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United States
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Pacific
Northwest
Region

Upper Kalama River Watershed Analysis

Gifford Pinchot National Forest





Upper Kalama River Watershed Analysis

Mount St. Helens National Volcanic Monument
Gifford Pinchot National Forest
Pacific Northwest Region
USDA, Forest Service

September, 1996



EXECUTIVE SUMMARY

The 25,045-acre Upper Kalama River Watershed is comprised of National Forest (12,272 acres) and State and private (12,773 acres) ownership. The area has been divided into eight sub-basins for analysis by an interdisciplinary team.

In this first iteration of analysis, the following ten issues are analyzed: Mass Wasting; Surface Erosion from Roads; Riparian Reserve Habitats and Fragmentation; TES Plants and C-3 Species; Habitat Condition for TES Animal Species; Hydrologic Changes; Water Quality and Key Habitat Attributes for Salmonids; Dispersed Camping; Winter Recreation Parking; Horse Camping Capacity; and Recreation Use in Goat Marsh RNA.

Characterization

The Upper Kalama is of volcanic origin and has been shaped from volcanic activity up to the recent past. Lava flows, lahars (mudflows), and tephra deposits range in age from over 23 million years to material laid down during the eruption of Mount St. Helens in 1980. The watershed has some sites containing fossils. Elevations range from 1250 feet below Kalama Falls to 8,298 feet at the summit of Mount St. Helens. Drained by Merrill Lake, Dry Creek, Fossil Creek, the upper reaches of the Kalama River, Fossil Creek, and their tributaries, the watershed is vegetated by coniferous forest plant associations which provide habitat for 199 known wildlife species.

A pattern of large, although low-frequency, high-intensity, stand-replacement fires have occurred through time. During the past 100 years, however, very little of the watershed has burned from wildfire.

Current Conditions

Unstable and potentially unstable lands are mapped. Surface erosion from sensitive tephra deposits have contributed large amounts of sediment to streams. Erosion rates have been especially high since the 1980 eruption of Mount St. Helens, with road construction playing a significant role as well.

During February 1996, much of the Pacific Northwest experienced an unusually heavy storm in which relatively large amounts of warm rain fell on a significant snowpack. The resulting runoff caused severe damage at various elevations ranging from flooding in lowlands to landslides, road washouts, debris torrents, and stream channel scouring and widening in the uplands. Mass wasting and erosion moved large amounts of sediment in short periods of time. While this storm event is recognized, mapping of the affected areas in the Upper Kalama River Watershed has not yet been completed. Therefore, the ID team was not able to account for most of these newly-damaged areas in this analysis.

A large portion of the non-federally administered lands have been harvested and are now

occupied by young plantations. Timber harvesting on National Forest lands, has left a patchwork of stands, which has fragmented both riparian and upland habitats. Less than five percent of the watershed has been surveyed for TES plants, and none has been surveyed for C-3 species.

Twelve animal species, federally-listed as threatened, endangered, or species of concern, are known to, or are likely to, occur in the Upper Kalama. These include the bald eagle, Cascades frog, gray wolf, Harlequin duck, Larch Mountain salamander, northern goshawk, northern spotted owl, peregrine falcon, red-legged frog, fisher, mountain quail, and Townsend's big-eared bat. Of the four spotted owl activity centers within the watershed, none have enough suitable habitat within the home ranges to be above the "take" threshold. Although there are no known peregrine falcon eyries, potential nest cliffs have been identified in two locations. There have been many sightings of Townsend's big-eared bats in the watershed, and a maternity colony is known to exist on private land near the Forest boundary.

Six sub-basins show peak flow increases of more than 10 percent (compared to a fully-forested condition). Five sub-basins are of concern because the stream channel network has been extended more than 40 percent by roads and ditch lines in roads.

Information on aquatic organism populations is lacking. Anadromous fish are found in the watershed in the Kalama River, only up to the barrier of Kalama Falls. Resident fish species in the watershed include rainbow trout cutthroat trout, brown trout, and brook trout. Both McBride and Merrill Lakes support highly used recreational fisheries.

Forty percent of surveyed streams were rated as poor for the amount of large woody debris, while 61 percent were rated poor for the number of primary pools.

Stream temperature data is limited, but measurements from one monitoring station show water temperature concerns in Fossil Creek.

Road densities in the Upper Kalama are relatively high, with an average value for the entire area of 4.0 miles per square mile; six of the eight sub-basins exceed 3.0 miles per square mile. The Upper Kalama watershed is the most highly fragmented watershed examined to date on the Mount St. Helens administrative unit, with an average of 2.6 road crossings per mile of stream.

Most visitors to the watershed come for recreation purposes. Situated near urban populations, recreation demand is high and often exceeds the facilities and the ability of the ecosystem to absorb the impacts. Of particular concern, the area disturbed by dispersed camping and self-constructed access roads is growing cumulatively. Horse use has outstripped the facilities at the Kalama Horse Camp. Parking problems associated with winter recreation are occurring.

Reference Conditions

Reference conditions explain how the existing conditions have changed over time as a result of

human influence and natural disturbances. They describe the known or inferred history of the landscape. From this, we may understand what was sustainable in the past and what changes have occurred to affect sustainability.

Volcanic processes and glaciers have created a landscape naturally prone to movement through mass wasting and surface erosion. Soil movement has been accelerated by roading and to a lesser degree by timber harvest.

Past vegetation patterns were shaped predominately by volcanic eruption and large, stand-replacement fires, changing thousands of acres at a time. Over the past 50 years timber harvest and related activities have altered stand structure, composition and distribution across the landscape by creating numerous small openings containing little if any standing multi-layered old trees and down woody material. Accordingly, plant and animal habitats have changed.

The extent and magnitude of human uses in the watershed has grown exponentially from the mid-1800's until present time, intensified by population growth and technological advancements accompanying the industrial era.

Interpretation

Eight dominant processes affecting the watershed's ecosystem are identified: volcanic and seismic activity, erosion, fire, roading, peak flow increases, flooding, timber management, and recreation activities.

For each of the eleven issues, current and reference conditions are compared by explaining significant differences, similarities, or trends and their causes. The comparisons, explanations, and discussions are presented in a similar series of tables and paragraphs that enable the reader to follow the logic of the analysis.

Information from earlier stages of the analysis is synthesized in order to further understand and discover interrelationships between elements of the ecosystem. The synthesis is presented in an explanation, a table and a map.

These compilations of integrated and synthesized data, information, and interpretations form the basis for recommendations.

Recommendations

The ID team recommends activities that could move the system toward management objectives or reference conditions, as appropriate.

<u>Restoration Activities</u>	<u>Priority</u>	<u>Number of Sub-basins</u>
Road Decommissioning	High	5

Road Weatherization	Moderate	4
Silvicultural Treatment of Upland Stands	Moderate	4
Silvicultural Treatment of Riparian Stands	Moderate	7
Stream Enhancement	Moderate	2
Erosion Control/Slope Stabilization	High	5
Coop Restoration Among Landowners	High	8

Monitoring Activities

Number of Sub-basins

Number of Vehicles on Roads		8
Goat Marsh RNA		1
Stream Temperature		4
Stream Surveys		4
Fish Surveys		3
Amphibians		4
Riparian Reserve Rehabilitation Monitoring		4
Verification of Ecological Inventory Data		7
Phase II Road Condition Surveys		7
Peregrine Falcon Surveys		2
Mountain Quail Surveys		1

Commodities and Development

Number of Sub-Basins

Dispersed Camping Management		3
Winter Recreation Parking		3
Horse Camping Capacity Increase		2
Road Paving		2

In Appendix D, each team member discusses the limitations of the analysis, confidence in the analysis, data gaps, and implications of these limitations for management.

TABLE OF CONTENTS

INTRODUCTION	1
CHAPTER I CHARACTERIZATION	I-1
CHAPTER II ISSUES AND KEY QUESTIONS	II-1
CHAPTER III CURRENT CONDITIONS	III-1
Geology, Physical Processes	III-1
Fire	III-3
Vegetation.....	III-3
Habitat Conditions for TES Animal Species.....	III-8
Hydrologic Changes.....	III-13
Aquatic Animals and Habitat.....	III-16
Recreation Use.....	III-33
CHAPTER IV REFERENCE CONDITIONS	IV-1
Geology and Physical Processes.....	IV-1
Vegetation.....	IV-1
Habitat Conditions for Animal Species.....	IV-2
Hydrologic Changes.....	IV-2
Aquatic Animals and Habitat.....	IV-3
Human Dimension.....	IV-3
CHAPTER V INTERPRETATION	V-1
Section 1. Dominant Processes.....	V-1
Section 2. Interpretation.....	V-4
Mass Wasting.....	V-5
Erosional Processes.....	V-7
Stream Riparian Reserve Fragmentation and Riparian Habitat.....	V-9
Habitat for Threatened, Endangered, and Sensitive Plants and C-3 Species.....	V-11
Habitat for TES Animal Species.....	V-13
Hydrologic Change.....	V-18
Key Habitat Attributes for Salmonids.....	V-20
Recreation Use.....	V-25
Section 3. Synthesis.....	V-29
Anticipated Social or Demographic Changes or Trends.....	V-34

CHAPTER VI RECOMMENDATIONS	VI-1
<u>Restoration Activities</u>	
Road Decommissioning.	VI-3
Road Weatherization.	VI-4
Silvicultural Treatments to Accelerate Development of Riparian Sapling/Pole and Small Tree Stands.	VI-5
Silvicultural Treatments to Accelerate Development of Upland Sapling/Pole and Small Tree Stands.	VI-7
Stream Enhancement.	VI-9
Erosion Control/Slope Stabilization.	VI-10
Cooperative Restoration of the Lewis River Basin by All Landowners.	VI-11
<u>Monitoring Activities</u>	
Recreation Use.	VI-12
Goat Marsh Research Natural Area	VI-13
Stream Temperature.	VI-14
Stream Surveys.	VI-15
Fish Surveys.	VI-16
Riparian Reserve Rehabilitation Monitoring.	VI-17
Verification of Ecological Inventory Data.	VI-18
Road Condition Surveys (ATM Phase II).	VI-19
Amphibian Surveys.	VI-20
Mountain Quail and Peregrine Falcon.	VI-21
<u>Commodities and Development</u>	
Dispersed Camping.	VI-22
Winter Recreation Parking	VI-23
Horse Camping Capacity Increase.	VI-24
Road Paving.	VI-25
Riparian Reserve Widths.	VI-26
Recommendations Table.	VI-27

APPENDICES

- A: Glossary
- B. References
- C. Issues and Key Questions
- D. Limitations of the Analysis, Confidence in the Analysis, Data Gaps, and Implications
 of Limitations for Management
- E. Vegetation Stand Structure Definitions

LIST OF FIGURES

	<u>Page</u>
1. Vicinity Map.	3
2. Gifford Pinchot National Forest Plan Land Allocations	4
3. Northwest Forest Plan Allocations	5
4. Sub-Basins.	I-2
5. Vegetation Zones (Ecoclasses)	I-4
6. Riparian Reserves.	I-6
7. Stream Classes in the Upper Kalama River Watershed	I-8
8. Erosion From Roads	III-2
9. Grouped Vegetation Structural Stages.	III-6
10. Spotted Owl Habitat	III-11
11. Peak Flow	III-14
12. Distribution of Resident Fishes	III-18
13. Large Woody Debris Ratings by Stream Reach	III-20
14. Large Woody Debris Recruitment Potential.	III-21
15. Stream Segment Ratings for Primary Pools per Mile of Stream	III-23
16. Road Network and Class 1-4 Streams	III-24
17. Road Densities Greater Than 3.0 Miles per Square Mile.	III-26
18. Sub-Basins that are Highly Fragmented	III-29
19. Erosion-Transport-Response Reaches	III-31
20. Response Reaches	III-32
21. Recreation Facilities.	III-35
22. Synthesis Map	V-32

LIST OF TABLES

1. Percentages of Unstable and Potentially Unstable Land, by Sub-Basin.	III-3
2. Vegetation Zones.	III-4
3. Vegetation Zones, by Sub-Basin.	III-4
4. Percent Grouped Vegetation Structure Stages, by Sub-Basin.	III-5
5. Percent Grouped Structure Stages of Stream Riparian Reserves, by Sub-Basin.	III-7
6. Threatened, Endangered, and Species of Concern in the Watershed.	III-8
7. Spotted Owl Habitat in the Watershed.	III-9
8. Peak Flow Increases.	III-15
9. Extension of the Stream Channel Network by Roads and Ditch Lines in Roads.	III-9
10. Optimum Habitat Condition Factors for Aquatic Organisms, by Life Stage.	III-19
11. Road Densities, Number of Stream Crossings, and Number of Stream Crossings per Mile of Stream, by Sub-Basin.	III-27
12. Riparian Reserve Aquatic Habitat Fragmentation (Road/Stream Crossings per Mile of Stream) for Watersheds Within the Lewis River Basin and the Upper Kalama River Watershed.	III-28
13. Synthesis Table.	V-33
14. Recommendations by Sub-Basin.	VI-27

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INTRODUCTION

Management direction for the National Forest lands comprising the Upper Kalama River watershed (Figure 1, Vicinity Map) is set forth in the Gifford Pinchot National Forest Land and Resource Management Plan, 1990 as amended (through amendment 11 Update No. 2, June 26, 1995), hereafter referred to as the 1990 GPNF Forest Plan (Figure 2, Land Allocations). On April 13, 1994, the 1990 GPNF Forest Plan was amended by the Secretary of Agriculture as documented in the Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl, hereafter referred to as the ROD. This Record of Decision is the culmination of a public land management effort initiated by President Clinton in April, 1993, and along with the accompanying Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl is frequently called the Northwest Forest Plan. The Northwest Forest Plan (NFP) provides extensive management direction, including land allocations, see Figure 3 Northwest Forest Plan Allocations, that comprise a comprehensive ecosystem management strategy. A major part of this strategy is the Aquatic Conservation Strategy (NFP, page B-9) which has four components (NFP, Page B-12)

- Riparian Reserves
- Key Watersheds
- Watershed Analysis, and
- Watershed Restoration

The Upper Kalama River Watershed was selected for analysis at this time because:

1. it is known to contain high priority watershed restoration needs, and
2. a watershed-scale analysis is needed to develop strategies for dealing with recreation use that currently exceeds management standards and to support recreation-related development work.

During February, 1996 much of the Pacific Northwest experienced an unusually heavy storm in which relatively large amounts of warm rain fell on a significant snowpack. The resulting runoff caused severe damage at various elevations ranging from flooding in lowlands to landslides, road washouts, debris torrents, and stream channel scouring and widening in the uplands. Mass wasting and erosion moved large amounts of sediment in short periods of time. While this storm event is recognized and some damage has been inventoried, mapping of the affected areas in the Upper Kalama River Watershed has not yet been completed. Therefore, the ID team was not able to account for all of these newly-damaged areas in this analysis.

The purpose of this watershed analysis is to: 1) develop and document an understanding of the ecological structures, functions, processes and interactions occurring within the Upper Kalama

River Watershed; and 2) identify desired conditions, trends, and restoration and management opportunities.

The responsible official who will make decisions about site-specific project proposals will use this landscape scale analysis to help decide whether or not a particular proposal or management action meets the Aquatic Conservation Strategy objectives (NFP, page B-11).

Upper Kalama River Vicinity Map

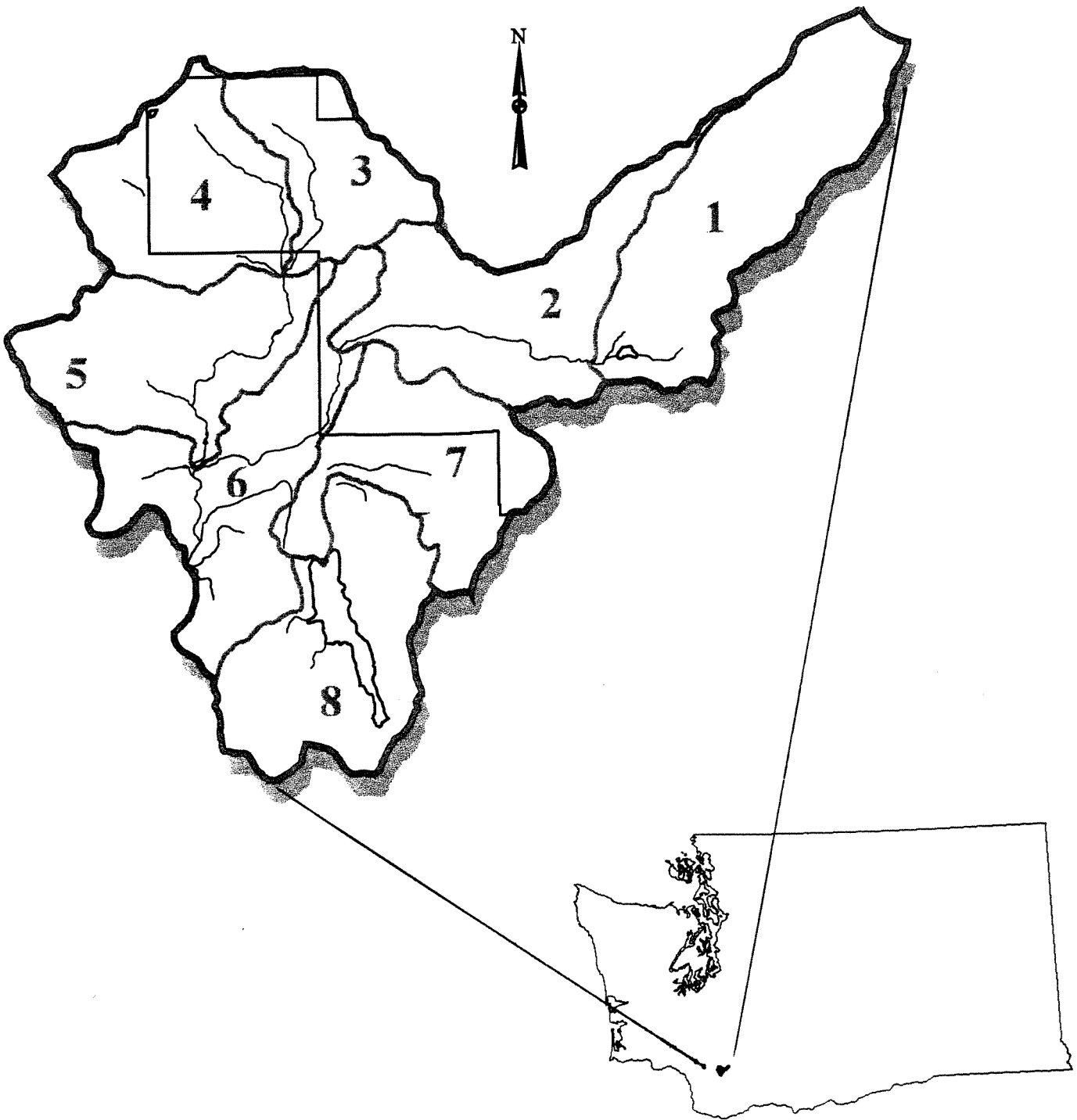


Figure 1. Vicinity Map. The Upper Kalama River Watershed is located in the southwest corner of the State of Washington.

Upper Kalama River Land Allocations

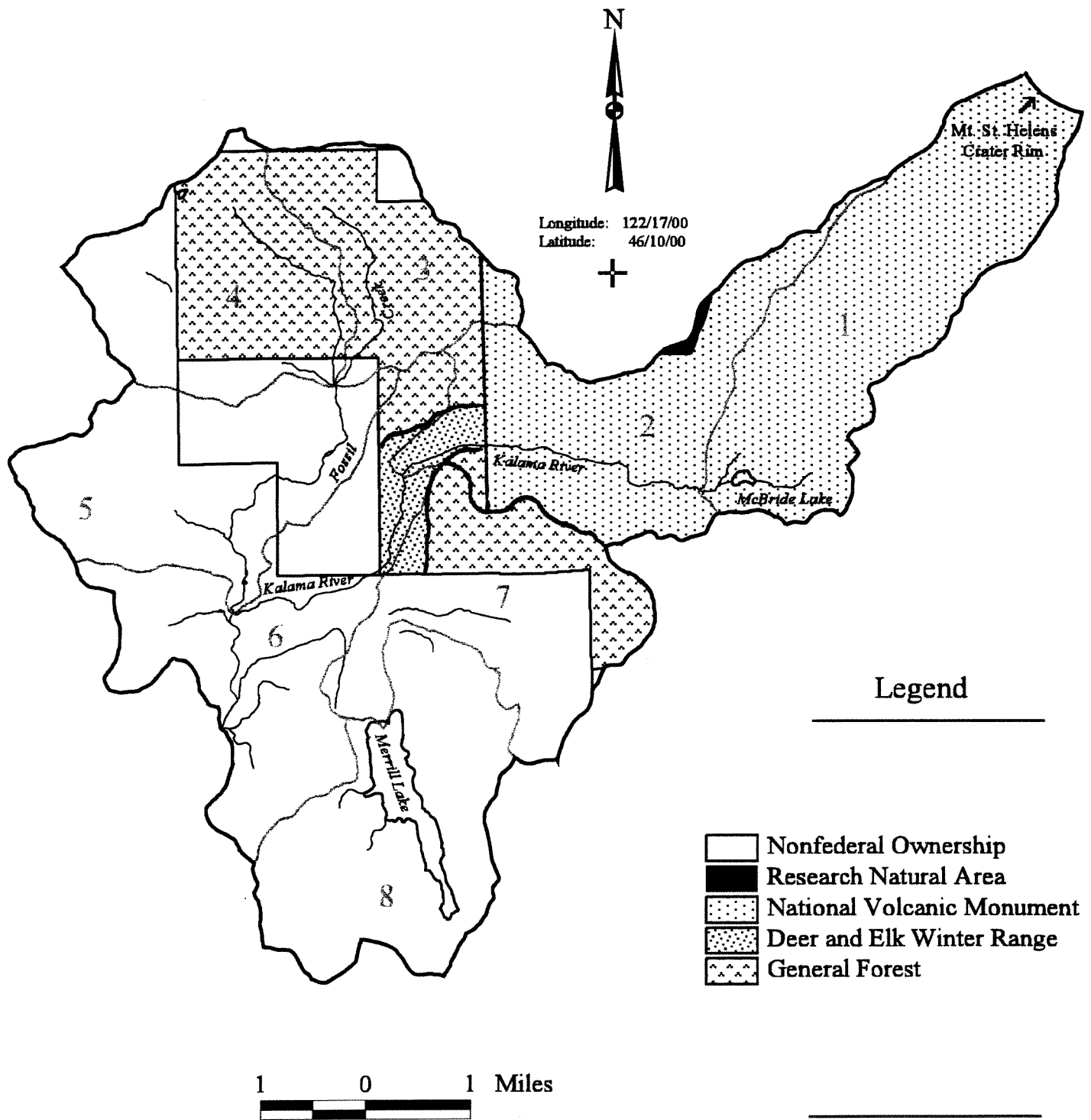


Figure 2. National Forest land within the Gifford Pinchot National Forest is assigned to various Management Area Categories (MACs). Each MAC has a goal or management emphasis.

Upper Kalama River Northwest Forest Plan Allocations

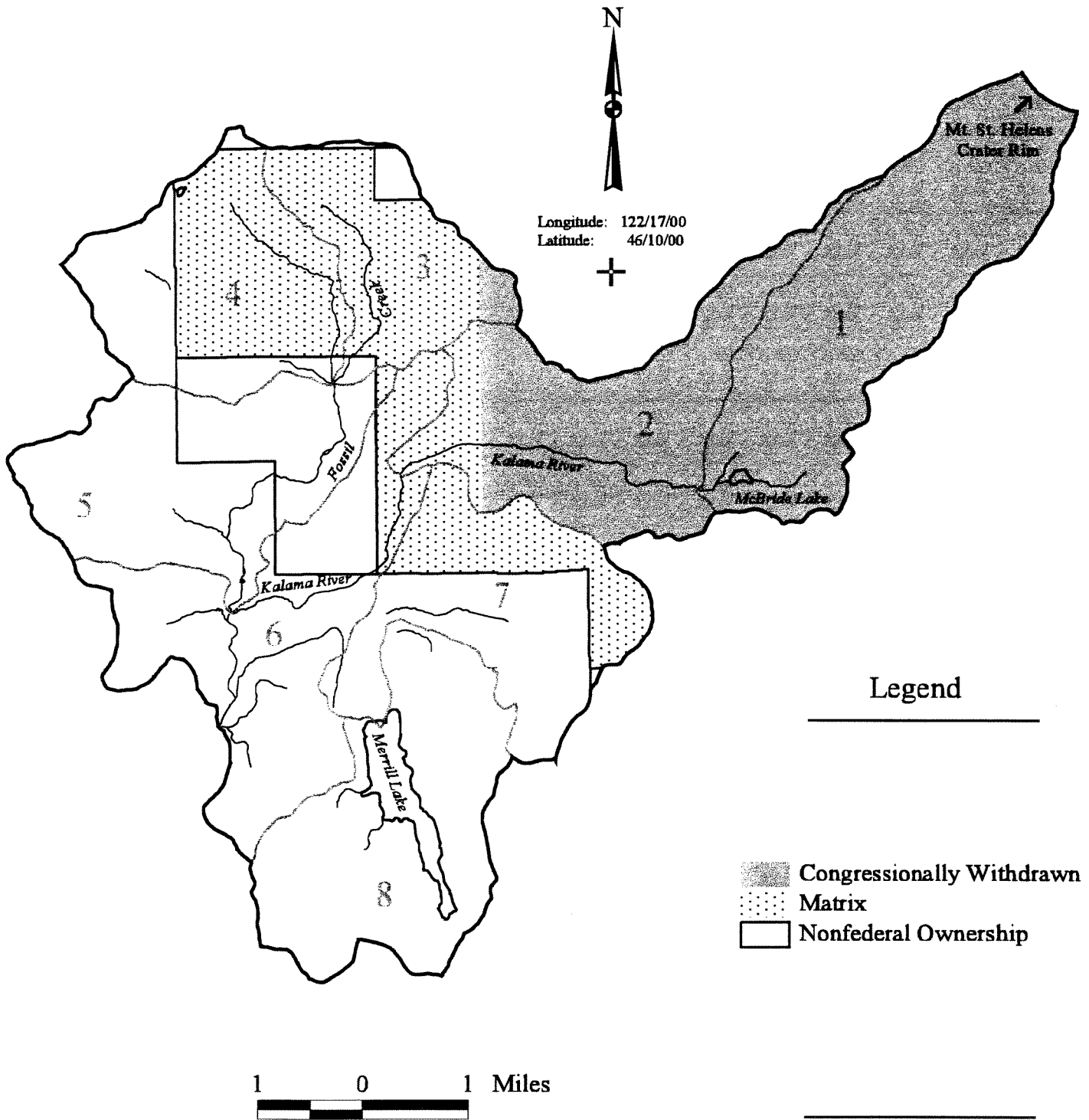


Figure 3. Under the Northwest Forest plan, all federally administered lands within the range of the northern spotted owl are assigned to specific land allocations.

The analysis was conducted by an interdisciplinary (ID) team of specialists trained in the fields of geology, soils, hydrology, botany, fisheries, and wildlife biology, recreation management, forest fuels, and silviculture (see List of Preparers).

The ID team used the Ecosystem Analysis at the Watershed Scale (The Revised Federal Guide for Watershed Analysis) Version 2.1, March 24, 1995, hereafter referred to as the 6-Step Guide, to structure the analysis of the Upper Kalama River Watershed.

This report is organized to help readers understand the six-step process followed by the ID team, and to provide an understanding of the processes and interactions occurring in the watershed.

Chapter I - **Characterization of the Watershed** - (a) places the watershed in context within a broader geographic area and (b) briefly describes the dominant physical, biological, and human dimension features, characteristics, and uses of the watershed.

Chapter II - **Issues and Key Questions** - identifies the variety of uses and values associated with the watershed in order to focus the analysis on the **key elements** that are most relevant to the management questions, human values, and resource conditions within the watershed.

These elements formulate analysis questions using the indicators most commonly used to measure or interpret these ecosystem elements.

Chapter III - **Current Conditions** - documents the range of the ecosystem elements' current conditions and how they are distributed.

Chapter IV - **Reference Conditions** - explains how the existing conditions from Chapter III have changed over time as the result of human influence and natural disturbances. It's purpose is to describe the known or inferred history of the landscape to better understand what was sustainable in the past and what changes have occurred to affect sustainability.

Chapter V - **Interpretation** - compares the existing historical, and reference conditions of specific ecosystem elements by explaining significant differences, similarities, or trends and their causes. The capability of the system to achieve key management objectives is also explored.

Chapter VI - **Recommendations** - identifies those management activities that could move the system toward reference conditions or management objectives, as appropriate.

Material is presented in the same general order in each chapter to follow a logical and parallel pattern as follows:

1. Geology and physical processes,
2. Fire
3. Vegetation
4. Riparian Reserve Habitats
5. TES Plants and C-3 species
6. Habitats for TES animal species
7. Hydrology
8. Water quality and key habitat attributes for salmonids
9. Demand for Recreational Opportunities



CHAPTER I CHARACTERIZATION

A large portion of the Pacific Northwest lies within the Columbia River basin, which can in turn be divided along watershed boundaries into smaller component river basins such as the Kalama River basin. The Upper Kalama River is a relatively small watershed that occupies a portion of the Kalama River basin. See Figure 1, Vicinity Map in the Introduction.

The Upper Kalama River Watershed Analysis Area (hereafter referred to as the Upper Kalama) encompasses an area of National Forest and other ownership lands within the Kalama River watershed and some of its tributaries. The Upper Kalama includes lands drained by Fossil Creek, Dry Creek, Cedar Creek, the upper reaches of the Kalama River, Merrill Lake, and several other smaller unnamed, interspersed drainages.

The analysis area is divided into eight sub-basins (Figure 4, Sub-Basins Map).

The Upper Kalama covers 25,045 acres (12,272 of National Forest and 12,773 of State of Washington and private ownership), and ranges in elevation from 1,250 feet below Kalama Falls to 8,298 feet at the crater rim of Mount St. Helens. All of the land, water, plants, animals, and people within this area make up the Upper Kalama ecosystem.

Geology, Soils, Erosion Processes

The Kalama watershed is of volcanic origin and has been shaped from volcanic activity up to the recent past. Lava flows, lahars (mudflows), and tephra deposits have been the major contributors in shaping the watershed.

Deposits range in age from over 23 million years to material laid down during the eruption of Mt. Saint Helens in 1980. Much of the landscape was formed over the last 20,000 years as the result of Mount St. Helens' volcanic activity occurring at intervals of 100 to 400 years.

Some of the lahars were large enough to block drainages and create lakes behind them. Merrill Lake, a good example, has been dated at about 400 years ago, although whether the lake existed prior to this from older flows is not known. As seen at Spirit Lake (located on the north side of Mount St. Helens), the 1980 eruption demonstrated the magnitude of possible changes.

The lahars that traveled down the area's drainages are mostly unconsolidated material which has a tendency to erode on steep slopes. This is a concern in the upper portions of the Kalama and some of its tributaries, since these areas are incised with steep banks directly above the water.

Underlying these lahars there is evidence of andesitic lava flows that flowed in and filled in older channels of the Kalama River. Intrusive volcanics that pushed up through older deposits also

Upper Kalama River Sub-basins

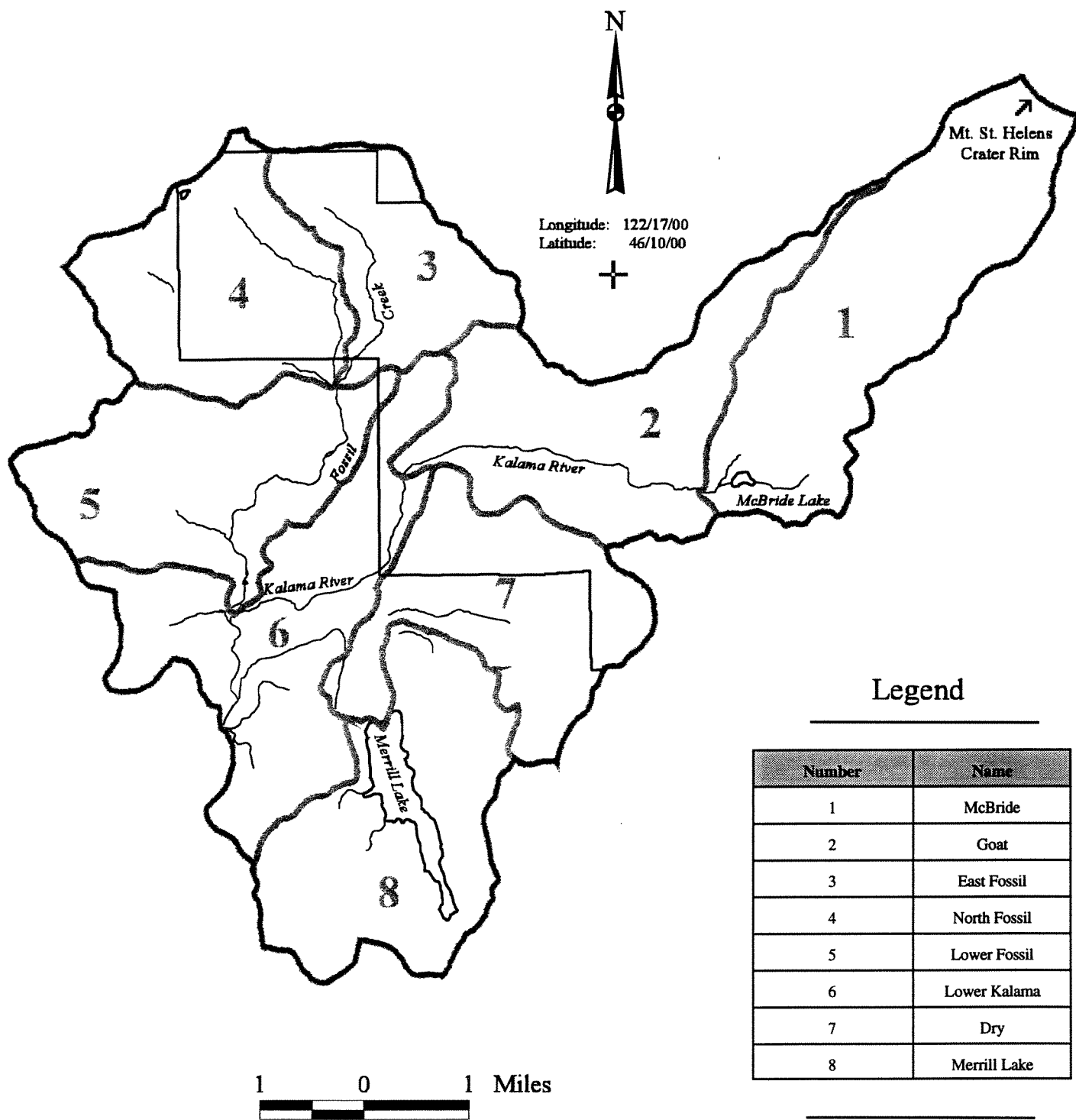


Figure 4. Sub-basins. For this analysis, the 25,045-acre Upper Kalama River Watershed is divided into eight sub-basins.

exist. These occurred about 20,000 years ago. The most prominent is Goat Mountain on the eastern end of the watershed. Slope instability can occur where these different flows meet, but this is not a large factor in this watershed.

