foreseeable future. Consequently, \$84,000 was selected as the planned amount for the

minimum affordable road system for each sub-basin. Based on that funding level and the average costs per mile by maintenance level, the following tables show the extremes in the range of potential road management scenarios.

Option A shows the number of miles of road that can be maintained to standard starting with the level 2 (high clearance vehicle) roads first. The number in parenthesis is the percent of the total system roads in the sub-basin that would be maintained to standard. Option B shows the number of miles of road that can be maintained to standard starting with the level 3-5 (passenger vehicle) roads first. From a practical standpoint, the minimum affordable system would likely be a combination of arterials and collectors maintained for passenger cars, and local roads maintained for high clearance vehicles.

Table 11. Entiat minimum affordable road system options

Maint. level	Option A		Option B	
	mi.	(% of total)	mi.	(% of total)
ML 2 (high cl.)	83	(8)	0	(0)
ML 3-5 (pass.)	0	(0)	22	(2)

Table 12. Chelan minimum affordable road system options

Maint. level	Option A		Option B	
	mi.	(% of total)	mi.	(% of total)
ML 2 (high cl.)	83	(25)	0	(0)
ML 3-5 (pass.)	0	(0)	22	(7)

This analysis demonstrates there are many more miles of roads than can be fully maintained with the expected funding. However, a rapid reduction in accessible road mileage is not acceptable to a large segment of forest users, would not meet agency management access needs, and would incur significant expenses to properly implement.

As stated above, this analysis recommended decommissioning portions of only three road segments. Future studies that will analyze the local roads, (those maintained for high clearance vehicles) have the potential to recommend decommissioning some roads in an effort to adjust the size of the road system.

Entiat Watershed

Seven roads received a recommendation of “major repair or improvement.” “Minor repair, improvement or seasonal restrictions” was the recommended strategy for eight roads, and “decommission” was the recommendation for a portion of one road. All other roads analyzed in the drainage received “leave as is” recommendation.

The recommended major repair strategy for all the roads but Shady Pass is to consider relocation for all or a portion of the roads, along with other improvements.

Fox Creek Campground road (5100113) should be relocated to reduce the impact from frequent flooding. Relocation should be considered for approximately one mile of Entiat Ridge Road in the Mills Creek area.

Entiat Ridge Road (5200) and Dinkelman Ridge Road (5210) basically parallel each other. Future analysis should investigate the possibility of closing one of the roads to help reduce road densities. Drainage improvements are also recommended on both these roads. In lieu of relocation on Dinkelman Ridge Road, consider implementing a wet season closure.

For Mud Creek road (5300), also consider relocating the mid section or implementing a winter season closure.

The recommendation for Potato Creek road (5380) is drainage improvements and a few small spot relocations. On Shady Pass road (5900) there is a safety concern. The road should be reconstructed to provide intervisible turnouts the length of the road. Drainage improvements and spot surfacing are also needed on the first 4.2 miles of the road.

Minor surfacing and drainage improvements are recommended for Entiat Valley road (5100), North Fork Entiat road (5606), Duncan Hill road (5608), and Slide Ridge road (8410).

The recommended strategy for Power Line road (5303) and Steliko road (5310) is to provide drainage improvements and consider a winter season closure.

On Murdock Creek road (5320) the concerns are with snowplowing and snowmobile impact on winter habitat, seasonal closures should be considered if possible. Drivable drain dips should be installed in the lower portion to help with drainage concerns.

The recommendation for Old Camp road (5212) is for drainage improvements on the first four miles and consider decommissioning the last 3 miles.

Table 13. Recommended management actions: Entiat Watershed

Road name	FS rd #	Seg. length (mi)	Aquatic rating	Wildlife rating	Human use rating	Draft recom. mgmt.	Final recom. mgmt.
Fox Creek Campground	5100113	0.2	M	M	M	Major Repair	
Entiat Ridge	5200000	18.3	M	M	H	Major Repair	
Dinkleman Ridge	5210000	3.5	M	M	H	Major Repair	
Mud Creek	5300000	4.5	H	H	H	Major Repair	
Potato Creek	5380000	5.5	H	H	H	Major Repair	
Shady Pass	5900000	4.2	M	H	H	Major Repair	
Shady Pass	5900000	6.9	L	H	M	Major Repair	
Entiat Valley	5100000	5.1	L	H	H	Minor Repair	
Power Line Road	5303000	4.2	M	M	H	Minor Repair	
Steliko	5310000	5	M	M	H	Minor Repair	
Murdock	5320000	0.5	M	H	H	Minor Repair	
Murdock	5320000	6	M	H	H	Minor Repair	
North Fork Entiat	5606000	0.9	M	H	L	Minor Repair	

Road name	FS rd #	Seg. length (mi)	Aquatic rating	Wildlife rating	Human use rating	Draft recom. mgmt.	Final recom. mgmt.
Duncan Hill	5608000	7.2	M	H	L	Minor Repair	
Slide Ridge	8410000	10.5	L	M	M	Minor Repair	
Old Camp	5212000	Upper 3.0	M	M	H	Decomm.	

Mad River Watershed

In this watershed two roads received a recommendation of “major repair or improvement.” “Minor repair, improvement or seasonal restrictions” was the recommended strategy for three roads, and decommissioning was the recommendation for a portion of one road. All other roads analyzed in the drainage received “leave as is” recommendation.

The recommended major improvement strategy for the Tillicum road (5800) is to consider paving a two-mile section that is adjacent to the creek. This would reduce the sediment entering the stream from road runoff. A geotechnical review should also be considered to address drainage concerns.

On Indian Creek Road (5808410), the recommendation is to relocate or obliterate approximately two miles in the middle to improve slope stability issues.

The minor improvements recommended for Tye Lookout Road (5713) and Roaring Ridge Road (5801) are to provide drainage improvements and spot surface repairs where needed.

Rothrock Road (5810): the recommended strategy is to improve drainage on the lower one mile and replace the fish barrier.

Table 14. Recommended management actions: Mad River Watershed

Road name	FS rd #	Seg. length (mi)	Aquatic rating	Wildlife rating	Human use rating	Draft recom. mgmt.	Final recom. mgmt.
Tillicum	5800000	9	H	H	H	Major Repair	
Indian Creek	5808410	3.6	H	M	M	Major Repair/ Decomm.	
Tye Lookout	5713000	4.1	M	M	L	Minor Repair	
Roaring Ridge	5801000	16.7	M	H	H	Minor Repair	
Rothrock	5810000	7.3	M	H	M	Minor Repair	

Columbia Breaks Watershed

Only two roads in this watershed received a recommendation other than “leave as is.” The recommended action for both roads is to improve the drainage. In addition, on Mud Creek road (5300) consider a winter season closure. There are also beaver concerns on the Swakane road

(7415).

Table 15. Recommended management actions: Columbia Breaks Watershed

Road name	FS rd #	Segment length (mi)	Aquatic rating	Wildlife rating	Human use rating	Draft recom. mgmt.	Final recom. mgmt.
Mud Creek	5300000	1.4	M	H	H	Minor Repair	
Swakane	7415000	7.5	M	H	H	Minor Repair	

Chelan Watershed

In this watershed six roads received a recommendation of “major repair or improvement,” four roads received a recommendation of “minor repair, improvement or seasonal restrictions,” and decommissioning was the recommendation for a portion of one road. All other roads analyzed in the drainage received “leave as is” recommendation.

On Shady Pass road (5900) there are safety concerns. The road should be reconstructed to provide intervisible turnout the length of the road.

There are also safety concerns on Wash Creek road (8021). The recommendation is to add more turnouts and install guardrail as needed. It was also recommended that the maintenance level be raised from a 2 (passable by high clearance vehicle) to a 3 (accessible by passenger car) for this road.

Echo Ridge Road (8021100) also has safety concerns and an engineering study is recommended for this road.

Grade Creek Road has major safety and stability concerns for the length of the road. It would be extreme costly to repair or relocate; however, access must be maintained because it is the only access to the northern portion of the watershed and wildfires are a concern. Therefore, the recommendation at this time is to “leave as is” at the current maintenance level.

The recommendation for Slide Ridge Road (8410) is to add more turnouts, provide spot surfacing repairs, and drainage improvements as needed.

On First Creek Road (8505) the recommended strategy is to provide drainage and a ditch along the length of the road. It is also recommended the last 1/3 mile be closed or converted to a trail.

The recommended strategy for Grouse Mountain CG (5900116) road is to provide dust abatement during the camping season. Some minor widening and surface repairs are the recommended actions for Cooper Mountain Road (8020) to improve safety. Drainage improvements are recommended for Railroad Creek (8301) by installing rolling dips.

Table 16. Recommended management actions: Chelan Watershed

Road name	FS rd #	Seg. length (mi)	Aquatic rating	Wildlife rating	Human use rating	Draft recom. mgmt.	Final recom. mgmt.
Shady Pass	5900000	14.8	M	M	H	Major Repair	
Wash Creek	8021000	4	L	M	H	Major Repair	
Echo Ridge	8021100	0.7	L	L	H	Major Repair	
Grade Creek	8200000	39.1	H	H	H	Major Repair/ Leave as is	
Slide Ridge	8410000	0.8	M	M	H	Major Repair	
First Creek	8505000	0.7	M	H	H	Major Repair/ Decomm.	
Grouse Mtn. Campground	5900116	0.2	L	M	M	Minor Repair	
Cooper Mtn.	8020000	21.5	L	M	H	Minor Repair	
Railroad Creek	8301000	11.5	M	H	H	Minor Repair	
Slide Ridge	8410000	18.4	M	M	M	Minor Repair	

Watershed Analysis Priority

To determine a priority recommendation for the completion of the watershed scale analysis, during the analysis process the team reviewed the condition and uses of the watersheds as a whole. The team looked at the existing conditions and impact within the watershed, types of use, anticipated future resource management projects (such as dry site management or fuels planning), and the ability or opportunity to make changes. The priorities are shown below. It was felt that the recreational aspect that was occurring across the district was not significantly different to justify rating that portion of the human use module.

Within the Entiat Sub-Basin, the Mad River and Entiat Watersheds were given the highest priority because of the presence of bull trout, salmon, and steelhead species. The majority of both watersheds are in good condition. Impact of past, present, and future activities are confined to specific sub-drainages. The Columbia Breaks rated the lowest because the majority of the land base is outside the forest boundary and is more developed with fewer opportunities for improvements to habitat.

Table 17. Watershed ratings

Watershed	Human use rank	Wildlife rank	Aquatic rank	Composite rating
Mad River	H	H	H	H (1)
Entiat	H	H	M	H (2)
Columbia Brakes	L	M	L	M
Chelan	H	H	H	H

Works Cited

Archibald, P. 2002. Personal communication. Fisheries Biologist, Entiat Ranger District , 2108 Entiat Way, Entiat WA 98822.

MacDonald, K., Noble, S., Haskins, J. 1996. An assessment of the status of aquatic resources within subbasins on the Wenatchee National Forest. U.S. Department of Agriculture, Forest Service, Wenatchee National Forest. Wenatchee , WA. 22 pp.

McCorquodale, S.M. 1991. Energetic considerations and habitat quality for elk in arid grasslands and coniferous forests. *Journal of Wildlife Management*. 55(2):273-242.

Puchlerz, T.; Servheen, C. 1998. Interagency Grizzly Bear Committee Taskforce report: grizzly bear/ motorized access management. Interagency Grizzly Bear Committee, Denver, CO.

Ruediger, B.J.; Claar, J.; Gniadek, B.; Holt, L.; Lewis, S.; et al. 2000. Canada lynx conservation assessment and strategy. Forest Service pub. #R1-00-53. U.S. Department of Agriculture, Forest Service; U.S. Department of Interior, Bureau of Land Management; U.S. Department of Interior, National Park Service. Missoula, MT: 142 pp.

