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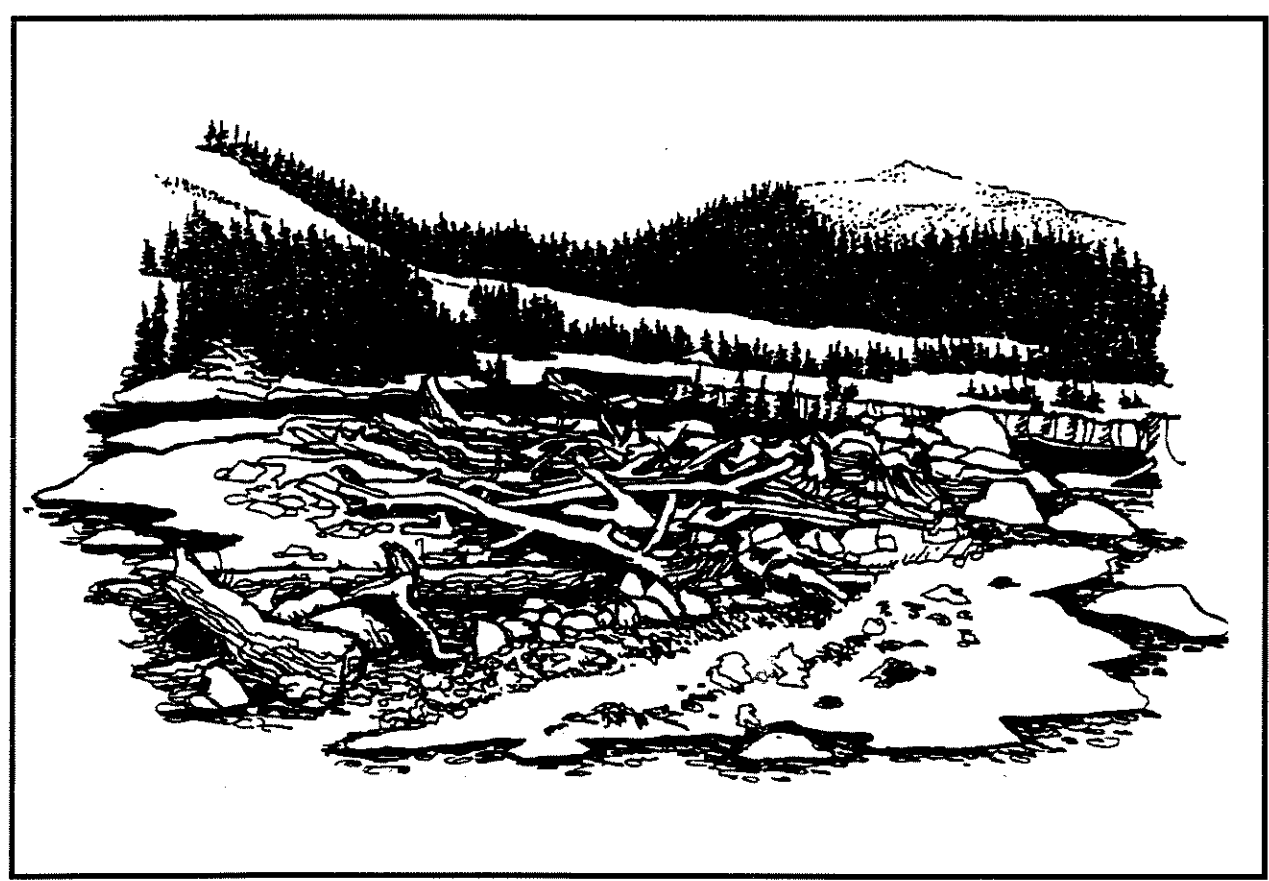
Forest Service

Pacific
Northwest
Region



Upper Toutle River Watershed Analysis

Gifford Pinchot National Forest





Upper Toutle River Watershed Analysis

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

September, 1997



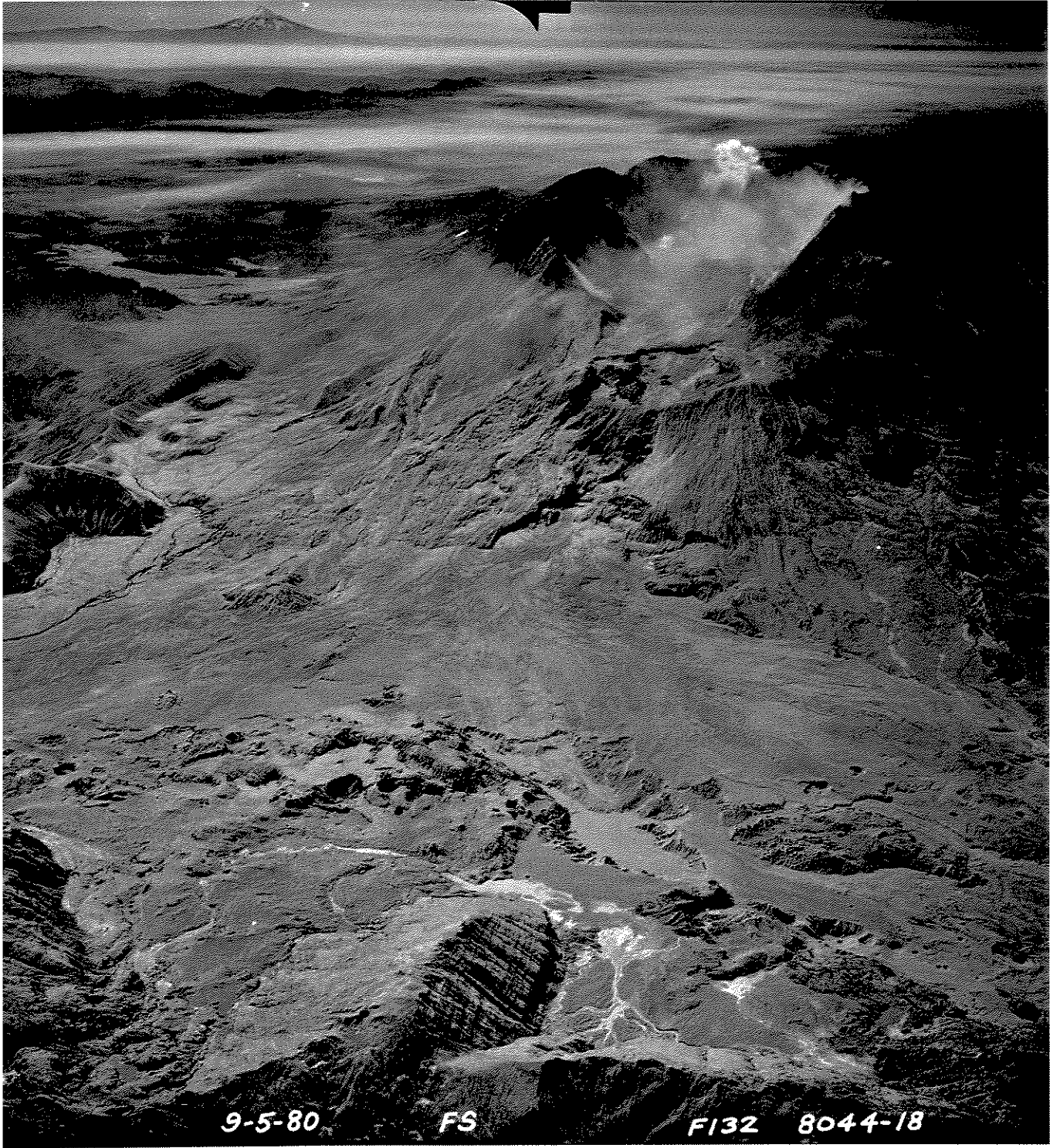


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EXECUTIVE SUMMARY

Introduction

The 109,557-acre Upper Toutle River Watershed is comprised of National Forest (73,302 acres) and private (36,255 acres) ownership. The area has been divided into 9 sub-basins for analysis by an interdisciplinary team.

In this first iteration of analysis, the following eleven issues are analyzed: Mass Wasting; Surface Erosion from Roads and Upland Slopes; Fire History; Vegetation Structure and Composition; Sensitive and C-3 Plant Species; Habitat Condition for TES, C-3, and Cavity-Dependent Animal Species; Hydrologic Changes; Water Quality and Key Habitat Attributes for Resident and Anadromous Salmonids; Completion of Trail System and Trail Connectors; Recreational Road Access; and Resource Impacts from Recreation Use.