The watershed has some sites containing fossils. The unauthorized collecting of fossils on federal land is prohibited. The locations of these non-renewable resources are treated as confidential information.

Fire

Wildfires have not played a dominant role in changing the forest landscape in the Upper Kalama Watershed, although they have affected some areas. The watershed is outside areas known to have low-frequency, high-intensity, stand-replacing fires, such as the Yacolt burn area in the Lower Lewis Watershed.

Vegetation

Approximately 12 percent of National Forest lands within the watershed is in the Western Hemlock vegetation zone, and 58 percent is within the Pacific Silver Fir vegetation zone. Only a trace of the watershed is considered wetland. The vegetative patterns have historically been shaped by large-scale disturbances such as volcanic activity as well as by past timber management regimes. Recently, staggered-setting timber harvesting has changed the distribution of vegetation creating a mosaic of relatively small, homogenous patches of varying ages across the landscape. Six sightings of fringed pinesap (*Pleuricospora fimbriolata*), a State-listed sensitive plant species have been documented in the watershed.

Terrestrial Animals and Habitat

This watershed contains habitat that supports 199 known wildlife species, including 39 species that are dependent on snags, and 52 species that are dependent on down logs for a part of their life cycles. Species of interest include bald eagle, northern spotted owl, northern goshawk, peregrine falcon, gray wolf, Townsend's big-eared bat, Larch Mountain salamander, Cascades frog, red-legged frog, harlequin duck, fisher, and mountain quail.

The remaining old-growth and large tree conifer habitats are highly fragmented. This results in a higher ratio of edge-to-interior habitat than is desired for most late-successional and old-growth related species such as northern spotted owl. The Upper Kalama River Watershed contains 2,746 acres of suitable (nesting, roosting, and foraging) spotted owl habitat. This represents approximately 22 percent of the Federally administered land within the watershed.

The Upper Kalama contains 970 acres of elk and deer winter range, approximately 11 percent of the forested acres.



Upper Kalama River Vegetation Zones

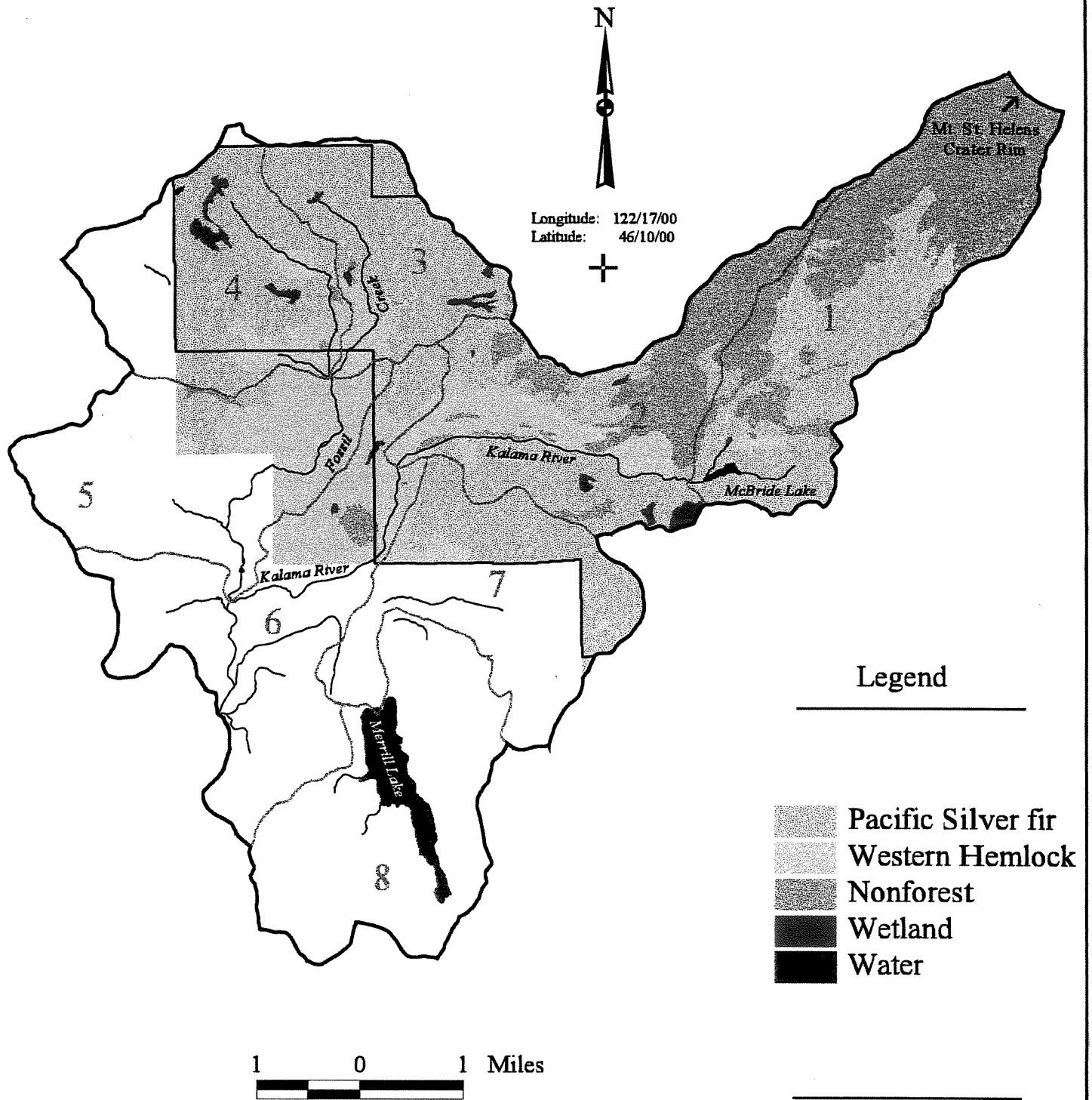


Figure 5. Vegetation Zones (Ecoclasses) of the Upper Kalama River Watershed.



Water Features and Hydrologic Processes

General physical characteristics

The Kalama River originates at Kalama Springs (on the southwest side of Mount St. Helens) and flows for 3.3 miles within the National Volcanic Monument boundaries. It then continues due west to the Columbia River. A few small streams provide direct snow-melt water into the Kalama between Goat Marsh and Kalama Springs; however, the greater portion of Kalama River water arises from springs within the Monument and major tributaries entering outside of the Monument. The Kalama River and its tributary Fossil Creek, are the two main stream systems in the watershed.

In the Upper Kalama River watershed, the average annual precipitation ranges from 110 to 130 inches per year. The maximum yearly flow of record ranges from 17,900 cubic feet per second (cfs) in 1972 to 3990 cfs in 1977, measured just upstream from the town of Kalama.

Riparian Reserves

As a key element of the Aquatic Conservation Strategy (ROD, B-9), the Riparian Reserves provide an area along all streams, wetlands, ponds, lakes and unstable and potentially unstable areas where riparian-dependent resources receive primary emphasis. Riparian Reserves are important to the terrestrial ecosystem as well, serving, for example, as dispersal habitat for certain terrestrial species. Figure 6 shows the riparian reserves in the Upper Kalama River Watershed in two categories, those associated with streams and wetlands and those associated with unstable and potentially unstable ground.

Water Quality

No 303 (d) water quality impaired stream segments within the analysis area are presently identified on the Washington State 303 (d) list. However, 10 miles of the lower portion of the river (outside the analysis area) has been identified as water quality limited due to water temperature. Water quality data is lacking within the analysis area.

The February 1996 flooding triggered at least 39 new slides in the Kalama River Basin, some of which occurred in the analysis area. Stream channels were simplified and sediment was introduced into Fossil Creek, Dry Creek, Merrill Lake, and McBride Lake by debris torrents.

Water Quantity

The majority of the Upper Kalama is in the transient snow zone and subject to rain-on-snow storm events.

Upper Kalama River Riparian Reserves

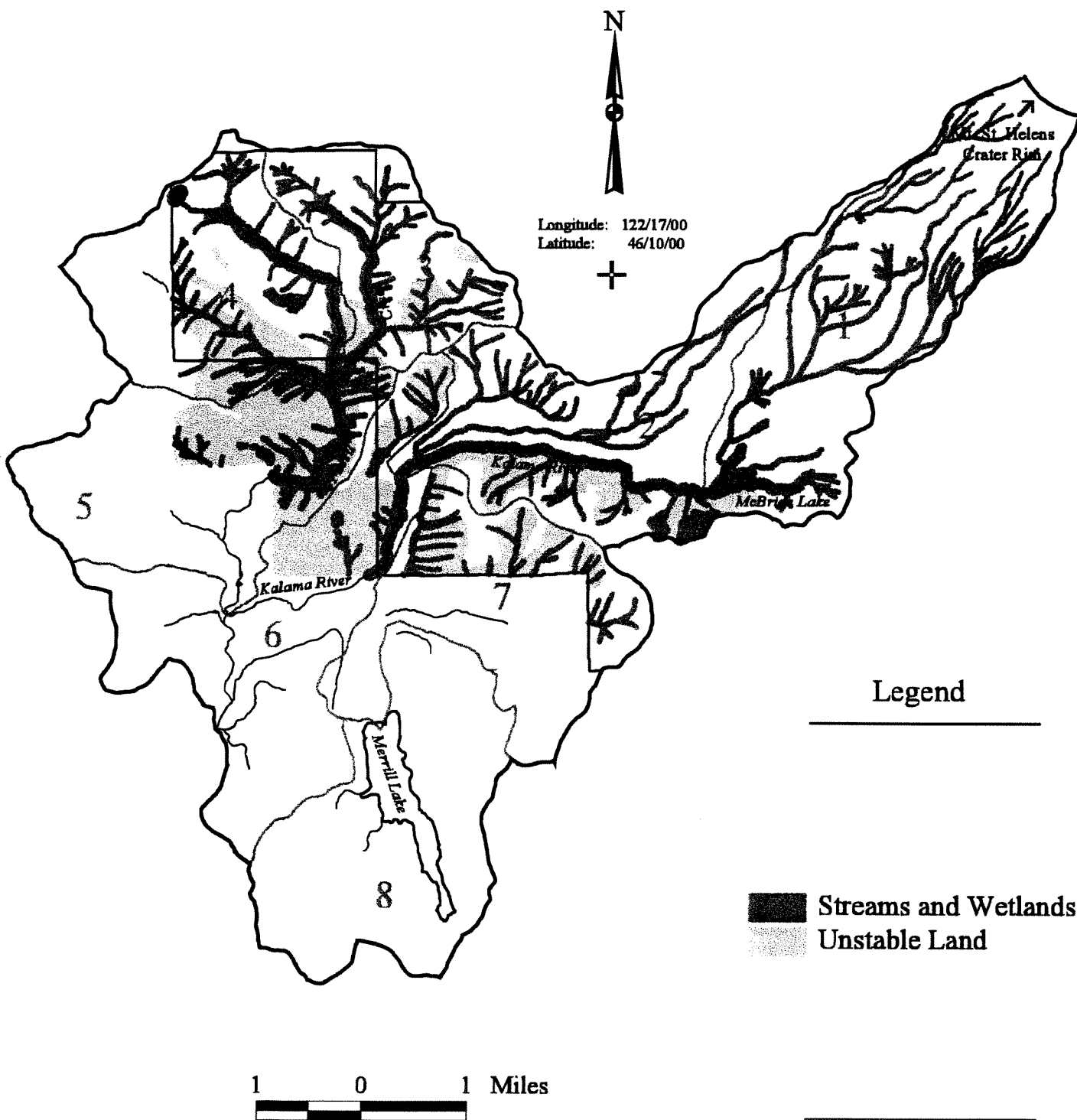


Figure 6. Riparian Reserves within GPNF lands provide an area along all streams, wetlands, ponds, lakes and unstable and potentially unstable areas where riparian-dependent resources receive primary emphasis.

The likelihood of peak-flow increases caused by natural or human activity is of high concern in Fossil Creek and Dry Creek.

Aquatic Animals and Habitat

The Upper Kalama River Watershed has approximately 265 miles of stream; 26 miles are Class II, 36 miles are Class III and approximately 203 are Class IV (Figure 7). Rainbow trout (*Oncorhynchus mykiss*) and cutthroat trout (*O. Clarki*) are the most common fishes found in the streams. Summer and winter steelhead (*O. Mykiss*) and spring chinook (*O. Tshawytscha*) habitat extends up to Kalama Falls. The falls are located near where the Kalama River crosses the western watershed boundary in Sub-basin 6.

Two natural lakes are located in this area: McBride Lake and Merrill Lake. Merrill Lake receives a high recreation use and has a developed campground and boat landing on its shores. Merrill Lake is well known for its fly fishing opportunities. It supports native cutthroat trout, stocked brown trout (*Salmo trutta*), brook trout (*Salvelinus fontinalis*), and rainbow trout. McBride Lake also receives a relatively high amount of recreation use, but access is primarily from trails. McBride Lake supports stocked brook trout.

Specific goals in the Upper Kalama River watershed include:

- increase fish populations by restoring/protecting key habitat attributes necessary for resident fish survival
- reduce stream temperatures to meet state water quality standards
- reduce aquatic habitat fragmentation, and
- reduce the quantity of management-related sediment that reaches the stream channels.

Objectives will be set at the project level to meet these goals.

Human Uses

The Kalama Watershed has been occupied by, and its environment modified by humans, for the past six thousand years. Native Americans established villages along the Lewis River to the south, and searched the surrounding hills for edible plants, fished area streams, and hunted for game. Fires were often set to clear undergrowth, to rejuvenate berry fields, to make travel easier, and to enhance hunting. When European immigrants first entered the area in the early 1800's, they encountered a landscape already modified by human presence.



Upper Kalama River Stream Classes

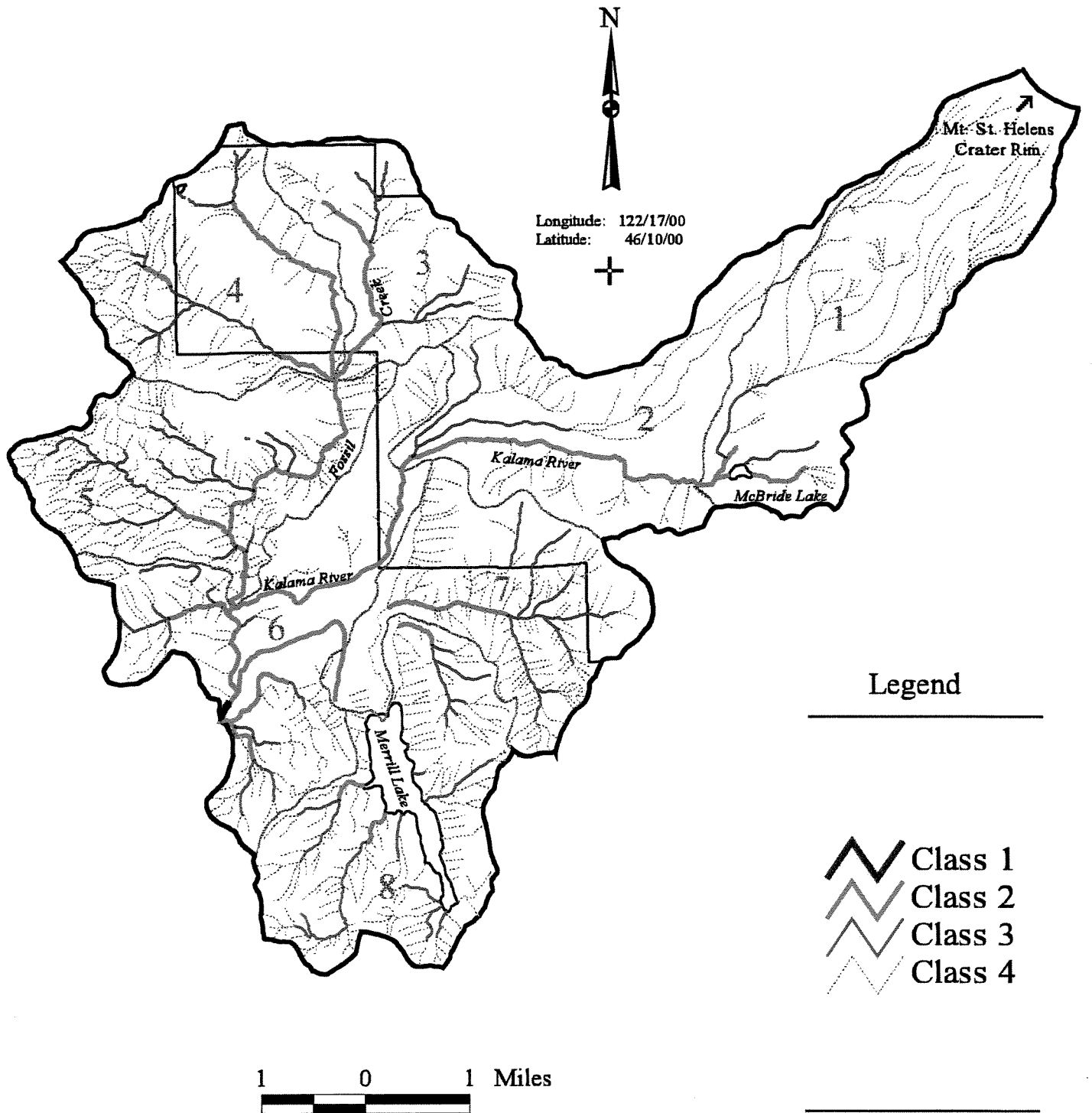
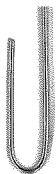


Figure 7. Stream segments have been grouped according to their size and presence of beneficial uses. These groups, referred to as stream classes, range from Class 1, which is a large perennial stream, to Class 4 which is a small, intermittent stream.



Native American populations markedly decreased during the 1800's due to the introduction of European diseases to which they had almost no resistance. During this period, land was made available to homesteading, and land grants encouraged development of railroads. The Lewis River Valley was homesteaded, with the development of many small farms. Trails were converted to roads, while river boat travel provided access and a means of transporting goods on the lower Lewis River. By the year 1900, native American populations were nearly completely replaced by European settlers.

As access to the Lewis River Valley improved, so did leisure time for hunting and fishing. By 1920, a trail extended from Cougar to Merrill Lake (then called Trout Lake), and cabins were constructed to lodge visitors. By 1935, the trail was improved to a narrow road, and Merrill Lake became a local attraction. Road signs as far away as Battle Ground pointed the way to "Trout Lake". Beyond the lake, trails led northward toward Mount St. Helens onto public lands of the Rainier Forest Reserve, precursor of the Gifford Pinchot National Forest. Over time, the trail leading past Merrill Lake was improved to a jeep track leading to Goat Marsh and Butte Camp. This primitive path was used mostly by hunters and fishermen.

In 1949, the Gifford Pinchot National Forest was established. By the late 1950's, emphasis for management had shifted from fire protection to commodity production. Logging of private lands in the Lewis River Valley had depleted the available supply of inexpensive timber placing demands upon the Forest Service to supply logs to mills. In 1958, Road 81 was constructed from the Lewis River Valley, past Merrill Lake, into the Kalama River watershed. A work center was then constructed in the location now occupied by the Kalama Horse Camp. Two bunkhouses, a cook house, and a generator building provided accommodation for Forest Service Crews laying out timber sales. During this period, several large areas were logged to salvage timber damaged by forest insects.

Following the construction of roads into the drainage, hunting activity increased. This activity remains popular, particularly during elk hunting season. Dispersed camp sites originally developed as hunting camps line Roads 81 and 8123. These camps are now also popular with summer visitors, particularly when the Kalama Horse Camp is full.

The eruption of Mount St. Helens in 1980 marked a shift in the local economy from logging to tourism. By 1982, following world-wide publicity surrounding the eruption of the volcano and the establishment of the Mount St. Helens National Volcanic Monument, the area became an international destination point for tourists. By 1984, volcanic activity decreased enough to allow the area to be reopened to visitors. Tourism increased at a rapid rate. On the south side of Mount St. Helens recreation sites were developed or improved to accommodate visitor use. In the Kalama Watershed new trails were developed, and old trails were improved. The former Kalama Work Center was converted to the Kalama Horse Camp. Snow-covered roads were discovered by skiers and snowmobilers, attracting winter recreation use. A new trailhead at Redrock Pass provided access to area trails and a starting point for mountain climbers ascending the Butte Camp climbing route to the summit of Mount St. Helens.

With a downturn in logging, tourism has formed a new economic base for the communities of Yale and Cougar. The Kalama Watershed now attracts visitors year-round to the area. In 1995 over 150,000 visitors entered the watershed by traveling north on Road 81 from Cougar.

CHAPTER II ISSUES AND KEY QUESTIONS

Having characterized the watershed, the ID team assembled the issues to be studied. For this watershed analysis, "Issues" are topics of concern about key elements of the ecosystem that are related to:

- management goals and objectives,
- human values, or
- resource conditions within the Upper Kalama River Watershed.

Each issue generates Key Questions to be investigated. These questions

1. address the issues by focusing on the elements that influence and are influenced by humans, and which can be measured at the watershed scale, and
2. are expected to be answered by the analysis.

A general letter announcing the beginning of the watershed analysis and soliciting ideas about topics that should be investigated was mailed to 84 addressees which included individuals interested in watershed analysis in general and other agencies. Neal Darby, US Fish and Wildlife Service, provided input.

From the characterization (Chapter I of this report) and from verbal and written input, a list of Issues and Key Questions was compiled. See Appendix C, List of Issues and Key Questions.

In order to proceed, the total list was narrowed to concentrate the team specialists' limited time and resources on those issues of greatest importance.

Being prepared to answer watershed-scale questions about anticipated future land management project decisions is the driving force behind this iteration of the Upper Kalama River Watershed Analysis. Accordingly, the types of future projects needing a watershed-scale perspective include:

1. Watershed Restoration
 - Road decommissioning/weatherization
 - Placement of in-stream structures
 - Riparian Reserves - planting, vegetation manipulation
2. Road paving to reduce surface erosion
3. Flood repair to roads, facilities, other (slides, etc.)

4. Management of dispersed recreation camping
5. Develop camping facilities
6. Develop a snow-park
7. Management of commercial-use permittee camping
8. Management of recreational use in the Goat Marsh Research Natural Area.

Previous analysis conducted for the Middle Fork Timber Sale (See Environmental Assessment, 1996) found the aquatic environment needs a period of time for recovery before further timber harvest is planned. Therefore, this iteration of the Upper Kalama Watershed Analysis will not consider timber harvest as one of the above listed types of projects.

A total of eleven issues will be addressed in the Upper Kalama River Watershed Analysis. These issues are

- **Mass Wasting:** The Upper Kalama River has numerous landslides and debris flows within its boundaries. Management activities may have activated or worsened a number of these features, sometimes impacting streams. The major storm event of February 1996, which caused numerous landslides and debris torrents, demonstrated the magnitude these recurring disturbances can attain.
- **Surface Erosion From Roads:** Surface erosion from roads has been a major contributor to sedimentation to streams in the past. During new construction and within the first two to three years is when most of the sediment is transported. After this time, vegetative growth on the fill slopes and cut slopes help alleviate this problem, but in areas near stream crossings the problem can continue to influence stream habitat for many years. Poor construction practices in the past have created numerous problems recently from fill slope failures that directly and indirectly move sediment into many streams. This is especially evident since the storm event of February 1996.
- **Riparian Reserve Habitats and Fragmentation:** Some critical components of terrestrial habitat within the Riparian Reserves have been altered. This influences the capability of these ecosystems to provide effective habitat for riparian dependent plant and animal species, and other species that may use Riparian Reserves as habitat connections between larger habitat blocks.
- **TES Plants and C-3 Species:** The Endangered Species Act and the Northwest Forest Plan mandate that we monitor for threatened, endangered, and sensitive (TES), and late-successional-dependent (C-3) species respectively. Less than five percent of the watershed has been surveyed for TES species, and none of the watershed has been surveyed for C-3 species.

- **Habitat Condition for TES Animal Species:** The watershed contains suitable, or potentially suitable habitat for TES species including spotted owl, peregrine falcon, bald eagle, Townsend's big-eared bat, and Larch Mountain salamander.
- **Hydrologic Changes:** Past disturbances may have influenced basin hydrology by increasing peak flows during fall and winter storms and decreasing summer low flows. Human activities have occurred throughout the watershed and may influence the timing and quantity of runoff as well. Due to time limitations the analysis will focus on peak flows only.
- **Water Quality and Key Habitat Attributes for Salmonids:** Current aquatic habitat conditions are a result of past natural and human induced processes that have occurred in the watershed. Volcanic activity, road building combined with timber harvest, and increased human populations in the watershed have through time altered stream habitats and aquatic communities. Degraded water quality from sediment may be affecting fish habitats. State water quality regulations are in place to protect existing and designated uses of water (i.e., beneficial uses). Due to time and analysis information limitations the focus will be on fish distribution and habitat condition.
- **Dispersed Camping:** Dispersed camping is popular along Roads 81 and 8123 during the summer season and in the fall during hunting season. The volume of this recreational use may be causing adverse effects upon the area.
- **Winter Recreation Parking:** The Kalama Ski Trail terminates at Kalama Horse Camp. Plowed parking has not been provided at this site since 1988. Additional winter access may be needed to meet current and future demand for winter recreation?
- **Horse Camping Capacity:** The Mount St. Helens Comprehensive Management Plan directed the development of a system of horse trails, and the development of Kalama Horse Camp, to provide an opportunity for equestrian use of the National Volcanic Monument. Existing facilities may not be providing adequate camping capacity for equestrians.
- **Recreation use in Goat Marsh RNA:** The Goat Marsh Research Natural Area was established for the purpose of preserving a unique Cascade Mountains habitat for research and scientific study. The RNA is popular for hunting, fishing, and limited horse back riding. Some camping occurs adjacent to Goat Marsh Lake. Recreation use may be compromising the purposes for which the research natural area was established.



CHAPTER III CURRENT CONDITIONS	III-1
Geology, Physical Processes	III-1
Fire	III-3
Vegetation	III-3
Habitat Conditions for TES Animal Species	III-8
Hydrologic Changes	III-13
Aquatic Animals and Habitat	III-16
Recreation Use	III-33



CHAPTER III CURRENT CONDITIONS

Chapter III consists of brief presentations (illustrated by maps, tables, and charts) which describe current conditions and trends of relevant ecosystem elements and processes within the watershed.

Geology, Physical Processes

Mass Wasting

Unstable and potentially unstable lands in the Upper Kalama River Watershed are shown on Figure 6. These areas have been placed in riparian reserves in accordance with the Northwest Forest Plan. Current conditions in the watershed have been mapped from existing data available in the forest files and the use of aerial photos. Mapping of newly damaged areas from the 1996 storm events has not yet been accomplished. Some of these areas will eventually be identified as unstable and potentially unstable land, and this will increase the area of riparian reserves in the watershed. Table 1 shows the percentage of unstable and potentially unstable ground by sub-basin. Unstable and potentially unstable ground outside the National Forest is not identified, so reviewers should be aware that only National Forest acres appear in the table.

The 1996 storm events resulted in mass wasting and erosion moving large amounts of sediment in short periods of time. These types of events tend to scour channels and drastically alter the hydrologic regime of an area for many years.

Erosional processes

Surface erosion is a concern due to the sensitive tephra deposits from past eruptions of Mount St. Helens. The ash and pumice soils from these eruptions are highly erodible and easily transported. With the 1980 eruption of Mount St. Helens and the resulting loss of vegetation, erosion has proceeded at higher levels than seen prior to the eruption. Road construction has also increased sediment production and transport. Sub-basins with relatively high road densities, steeper slopes, and highly erodible soils are the areas of most concern. This is displayed in Figure 8. This map shows (by sub-basin) where erosion rates from roads are contributing the most sediment to streams.

Upper Kalama River Erosion from Roads

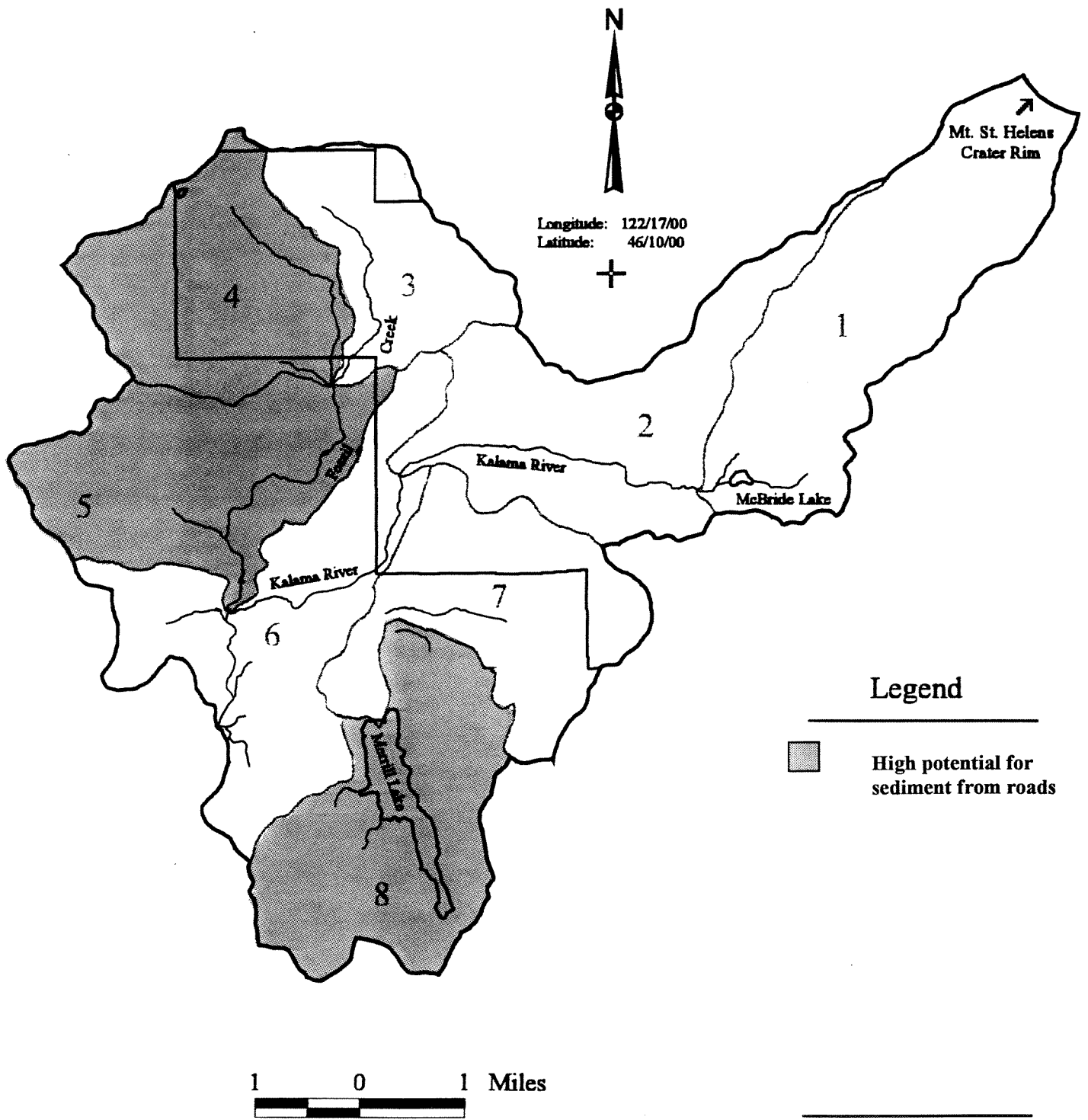


Figure 8 : Sub-basins with the highest potential for moving sediment from roads to streams.