Thomas, J.W.; Maser, C.; Rodiek, J.E. 1979. Riparian zones. In: Thomas, J.W., ed. *Wildlife habitats in managed forests: the Blue Mountains of Oregon and Washington*. U.S. Department of Agriculture, Forest Service Agriculture Handbook No. 553. p. 40-47.

U.S. Department of Agriculture, Forest Service. 2001a. Draft biological assessment for steelhead, spring and summer chinook, bull trout and cutthroat trout in the depositional zone of the Entiat Watershed, Chelan County, Washington. Baseline conditions and effects of the proposed Bockoven Land Interchange." Unpublished agency document. On file with: Okanogan and Wenatchee National Forests, Entiat Ranger District, P.O. Box 476, Entiat, WA 98822.

U.S. Department of Agriculture, Forest Service. 2001b. Draft biological assessment for steelhead, spring and summer chinook, bull trout and cutthroat trout, Preston/Fox Analysis Area. Unpublished agency document. On file with: Okanogan and Wenatchee National Forests, Entiat Ranger District, P.O. Box 476, Entiat, WA 98822.

U.S. Department of Agriculture, Forest Service. 2001c. Draft biological assessment for steelhead, spring chinook, bull trout and cutthroat trout in the Mad River Watershed Chelan County, Washington. Baseline conditions and effects of Mad River trail improvement projects. Unpublished agency document. On file with: Okanogan and Wenatchee National Forests, Entiat Ranger District, P.O. Box 476, Entiat WA 98822.

U.S. Department of Agriculture, Forest Service. 2000a. Wenatchee National Forest: Draft Upper Chelan Watershed assessment. On file with: Okanogan and Wenatchee National Forests, Chelan Ranger District, 428 W. Wooden Ave., Chelan, WA 98816.

- U.S. Department of Agriculture, Forest Service. 2000b. Wenatchee National Forest: "Fisheries biological assessment for First Creek project". Unpublished agency document. On file with: Okanogan and Wenatchee National Forests, Chelan Ranger District, 428 W. Wooden Ave., Chelan, WA 98816.
- U.S. Department of Agriculture, Forest Service. 1999a. Roads analysis: Informing decisions about managing the national forest transportation system. Misc. Rep. FS-643. Washington, D.C. 222 p.
- U.S. Department of Agriculture, Forest Service. 1999b. Wenatchee National Forest: Middle Chelan Watershed assessment. On file with: Okanogan and Wenatchee National Forests, Chelan Ranger District, 428 W. Wooden Ave., Chelan, WA 98816.
- U.S. Department of Agriculture, Forest Service. 1998. Wenatchee National Forest: North Shore of Lake Chelan Watershed assessment. On file with: Okanogan and Wenatchee National Forests, Chelan Ranger District, 428 W. Wooden Ave., Chelan, WA 98816.
- U.S. Department of Agriculture, Forest Service. 1997. Wenatchee National Forest late-successional reserve assessment. On file with: Okanogan and Wenatchee National Forests, Wenatchee, WA. 217 pp.
- U.S. Department of Agriculture, Forest Service. 1996. Wenatchee National Forest: Entiat Watershed assessment. On file with: Okanogan and Wenatchee National Forests, Entiat Ranger District, P.O. Box 476, Entiat, WA 98822.
- U.S. Department of Agriculture, Forest Service. 1995a. Wenatchee National Forest: Chelan Basin Watershed assessment. On file with: Okanogan and Wenatchee National Forests, Chelan Ranger District, 428 W. Wooden Ave., Chelan, WA 98816.
- U.S. Department of Agriculture, Forest Service. 1995b. Wenatchee National Forest: First/Twenty-Five Mile Creek Watershed assessment. On file with: Okanogan and Wenatchee National Forests, Chelan Ranger District, 428 W. Wooden Ave. Chelan, WA 98816.
- U.S. Department of Agriculture, Forest Service; U.S. Department of Interior, Bureau of Land Management. 1994. Record of decision for amendments to Forest Service and Bureau of Land Management Planning Documents within the Range of the Northern Spotted Owl. [Northwest Forest Plan.] Portland, OR. 200 pp.
- U.S. Department of Interior, Fish and Wildlife Service. 1998. A framework to assist in making Endangered Species Act determinations of effect for individual or grouped actions at the bull trout subpopulation watershed scale. 46 pp. [Adapted from: National Marine Fisheries Service. 1996. Coastal Salmon Conservation: Working guidance for comprehensive salmon restoration initiatives on the Pacific coast. Appendix II.]
- Weaver, J.L; Paquet, P.C.; Ruggerio, L.F. 1996. Resilience and conservation of large carnivores in the Rocky Mountains. *Conservation Biology*. 10:964-976.

Wisdom, M.J.; Hargis, C.D.; Holthausen, R.S. [et al.]. 1999. Wildlife habitats in forests of the interior northwest: history, status, trends, and critical issues confronting land managers. Transactions of the 64th North American Natural Resources Conference: 79-93.

Appendices

Appendix A: Human Use

Appendix B: Aquatic

Appendix C: Wildlife

Appendix D: Management Actions

Appendix E: Public Input Summary

Appendix F: Definitions

Appendix A: Human Use Rating Criteria

The objective of the Human Use portion of the roads analysis is to identify the importance the road system is to the human use activities in the particular sub-basin or watershed and to further identify the primary activities or combination of activities the road system is used for. Social values vary greatly among users. Further, users with similar interests will have greatly differing perceptions of what constitutes appropriate access.

It is not possible to satisfy every individual or group of individuals, nor is it possible to identify what people will desire tomorrow or into the next decade. It is possible to observe trends and at least make some qualitative estimates of what the future needs may be. However, we generally lack sufficient data to make accurate quantitative predictions. This exercise attempted to show the major categories of human use that exist today on a broad scale, but did not attempt to make quantitative predictions of future needs.

There is a great deal of overlap in social needs, so it is important to keep in mind the scale of population of users being considered; is it small scale/local community, medium scale/multiple community, large scale/regional, or very large scale/national importance? This consideration will help the decision maker determine whether the management of a particular road segment will have a direct or indirect effect on the user.

The human use factors are grouped into broad categories relating to the amount of flexibility the decision maker has, whether the value is expected to be of a local, regional or national scale, the current use pattern, and desired future condition.

Factor 1: Required by Law, Agreements, and Permits

This factor includes access needs that are necessary to meet legal requirements such as: the Alaska National Interest Conservation Act (ANILCA), treaty requirements, easements, Memorandums of Agreement (MOA's), or permits of various kinds. RS 2477 (Revised Statute 2477) roads are included in this group. This factor includes the legal requirements, agreements, and commitments to other parties, including other federal, state, local agencies, Native American Tribes and private parties. Agreements can sometimes be modified, but usually they are of a long-term nature and can have significant influence on how a road is managed.

In the Questions Addressed section, an alphanumeric code that corresponds to Appendix 1 in the "Roads Analysis Handbook" is listed for each bulleted item. This code is linked to an ecological, social, or economic consideration that has been formulated as a question. Each risk factor being evaluated is addressing one or more of these questions. The appendix should be consulted for more information on the risk factor, including a list of potential indicators (tools) that may be considered to appropriately rate each factor.

Questions Addressed

Legal basis (GT-1, 2, and 3)
Special Use Permits (SU-1)
Water Production (WP-1)

Ratings

1. Identify roads and segments to which Public Laws such as ANILCA, RS 2477 or treaty requirements apply.
2. Identify roads or segments, which have active permits, cost share agreements, easements or binding agreements.
3. Identify roads or segments that have special use permits involved.
4. Relative ranking is based on the above information:
 - a. High (10) public law requires the road access be provided. These include roads that have Cost/Share agreements and long term easements in place.
 - b. Medium (7) agreements or permits exist, but there are alternatives or options available to meet identified needs.
 - c. Low (3) there are short-term commitments, which will expire or can be replaced with suitable alternatives.

Data Sources

Special Uses Data System (SUDS)
Forest Land Use Report (FLUR)
INFRA
District files of Agreements and Easements

Factor 2: Resource Management

This factor addresses the importance of the road system for administration, management, or protection of forest resources. The forest manager has the flexibility to analyze options and select the one that provides the best balance of resource, social and economic needs. At a sub-basin scale, definitions or classifications would be identified by broad groupings such as the percent of a watershed, the percent of a dry site, or a FMAZ zone.

Examples of subelements include:

Value of the road for implementation of desired future condition strategies, such as the “Dry Site Strategy” or Fire Management Plan.

Administrative Use needs (AU-1).

Value of the road for Forest Service and cooperators to suppress wild land fires. Fire risk can be based on a combination of fire intensity mapping and knowledge of past fire occurrence. Fire intensity mapping is based on current vegetation, slope, aspect, elevation, and landform. This factor is considered highly important and is given a heavy numerical weighting. (PT-2).

Value of the road for management of insect, disease, or noxious weed infestations.

Does road system address public health and safety (GT-4)?

Does the Forest have the necessary easements and rights on the road?

Ratings

1. Identify roads which are needed for access to protect forest resources, facilities, or property.
2. Identify roads that are important for implementation of management strategies.
3. Roads covered within this analysis provide primary access to wildfires occurring on the district, either directly to the fire or to connecting roads, trails, and/or drop-off points. Roads can also serve as primary control lines, fuel breaks, or firefighter escape routes.
4. Vehicle travel on roads is a primary contributor to fugitive dust on the forest. Vehicle speed on any given road surface is the primary factor in determining the amount of dust or particulate matter introduced into the air shed. Of greatest concern is particulate matter less than 10 microns in diameter (PM10) and particulate matter less than 2.5 microns in diameter (PM2.5). Refer to individual watershed assessments for further discussion on the effects and importance of particulate matter.
5. Identify the roads that are important for research, monitoring, or inventory.
6. Relative ranking is based on the above information:
 - a. High (10) life or property is at risk or a history of severe resource damage occurring in this area. Road is necessary for protection of life and property. Access to private or leased property and/or structures and access must be retained. A road ranked high if it is considered important for protection of resources and there are few or no alternative ways to access the area. Road serves developed recreation site or administrative sites. Road is part of a designated or informal, but well recognized, auto tour.
 - b. Medium high (7) access is necessary for resource protection for long term. Roads within the Low Fire Regime (naturally occurring as high frequency/low intensity) or roads that access preattack facilities. Road is needed for access to an active range allotment. Important for silvicultural treatments in dry and mesic sites. Road is important for treatment of existing noxious weed infestations in dry and mesic sites.
 - c. Medium low (5) roads within the Moderate Fire Regime with a high occurrence (also referred to as Dry Mesic) or roads that provide a mid-slope fire break.
 - d. Low (3) access is needed for implementation of management strategies for the near future. Roads within the Moderate Fire Regime with a moderate or low occurrence. Needed for silvicultural treatment in wet sites. Noxious weeds present in wet sites and road access will be needed for treatment. Paved or rock surface; not a significant source of fugitive dust and particulate matter. On a short-term basis, this may also refer to roads treated with dust suppressant such as water, lignin, or oil-based products.
 - e. Low (2) Gravel: fugitive dust and particulate matter will largely depend on vehicle speed and road condition.
 - f. Very Low (1) Fires within the High Fires Regime, (naturally occurring as low frequency and high intensity. Native surface; significant source of fugitive dust and particulate matter.
 - g. Not needed (0) road does not serve a range allotment. Road is not necessary for fire protection. No noxious weed infestations present.

Data Sources

- Analysis Files for Timber Sales and other projects
- Past Harvest Layer – 5-year action plan
- Fire Ignition Layer in GIS
- Urban Interface mapping in GIS – natural versus human caused fires
- Infestation maps for insect and disease surveys
- Past activity layer for weeds in GIS
- Archeological probability maps (H/M/L)
- Public Scoping

Factor 3: Public Access and Level of Use

The factor includes both active and passive use by the public for all forms of outdoor recreation where people are actually present on the Forest.

It also includes elements that do not necessarily involve active participation but just knowing these elements are in place or available has significant value. The forest manager will need to involve large numbers and diverse groups in any decisions associated with this factor.