Characterization

The Upper Toutle River and its tributaries drain the northern slopes of Mount St. Helens and the immediately adjacent lands to the west.

The Upper Toutle River watershed primarily developed from volcanic and glacial geologic processes and has been shaped by recent wind and rain erosional processes working on the surface deposits. Heavily influenced by the eruptive history of Mount St. Helens in the southern part of the watershed, most of the northern part of the area was formed as volcanic intrusive (molten material that cooled before reaching the surface). Surrounding this intrusive mass is older tertiary rock. Management activities (primarily roading) have contributed to extensive debris flows and mass wasting during recent storms. Elevations range from 1,360 feet at the North Fork of the Toutle River to 8,298 feet at the crater rim of Mount St. Helens. Drained by the North and South Forks of the Toutle River, the Green River, and their tributaries, the watershed is vegetated by coniferous forest plant associations which provide habitat for 256 wildlife species.

Due to the periodic eruptions of the volcano and the associated ash falls, major catastrophic fire is extremely infrequent, occurring in the range of 750 to 1,000

years. Since 1920, very little of the watershed has burned from wildfire.

Current Conditions

Unstable and potentially unstable ground is mapped throughout the watershed, with Sub-basin 5, South Coldwater Creek, having greater than 28 percent of its area occupied by lands in these categories. The other eight sub-basins have considerably less unstable ground. Mass wasting and surface erosion from sensitive tephra deposits have contributed large amounts of sediment to streams particularly in the North and South Forks of the Toutle River. 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. Much of this storm damage has been mapped, and further evaluation and rehabilitation is currently under way.

Since the mid-1800's, no large fires of catastrophic intensity have burned in the Upper Toutle. Large contiguous areas of non-forest and early-seral structural stages are obvious where the 1980 eruption of Mount St. Helens occurred. Private and State lands within the blast zone of the eruption were planted in the 1980's, and are primarily in open to closed sapling/pole structure stages. Private land within the watershed outside of the blast zone has also been harvested within the last twenty-five years. There is very little mature forest left outside of the National Forest, and where it does occur it's in small isolated stands. Four State sensitive plant species (in Sub-basin 4) and at least one C-3 plant species (vicinity of Goat Marsh RNA) are present in the watershed.

Four animal species which are federally-listed as

threatened or endangered, as well as a number of sensitive species, C-3 species, or high interest species, are known to, or are likely to, occur in the Upper Toutle. These include the northern spotted owl, bald eagle, peregrine falcon, gray wolf, wolverine, common loon, Larch Mountain and Van Dyke's salamanders, great gray owl, four bat species, and mountain goats. Of the three spotted owl activity centers located within the watershed, two are located within the National Volcanic Monument and the third is in Matrix. Chance sightings of bald eagles have occurred in the watershed, although no formal surveys have been conducted. Bald eagles are commonly seen during the spring near the wetlands southwest of Coldwater Lake. It is likely that they also forage at Coldwater Lake. Absence of large trees or snags that could function as perch and roost sites probably makes it unlikely that the area would attract a large number of eagles. There are no known active peregrine falcon eyries in the watershed although the legislated Monument contains numerous cliffs that appear to be suitable nest sites. One gray wolf sighting (unconfirmed) was reported in 1992. Before the 1980 eruption, a small herd of mountain goats inhabited portions of the Mount Margaret Backcountry; however, they were killed by the eruption.

Five sub-basins show peak flow increases (compared to a fully-forested condition) of more than 10 percent. An additional two sub-basins are of concern because the stream channel network has been extended more than 25 percent by roads and ditch lines in roads.

Information on aquatic organism populations is lacking. Resident fish species in the watershed include rainbow trout, cutthroat trout, lake trout, brown trout, and sculpin. Both coho salmon and winter steelhead spawn in the lower parts of the Green River within the watershed, but both populations of these fish species are depressed.

Although no stations have collected continuous stream temperature readings in the area since the eruption, it is anticipated that streams are exceeding the State Water Temperature Standard of 16 degrees Celsius.

Road densities in the Upper Toutle average 1.83 miles per square mile for the entire area, with two sub-basins exceeding the "red flag" density of 3.0 miles per square mile.

Most visitors to the watershed (an average of 1.5

million per year) come for recreation purposes: to view the Mount St. Helens blast area, to use the trails, or to hunt big game. Situated near urban populations, trail use is heavy. Dispersed campsites are heavily used, particularly at favored hunting camp locations, and in two instances, the locations are causing resource damage.

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 in the future.

Volcanism 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, changing plant and animal habitats.

The distribution of fish within the watershed has been sharply altered by the 1980 eruption of Mount St. Helens and the subsequent erosion that has occurred.

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, timber management, roading, peak flow increases, flooding, and recreation activities.

In the interpretation section, current and reference conditions are compared by explaining significant differences, similarities, or trends and their causes. Current conditions are also compared with management objectives and desired future conditions. The

comparisons, explanations, and discussions are presented in a similar series of 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 was conducted in three dimensions of the ecosystem: aquatic, terrestrial, and social/economic. Each is presented in an explanation, a table and a map.

Finally, a table was compiled showing the different factors of ecological concern (columns) for each sub-

basin (rows) in comparative format. 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.

Recommendations for the Upper Toutle River Watershed

<u>Restoration Activities</u>	<u>Priority</u>	<u>Number of Sub-basins</u>
Road Decommissioning	High	3
Road Weatherization	Moderate	3
Recreational Road Access	Moderate	3
Stream Enhancement	Moderate	2
Erosion Control/Slope Stabilization	High	2
Resource Impacts from Recreation Use	Moderate	2
Protection of Late-Successional Stands	High	2
<u>Monitoring Activities</u>		<u>Number of Sub-basins</u>
Recreation Use		4
Dispersed Camping		4
Stream Temperature		9
Stream Surveys		3
Lake Surveys		3
Phase II Road Condition Surveys		3
Peregrine Falcon		2
Verification of Ecological Inventory Data		9
Castle Lake/Spirit Lake Blockages		4
<u>Commodities and Development</u>		<u>Number of Sub-Basins</u>
Completion of Trail Systems and Trail Connectors		2
Opportunities for Timber Harvest		1

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.



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INTRODUCTION

Management direction for the National Forest lands comprising the Upper Toutle 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 Toutle 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 access roads for recreation, dispersed recreation use, trail development, various

flood damage repair projects, monitoring, research and science projects and access, and vegetation management activities such as young stand thinning.

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. Preliminary investigations have been conducted on most of the affected areas in the Upper Toutle River Watershed. Damage inventories are continuing.

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 Toutle 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).

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 Toutle River Watershed.