Table 1. Upper Kalama River Watershed: Percentages of Unstable and Potentially Unstable Land by Sub-basin (data is for National Forest lands only)

Sub-Basin	Acres in Sub-Basin (N.F. land)	Acres Unstable	Acres Potentially Unstable	Percent of Sub-Basin
1	4046	102	54	4.0%
2	3224	21	501	16.2%
3	1682	21	196	12.8%
4	1674	0	377	22.5%
5	37	6	29	97.2%
6	503	0	279	55.6%
7	1106	1	469	42.4%
8	0	-	-	-
TOTALS	12,272	151	1904	16.7%

Fire

Wildfires have not played a dominant role in changing the forest landscape in the Upper Kalama Watershed. The watershed is outside areas known to have low-frequency, high-intensity, stand-replacing fires, such as the Yacolt burn area in the Lower Lewis Watershed.

Vegetation

Stand Composition

The vegetation of the watershed has been categorized into vegetation zones or Ecoclasses (Figure 5). The vegetation characterizations are based on plant species present, their proportions, and potential vegetation (Brockway et al. 1983; Topic et al. 1986; Topic 1989). The Western Hemlock zone is generally the most productive for timber, followed by the Pacific Silver Fir zone. Table 2 (Vegetation Zones) shows the amounts of each vegetation zone in the watershed, and Table 3 (Vegetation Zones by Sub-basin) shows the breakdown of these zones by sub-basin. The non-Federal lands have not been partitioned into vegetation zones and are not included in the analysis. Note: Sub-basin 8, Merrill Lake, contains no Federal land.

Table 2. Vegetation Zones (National Forest lands only)

Vegetation Zone	Acres	Percent of Watershed
Western Hemlock	1,532	12%
Pacific Silver Fir	7,080	58%
Shrubland	205	2%
Rock, Talus, Cinder, Lava, glacial	3,432	28%
Lake, pond	23	trace

Table 3. Vegetation Zones by Sub-basin (National Forest lands only)

Sub-basin	Acres N.F. Land	Western Hemlock	Pacific Silver Fir	Shrubland	Rock	Water
01	4,046	48	1,803	4	2,172	19
02	3,224	633	1,299	71	1,221	0
03	1,682	143	1,479	44	16	0
04	1,674	261	1,310	81	18	4
05	37	19	18	0	0	0
06	503	282	210	5	6	0
07	1,106	144	961	0	1	0
08	0	-	-	-	-	-

Stand Age

Stands in the 0 to 40 year age class are probably more numerous today than historically. Forty-one percent of the National Forest lands are in this age class. If private lands are considered, the figure is much higher. There are essentially no stands that are 40 to 80 years old, and about thirty-two percent of the stands on National Forest are 80 to 160 years old. The stands in the early age class are the result of timber harvest, while the 80 to 160 age class is the result of large scale disturbance such as volcanic activity or fire. The remaining twenty-seven percent of the National Forest land is either stands 161+ years old or non-forested lands such as rock.

Stand Structure

Stand structure is often more informative in determining the ecological function than stand age or seral (successional) stage. Stand structure definitions have been developed based on a number of different criteria (Hall et al. 1985), and were recently expanded to include a total of 16 categories (Appendix E, Structural Stage Definitions). Approximately 51 percent of the watershed is in non-National Forest ownership. Because analyses are of National Forest lands only, the ecological conditions of the entire watershed are not depicted and constitute a data gap.

For ease of interpretation, structural stages are combined into seven groups based on ecological functions at a more coarse scale. Since a large portion of the non-Federally owned lands have been harvested, the percentages for the different structural stages on a watershed scale would vary considerably from what is shown here. There would be a higher percentage in the young stages and a lower percentage in the large tree component. Figure 9 shows the grouped vegetation structural stages. Note: Sub-basin 8, Merrill Lake, contains no Federal land.

Table 4. Percent Grouped Vegetation Structure Stages by Sub-basin. Calculations are for National Forest lands only.

Sub-basin	Acres N. F.	% Other Ownership	Grass/Forb/Seedling	Open Sap/Pole/Small Tree	Closed Sap/Pole/Small Tree	Large Tree Single Layer	Large Tree Multi-Layer	Non-Forest, e.g. rock
01	4,046	0	0	38%	4%	0	3%	54%
02	3,224	0	1%	13%	31%	Trace	14%	40%
03	1,682	10%	13%	19%	29%	0	35%	4%
04	1,674	41%	10%	29%	24%	0	30%	6%
05	37	99%	Trace	0	97%	0	2%	0
06	503	86%	3%	21%	35%	0	39%	2%
07	1,106	60%	16%	15%	34%	0	34%	0
08	0	100%	-	-	-	-	-	-
Total	12,272	51%	5%	19%	22%	0	18%	30%

The watershed contains relatively extensive stands of lodgepole pine, that are associated with pyroclastic flows. Pure lodgepole stands are relatively rare in the Central Skills Center, and these stands add to the overall habitat diversity in the landscape. Lodgepole stands are fairly short-lived in the absence of disturbance by fire, and maintaining these stands may require treatment such as prescribed burning.



Upper Kalama River Stand Structure

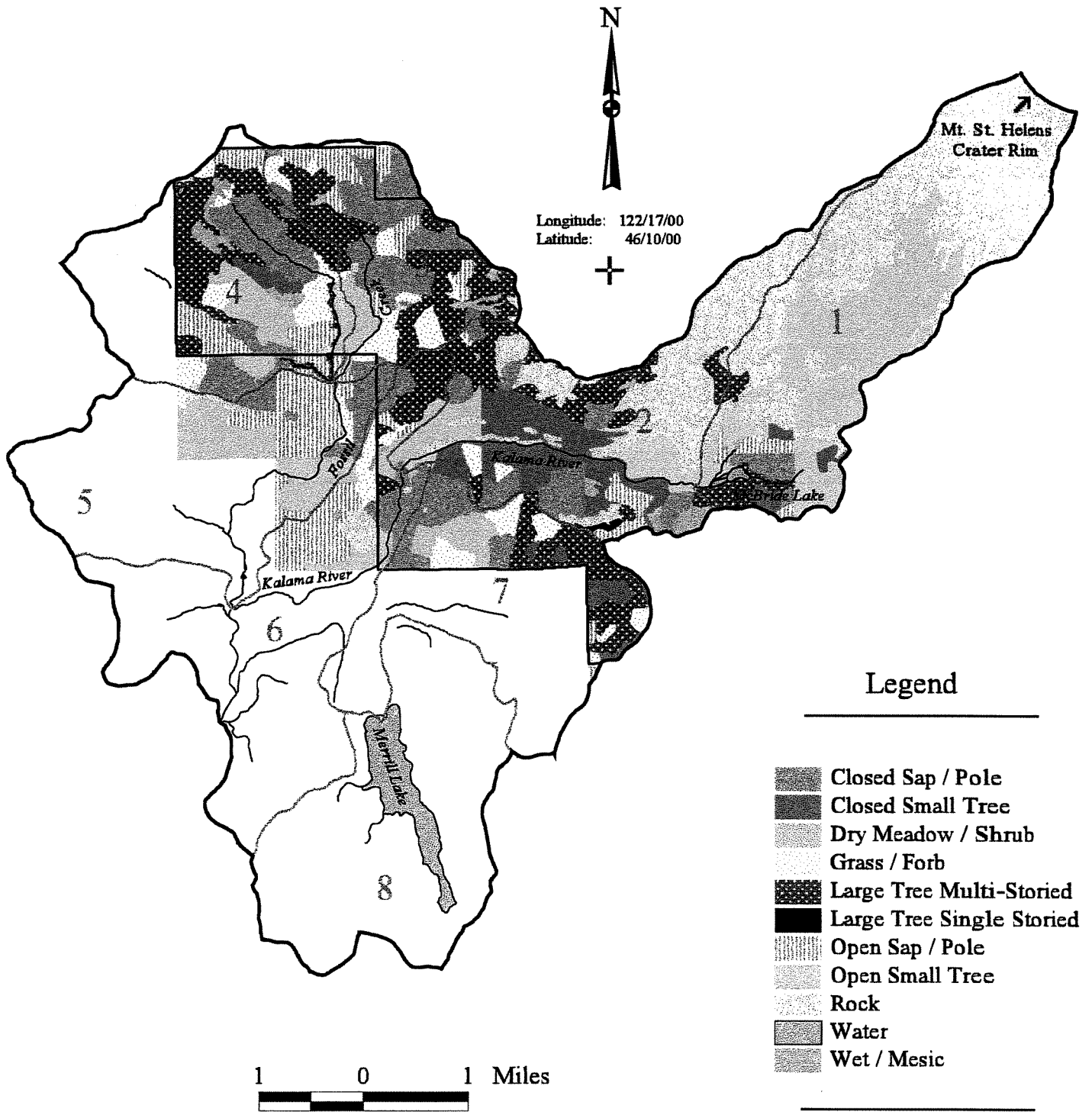


Figure 9. Vegetation structural stages in the Upper Kalama River watershed.



Riparian Reserves

Stand structure and composition within stream Riparian Reserves have been altered by fire, volcanism, and timber harvest within the watershed. Eighteen percent of the stream Riparian Reserves are in late-successional structural stages, with the remainder in early- to mid-successional structural stages. Table 5 shows structural stages within Stream Riparian Reserves by sub-basin. The loss of late-successional stands along streams has affected the capacity of the ecosystem to provide effective habitat and dispersal corridors between large habitat blocks. Areas damaged by flooding during February 1996 are not accounted for in this portion of the analysis.

Table 5. Percent Grouped Structure Stages of Stream Riparian Reserves by Sub-basin. Calculations are based upon Stream Riparian Reserves on National Forest lands only.

Sub-basin	Stream Rip. Res.	Grass/ Forb/ Seedling	Open Sap/ Pole/ Small Tree	Closed Sap/ Pole/ Small Tree	Large Tree Single Layer	Large Tree Multi-Layer	Non-Forest, e.g Rock
01	1,043	0	44%	4%	0	4%	48%
02	876	1%	15%	41%	0	10%	33%
03	505	16%	15%	29%	0	34%	6%
04	471	10%	22%	35%	0	29%	3%
05	14	0	0	100%	0	0	0
06	174	3%	25%	42%	0	29%	2%
07	275	11%	14%	35%	0	39%	0
08	-	-	-	-	-	-	-
Total	3,358	5%	26%	27%	0	18%	25%

Threatened, Endangered and Sensitive Plants

There are 6 documented sightings of fringed pinesap (*Pleuricospora fimbriolata*) in the watershed. The sites are in sub-basins 2, 6, and 7. Fringed pinesap is a State-listed sensitive species that is found in the duff and humus layer in shaded coniferous forests from southern Washington to California.

Another species, pine broomrape (*Orobancha pinorum*) was documented just outside of the watershed boundary, near the Blue Lake trailhead. This species typically occurs in open coniferous woods, and is parasitic on the roots of oceanspray (*Holodiscus discolor*). Because of the proximity of this site to the boundary, it is likely that it also occurs in the watershed.

Habitat Conditions for Threatened, Endangered Animal Species and Species of Concern

As stated before, the watershed contains habitat for an estimated 199 known wildlife species; 39 are directly dependent on snags for feeding or breeding, and 52 are directly dependent on down-logs. Of the 199 wildlife species, 47 are thought to have declining populations.

There are 12 federally-listed species that are known or suspected to occur in the watershed area. Federal listing under the Endangered Species Act has three categories: Threatened, Endangered, or Species of Concern (C2). For the Kalama watershed, the following table (Table 6) shows the wildlife species, federal listing, and if populations are thought to be decreasing.

Table 6. Threatened, Endangered, and Species of Concern in the Watershed

COMMON NAME	FEDERAL LISTING	DECREASING POPULATION
Bald eagle	Threatened	
Northern spotted owl	Threatened	Yes
Northern goshawk	C2	Yes
Peregrine falcon	Endangered	
Gray Wolf	Endangered	
Townsend's big-eared bat	C2	Yes
Larch Mountain salamander	C2	
Cascades frog	C2	Yes
Red-legged frog	C2	Yes
Harlequin duck	C2	Yes
Fisher	C2	
Mountain quail	C2	

Bald eagle

An active bald eagle nest is located at Swift Reservoir, and bald eagles are known to forage at the reservoirs along the Lewis River and in the main stem of the Lewis River just above Swift Reservoir. There have been documented sightings of eagles in the watershed and it is likely that bald eagles also forage at Merrill Lake. There are no known nest or roost sites in the watershed, but suitable roost trees exist around Merrill Lake.

Spotted owl, Goshawk

Spotted owls and goshawks have similar habitat requirements, so the current habitat condition in the watershed would apply to both. Both species have been documented in the watershed. Table 7 shows the acreage of spotted owl nesting, foraging and dispersal habitat by sub-basin, and the percent of the area in the sub-basin with that type of habitat. The distribution of these habitats is shown in Figure 10.

Table 7. Spotted Owl Habitat in the Watershed (National Forest lands only)

Sub-basin	Nesting acres and percent		Foraging acres and percent		Dispersal acres and percent	
1	133	3%	22	<1%	1367	34%
2	765	24%	42	1%	656	20%
3	216	13%	0		0	
4	478	29%	256	15%	0	
5	0		0		0	
6	197	39%	0		56	11%
7	408	37%	229	21%	27	2%
8	-	-	-	-	-	-
Total	2197	18%	549	4%	2106	17%

There are four spotted owl activity centers located on National Forest Lands within the watershed.

Activity Center	Status
102	Pair found in 1979. Latest survey in 1994: pair found, no reproduction.
122	Pair found in 1990. Latest survey in 1994: pair present, reproduction confirmed.
115/1204	Pair and sub-adult found in 1989. Surveys conducted in 1990 thru 1992: no owls found.

The home range surrounding an activity center is considered viable if at least 40 percent of the area within the home range is suitable nesting or foraging habitat. To meet this threshold there must be 500 acres of suitable habitat within 0.7 miles of the activity center, and 2,663 acres of suitable habitat within 1.82 miles. None of the home ranges in the watershed contain enough habitat to meet these minimums and are therefore not considered viable, and successful reproduction is not likely to occur each year.

Peregrine Falcon

There are no known active or historical eyries in the watershed. Surveys for potential nest cliffs utilizing maps and aerial photos identified two possible locations in the watershed, Butte Camp Dome and Goat Mountain.

These sites are within the boundary of the National Volcanic Monument and Goat Marsh Research Natural Area, so disturbance associated with recreational use is the most likely management concern. Hiking trails 238 and 238A are near Butte Camp Dome. Trails also pass near Goat Mountain. The amount of off-trail hiking in these areas during the summer months is probably low, but any hiking off the trails or climbing at these sites would affect their suitability for peregrines.

Gray Wolf

Because of the high road density in the watershed and high amount of year-round recreational use, there are no opportunities for wolves to find secluded habitat. For this reason, the watershed is not likely to be inhabited by gray wolves, and habitat for this species will not be analyzed.

Upper Kalama River Spotted Owl Habitat

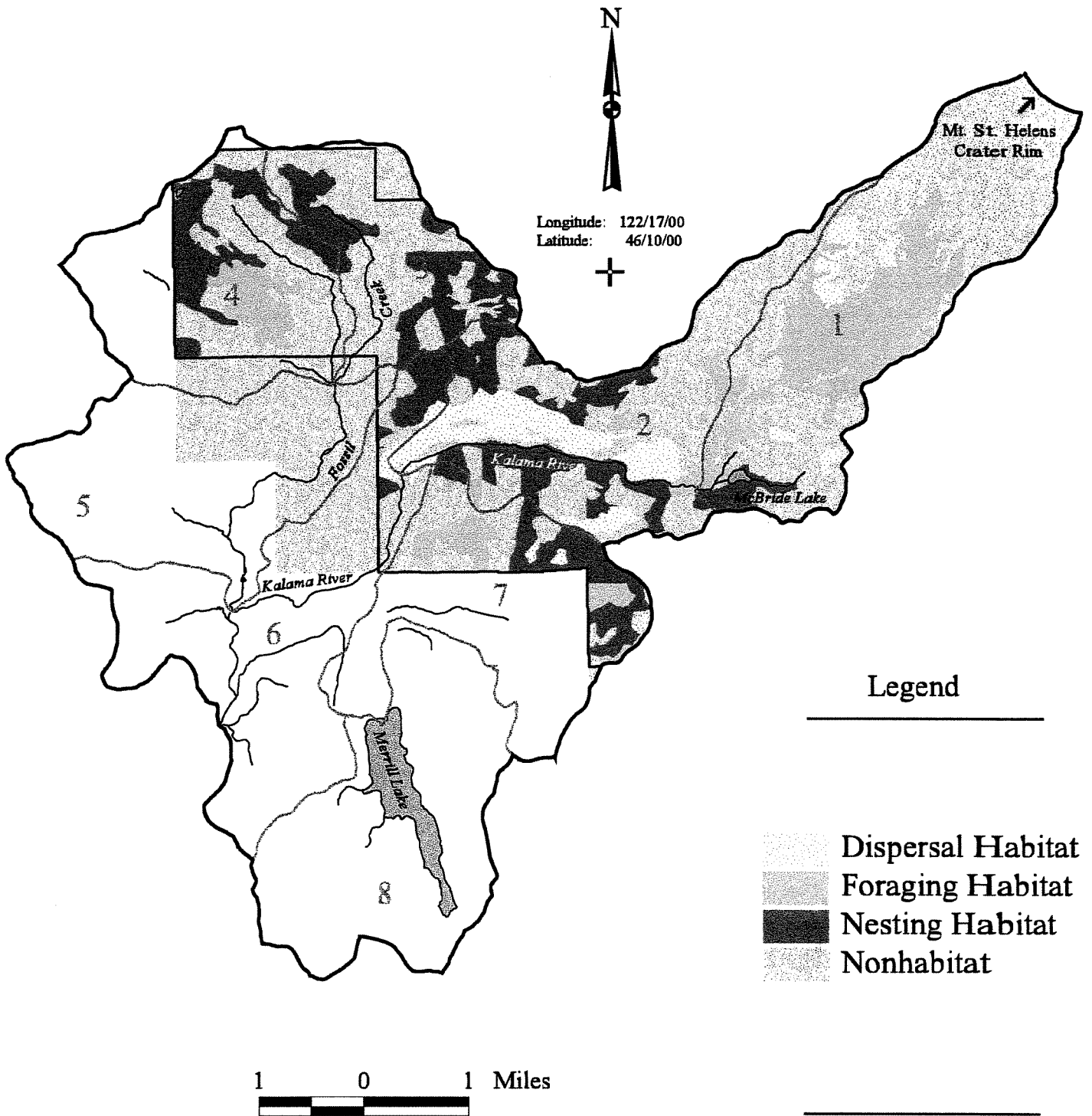


Figure 10 Distribution of spotted owl habitat within the watershed.



Townsend's Big-eared Bat

There have been many sightings of this species in the watershed, and a maternity colony is known to exist on private land near the Forest boundary. Caves are found on the south side of Mount St. Helens outside of the watershed where this species is known to hibernate. Timbered edges in the watershed are foraging sites, and maintaining mature timber in the vicinity of the maternity colony is important for the maintenance of the colony.

The location of the maternity colony makes it unlikely that it would be disturbed by recreationists, and timber harvest in the vicinity of the colony is not anticipated because it is generally surrounded by young stands.

Larch Mountain Salamander

No known populations of this species are documented in the watershed, but potentially suitable habitat exists. Forested lava flows and talus fields in the watershed are potential habitat.

Cascades frog, Red-legged frog, Harlequin duck

These species are dependent on riparian areas and adjacent timbered habitat. The Riparian Reserves in the watershed contain a low percentage of stands that are in mid- to late-seral structural stages (0 to 43 percent). Harvest in these areas has probably resulted in low densities of snags, large logs, and large remnant green trees. The loss of these structures has affected the ability of these species to breed and disperse through the watershed.

Fisher

Fishers are generally found in conifer-dominated forests containing a diversity of habitat types and successional stages. Fishers are closely associated with forested riparian areas which are used extensively for foraging, resting, and as travel corridors. They have been found to prefer mature and old-growth coniferous forest stands with continuous cover, though use of shrubby clearings can occur during summer months. Potential barriers to dispersal include large rivers, mountain divides above timberline, and open-canopied habitats. Hollow logs, tree cavities, boulder piles, and witch's brooms are used for resting sites. Tree cavities are most frequently used as natal dens.

Extensive timber harvest in the watershed, especially in riparian areas, has left most of it

unsuitable for fishers. Suitable habitat still exists along the Kalama River on National Forest land. However, extensive year-round recreation in the watershed, including hiking and ski trails along the Kalama River, has reduced the habitat suitability.

During February and March of 1996 a camera bait station was established near the Kalama River in an effort to detect fishers. No fishers were detected.

Mountain Quail

This species inhabits mountain forests with a well-developed shrubby understory, steep slopes around the edges of mountain meadows, and in logged or burned-over forests from 1,500 to 10,000 feet. Nests are always near water.

McBride Lake, Goat Mountain, and Butte Camp Dome are potential nesting sites. Other potential nesting sites are near the small unnamed lakes and meadows in the watershed.

Hydrologic changes

A peak flow analysis was conducted using the State of Washington "Standard Methodology for Conducting Watershed Analysis" procedure. The analysis models changes in stream discharge resulting from vegetation removal. As recommended in the procedure, a two-year storm event was modeled.

Table 8 displays sub-basins that, when compared to a fully forested condition, currently have increased peak flows more than 10 percent (see Figure 11, Peak Flow). This threshold is used by the State of Washington to indicate areas that have a possibility for adverse watershed effects due to peakflow increases. Note that this modeling did not include information on State or privately-owned land due to the lack of GIS vegetation data. General observations made from orthophoto interpretation indicate that most of the private land has been recently harvested, so it is likely peakflow increases are greater than 10 percent in these areas as well.

Upper Kalama River Peakflow

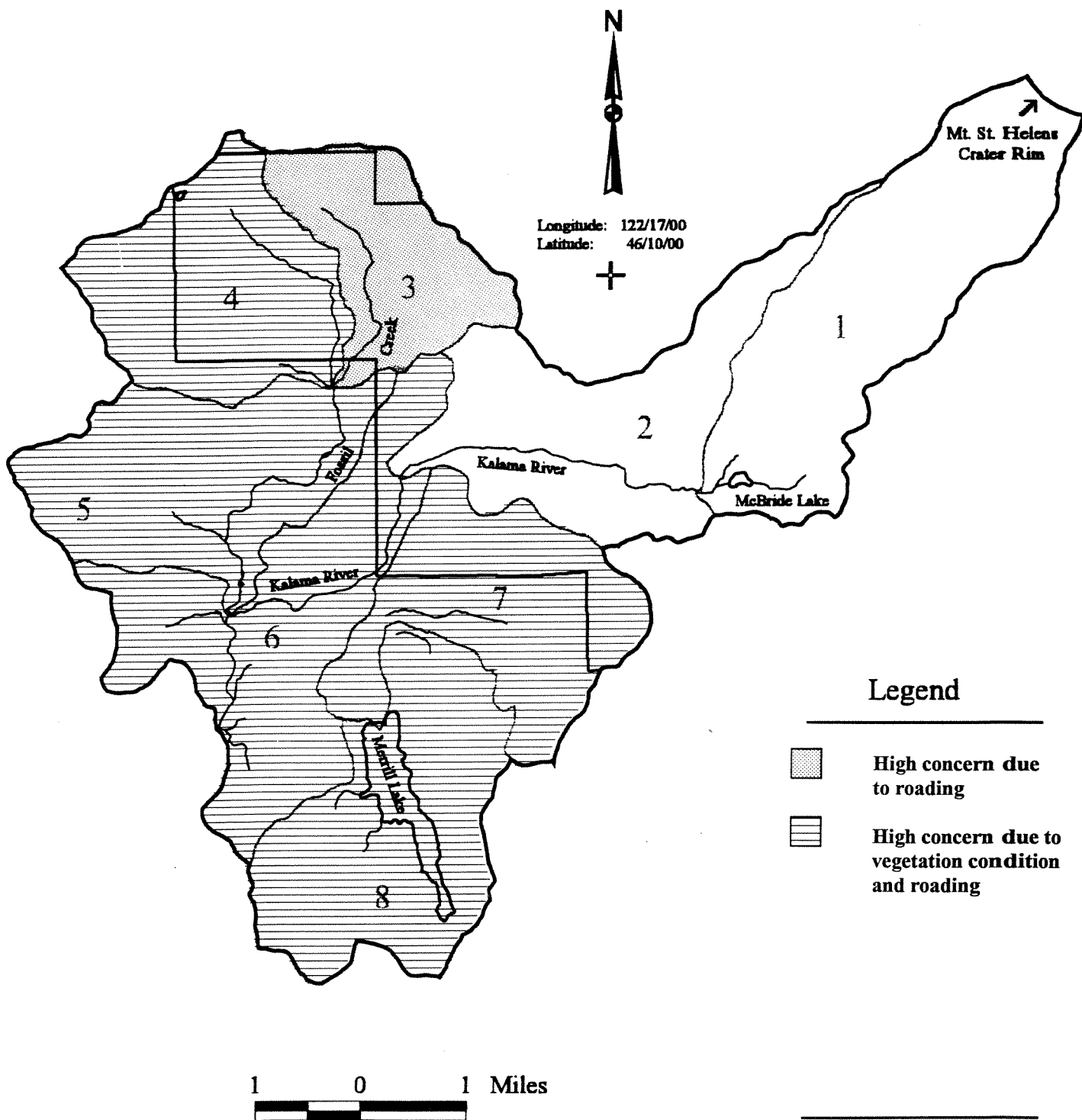


Figure 11. Areas of high peak flow concern in the Upper Kalama River Watershed. These are defined as sub-basins with peak flow increases greater than or equal to 10% due to vegetation removal, sub-basins that have increased channel length by at least 40% from roading, or areas that meet both of these criteria.

Table 8. Peak Flow Increases

Sub-basin	Peak Flow Increase
3	5%* - 10%**
4	6%* - 12%**
5	>10% ***
6	>10% ***
7	>10%***
8	>10%***

- * - peak flow increase for an average two year storm
- ** - peak flow increase for an unusually strong two year storm
- *** - peak flow increase estimated to be >10% based on review of ortho-photos of state and private land

Another phase of the peak flow analysis examines the extension of the stream channel network by roads and ditch lines in roads. These factors may increase peak flows through road cut slope interception of subsurface flow and routing of surface waters through road ditch lines as "pseudo channels." Table 9 displays sub-basins where roads have increased the length of natural stream miles by 40 percent or more. (see Figure 11, Peak Flow).

Table 9. Extension of the Stream Channel Network By Roads and Ditch Lines in Roads

Sub-basin	Percent increase
4	70%
5	59%
6	42%
7	67%
8	73%

A large flood event affecting a majority of the analysis area occurred in February, 1996. The magnitude of this flood and the full extent of the damage was still being investigated at the time this report was written. As this information becomes available, it will be added to the analysis file and included in future iterations of the Upper Kalama River Watershed Analysis.

Aquatic Animals and Habitat

General Physical Characteristics

The Kalama River originates at Kalama Springs (on the southwest side of Mount St. Helens) and flows for 3.3 miles within the Monument boundaries. It then continues due west to the Columbia River. A few small streams provide direct snow-melt water into the Kalama between Goat Marsh and Kalama Springs; however, the greater portion of Kalama River water arises from springs within the Monument and major tributaries entering outside of the Monument. The Kalama River and its tributary Fossil Creek, are the two main stream systems in the watershed.

Information on aquatic organism populations is lacking. This discussion will focus on the limited aquatic information that is available, which is primarily fish habitat and distribution data. Limiting factors to fish production in the Kalama River appear to be the cold water temperatures, which reduce food production and fish growth rates, and the pumice gravels, which are also not conducive to food production or quality spawning habitat (CMP 1989)

Existing habitat conditions were evaluated using the following aquatic habitat attributes: Pieces of in-channel large woody debris (LWD) per mile, potential recruitment of LWD, primary pools per mile, water temperature, and aquatic habitat fragmentation. A brief discussion of the processes that are affecting the aquatic environment is included at the end of this chapter.

Stream habitat surveys have been completed on approximately 10 miles of stream. Fish currently occupy approximately 11 miles of stream in the watershed (Figure 12). Fish and other aquatic organisms are sensitive to a variety of disturbance factors and have specific habitat requirements for their life stages. The optimum habitat factors for species present in this watershed are displayed in Table 10.

Fish distribution and abundance

Resident fishes within Upper Kalama River Watershed streams include rainbow trout, cutthroat trout, brown trout, and brook trout. No anadromous fish access the Upper Kalama River Basin upstream of the Kalama Falls, an impassable upstream fish barrier (Figure 12).

Two natural lakes are located in this area: Merrill Lake and McBride Lake. Merrill Lake receives a high recreation use and has a developed campground and boat landing on its shores. Merrill

Lake is well known for its fly fishing opportunities. It supports native cutthroat trout, stocked brown trout, brook trout, and rainbow trout. McBride Lake also receives a relatively high recreation use, but access is primarily from trails going down the steep hill from Road 8100. McBride Lake supports stocked brook trout.

Large woody debris

Large woody debris is a critical component of aquatic habitats for a variety of organisms. It influences channel morphology, the storage and routing of sediment, and the amount and complexity of habitat for aquatic organisms (Hicks et. al 1991). Wood is delivered to the stream channel through a variety of mechanisms (i.e., landslides, transport from upstream areas, and direct entry from adjacent sideslopes). Management activities and natural processes alter the effectiveness of these natural delivery mechanisms and the longevity of wood in the system. For example, harvest within the riparian zone reduces the available wood supply for direct entry from adjacent slopes.

The USDA Columbia River Basin Policy Implementation Guide of 1991 (CRBPIG) identified standards for quantities of (LWD) in western Cascade streams to provide quality salmonid habitat. The existing condition identified in stream surveys is evaluated against this standard, to determine a rating of good, fair or poor. Streams in good condition meet or exceed the standard of 80 pieces per mile. Streams in fair condition contain 40-79 pieces of LWD/mile, and streams in poor condition contain less than 40 pieces of LWD per stream mile. Stream survey data indicate, approximately 40 percent of the surveyed streams are rated as poor, approximately 37 percent are rated as fair, and 23 percent are rated as good. Figure 13 shows the stream segment LWD ratings for surveyed streams.

Sub-basins where more than 30 percent of the stream-side riparian areas have been logged are considered to have low potential for LWD recruitment because of the time needed for conifer trees along the streams to mature and grow more dense. The harvest level was determined using USFS GIS data for National Forest lands, and an "ocular estimate of harvest" on other-ownership lands. Figure 14 displays the sub-basins having low potential for LWD recruitment.

Upper Kalama River Fish Distribution

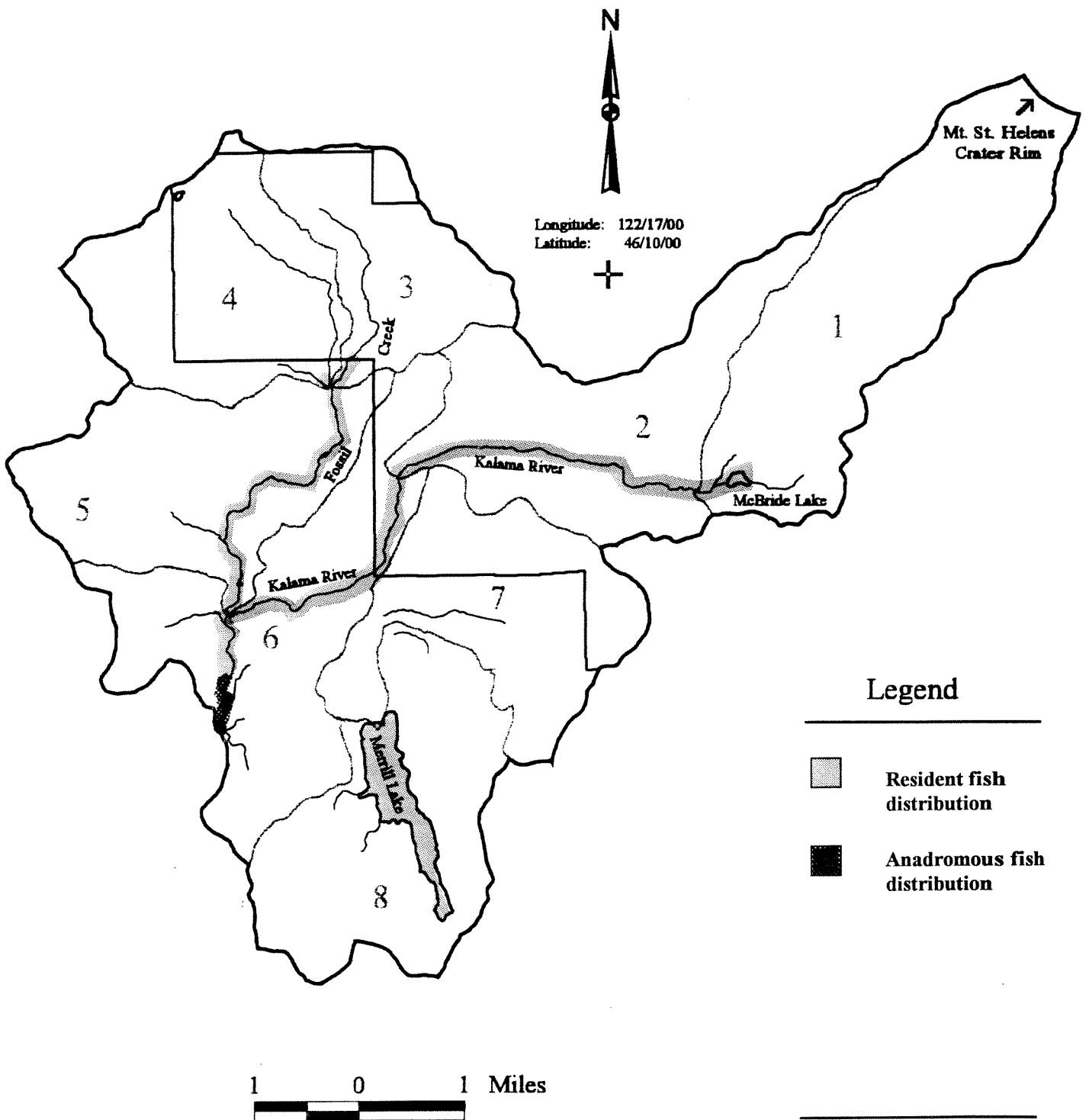


Figure 12. Upper Kalama River Fish distribution. Resident fishes include rainbow trout and cutthroat trout in the streams. McBride Lake has brook trout. Merrill Lake has all of these species and brown trout. Anadromous fishes include winter and summer steelhead and spring chinook.