The most common public needs are generally associated with some form of recreation or leisure activity. Since this factor by definition involves actual access and use of the road, it is most important on a local and regional scale. There would be a lesser degree of importance on a national scale for stakeholders who come from other regions or states and use the Forest.

The Recreation Opportunity Spectrum (ROS) classification is used in the Forest Plan to arrange the possible experience opportunities across a spectrum. ROS land delineations identify a variety of recreation experiences in six classes along a continuum from primitive to modern-urban. Each class is defined in terms of the degree to which it satisfies certain recreation needs based on area size, the extent to which the natural environment has been modified, the type and development of facilities available and the degree of outdoor skills needed to enjoy the area. The seven ROS classes are: Primitive, semi-primitive non-motorized, semi-primitive motorized, roadbed natural, roadbed modified, rural, and urban.

Questions Addressed

- Unique physical or biological characteristics (PV-1)
- Unique cultural or spiritual value (PV-2)
- People's perceived needs and values for the road (SI-1)
- Value to local community social and economic health (SI-6)
- Effect on people's sense of place (SI-10)
- Unloaded recreation values (UR-1 through 5)
- Roadbed recreation values (PR-1 through 5)
- Access to developed sites
- Access to undeveloped sites

Consistency with ROS classifications in the Forest Plan

Ratings

1. Identify road or segments that serve developed sites, popular dispersed sites, or that are popular for recreation activities.
2. Identify the predominant ROS classification served by the road or segment.
3. Identify areas where the predominant recreation use is enhanced by lower road density. Leaning toward more primitive recreation activities.
4. Identify roads or segments that stakeholders have an expressed interest in keeping open for general Forest travel or exploring.
5. Identify roads or segments that stakeholders have expressed interest in reducing to a lower standard, converting to trail, or obliterating.
6. Relative rankings are based on above elements:
 - a. High (10) road is needed to access developed facilities and activities toward the developed end of the ROS scale.
 - b. Medium (6) activities are semi-primitive motorized or semi-primitive non-motorized portion of the ROS scale. Low standard roads are preferred and/or low density is preferred to enhance the recreation activity.
 - c. Low (3) semi-primitive non-motorized or primitive ROS classification. Activities in this area are characterized as more challenging and more secluded. The degree of skill needed to participate is greater.

Data Sources

Scoping for specific projects
Frontline contacts
Comment boxes and comment cards
Personal contacts
Travel cost surveys

Factor 4: Economics

This factor includes the relationship of the road system to local and regional economic values. The stakeholders in this group would be individuals and businesses that receive direct or indirect economic benefit from the Forest. Though there are direct economic benefits from commodity production such as mining, grazing and wood products manufacturing, economic benefits are also derived by providing services through contracts or permits. Permitted uses could include such things as mushroom gathering, posts, poles, floral greenery, boughs, Christmas trees, and other miscellaneous forest products, as well as services provided along the route, either privately or by permit. The indirect benefits from people visiting the forest for business or pleasure are also important to communities at a local and regional scale. Economic values are market based involving supply and demand.

The Interior Columbia Basin Ecosystem Management Project (ICBMP) scientists concluded, "...that recreation use generates far more jobs than other uses of Forest Service and BLM

administered lands. Recreation provided by these public lands contributed about 15 percent of total jobs, area-wide.” (USDA,USDI 1996) The geographic scale for this factor is primarily local and regional.

Questions Addressed

Recreation and tourism (EC-3)
Commodity production (TM-3), MM-1), (RM-1)

Ratings

1. Identify roads or segments that access developed sites, fee sites, concession, or commercial permit operations, and that are necessary to directly support these services.
2. Identify roads or segments that are important for activities, which provide revenue to local communities and businesses.
3. Relative rankings are based on above:
 - a. High (10) access is essential for commodity production or area business. Area served by road is in Matrix land allocation in Forest Plan and is important for timber production.
 - b. Medium (6) tourism or local businesses benefit indirectly; other access points or forms of access could replace this road and businesses would not be severely effected. Road access is desirable to draw users into the communities. Area is allocated as MLSR and will have some timber management activities. Includes areas that are in Matrix and are important for firewood gathering. Provides access to a range allotment.
 - c. Low (3) economic dependency on access is either low or short term. Land allocation is LSR and will have limited timber treatment. Area is utilized for special forest products including products such as boughs, cones, bear grass, and transplants. Area is allocated MLSA and receives some use for firewood gathering.
 - d. Very Low (1) Land is Administratively Withdrawn, or in LSR and will have only incidental timber treatment, and will occasionally produce some firewood as a byproduct of another activity.

Data Sources

Sales Tax
Costs for Police, Ambulance and Fire services
SCORP report
Permits

Appendix A Works Cited

U.S. Department of Agriculture, Forest Service, U.S. Department of Interior, Bureau of Land Management. 1996. Integrated Scientific Assessment for Ecosystem Management in the Interior Columbia Basin, and Portions of the Klamath and Great Basins. Pacific Northwest Research Station, Portland Oregon. 197 p.

Table A-1. Human Uses, Entiat, and Chelan Sub-Basins

Road Seg. #	FS road #	Segment length	Access required by law/agree	Resource mgmt.	ROS class	Level of use	Economics	Human use total	Human use rating
1	5100000	10.2	9	10		10	10	39	H
2	5100000	5.1	9	10		10	10	39	H
3	5100113	0.2	0	7		10	7	24	M
4	5100114	0.4	0	10		10	10	30	M
5	5100115	0.2	0	7		10	7	24	M
6	5100116	1	0	10		10	10	30	M
7	5100120	0.2	0	7		10	7	24	M
8	5100122	0.2	0	3		10	3	16	L
9	5100123	0.2	0	7		10	7	24	M
10	5100124	0.5	0	7		10	7	24	M
11	5200000	29.4	9	10		7	10	36	H
12	5200715	0.5	drop					0	
13	5210000	3.5	6	10		7	10	33	H
14	5210215	4.5	6	10		7	10	33	H
15	5212000	7.8	6	10		7	10	33	H
16	5300000	4.5	9	10		3	10	32	H
17	5300000	1.4	9	10		3	10	32	H
18	5303000	4.2	9	10		3	10	32	H
19	5310000	0.1	9	10		3	10	32	H
20	5310000	5	9	10		3	10	32	H
21	5310111	0.1	drop					0	
22	5320000	0.5	9	10		7	10	36	H
23	5320000	6	9	10		3	10	32	H
24	5340000	3	9	10		3	10	32	H
25	5380000	5.5	9	10		7	10	36	H
26	5501000	2.3	0	10		3	10	23	M
27	5605000	6.3	0	10		7	10	27	M
28	5605000	0.8	0	7		7	7	21	L
29	5605112	0.1	0	10		7	10	27	M
30	5606000	3.2	0	7		7	7	21	L
31	5606000	0.9	0	7		7	7	21	L
32	5608000	7.2	0	7		7	7	21	L
33	5700000	12.4	0	10		10	10	30	M
34	5700000	1.8	0	10		10	10	30	M
35	5700100	0.3	0	10		10	10	30	M
36	5702000	5.2	0	10		3	10	23	M
37	5702710	0.5	0	10		3	10	23	M

Road Seg. #	FS road #	Segment length	Access required by law/agree	Resource mgmt.	ROS class	Level of use	Economics	Human use total	Human use rating
38	5710000	0.2	0	10		3	10	23	M
39	5713000	4.1	0	7		7	7	21	L
40	5800000	9	6	10		7	10	33	H
41	5801000	16.7	9	10		3	10	32	H
42	5808000	5.5	9	10		3	10	32	H
43	5808410	3.6	0	10		3	10	23	M
44	5810000	7.3	6	10		3	10	29	M
45	5900000	4.2	0	10		10	10	30	M
46	5900000	6.9	0	7		10	7	24	M
47	5900112	2.1	0	7		7	7	21	L
48	7415000	7.5	9	10		7	10	36	H
49	8410000	10.5	0	10		3	10	23	M
50	5900000	14.8	9	10		7	10	36	H
51	5900116	0.2	0	10		7	10	27	M
52	8020000	21.5	9	10		7	10	36	H
53	8020145	0.2	0	3		7	3	13	L
54	8021000	1.5	0	10		7	10	27	M
55	8021000	4	9	10		10	10	39	H
56	8021100	0.7	9	10		10	10	39	H
57	8140000	10.6	9	10		7	10	36	H
58	8200000	39.1	9	10		10	10	39	H
59	8200115	0.2	9	7		10	7	33	H
60	8200155	1	0	10		10	10	30	M
62	8210000	7.8	9	10		7	10	36	H
63	8301000	11.5	9	10		10	10	39	H
64	8405000	0.5	0	7		10	7	24	M
65	8410000	0.8	9	10		10	10	39	H
66	8410000	18.4	0	10		7	10	27	M
67	8410100	0.2	0	7		10	7	24	M
68	8505000	0.7	9	10		7	10	36	H

Appendix B: Aquatic Rating Criteria

The objective of the Aquatic Assessment is to characterize how the transportation system may be influencing watershed processes and aquatic habitat at the sub-basin and site scale. The assessment at the sub-basin and watershed scale is basically the same, the primary difference being the scale of road segment to be analyzed. The basic units of assessment at the sub-basin scale are the watersheds within the sub-basin and road segments of arterial and collector roads within the watersheds. The sub-basin scale analysis will help prioritize watersheds for further analysis based upon aquatic resources and potential restoration needs, identify issues within watersheds, establish context for the watershed or project scale analysis and identify potential management of the arterials and collectors. Analysis of local roads at the watershed or project level is basically the same while the segment length may be different. Ratings for the sub-basin scale analysis include overall watershed condition ratings and segment specific ratings. Once the sub-basin scale assessment is completed it is hoped that only information specific to the smaller segments will be needed as part of project analysis. The watershed condition ratings are based on the watershed BAs with further information provided by completed watershed analysis and existing GIS layers. The watershed condition ratings establish a context for the road segment ratings. The segment ratings are based on stream survey data, road logs, culvert surveys, and local knowledge.

Development of Aquatic Impact, At-Risk Criteria

Aquatic criteria were developed to capture key processes associated with roads as they link to aquatic environments.

Criteria include:

1. Geologic hazard
2. Road-related Sediment
3. Floodplain off-channel habitat riparian reserve function
4. Flow effects
5. At-risk fish populations and wetlands.
6. Wetlands and wet meadows

In the Questions Addressed section an alphanumeric code that corresponds to the section in the “Roads Analysis Handbook,” Appendix 1 is listed with each bulleted item. This code is linked to an ecological consideration that has been formulated as a question. Each risk factor being evaluated is addressing one or more of these questions. The appendix should be consulted for more information on the risk factor, including a list of potential indicators (tools) that may be considered to appropriately rate each factor. The term “at-risk fish” in this document refers to fish listed as threatened or endangered under the Endangered Species Act.

Criterion 1: Geologic Hazard

This criterion was developed to incorporate the natural risk of mass wasting as an effect on roads or potential for roads to accelerate mass movement events. Three forms of mass movement were identified: debris slides (shallow rapid landslides); earth slumps (fairly deep land slides); and

deep-seated landslides. On the Wenatchee and Okanogan National Forests debris slides are often associated with coarse textured sediment, earth slump medium textured sediment, and deep seated fine and very fine sediment.

The interpretation of mass wasting was taken from the Landtype Associations of North Central Washington's preliminary report (USDA FS 2000). These interpretations were based upon observations of landslide features, Landtype Association site features, and literature references. The interpretations are based upon geomorphic mapping, bedrock weathering properties, geologic structural features, slope gradient, drainage characteristics and patterns, and regolith features.

Geologic Hazard was considered to be a highly important factor relating to aquatic conditions. The numerical weighting however was restricted, weighted heavily toward the high and very high hazards. Each road segment will receive a rating for Geologic Hazard.