Upper Toutle River

Vicinity Map



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

Upper Toutle River

Land Allocations

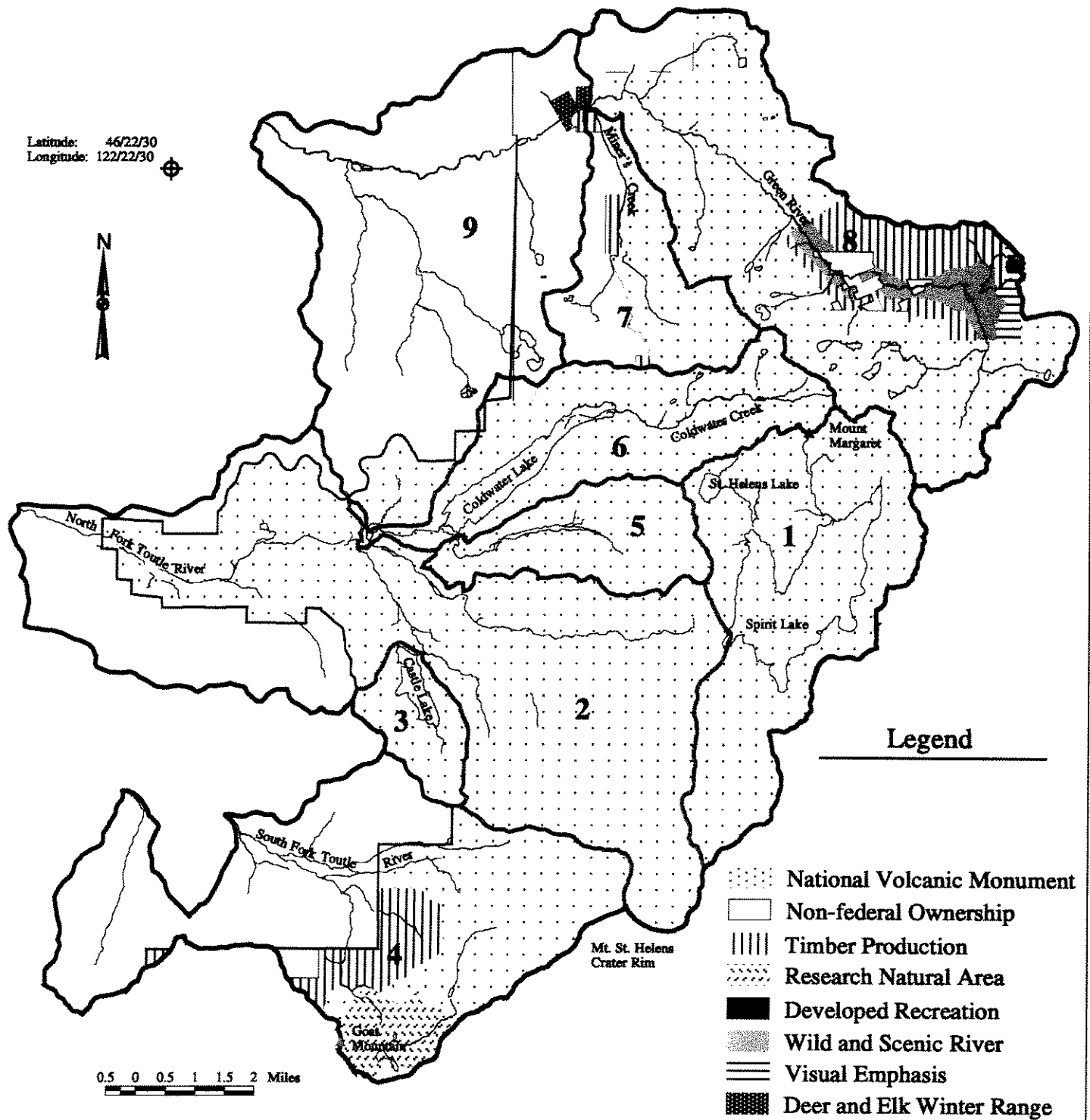


Figure 2. National Forest land within the Gifford Pinchot National Forest is assigned to various Management Area Categories (MACs). Each MAC has a goal or management emphasis.

Upper Toutle River

Northwest Forest Plan Allocations

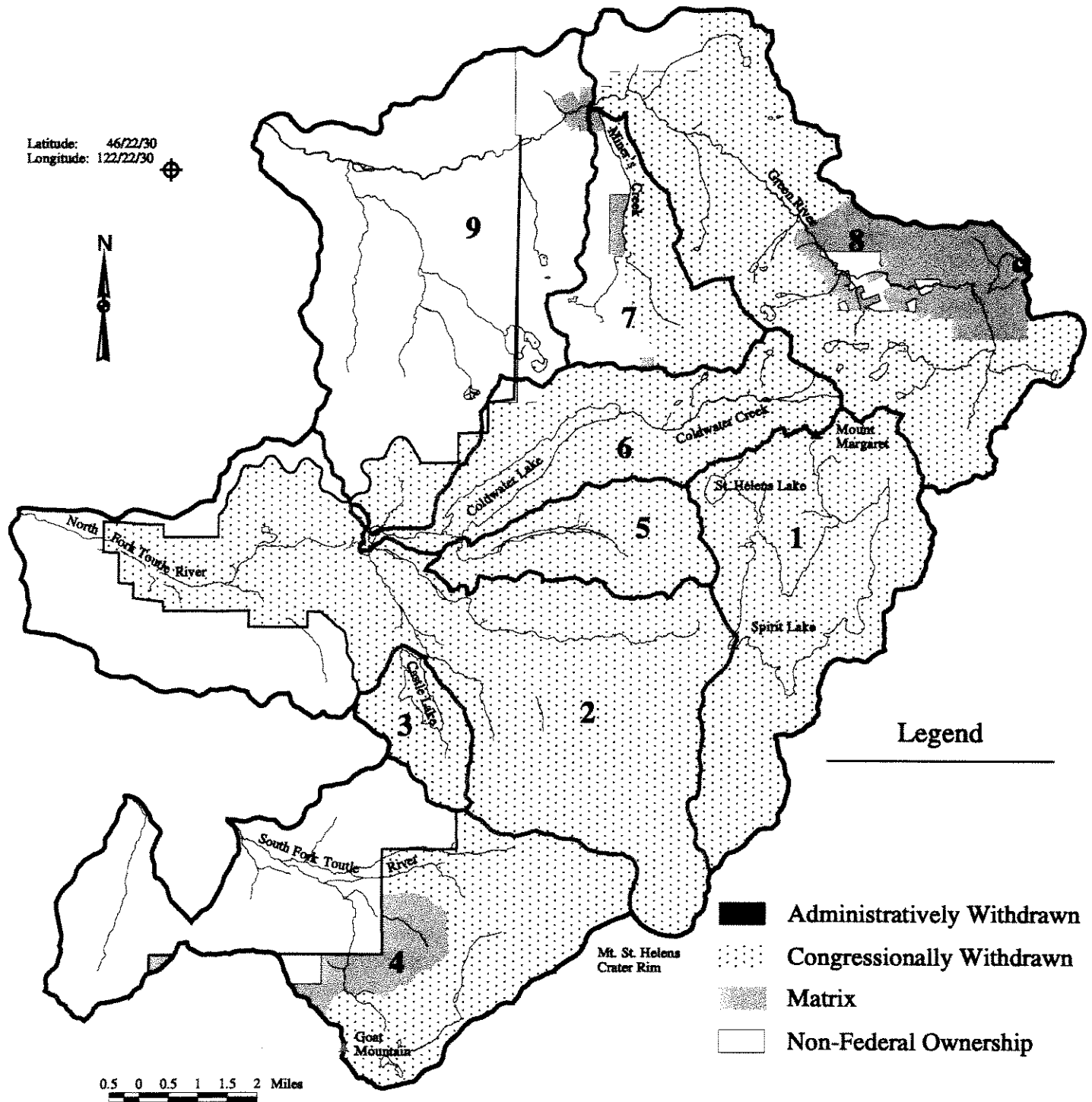


Figure 3. Under the Northwest Forest Plan, all federally administered lands within the range of the northern spotted owl are assigned to specific land allocations.

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.

Other important material is included in the Appendices of the report as follows:

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

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

- Geology and physical processes,
- Fire
- Vegetation and Riparian Reserve Habitats
- TES Plants and C-3 species
- Habitats for TES animal species
- Hydrology
- Water quality and key habitat attributes for fish
- Recreational Uses and 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 Cowlitz River basin. The Upper Toutle River is a relatively small watershed that occupies a portion of the Cowlitz River basin. See Figure 1, Vicinity Map in the Introduction.

The Upper Toutle River Watershed Analysis Area (hereafter referred to as the Upper Toutle River) encompasses an area of National Forest and other ownership lands within the Upper Toutle River watershed and some of its tributaries. The Upper Toutle River includes lands drained by the Green River, Falls Creek, Miners Creek, Tradedollar Creek, Coldwater Creek, Grizzly Creek, Castle Creek, Studebaker Creek, Coldspring Creek, the upper reaches of the Toutle River, and several other smaller unnamed, interspersed drainages.

The analysis area is divided into nine sub-basins (Figure 4).

The Upper Toutle River covers 109,557 acres (73,302 of National Forest and 36,255 of private ownership), and ranges in elevation from 1360 feet at the North Fork of the Toutle River 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 Toutle River ecosystem.

Geology, Soils, Erosion Processes

The Upper Toutle Watershed has been developed from volcanic and glacial processes along with erosional processes of wind and rain. Most of the northern portion of the watershed was formed as volcanic intrusive (molten material that cooled and solidified before it reached the surface). This material has been dated in the range of 20 to 22 million years of age. Surrounding this intrusive mass is older tertiary rock aged at 26 to 23 million years. From about 19 million years ago until the relatively recent past, volcanic activity decreased. Mount St. Helens began forming about 40,000 years in the past, and with the 1980

awakening of the mountain, activity continues up to the present time.