Table 10. Optimum Habitat Condition Factors for Aquatic Organisms, by life stage

Organism/ Life Stage	Cutthroat Trout	Rainbow Trout	Brook Trout
Distribution	Throughout basin	Throughout basin	McBride Lake
Spawn Season	Spring (Feb.-Mar)	Spring (Feb.-Mar)	Fall (Sept. - Oct.)
Temp	6.1-17.2 C	2.2-20 C	4.5-10 C
Habitat Factors	cover, coldwater, substrate 1.3-10 cm. quantity pools, volume pools	cover, coldwater, substrate 1.3-10 cm	Tied to springs/upwelling
Rear Season	April - January	April - January	Nov. - Aug.
Habitat Factors	Enter substrate in winter for hiding cover, fine sediment deposits decrease populations.	Slow velocities, cover, densities higher in pools, enter substrate in winter for hiding cover. Avg. Max. Weekly Temp 19 C. 25-50 NTU's for 2.5-4.5 days = reduced growth and emigration.	Enter substrate in winter for hiding cover, Avg. Max. Weekly Temp 19 C. 25-50 NTU's for 2.5-4.5 days = reduced growth and emigration
Adult	Year Round	Year Round	Year Round
Habitat Factors	associated with cover, use upper reaches of streams when other spp. present, cold water.	cover, cold water substrate used as cover	LWD cover, cold water, substrate used as cover

Upper Kalama River

Large Woody Debris Ratings by Stream Reach

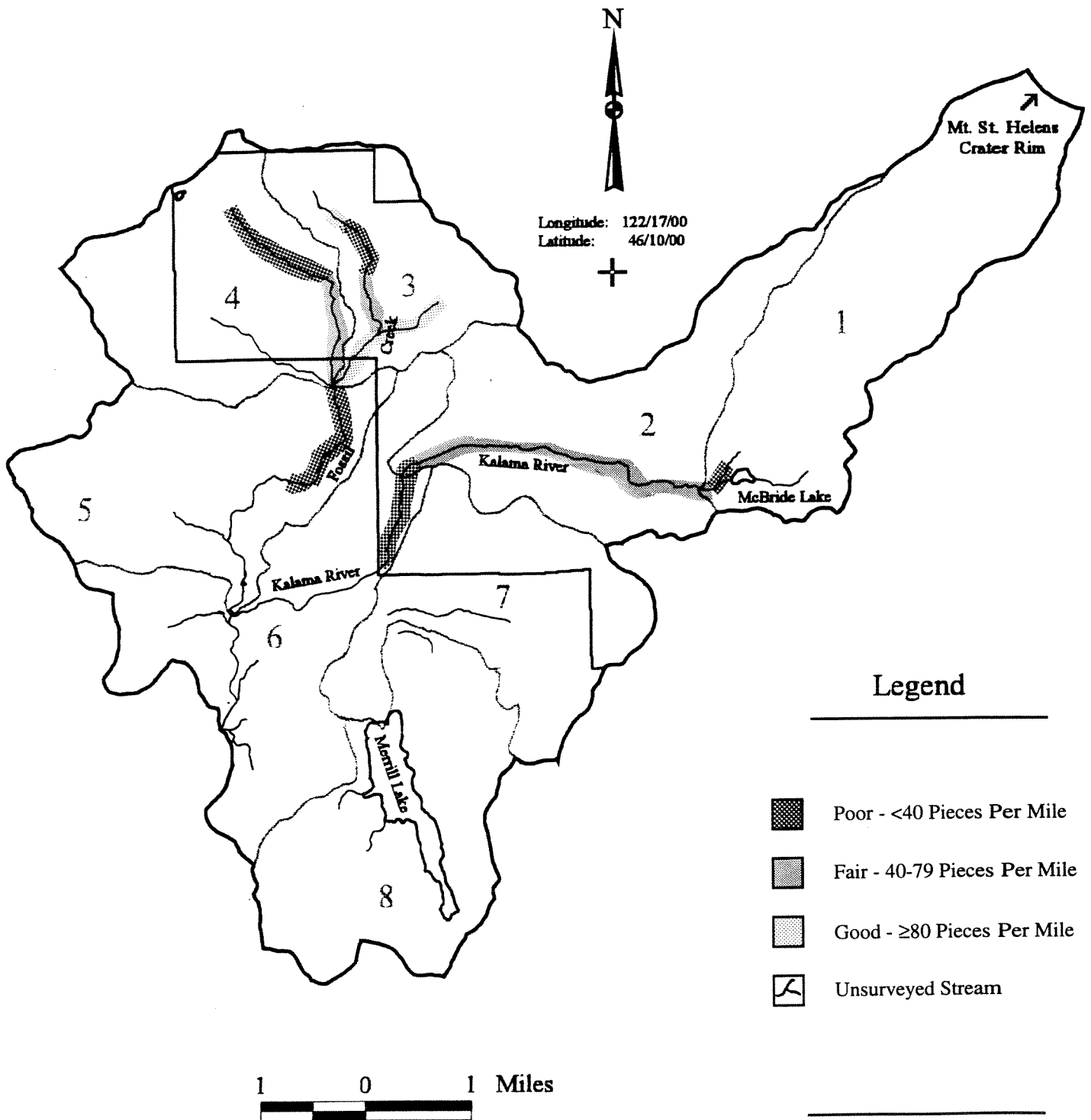


Figure 13. Large Woody Debris (LWD) ratings per mile ratings for surveyed streams in the Upper Kalama River Watershed, 1990.

Upper Kalama River

Large Woody Debris Recruitment Potential

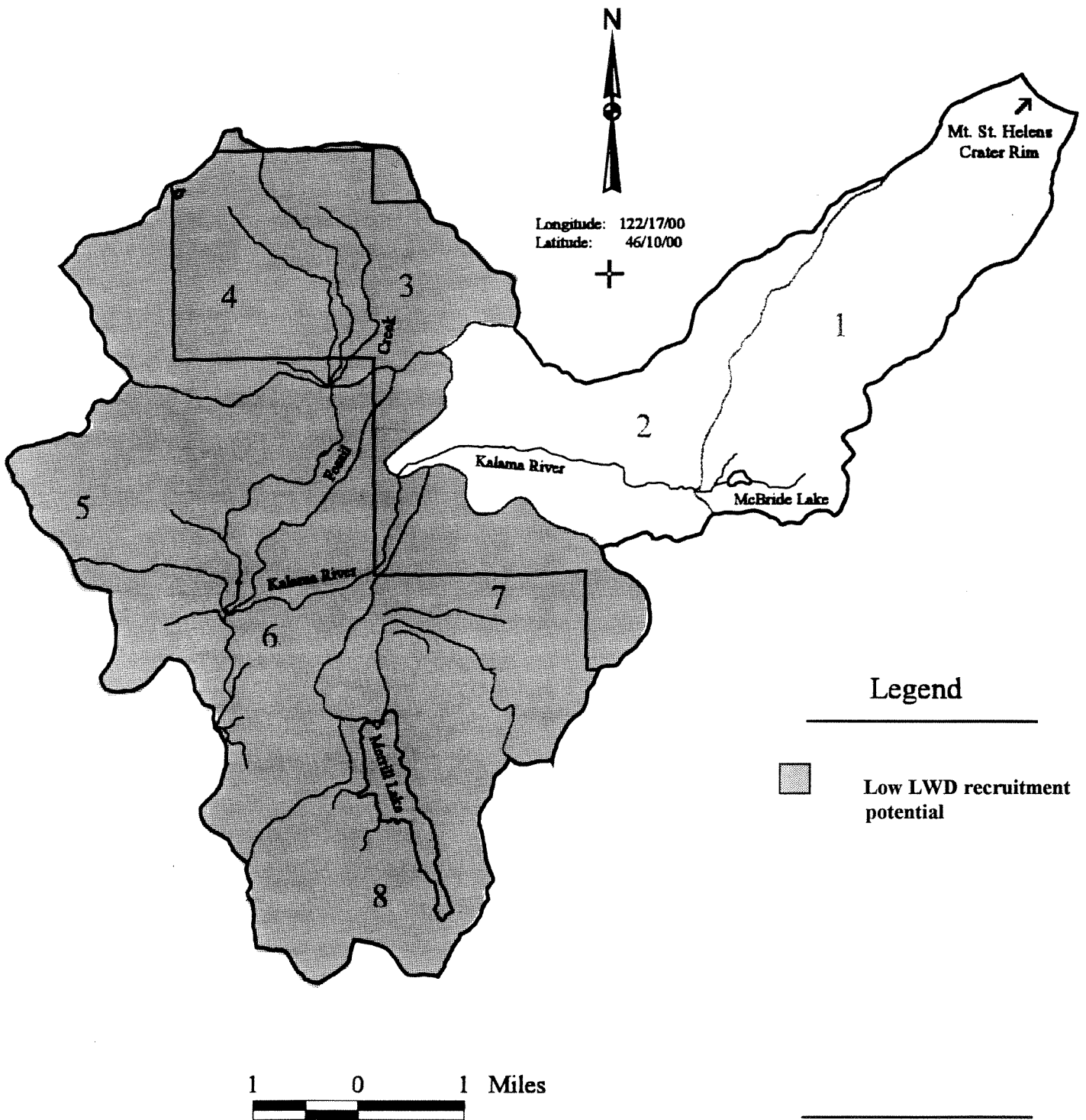


Figure 14. Upper Kalama River Watershed sub-basins classified as having low potential for large woody debris (LWD) recruitment, i.e., greater than 30% of streamside riparian reserve has been harvested.

Primary Pools per Mile

Pools provide thermal refuge for aquatic organisms dependent on cool stream temperatures; protective cover for rearing; and act as holding areas for LWD flowing through the stream system. The quality of habitat formed by pools is based on several factors including: pool depth, stream width, amount of LWD in place, and the complexity of sub-habitats within the pool. The number of pools increases as the stream size decreases. Channel morphology influences where pools are formed in the stream channel, and determines the hydraulic controls that create the pools.

The CRBPIG establishes standards for quantities of pools per mile in streams, based on stream width, to provide quality salmonid habitat. The "existing condition" (identified in stream surveys) is evaluated against this standard to determine a rating of good, fair or poor. Streams in good condition meet or exceed the quantity of pools; streams in fair condition contain 50-99 percent of the desired number of pools; and streams in poor condition contain fewer than 50 percent of the desired pools per mile. Stream survey data indicate, approximately 61 percent of the surveyed streams are rated as poor, and approximately 39 percent are rated as fair (Figure 15).

Upper Kalama River

Primary Pools per Mile of Stream

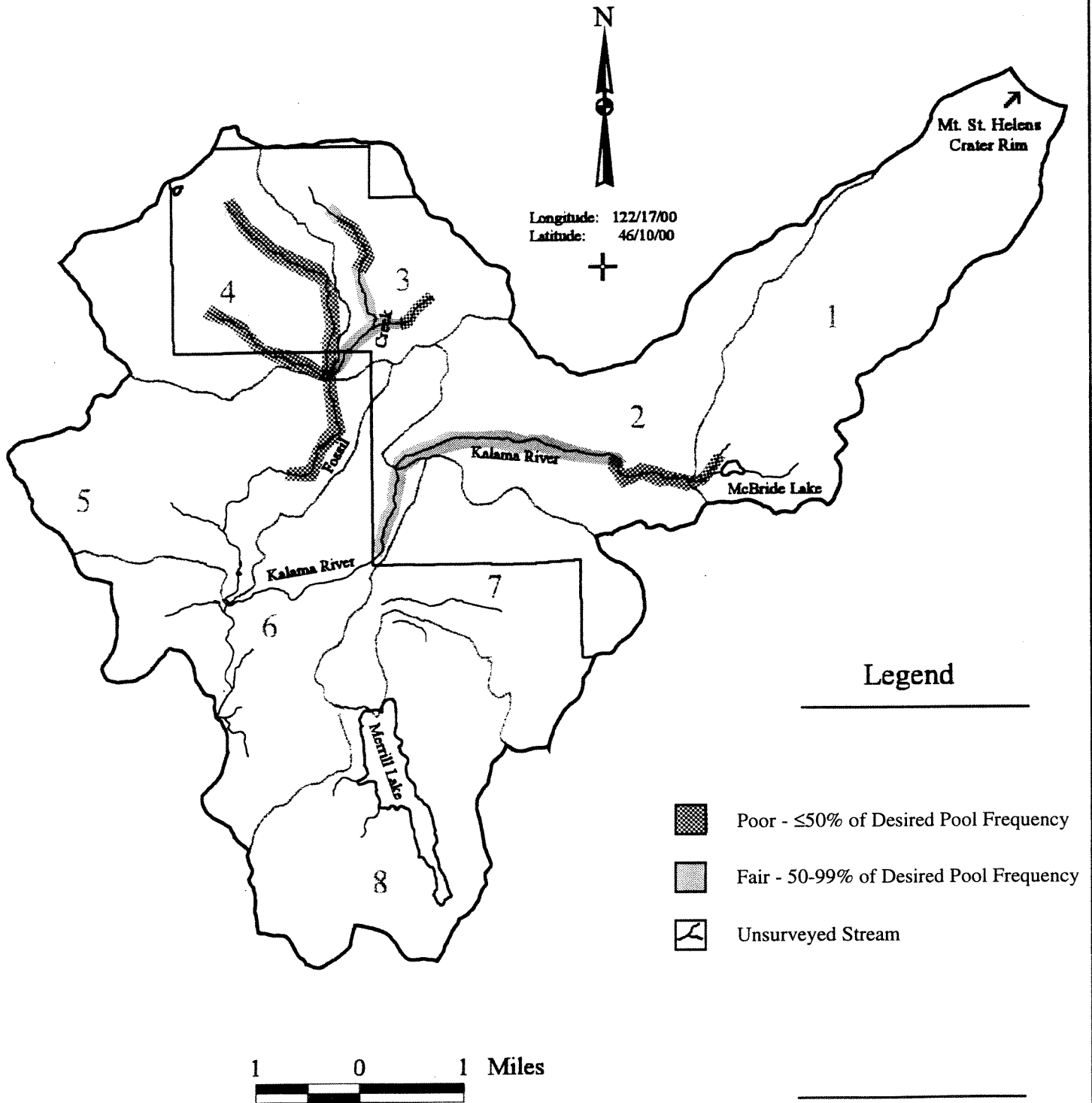


Figure 15. Primary pools per mile ratings for streams surveyed through 1990 in the Upper Kalama River Watershed.

Upper Kalama River Roads and Streams

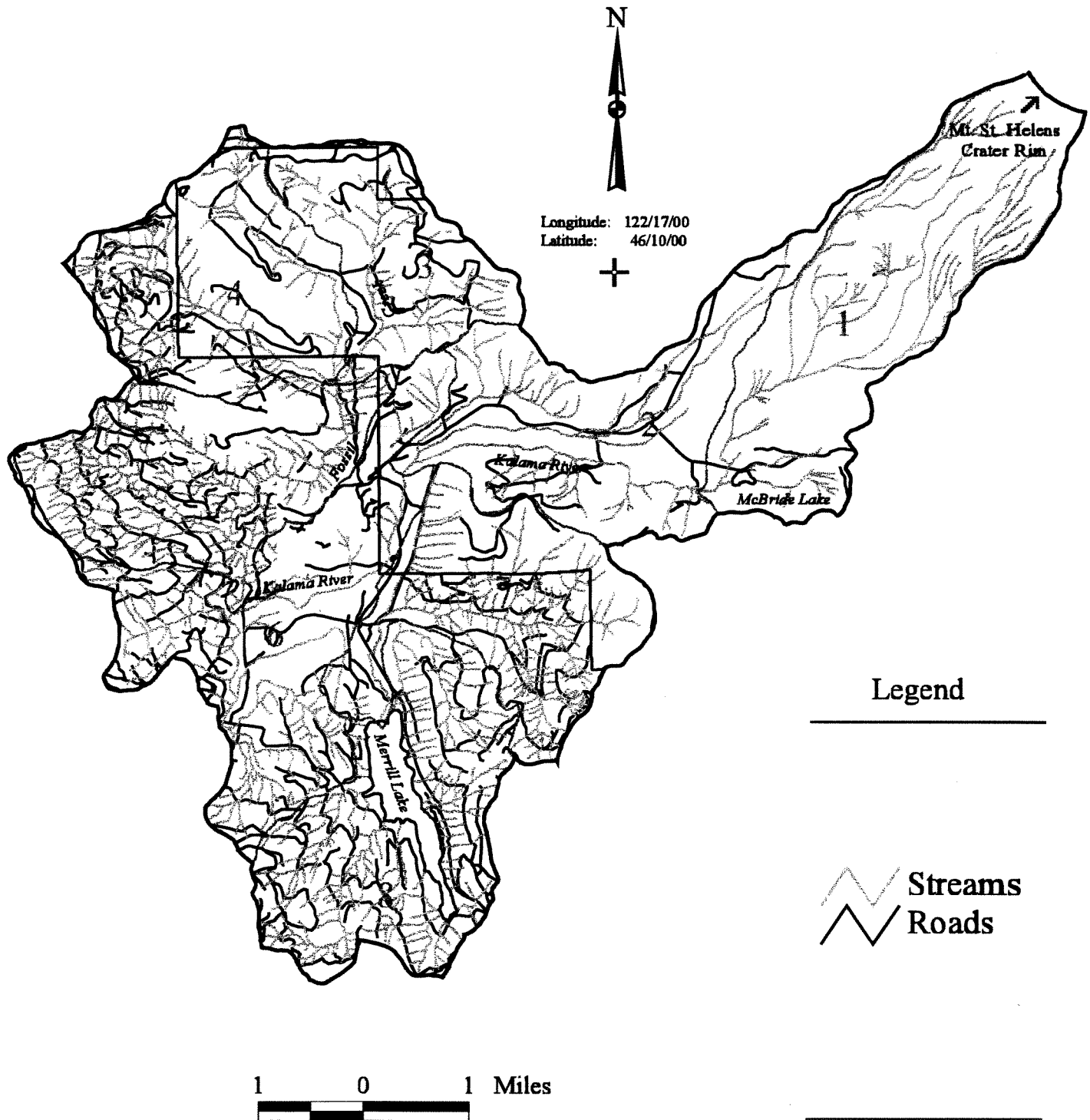


Figure 16. Display of where the road network crosses Class I - IV streams in the Upper Kalama River Watershed. Stream crossings are shown as "light lines" bisecting the road network.

Stream Temperature

Stream water temperature is a major factor influencing the composition and productivity of aquatic ecosystems. Fish, aquatic macro-invertebrates, and other aquatic organisms are affected directly and indirectly by changes in water temperatures. Specifically for salmonids, stream temperature influences the timing of migration, spawning, incubation rates, growth, distribution, resistance to parasites, food supply and quality, and tolerances to diseases and pollutants (Bjornn and Reiser 1991). Aquatic organisms are often able to withstand short term increases in stream temperature, and adjust by locating optimum habitat within the channel. Long term changes or peaks in water temperature may directly alter the established patterns of the salmonid populations.

No 303 (d) water quality impaired stream segments within the analysis area, are presently identified on the Washington State 303 (d) list. However, 10 miles of the lower portion of the river (outside the analysis area) has been identified as water quality limited due to water temperature. Water temperature monitoring data for the analysis area are very limited. One station on the Kalama River, above Fossil Creek's confluence, had one sample that was 4.7 degrees C. Grab samples from past stream surveys range from 4 - 8 degrees C for the Kalama River, 10 degrees C for the West Fork of Fossil Creek, 8 - 14 degrees C for the East Fork Fossil Creek, and 14 - 23 degrees C on the Main Fork of Fossil Creek. This indicates stream temperature concerns for Fossil Creek.

Roads

Roads have been identified as an important factor in the decline of fish populations. Culverts that do not pass fish, and/or other road crossings that alter the flow of LWD and sediment through the system fragment the aquatic system. Roads and culverts can not only block upstream migration of resident fish, they can alter the flow pattern of LWD through the system, and increase sediment input (Furniss et. al. 1991). Figure 15 displays a map of the road network and Class 1-4 streams. The number of stream crossings in each sub-basin range from 7 to 161. There are a total of 687 stream crossings within the Upper Kalama River Watershed (Table 11).

Upper Kalama River

Road Densities Greater Than 3 mi./sq.mi.

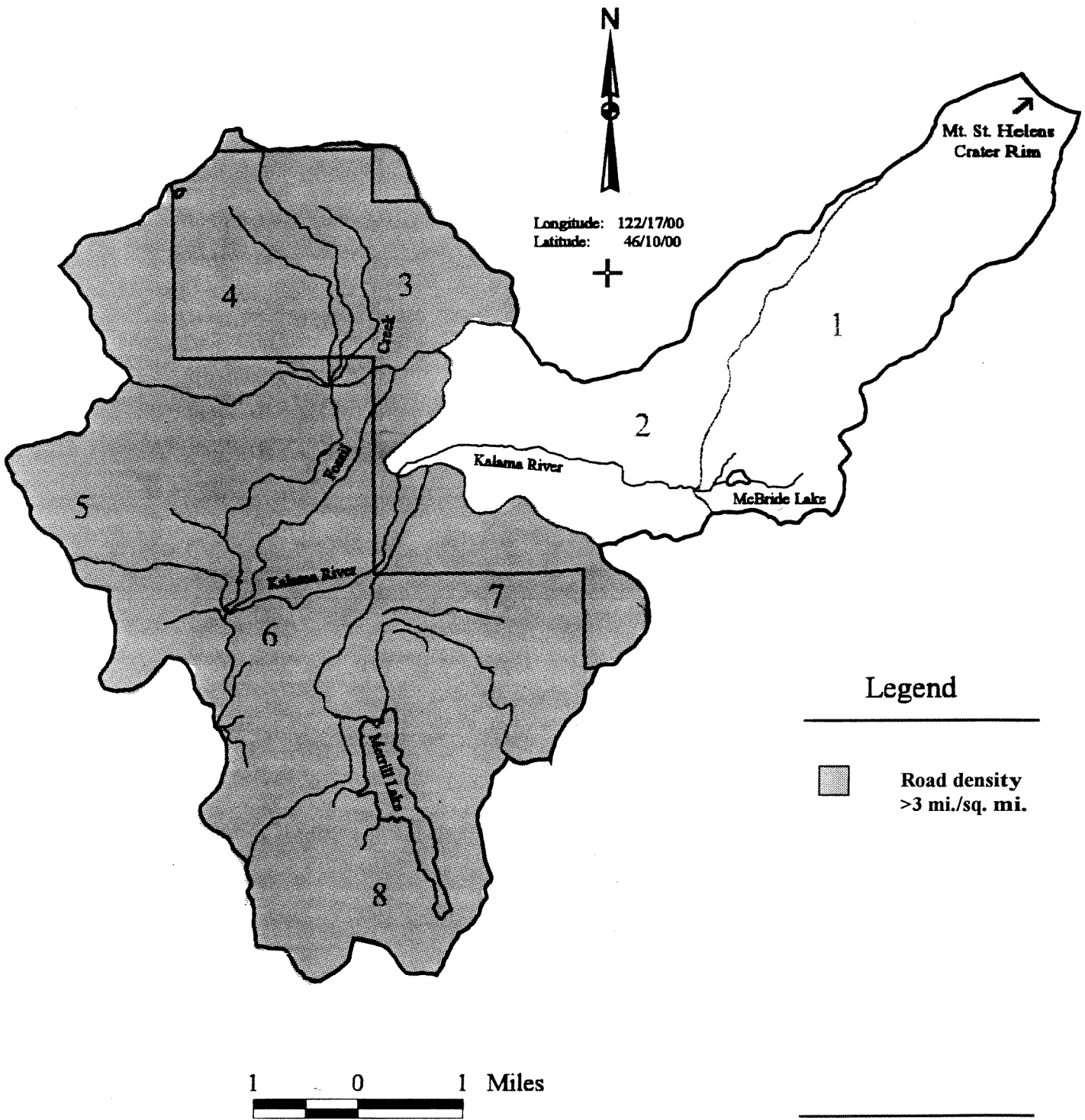


Figure 17. Upper Kalama River Watershed sub-basins with road densities greater than 3.0 miles/square mile.

Table 11. Upper Kalama River Watershed Road Densities, Number of Stream Crossings, and Number of Stream Crossings per Mile of Stream by Sub-Basin.

Sub-Basin	Road Densities (mi./sq. mi.)	Number of Stream Crossings	Number of Road Crossings per Mile of Stream
1	0.4	7	.2
2	2.5	32	1.3
3	4.6	29	1.8
4	5.2	107	3.7
5	5.5	147	3.1
6	5.1	79	2.2
7	5.0	125	3.5
8	5.6	161	3.9
Total	4.0	687	2.7

Road densities within a sub-basin that exceed 3.0 miles per square mile of area are viewed as “red flags” and indicate where road related problems are most likely to occur. This value is based on several years of observations by Gifford Pinchot National Forest hydrologists and fishery biologists. Currently the average road density in the entire watershed is 4.06 miles per square mile. Individual sub-basins road densities range from 0.38 up to 5.62 miles per square mile (Table 11. Road Densities, etc.). Figure 17 highlights those sub-basins that exceed 3.0 miles per square mile.

Riparian reserve aquatic habitat is adversely affected by each instance where a road crosses a stream. The flow of fish, LWD, and sediment can be interrupted, i.e. the habitat becomes fragmented. The degree of this fragmentation/impact can be gauged (and sub-basins can be compared) by the number of road/stream crossings per mile of stream length. High sub-basin aquatic habitat fragmentation values, defined as greater than 1.5 road/stream crossings per stream mile (see the Upper Lewis River, Middle Lewis River and the Upper East Fork Lewis River Watershed analyses), are highlighted in Table 12. Also, see Figure 18.

Table 12. Riparian Reserve Aquatic Habitat Fragmentation (Road/Stream Crossings per Mile of Stream) for Watersheds Within the Lewis River Basin and the Upper Kalama River Watershed.

Watershed	Average of All Sub-basins	Maximum Value in One Sub-basin
Upper Lewis River	0.8	1.8
Middle Lewis River	1.3	3.1
Upper East Fork Lewis River	1.1	2.1
Lower Lewis River	1.7	4.2
Upper Kalama River	2.6	3.9

Sub-basins within the highest one-third of the Upper Kalama River Watershed values (i.e., greater than 2.6 stream road-crossings/mile of stream) are also highlighted in Figure 18. This indicates these sub-basins have received the most intense degree of habitat fragmentation caused by roads. Sub-basin 8 has the highest value: 3.9 crossings/mile of stream. This drainage (3374 acres) with only 41.7 miles of stream has 161 stream road-crossings

Upper Kalama River

Sub-basins That are Highly Fragmented

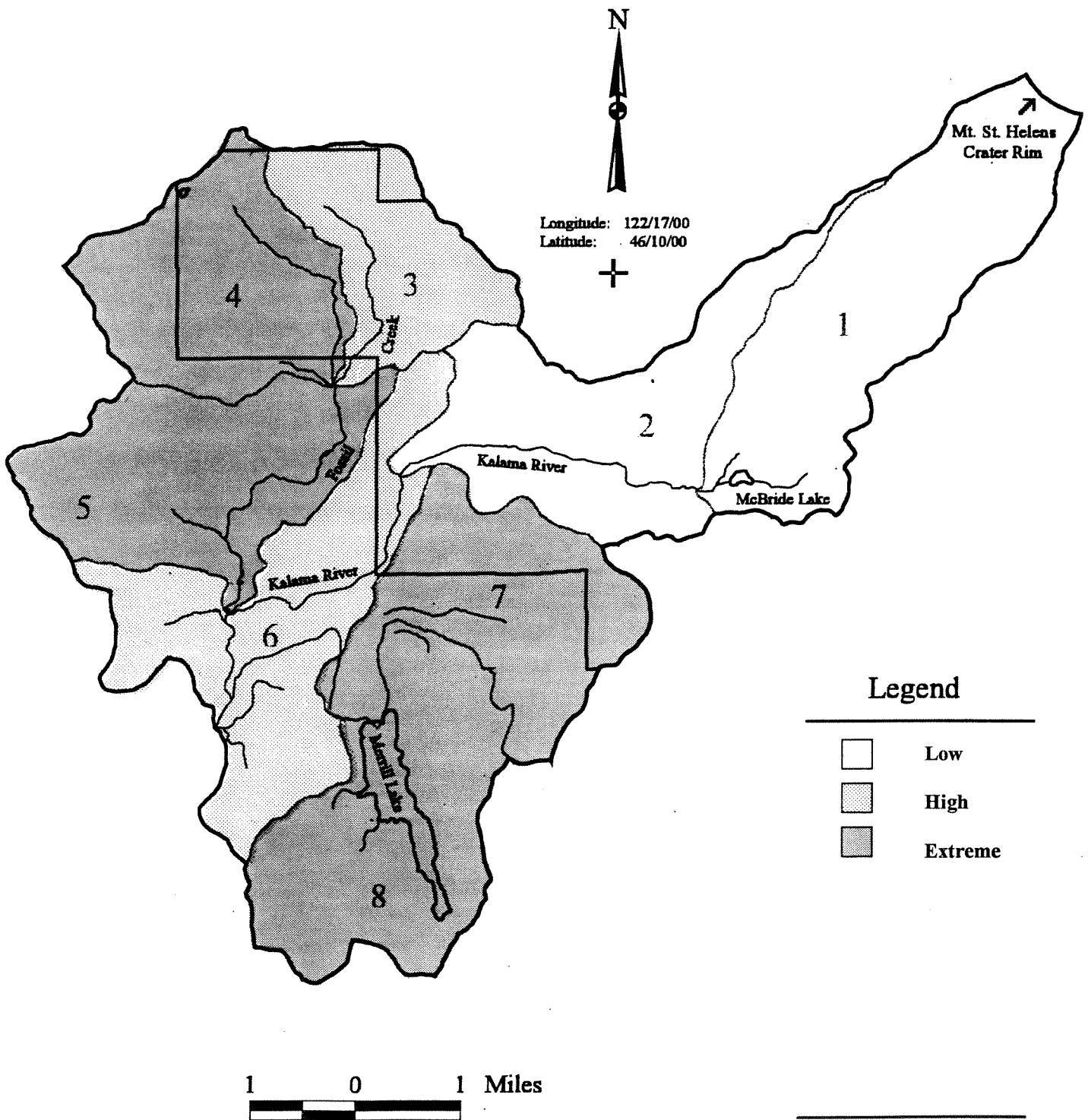


Figure 18. Upper Kalama River Watershed sub-basin stream fragmentation values. Low is less than or equal to 1.5 crossings/stream mile. High is greater than 1.5 road crossings/stream mile. Extreme is greater than 2.6 road crossings/stream mile (these sub-basins are within the upper 1/3 of stream fragmentation values for the Watershed).

Sediment

Increased levels of sediment can adversely affect fish habitat and riparian ecosystems. Spawning gravels can be filled in by fine sediment, reducing survival of eggs and developing small salmonids (Everest et al. 1987); food availability can be reduced (Cordone and Kelley 1961), and an important habitat such as pools may be filled in by excess sediment (Megahan 1982).

Stream channels can be classified as either erosion, transport, or response type reaches depending on their physical condition. The majority of stream channels in the analysis area are characterized as "erosion" reaches. Erosion-type channels usually have relatively steep gradients and are actively downcutting at various rates due to underlying geology and other physical characteristics. They are also travel paths for upslope mass wasting events (debris torrent areas). Some channels with more gentle gradients can be defined as erosional reaches if they have high rates of bankcutting. Transport reaches, on the other hand, have moderate gradients and are less confined than erosion-type channels. Both erosional and transport channels tend to move "input variables" such as wood, water, and sediment through relatively quickly; the majority of the Upper Kalama stream system is classified as erosion reaches (Figure 19).

A few stream channels in the analysis area are characterized as "response reaches". They have low gradients and are less confined sections that tend to be more sensitive to changes in the amounts of these input variables. Consequently, these response reaches tend to degrade easier and take longer to recover from disturbances than the erosion and transport reaches. Figure 20 shows the location of response reaches.

Refer to the discussion of geologic processes for potential sources of sediment input in the analysis area.