Questions Addressed

Mass wasting (AQ-3)

Ratings

1. Low risk = 0
2. Moderate risk = 2
3. High risk = 6
4. Very high risk = 9

Criterion 2: Road-Related Fine Sediment

Surface erosion occurs on forest roads due to erosion of the road surface, cut and fill slopes, and accelerated mass failures. Erosion of the road is sensitive to road design, road maintenance, and geologic hazard. Road surface type, and design and maintenance of drainage structures can influence the amount of road surface erosion. Insufficient drainage structures, culverts, including ditch-relief culverts can also be sources of sediment.

Roads crossing areas of high geologic hazard or with unstable fill slopes may contribute to accelerated mass wasting initiated by the failure of the fill slope. Culverts at stream crossings can be a sediment source if the culvert is under-sized and the hydraulic capacity is exceeded or the culvert inlet is plugged causing stream flow to overtop the road. Large amounts of sediment or mass wasting can also be generated if the plugged culvert results in failure of the crossing resulting in a debris flow, when the culvert is overrun resulting in the stream flowing down the road, eroding the surface and fill. Ditch relief culverts that erode fill material directly into streams is another sediment source.

Questions Addressed

Generated Surface Erosion (AQ-2)

Mass Wasting (AQ-3)

Stream crossing influence local stream channels and water quality (AQ-4)

Ratings

1. Fine Sediment -Watershed Condition

- a. 1 = Watershed is rated as Functioning Appropriately for fine sediment; transportation system consistent with the Aquatic Conservation Strategy (ACS).
- b. 3 = Watershed is rated as Functioning at Risk for fine sediment; road system is a contributor to fine sediment but is not felt to be a major contributor and road system is generally consistent with ACS.
- c. 6 = Watershed is rated as Functioning at Risk for fine sediment; roads are felt to be a major source of fine sediment and road system is inconsistent with ACS.
- d. 10 = Watershed is rated as Functioning at Unacceptable Risk for fine sediment; road system is felt to be a major contributor of fine sediment, and road system is inconsistent with the ACS.

1. Fine Sediment – Segment

- a. 1 = Road segments with a paved surface, crossings are bridged or sufficient to pass the 100 year flood and associated debris. Cut and fill slopes are vegetated and not eroding. Crossings are not impacting channel morphology downstream.
- b. 3 = Road segment is native or gravel surfaced but no visible erosion, ditch relief culverts are not causing erosion of fill into streams, crossings are perpendicular to the stream and sufficient to pass the 100 year flood, or designed so that if they do fail only the prism at the crossing fails. Crossings are not impacting channel morphology downstream or causing downstream bank erosion. There is no evidence of accelerated mass wasting due to the road segment.
- c. 5 = Road segments not meeting above criteria to some degree but potential impact to at-risk fish habitat appear to be minor due to amount of erosion, potential sediment delivery if a crossing failure or fill slope failure were to occur, changes to channel morphology due to a crossing is confined to the site or does not alter the channel type.
- d. 10 = Road segments with high potential impact to at-risk fish habitat. Road surface and/or fill slopes exhibit either erosion into streams, visible ditch erosion, or cut slope erosion into ditches. Sediment directly enters fish-bearing stream from ditch, fill slopes begin to fail, and evidence of accelerated mass wasting due to the sediment becomes prevalent. Crossings with high potential for failure where failure of the prism will result in a large amount of sediment into at-risk fish habitat or the culvert is over-topped it is highly likely the stream will travel down the road and deliver sediment to at-risk fish habitat, crossing are altering stream channel type downstream and/or causing downstream bank erosion.

Criterion 3: Flood Plain Function, Off-Channel Habitat, and Riparian Reserves

This criterion addresses how the road segment has altered the function of a stream's floodplain and/or off-channel habitat. Flood plains are important regulators of stream flow and water quality. They absorb over bank floodwaters, allowing water to soak through vegetation/organic

mat, and into the ground. Here water can be stored and released more slowly into streams. In doing so, functioning floodplains can provide more water in late summer and reduce peak floods in winter and spring.

Roads can affect flood plains by:

- Limiting the frequency of over bank flows and concentrates greater volumes of water within stream banks.

- Interfere with the ability of the stream to migrate across its flood plain.

- Prevents slope runoff from recharging flood plain aquifers.

- Intercept runoff and floodwaters thereby eroding and degrading water quality.

- Indirectly degrade flood plain function by encouraging off-road motorized access from roads onto flood plains.

Indicators of direct and indirect flood plain or riparian reserve degradation include:

- Soil compaction

- Noxious weed introduction

- Evidence of soil erosion or mass wasting of road fill during peak runoff

- Water quality changes

- Artificial confinement of streams

- Stream bank erosion

- Interruption of hill slope delivery of water onto floodplain

- Loss of downed or standing woody debris that is both an energy dissipater and a habitat component

Similar impact occurs if roads are within or provide vehicle access to the portion of a riparian reserve that affects aquatic habitat. Effects include loss of bank vegetation with associated loss in cover and accelerated bank erosion, reduction in large wood from the channel or potential large wood due to wood cutting or hazard tree removal, soil compaction, and accelerated surface erosion.

Off-road access, provided by roads onto flood plains or riparian reserves is influenced by factors which include:

- Proximity of road to flood plain

- Slope of ground leading from road onto floodplain

- Desirability of flood plain determined by its width and demands for dispersed use

With more alteration the likelihood increases that stream systems will not function properly and those road segments within the flood plain will be at higher risk of damage.

Off-channel habitats provide important rearing habitat and refuge habitat during high flows.

Roads in flood plain may isolate these off-channel areas so they are no longer accessible to fish or completely fill them. A road system may not isolate or fill an off-channel area but by providing access to vehicles result in loss of vegetation, bank stability, large wood input, cover, and a loss of overall habitat quality.

Questions Addressed

Changes in physical channel dynamics (AQ-9)

Affects to shading, litterfall and riparian plant communities (AQ-11)

Affects of fishing, poaching and direct habitat loss for at-risk aquatic species (AQ-12)

Ratings

1. Flood Plain Function – Watershed Condition:

- a. 1 = Main arterials and collectors are not located in valley bottoms or if located in valley bottom are not constricting the channels nor providing dispersed recreation access which is diminishing flood plain function or off-channel habitat quality. Flood plain connectivity, off-channel habitat and riparian reserves are rated as Functioning Appropriately.
- b. 3 = Some arterial and collector roads are located in the valley bottoms and are causing minor stream confinement. Dispersed recreation access is not resulting in adverse impact to the flood plain, riparian function that affects aquatic habitat, or off channel habitat. Flood plain connectivity, off channel habitat and riparian reserves are rated as Functioning Appropriately. If riparian reserves are rated as Functioning at Risk the rating is not primarily due to the road system or dispersed recreation. While riparian reserves may be at risk, off-channel habitat and flood plains are functioning appropriately.
- c. 9 = Main arterial and/or collectors are constricting streams so that floodplain connectivity and/or off channel habitat are rated Functioning at Risk and/or Riparian Conservation Areas are rated as Functioning at Risk due to dispersed recreation, or if there is concern over potential dispersed use, even if Riparian Conservation Areas are currently Functioning Appropriately. Dispersed use is not consistent with ACS or appears to be moving towards being inconsistent with ACS.
- d. 10 = Flood plain connectivity or off-channel habitat and/or Riparian Conservation Areas are considered to be Functioning at Unacceptable Risk due to the road system and or dispersed recreation. Generally dispersed recreation would currently be inconsistent with ACS.

2. Flood Plain Function – Road Segment:

- a. 1 = Road segment is not located in valley bottom or is located on toe slope in confined valley bottom outside the 100 year floodplain and not interfering with floodplain function.
- b. 6 = Road segment located on moderately confined valley or unconfined bottoms with localized areas of road encroachment on stream channel. Road location may be providing motorized off-road access onto flood plain or within riparian reserve such that flood plain or riparian habitat conditions which affect aquatic habitat showing signs of degrading in localized areas (see indicators above).
- c. 9 = Road segment located on unconfined valley bottom which frequently or continuously restricts channel migration, off-channel habitat and riparian habitat conditions affecting vegetation, altering movement of water, accelerating erosion processes, interfering with recruitment of large woody debris, and/or is providing access for motorized off-road dispersed use within the flood plain or riparian reserve

to the point riparian habitat conditions affecting riparian habitat are being degraded.

Criterion 4: Flow Effects

Criterion 4 addresses if road segments

intercept surface runoff and near surface ground water, along cut slopes and ditch lines, converting subsurface flows to surface flows.

increase delivery efficiency of these flows by diverting them directly to streams.

Where these combined flows are continuous between roads and stream systems there is hydrologic connectivity. Hydrologic connectivity is defined as any road segment that during runoff has a continuous surface flow between any part of the road prism and a natural stream channel. Water moves from hill slopes to valley bottom via surface and subsurface paths. Roads affect flow when they cut across hill slopes and/or require fill material through depressions that interrupt these natural paths. Road cut slopes or ditches intercept surface runoff and groundwater, accelerating their movement toward stream crossings. This action frequently increases soil erosion risks and routing efficiencies, which deliver road derived sediments and contaminants to streams and can alter peak flows and channel characteristics downstream. Precipitation runoff mechanisms including rain-on-snow, spring snowmelt and convectional storms should be considered when evaluating a road segment's hydrologic connectivity. Indicators of these effects include water interception on road surfaces and ditch lines, absences of ditch line relief culverts or cross drains, or interruption and detention of flows by road fill.

Questions Addressed

Affects to surface and subsurface hydrology (AQ-1)

Affects to water quality, quantity and hydrologic connectivity (AQ-6)

Ratings

1. Flow affects – Watershed Condition:
 - a. 1 = Roads are not greatly impacting watershed function. Road Density and Location, changes in peak/base flows are Functioning Appropriately.
 - b. 3 = Road Density and Location are Functioning at Risk but Change in Peak/Base Flows is Functioning Appropriately
 - c. 6 = Road Density and Location are Functioning at Risk or Unacceptable Risk and Change in Peak/Base Flows is Functioning at Risk
 - d. 9 = Road Density and Location is Functioning at Risk or Unacceptable Risk and Change in Peak/Base flows is Functioning At Unacceptable Risk
2. Flow Effects – Segment:
 - a. 0 = Road segment is not intercepting concentrating runoff or groundwater in ditch lines. Runoff is cross-drained through a vegetative filter prior to reaching stream channels. Natural flow paths are maintained uninterrupted.
 - b. 3 = Road segment is occasionally intercepting runoff, esp. during peak events, but generally not groundwater. Delivery efficiencies are low due to combination of landform slope and weakly developed stream networks. Some additional ditch relief is necessary

for routing surface runoff through vegetative filter. Downstream stream reaches may be susceptible to damage from increase peak flows.

- c. 9 = Road segment frequently intercepting both surface runoff and/or groundwater in sufficient volumes to influence flow downstream and delivering waters directly to streams. Landform slopes are steep and drainage densities high, providing increased delivery efficiency to stream channels. Downstream channels are unstable and susceptible to damage from increased peak flows. Road prisms may be interrupting and detaining water preventing it from recharging floodplain aquifers. Road has high hydrologic connectivity to the stream system.

Criterion 5: At-Risk Fish Populations

This criterion addresses the relative importance of a sub-watershed to the conservation and recovery of at-risk fish and to help weigh the potential for adverse impact to at-risk fish or their habitat. Besides the potential impact to aquatic habitat, roads can increase the potential for poaching or introduction of exotic species.