Glacial activity has also had a significant effect on the landscape. Two major glacial periods have been mapped in the watershed, Hayden Creek dated approximately 70,000 to 140,000 years before the present and Evans Creek dated about 22,000 to 10,000 years ago. During these periods, glaciers carved many of the typically U-shaped valleys and left many cirque basins in the higher country (Mount Margaret area). The Coldwater drainage, where a prominent lateral moraine is visible on the southeast wall above Coldwater lake, is a good example of a glacial valley.

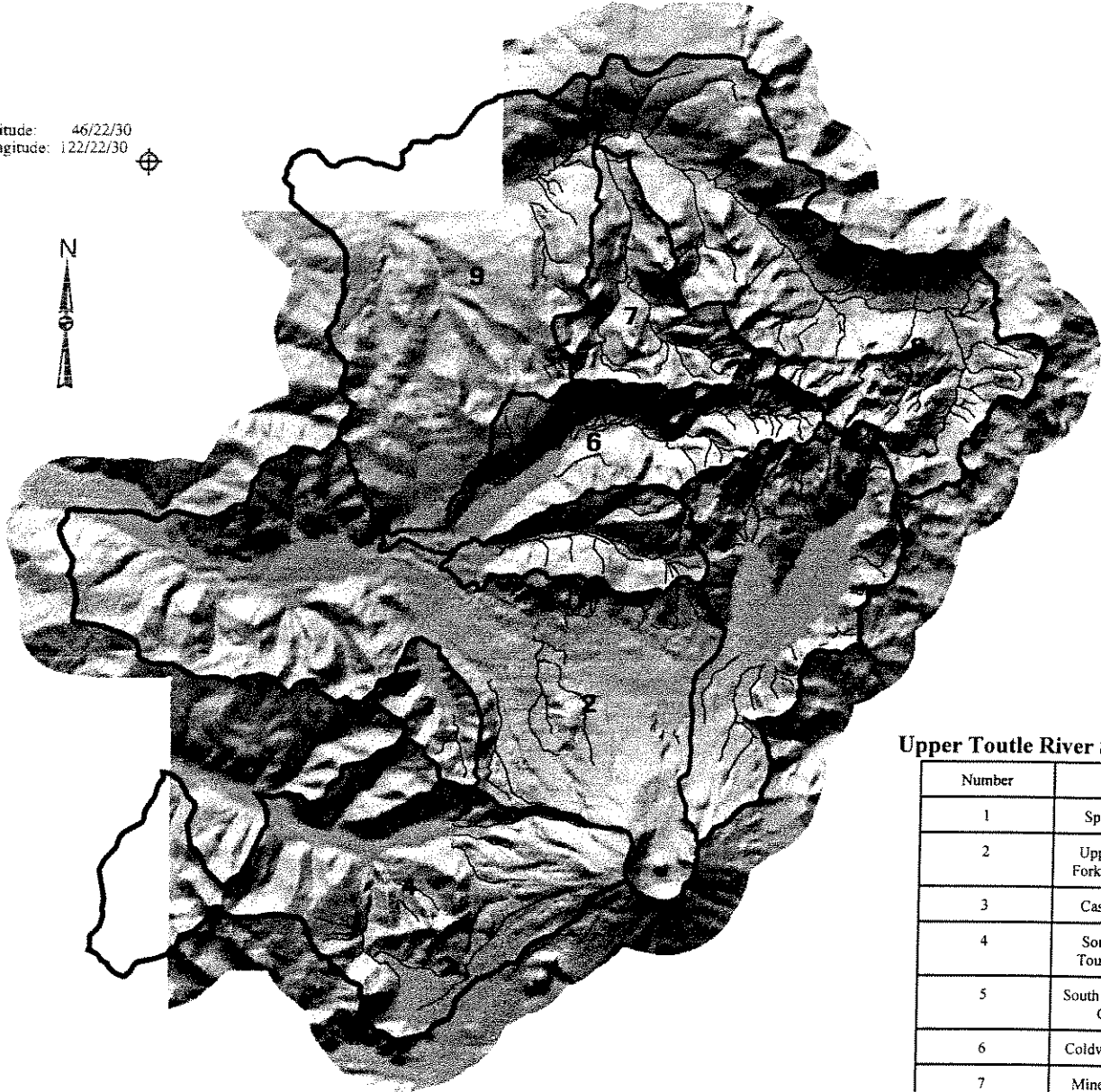
The 1980 eruption of Mount St. Helens provided a first hand view of the effects volcanic activity can have on the landscape. The lateral blast removed and destroyed most of the vegetation up to 15 miles away from the volcano. Pyroclastic flows and mudflows rushed down the Toutle River filling the valley with deposits up to 300 feet in depth. Figure 5 shows the extent of down and dead material and the areas of standing dead trees killed by the heat.

Another main feature of volcanic activity is the extent and problems associated with tephra deposits. These deposits are usually comprised of loose unconsolidated gravels and sands that have a high potential to be transported by wind and rain. During large storm events this material may become saturated enough to cause shallow rapid failures even reaching down into the more stable mantle soils beneath. Material from these tephra deposits also tends to build up in drainages and eventually causes debris torrents that scour the drainages for relatively long distances.

Numerous mineral deposits are found around the margins of the Spirit Lake intrusive body. In the past, these minerals have been mined, mainly for copper. Most of the existing claims are located in the northern part of the watershed along the Green River. If markets improve, some of these mining claims may again become active.

Upper Toutle River Sub-Basins

Latitude: 46/22/30
Longitude: 122/22/30



0.5 0 0.5 1 1.5 2 Miles

Upper Toutle River Sub-Basins

Number	Name
1	Spirit Lake
2	Upper North Fork Toutle R.
3	Castle Lake
4	South Fork Toutle River
5	South Coldwater Creek
6	Coldwater Lake
7	Miners Creek
8	Upper Green R.
9	Lower Green R.

Figure 4. Sub-basins. For this analysis, the 109,577-acre Upper Toutle River Watershed is divided into nine sub-basins.

Fire

Although large catastrophic wildfires have been a major change agent in the Upper Toutle River watershed, the most devastating natural agent (on a landscape basis) has been the volcanic episodes associated with Mount St. Helens. For example, during the May 18, 1980 eruption, large areas were completely devastated by the extremely powerful lateral blast that left many square miles of previously forested land void of vegetation and covered with ash and pumice. Other large areas of the watershed have been drastically altered by ash falls and localized lava and pyroclastic flows. These natural disturbances have been an integral part of the forest ecosystem affecting wildlife habitat, vegetation dynamics, soil properties and general physical appearance.

The natural fire regime of the Upper Toutle River watershed is somewhat different than at other locations on the Westside of the Cascade Mountains in Washington. Due to the periodic eruptions of the volcano and the associated ash falls, major catastrophic fire is extremely infrequent in the watershed, occurring in the range of every 750 to 1000 years. The area is dominated by highly productive and long-lived tree species (associated with the Douglas-fir zone) which have the potential to accumulate great amounts of intermediate- to large-size class fuels. Fine fuels (the most readily ignitable, however) are available only in relatively small amounts because they become covered by ash and pumice.

Historical records indicate that numerous small (0.5 acres or less) fires occurred within the watershed since the early 1900's. Their frequency was approximately 3.75 fires per year. The majority of these fires were associated with either lightning or campfires that escaped or were left unattended. The campfire problems occurred generally in the Spirit Lake basin, while the lightning- ignited fires were concentrated in the Mount Margaret area north of Spirit Lake and in the higher elevations on the western flanks of Mount St. Helens. The few large fires that have been documented (Figure 7) were human-caused and associated with industrial operations such as logging and road construction.

Since the latest eruption of Mount St. Helens in 1980, the frequency of fires in the watershed is less than 0.25 fires per year. This drastic reduction in the number of fires is primarily due to two factors: the removal and/or

covering with ash of the fine fuels and the closure of the area to the public. With the opening of the Mount Margaret country to hiking and camping the potential for increased fire frequency exists, but a return to historical levels is unlikely due to fire prevention regulations that have been formulated for the area.

Vegetation

The watershed is comprised of primarily three vegetation zones. The Western Hemlock vegetation zone is found on about seven percent of the National Forest lands within the watershed, and occurs along the lower elevations of the Toutle and Green Rivers. The Mountain Hemlock zone is found in the higher elevations of the Mount Margaret Backcountry and the two Goat Mountains. This zone comprises one percent of the watershed. The Pacific Silver Fir zone makes up a majority of the watershed, (48 percent) and is found on the mid-elevation area between the Western and Mountain Hemlock zones.