Erosion-Transport-Response Reaches

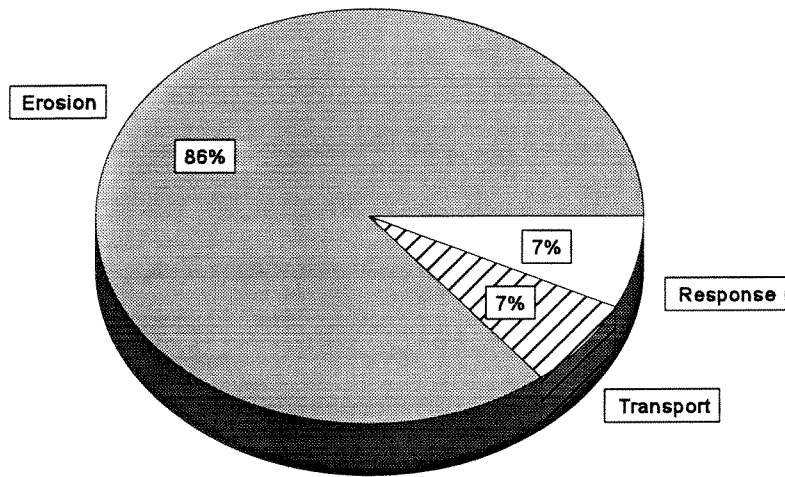


Figure 19 - Percent of stream reaches that were classified as either erosion, transport, or response.

Upper Kalama River Response Reaches

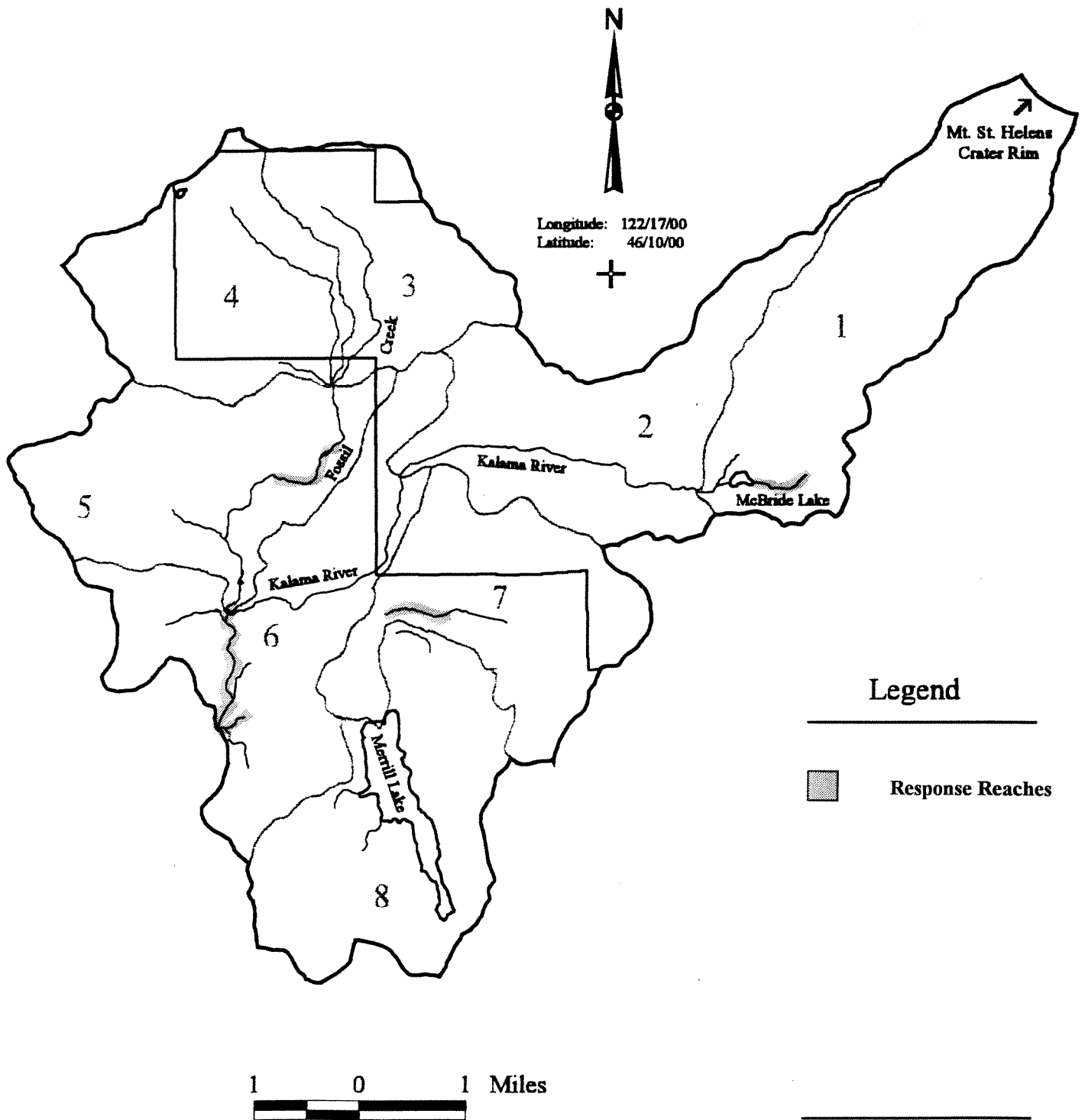


Figure 20. Stream response reaches (low gradient streams that are sensitive to inputs of wood, water and sediment) in the Upper Kalama Watershed.

Recreation Use

Most visitors to the Kalama River Watershed are seeking recreational opportunities. The northeast portion of the watershed is dominated by Mount St. Helens, which is crossed by a network of summer and winter trails. The watershed is popular for snowmobiling, cross country skiing, horse riding, and hiking. The Kalama River, McBride Lake, and Merrill Lake are popular destinations for anglers. In the late summer and fall, the dominant use becomes hunting. Washington State game regulations establish hunting requirements and the type of arms allowed during different hunting periods. Camping opportunities are provided at the Kalama Horse Camp, Merrill Lake Campground (DNR), and a large number of dispersed camp sites, found principally along Roads 81 and 8123.

Mountain climbers use the Redrock Pass Trailhead for access to the southwest side of Mount St. Helens. Climbers find climbing from Butte Camp provides a less crowded route to the summit and provides more solitude than the popular Monitor Ridge Route. Climbing above the 4800 foot level is limited to 100 climbers per day between May 15 and November 1. Climbing is not limited when winter snow cover protects alpine vegetation.

The Kalama Horse Camp (Figure 21) provides eight camp sites suitable for a single truck and horse trailer, and two group sites where several vehicles with trailers can be parked. Also present are corrals, bins for depositing horse manure, stock water, and restrooms. The site is popular and filled to capacity most summer weekends. When the campground is full, use spreads to nearby dispersed camp sites along Road 81.

The Kalama Horse Camp also acts as a trailhead for 25 miles of horse trail. The area was designated for horse use in the Mount St. Helens Comprehensive Management Plan and has trails that were developed for that use. The area provides one of the most accessible and popular riding areas in southwest Washington (Figure 1, page 3). Two additional trails are under consideration, a loop trail on Cinnamon Peak and an extension of the Sheep Canyon trail to the west of Goat Mountain. These new trails will provide dispersal of horse riders and additional loop opportunities. Local equestrian clubs have taken a strong interest in the Kalama Horse Camp and adjacent trail network, providing volunteer assistance in construction and maintenance of facilities. During summer weekends campground hosts monitor campground use and provide assistance to visitors. Each spring volunteers log out and maintain trails.

Merrill Lake Campground provides developed camping opportunity and fishing access to Merrill Lake. This popular destination is located on State of Washington lands managed by the Department of Natural Resources. The facility was severely damaged by a landslide and flooding during February of 1996. The DNR plans to reopen the facility following restoration.

Dispersed camping in the watershed is very popular with 56 sites identified on national forest lands (Figure 21). An additional 20 sites were recently closed on private land in the vicinity of Kalama Falls creating additional camping pressure on national forest lands. Camping at dispersed

sites begins on weekends in early spring and continues through hunting season. Winter snow normally blocks camping access in mid December.

Dispersed camp sites have grown in number and size since the 1970's. Merging of camp sites along Road 81 have created several linear camping areas. In an attempt to access camp sites, campers have driven vehicles off Roads 81 and 8123. Many primitive roads have been generated from this activity, one over 600 feet long. None of the dispersed camp sites have restrooms, leading to accumulations of human waste in their vicinity. At one camp site, near a small stream, human waste was found within four feet of the water. At most camp sites there are few terrain features to limit camp site expansion leading to an ever increasing number of sites. Expansion occurs mostly during hunting season when all existing sites are occupied and hunters are forced into new areas.

Goat Marsh Research Natural Area (Figure 21) lies on the northern fringe of the watershed. This specially designated area was established to preserve a unique Cascade Mountains habitat for research and scientific study. The RNA is open to hunting and fishing, but closed to horse and motorized use. Access to the area is from Road 8123 on Goat Marsh Trail 237A.

Skiing and snowmobiling are popular winter activities. Roads 81, 8123, 8127, and Blue Horse Trail 237 are designated snowmobile routes. The Kalama Ski Trail 231 leads from the Cougar Sno-Park 11 miles to its western terminus in the Kalama Horse Camp. Winter access is from the Cougar Sno-Park, or lower Road 81. Road 81 has not been plowed for winter recreation since 1989, when all plowing effort was transferred to sno-parks on Road 83. Since that time demand for winter access has increased beyond parking capacity. The Kalama Horse Camp requires only resumption in snow plowing to become an additional sno-park. Currently winter recreationists drive up Road 81 until snow prevents further progress to unload snowmobiles or strike off on skis. Deep ruts in snow often make it difficult for visitors to turn around, leading to traffic jams and stuck vehicles.

Roads in the watershed were constructed for logging purposes, but are now used almost exclusively for recreation access. Road 81 is paved to a point two miles east of the Kalama Horse Camp. Traffic counters indicate 28,888 vehicles traveled the paved portion of Road 81 in 1995. During the summer, when Road 81 is free of snow, about 57 percent of all vehicles continued east, passing McBride Lake. Heavy traffic loads during the snow-free season rapidly degrade the gravel surface, causing pot-holes and washboard conditions. In dry weather, dust reduces the sight distance between vehicles and settles on vegetation along the road right-of-way. Much of the road lacks surface rock suitable for grading, making road maintenance difficult.

Upper Kalama River Recreation Facilities

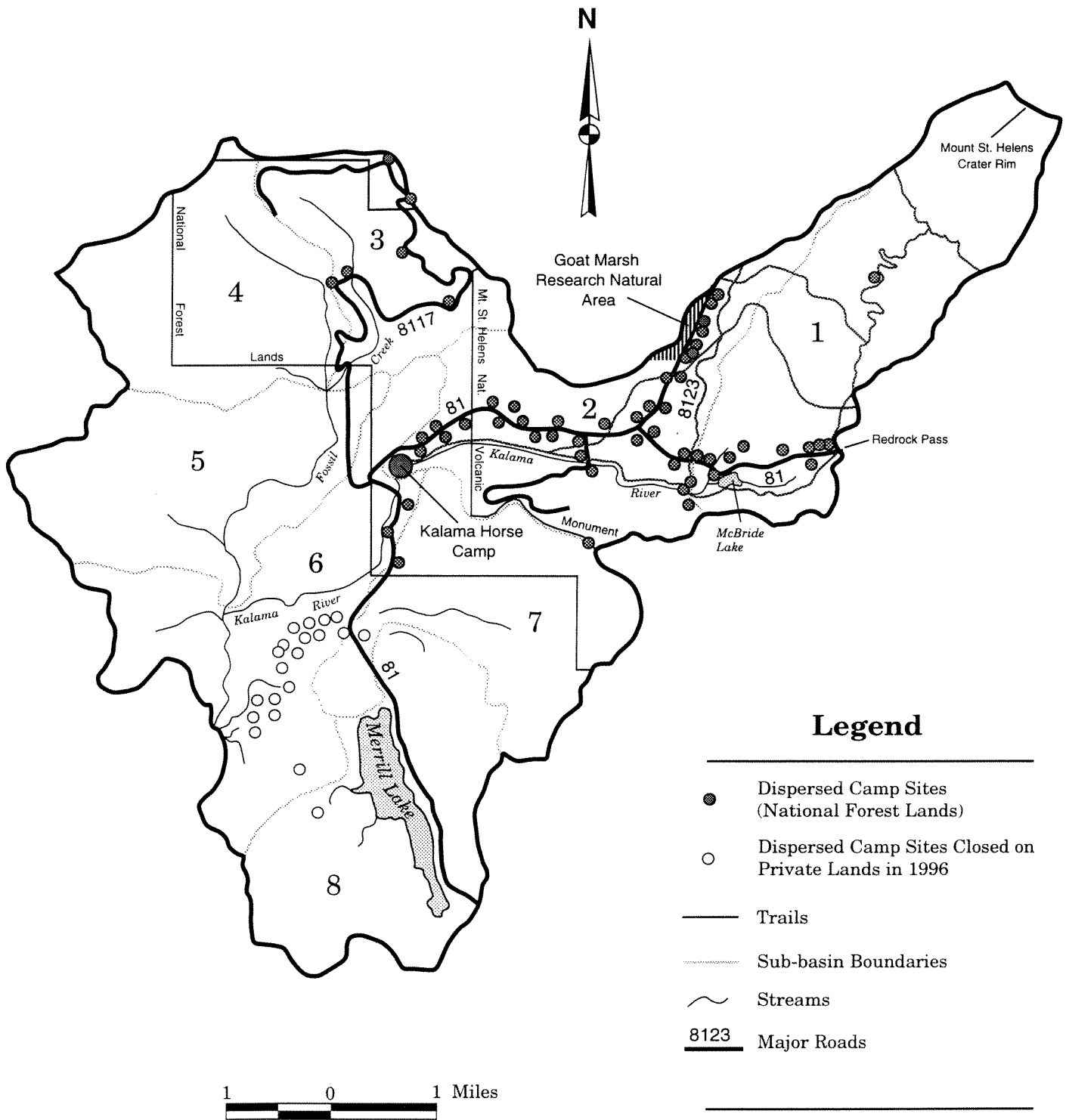


Figure 21. Recreation use is concentrated along Roads 81, 8123, and 8117. A network of 25 miles of horse, hiker, and ski trails is found in Sub-basins 1 and 2. The Kalama Horse Camp is a trailhead for the Kalama Trail.

CHAPTER IV REFERENCE CONDITIONS

This chapter explains how the existing conditions from Chapter III have changed over time as a result of human influence and natural disturbances. The following paragraphs describe the known or inferred history of the landscape so we may know what was sustainable in the past and what changes have occurred to affect sustainability.

Geology and Physical Processes

Mass wasting

Volcanic and glacial activity in the Upper Kalama River Watershed have been major processes in forming the landscape as we see it today. Folding, faulting, wind and water have also influenced the shape of the land. The watershed is continually changing through natural means as well as management activity that has occurred since humans have been in the area. Much of the geology has been dated to 10 to 30 million years of age. It consists of interbedded materials of basalt/andesite with pyroclastic flows. Most of the watershed's large deep-seated landslides have occurred in the past in the areas of pyroclastic flows and near the margins of the basalts and pyroclastic materials. There is still evidence of movement in these areas today.

Surface erosion

Natural conditions leading to relatively high rates of surface erosion during storms include (1) eruptive deposits from volcanic activity, and (2) high intensity burns that consume vegetation leaving bare slopes. No quantitative information is available about the amounts of sediment these processes created. It can be assumed, however, that management activities (particularly logging and road building) have probably increased the amount of sediment moving to streams above the "natural" levels. This is evident from the heavy damage which occurred during recent storm events in the watershed.

Vegetation

According to REAP (Diaz & Apostol 1992), the Lewis River Basin was historically covered with broad continuous conifer stands of varying age classes. Large-scale disturbances resulted from fire and the eruption of Mount St. Helens about every 200 years. These continuous stands were characterized by diverse species composition and diverse structure, including older remnant live trees, standing dead trees, and downed logs. Wetlands and other special habitats were scattered across the landscape.

The REAP document estimates that in the Lewis River Basin, late-successional vegetation covered between 45 and 70 percent, and early to mid-successional vegetation covered

between 8 and 18 percent of the area. Because the Upper Kalama River watershed encompasses some of Mount St. Helens' "blast-zone", historical amounts of late-successional vegetation were probably less than other areas which are within the Lewis River Basin. If the assumption is made that the stands that are presently 0 to 40 years old were late successional at the time of harvest, historical levels of late-successional vegetation would have been about 55 percent, which is at the lower end of the REAP's 45 to 70 percent estimate.

Habitat Condition for Animal Species

Historically, animal habitats in the watershed included a variety of timber age classes that occurred in large blocks that were the result of large scale volcanic activity and stand replacing fires. The different age class stands would have occurred in large blocks that provided more interior habitat than what exists today. Early- and mid-successional stands likely contained remnants of the previous stand, including large old live trees, large snags and down logs in various decay stages.

This vegetation pattern would have favored interior species over edge species, especially those with large home ranges. Species such as elk, black-tailed deer, and great horned owl would probably have been less common, while species such as spotted owl, northern flying squirrel and northern goshawk would have been more common.

It is likely that riparian areas burned less often than surrounding uplands, or fires there were normally cooler ground fires that did not kill many of the overstory trees. Because of this, riparian areas in the watershed could have functioned as corridors through younger age class stands for species dependent on mature forest.

Old-growth habitat that existed on what is today privately-owned land, played an important function in maintaining species that require this habitat across the landscape. Most old growth on private land is now gone and is not likely to be replaced, so this type of habitat on the National Forest is especially important.

Road construction in the watershed occurred after the turn of the century. Before that time, the watershed was not as easily accessible, and habitat conditions would have been much more favorable for species sensitive to human disturbance and for small animals that will not readily cross roads.

Hydrologic Changes

The 1996 floods were associated with rain-on-snow precipitation events. Since volcanic eruption occurred at relatively frequent intervals in the Upper Kalama portion of the Kalama River Basin,

one could logically infer that more than five percent of the Upper Kalama was in a disturbed state at any one time.

Road construction, as a contributor to peak flow increases, was not a factor prior to the 1930's.

Aquatic Animals and Habitat

Historical aquatic habitat and population information in the watershed is poorly documented. The distribution of resident fish may have been altered by road construction.

No reference information is available for the number of pieces of LWD per mile. A 1967 district report recommended the removal of "debris" from 40 different sites in Fossil Creek. It also recommended clearcutting to the stream channel and removing all large cull material from the "steep side slopes adjacent to the stream channel and placed in a more stable location". Given these types of past management activities, and the natural decay of LWD pieces, we can assume that the reference condition for pieces of LWD was higher than present day conditions.

It is unknown if the CRBPIG standards are appropriate for this watershed.

Sediment

Stream channels have been subjected to a natural disturbance regime consisting of floods and repeated volcanic eruption. This has led to channels that probably have had a high frequency of disturbance. Due to the underlying geology, these channels are also very sensitive to disturbances and slow to recover from them.

Stream temperature

Past stream temperature information in this watershed is lacking. Since the Upper Kalama River is spring fed, it can be inferred that this system has maintained consistently low stream temperatures for some time. It can be assumed that water temperature increases for other streams in the area probably coincided with the loss of riparian vegetation associated with large floods and volcanic eruption.

Human Dimension

Even though the Kalama River Watershed has had a long period of human use (mostly prehistoric) most human-caused environmental changes have occurred since 1940. Since that time, logging and associated road building have become dominant processes in the landscape. Intense logging of privately-owned and National Forest System lands has created a patchwork of even-aged stands and an extensive network of logging roads. These roads provide recreational

access where previously only trails existed.

The eruption of Mount St. Helens on May 18, 1980 marked another change in the northeast portion of the watershed. The eruption destroyed the Kalama Spring Campground, and severely damaged the Butte Camp and Kalama Trails. All recreation facilities in the watershed were either destroyed or rendered unusable. Following the establishment of the Mount St. Helens National Volcanic Monument in August of 1982, a management plan for the monument was developed. The plan directed construction of the Kalama Horse Camp and a system of winter and summer trails.

Hunting and camping have continued to grow in popularity, particularly since the establishment of the national monument. Dispersed camping has generated 56 camp sites along roads in the watershed, created principally as hunting camps. They are also used by summer visitors.

With the establishment of the Mount St. Helens National Volcanic Monument, the eastern portion of the watershed is no longer affected by timber harvest. Logged areas are regrowing at a rapid rate, hiding evidence of timber harvest in the 1960's and early 1970's.

CHAPTER V INTERPRETATION. V-1

Section 1. Dominant Processes. V-1

Section 2. Interpretation. V-4

Mass Wasting. V-5

Erosional Processes. V-7

Stream Riparian Reserve Fragmentation and Riparian Habitat. V-9

Habitat for Threatened, Endangered, and Sensitive Plants and C-3 Species. . . V-11

Habitat for TES Animal Species. V-13

Hydrologic Change. V-18

Key Habitat Attributes for Salmonids. V-20

Recreation Use. V-25

Section 3. Synthesis. V-29

Anticipated Social or Demographic Changes or Trends. V-34



CHAPTER V INTERPRETATION

Chapter V compares the existing, historical, and reference conditions of specific ecosystem elements by explaining significant differences, similarities, or trends and their causes. The capability of the system to achieve key management plan objectives is also explored. The chapter is divided into three sections,

- **Dominant Processes**
- **Interpretation**
- **Synthesis**

In Section 1, **Dominant Processes**, the principal processes that have shaped the watershed's ecosystem at the landscape level are briefly described.

In Section 2, **Interpretation**, the issues, such as mass wasting, surface erosion from roads, etc., are each addressed in turn. The comparisons, explanations, and discussions for each issue are presented in a similar series of paragraphs and tables to enable the reader to follow the logic of the analysis.

In Section 3, **Synthesis**, different parts of the analysis are integrated. Using the material detailed in the paragraphs and tables in Section 2, the team began integrating this information spatially, i.e. displaying which sub-basins were of concern and correlating relationships between sub-basins across the watershed. This integration and synthesis is portrayed in an explanation, a table of information, and a map. Through this analysis, sub-basins having more than one ecological concern are readily apparent. Also, the various linkages between, and flows of, elements within the ecosystem can be viewed spatially. These displays of data, information, and interpretations form the basis for recommendations which are detailed in Chapter VI.

Section 1 Dominant Processes

During the analysis of current and reference conditions in the watershed, and the identification of issues and key questions for geology and physical processes, vegetation, wildlife, hydrology, fisheries, and the human component, various processes that have shaped the watershed became obvious. These processes were both natural and human induced. The processes that shaped the watershed at the landscape level are described below.

Because of the complexity of ecological systems, the interrelatedness of all ecosystem components, the scale at which the analyses were performed, and the limitations of humans to accurately identify key biotic and abiotic processes that influence an ecosystem, it is unlikely that all processes were necessarily identified. The following list serves as a starting point for future analyses. To minimize redundancy, the tables and paragraphs in Section 2 will reference these process descriptions.

Volcanic and Seismic Activity

Volcanic and seismic activity in the watershed have been occurring for millions of years with a concentration of events in the last 40,000 years around Mount St. Helens. This activity continues with the most noteworthy occurrence being the eruption of Mount St. Helens in 1980. This event demonstrated that volcanic activity can be devastating to the landscape with effects lasting for many years afterward. Loss of vegetation, loss of wildlife and increases in sediment movement from tephra deposits all have lasting effects on the future of the watershed. This activity can also induce further effects such as an increase in human activities.

Erosion

The erosion processes in the watershed are controlled by such factors as slope, water, soil type and what kind of management activities have occurred in the area. The main erosion concern is effects associated with road construction. During large storm events a noticeable increase in erosion rates is indicated by the greater amounts of sediment in streams. Several sites within the watershed have shown increases in erosion during large storm events, for example, the rain-on-snow event of February, 1996. Erosion will be a continual process even if all human activity were to stop. Management activity will only increase the amount of sediment transport to streams but with better management practices this amount may be kept at a minimal amount.

Roading

Roading in this area has extended the stream channel network through roads and ditch lines along roads. These features may increase peak flows through road cut slope interception of subsurface flow and routing it to surface waters using road ditch lines as "pseudo channels". Some culverts do not allow fish passage resulting in fragmentation of fish habitat. Roads and culverts can block not only upstream migration of resident fish, they can alter the flow pattern of large woody debris through the system and increase sediment input (Furniss et al. 1991). Poor road construction practices can result in a wide spectrum of effects: from increased surface erosion (especially during wet weather use) to massive road failures. All lead to increased sedimentation to streams.

Fire

Wildfires are not known to have played a major role in modifying vegetation in this watershed, However, it is possible that present-day timber stands which are 80 - 160 years old originated on burned-over land.

Timber Management

Intensive timber harvesting in this watershed began in the 1940's and has continued through the last four decades. The objective of timber management on both federal and non-federal lands was

to increase conifer growth by clearcutting slow growing, older stands and replacing them with fast growing, young conifers. Harvest units on federal lands tended to be smaller than non-federal harvest areas and were usually dispersed in relatively small patches across the watershed. Subsequent reforestation and stand tending operations were implemented with the objective of increasing the growth of conifer species.

Peak Flow Increases

Peak flow increases during fall and winter storms occur as a result of vegetation removal (fire or timber harvest), road cuts intercepting subsurface flow, and surface waters being routed through road ditch lines. The result is increased erosion and therefore an increased sediment load going into streams during high peak flows. Altering the natural flow regime of sub-surface waters may also decrease summer low flows, with negative consequences for water dwelling organisms, e.g., fish and amphibians.

Flooding

Flooding can modify both upslope and aquatic terrain through initiation of landslides and removal, transport, and deposition of wood, water and sediment. In the case of debris torrents, floods can remove much of the channel complexity (LWD, sediment) and transport it to other reaches in a stream. This will simplify some sections of stream while making other sections more complex. This may influence success of some beneficial uses such as fish by altering use patterns. Flooding can also increase bank erosion and sediment introduction in general. Floods may also damage structures such as campgrounds and roads, thus altering use patterns. Flooding can also be very beneficial by adding LWD that is stored in small tributaries to main channels as well as adding gravels for spawning and rearing.

Recreation Activities

The close proximity of this area to large population centers and the ease of access attract large numbers of visitors. Principal among these are horse riding, camping, hunting, and mountain climbing. The establishment of the Mount St. Helens National Volcanic Monument in 1982, following the cataclysmic volcanic eruptions of 1980, brought world-wide, as well as local attention to the area. Visitor facilities have been built at the Kalama Horse Camp and a large network of horse/hiking trails established. Recreational use in the area has approximately doubled since 1980, placing heavy demand on existing camping facilities. This has manifested itself in the establishment of dispersed camp sites along Roads 81 and 8123. Increases in recreational use threaten to impact the Goat Marsh Research Natural Area, an area established for scientific study.

Section 2 Interpretation

The following pages provide a systematic interpretation of the eleven issues that were analyzed in this iteration of the Upper Kalama River watershed analysis. This interpretation is presented one issue at a time, each led off by a summary paragraph. Then, in a table format, the current conditions are compared to the reference conditions, and the dominant processes and significant trends or rates of change are identified. The existing management objectives and the desired future conditions from current management plans are compared to the current conditions. This array of information, along with the synthesis which immediately follows, sets the stage for the recommendations detailed in Chapter VI.

Issue No. 1: MASS WASTING

Summary

Most of the landslides in the watershed are naturally occurring. Some slides (the shallow rapid torrents and flows) have been activated by management activities and are typified by the damage done to the Fossil Creek drainage during the floods of February, 1996. Future landslides in the watershed are very probable in that there are many soils susceptible to sliding as well as steep slopes. There is also the potential for existing landslides to continue to move and possibly increase due to management activities.

Components of Issue	Locations	Current Conditions Compared to Reference Conditions	Dominant Processes	Significant Trends Or Rates of Change
Harvest Techniques	Throughout watershed	Clear cutting has removed vegetation which has increased groundwater levels which in turn will increase potential for movement of the ground on steep slopes	Peak flow increases	Has been a definite increase since harvesting has taken place.
Soils	Throughout watershed	Soils probably have not changed from reference conditions	Silts and clay soils on steep slopes	No change
Water	Throughout watershed	Changes in precipitation over time may increase movement of the ground	Rain and groundwater levels	Increase in movement in years where there is a higher amount of rainfall.

Issue No. 1: MASS WASTING (Continued)

Components of Issue	Existing Management Objectives and Desired Future Conditions	Current Conditions Compared to Management Objectives & Desired Future Conditions
Fire	Current management objectives are to suppress fire in the watershed which would increase the amount of vegetation.	
Harvest Techniques	Harvest is going from clearcutting to harvest with some of the existing stands being retained. Also areas of unstable and potentially unstable ground are being placed in riparian reserve.	Leaving vegetation in potentially unstable ground should create a more natural regime in the movement of landslides.

Issue No. 2: EROSIONAL PROCESSES

Summary

Road construction has had a tendency to increase sediment into streams over the past century. Most of this increase occurs in the first 2 to 5 years following construction or until an increase in vegetation on the fills and cuts reduces soil movement. The amount of sediment attributable to roading depends on many variables which makes it difficult to quantify the amount of sediment eroding from any portion of the road. These quantified numbers are based on some data in the basin and on interpretation of data from similar roads that have survey data available. These numbers show a low to moderate amount of sediment being transported from the roads to streams compared to other areas on the forest.

Volcanic activity from Mount St. Helens has had a major impact on the area from about 40,000 years ago up to the present. Volcanic activity has occurred in cycles of about 150 years over the past 2000 to 4000 years. This can easily change the landscape as shown by the 1980 eruption. Mud flows not only remove any thing in their path initially, but over long periods of time have a tendency to be very erosive prolonging the time needed for vegetation re-establishment on steeper slopes.

Component of Issue	Locations	Current Conditions Compared to Reference Conditions	Dominant Processes	Significant Trends Or Rates of Change
Roading	Sub-basins 4,5,8	Increased roading has increased sediment input to streams	Poor road construction practices Side cast of waste material High use of roads Wet weather use Non-cohesive soils Surfacing types	Increase in erosion

Component of Issue	Locations	Current Conditions Compared to Reference Conditions	Dominant Processes	Significant Trends Or Rates of Change
Volcanic	Sub-basins 1,2,8	Volcanic activity in the watershed is similar to reference conditions. We are currently in a period of volcanic activity.	Mud flows Tephra eruptions	Potential increase in erosion.
Glacial	Sub-basin 1	Glaciers are not present but may have been when the mountain was taller.		

Issue No 2: EROSIONAL PROCESSES (Continued)

Components of Issue	Existing Management Objectives and Desired Future Conditions	Current Conditions Compared to Management Objectives & Desired Future Conditions
Roading	For each existing or planned road, meet the Aquatic Conservation Strategy. ROD C32 & B11 Minimize sediment delivery to streams from roads. ROD C33	Existing roads need to be evaluated for their capability to introduce sediment into the stream system. New construction would follow the Aquatic Conservation Strategies for road management
Fire	Current management objectives are to suppress fire in the basin which would keep erosion at a low rate.	

Issue No. 3: STREAM RIPARIAN RESERVE FRAGMENTATION AND RIPARIAN HABITAT

Summary

Stream Riparian Reserve vegetation composition and structure are below the historic range of variability. The coniferous and hardwood components are lacking in many areas, structural diversity is low, and riparian functions are impaired. Stream Riparian Reserves are intended to provide important habitats and ecosystem functions within areas having high levels of timber harvest. Sub-basins with greater than 30 percent of the Stream Riparian Reserves harvested are identified as areas especially vulnerable to impaired ecological functioning; sub-basins with a high proportion of non-Federal land ownership are also vulnerable. Stream Riparian Reserve restoration and enhancement opportunities exist in many areas within the matrix.

Components of Issue	Locations	Current Conditions Compared to Reference Conditions	Dominant Processes	Significant Trends Or Rates of Change
Reduced Structural Diversity	Sub-basins 3, 4, 5, 6, and 7	There is more early-successional and less late-successional vegetation structure than was present historically.	Timber Harvest Volcanism	It could take many decades before historic conditions are restored.
Impaired Functional Roles of Stream Riparian Ecosystems	Sub-basins 3, 4, 5, 6, and 7	Because of reduced structural diversity; some stream riparian ecosystem functions are impaired.	Timber Harvest Volcanism	It may be a century or more before some historic functional roles are restored, especially large woody debris input.

Issue No. 3: STREAM RIPARIAN RESERVE FRAGMENTATION AND RIPARIAN HABITAT (Continued)

Components of Issue	Existing Management Objectives and Desired Future Conditions	Current Conditions Compared to Management Objectives & Desired Future Conditions
Reduced Structural Diversity	Restoration and maintenance of environmental quality are of critical importance. ¹	Structural diversity is below desired future conditions.
Impaired Functional Roles of Stream Riparian Ecosystems	The interrelationship of all components of the natural environment are recognized. ² “Survey and manage” standard and guideline will provide benefit to vascular plants, lichens, bryophytes, and fungi. ³	Some ecological roles are impaired, are not meeting management objectives, and are below desired future conditions.

¹ National Environmental Policy

² GPNF Forest Plan, Amendment 11, 2-74

³ ROD p. 5

Issue No. 4: HABITAT FOR THREATENED, ENDANGERED, AND SENSITIVE PLANTS AND C-3 SPECIES

Summary

Many TES plants and C3 plants, lichens, mosses and fungi are associated with specific habitats such as stream and wetland riparian areas and late-successional stands. Because all sub-basins have less than 40 percent in late-successional stands, habitat for some TES plants and C3 plants, lichens, mosses and fungi has probably decreased. This could adversely impact population viability and dispersal processes for some species. Land management activities within sub-basins with a high proportion of non-Federally owned lands could also adversely impact population viabilities. Conditions caused by the on-Forest floods during February 1996 were not included in this portion of the analysis.

Components of Issue	Locations	Current Conditions Compared to Reference Conditions	Dominant Processes	Significant Trends Or Rates of Change
Reduced Late-Successional Habitat	All sub-basins	These sub-basins have less than 40 percent late-successional vegetation, which is below the REAP (Diaz & Apostle 1992) estimate.	Timber Harvest Volcanism	It may take many decades to return to historic conditions.
Reduced Stream Riparian Reserve Habitat	All sub-basins	All sub-basins have at least 44 percent of their vegetation classified in early seral-stages.	Timber Harvest	It may take many decades to return to historic conditions.
Population Viability and Dispersal Capabilities	All sub-basins	Late-successional and stream riparian conditions are below historic conditions.	Timber Harvest	It may take many decades to return to historic conditions.