Questions Addressed

- Downstream beneficial uses of water and demands (AQ-7)
- Affects to migration and movement of aquatic organisms (AQ-10)
- Affects to fishing, poaching and direct habitat loss for at-risk aquatic species (AQ-12)
- Affects to areas of exceptionally high aquatic diversity or rare or unique species (AQ-14)

Ratings

1. At-risk fish populations:
These criteria addresses whether fish listed for protection under the Endangered Species Act are present in the watershed and the relative importance to recovery within the sub-basin.
 - a. 0 = No at-risk fish present in the sub-basin or watershed
 - b. 1 = At-risk fish are present but there are no significant sub-watersheds.
 - c. 3 = At-risk fish are present but there are no significant sub-watersheds because populations are depressed preventing identification of significant sub-watersheds or significant sub-watersheds have been identified but populations are very low and habitat is fragmented or severely degraded.
 - d. 6 = At-risk populations are present with significant sub-watersheds for one or multiple species; habitat connectivity exists within the watershed. Habitat conditions are such that with relatively low investment in restoration the watershed could be a refugia from a habitat standpoint or management emphasis on restoration for other resources can be coordinated with aquatic/watershed restoration (i.e., “dry site or 303d.)
 - e. 9 = Multiple significant sub-watersheds exist for multiple species or watershed represents a refugia within the sub-basin for one or more species
2. At-risk fish populations – Road Segment (AQ - 7, 10, 12, 14)
 - a. 1 = Road segment with the following set of conditions: road segments located in 6th field watershed with no listed fish species; stream crossings are not migration barriers (any life

- stage) for other fish species.
- b. 3 = Road segment is in a sub-watershed with at-risk fish or tributary to a watershed with at-risk fish, but neither the sub-watershed is within nor the sub-watershed downstream is a significant sub-watershed for an at-risk species. Stream crossings are not barriers to at-risk fish, but may be to other species.
 - c. 5 = Road segment is in a sub-watershed with at-risk fish or tributary to a watershed with at-risk fish, but neither the sub-watershed is within nor the sub-watershed downstream is a significant sub-watershed for an at-risk species, but one or more crossings are present that present a barrier to at-risk fish at some life stage.
 - d. 6 = Road segment is in a significant sub-watershed for an at-risk species or is a tributary to significant sub-watershed, no road crossings are barriers to any life stage of an at-risk species, poaching is not a major concern.
 - e. 8 = Road segment is in a significant sub-watershed for an at-risk species or is tributary to a significant sub-watershed, no road crossings are barriers to any life stage of an at-risk species, but poaching due to access from the road segment is a concern though not necessarily documented.
 - f. 10 = Road segment is in a significant sub-watershed for an at-risk species or is tributary to a significant sub-watershed. The road segment is or has potential, based upon the previous factors, to have serious adverse impact to at-risk fish habitat; and/or there are road crossing barriers to some life stage of at-risk species and/or there is known poaching of at-risk fish occurring.

Criterion 6: Wetlands and Wet Meadows

This criteria addresses whether wetlands are present along road systems, do road segments interfere with their condition and function, ground water movement or wetland vegetation.

A road segments influence on the condition and function of adjacent wetlands is a result of either a direct impact such as:

- a road location relative to the wetland.
- indirect impact related to the roads effect on the wetland supporting hydrology.
- vegetative community and soil characteristics.

The most notable effects include:

- converting productive wetlands to compacted road surfaces
- providing motorized off-road access into these areas
- constraining and diverting both surface and subsurface flows that support the water table
- intercepting runoff which can accelerate erosion and lower water tables
- increase sediment loading and delivery of toxic pollutants
- conversions in plant species composition by introducing noxious weeds
- reduce base flows and increase peak flow and flood frequencies and degrade water quality

Of these effects, those that affect the areas ability to receive, store, and move water will likely have the greatest impact on the wetland's condition and function.

Questions Addressed

Affects of wetlands

Ratings

1. Listed below is a summary of hazard rating for road segments:
 - a. 0 = Road segment is either not near or adjacent to wetlands/wet meadows, or road design characteristics are providing for the uninterrupted movement of surface and groundwater necessary to support the wetland's vegetation and soil characteristics.
 - b. 3 = Road segment is adjacent to or crosses small localized wetlands or wet meadows. Road design characteristics, particularly crossings of surface and near surface water paths are limiting the available water necessary to inundate and saturate the landform and support the wetland's vegetation and soil characteristics. Initiation of wetland degradation including noxious weed establishment, increased sediment loading, and decreased area of saturation is occurring.
 - c. 6 = Road segment is adjacent to or crosses landscape scale wetland's or wet meadows. Road location and design have displaced or degraded the wetland's size and function. Runoff is being delivered directly to the wetland, increasing sediment and contaminant loadings. Crossings of surface and near surface water paths have severely limited the volume, timing and distribution of water necessary to saturate the landform and support the wetland's vegetation and soil characteristics. Road segment may be providing motorized off-road vehicles access into the area, further contributing to its degradation.

Appendix B Works Cited

U.S. Department of Agriculture, Forest Service. 2000. Landtype associations of North Central Washington, Wenatchee, Okanogan and Colville National Forests. Preliminary report, unpublished agency document. On file with: Okanogan and Wenatchee National Forests Headquarters Office, 215 Melody Lane, Wenatchee, WA 98801. 98 p.

Table B-1. Aquatic impact, at-risk, Entiat and Chelan Sub-Basins

Road seg #	FS road #	Seg. length	Geologic hazard	Rd-related fine sed.	Floodplain function	Flow effects	At-risk fish pops	Wetlands & meadows	Aquatic total	Aquatic rating
1	5100000	10.2	2	1	1	3	6	0	13	M
2	5100000	5.1	0	5	1	3	1	0	10	L
3	5100113	0.2	0	1	6	0	6	0	13	M
4	5100114	0.4	0	1	1	0	6	0	8	L
5	5100115	0.2	0	3	1	0	6	0	10	L
6	5100116	1	0	1	6	0	6	3	16	M
7	5100120	0.2	0	3	6	0	1	0	10	L
8	5100122	0.2	0	3	1	0	1	3	8	L
9	5100123	0.2	0	3	6	0	1	3	13	M
10	5100124	0.5	0	3	6	0	1	0	10	L
11	5200000	18.3	2	5	6	3	1	3	20	M
12	5200715	0.5							0	
13	5210000	3.5	2	5	1	3	1	3	15	M
14	5210215	4.5	2	5	1	3	1	3	15	M
15	5212000	7.8	2	5	1	3	1	3	15	M
16	5300000	4.5	2	5	9	3	3	3	25	H
17	5300000	1.4	2	3	6	3	1	0	15	M
18	5303000	4.2	2	5	1	3	5	0	16	M
19	5310000	0.1							0	
20	5310000	5	2	5	1	3	5	0	16	M
21	5310111	0.1							0	
22	5320000	0.5	0	5	1	3	5	3	17	M
23	5320000	6	2	5	1	3	6	3	20	M
24	5340000	3	0	3	1	3	5	0	12	M
25	5380000	5.5	0	5	9	3	5	3	25	H
26	5501000	2.3	2	3	1	3	1	0	10	L

Road seg #	FS road #	Seg. length	Geologic hazard	Rd-related fine sed.	Floodplain function	Flow effects	At-risk fish pops	Wetlands & meadows	Aquatic total	Aquatic rating
27	5605000	6.3	6	3	1	9	5	3	27	H
28	5605000	0.8	0	3	1	0	5	0	9	L
29	5605112	0.1							0	
30	5606000	3.2	2	3	1	3	3	0	12	M
31	5606000	0.9	2	5	1	3	3	0	14	M
32	5608000	7.2	2	5	1	3	3	0	14	M
33	5700000	12.4	2	1	6	3	10	3	25	H
34	5700000	1.8	0	3	1	3	6	0	13	M
35	5700100	0.3	0	3	6	0	10	0	19	M
36	5702000	5.2	2	3	1	3	6	3	18	M
37	5702710	0.5	2	3	1	3	6	3	18	M
38	5710000	0.2	2	3	1	3	6	3	18	M
39	5713000	4.1	0	3	1	3	6	3	16	M
40	5800000	9	6	5	6	9	10	0	36	H
41	5801000	16.7	2	3	1	3	6	3	18	M
42	5808000	5.5	0	3	1	3	6	0	13	M
43	5808410	3.6	6	5	6	9	6	6	38	H
44	5810000	7.3	0	5	1	3	10	3	22	M
45	5900000	4.2	2	5	1	3	1	0	12	M
46	5900000	6.9	0	5	1	3	1	0	10	L
48	7415000	7.5	2	5	6	3	1	6	23	M
49	8410000	10.5	2	3	1	3	1	0	10	L
50	5900000	14.8	2	5	1	3	3	0	14	M
51	5900116	0.2	0	3	1	0	1	0	5	L
52	8020000	21.5	0	3	1	0	1	3	8	L
53	8020145	0.2	0	3	1	0	1	0	5	L
54	8021000	1.5	2	3	3	3	1	3	15	M
55	8021000	4	2	3	1	3	1	0	10	L
56	8021100	0.7	2	3	1	3	1	0	10	L

Road seg #	FS road #	Seg. length	Geologic hazard	Rd-related fine sed.	Floodplain function	Flow effects	At-risk fish pops	Wetlands & meadows	Aquatic total	Aquatic rating
57	8140000	10.6	2	3	1	3	1	0	10	L
58	8200000	39.1	6	10	6	9	5	3	39	H
59	8200115	0.2	0	3	1	0	1	0	5	L
60	8200155	1	0	3	1	3	3	0	10	L
61	8200160	0.1	0	3	1	0	1	0	5	L
62	8210000	7.8	2	3	1	3	1	0	10	L
63	8301000	11.5	2	5	6	3	3	3	22	M
64	8405000	0.5	0	1	1	0	0	3	5	L
65	8410000	0.8	2	5	6	3	3	0	19	M
66	8410000	18.4	2	5	1	3	3	0	14	M
67	8410100	0.2	0	3	1	0	3	0	7	L

Appendix C: Wildlife Rating Criteria

This portion of the roads analysis characterizes the wildlife/road interactions that occur within each watershed within a sub-basin. The sub-basin analysis will identify the major arterial and collector roads for management, prioritize watersheds for further analysis at the watershed scale based upon potential restoration needs for wildlife habitats, identify issues within watersheds, and establish the context for watershed scale roads analysis.

The analyses described below can be used to address wide-ranging carnivores, late-successional associated species, riparian-dependent species, ungulates, and unique habitats. Table C-1 provides an approach to rank watersheds based upon the wildlife issues within each watershed and the potential to provide benefits to the restoration of wildlife habitats. Table C-2 summarizes road-associated factors that affect wildlife habitats or populations (Wisdom et al. 1999). The analyses address the terrestrial wildlife (TW) roads analysis questions, TW-1, TW-2, TW-3, TW-4, and ecosystem functions (EF) question EF (2) identified in Appendix 1 of “Roads Analysis: Informing Decisions about Managing the National Forest Transportation System” (U.S.D.A. Forest Service 1999). The analyses described in this document are an adaptation of the TW questions to better address the issues and conditions on the Forests.

Table C-1. Relative ranking scheme: determining the priority of watersheds for watershed scale analysis within each sub-basin for each species group or habitat

Species/Group habitat	High	Moderate	Low
Wide-Ranging Carnivores	9	5	1
Late-Successional Species	10	6	2
Riparian Dependent	10	6	2
Ungulates	9	5	1
Unique Habitats	10	6	2

In the Questions Addressed section, the alphanumeric code listed corresponds to the section in the “Roads Analysis Handbook,” Appendix 1. This code is linked to an ecological consideration, which has been formulated as a question. Each risk factor being evaluated is addressing one or more of these questions. The appendix should be consulted for more information on the risk factor, including a list of potential indicators (tools) that may be considered to appropriately rate each factor.

Definitions

Impassable road: Roads that are not reasonably or prudently passable by conventional four wheeled passenger vehicles, motorcycles or all terrain vehicles.

Open road: Roads open to motorized use during any portion of the season of concern for the particular species being addressed. If information is not available concerning the effectiveness of a gate or berm it may be best to assume it is open.

Restricted road: Roads that are legally restricted, typically with gates or berms and information is available showing that use does not exceed 14 days.