The vegetative pattern of the watershed has historically and recently been shaped by volcanic activity. The 1980 eruption of Mount St. Helens destroyed vegetation over most of the National Forest land in the watershed, and a large portion of the private land as well. Not only were upland tree stands incinerated or blown over, riparian vegetation along streams, and around lakes was destroyed by the blast or by the large mud flows that followed. Gradual recovery of vegetation within the blast zone is taking place. The recovery is most evident in the riparian areas where alder, willow, and various herbaceous species are growing. The portions of the blast zone on private land were replanted following the eruption and are currently stocked with vigorously growing young trees.

Timber production was a dominant use of National Forest as well as private lands in the watershed before the eruption. Salvage of trees killed in the eruption has occurred on private land in the watershed. National Forest land now designated as timber emphasis (Matrix) comprises a minor part of the watershed and is found generally in two blocks located in the southwestern and northeastern corners. The Matrix block in the northeastern portion of the watershed has been affected by both timber harvest and the eruption, and supports primarily young tree stands.

Upper Toutle River

Seared Zone of the 1980 Eruption

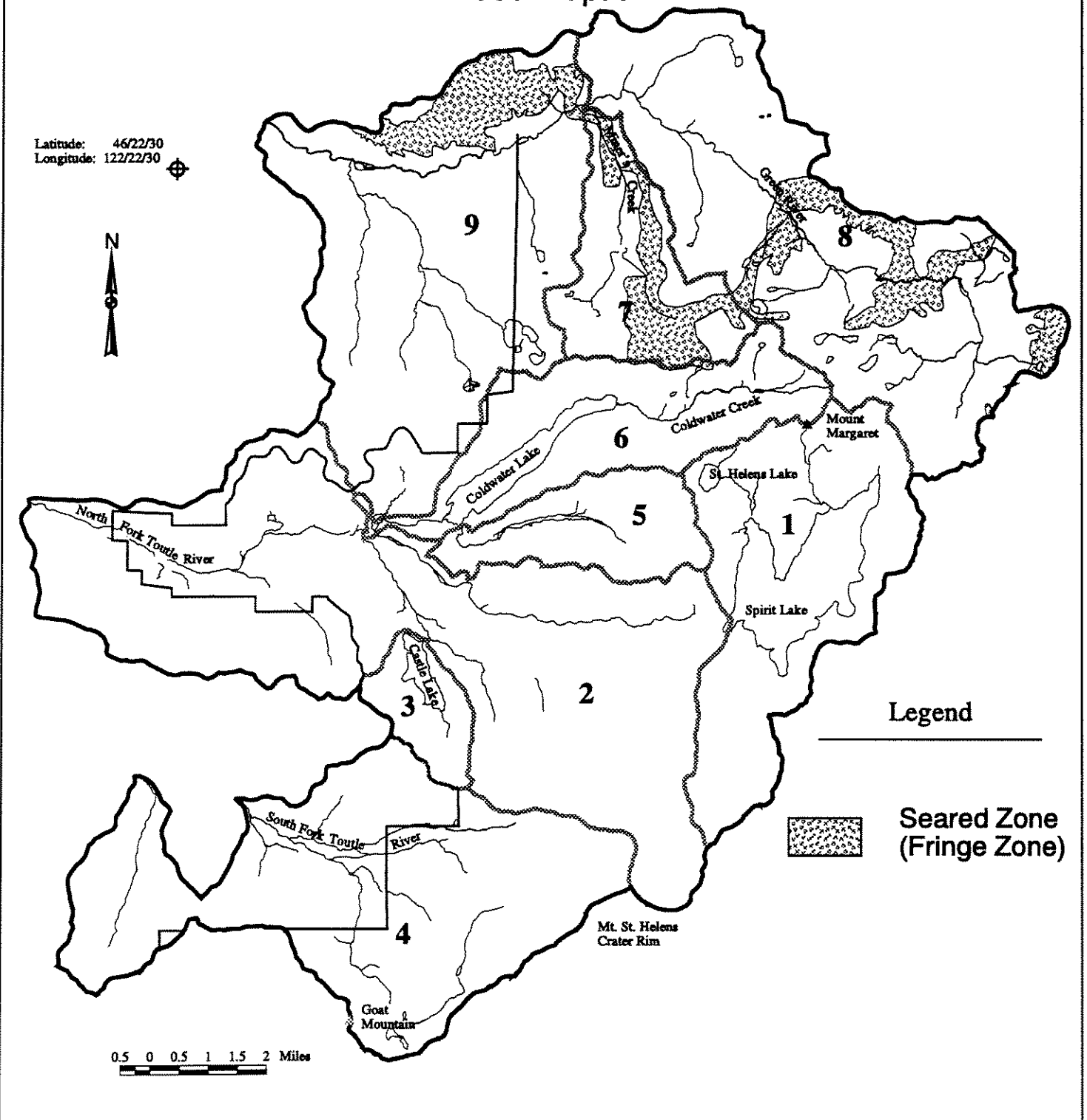


Figure 5. The shaded area indicates where the lateral blast from the eruption lost the energy to knock down trees but retained enough heat to kill the vegetation. Standing dead trees remain to mark this area.

Upper Toutle River

Fire Ignition Points
1970 to Present

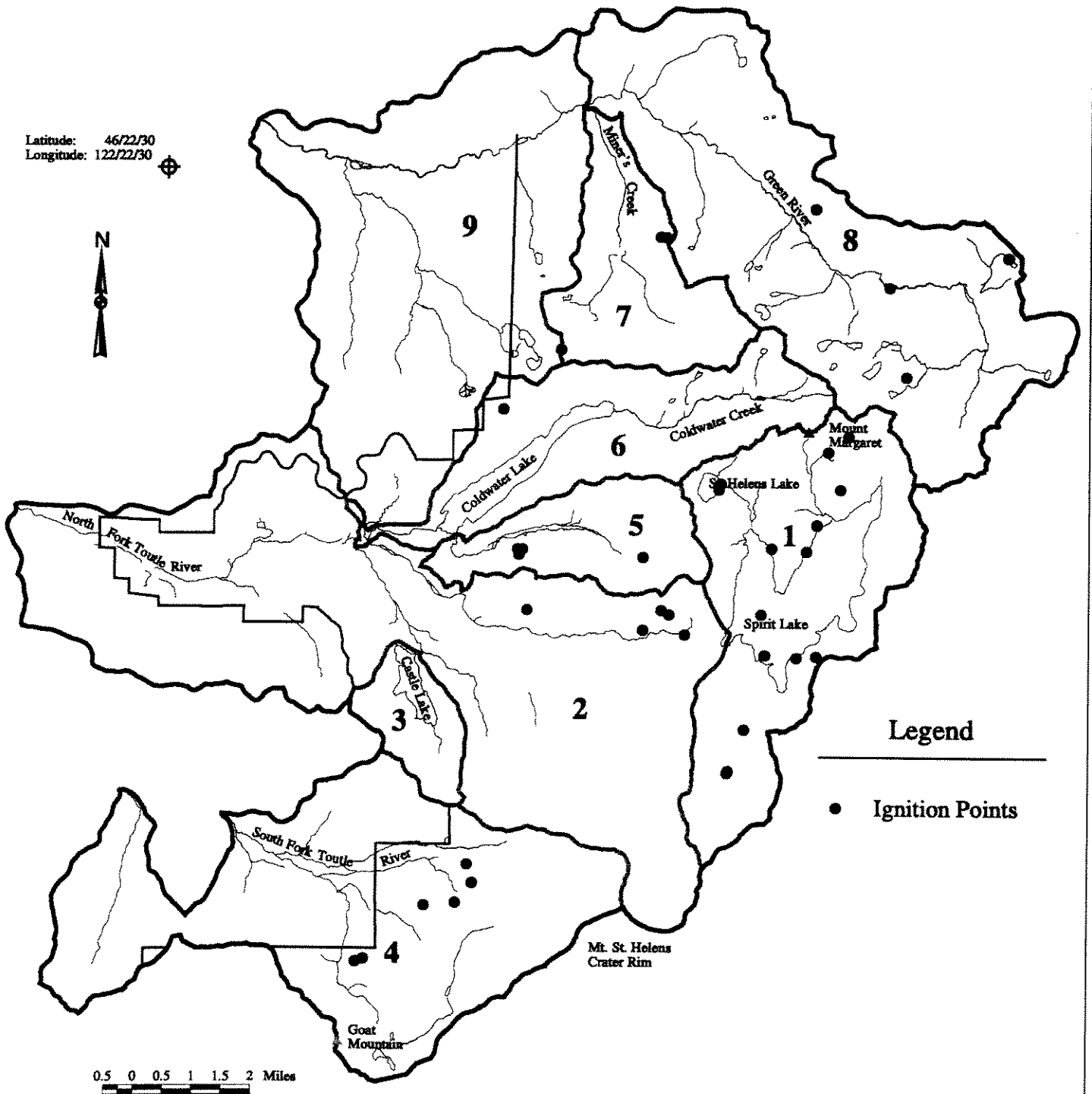


Figure 6. Fire ignitions recorded by the Forest Service in the Upper Toutle River Watershed from 1970 to present.