Issue No. 4: HABITAT FOR THREATENED, ENDANGERED, AND SENSITIVE PLANTS AND C-3 SPECIES (Continued)

Components of Issue	Existing Management Objectives and Desired Future Conditions	Current Conditions Compared to Management Objectives & Desired Future Conditions
Reduced Late Successional Habitat	Restoration and maintenance of environmental quality are of critical importance. ¹	Current amounts of late successional habitat are below desired future conditions.
Reduced Stream Riparian Reserve Habitat	Sustainability of all the Forests' natural resources, including the species that inhabit them, will be provided for by management. ²	Natural stream riparian reserve conditions are below desired future conditions.
Population Viability and Dispersal Capabilities	Sustainability of all the Forests' natural resources, including the species that inhabit them, will be provided for by management. ² Research activities may be ongoing and proposed in all land allocations. ³	Data are lacking to document population viability and dispersal capabilities for some species. Other species, particularly wetland and riparian dependent species, will benefit as riparian structure and functions are resumed.

¹ National Environmental Policy

² NFP ROD p. 5

³ GPNF Forest Plan, Amendment 11, 2-53

Issue No. 5: HABITAT FOR THREATENED, ENDANGERED, AND SENSITIVE ANIMAL SPECIES

Summary

The watershed contains habitat for several species listed as threatened, endangered, or sensitive. Habitat conditions for bald eagles in the watershed are discussed in the Lower Lewis Watershed Analysis. Approximately 9 percent of the elk and deer winter range in the watershed is optimal thermal cover. A majority of the suitable spotted owl habitat in the watershed is contained within management allocations that allow timber harvest. The stream riparian reserves in the watershed are heavily fragmented, affecting ability of old growth dependent species and amphibians to disperse.

Components of Issue	Locations	Current Conditions Compared to Reference Conditions	Dominant Processes	Significant Trends Or Rates of Change
Conditions for species requiring late-successional habitat.	Watershed-wide.	Amount of late-successional habitat less than reference conditions. (Approximately 19% compared to 45% - 70% historically). Existing late-successional habitat is more fragmented than historical conditions. Snag density in the watershed is lower than reference.	Timber harvest.	It may take many decades to return to historic conditions.
Conditions for species requiring seclusion from human disturbance (low road density).	Watershed-wide.	The road density is higher than reference conditions, and human use of the watershed is significantly higher.	Road construction for timber harvest.	Under the Northwest Forest Plan the trend is toward a reduction in road density through watershed restoration projects.

Components of Issue	Locations	Current Conditions Compared to Reference Conditions	Dominant Processes	Significant Trends Or Rates of Change
Conditions for Peregrine Falcon.	Potential eyrie sites at Butte Camp Dome, and Goat Mountain.	Recreational use within the vicinity of the potential eyrie sites is much higher than reference conditions; possibly affecting the suitability of the sites	Recreation Activities.	Increased visitor use can be expected with the growth of the Vancouver and Portland metro areas.
Conditions for aquatic amphibian species.	Stream Riparian Reserves.	Fragmentation of the Riparian Reserves through road building and timber harvest has left the habitat more fragmented than reference conditions.	Timber harvest and road construction.	Slow trend to development of more large tree habitat in Riparian Reserves through forest succession. Riparian Reserves will be protected under the ROD.
Conditions for Townsend's big-eared bat.	A maternity colony in the watershed.	The maternity colony is in an area that has been heavily harvested, and foraging habitat has been reduced.	Road building has improved access. Timber harvest has reduced foraging habitat.	Because the maternity colony is surrounded by young stands, additional disturbance is not likely for many years.
Conditions for Larch Mountain Salamander.	Forested talus areas.	Large scale clearcutting has reduced suitability of potential habitat.	Timber Management.	Surveys required in the ROD for this species will help to minimize impacts to this species from timber harvest.

Components of Issue	Locations	Current Conditions Compared to Reference Conditions	Dominant Processes	Significant Trends Or Rates of Change
Conditions for Mountain Quail.	Forest with a well-developed shrubby understory near meadows and bodies of water (e.g., Goat Mountain, Butte Camp Dome, and McBride Lake).	The increase in the number of sapling/pole/small-tree stands in the watershed, has led to a decrease in the amount of habitat with a well-developed shrubby understory.	Timber Management	A slow trend towards improved habitat, as early-seral stands in the Riparian Reserves mature.

Issue No. 5: HABITAT FOR TES ANIMAL SPECIES (continued)

Components of Issue	Existing Management Objectives and Desired Future Conditions	Current Conditions Compared to Management Objectives & Desired Future Conditions
Conditions for species requiring late-successional habitat.	Landscape areas where little late-successional forest persists should be managed to retain late-successional patches. This standard and guideline will be applied in 5th field watersheds in which federal forest lands are currently comprised of 15% or less late-successional forest.	Currently, about 18% of the watershed is late-successional habitat, and 18% of the Stream Riparian Reserves is Late-Successional habitat. The amount of Late-Successional habitat in Riparian Reserves is not sufficient for them to function as corridors as intended in the ROD.
Conditions for species requiring seclusion from human disturbance.	Roads not required for resource use, protection, or some other demonstrated access need should be closed or decommissioned.	There are opportunities to decommission roads as part of watershed restoration.
Conditions for Peregrine Falcon	The Endangered Species Act warrants returning a federally listed species into recovery status.	If these sites are deemed to be suitable nesting cliffs, existing and new recreation activities may warrant a seasonal restriction.
Conditions for aquatic amphibian species.	Standards and guidelines in the Forest Plan prohibit and regulate activities in Riparian Reserves that retard or prevent attainment of Aquatic Conservation Strategy.	Currently, about 58 percent of the stream riparian reserves is early to mid-seral habitat. Riparian Reserves will be identified in the watershed and managed to protect and enhance habitat.
Conditions for Townsend's big-eared bat.	Forest Service policy is to ensure that species listed as "sensitive" do not become listed as threatened or endangered.	The known maternity colony will be protected in future project planning.

Components of Issue	Existing Management Objectives and Desired Future Conditions	Current Conditions Compared to Management Objectives & Desired Future Conditions
Conditions for Larch Mountain salamander	Forest Service policy is to ensure that species listed as “sensitive” do not become listed as threatened or endangered.	Surveys for this species will be conducted in the watershed to determine its presence and distribution. Surveys will be conducted on potentially affected sites before ground-disturbing activities.

Issue No. 6: HYDROLOGIC CHANGE

Summary

In general, sub-basins within the analysis area are recovering from timber harvest. Analysis found that 75 percent of the sub-basins in the area have increased peak flows of 10 percent or greater, due to removal of the mature conifer vegetation component by fires and timber harvest. It should be noted that the vegetation condition for all the non-National Forest Land was estimated from a review of ortho-photos. Roading has also contributed to the situation by increasing stream lengths in the watershed by 49 percent, thus contributing more surface water to streams.

Components of Issue	Locations	Current Conditions Compared to Reference Conditions	Dominant Processes	Significant Trends Or Rates of Change
Peak Flow Increase - Vegetation Related	Sub-basins 3,4,5,6,7,8	25% of the watershed in early successional stands currently compared to 8 to 18% (USDA, 1993) of the watershed historically.	Fire and timber harvest	Recovering as large conifers return to the sub-basins.
Peak Flow Increase - Road Related	Sub-basins 4,5,6,7,8	Approximately 395 miles of stream channel currently compared to 265 miles historically.	Road systems have increased the length of stream channels	Number of miles increasing due to increasing road miles.

Issue No. 6: HYDROLOGIC CHANGE (Continued)

Components of Issue	Existing Management Objectives and Desired Future Conditions	Current Conditions Compared to Management Objectives & Desired Future Conditions
Peak Flow Increase - Vegetation Related	<p>The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.¹</p> <p>The distribution of land use activities, such as timber harvest or roads, must minimize increases in peak flows.²</p>	Current condition is not consistent with management objectives for sub-basins mentioned in previous table.
Peak Flow Increase - Road Related	See Above	Current condition compared to management objectives is unknown due to lack of knowledge about the amount of increased peak flow, if any, resulting from roading.

¹ ROD B11

² ROD B9

Issue No. 7: KEY HABITAT ATTRIBUTES FOR SALMONIDS

Summary

Components of salmonid habitat in the Upper Kalama River Watershed are affected by the following natural and human induced processes: fire, harvest/management activities, and road construction.. Each of these processes has influenced the condition of habitat in the watershed.

Riparian harvest and LWD removal from stream channels has resulted in a limited supply of large woody debris that is available to the stream channel. Lack of LWD in the channels could be contributing to a lack of pools in the channels as well, which results in a lack of quality habitat for the salmonid species that use this watershed.

Road construction resulted in loss of available habitat when fish were not provided adequate passage facilities through culverts. Roads constructed on native surfaces also deliver additional sediment to the stream channels that can alter in-channel conditions decreasing quality habitat (i.e., filling in pools, silting in spawning beds, etc.).

The following information is provided for each component of salmonid key habitat attributes addressed in this watershed analysis: locations (each stream and sub-basin is listed where the habitat attribute is below desired management objectives), current conditions compared to reference conditions, what the dominant processes are affecting the attribute, and how the attribute is changing (or expected to change with current management policies).

Components of Issue	Locations	Current Conditions Compared to Reference Conditions	Dominant Processes	Significant Trends Or Rates of Change
In-Channel Large Woody Debris (LWD)	Sub-basins 2,3,4,5	Below natural levels due to management activities and fire regime	Past harvest activity in riparian areas and removal of LWD from stream channels	LWD increasing as ROD is implemented and riparian areas continue to mature into a late successional forest

Components of Issue	Locations	Current Conditions Compared to Reference Conditions	Dominant Processes	Significant Trends Or Rates of Change
Large Woody Debris Recruitment Potential	Sub-basins: 3,4,5,6,7,8	Outside the range of natural condition identified by the CRBPIG	Past harvest activity in riparian areas	Maintaining/ Increasing LWD potential as ROD is implemented and riparian areas continue to mature into a late successional forest
Primary Pools Per Mile	2,3,4,5	Outside range of natural variability as identified by REAP 1993	Fire Erosion Lack of LWD	Maintaining/ Increasing pools as ROD is implemented and riparian areas continue to mature into a late successional forest
Stream Temperature	Sub-basin 5	Exceeds State Water Quality Standard	Exposed channels due to fire regimes, timber harvest, and roadbuilding	Temperature decreasing as canopies develop and mature with implementation of riparian reserves

Components of Issue	Locations	Current Conditions Compared to Reference Conditions	Dominant Processes	Significant Trends Or Rates of Change
Aquatic Habitat Fragmentation	Sub-basins: 3,4,5,6,7,8	<p>Fragmentation has increased due to road building</p> <p>Flow of LWD thru system has decreased</p>	<p>Road building without fish passage</p> <p>Road Maintenance removes LWD at crossings</p>	<p>Fragmentation is decreasing as ROD is implemented, and roads are decommissioned, and culverts replaced</p> <p>Maintain/Slight increase of LWD</p>
Sediment	4, 5, 8	Chronic input of fine sediment now compared to episodic input of fine sediment in the past.	Surface erosion from roads.	Unchanged to slight recovery.

Issue No. 7: KEY HABITAT ATTRIBUTES FOR SALMONIDS
(Continued)

Components of Issue	Existing Management Objectives and Desired Future Conditions	Current Conditions Compared to Management Objectives & Desired Future Conditions
In-Channel Large Woody Debris	> 80 pieces per mile that are > 50' long and 24" DBH (Columbia River Policy Implementation Guide)	Of the total length of surveyed streams, 40 percent are outside the management objectives (i.e., have a poor rating).
Large Woody Debris Recruitment Potential	Aquatic Conservation Strategy Objectives (ROD B-11)	Riparian areas not currently supplying amounts and distributions of LWD sufficient to sustain physical complexity and stability.
Stream Temperature	Stream Temperatures shall not exceed 16°C due to human activities (Water Quality Standards for Waters of the State of Washington)	Stream water temperature is outside management objectives for the main fork of Fossil Creek.
Primary Pools Per Mile	The number of pools per mile are established by the CRBPIG and relate to the average wetted width of the channel (CRBPIG)	Of the total length of surveyed streams, 61 percent is outside the management objectives (i.e., have a poor rating).
Aquatic Habitat Fragmentation	Provide and maintain fish passage at all road crossings of existing and potential fish-bearing (ROD S&G's C-33) New stream crossings on fish-bearing streams should be designed to allow fish passage (GPNF Forest Plan)	Some existing culverts do not provide fish passage, these are not meeting management objectives.

Components of Issue	Existing Management Objectives and Desired Future Conditions	Current Conditions Compared to Management Objectives & Desired Future Conditions
Sediment	Existing beneficial uses shall be maintained and protected, and no further degradation which would interfere with or become injurious to existing beneficial uses will be allowed	Current sediment levels are high due to roads.

Issues 8, 9, 10, and 11: RECREATION USE

Summary

Recreation use in the Kalama Watershed has nearly doubled since the establishment of the Mount St. Helens National Volcanic Monument in 1982. This increase is seen by the number of new dispersed camp sites and the demand for horse camping at the Kalama Horse Camp. A network of 25 miles of horse trails disperses users from the Horse Camp, one of the most accessible riding areas in Southwest Washington. Traffic levels in excess of road design standards create visual and environmental impacts along Roads 81 and 8123. High traffic flow makes it difficult to maintain the unpaved portion of Road 81. Rough road conditions, combined with dust and sediment laden road runoff create impacts in visual and water quality, and on public safety.

The Goat Marsh RNA was established for scientific study but is receiving some impact from recreational use. This use is presently at low levels, but may be impacting resources that the area was designated to protect. Over time, these impacts may increase, necessitating action to halt or maintain impacts at an acceptable level.

The Kalama Ski Trail terminates at the Kalama Horse Camp. The Road 81 snowmobile route passes the site. The demand for winter recreation has increased on the Monument since 1989, when the Road 81 was last plowed for winter access. The Mount St. Helens Winter Recreation Area (mostly along Road 83) is now the most popular skiing and snowmobiling destination in Southwest Washington. Demand for parking exceeds capacity on most weekends. The Kalama Horse Camp parking lot was designed to allow snow plowing, and function as a sno-park. The area would need to be added to the Washington State Parks and Recreation Commission sno-park program to receive funds for snow plowing.

Components of Issue	Locations	Current Conditions Compared to Reference Conditions	Dominant Processes	Significant Trends or Rates of Change
Dispersed Camping	Sub-basins 1,2,3,4	Doubling of the number of sites since establishment of Mount St. Helens National Volcanic Monument.	Increased recreational use	Increase in demand for camping is expected.
Winter Recreation Parking	Sub-basin 2	Demand for plowed winter parking in the vicinity of the Kalama Horse Camp, to access winter trails.	Increased recreational use	Increase in demand for winter access is expected.

Components of Issue	Locations	Current Conditions Compared to Reference Conditions	Dominant Processes	Significant Trends or Rates of Change
Horse Camping Capacity	Sub-basin 2	Demand for horse camping has exceeded the design capacity of the Kalama Horse Camp.	Increased recreational use	Increase in demand for horse camping opportunities is expected.
Unpaved Roads	Sub-basins 1, 2	Use of some unpaved (gravel) roads is exceeding design capacity causing road surfaces to deteriorate and creating nearby impacts from dust and sedimentation.	Increased recreational use	An increase in road use is expected.
Recreation use in Goat Marsh RNA	Sub-basin 2	Hiking, horseback riding, hunting, fishing, and camping occur adjacent to the RNA. Some use extends into this specially designated research area.	Increased recreational use	A slow increase in recreational use is expected.

Issues 8, 9, 10, and 11: RECREATION USE (Continued)

Component of Issue	Existing Management Objectives and Desired Future Conditions	Current Conditions Compared to Management Objectives & Desired Future Conditions
Dispersed Camping	Dispersed camping will be limited to areas determined suitable for that purpose. Development of additional dispersed sites by users will be halted. Development of roads to dispersed camp sites, or the use of vehicles off of forest development roads will be limited to designated access points. Use of dispersed camping sites by commercial permittees will be managed by issuance of camping permits.	Each year more dispersed camp sites are appearing, and roads developed for access. User generated sites are creating a variety of impacts, including visual impairment, improper disposal of human waste, and development of unauthorized roads. Some commercial permittees use dispersed camp sites without authorization for commercial camps.
Winter Recreation Parking	The Washington State Parks and Recreation Commission will be contacted concerning establishment of a sno-park at Kalama Horse Camp for winter access. Snow would be plowed from SR 503S to the Kalama Horse Camp. Winter users would be required to display a sno-park permit to use the area. If Kalama Horse camp provides inadequate parking space, additional parking would be plowed at the gravel pit ½ mile south of the camp, along Road 81.	An increase in winter recreation demand, combined with inadequate parking, is creating crowded conditions in the Mount St. Helens Winter Recreation Area. Road 81 was plowed to the Kalama Horse Camp vicinity until 1989 when all plowing shifted to the Road 83. Since the time plowing was curtailed, parking demand has exceeded available parking space on weekends.
Horse Camping Capacity	Camp sites at the Kalama Horse Camp need to be increased to meet current demand. Available space for expansion will be investigated in the vicinity of the existing camp, and at on the south side of the Kalama River.	Demand for horse camping is increasing yearly, exceeding available camp sites almost every summer weekend. Horse users are dispersing to undeveloped camp sites along Road 81, adding to impacts in those areas.

Component of Issue	Existing Management Objectives and Desired Future Conditions	Current Conditions Compared to Management Objectives & Desired Future Conditions
Unpaved Roads	<p>The remaining unpaved portion of Road 81 will be scheduled for paving when funds become available. Traffic use on Road 8213 will continue to be monitored. If traffic levels are found to create unsatisfactory road conditions, paving will be considered. In the interim, the road maintenance level will be increased to provide more frequent grading, and surface rock replacement.</p>	<p>Road 81, and to a lesser extent Road 8123 are carrying traffic loads of recreational vehicles in excess of design capacity. The road surface rapidly becomes uneven due to potholes, and washboard. Flying dust obscures visibility, and settles on vegetation creating an undesirable visual impact within the NVM. Runoff from Road 81 in the vicinity of McBride Lake is contributing to sediment deltas at the inlet end of the lake, and sediment deposits in the riparian zone near the north shore. High levels of traffic, combined with low maintenance standards contribute to these impacts.</p>
Recreation use in Goat Marsh RNA	<p>Goat Marsh Trail No. 237A provides access to Goat Marsh Lake, along the boundary of the Research Natural Area. Incursions of recreation use will be monitored to determine if unsatisfactory impacts are being created in the RNA. If the level of use increases from current levels, action to limit impacts will be taken. That portion of the Goat Marsh Trail within the RNA will not be maintained. Incursion of non-native plants will be monitored to determine if management action is needed.</p>	<p>Some hiking, camping, fishing, and horseback riding takes place along the fringe of Goat Marsh RNA. Horses and camping can cause impacts incompatible with the purpose for which the RNA was established. Impacting use within the RNA has remained at a relatively constant level over the past decade. A species of thistle, not native to Washington, has recently been observed in the vicinity of the Kalama Horse Camp, leading to concern that noxious weeds may be introduced through horse feed.</p>

Section 3 Synthesis

In the following section, information from earlier stages of the analysis is synthesized in order to further understand and discover interrelationships between elements of the ecosystem. The synthesis is discussed in three dimensions of the ecosystem: aquatic, terrestrial, and human activity. An explanation for each of these three dimensions is presented below. Table 13 shows the location (sub-basins) of conditions of concern, and Figure 22 shows the locations of important features. The table and map provide readers with an over-all view of the watershed and highlights those sub-basins with the greatest number of concerns.

Aquatic Synthesis Explanation

For the aquatic synthesis process, areas that have linkages are combined to identify critical zones within the analysis area. For example, the locations of stream channels that are sensitive to sediment input are compared with areas that have high surface erosion rates from roads. The places where these two polygons overlap identify very critical zones because this is where we currently have high surface erosion rates and stream channels that are easily degraded from sediment input.

Other relevant information is shown on the synthesis map and in the synthesis table. This includes: (1) sub-basins that have high aquatic fragmentation from roads and low LWD recruitment potential are combined to identify places of high concern for replenishment and flow of large wood to stream systems; (2) stream reaches that lack both LWD and pools, considered to be in extremely poor condition for fish; (3) areas that have increased peakflows from timber harvest and roading; and (4) stream response reaches that are sensitive to input changes of wood, water, and sediment.

A large area, encompassing Sub-basins 3 -8 (Figure 22), is identified as having concerns due to timber harvest, road construction, and the presence of sensitive stream response reaches. The aquatic environment in Sub-basins 4 and 5 are areas of special concern. These sub-basins are extremely fragmented from roads, have low LWD recruitment potential due to timber harvest in the Riparian Reserves, and have the highest potential for moving sediment from roads to streams. This has probably contributed to some of the poor conditions noted in several of the stream reaches.

Sub-basin 8 is in a similar condition, although aquatic habitat data is lacking. Therefore, it's unknown how streams and Merrill Lake are being affected. The response reach of the Kalama River in Sub-basin 6 may also be impacted by upstream processes and land condition, but again - no data is available for the stream habitat.

An increase in the number of dispersed camp sites along road corridors are a concern, because it would also mean an increase in the number of associated access "roads." These roads begin as

wheel tracks and are then created gradually over time by those who use the campsites. The concern centers on a potential increase in the amount of sediment these access roads would produce. However, the increase in dispersed camp sites is not expected to cause major problems, i.e., most of the camp sites are expected to occur on relatively flat ground outside of riparian areas.

Terrestrial Synthesis Explanation

The wildlife and riparian issues are combined to illustrate the holistic interrelationship of both and assist in identifying which areas need restoration work. The analysis has shown the riparian reserves in the Kalama are fragmented which has impacted the biodiversity within this watershed.

The riparian reserves in the Kalama watershed are highly fragmented from past clear-cutting practices. The resulting deficiency in late-successional habitat has inhibited animal and plant species from dispersing. This scenario is called the "island effect." The basic principle is that habitat islands across the landscape need to be linked in some way so species can move between them (Mellen 1996). Dispersal across the landscape prevents localized extinction of small isolated populations caused by inbreeding depression and demographic stochasticity (Noss 1983, Simberloff et al. 1992).

Presently, the fragmented riparian reserves are mostly in the early-seral stages and do not have enough down woody-material and snags. As previously stated in Chapter I, 91 of the 199 terrestrial animal species are dependent on snag and down-logs. Wildlife that prey on rodents and other small mammals have minimal opportunity in these areas, because rodents need coarse woody-debris. Rodents usually gravitate toward this habitat condition; using it for protection from predation.

To illustrate the wildlife concerns on the synthesis map (Figure 22), the peregrine falcon, Larch Mountain salamander, mountain quail, and the Townsend's big-eared bat were analyzed to determine if there would be any impacts from an increase of dispersed camping. Among these species the mountain quail was the only species considered to have a critical concern. Mountain quail habitat may be degraded from the predicted increase in day-use around McBride lake.

Pre-commercial or commercial thinning in the riparian reserves could improve habitat conditions by releasing the remaining trees and accelerating the diameter growth rate. Over time, old-growth characteristics will return to the riparian reserve.

Riparian reserves serve purposes not only for terrestrial species, but for salmonids, as well. Recruiting of large woody debris, stabilizing water temperatures, and inhibiting excessive sedimentation are some beneficial effects for riparian reserves.

Human Activity

Recreational use is concentrated in Sub-basins 1, 2, and a fringe of 6. While a variety of activities are popular, dispersed camping along Roads 81 and 8123 create the largest impacts. Camping pressure is expected to increase on the National Forest in response to closure of 20 dispersed camp sites on adjacent private lands in 1996. Most new camp sites are expected to appear along Road 81, in Sub-basin 6. Dispersed camping activity peaks during hunting season in the months of September, October, and November, and new camp sites are most likely to appear during this period.

Snow plowing of Road 81 and creating a sno-park at Kalama Horse Camp would direct motor vehicle traffic through deer and elk biological winter range. Opening this route from State Route 503S to the horse camp would likely have a neutral or slightly beneficial effect on the wintering animals. Presently no impediments to snowmobile activity occur in Sub-basins 6, 7, or 8 and Road 81 and its tributary side roads see considerable use. With plowing of Road 81, snowmobile access would be blocked on the lower elevation side roads, forcing snowmobile use toward higher elevations above the horse camp. Road traffic would pass through biological winter range but no parking facilities would be provided for snowmobile access to side roads. Wildlife is expected to become habituated to traffic on the plowed road and benefit from reduced disturbance on lower elevation side roads.

Mountain quail inhabits open montane forest having a well-developed brushy understory and steep slopes around the edges of mountain meadows. The nests are usually on the ground and near water.

Suitable habitat for mountain quail is located on the south and west side of McBride lake. The mountain-side on the south is vegetated by a mature tree stand with a shrubby understory, while the west side has a fringe mixture of marshy delta and shrubs in close proximity to the water.

A significant increase of human day-use at McBride lake is expected stemming from more dispersed camping in the vicinity. Currently, fishing is the identified popular recreation for the vicinity. If use increases in this already popular location and the shrub layer is degraded, suitable habitat for the mountain quail will decrease.

Upper Kalama River Synthesis Map

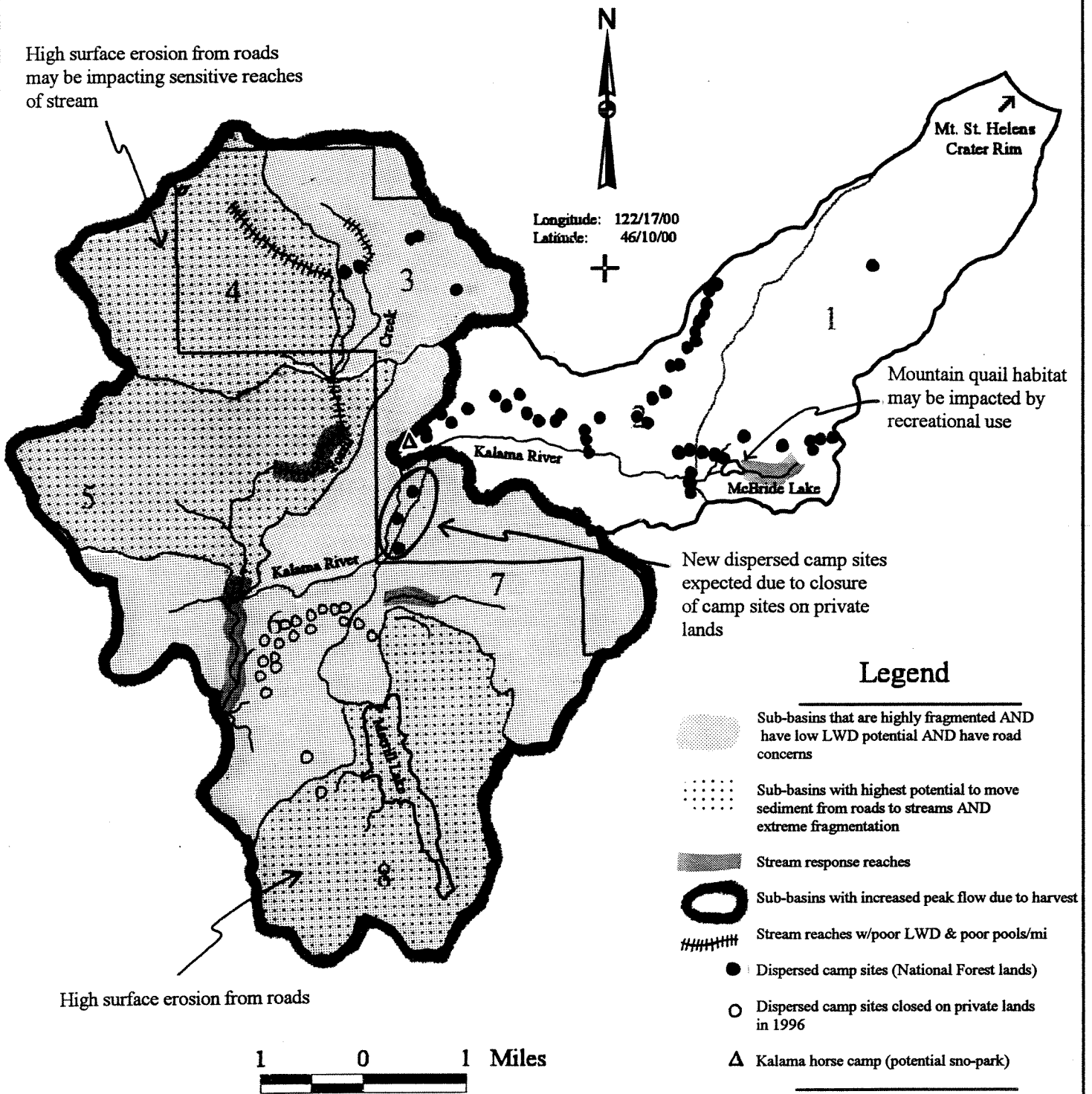


Figure 22. Synthesis of data showing sub-basins and stream reaches that have known problems (based on in-channel and up-slope conditions), wildlife concerns, and the area where dispersed camping is expected to increase due to camp sites closed on private lands in 1996.

Table 13 Aquatic, Terrestrial, and Social and Economic Synthesis Elements by Sub-basin.

Sub-Basin	Aquatic						Terrestrial						Social and Economic			
	High Frag. Stream/Road Crossings	Extreme Frag. Stream/Road Crossings	Low LWD Potential Habitat	High Risk of Increased Peak Flow	Extremely Poor Fish Habitat	Sensitive Stream Response Reaches	Potential Peregrine Falcon Nest Sites	Townsend's Big Eared Bat Maternity Sites	Potential Larch Mtn. Salamander Habitat	Potential nesting/brooding Mtn. Quail Habitat	Known Fringed Pinesap Populations	Lrch Mt. Salmndr/Twnsnd's Big-eared Bat	High Demand Dispersed Camping (Site Concentrations)	High Demand for Winter Parking	High Demand for Horse Camping	Road Use Beyond Designed Capacity
1 McBride					X	X	X	X	X	X	X	X	X	X		
2 Goat							X	X	X	X	X	X	X	X	X	X
3 East Fossil	X		X		X											
4 North Fossil	X	X	X	X	X		X									
5 Lower Fossil	X	X	X	X	X	X										
6 Lower Kalama	X		X	X		X		X		X	X	X		X		
7 Dry	X		X	X		X		X		X	X	X				
8 Merrill Lake	X	X	X	X							X	X				

Anticipated Social or Demographic Changes or Trends

The trends in social use and values associated with this watershed reflect the diversity of those segments of the public who see themselves as stakeholders in the management of these lands. People will continue to seek both commodities and spiritual and emotional enrichment from the forest.

The demand for year-round recreational opportunities is primarily on weekends and holidays. Approximately two-thirds of the Vancouver and rural southwest Washington residents visit the Forest several times each year. Developed sites are full during peak seasons of use and the overflow moves out to dispersed recreation sites (Porter, December 1993).

Sightseeing, picnicking, camping, hiking, nature study, hunting, fishing and winter sports are the most popular recreation activities for the Forest in order of participation. The demand for recreation activities from 1990 to 2000 is expected to exceed the Washington State population increase of 18 percent. Forecasted increases in activity demand are highest for Nature study, hiking, mountain biking, photography and four-wheel-drive riding (Porter, December 1993).

During the next decade, the Forest can expect increased activity, primarily by middle-aged and older users with advanced education and higher disposable incomes. These people will be looking for a greater variety of activities (Porter, December 1993).

We can expect an increase in the number of illegal dump sites and activities such as drug manufacturing, crime and conflicts between user groups. These adverse impacts could degrade the environment and decrease the quality of recreational experiences.

The demand for Special Forest Products will continue to increase and will create a need to develop more regulations to manage these resources.

Attracted by the quality of life compared to other parts of the nation, people will be drawn to Southwest Washington in greater numbers. With these population increases, the demand for housing is expected to increase. The need for a sustainable flow of wood products from the National Forests will become even more acute.

CHAPTER VI RECOMMENDATIONS VI-1

Restoration Activities

Road Decommissioning. VI-3
Road Weatherization. VI-4
Silvicultural Treatments to Accelerate Development of Riparian Sapling/Pole
and Small Tree Stands. VI-5
Silvicultural Treatments to Accelerate Development of Upland Sapling/Pole
and Small Tree Stands. VI-7
Stream Enhancement. VI-9
Erosion Control/Slope Stabilization. VI-10
Cooperative Restoration of the Lewis River Basin by All Landowners. VI-11

Monitoring Activities

Recreation Use. VI-12
Goat Marsh Research Natural Area VI-13
Stream Temperature. VI-14
Stream Surveys. VI-15
Fish Surveys. VI-16
Riparian Reserve Rehabilitation Monitoring. VI-17
Verification of Ecological Inventory Data. VI-18
Road Condition Surveys (ATM Phase II). VI-19
Amphibian Surveys. VI-20
Mountain Quail and Peregrine Falcon. VI-21

Commodities and Development

Dispersed Camping. VI-22
Winter Recreation Parking VI-23
Horse Camping Capacity Increase. VI-24
Road Paving. VI-25
Riparian Reserve Widths. VI-26
Recommendations Table. VI-27



CHAPTER VI RECOMMENDATIONS

From the information gathered, synthesized, interpreted and displayed in previous chapters, the ID team identified those management activities that could move the system toward reference conditions or management objectives, as appropriate.