Table C-2. Road-associated factors negatively affecting habitat or populations of wildlifespecies (based on Wisdom et al. 1999) and the species group for which effects of the road-associated factor has been documented

Road-associated factor	Effect of the factor	Wildlife group affected
Hunting	Non-sustainable or non-desired legal harvest by hunting facilitated by road access.	Wide-ranging carnivores; Ungulates
Poaching	Increased illegal take of animals, as facilitated by roads.	Wide-ranging carnivores; Ungulates
Collisions	Death or injury resulting from a motorized vehicle running over or hitting an animal	Wide-ranging carnivores; Late-successional; Riparian dependent; Ungulates; Unique Habitats
Chronic negative human interactions	Increased mortality of animals (e.g. euthanasia or shooting) due to increased contact with humans, as facilitated by road access.	Wide-ranging carnivores
Movement barrier	Interference with dispersal or other movements as posed by a road itself or by human activities on or near a road or road network.	Wide-ranging carnivores; Late-successional; Riparian dependent; Ungulates; Unique Habitats
Displacement or avoidance	Spatial shifts in populations or individual animals away from a road or road network in relation to human activities on or near a road or road network.	Wide-ranging carnivores; Late-successional; Riparian dependent; Ungulates; Unique Habitats
Habitat loss and fragmentation	Loss and resulting fragmentation of habitat due to the establishment of roads, road networks, and associated human activities.	Wide-ranging carnivores; Late-successional; Riparian dependent; Ungulates; Unique Habitats

Criterion 1: Wide-Ranging Carnivores

This group of species includes the grizzly bear (threatened), gray wolf (endangered), wolverine, and lynx (threatened). Several studies have documented the effects of road-associated factors on carnivores and they have included hunting, poaching, collisions, chronic negative human interactions, movement barriers, displacement/avoidance, habitat loss and fragmentation (Thiel 1985, McLellan and Shackleton 1988, Mech et al. 1988, Kasworm and Manley 1989, Mace et al. 1996, Singleton and Lehmkuhl 1998). Several questions remained unanswered concerning the

relationship between lynx and roads. McKelvey et al. (1999) found no evidence that narrow forest roads at relatively low road densities affected habitat use by lynx. However, their analyses did not address potential indirect effects of roads on habitat quality for lynx. There is some additional speculation that roads used during the winter for snowmobile routes may increase the interactions between lynx and other competitors such as bobcat and coyotes (Buskirk et al. 1999). Therefore, to err on the conservative side, road associated factors and lynx are considered in this analysis. Table C-3 describes all the Lynx Analysis Units identified in the Entiat and Chelan Sub-basins.

Table C-3. Road density of each Lynx Analysis Unit (LAU) on the Entiat and Chelan Sub-Basins

LAU	Road length (miles)	Total area (acres)	Total area (sq. miles)	Road density (mi/mi ²)
Chumstick Mtn.*	225.3	28,864	45.1	4.9
Cooper Mtn.	26.1	9,216	14.4	1.8
Copper Peak*	4.2	46,592	72.8	0.1
Cougar*	133.8	50,496	78.9	1.7
Ferry Basin	25.1	34,112	53.3	0.5
Fourth of July Basin	0	15,424	24.1	0
Garland*	5.2	20,288	31.7	0.2
Hungry Ridge	7.8	7,232	11.3	0.7
Indianhead Basin	0	38,208	59.7	0
Lake Basin	237.7	71,296	111.4	2.1
Pyramid	37.8	39,168	61.2	0.6
Upper Entiat*	0	28,928	45.2	0

*Figures refer to areas only within Entiat and Chelan Sub-Basin. Portions of LAU area also on the Lake Wenatchee and Leavenworth Sub-Basins.

Questions Addressed

- Direct effects on terrestrial species habitat (TW-1)
- Affects to habitat by facilitating human activities (TW-2)
- Affect to legal and illegal human activities i.e. trapping, hunting, poaching (TW-3)

Ratings

1. Analysis area: The watershed (fifth field) within the sub-basin (fourth field).
2. Follow the process described in the Interagency Grizzly Bear Committee Task Force Report (Puchlerz and Servheen 1998) to develop maps of core areas and road densities within each watershed in the sub-basin.
3. Identify issues and priorities for further watershed level roads analysis and for habitat restoration of the major arterial and collector roads in each watershed within the sub-basin based on the following:
 - a. Amount and location of core areas in the watershed.
 - b. Road density within the watershed, defined as: high = >2mi/mi², moderate = 1-2mi/mi², and low = <1 mi/mi².

- c. Proportion of the watershed affected by winter use of road in a Lynx Analysis Unit.
- 4. Relative ranking. Based on the above information rank the watershed and the major arterial and collector roads as follows:
 - a. Low (1) – low potential to improve conditions for the target species.
 - b. Moderate (5) – moderate potential to improve conditions for the target species.
 - c. High (9) – high potential to improve conditions for the target species.

Criterion 2: Late-Successional Associated Species

Over 100 wildlife species were identified on the Wenatchee National Forest which were associated with some type of late-successional forest type (UDSA FS 1997). A review of the available literature on these species showed that approximately one-third could be affected by roads or road-related activities (UDSA FS 1997). Road-associated factors that could affect these species include collisions, movement barriers, displacement/avoidance, habitat loss and fragmentation (UDSA FS 1997, Singleton and Lehmkuhl 1998, Wisdom et al. 1999).

Questions Addressed

Direct effects on terrestrial species habitat (TW-1)

Affects to habitat by facilitating human activities (TW-2)

Affect to legal and illegal human activities, such as trapping, hunting, poaching (TW-3)

Ratings

1. Analysis area: The watersheds within the sub-basin.
2. Follow the process outlined in the Wenatchee National Forest Late-Successional Reserve Assessment (LSRA, page 107 of the forest wide). Refer to the LSRA to determine the current condition of security habitat within the LSR.
3. Identify the issues and priorities for further analysis, and the major arterial and collector roads restoration opportunities for each watershed within the sub-basin based on the following:
 - a. Juxtaposition of late-successional habitat to road or road segment.
 - b. Road density (high = $>2\text{mi}/\text{mi}^2$, moderate = $1\text{-}2\text{mi}/\text{mi}^2$, and low = $<1\text{ mi}/\text{mi}^2$.) and security habitat conditions within the LSR.
 - c. Potential of the road to enhance security habitat within the LSR.
4. Relative ranking. Based on the above information rank the watershed and the major arterial and collector roads as follows:
 - a. Low (2): low potential to improve the security habitat and habitat effectiveness in the LSR.
 - b. Moderate (6): moderate potential to improve the security habitat and habitat effectiveness in the LSR.
 - c. High (10): high potential to improve the security habitat and habitat effectiveness in the LSR.
 - d. If none of the watershed is within an LSR score as 0.

Criterion 3: Riparian-Dependent Species

This group of wildlife species includes about 285 vertebrate species that are either directly dependent on riparian habitat or use them more than other habitats (Thomas et al. 1979). Road-associated factors that could affect these species include collisions, movement barriers, displacement/avoidance, habitat loss and fragmentation (UDSA FS 1997, Singleton and Lehmkuhl 1998, Maxwell and Hokit 1999, Wisdom et al. 1999).

This analysis addresses terrestrial wildlife roads analysis question TW-4 identified in Roads Analysis: Informing Decisions about Managing the National Forest Transportation System (UDSA FS 1999).

Question Addressed

Affects of unique communities or special features (AW-4)

Ratings

1. The analysis area: The watersheds within the sub-basin.
2. Determine the area within riparian reserves and density of roads within riparian reserves.
3. Identify the issues and priorities for further analysis, and the major arterial and collector roads restoration opportunities for each watershed within the sub-basin based on the following:
 - a. Proportion and area of the watershed in riparian reserves.
 - b. Road density within the riparian reserves (high = $>2\text{mi}/\text{mi}^2$, moderate = $1\text{-}2\text{mi}/\text{mi}^2$, and low = $<1\text{ mi}/\text{mi}^2$).
 - c. Proportion of the major arterial and collector roads that occur in the riparian reserve.
4. Relative ranking. Based on the above information rank the watershed and the major arterial and collector roads as follows:
 - a. Low (2): low potential to restore riparian habitat and habitat connectivity.
 - b. Moderate (6): moderate potential to restore riparian habitat and habitat connectivity.
 - c. High (10): high potential to restore riparian habitat and habitat connectivity.
 - d. None (0): road not located in a riparian reserve.

Criterion 4: Ungulates

This group of species includes mule deer, elk, mountain goats, and bighorn sheep. Road-associated factors that could affect these species include hunting, poaching, collisions, movement barriers, displacement/avoidance, habitat loss and fragmentation (UDSA FS 1997, Singleton and Lehmkuhl 1998, Canfield et al. 1999, Wisdom et al. 1999).

Questions Addressed

Direct effects on terrestrial species habitat (TW-1)

Affects to habitat by facilitating human activities (TW-2)

Affect to legal and illegal human activities i.e., trapping, hunting, poaching (TW-3)

Ratings

1. Analysis area: The watersheds within the sub-basin.
2. Determine the proportion and area of winter ranges, young rearing areas, and migration routes for these ungulate species within each watershed.
3. Identify the issues and priorities for further analysis and the major arterial and collector roads restoration opportunities based on the following:
 - a. Proportion and area of the winter range, young rearing areas, and migration routes in each watershed.
 - b. Density of roads (high = $>2\text{mi}/\text{mi}^2$, moderate = $1\text{-}2\text{mi}/\text{mi}^2$, and low = $<1\text{ mi}/\text{mi}^2$) within these areas, based on the assumption that road density is a good indicator of snowmobile/winter use.
 - c. Potential of the major arterial and collector roads to enhance winter range, based on actual winter range and not EW-1, young rearing areas and migration routes through a management action.
4. Relative ranking. Based on the above information rank the major arterial and collector roads and watershed as follows:
 - a. Low (1): low potential to enhance habitat effectiveness of winter ranges, young rearing areas and migration routes.
 - b. Moderate (5): moderate potential to enhance the habitat effectiveness of winter ranges, young rearing areas and migration routes.
 - c. High (9): high potential to enhance habitat effectiveness of winter ranges, young rearing areas and migration routes
 - d. None (0): not located within winter range, young rearing area or on migration route for ungulates.

Criterion 5: Unique Habitats

Unique habitats include wetlands, talus slopes, caves, cliffs, snag patches, hardwood forests, etc. These habitats tend to be used disproportionate to their availability on a landscape, making them particularly important for wildlife and greatly enhancing biodiversity. Road-associated factors that could affect the wildlife species associated with these habitats include collisions, movement barriers, displacement/avoidance, habitat loss and fragmentation (UDSA FS 1997, Singleton and Lehmkuhl 1998, Wisdom et al. 1999).

Question Answered

Affects of unique communities or special features (TW-4)

Ratings

1. The analysis area: the watersheds within the sub-basin.
2. Identify the unique habitats within each watershed.
3. Identify the issues and priorities for further analysis, and the major arterial and collector roads restoration opportunities based on the following:
 - a. The density of unique habitats (acres/mile road within 100m of the major arterial and collector roads) within the watershed.

- b. The quantity of unique habitats (number of unique habitat types/road segment or road within 100m of the major arterial and collector roads).
- c. Rating of unique habitats will be based on the following formula and then applied to relative ranking below:
 - 1) Low density + low quantity = low
 - 2) Low/moderate density + moderate quantity = moderate
 - 3) Moderate density + low/moderate quantity = moderate
 - 4) High/moderate density + high quantity = high
 - 5) High density + high/moderate quantity = high

Determination of low/mod/high density and quantity will be a function of statistical distribution and ecological situation specific to each sub-basin.
- 5. Relative ranking. Based on the above information rank the watershed as follows:
 - a. Low (2): low density/quantity of unique habitats and low potential to restore unique habitats.
 - b. Moderate (6): moderate density/quantity of unique habitats and moderate potential to restore unique habitats.
 - c. High (10): high density/quantity of unique habitats and high potential to restore unique habitats.
 - d. None (0): Road does not affect unique habitats.