Upper Toutle River

Vegetation Zones

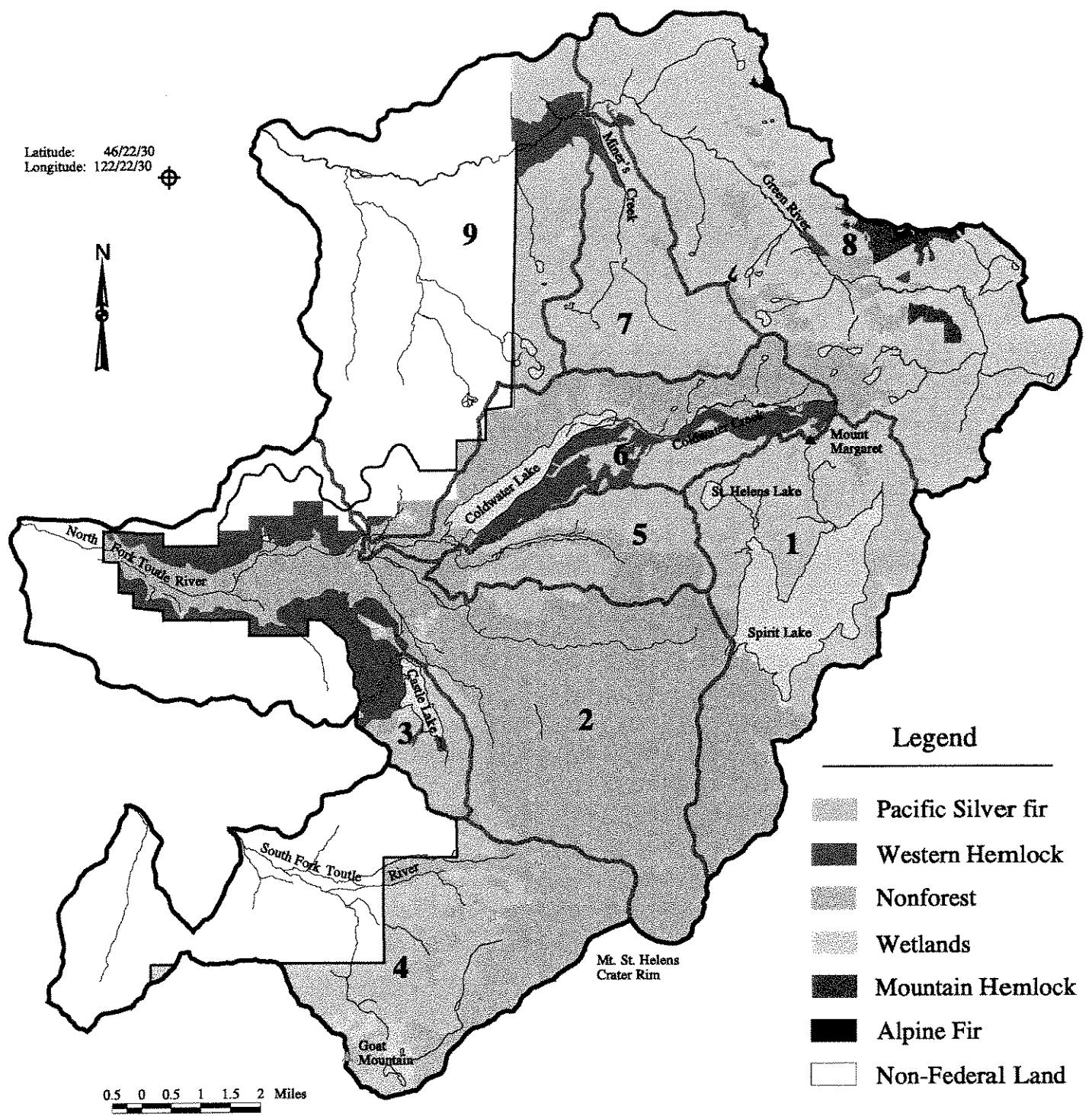


Figure 7. Vegetation Zones (Ecoclasses) of the Upper Toutle River Watershed.



Timber harvest opportunities on National Forest lands are primarily limited to commercial thinning at this time.

Known populations of fringed pinesap (*Pleuricospora fimbriolata*), pine broomrape (*Orobancha pinorum*), lance-leaved grape-fern (*Botrychium lanceolatum*) and northern moonwort (*Botrychium pinnatum*) occur in the watershed. These four species are listed by the state of Washington as sensitive. Another species, noble polypore (*Oxyporus nobilissimus*) is also known to exist in the watershed. This fungus is on the Survey and Manage (C-3) species list.

Terrestrial Animals and Habitats

The watershed contains habitat suitable for a total of 256 wildlife species. Of these, 46 are dependent on snags for a portion of their life cycle, and 62 are dependent on down logs. Fifty-one of these species are thought to have declining populations regionally. Species listed by the Federal government as threatened or endangered that could occur in the watershed include bald eagle, peregrine falcon, gray wolf, and northern spotted owl. There have been recorded sightings of all of these species in the watershed. The gray wolf sighting, made in 1992, was not confirmed.

Habitat in the watershed has been significantly altered by the 1980 eruption of Mount St. Helens. Stands in the large tree structure stages (stands with an average DBH of at least 21 inches) are confined to the Goat Mountain/Blue Lake area in the southwest corner of the watershed, and in the vicinity of the Green River inside the legislated National Volcanic Monument. These stands, which are considered late-successional, comprise about ten percent of the watershed, and 87 percent of these acres are in management allocations that restrict timber harvest. These two areas of large tree stands are isolated from each other by the devastated area north of Mount St. Helens. The possibility of species migration between these stands is currently low to non-existent.

The watershed contains over thirty lakes of various sizes. The largest of these are Spirit, Coldwater, Castle, and St. Helens Lakes. Large wetlands occur at Goat Marsh in the southwestern portion of the watershed and along Falls Creek in the northern portion. Small wetlands dot the devastated area of the blast zone.

A large resident elk herd can be found along the Toutle River. Other species sightings have included common loons at Spirit Lake, ptarmigan, pine marten and mountain goats. A small introduced mountain goat herd inhabited the Mount Margaret area before the eruption but was wiped out in the blast. Since then, only sporadic sightings of individual mountain goats have been made along Boundary Trail Ridge and in this watershed. These animals are possibly migrating from the Goat Rocks area east of Packwood.

Water Features and Hydrologic Processes

General physical characteristics.

The Toutle River originates on the north flank of Mount St. Helens. Major streams and lakes in the area include South Fork Toutle River, Coldwater Creek, Green River, Coldwater Lake, Castle Lake, and Spirit Lake. This entire area is in the blast zone of the May 1980 eruption of Mount St. Helens. The Toutle River and South Fork Toutle River carried mud flows from rapidly melted glaciers after the eruption. A large landslide from the 1980 eruption dammed South Fork Castle Creek and Coldwater Creek. Castle Lake and Coldwater Lake formed behind these large debris dams.

In the Upper Toutle River Watershed, the average annual precipitation ranges from 80 to 140 inches per year. The nearest stream gaging station to the analysis area is located on the Toutle River near Silver Lake which is approximately 27 miles downstream from the area. The maximum yearly flow of record at this station ranges from 5,420 cubic feet per second (cfs) in water year 1977 (on March 9, 1977) to 43,200 cfs in water year 1978 (on December 2, 1977). A water year extends from October 1 to September 30. This station operated from 1910 to 1979 before it was washed away by the eruption of Mount St. Helens. A replacement station was constructed on the Toutle in the mid-1980's.

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 8 shows the Riparian Reserves in the Upper Toutle Watershed in two categories, those associated with streams and wetlands, and those lying on unstable ground.