The recommended actions are grouped into three categories:

- Restoration Activities
- Monitoring Activities, and
- Activities associated with Commodities and Development

For each of the 22 recommended actions, an explanation of the rationale for the recommendation is presented. This is displayed under four sub-headings for each recommendation in turn, as follows:

- A. What is it? Specific description of the recommended activity.
- B. Ecosystem conditions and/or functions that would be altered, maintained, or restored.
- C. Appropriate timing, sequencing, and general location. Show priorities for sub-basins.
- D. The anticipated rates and time-lines for achieving the management objectives.

Priorities: In the paragraphs describing each recommendation, the priority sub-basins to which a particular recommendation applies is shown.

For the restoration grouping, the types of recommendations are prioritized as High or Moderate as follows:

High	Road Decommissioning
Moderate	Road Weatherization
Moderate	Silvicultural Treatment of Upland Stands
Moderate	Silvicultural Treatment of Riparian Stands
Moderate	Stream Enhancement
High	Erosion Control/Slope Stabilization
High	Cooperative Restoration Among Landowners

The team could see no purpose in applying priorities to the other two groupings: Monitoring and Commodities/Development.

It is expected that priorities will be used later to help decide which proposed projects will be implemented when competing for limited funds. Decision makers are reminded the above

priorities are based upon limited knowledge, and projects of higher priority may become known as more is learned about site-specific conditions on the ground. Because of the February, 1996 storm damage (an inventory of which is not yet complete), the likelihood of discovering other high priority restoration needs is high.

The locations of recommended activities (by sub-basin) are shown in Table 14- Recommendations by Sub-basins. This table shows the full array of recommended activities where readers may see which sub-basins contain more than one recommendation.

Restoration Activity:

ROAD DECOMMISSIONING

A. What is it?

Road decommissioning is the action of removing a road from the transportation system and returning the ground to a stable configuration to revegetate and recover. This action includes but is not limited to culvert removal, construction of water bars and cross-drains to control surface water runoff (such as where ephemeral draws cross the roadway), fill slope removal in areas of unstable road fill, and subsoiling or ripping of the road running surface in areas of soil compaction. Subsoilers are large shanks attached to a tool bar mounted to the rear of a crawler tractor.

Following equipment operations, all exposed soil is seeded and fertilized. Annual grasses such as cereal rye are utilized to provide quick cover while not adversely affecting the re-establishment of native vegetation (native species are preferred and if available will be used). Conifers may also be planted on these sites. Native species are preferred for re-establishment of vegetation. Finally, a closure berm is constructed to prevent vehicular access to the treated area.

B. Ecosystem conditions and/or functions that would be altered, maintained or restored?

The purpose of decommissioning roads is to reduce habitat fragmentation in uplands and Riparian Reserves, erosion rates from roads, mass wasting hazards, and peak flows. It will also improve habitat quality for wildlife species that are sensitive to human activity and provide quality hunting, fishing, and recreation areas.

C. Appropriate timing, sequencing, and general location. Show priorities for sub-basins.

The highest priority for this treatment on National Forest lands is Sub-basins 3, 4, and 7. Sub-basins that are a medium priority for this treatment on National Forest lands include 5 and 6. Priority areas were identified as those places where multiple road-related concerns exist. These include sub-basins that had high aquatic fragmentation, high surface erosion, adjacent beneficial uses, and road related peakflow concerns.

Among restoration recommendations for the watershed, this is given a high priority.

D. The anticipated rates and time frames for achieving the management objectives.

Benefits derived from reducing aquatic fragmentation begin immediately after project implementation. It takes 20 or more years to realize the benefits related to reducing upland habitat fragmentation. One immediate benefit is reduced sedimentation. The benefits relating to reduced surface erosion and reduced peak flows are realized within five years as vegetation is established on exposed soil. The time line for achieving these benefits is dependent on available funding.

Restoration Activity:

ROAD WEATHERIZATION

A. What is it?

Road weatherization involves stabilizing a road that is not currently needed for transportation, but will be needed in the future (10-20 years from the present). This involves putting the road in a stable configuration that will not create resource damage while requiring a minimum of road maintenance. This action includes but is not limited to construction of water bars and cross-drains to control surface water runoff (such as where ephemeral draws cross the roadway), fill slope removal in areas of an unstable road fill, and to a lesser extent, culvert removal and to subsoiling or ripping of the road running surface in areas of soil compaction.

Following equipment operations, exposed soil is seeded and fertilized. Annual grasses such as cereal rye are utilized to provide quick cover while not adversely affecting the re-establishment of native vegetation. Finally, a closure berm is constructed to prevent vehicular access to the treated area.

B. Ecosystem Conditions and/or functions that would be altered, maintained or restored?

Weatherizing roads reduces surface erosion rates from roads, including the cut banks and fill slopes. It also reduces the amount of surface water flow, helping to reduce peak flows in the watershed.

C. Appropriate timing, sequencing, and general location. Show priorities for sub-basins.

Sub-basins where this treatment is a priority are those primarily in Matrix, which have a high road density, and where surface erosion is a concern, but where roads are needed for future timber sales or for fire control purposes.

Isolated roads or individual sites that are a high priority for this treatment on National Forest lands is located in Sub-basin: 4.

Treatment areas on National Forest lands that are a moderate priority are located in Sub-basins 3,6, and 7.

Among restoration recommendations for the watershed this is given a moderate priority. Isolated opportunities exist for this type of activity in this watershed.

D. The anticipated rates and time frames for achieving the management objectives.

Benefits relating to decreased surface erosion and mass wasting will take up to five years as vegetation establishes on exposed soil. Some immediate benefits will be derived relating to peak flow decreases by allowing moisture to infiltrate the soil profile in ripped areas, routing flow away from road ditch lines. Another immediate benefit is reduced sediment that results from vehicle use on these roads. The time line for achieving these benefits is dependent on availability of restoration funding.

Restoration Activity:

SILVICULTURAL TREATMENTS TO ACCELERATE DEVELOPMENT OF RIPARIAN SAPLING/POLE & SMALL, TREE-STANDS

A. What is it?

The objective is to encourage development of a mixed stand of hardwoods and large conifers.

Interplanting of conifer, hardwood, and shrub seedlings will (1) increase the conifer component of riparian stands, (2) enhance species and structural diversity, and (3) allow for future recruitment of quality large woody material. Conifer seedlings (western red cedar, western hemlock, and Douglas-fir) are hand planted in areas where vegetation or species diversity is lacking. Trees are planted between 100 feet and 300 feet from channels, in existing openings or small openings which are created with chain saws to facilitate open growing of seedlings. Seedlings may be protected with vexar tubing or netting to prevent browse damage.

Thinning of conifers in riparian areas will accelerate development of large conifer trees. Chain saws are used to fell young conifers. Trees are left in place where they fall. Minor species in the stand are favored as leave trees to promote species and structural diversity. In riparian reserves, emphasis is on thinning wide enough to avoid the need for future thinning or other stand manipulation (falling of larger trees may be more likely to result in soil disturbance).

B. Ecosystem conditions and/or functions that would be altered, maintained or restored?

Interplanting of conifers, hardwoods, and shrubs enhances species diversity. Thinning of conifers, results in fewer trees using limited resources and residual trees respond with accelerated diameter growth. Accelerating conifer development in riparian areas provides quality future habitat for fish and wildlife and reduces erosion and peak flows.

C. Appropriate timing, sequencing, and general location. Show priorities for sub-basins.

Treatments are conducted spring through fall when areas can be reached.

These treatments are a priority in sub-basins with riparian areas lacking large conifers. The highest priority sub-basins to evaluate for treatment is 3, 4, and 7. These three sub-basins have had extremely high riparian harvest, are highly fragmented, and have high potential to move sediment from roads to streams. The other priority sub-basin to evaluate is: 5 (synthesis map).

Potential treatment areas should be walked by an integrated resource staff group with expertise from silviculture, watershed/fisheries, and wildlife/ecology to evaluate site specific treatment needs and methods.

Among restoration recommendations for the watershed, these treatments were assigned

high priority. Treatments that create large wood will provide long-term results.

D. The anticipated rates and time frames for achieving the management objectives.

Treatments will generally take place within 1 to 3 years after the project is identified. Silvicultural treatments enhance movement toward desired conditions, but many years of stand growth, natural disturbance, and other dynamics contribute to gradual development of desired conditions.

Restoration Activity:

SILVICULTURAL TREATMENTS TO ACCELERATE DEVELOPMENT OF UPLAND SAPLING/POLE & SMALL TREE STANDS.

A. What is it?

Precommercial thinning: Chain saws are used to fell trees in closed sapling/pole stands (less than 8 inches DBH). Lacking a market value, felled trees are left in place where they fall. Minor species in the stand are favored as leave trees to promote species and structural diversity. Leave trees are irregularly spaced to promote structural diversity.

Commercial thinning: This activity occurs in closed small tree stands, generally about 8 inches to 15 inches DBH. Felled trees are bucked and yarded to a landing and are hauled to markets by truck.

Fertilization: Helicopters are used to spread nitrogen fertilizer in urea form over young managed stands which have been previously thinned. Application is done in the spring or fall when temperatures are relatively cool but not during heavy rains.

Interplanting and planting: Tree and shrub seedlings are hand planted in areas where vegetation or species diversity is lacking.

B. Ecosystem conditions and/or functions that would be altered, maintained or restored?

Upland silvicultural treatments accelerate the development of large diameter trees and species and structural diversity in stands. The result is quicker development of stand characteristics towards mid- and late-successional size and structure.

Thinning (precommercial and commercial) results in fewer trees using limited resources (nutrients, moisture, light). Residual trees respond with accelerated diameter growth. Variations in tree species, genetic traits, and micro-sites, along with some gradual in-seeding of new trees, result in variable height growth of trees and gradual development of different canopy levels. The diverse stands which develop provide quality habitat for many wildlife species and provide root strength and snow interception for watershed protection.

Fertilization results in a temporary increase in available nitrogen (approximately 10 years duration). Trees respond with accelerated height and diameter growth. Variable responses among trees result in enhanced development of different canopy levels. The resulting structural diversity provides quality wildlife habitat and root strength and snow interception for reduced peak flows and watershed protection.

Interplanting and planting results in establishment of diverse vegetation on exposed sites. This initiates or enhances development of quality wildlife habitat and reduces erosion and peak flows.

C. Appropriate timing, sequencing, and general location. Show priorities for sub-basins.

Young stand thinning and fertilization treatments are recommended

- (a) in sub-basins where vegetation removal has increased peak flow more than 10 percent.
- (b) in areas within the riparian reserves where accelerated successional development will reduce fragmentation of existing or soon-to-be- late-successional habitat.

© on lands managed for timber growth and yield

Pre-commercial thinning is most appropriate in closed sapling/pole stands. The structure stage information used in this analysis indicates Sub-basins 3 and 4 are considered to be the highest priorities. All of the other sub-basins except Sub-basins 1 and 2 should be considered for this treatment, as well. Sub-basins 1 and 2 are mostly rock, therefore potential vegetation is minimal in comparison to the other sub-basins. Additionally, Sub-basins 1 and 2 only have 9.54 percent and 16.16 percent respectively of their Riparian Reserves harvested, in comparison to the 30 percent used to determine whether the reserves functions are impaired from fragmentation.

There are no commercial thinning opportunities within this watershed. Since most of the watershed's vegetation is within the sapling/pole seral stage, the existing vegetation would be lacking market value.

Fertilization opportunities exist in sapling/pole or small tree stands between 15 and 80 years of age which have been thinned. Previously thinned units were not identified as part of this analysis. Opportunities to fertilize previously thinned or proposed thinning units should be identified as time allows or as part of proposed silvicultural projects within the watershed.

Specific inter-planting and planting projects should be identified as additional fieldwork or project planning occurs.

These types of treatments are a medium priority in the group of restoration activities.

D. The anticipated rates and time frames for achieving the management objectives.

Treatments will generally take place within 1 to 3 years after the need is identified. Silvicultural treatments enhance movement towards desired conditions but many years of stand growth, natural disturbance, and other dynamics contribute to gradual development of desired conditions.

Restoration Activity:

STREAM ENHANCEMENT

A. What is it?

Stream channels would be modified through the addition of LWD or boulders to create additional or higher quality salmonid habitat. Structures could be added in several ways 1) large machinery used to place boulders/LWD, 2) helicopters used to place boulders/LWD 3) hand winching of existing on-site material into different locations or 4) a combination of one or all of these methods. Large woody debris would not be removed from existing riparian areas, but instead would be located through reconnaissance of blow-down sites and from other off-site locations.

B. Ecosystem conditions and/or functions that would be altered, maintained or restored?

Channel morphology indicates that specific reaches are better able to “use” large woody debris. These reaches are likely suitable for stream enhancement of the existing condition to bring the channel into the range of natural variability for pools per mile and pieces of LWD per mile. Channels would become more complex, and pools would be created enhancing salmonid habitat for both spawning and rearing.

C. Appropriate timing, sequencing, and general location. Show priorities for sub-basins.

Stream enhancement projects should be done only after upslope stabilization problems have been corrected. Enhancement activities could proceed after an intensive stream survey of the reach is completed and designs for the structures are developed. Design of the project would receive peer review prior to implementation. Work would likely occur during the late summer (low water times). Sub-basins on National Forest lands where this activity may be appropriate include: 3 and 4.

Among restoration activities, this is rated as a moderate priority.

D. The anticipated rates and time frames for achieving the management objectives.

Time frames for this activity are dependent on receiving restoration funding. A project of this scope and scale could cost as much as \$100,000, and would need to be prioritized with other restoration activities both in this sub-basin and across the Forest.

Restoration Activity:

EROSION CONTROL/SLOPE STABILIZATION

A. What is it?

Erosion control/slope stabilization is the action of stabilizing actively eroding areas such as mass wasting sites, dispersed recreation sites, rock quarries, road cut and/or fill slopes, and stream banks, in an effort to reduce sediment input. This involves primarily soil bio-engineering techniques such as planting trees and shrubs, live fascine bundles and live staking, erosion control blankets, hydro-mulching, and installing live cribwalls.

B. Ecosystem conditions and/or functions that would be altered, maintained or restored?

The major condition restored are sediment regimes that more reflect historic conditions.

C. Appropriate timing, sequencing, and general location. Show priorities for sub-basins.

Sub-basins where this treatment is a priority are those areas that are known or suspected sediment sources that have the potential to deliver sediment to beneficial use areas.

Sub-basins on National Forest lands that are a high priority for this treatment are: 3, 4, and 7. Sub-basins that are a moderate priority for this treatment are: 5 and 6.

Among restoration recommendations for the watershed this is given a high priority.

D. The anticipated rates and time frames for achieving the management objectives.

Benefits relating to reducing surface erosion and mass wasting will take three to five years after project implementation to begin to see results of reduced sedimentation. This is due to the time necessary for the vegetation to establish on exposed soil. Time frames for achieving these benefits are dependent on availability of restoration funding.

Restoration Activity:

COOPERATIVE RESTORATION PROGRAM BETWEEN LANDOWNERS

A. What is it?

Due to the mixed ownership pattern in this analysis area, it would be opportune to implement a restoration program that includes all landowners, in order to achieve success. Many key aquatic resources are located in or have to travel through non-National Forest areas. A restoration group consisting of major land owners could be created to address issues such as restoration priorities and funding sources, in order to maximize restoration success. If other landowners saw this as a course they wished to pursue, the Forest Service would cooperate.

B. Ecosystem conditions and/or functions that would be altered, maintained or restored?

A coordinated restoration program would insure that the highest priorities for the entire basin would be addressed instead of the highest priority in a particular land ownership. It would also ensure that restoration projects are compatible with each other. An example of this would be an opportunity to stabilize all upslope areas prior to implementing in-stream types of projects. The result would be restoration of the aquatic environment.

C. Appropriate timing, sequencing, and general location. Show priorities for sub-basins.

This recommendation should be implemented in the entire analysis area.

Among restoration activities this is rated as a high priority.

D. The anticipated rates and time frames for achieving the management objectives.

It would take one to two years to convene the group, agree on objectives, support some kind of analysis that lays the foundation for restoration projects, and start reviewing project proposals. Once established, this group could meet periodically to review and prioritize projects, secure funding, and adjust the process.

Monitoring Activity:

RECREATION USE

A. What is it?

Monitor changes in recreation use through use of traffic counters located on Roads 81 and 8123. By monitoring traffic, total visitor use of the area can be monitored and quantified. By comparing this data with previous years, trends in recreation demand can be determined.

B. Ecosystem conditions and/or functions that would be altered, maintained or restored?

Monitoring will identify areas where use levels are changing and where use conflicts are developing. By monitoring for peaks in recreation use, strategies can be developed to spread use over time or identify areas where changes in facilities are needed.

C. Appropriate timing, sequencing, and general location. Show priorities for sub-basins.

Monitoring would be conducted year-round on roads providing access to all sub-basins in the watershed.

D. The anticipated rates and time frames for achieving the management objectives.

Traffic monitoring is currently active and will continue indefinitely.

Monitoring Activity:

GOAT MARSH RESEARCH NATURAL AREA

A. What is it?

The Goat Marsh RNA was established to preserve a unique Cascade Mountains habitat for research and scientific study. The area is also popular for hunting and fishing. Camping or horse use within or near the RNA boundary concerns scientists. Camping can cause loss of vegetation and disruption of scientific studies. Horses pose a threat of trampling vegetation and introduction of non-native plants. A non-native thistle has already been introduced at the Kalama Horse Camp in association with horse manure and spilled feed.

Goat Marsh Trail is closed to motorized and horse use, but occasional violations take place. A stock barrier is maintained on the Goat Marsh Trail about ½ mile southeast of Goat Marsh Lake. The Goat Marsh Trail is maintained to the boundary of the RNA at Goat Marsh Lake but not inside the RNA.

B. Ecosystem conditions and/or functions that would be altered, maintained or restored?

The stock barrier and use restrictions now in place will be retained. Monitoring will be used to identify any changes in use or invasion of non-native plants. If changes take place, action will be taken to minimize or reverse impacts.

C. Appropriate timing, sequencing, and general location. Show priorities for sub-basins.

Monitoring activity will take place along the Goat Marsh Trail in Sub-basin 2.

D. The anticipated rates and time frames for achieving the management objectives.

Recreation use monitoring, and inspection of the stock enclosure barrier will take place yearly during maintenance of the Goat Marsh Trail. Specialized monitoring for the introduction of non-native plants will take place every three years.

Monitoring Activity:

STREAM TEMPERATURE.

A. What is it?

Monitoring to ensure that stream temperature is within State water quality standards, and if not, identify where problems exist.

B. Ecosystem conditions and/or functions that would be altered, maintained or restored?

Maintain or restore the functions of aquatic ecosystems that depend upon cold water temperatures.

C. Appropriate timing, sequencing, and general location. Show priorities for sub-basins.

Sub-basins that are priorities on National Forest lands for this monitoring include 2,3,4, and 7. They are located along the Kalama River and Fossil Creek and its tributaries.

There is a high need for this type of monitoring.

D. The anticipated rates and time frames for achieving the management objectives.

Identifying areas that are not within State water quality standards could happen within a short time if funding is received. However identifying the causes of water temperature problems within a reach, would probably not be done until the next iteration of watershed analysis in the watershed.

Monitoring Activity:

STREAM SURVEYS.

A. What is it?

Stream surveys would collect data on the condition of aquatic and riparian habitat and may include characterization of riparian vegetation, channel type and stability, bank stability, substrate type, and fish species present and their distribution.

B. Ecosystem conditions and/or functions that would be altered, maintained or restored?

Collecting stream survey data would help to identify which stream reaches do not meet the desired condition. These streams would then be a priority for restoration.

C. Appropriate timing, sequencing, and general location. Show priorities for sub-basins.

Sub-basins that are a priority for this monitoring are those for which there is no existing stream survey data, and/or where there is a high likelihood of future management actions. These National Forest land sub-basins are: 2, 3, 4, and 6. Class I and II streams within the remaining sub-basins should also be surveyed.

Since this type of monitoring is ongoing, there is only a medium priority for emphasis in comparison to other monitoring needs.

D. The anticipated rates and time frames for achieving the management objectives.

Stream surveys are completed at a rate of about 12-20 miles per year (over the entire Lewis River Watershed), depending on availability of funding and management activity levels. There are approximately 26 miles of Class II streams in the Upper Kalama River Watershed sub-basins that need to be surveyed. At current funding and management activity levels these surveys would be completed within a minimum of six to eleven years.

Monitoring Activity:

FISH SURVEYS.

A. What is it?

Survey fish populations to identify which species inhabit a given stream and utilize available habitat for spawning and rearing. Information collected would include: habitat type, type of use by salmonids, and population estimates. The survey methods could include: redd counts, snorkeling, and electro-shocking.

B. Ecosystem conditions and/or functions that would be altered, maintained or restored?

Results from the monitoring would allow better decisions to be made in the future regarding habitat management for the salmonids that utilize this watershed. It may also help to define limiting factors of reproduction success.

C. Appropriate timing, sequencing, and general location. Show priorities for sub-basins.

Sub-basins on national forest lands that should receive periodic surveys are 1, 2, and 6.

Since this type of monitoring is ongoing, there is only a medium priority for emphasis in comparison to other monitoring needs.

D. The anticipated rates and time frames for achieving the management objectives.

Surveys are completed annually on known spawning and rearing areas depending on availability of funding and management activity levels.

Monitoring Activity:

RIPARIAN RESERVE REHABILITATION MONITORING

A. What is it

Long-term monitoring of riparian areas to determine whether restoration activities are creating desired vegetation conditions and whether these conditions provide the habitat for species assumed to be dependent on these areas. Activities to be monitored include:

- thinning to accelerate tree, shrub, or forb development
- planting native species to increase species diversity and structural heterogeneity
- placement of in-stream large woody debris

Monitoring vegetation, plant and animal presence, abundance and diversity (including C-3 species) to determine the functional ability of these riparian areas to provide protection and dispersal habitat.

B. Ecosystem conditions and/or functions that would be altered, maintained or restored?

Riparian areas are intended to provide for a diversity of plant and animal needs, especially within matrix lands. Restoration of forested stands with a large component of older, large sized conifers and a mix of hardwood, shrub and forb species should provide future large woody debris, stream side shading, suitable habitat for many plant and animal species, and serve as a dispersion corridor for some wildlife species.

Functioning riparian areas reduce the amount of surface water flow, helping to reduce peak flows in the watershed.

C. Appropriate timing, sequencing, and general location. Show priorities for sub-basins.

Individual projects should include monitoring procedures and time frames. For longer term monitoring, a monitoring proposal should be written and baseline data in the treatment and control areas will be collected. Monitoring objectives will dictate timing and intervals of subsequent monitoring.

Sub-basins 3 and 4 are the highest priority. Evaluating sub-basins 5 , 6, and 7 are priorities also.

This is high priority monitoring.

D. The anticipated rates and time frames for achieving the management objectives.

Ongoing.

Monitoring Activity:

VERIFICATION OF ECOLOGICAL INVENTORY DATA.

A. What is it?

Much of the vegetation, soil, and water data used in this analysis is from air photo and map analysis and has not been field verified. The highest priority need is verification of locations of and ecological conditions within large tree stands, and locations and ecological data for TES species, C-3 species, class IV streams, wetlands, and potentially unstable soils. Field vegetation surveys have been completed on approximately 50 percent of the watershed. Less than 5 percent of the watershed has been surveyed for TES species and there have been no field surveys for C-3 species in the watershed.

B. Ecosystem Conditions and/or functions that would be altered, maintained or restored?

An accurate inventory will enable better decisions to be made regarding potential projects.

C. Appropriate timing, sequencing, and general location. Show priorities for sub-basins.

Field verification of ecological data is a high priority in all sub-basins.

D. The anticipated rates and time frames for achieving the management objectives.

The most efficient and effective way to verify ecological data is to use systematic surveys throughout the watershed. Areas in the watershed should be stratified based on conditions and issues and prioritized for surveys. Funding for ecosystem condition surveys has been very limited. The best opportunities for field surveys have been during project analysis. The amount of funding available along with the scope of issues will determine actual survey priorities and accomplishment levels. Since most projects are anticipated to occur in the Matrix, a higher amount of field verification is expected to occur in Matrix lands than in Administratively Withdrawn areas.

Monitoring Activity:

PHASE II ROAD CONDITION SURVEYS

A. What is it?

Inventory of road conditions for all system roads. A protocol is already in place to identify a variety of road related conditions that help in determining whether particular roads are causing, among other things, resource damage. This information is used for many programs including restoration, road maintenance, and project planning. This inventory has not been done on any roads in the analysis area.

B. Ecosystem conditions and/or functions that would be altered, maintained or restored?

The inventory would identify locations where unacceptable resource damage (mainly sedimentation) is occurring and areas where resource damage has a potential to occur. Mitigation to reduce the impacts could then be proposed and implemented.

C. Appropriate timing, sequencing, and general location. Show priorities for sub-basins.

Sub-basins on National Forest lands where the inventory would be a priority are those with high sediment concerns: 4,3,6, and 7, although this inventory is a priority to conduct throughout the analysis area.

This is high priority monitoring.

D. The anticipated rates and time frames for achieving the management objectives.

Completion of phase II road surveys would be the first step in a restoration program aimed at achieving management objectives dealing with sedimentation and aquatic habitat fragmentation.

Monitoring Activity:

AMPHIBIANS

A. What is it?

Monitoring for the presence of the Larch Mountain salamanders.

B. Ecosystem conditions and/or functions that would be altered, maintained or restored?

The objective of this monitoring is to increase knowledge about the types of habitat where this species is most likely found. It will allow better decisions to be made in the future regarding what is needed to preserve this species.

C. Appropriate timing, sequencing, and general location. Show priorities for sub-basins.

Sub-basins that are a priority for this monitoring are those that are in Matrix where these species have been found in the past, are adjacent to sub-basins where these species have been found in the past, or other sub-basins with suitable habitat. Sub-basins with the highest priority are 1,2,6, and 7.

Surveys would be done according to established protocol, which requires surveys to be conducted generally in April or May or in October and November.

D. The anticipated rates and time frames for achieving the management objectives.

Monitoring should begin as soon as funding is available or as timber sales and other ground-disturbing activity is planned. Increased knowledge gained from monitoring would be an immediate benefit.

Monitoring Activity:

MOUNTAIN QUAIL AND PEREGRINE FALCON

A. What is it?

Monitoring for the presence of mountain quail and peregrine falcon.

B. Ecosystem conditions and/or functions that would be altered, maintained or restored?

The objective of this monitoring is to confirm presence and increase knowledge about the types of habitat where these species are most likely found. It will allow better decisions to be made in the future regarding what is needed to preserve these species.

C. Appropriate timing, sequencing, and general location. Show priorities for sub-basins.

Sub-basins that are a priority for this monitoring are those that are in Matrix where these species have been found in the past, are adjacent to sub-basins where these species have been found in the past, or other sub-basins with suitable habitat. Sub-basins with the highest priority for both species are 1 and 2.

Monitoring for the quail and falcon would be done during breeding seasons.

D. The anticipated rates and time frames for achieving the management objectives.

Monitoring should begin as soon as funding is available or as timber sales and other ground-disturbing activity is expected/ planned. Increased knowledge gained from monitoring would be an immediate benefit.

Commodities and Development:

DISPERSED CAMPING

A. What is it?

Dispersed camping is camping outside of developed campgrounds and is allowed on national forest lands, except where it conflicts with resource management or other designated uses. Where conflicts take place, camping may be prohibited or limited to designated areas.

Fifty-six dispersed camp sites, located mostly along the edges of Roads 81 and 8123, are found within this watershed. Some of the sites are close to each other, creating linear campgrounds. Campers have developed primitive roads by driving their vehicles through the woods to camp sites. The intensity of camping is creating visual and environmental impacts in some areas. Accumulations of horse manure, straw, and human waste present environmental and health problems at dispersed camp sites heavily used by equestrians.

B. Ecosystem conditions and/or functions that would be altered, maintained or restored?

The objective of this recommendation is to manage dispersed camping consistent with sound recreation management practices. A management plan for dispersed camping will include the following components:

1. Inventory of all camp sites along the 81 and 8123 road corridors.
2. Identification of all user generated roads.
3. Identification of resource conflicts.
4. Designation of camp sites available for dispersed camping; others to be closed..
5. Restriction of vehicles to forest development roads or designated parking areas.
6. Horse use would be moved to the Kalama Horse Camp when the campground is expanded. At that time, horse camping would be prohibited along roads 81, and 8123.

C. Appropriate timing, sequencing, and general location. Show priorities for sub-basins.

Areas of concern are located in Sub-basins 1, 2, and 6.

D. The anticipated rates and time frames for achieving the management objectives.

Use monitoring is currently active and will continue indefinitely. Designation of dispersed camp sites will take place by August of 1998.

Commodities and Development:

WINTER RECREATION PARKING

A. What is it?

Winter parking is necessary to provide access for snowmobiling and skiing. Plowing of roads and parking lots is funded through the Sno-park Program managed by the Washington State Parks and Recreation Commission. For an area to be added to the program an application must be submitted through the Sno-park Advisory Committee. If approved, the candidate area is added to the program.

Demand for winter recreation parking is high within the Mount St. Helens Winter Recreation Area. Sno-parks on Road 83 are filled to capacity by noon on most weekend days, forcing drivers to block traffic or leave the area. The trailhead parking area in Kalama Horse Camp was designed to serve as a winter parking lot. The western end of the Kalama Ski Trail terminates in the horse camp, and the road 81 snowmobile trail passes nearby. Between 1984, and 1989 snow was plowed to this site, but was discontinued when new parking lots came into use on Road 83. Using the Kalama Horse Camp as a sno-park will reduce parking pressure on Road 83, while providing access to the west side of the winter recreation area.

B. Ecosystem conditions and/or functions that would be altered, maintained or restored?

Under this proposal, the Kalama Horse Camp day-use parking lot would become a sno-park. An application will be submitted to Washington State Parks for the area to be added to the sno-parks program. If accepted, snow would be plowed on Road 81 between SR 503S and Kalama Horse Camp. Winter recreationists would be required to display a sno-park permit to use the area.

The plowed portion of road 81 passes through biological winter range. Plowing of this route would create a neutral or slightly improved condition for deer and elk. Plowing of the road would prevent dispersal of snowmobiles onto side roads as currently takes place. Vehicle traffic would pass through winter range to the sno-park. From the sno-park recreationists would be directed onto trails outside winter range.

C. Appropriate timing, sequencing, and general location. Show priorities for sub-basins.

Snow would be plowed in Sub-basins 2, 6, and 7. An application will be submitted to Washington State Parks and Recreation Commission in the spring of 1997. If approved, the area would be added to the sno-park program.

D. The anticipated rates and time frames for achieving the management objectives.

If accepted as a new sno-park, plowing would commence the winter of 1997-1998. If not accepted, subsequent applications may be needed.

Commodities and Development:

HORSE CAMPING CAPACITY INCREASE

A. What is it?

The Kalama Horse Camp provides ten camp sites which quickly fill on summer weekends. Restrooms, corals, and disposal bins for horse manure are provided in the campground. When full, horse users spread out to occupy nearby dispersed camp sites which lack sanitation facilities. Straw, manure, and human waste accumulates at these other sites due to over-use.

The objective is to identify an expansion area(s) for horse camping. Horse camp expansion is needed to accommodate larger numbers of campers and reduce dependence on dispersed camp sites.

B. Ecosystem conditions and/or functions that would be altered, maintained or restored?

Under this proposal, the Kalama Horse Camp would be expanded into areas adjacent to existing facilities and/or on the south side of the Kalama River. If expanded across the river, a trail bridge would be used to provide access to the Toutle Trail, and between campground nodes. Camp sites would be located outside of riparian zones, away from the river. Vehicle access on the south side of the Kalama River would mostly follow existing roadways. Horse camping at dispersed camp sites along Roads 81 and 8123 would be terminated following campground expansion.

C. Appropriate timing, sequencing, and general location. Show priorities for sub-basins.

Campground expansion would occur in Sub-basins 2 and 6. Expansion would be based on acquisition of funding for analysis, survey, design, and construction. The project would compete with other regional projects for funding.

D. The anticipated rates and time frames for achieving the management objectives.

Project implementation would be expected within ten years.

Commodities and Development:

ROAD PAVING

A. What is it?

Road 81, and to a lesser extent Road 8123 are carrying traffic loads in excess of design capacity. These gravel surface roads rapidly develop potholes and washboard following grading. Dust obscures visibility between vehicles and settles on vegetation creating an undesirable visual impact. These factors detract from the recreation experience of visitors to the Mount St. Helens National Volcanic Monument.

Sediment carried by runoff from Road 81 is accumulating in the riparian zone on the north shore of McBride Lake.

B. Ecosystem conditions and/or functions that would be altered, maintained or restored?

The remaining unpaved segment of Road 81 would be paved to improve recreation experience, and reduce environmental impacts. In the interim the road maintenance level will be increased on Roads 81, and 8123 to allow surface rock replacement and more frequent maintenance.

C. Appropriate timing, sequencing, and general location. Show priorities for sub-basins.

The segment of Road 81 requiring paving is located in Sub-basins 1 and 2. Maintenance levels will be increased on Roads 81, and 8123 in Sub-basins 1 and 2..

D. The anticipated rates and time frames for achieving the management objectives.

Road 81 must compete with other projects for funding, but the goal is to have paving completed by the year 2001. Maintenance levels on Roads 81, and 8123 will be increased to allow improved maintenance starting in 1997.