Appendix C Works Cited

- Buskirk, S.W.; Ruggiero, L.F.; Krebs, C.J. 1999. Habitat fragmentation and interspecific competition: Implications for lynx conservation. In: Ruggiero, L.F., et al. eds., Ecology and conservation of lynx in the United States. University Press, Boulder, CO. 83-100.
- Canfield, J.E.; Lyon, L.J.; Hillis, J.M.; Thompson, M.J. 1999. Ungulates. In: Joslin, G. and Youmans, H., coordinators. Effects of recreation on Rocky Mountain wildlife: A review for Montana. Committee on Effects of Recreation on Wildlife. Montana Chapter of the Wildlife Society: Bozeman, MT: 6.1-6.25.
- Kasworm, W.F.; Manley, T.L. 1989. Road and trail influences on grizzly bears and black bears in northwest Montana. International Conference on Bear Research and Management. 8: 79-84.
- Mace, R.D.; Waller, J.S.; Manley, T.L. [et al.]. 1996. Relationships among grizzly bears, roads, and habitat in the Swan Mountains. Montana Journal of Applied Ecology. 33:1395-1404.
- Maxwell, B.A.; Hokit, D.G. 1999. Amphibians and reptiles. In: Joslin, G. and Youmans, H., coords. Effects of recreation on Rocky Mountain wildlife: A Review for Montana Committee on Effects of Recreation on Wildlife. Montana Chapter of the Wildlife Society: Bozeman, MT: 2.1-2.29.
- McKelvey, K.S.; Ortega, Y.K.; Koehler, G.M. [et al.]. 1999. Canada lynx habitat and topographic use patterns in North Central Washington: A Reanalysis. In: Ruggiero, L.F. et al. eds., Ecology and conservation of lynx in the United States. University Press, CO: 307-336.
- McLellan, B.N.; Shackelton, D.M.. 1988. Grizzly bears and resource-extraction industries:

Effects of roads on behaviour, habitat use and demography. *Journal of Applied Ecology*. 25:451-460.

Mech, L.D.; Fritts, S.H.; Radde, G.L.; Paul, W.J. 1988. Wolf distribution and road density in Minnesota. *Wildlife Society Bulletin*.16:85-87.

Puchlerz, T., and Servheen, C. 1998. Interagency Grizzly Bear Committee Taskforce report: Grizzly bear/ motorized access management. Interagency Grizzly Bear Committee, Denver, CO.

Singleton, P.H.; Lehmkuhl, J.F. 1998. Wildlife-roadway interactions. U.S. Department of Agriculture, Forest Service, Wenatchee Forestry Sciences Lab, Wenatchee, WA. 162 p.

Thiel, R.P. 1985. The relationship between road densities and wolf habitat suitability in Wisconsin. *American Midland Naturalist*. 113:404-407.

Thomas, J.W.; Maser, C.; Rodiek, J.E. 1979. Riparian zones. In: Thomas, J.W., ed. *Wildlife habitats in managed forests: the Blue Mountains of Oregon and Washington*. U.S. Department of Agriculture, Forest Service Agriculture Handbook No. 553. p. 40-47.

U.S. Department of Agriculture, Forest Service. 1999. Roads analysis: Informing decisions about managing the national forest transportation system. Misc. Rep. FS-643. Washington, D.C. 222 p.

U.S. Department of Agriculture, Forest Service. 1997. Wenatchee National Forest late-successional reserve assessment. On file with: Okanogan and Wenatchee National Forests, Wenatchee, WA. 217 pp.

Wisdom, M.J.; Hargis, C.D.; Holthausen, R.S. [et al.]. 1999. Wildlife habitats in forests of the interior northwest: history, status, trends, and critical issues confronting land managers. *Transactions of the 64th North American Natural Resources Conference*: 79-93.

Table C-4. Wildlife impact, at-risk, Entiat and Chelan Sub-Basins

Road seg #	FS road #	Watershed	Seg. length	Wide range carniv.	Late success species	Riparian depend.	Ungulates	Unique habitats	Wildlife total	Wildlife rating
1	5100000	Entiat	10.2	5	6	10	5	na	26	H
2	5100000	Entiat	5.1	5	10	10	5	na	30	H
3	5100113	Entiat	0.2	1	0	10	1	na	12	M
4	5100114	Entiat	0.4	1	0	10	1	na	12	M
5	5100115	Entiat	0.2	1	0	10	1	na	12	M
6	5100116	Entiat	1	1	2	10	1	na	14	M
7	5100120	Entiat	0.2	1	2	10	1	na	14	M
8	5100122	Entiat	0.2	1	2	10	1	na	14	M
9	5100123	Entiat	0.2	1	2	10	1	na	14	M
10	5100124	Entiat	0.5	1	2	10	1	na	14	M
11	5200000	Entiat	29.4	5	6	0	5	na	16	M
12	5200715	Wenatchee River	0.5	na	na	na	na	na	0	na
13	5210000	Entiat	3.5	1	0	0	5	na	6	M
14	5210215	Entiat	4.5	5	0	0	5	na	10	M
15	5212000	Entiat	7.8	9	0	0	5	na	14	M
16	5300000	Entiat	4.5	5	0	10	9	na	24	H

Table C-5. Results of roads analysis, rating and notes, for wildlife habitat on Entiat and Chelan Sub-Basins

Seg#	Road #	Watershed name	Length	Wide range carniv.	Late success species	Riparian depend.	Ungul.	Unique habitats	Wildlife total	Rating	Notes (W=Wide range carnivores L=LSR R=Riparian dependent U=Ungulates UH=Unique hab.)
1	5100000	Entiat	10.2	5	6	10	5	na	26	H	W-accesses wilderness, campground (CG), paved, would be high rating but human use limits.; L-up middle of Shady Pass LSR.; U-fawning(F).; R-up Entiat R.
2	5100000	Entiat	5.1	5	10	10	5	na	30	H	W-same as above.; L-road bisects Shady Pass LSR, owl nests in CG.; U-F.; R-same as above.
3	5100113	Entiat	0.2	1	0	10	1	na	12	M	W-Road segments 3-10 rate low because they access CGs and are parallel to main road. Changes would therefore have little effect.; R-look at moving some camping sites off river.
4	5100114	Entiat	0.4	1	0	10	1	na	12	M	see seg. #3
5	5100115	Entiat	0.2	1	0	10	1	na	12	M	see seg. #3
6	5100116	Entiat	1	1	2	10	1	na	14	M	see seg. #3
7	5100120	Entiat	0.2	1	2	10	1	na	14	M	see seg. #3
8	5100122	Entiat	0.2	1	2	10	1	na	14	M	see seg. #3
9	5100123	Entiat	0.2	1	2	10	1	na	14	M	see seg. #3
10	5100124	Entiat	0.5	1	2	10	1	na	14	M	see seg. #3

Appendix D: Recommended Management Actions

Recommended management actions are alternatives that are possible options to meet the needs of the resources and the public. Any single action or combination of actions could be used. This analysis will give the broad category and the district will need to decide which actions are appropriate for each project.

A. Access needs to be maintained due to public needs; however, some major work or restrictions are needed to mitigate the resource impact. Options include but are not limited to: relocation, major rehabilitation such as raising grade, surfacing, installing a large CMP or bridge, major storm-proofing (investment needed, time, and money).

B. Access needs to be maintained due to public needs; however, some minor work or restrictions are needed to mitigate the resource impact. Options include but are not limited to: seasonal restrictions or gating entrance, minor ditch work, adding small CMP, improved or more frequent maintenance, minor storm proofing (only enough work to address critical rating element).

C. Due to limited access needed and minimal resource impact, these are candidates to leave as is, maintenance continues as is.

D. Access needs to be maintained due to limited public or resource needs; there is little or no resource impact, so it would be possible to reduce the maintenance level.

E. Access may be available but due to budget constraints and minimal resource impact, these are candidates to stop maintaining after putting in a self-maintaining status.

F. Access does not need to be maintained and some form of decommissioning to provide ecosystem restoration would mitigate resources impact. Options include but are not limited to: blocking the entrance (includes gating for other than annual type seasonal use), rip & seed, removing culverts, partial or full obliteration.

Quandary. This is for segments when there are conflicting management recommendations.

Resolve all possible recommendations within the team. All quandaries: write up why it is a quandary and present to line officer. Also provide short write-up for each priority project, include: description, location, short and long term alternatives if needed.

Table D-1. Ratings and recommended management actions, alternatives

Aquatic rating	Wildlife rating	Human use rating	Recommended mgmt.
High	High	High	A
High or Moderate	High or Moderate	Low	E
Moderate	Moderate	Moderate	Quandary
Low or Moderate	Low or Moderate	High	B or D
Low	Low	Moderate	C
Low	Low	Low	D or E
High	Low or Moderate	High	A
Low or Moderate	High	High	A

Table D-2. Recommended management actions, Entiat and Chelan Sub-Basin

Road seg #	Water-shed	FS rd #	Road name	Seg lngh	Aqua. rate	Wild. rate	Human use rate	Draft rcmd mgmt	Curr. maint level	Curr. maint cost	Prop maint level	Cost to maint	Final rcmd mgmt	Priority & remarks
1	Entiat	5100000	Entiat River	10.2	M	H	H	C	5	23460	5	23460		consider paving 1/4 mi for campground
2	Entiat	5100000	Entiat River	5.1	L	H	H	B	3	19380	3	19380		spot surfacing/ spot drainage work
3	Entiat	5100113	Fox Creek Campground	0.2	M	M	M	A	4	460	4	460		consider relocating due to flooding
4	Entiat	5100114	Lake Creek Campground	0.4	L	M	M	C	4	920	4	920		
5	Entiat	5100115	Box Canyon	0.2	L	M	M	C	3	760	3	760		trail entrance repair/ manage parking
6	Entiat	5100116	Silver Falls Campground	1	M	M	M	C	4	2300	4	2300		
7	Entiat	5100120	North Fork Campground	0.2	L	M	M	C	2	202	2	202		
8	Entiat	5100122	Spruce Grove Campground	0.2	L	M	L	C	2	202	2	202		manage river access
9	Entiat	5100123	Three Creek Campground	0.2	M	M	M	C	2	202	2	202		
10	Entiat	5100124	Cottonwood Campground	0.5	L	M	M	C	3	1900	3	1900		consider relocate rd/spurs out of flood plain, manage river access
11	Entiat	5200000	Entiat Ridge	18.3	M	M	H	A	2	18483	2	18483		Improve drainage, consider relocate 1

Road seg #	Water-shed	FS rd #	Road name	Seg lngth	Aqua. rate	Wild. rate	Human use rate	Draft rcmd mgmt	Curr. maint level	Curr. maint cost	Prop maint level	Cost to maint	Final rcmd mgmt	Priority & remarks
														mi.- off Dinkelman
12	Wenatchee River	5200715	Sugarloaf Lookout	0.5	0	na	0	-	2	0		0	-	
13	Entiat	5210000	Dinkelman Ridge	3.5	M	M	H	A	2	3535	2	3535		Improve drainage, consider relocation or seasonal closure for wet conditions
14	Entiat	5210215	Dinkelman Tie	4.5	M	M	H	C	2	4545	2	4545		Consider gate for wildlife
15	Entiat	5212000	Old Camp	7.8	M	M	H	F/C	2	7878	0	4040		drainage treatment in lower 4 mi
16	Entiat	5300000	Mud Creek	4.5	H	H	H	A	3	17100	3	17100		consider winter seasonal closure, consider relocation in mid section
17	Columbia Brakes	5300000	Mud Creek	1.4	M	H	H	B	2	1414	2	1414		Improve drainage/surfacing, consider winter seasonal closure
18	Entiat	5303000	Power Line Road	4.2	M	M	H	B	2	4242	2	4242		Improve drainage, consider winter seasonal closure
19	Entiat	5310000	Steliko	0.1	0	M	H	C	5	230	5	230		
20	Entiat	5310000	Steliko	5	M	M	H	B	2	5050	2	5050		Improve drainage, consider winter and wet seasonal closure
21	Entiat	5310111	Steliko Work Center	0	0		0	-	5	0		0	-	
22	Entiat	5320000	Murdock	0.5	M	H	H	B	2	505	2	505		install drivable dips, snowplowing