Water Quality

One water-quality-impaired stream segment on the Toutle River is presently identified on the Washington State 303 (d) list. The segment is located downstream from the analysis area and exceeded State water temperature standards eight times between January 1, 1988 and January 1, 1992. As mentioned in the section above, the Toutle River lost nearly all riparian vegetation as a result of the May 1980 eruption of Mount St. Helens probably leading to these increased water temperatures.

There are 43 water quality monitoring stations within the Upper Toutle River Watershed which have been active for varying lengths of time since 1975. The majority of these stations have collected "grab samples" for extensive chemical analyses after the 1980 eruption, so long-term records are rare.

Water Quantity

About 70 percent of the Upper Toutle River Watershed is in the transient snow zone and subject to rain-on-snow storm events.

Aquatic Animals and Habitat

The Upper Toutle River Watershed (a Tier 1 Key watershed) has approximately 1,283 miles of stream. Of the 833 miles of stream on the National Forest portion of the watershed, 15 miles are Class I, 33 miles are Class II, 162 miles are Class III, and 623 miles are Class IV (Figure 9). Stream mileages are on National Forest land only. Rainbow trout (*Oncorhynchus mykiss*), cutthroat trout (*Oncorhynchus clarki*), brook trout (*Salvelinus fontinalis*), brown trout (*Salmo trutta*), lake trout (*Salvelinus namaycush*), and sculpins (*Cottus* sp.) are the most common fishes found in the streams and lakes. Coho salmon (*Oncorhynchus kisutch*) and winter steelhead (*Oncorhynchus mykiss*) are found in the Green River within the analysis area. Other stocks of anadromous fishes occur in rivers downstream of the analysis area. Fall chinook (*Oncorhynchus tshawytscha*) occur in the South Fork Toutle and Green

Rivers. Coho salmon occur in the Toutle River and South Fork Toutle River. Winter steelhead are found in the Toutle, North and South Fork Toutle River. Stream survey data exists for 12.42 miles within this watershed; however, only 11.6 miles of this data was suitable for analysis using standards developed by the Columbia River Basin Policy Implementation Guide (CRBPIG) (USDA FS 1993).

Mean stream water temperature in the Green river meet the State Water Quality standard of 16 degrees Celsius (60.8 degrees Fahrenheit); however, maximum temperatures exceed this standard for short periods of time. This could affect optimum spawning and rearing behavior for salmonids.

Culverts and road crossings can fragment aquatic habitat by interfering with fish migration, as well as the flow pattern of LWD and sediment through the system. The watershed contains 1,882 road/stream crossings, which, when divided by 1,189 stream miles equates to 1.58 crossings per mile of stream.

Only 0.65 percent of the Riparian Reserves along streams have undergone timber harvest in the past 50 years. Some resource damage is occurring from dispersed campsites within the watershed, particularly at Blue Lake and Deadman's Lake.

Coho salmon and winter steelhead currently access the Toutle River Watershed analysis area. Coho salmon spawn in the Green River up to river mile 25.0 where a 25-foot waterfall blocks upstream migration. Winter steelhead spawning distribution in the Green River is up to river mile 21.5 (WDFW 1992). Other species end their upstream migration at the Toutle River Hatchery, or are moved via truck above the sediment retention structure and migrate upstream, but may not go very far because of poor habitat conditions left behind from the eruption of Mount St. Helens.

Several lakes are located within the Toutle River watershed analysis area (Figure 21). Most of the lakes, except Fawn, Forest, Elk, Hanaford, Lonesome, and Tradedollar, are located inside the legislated National Volcanic Monument. Fish stocking is not allowed in Obscurity, Panhandle, Shovel, Spirit, St. Helens, Boot, Snow, Grizzly, Goat Marsh, Island and Heart Lakes due to its interference with the natural recovery processes being studied within the area. Lake surveys to identify fish habitat condition were completed on Coldwater, Obscurity, Panhandle, Venus, Grizzly, and

Shovel Lakes.

Aquatic habitat and organisms in the lakes and streams near Mount St. Helens were severely affected by the May 18, 1980 eruption. The South and North Forks of the Toutle, Castle, and Coldwater Creeks, incurred extreme channel changes from volcanic mudflows and pumiceous pyroclastic flows. Streams within the Monument continue to be affected by sedimentation due to erosion of the mudflows, and deposition of ash. Revegetation of mudflows and ash depositional areas has been slow, leading to increased stream temperatures, decreased nutrient levels from allochthonous materials, and decreased primary production. As a result of the eruption, populations of aquatic organisms dropped to very low levels or were decimated all together depending upon the elevation at which the stream or lake was located (USFS 1989).

Human Uses

The Upper Toutle Watershed has been occupied by, and its environment modified by, humans for at least six thousand years. American Indians established seasonal villages along the Toutle River and used the watershed for salmon fishing, collecting edible plants such as huckleberries, and hunting game in the surrounding mountains. Peeled cedar trees, which still exhibit scars from bark removal, testify to the making of cedar baskets which were used for storing and transporting berries.

Relatively open ridge tops were used as travel routes, preferred berry collecting areas, and perhaps vision questing. Outcrops of jasper and agate provided raw material for the manufacture of cutting tools and projectile points. The relative abundance of these materials in stream beds provided a ready source of material to early inhabitants. Historic records document that Indians intentionally set fires in the fall to control underbrush, to rejuvenate berry fields, and to enhance hunting. In the early 1800's, European immigrants encountered an altered landscape.

American Indian populations rapidly decreased during the 1800's with the introduction of European diseases to which they had almost no resistance. During this same period, land was made available for homesteading, while land grants encouraged railroad development. Settlers cleared land in the valleys, hunted game, and engaged in subsistence farming. Near the end of the century, gold was discovered in the

watershed which led to the attempted development of several mineral properties. The largest of these, the Polar Star Mine, on the north side of the Green River actually produced some gold commercially. Other mining ventures included the Sweden Mine above the northeast arm of Spirit Lake and the Lang Mine on the south slope of Mount Margaret. While documentation shows small quantities of copper ore were removed from the Sweden Mine for testing, the Lang Mine has no record of commercial mineral production. Several other small mines and prospects are found in the Green River Valley. Fur trapping was contemporaneous with mining activity. Many of the mining cabins were used for both purposes.

Government management of the area began in 1893 with the establishment of the Pacific Forest Reserve, a large area with vague boundaries. In 1897 the earlier boundaries were better defined when the Mount Rainier Forest Reserve was established, and then changed to the Rainier Forest Reserve in 1907. A second change in 1907 created the Rainier National Forest, and at roughly the same time the Forest Service came into being. By early 1908 still another change took place with the establishment of the Columbia National Forest, a name that would remain for the next 31 years. Early management was mostly custodial, with emphasis placed on fighting fires and "regulating" grazing. Trails, the "forest highways" of the time, were mostly already in existence, established by Indians and sheep herders. The first fire lookouts appeared as early as 1910, but in the 1930's became a major emphasis. This also marked a period of increased trail construction and stringing of grounded phone wire for communication between outposts and ranger stations. In 1949 the Columbia National Forest was divided, with the south half becoming the Gifford Pinchot National Forest, which it remains today.

Sheep grazing was well established before 1893 (before government management of the area) and remained active until the 1980's under permit through grazing allotments in some parts of the Gifford Pinchot National Forest. The Wright Meadow Trail provided access, from the Lewis River area to the south, to grazing areas along the Boundary Trail divide and as far west as Mount Margaret. Grazing probably owes its demise to the success of the Forest Service in suppressing wild fires. As wildfire was removed from the environment, forests encroached on former meadows shrinking the opportunities for grazing.