Riparian Reserve Widths: Interim Riparian Reserve Widths

The current condition of the riparian reserves is not conducive to reducing the interim widths that have been established by the ROD. Currently five sub-basins in the analysis area have more than 30 percent of the stream Riparian Reserves harvested, which is an indication of some widespread impaired condition. This decision should be revisited in future iterations of watershed analysis, to assess recovery of the entire area and determine if the Riparian Reserves are in a sufficiently recovered condition to consider reducing the width. NOTE: the Riparian Reserve land allocation applies only to National Forest land in the watershed.

Table 14 Recommendations by Sub-basin

Sub-basin	Restoration							Monitoring										Commodities/ Development						
	Road Decommissioning	Road Weatherization	Silviculture of Uplands	Silviculture of Riparian	Stream Enhancement *	Erosion Control/Slope Stab	Cooperative Restoration	No. of Vehicles on Roads	Goat Marsh RNA - Rec and Weeds	Stream Temperature	Stream Surveys *	Fish Surveys *	Amphibians	Riparian Reserve Rehab	Verify Ecological Inventory	Road Condition Surveys	Peregrine Falcon Surveys	Mountain Quail Surveys	Dispersed Camping Management	Winter Recreation Parking	Horse Camping Capacity Increase	Road Paving	Riparian Reserve Widths	
1 McBride								X											X			X		
2 Goat								X											X			X		
3 East Fossil	X			X	X	X	X		X	X				X	X	X								
4 North Fossil	X	X		X	X	X	X		X	X				X	X	X								
5 Lower Fossil									X	X				X	X	X								
6 Lower Kalama																				X				
7 Dry	X			X			X				X		X		X	X			X	X				
8 Merrill Lake							X							X	X	X								

* Recommendation for NF Lands Only



APPENDIX A

GLOSSARY



GLOSSARY

303(d): Sections of rivers, coastal waters, estuaries, and lakes that don't meet the state of Washington water quality standards. These standards include temperature, bacteria, siltation, oxygen levels, nutrients, and toxic compounds or heavy metals. These sections are identified by the Washington State Department of Ecology as a result of the Clean Water Act.

C-3 species: Old-growth associated species identified in the ROD to be protected through survey and management standards and guidelines. Four Survey Strategies have been identified in the ROD:

- 1: manage known sites
- 2: survey prior to activities and manage sites
- 3: conduct extensive surveys and manage sites
- 4: conduct general regional surveys

DBH: Diameter of a tree at breast height.

Guild - Groups of wildlife species that would be expected to react to different distributions and amounts of habitats in similar ways.

Limits of Acceptable Change (LAC): A pre-determined threshold or limit to the amount a site or area can change without exceeding acceptable standards for that site or area..

People At One Time (PAOT): The capacity of a recreation site in terms of People-At-One-Time (PAOT). The number of people that can use the area all at the same time.

Policy Implementation Guide (PIG): This refers to the Columbia River Basin Policy Implementation Guide which was developed in 1991 to document the implementation schedule for salmon restoration in the Columbia River Basin.

President's Forest Plan Allocations:

LSR - Late Successional Reserves - Lands with objectives to protect and enhance conditions of late-successional and old-growth forest ecosystems, which serve as habitat for late-successional and old-growth forest related species including the northern spotted owl.

Riparian Reserves - As a key element of the Aquatic Conservation Strategy (ROD, page B-9), the Riparian Reserves provide an area along all streams, wetlands, ponds, lakes, and unstable and potentially unstable areas where riparian dependent resources receive primary emphasis.

Matrix - Those federal lands not designated in other categories. Most timber harvest and other silvicultural activities would be conducted in that portion of the Matrix with suitable forest lands, according to standards and guidelines.

Large Woody Debris: Pieces of wood larger than 50 feet long and 36 inches in diameter at the large end.

Mass Wasting or Mass Movement: Dislodgement and downslope transport of earth material as a unit under direct gravitational stress. The process includes slow displacements such as creep and rapid movements such as landslides, rock slides, and falls, earthflows, debris flows and avalanches. Agents of fluid transport (water, ice, air) may play a subordinate role in the process.

Monitoring: A process of collecting information to evaluate if objective and anticipated or assumed results of a management plan are being realized or if implementation is proceeding as planned.

Reference Conditions: Those conditions which describe the known or inferred history of the landscape so we may know what was sustainable in the past and what changes have occurred to affect sustainability.

Refugia: a region of relatively unaltered conditions that remains as a center of relict forms of plants and animals that may re-colonize adjacent impacted habitats as they become suitable. Singular: refugium.

Seclusion Habitat - Refers to habitat for grizzly bears and gray wolves that is more than one mile from a road open to motorized vehicles.

Sediment: Solid material of any size, both mineral and organic, that is in suspension and is being transported from its site of origin by air, water, gravity, or ice, or has come to rest on the earth's surface either above or below sea level.

Survey strategy: One of four survey strategies for C-3 species identified in the ROD. See C-3 for explanations of strategies.

Wilderness: Undeveloped federal land retaining its primeval character, without permanent human habitation or improvements. It is protected and managed to preserve its natural condition. Wilderness areas are designated by an act of Congress.

APPENDIX B
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APPENDIX B REFERENCES

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APPENDIX C
ISSUES AND KEY QUESTIONS



APPENDIX C ISSUES AND KEY QUESTIONS

Issue: Mass Wasting

The Upper Kalama River has numerous landslides and debris flows within its boundaries. Management activities may have activated or worsened a number of these features, sometimes impacting streams. The major storm event of February 1996, which caused numerous landslides and debris torrents, demonstrated the magnitude these recurring disturbances can attain.

Key Questions:

1. Is there evidence of, or potential for, mass wasting in the watershed?
2. What mass wasting processes are active?
3. How are mass wasting features distributed throughout the landscape?
4. What physical characteristics are mass wasting features associated with?
5. Do landslides deliver sediment to stream channels or other waters?
6. Do forest management activities create or contribute to instability?
7. What areas of the landscape are susceptible to slope instability?

Issue: Surface Erosion From Roads

Surface erosion from roads has been a major contributor to sedimentation to streams in the past. New construction and within the first two to three years is when most of the sediment is transported. After this time growth on the fill slopes and cut slopes help alleviate this problem but in areas near stream crossings the problem can continue to influence stream habitat for many years. Poor construction practices in the past have created numerous problems recently from fill slope failures that directly and indirectly move sediment into many streams. This is especially evident since the storm event of

February 1996.

Key Questions:

1. What are the roads' erosion potential?
2. Are contributing activities present?
3. Is sediment delivered to streams?
4. What roads are sensitive to forest practices?
5. What is the potential effect of sediment on public resources?
6. What is the baseline sediment level?
7. What are the amounts and types of sediment contributions from forest practices?

Issue: Impact of Unpaved Roads

In the past, unpaved roads have been a major source of sedimentation to streams. Poor construction practices of the past have created fill slope failures that directly and indirectly move sediment into streams and lakes. This was particularly evident following the storm event of February 1996. Dust from unpaved roads can obscure the view of motorists, and settle on roadside vegetation degrading scenic quality. Gravel roads are subject to washboarding, potholes, and require frequent maintenance.

Key Questions:

1. What are the road' erosion potential?
2. Is sediment delivered to streams and lakes?
3. Which roads are delivering sediment to lakes and streams?
4. Are any roads receiving use beyond their design capacity?

Issue: Riparian Reserve Habitats and Fragmentation

Some critical components of terrestrial habitat within the Riparian Reserves have been altered. This influences the capability of these ecosystems to provide effective habitat for riparian dependent plant and animal species, and other species that may use Riparian

Reserves as habitat connections between larger habitat blocks.

Key Questions:

1. What is the current distribution of age classes, and stand structure types within Riparian Reserves?
2. Where are Riparian Reserves inadequate in providing dispersal habitat for species of concern?

Issue: TES and C-3 Plant Species

The Endangered Species Act and the Northwest Forest Plan mandate that we monitor for threatened, endangered, and sensitive (TES), and late successional dependent (C-3) plant species respectively. Less than about 5% of the watershed has been surveyed for TES species, and none of the watershed has been surveyed for C-3 species.

Key Questions:

1. Which TES species are present, and where?
2. Which TES and C-3 species are likely to occur, and in which habitats?
3. Has habitat fragmentation impacted TES or C-3 population viability?
4. How can population viability of TES and C-3 species be monitored?
5. Has disruption of dispersal corridors impacted population viability?

Issue: Habitat Condition for TES Animal Species

The watershed contains suitable or potentially suitable habitat for threatened, endangered and sensitive animal species including spotted owl, peregrine falcon, gray wolf, bald eagle, Townsend's big-eared bat, and Larch Mountain salamander.

Key Questions:

NORTHERN SPOTTED OWL:

1. Where are spotted owl activity centers located in the watershed? In which Northwest

Forest Plan allocation are they located? Which of these activity centers are currently above “take” thresholds?

PEREGRINE FALCON:

1. Are there suitable cliff sites in the watershed?
2. Are any of these sites historical or current peregrine falcon eyries?

GRAY WOLF:

1. Does any part of the watershed contribute to a portion of a wolf/pack territory?
2. What is the density and distribution of roads and trails in the watershed?

TOWNSEND’S BIG-EARED BAT:

1. Are there hibernacula, roost, or maternity sites in the watershed, and generally where are they located?
2. Is recreational use at these sites affecting habitat suitability?
3. Are any of these sites located in areas that could be affected by future projects?

LARCH MOUNTAIN SALAMANDER:

1. Are there known Larch Mountain salamander populations in the watershed?
2. Are any of these sites located in areas that could be affected by future projects?
3. Is recreational use at these sites affecting habitat suitability?

Issue: Hydrologic Changes

Past disturbances such as volcanoes in the analysis area may have influenced basin hydrology by increasing peak flows during fall and winter storms, and decreasing summer low flows. Human activities have occurred throughout the watershed, and may influence the timing and quantity of runoff as well.

Key Questions:

1. What are the current watershed conditions influencing hydrologic response?
2. How do management activities and past disturbances influence stream-flow regimes? Where are these influences occurring?

3. What is the history of floods and disturbance of hydrological significance?
4. What is the effect of changes in water available for runoff of flood peaks?
5. What is the future trend of the basin hydrology?
6. Are there any restoration and/or monitoring possibilities?

Issue: Water Quality and Key Habitat Attributes for Resident and Anadromous Salmonids.

Current aquatic habitat conditions are a result of past natural and human induced processes that have occurred in the watershed. Road building, timber harvest, and increased human populations in the watershed have through time altered stream habitats and aquatic communities. Degraded water quality from sediment and high water temperatures may be affecting habitats for cutthroat trout and rainbow trout, and downstream anadromous fishes. State water quality regulations are in place to protect existing and designated uses of water (i.e., beneficial uses). Due to time and analysis information limitations the focus will be on fish spawning and rearing.

Key Questions:

1. What is the current and historic range, and species composition of salmonids in the analysis area.
2. What is the current condition of the following key habitat and beneficial use attributes: Pools per mile, Large Woody Debris (LWD) per mile, and stream temperature.
3. Are any of these habitat variables of concern given the current condition? If so, where are these areas of concern?
4. Where have natural flows through the aquatic system (salmonids, LWD, sediment, etc.) been altered by human activities? How has this affected the connectivity of the aquatic system?
5. Where are the current sources of large woody debris? What were the past sources of large woody debris?

6. Are there habitat areas that have been degraded, that have a high potential for restoration and or monitoring activities?
7. What is the future trend of habitat quantity and quality for salmonids in this watershed?

Issue: Dispersed Camping

Dispersed camping is popular along roads 81 and 8123 during the summer season and in the fall during hunting season.

Key Questions:

1. Is dispersed camping compatible with management of the National Volcanic Monument?
2. What is the impact of off road vehicle access to dispersed camp sites.
3. Has closure of dispersed camp sites on adjacent privately owned lands increased demand for camping on national forest lands?
4. Are commercial permittees creating a dispersed camping impact?

Issue: Winter Recreation Parking

The Kalama Ski Trail terminates at Kalama Horse Camp. Plowed parking has not been provided at this site since 1988.

Key Questions:

1. What is the demand for winter access to snow trails within the watershed?
2. Is additional winter access needed to meet current and future demand for winter recreation?
3. Would wildlife be impacted by development of plowed winter access.

Issue: Horse Camping Capacity

The Mount St. Helens Comprehensive Management Plan directed development of a system of

horse trails, and the development of Kalama Horse Camp, to provide an opportunity for equestrian use of the National Volcanic Monument.

Key Questions:

1. Do existing facilities provide adequate camping capacity for equestrians?
2. Has limited campground size forced users to use nearby dispersed camp sites?

Issue: Recreation use in Goat Marsh RNA

The Goat Marsh Research Natural Area was established for the purpose of preserving a unique Cascade Mountains habitat for research and scientific study. The RNA is popular for hunting, fishing, and limited horse back riding. Some camping occurs adjacent to Goat Marsh Lake. .

Key Questions:

1. Is recreation use compromising the purposes for which the research natural area was established?



APPENDIX D

**LIMITATIONS OF THE ANALYSIS, CONFIDENCE IN THE ANALYSIS,
DATA GAPS, AND IMPLICATIONS OF THESE LIMITATIONS FOR
MANAGEMENT**



APPENDIX D

LIMITATIONS OF THE ANALYSIS, CONFIDENCE IN THE ANALYSIS, DATA GAPS, AND IMPLICATIONS OF THESE LIMITATIONS FOR MANAGEMENT

Terrestrial Vegetation Analysis - By Chiska Derr, Botanist and Cassius Cash, Wildlife Biologist

Confidence in Analyses

This section identifies concerns about the quality and accuracy of data that were used to analyze this watershed. All data came from GIS files; there was no ground verification of the numbers or categories produced by GIS.

The GIS vegetation layers were created primarily from timber inventory data and photo interpretation. The GIS specialist estimated that more than half of the total Central Skills Center vegetation layer was based on photo interpretation, and has never been ground verified. Timber inventory data are not ecological data. Unfortunately, as the only data we have, they were used to make the ecological interpretations within this document. Each issue is rated based on confidence in data, and data gaps and limitations.

Issue: Stand Structure and Composition

Confidence: LOW to MODERATE

Discussion: Nearly half of the watershed is in non-Federal land ownership. Many of these lands have been or will be managed for intensive timber harvest. There are no data on stand structure and composition other than what can be inferred from a few aerial photographs, which inhibited analysis at the watershed level.

Data Gaps:

- * none of the GIS stand structure data were field verified
- * none of the GIS stand composition (ecoclass) data were field verified
- * no comprehensive plant inventories have been conducted
- * there are limited data for non-Federal lands

Issue: Riparian Reserve Fragmentation

Confidence: LOW to MODERATE

Discussion: The nature of the data, and lack of field verification, lead to this rating. The lack of data for riparian corridors on non-Federal lands restricted our ability to evaluate riparian corridors at the watershed level

Data Gaps:

- *baseline data on intact stream and wetland riparian functions are lacking for comparison with riparian areas whose functions we will be “restoring”
- *baseline data on many riparian-dependent vascular plants and lichens, bryophytes and fungi species are lacking
- * there are no data for riparian corridors on non-Federal lands

Issue: TES and C-3 Species

Confidence: LOW to MODERATE

Discussion: The lack of data on C-3 species constitutes a data gap. Because some data exist for TES species, confidence in that analyses is low to moderate. The lack of data on non-Federal lands constitutes a data gap.

Data Gaps:

- * few general surveys for TES species have not been conducted
- * none of the watershed has been surveyed for C-3 species
- * ecological and distributional data are lacking for TES and C-3 species
- * there are no data on TES or C-3 species on non-Federal lands

**Threatened, Endangered, and Sensitive Wildlife - by Mitch Wainwright, Wildlife Biologist
and Cassius Cash, Wildlife Biologist**

Confidence in Analysis - Low to Moderate

My confidence in the acreage figures of the different structure stages within the watershed is moderate because a majority of the data has not been verified on the ground. However, I think the data is sufficiently accurate to be able to make the conclusions in the analysis, and these conclusions would not radically change if more accurate data were available.

Data Gaps:

Except for spotted owl, there is little to no survey information for the species analyzed in the watershed. There is little information available on the effects of riparian habitat fragmentation on the species discussed. There is no established threshold for what would be excessive fragmentation for most species.

A large portion of the watershed is in non-Federal ownership, and data for these lands is totally lacking. Again, except for spotted owl surveys on State land, there is no or very little survey information.

Hydrologic Condition - by Mark Kreiter, Hydrologist

Confidence in analysis - **Moderate-Low**

Limitations of the analysis - Limitations of this analysis include:

- Entire analysis was modeled using GIS data. No field verification of vegetation data was done to determine the accuracy of the information.
- Coefficients for the model were regional coefficients in some cases. Using coefficients that are not generated from the analysis area lowers the models accuracy.
- Assumptions in the model decrease the reliability of the resulting data. The model makes assumptions like the two year storm is responsible for the 2 year flood. This is rarely true in this area.
- The peak flow portion of the beneficial use analysis could not address channel bed scour, which is very important in determining quality of spawning and rearing habitat.
- Confidence is low for analysis in sub-basins 4, 5, 6, and 7 because DNR model only considered National Forest land due to lack of vegetation data for private and other land in the geographic information system database. Confidence is low in sub-basin 8 because all of it is non-National Forest and was estimated using air photos.

Data Gaps

- There is a need for field verification of the vegetation layer to improve the accuracy of the data.
- Field data that was pertinent to hydrologic interpretations such as width/depth ratios, pebble counts, v* was missing. This needs to be collected as part of stream surveys.
- There is a need to complete level II road surveys so possible restoration opportunities can be identified.
- A detailed review of the location of class IV streams is needed.
- There is a need to acquire vegetation data (crown closure, DBH, tree species) for non-National Forest lands.

Key Aquatic Habitat Attributes, and Aquatic Habitat Fragmentation - by Steve Lanigan, Fisheries Biologist

Confidence Estimates

Following is a discussion of the confidence in the analysis, limitations of the analysis, data gaps, and implications of these limitations for management. This discussion is presented by analysis group (LWD/Mile and LWD recruitment, Primary Pools/Mile, Sediment and Stream Temperature, and Aquatic Habitat Fragmentation).

LWD/Mile

Confidence in analysis: **Low - High**

Limitation of the Analysis include:

Data for this analysis came from the districts stream survey files and database. There is a moderate confidence in the original data collected due to the protocol used to identify large pieces of wood (i.e., visual estimation of size) during the stream surveys. This is an acceptable level of confidence. Data is available for approximately 91 percent (10 miles) of the fish bearing streams in the Watershed on USFS lands. No streams on private lands have been surveyed. Using this limited amount of data compromises the confidence.

Standards have been set at the Regional level, however, no watershed or basin wide analysis has been completed to verify these standards for this area. The stream channels in this area are high gradient channels that transport material such as wood and sediment fairly quickly. A standard of 80 pieces per mile may be too high, based on the channel morphology of this watershed.

LWD Recruitment - by Steve Lanigan, Fisheries Biologist

Limitation of the Analysis include:

Recruitment potential of LWD was based the percent streamside riparian area harvested. GIS data were used for USFS lands. The confidence in this portion of the analysis is high. Aerial photos were examined to estimate the percent riparian harvest on non-USFS lands. The confidence for this analysis is also high.

Data Gaps:

- Stream surveys cover primarily fish bearing sections of stream, class IV channel tributaries and many class III tributaries are not surveyed.

- No watershed or basin wide standards for habitat quality.
- No riparian area specific vegetation inventories are available
- No pristine stream survey data to develop relationships between current conditions in managed sub-basins with those in un-managed sub-basins.
- No data have been collected on Private Land within the watershed.

Implications for Management:

Managers need to consider the small amount of data and the lack of data available for this analysis, and recognize that this analysis is not complete and needs to be verified in the field at the sub-basin level, before management decisions are made.

Primary Pools/Mile - by Steve Lanigan, Fisheries Biologist

Confidence in analysis - Low - Moderate

Limitation of the Analysis include:

Data for this analysis came from the districts stream survey files and database. There is a moderate confidence in the original data collected due to the protocol used to identify pool size (i.e., visual) during the stream surveys. This is an acceptable level of confidence. Data is available for approximately 91 percent (10 miles) of the fish bearing streams in the Watershed on USFS lands. No streams on private lands have been surveyed. Using this limited amount of data compromises the confidence.

Standards have been set at the Regional level, however, no watershed or basin wide analysis has been completed to verify these standards for this area. The stream channels in this area are high gradient channels with many small pocket pools that may not meet the requirements of a primary pool as identified in the survey protocol. The standard is based on the width of the stream channel however, gradient and channel morphology are not considered.

Data Gaps:

- No pristine stream survey data to develop relationships between current conditions in managed sub-basins with those in un-managed sub-basins.
- No data has been collected on Private Land within the watershed.

Implications for Management:

Managers need to consider the small amount of data and the lack of data available for this analysis, and recognize that this analysis is not complete and needs to be verified in the field at the sub-basin level, before management decisions are made. Consideration also needs to be given to the fact that until pool standards are developed at the watershed scale for each watershed in the Forest we will not have an accurate picture of the severity of the existing situation.

Sediment and Stream Temperature - by Mark Kreiter, Hydrologist

Confidence in analysis - **Low-Moderate**

Limitations of the analysis - Limitations of this analysis include:

Stream channel analysis was limited to identification of response reaches by conducting a level 1 Rosgen stream channel classification. No historic air photo interpretation was conducted, so actual channel conditions, channel sensitivity, and reference conditions were not determined.

Stream temperature analysis only used existing data available at the time of the analysis. This was limited to mostly grab samples in the analysis area.

Data Gaps:

Stream temperature data was not available for a majority of the streams in the analysis area.

Field data that was pertinent to hydrologic interpretations such as width/depth ratios, pebble counts, v^* was missing. This needs to be collected as part of stream surveys.

Historic and reference information on stream temperatures and other physical stream channel parameters such as pools per mile and amounts of LWD is lacking for this area.

There is a need to complete level II road surveys so possible restoration opportunities as well as potential sediment sources can be identified.

Implications for Management:

Management decisions relating to activities such as restoration or timber harvest will not be as fully informed using this general information. Accurate identification of priority restoration areas may be less likely without the more specific information, due to the lack of establishment of cause and effect relationships. We might focus restoration for sediment control in a sub-basin that has high activity levels and generates some sediment, and miss the sub-basin that has less activity but generates large amounts of sediment.

Aquatic Habitat Fragmentation - by Steve Lanigan, Fisheries Biologist

Confidence in analysis - **Moderate - Low**

Limitation of the Analysis include:

This analysis was done using GIS data for road/stream crossings. It assumes that every stream crossing fragments the aquatic habitat. It assumes that none of the crossings are bridges which would presumably have less of an impact to the aquatic environment, and would allow a natural flow of sediment, wood, and organisms. It also assumes that all the roads and streams are present in the database. There are however, many small spur roads that are not currently in the database. There may be streams that are missing, from the database, however, this GIS layer was recently updated. The analysis uses an index value of 1.5 crossing per stream mile as a critical value. This number represents approximately one-third of the data values for the Lewis River Watersheds done to date. However, there is no basis for this value in the literature.

Data Gaps:

- Database without all the roads present
- Database without all the streams present
- Information on culverts and whether they pass fish is not available.
- Information on the condition of roads on Private Land within the watershed is not available.

Implications for Management:

This analysis is a surrogate for quantifying the amount of impact created by the number of roads in the watershed on the aquatic ecosystem. The analysis is logical, and serves a purpose for identifying the impacts, however it is a surrogate and has many assumptions about the impacts that roads and their management have. It should also be noted that this surrogate is intuitive in nature and has not been peer-reviewed or evaluated under strict scientific standards.

Human Dimension - by Jim Nieland, Recreation Planner

Confidence in Analysis - High

Limitations of the analysis Include:

Additional recreation use occurs in the watershed which was not analyzed. This includes hiking, fishing, driving for pleasure, mountain climbing, and hunting. These activities contribute to annual use, but appear to be adequately serviced by existing developments.

Data Gaps:

- Cultural and historic resource have only been surveyed for in conjunction with recent recreational developments, or timber sales. Much of the planning area has not been investigated for these resources.
- Baseline data on the impact of recreation use on natural resources has not been developed. Impacts caused by camping and trail use have not been monitored or evaluated except in isolated instances.

Implications for Management:

With a lack of baseline data on natural resources, it is possible for impacts to accumulate over time. These impacts may eventually require changes in recreation use management or rehabilitation of impacted areas. Dispersed camping along Roads 81 and 8123 appear to be creating adverse impacts. An analysis of this use and management of the activity are warranted.



APPENDIX E

VEGETATION STAND STRUCTIURE DEFINITIONS



STAND STRUCTURE DEFINITIONS FOR GPNF

Chiska Derr, Mt. St. Helens Botanist
10 July 1996

Stand structure/seral stage definitions have been developed for Western Oregon and Washington based on a number of different criteria (Hall et al. 1985). Structure definitions based in part on above work combined with Forest stand data available in the vegetation database are briefly described below (as based on the 1/11/95 seral meeting). Ecoclasses are specified based on potential plant associations (Brockway et al. 1983; Topic et al. 1986; Topic 1989). Major tree species can be a single species or combinations of conifer species present on the Gifford Pinchot National Forest, and are not specified.

Acceptable ecoclass codes for below stages are for coniferous forest only (codes that start with "C").

Grass/Forb /Seedling

Early seral. **Conifer openings** dominated by grasses, forbs, some shrubs and conifer seedlings less than 4.5' tall (or diameter breast height (dbh) less than 1.0 inches), either of natural or human origin. Pioneer species dominate and species richness is often high. Provides foraging opportunities but no cover. Condition typically lasts two to five (occasionally 10) years.

Shrub/Seedling

Early seral. **Coniferous** stands dominated by shrubs, and a mixture of conifer seedlings and saplings (0-20' tall, 0 to 4.9 inches dbh); natural or human origin. Pioneer species dominate and species richness is high. Provides foraging opportunities but no hiding/thermal cover. Condition typically lasts 3 to 10 years, but may persist 20 to 30 years if tree regeneration is delayed. **May provide hiding cover depending on height and density of shrubs and trees.**

Remnant Forest (Light Forest)

Early seral; ecoclass either western hemlock, Douglas-fir, or western red cedar. Stands with little understory development (grass and forbs present) and an open canopy (0% to 40% cover) of large trees. Cover results from residual conifers larger than 21 inches dbh. These stands are commonly a result of recently harvested shelterwood, or green tree retention units. Provides foraging opportunities, limited thermal protection, and may provide hiding cover. Also provides propagules of C-3 lichens and bryophytes, as well as habitat for C-3 lichens, bryophytes, fungi, arthropods and mollusks.

Open Sapling/Pole

Early seral. **Coniferous** stands with an open canopy (0% to 40% cover) that are dominated by sapling and pole-sized conifers of 4.5 feet tall up to 9" dbh. A shrub dominant understory is common. Provides some forage and limited

hiding/thermal cover. Condition may last from 8 to 20 years, sometimes longer, depending on tree crown closure and subsequent stand treatment.

Closed Sapling/Pole

Early to mid seral. **Coniferous** stands with a closed canopy (40% to 100% cover) that are dominated by sapling and pole-sized conifers of 4.5 feet tall up to 9" dbh. Ground vegetation dwindles during this stage as crowns of individual trees coalesce. Tree live crown ratios become reduced as lower limbs die back from lack of sunlight. Plant diversity is generally low at this stage as dense tree cover shades out many remaining pioneer species. A shift towards shade tolerant species may become more evident later in this structure stage. Structural diversity is also quite low. The scarcity of ground vegetation limits forage, and crowded trees can reduce accessibility of stand to wildlife for cover, **but can provide some hiding cover**. This stand condition can persist between 40 and 100 years.

Open Small Tree

Early to mid seral. **Coniferous** stands with less than 70% canopy closure AND meeting one of the following size criteria:

- 1) Ecoclass either western hemlock, Douglas-fir, western red cedar, or grand fir and dominated by trees with stand average dbh between 9 and 20.9 inches,
- OR: 2) Ecoclass silver fir, mountain hemlock, lodgepole pine, park-like mountain hemlock/subalpine fir, or Engelmann spruce, with stand average dbh between 9 and 18 inches.

The open canopy enhances understory development and wildlife forage and cover; **stands with over 40% canopy cover provide dispersal habitat for spotted owls**. Stands with 60-70% canopy closure provide thermal cover.

Closed Small Tree

Early to mid seral. **Coniferous** stands with 70% or greater canopy closure AND meeting one of the following size criteria:

- 1) Ecoclass either western hemlock, western red cedar, Douglas-fir, or grand fir and dominated by trees with stand average dbh between 9 and 20.9 inch dbh,
- OR: 2) Ecoclass silver fir, mountain hemlock, lodgepole pine, park-like mountain hemlock/subalpine fir, or Engelmann spruce, and stand average dbh between 9 and 18 inches.

Poor understory development and tree density limit wildlife habitat usefulness, **although some thermal cover and dispersal habitat for spotted owls is provided**. Ground vegetation is minimal. Length of time in this condition may range from 40 to 100 years or even longer in high elevation stands.

Large Tree Single Story

Mid to late seral. Closed **coniferous** canopy (between 40% and 100%) with only one canopy layer AND one of the following two criteria:

- 1) Ecoclass either western hemlock, western red cedar, Douglas-fir, or grand fir and stand average dbh greater than 21 inches,

OR: 2) Ecoclass silver fir, mountain hemlock, lodgepole pine, park-like mountain hemlock/subalpine fir, or Engelmann spruce, and stand average dbh greater than 18 inches.

These stands are the result of large-scale disturbances (fire, windthrow, volcanic activity, timber harvest) and have limited understory development. Typically they lack snag development and downed woody material limiting their **current quality** as wildlife habitat (Hall et al. 1985), **although they do provide thermal cover and dispersal habitat. These stands have excellent potential for restoration activities to mimic old-growth conditions.**

Large Tree Multi-Storied

Mid to late seral. Closed **coniferous** canopy (between 40% and 100%) with two or more canopy layers AND one of two following size criteria:

1) Ecoclass either western hemlock, western red cedar, Douglas-fir, or grand fir and stand average dbh greater than 21 inches,

OR: 2) Ecoclass silver fir, mountain hemlock, lodgepole pine, park-like mountain hemlock/subalpine fir, or Engelmann spruce, and stand average dbh greater than 18 inches.

Stand structure is high in these stands (various size and layers of trees, snags, down wood). Plant diversity is also high in many cases and strongly favors shade tolerant species. Stands of old-growth are included in this category. When this stand structure is present and Douglas-fir and western hemlock codominate, optimum wildlife habitat conditions can be met (Hall et al. 1986), including thermal cover, snow interception, and optimal nesting, foraging and roosting habitat for owls.

Hardwood Shrub/Seedling

Early seral, areas where ecoclass is a hardwood type ("H" codes). Does not include areas that are of coniferous forest climax that currently have an abundance of hardwoods. Dominated by hardwood species less than 4.9 inches dbh. Typically occurring on wet or bottomland soils and/or those closely associated with riparian areas and channel disturbance regimes. When alder is present, soil is enriched by nitrogen input. Provides good habitat for birds and other small wildlife species. When deciduous shrubby hardwood pockets are interspersed within larger conifer stands, they provide valuable seasonal canopy gaps and enhance C-3 lichen and bryophyte habitat and diversity (Neitlich & McCune 1995).

Hardwood Sapling/Pole

Early seral. Areas where ecoclass is a hardwood type ("H" codes). Does not include areas that are of coniferous forest climax that currently have an abundance of hardwoods. Stands are dominated by young hardwood trees between 4.9 and 8.9 inches dbh; small conifers may be present, but are not dominant. Typically occurring on wet or bottomland soils and/or those closely associated with riparian areas and channel disturbance regimes. When alder are present, soil is enriched by nitrogen input (up to 320 kg/ha/yr; Pojar & MacKinnon 1994). Provides good habitat for birds and other small wildlife species. When pockets of deciduous hardwood saplings and poles are interspersed within larger

conifer stands, they provide valuable seasonal canopy gaps and enhance C-3 lichen and bryophyte habitat and diversity (Neitlich & McCune 1995).

Hardwood Trees: Large & Small

Mid seral. Areas where ecoclass is a hardwood type ("H" codes). Does not include areas that are of coniferous forest climax that currently have an abundance of hardwoods. Hardwood trees with dbh 5 inches and larger. Conifers may be present, but are not dominant. Typically occurring on wet or bottomland soils and/or those closely associated with riparian areas and channel disturbance regimes. When alder are present, soil is enriched by nitrogen input. **Important habitat for many neotropical migrant birds; provides ungulate forage and hiding cover.** When pockets of deciduous hardwood saplings and poles are interspersed within larger conifer stands, they provide valuable seasonal canopy gaps and enhance C-3 lichen and bryophyte habitat and diversity (Neitlich & McCune 1995). Bigleaf maple host the largest biomass of canopy epiphytes in the Pacific Northwest (Pojar & MacKinnon 1994), and can function as epiphyte refugia as conifer development increases.

Water

Water covered areas including lakes, ice, running water, and intermittent streams and rivers.

Wet/Mesic

Non-forested wetlands including wet/moist shrub, forb, grass meadows. Wetlands contribute to biodiversity by providing habitats for unusual plants and animals; they also play many important hydrologic roles.

Dry Meadow/Shrub

Non-forested dry habitats including dry grasslands, meadows, shrublands, and alpine meadows and shrublands with less than 10% conifer canopy. These are naturally occurring habitats that provide valuable foraging habitat, travel corridors and connectivity between habitats.

Rock

Non-vegetated land with less than 10% potential plant cover. Can provide travel corridors and connectivity between habitats.

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