Road seg #	Water-shed	FS rd #	Road name	Seg length	Aqua. rate	Wild. rate	Human use rate	Draft rcmd mgmt	Curr. maint level	Curr. maint cost	Prop maint level	Cost to maint	Final rcmd mgmt	Priority & remarks
														concerns, look to give to county
23	Entiat	5320000	Murdock	6	M	H	H	B	2	6060	2	6060		snowmobile concerns for winter range, wet season closure, consider ford on Potato Cr.
24	Entiat/Columbia Br.	5340000	South Fork Mud Creek	3	M	M	H	C	2	3030	2	3030		wet season closure
25	Entiat	5380000	Potato Creek	5.5	H	H	H	A	2	5555	2	5555		Improve drainage, consider spot relocation
26	Entiat	5501000	Preston Creek	2.3	L	M	M	C	3	8740	3	8740		spot surfacing
27	Entiat	5605000	Tommy Creek	6.3	H	M	M	C	4	14490	4	14490		Consider Geotech review of cut slope failure
28	Entiat	5605000	Tommy Creek	0.8	L	H	L	C	3	3040	3	3040		
29	Entiat	5605112	M. Tommy Trailhead	0	0			-	3	0		0	-	-
30	Entiat	5606000	North Fork Entiat	3.2	M	H	L	C	3	12160	3	12160		
31	Entiat	5606000	North Fork Entiat	0.9	M	H	L	B	2	909	2	909		spot surfacing/ spot drainage work
32	Entiat	5608000	Duncan Hill	7.2	M	H	L	B	2	7272	2	7272		spot surfacing/ spot drainage work
33	Mad River/Entiat	5700000	Tyee	12.4	H	M	M	C	4	28520	4	28520		
34	Mad River	5700000	Tyee	1.8	M	M	M	C	3	6840	3	6840		DFW concerned about

Road seg #	Water-shed	FS rd #	Road name	Seg lngth	Aqua. rate	Wild. rate	Human use rate	Draft rcmd mgmt	Curr. maint level	Curr. maint cost	Prop maint level	Cost to maint	Final rcmd mgmt	Priority & remarks
35	Entiat	5700100	Pine Flats Campground	0.3	M	M	M	C	2	303	2	303		Consider ways to reduce poaching, reloc spurs
36	Entiat	5702000	Shamel Creek	5.2	M	M	M	C	2	5252	2	5252		Wildlife concerns about duplicate roads
37	Entiat	5702710	Shamel Tie	0.5	M	?	M	C	2	505	2	505		Wildlife concerns about duplicate roads
38	Mad River	5710000	Upper Shamel	0.2	M	M	M	C	2	202	2	202		Wildlife concerns about duplicate roads
39	Mad River/ Entiat	5713000	Tyee Lookout	4.1	M	M	L	B	2	4141	2	4141		Improve drainage/ditch relief, surface ~1/4 mi
40	Mad River	5800000	Tillicum	9	H	H	H	A	3	34200	3	34200		Pave ~ 2 mi, geotech review
41	Mad River/ Entiat	5801000	Roaring Ridge	16.7	M	H	H	B	2	16867	2	16867		Improve drainage, spot surface, replace CMP
42	Mad River	5808000	West Tillicum	5.5	M	M	HH	C	2	5555	2	5555		
43	Mad River	5808410	Indian Creek	3.6	H	M	M	A/F	2	3636	2	3636		Relocate center 2 mi, geotech review; consider oblit
44	Mad River	5810000	Rothrock	7.3	M	H	M	B	2	7373	2	7373		Improve drainage in lower 1 mi, replace fish barrier
45	Entiat	5900000	Shady Pass	4.2	M	H	M	A	3	15960	3	15960		Install intervisable turnouts, improve drainage, spot surfacing, winter

Road seg #	Water-shed	FS rd #	Road name	Seg length	Aqua. rate	Wild. rate	Human use rate	Draft rcmd mgmt	Curr. maint level	Curr. maint cost	Prop maint level	Cost to maint	Final rcmd mgmt	Priority & remarks
														closure
46	Entiat	5900000	Shady Pass	6.9	L	H	M	A	2	6969	2	6969		Install intervisable turnouts
47	Entiat	5900112	Big Hill	2.1	L	M	L	C	2	2121	2	2121		
48	Columbia Breaks	7415000	Swakane	7.5	M	H	H	B	2	7575	2	7575		Improve drainage/culverts, beaver concerns
49	Entiat	8410000	Slide Ridge	10.5	L	M	M	B	2	10605	2	10605		spot surfacing/spot drainage work
50	Chelan	5900000	Shady Pass	14.8	M	M	H	A	2	14948	2	14948		Install intervisable turnouts
51	Chelan	5900116	Grouse Mtn. Campground	0.2	L	M	M	B	2	202	3	760		Consider dust abatement
52	Chelan	8020000	Cooper Mtn.	21.5	L	M	H	B	2	21715	3	81700		Consider widening and surfacing for safety
53	Chelan	8020145	Poison Springs Campground	0.2	L	M	L	C	2	202	2	202		
54	Columbia	8021000	Wash Creek	1.5	M	M	M	B/D	3	5700	2	1515		Stabilize slopes, ripraian concerns
55	Chelan	8021000	Wash Creek	4	L	M	H	A	2	4040	3	15200		Widen turnouts/guardrail for safety
56	Chelan	8021100	Echo Ridge	0.7	L	L	H	A	3	2660	3	2660		safety concerns to ski area
57	Columbia	8140000	Antoine Creek	10.6	L	M	H	C	3	40280	3	40280		
58	Chelan	8200000	Grade Creek	39.1	H	H	H	A/C	2	39491	2	39491		Major safety concerns, major repairs needed at spots - very

Road seg #	Water-shed	FS rd #	Road name	Seg lngth	Aqua. rate	Wild. rate	Human use rate	Draft rcmd mgmt	Curr. maint level	Curr. maint cost	Prop maint level	Cost to maint	Final rcmd mgmt	Priority & remarks
														expensive maint.
59	Chelan	8200115	Antilon Campground	0.2	L	H	H	C	2	202	2	202		
60	Chelan	8200155	Safety Harbor Campground	1	L	M	M	C	2	1010	2	1010		
61	Chelan	8200160	South Navarre Campground	0.1	L	L	L	C	2	101	2	101		
62	Chelan	8210000	Joe Creek	7.8	L	H	H	C	2	7878	2	7878		
63	Chelan	8301000	Railroad Creek	11.5	M	H	H	B	3	43700	3	43700		Installing rolling dips
64	Chelan	8405000	Fields Point	0.5	L	L	M	C	5	1150	5	1150		
65	Chelan	8410000	Slide Ridge	0.8	M	M	H	A	2	808	3	3040		Install turnout for safety, spot surfacing/drain
66	Chelan	8410000	Slide Ridge	18.4	M	M	M	B	2	18584	2	18584		Spot drainage work
67	Chelan	8410100	Snowberry Campground	0.2	L	L	M	C	3	760	3	760		
68	Chelan	8505000	First Creek	0.7	M	H	H	A/F	2	707	2	707		Spot drainage/ditch work, close last 1/3 mi convert to trail
				133.8						534786		600698		

Appendix E: Public Input Summary

Public Input to Roads Analysis, Entiat Ranger District

A public meeting was held at the Entiat Grange and the roads analysis process presented. Five members of the public attended the meeting. They asked several questions and provided comments. Approximately 40 members of the public who were unable to attend the meeting provided verbal comments to District and Forest personnel. The comments revolved around continuing maintaining current public access to the Forest, maintaining access for fire suppression, and reopening the road to Spruce Grove campground.

Public Input to Roads Analysis, Chelan Ranger District

A public meeting was held at the Chelan Ranger District and the Roads Analysis process was presented. Two members of the public attended the meeting. They asked several questions but did not provide any comments. The Chelan Ranger District received no written comments.

Appendix F: Definitions

Definitions

Classified Road: Roads, wholly or partially within or adjacent to National Forest System lands, that are determined to be needed for long-term motor vehicle access, including state roads, county roads, privately owned roads, National Forest System roads, and other roads authorized by the Forest Service.

Road: A vehicle travel-way more than 50 inches wide unless designated and managed as a trail. A road may be classified, unclassified, or temporary.

Road Decommissioning: Activities that result in the stabilization and restoration of unneeded roads to a more natural state.

Road Maintenance: The ongoing upkeep of a road necessary to retain or restore the road to the approved road management objective.

Road Maintenance Levels:

1 - Assigned to intermittent service roads during the time they are closed to vehicular traffic. The closure period must exceed one year. Basic custodial maintenance is performed to keep damage to adjacent resources to an acceptable level and to perpetuate the road to facilitate future management activities.

2 - Assigned to roads open for use by high clearance vehicles. Passenger car traffic is not a consideration.

3 - Assigned to roads open and maintained for travel by a prudent driver in a standard passenger car. User comfort and convenience are not considered priorities.

4 - Assigned to roads that provide a moderate degree of user comfort and convenience at moderate travel speeds. Dust abatement is a consideration.

5 - Assigned to roads that provide a high degree of user comfort and convenience.

Road Reconstruction: Activities that result in improvements or realignment of an existing classified road.

Roads Subject to Highway Safety Act: National Forest System roads that are open to use by the public for standard passenger cars. This included roads with access restricted on a seasonal basis and roads closed during extreme weather conditions or for emergencies, but which are otherwise open for general public use.

Temporary Roads: Roads authorized by contract, permit, lease, other written authorization, or emergency operation, not intended to be part of the forest transportation system and not necessary for long-term resource management.

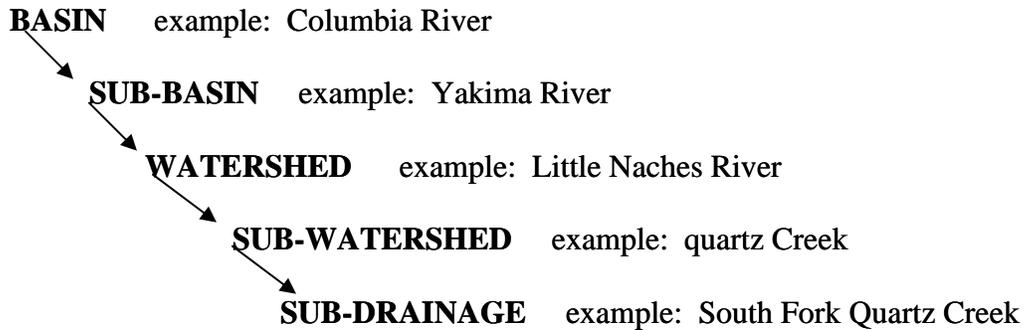
Unclassified Roads: Roads on National Forest System lands that are not managed as part of the forest transportation system, such as unplanned roads, abandoned travel-ways, and off-road vehicle tracks that have not been designated and managed as a trail; and those roads that were once under permit or other authorized and were not decommissioned upon the termination of the authorization.

Unroaded Areas (Roadless): Areas that do not contain classified roads.

Watershed Scale: A watershed is the area drained by a distinct stream or river system and separated from other similar systems by ridge top boundaries. Watersheds catch and store

precipitation, releasing the stored water to the stream channel.

Watershed Hierarchy: The terms “watershed,” “basin,” “sub-basin,” “sub-watershed,” and “sub-drainage” are used to describe a hierarchy of “watershed.” Areas that have been established by the Forest Service and other agencies. The hierarchy is as follows:



Terms Used in Wildlife Rating Criteria

Impassable road: Roads that are not reasonably or prudently passable by conventional four-wheeled passenger vehicles, motorcycles, or all terrain vehicles.

Open road: Roads open to motorized use during any portion of the season of concern for the particular species being addressed. If information is not available concerning the effectiveness of a gate or berm it may be best to assume it is open.

Restricted road: Roads that are legally restricted, typically with gates or berms and for which information is available showing that use does not exceed 14 days.