Upper Toutle River

Riparian Reserves

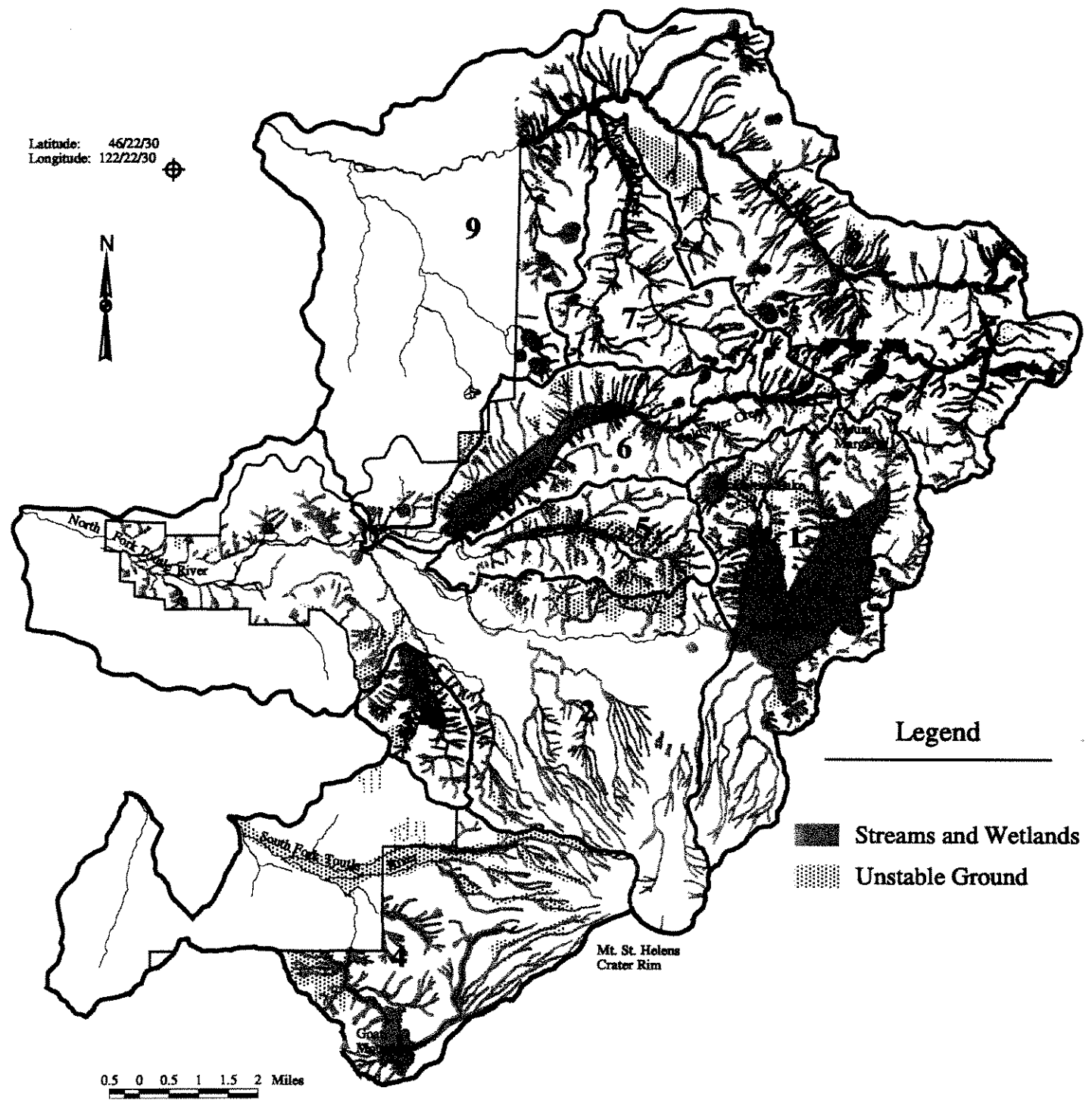


Figure 8. Riparian Reserves within GPNF lands provide an area along all streams, wetlands, ponds, lakes, and unstable and potentially unstable areas where riparian-dependent resources receive primary emphasis.

Upper Toutle River

Stream Classes

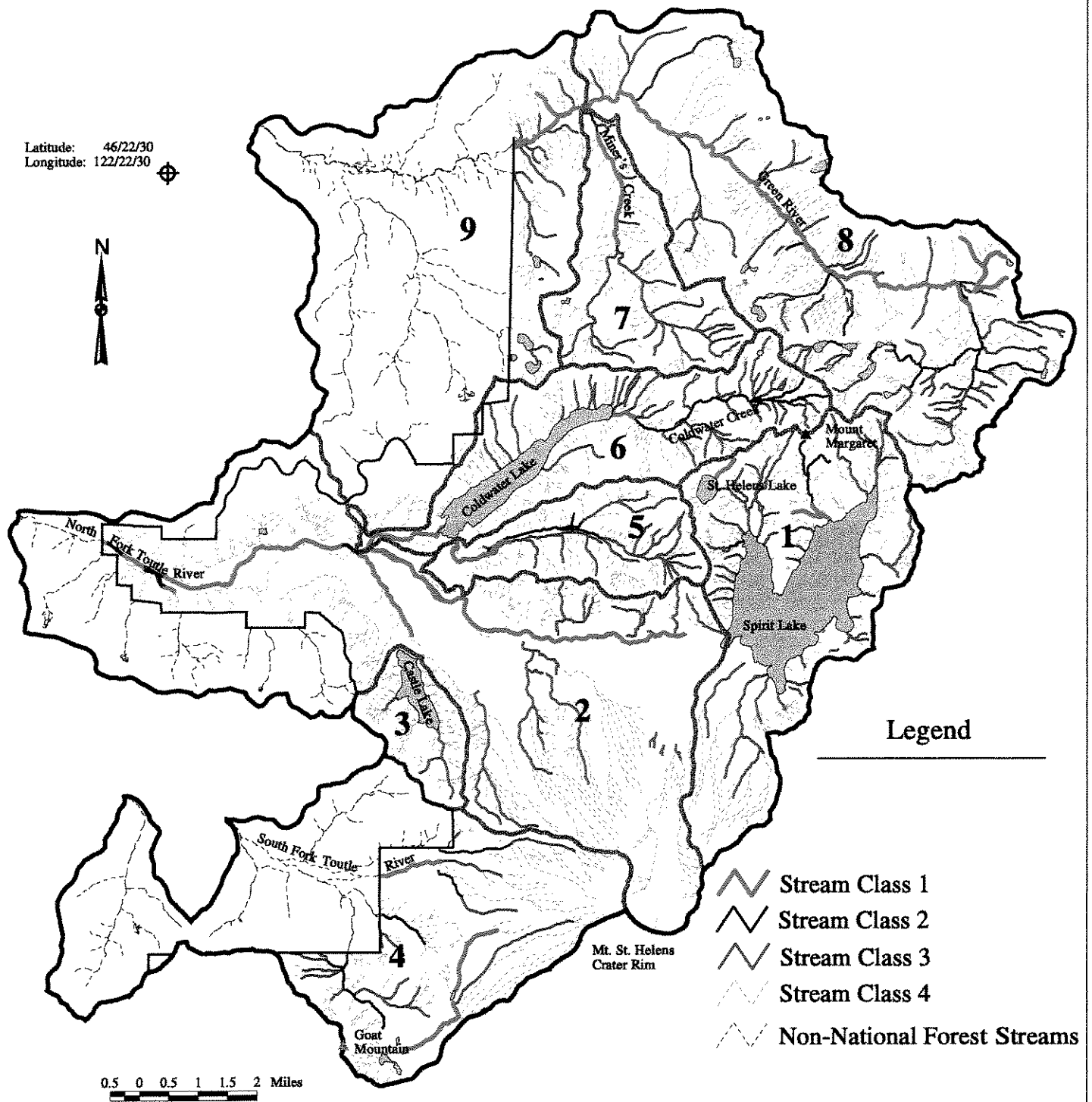


Figure 9. Stream segments have been grouped according to their size and presence of beneficial uses. These groups, referred to as stream classes, range from Class 1, which is a large perennial stream, to Class 4, which is a small intermittent stream.



The first road into the area was constructed in 1902 from the town of Toutle to Spirit Lake. The road provided access to miners, an early Forest Service ranger station, and to the Lang Homestead one mile west of Spirit Lake.

Starting as early as 1915, Spirit Lake attracted recreational use. Youth camps for the Longview YMCA, Boy Scouts, and Girl Scouts were established over the next fifty years. Many young people from the region had their first taste of camping and experience away from home at these camps. In addition, two commercial lodges were operated, the St. Helens Lodge by Harry Truman, and the Harmony Falls Lodge (which was accessible by boat only). The Forest Service operated four campgrounds, a ranger station, and a visitor information station on the lake shore. By the late 1970's Spirit Lake was the most popular recreational destination in the Gifford Pinchot National Forest, attracting year-round use. Summer activities included boating, camping, fishing, hiking and mountain climbing. In the fall, elk hunting was popular, followed by snowmobiling, cross country skiing, and snow play in the winter. The State Department of Transportation kept State Highway 504 open to the timberline turnaround all year providing recreational access.

The eruption of Mount St. Helens on May 18, 1980 devastated the Spirit Lake Basin, all its recreational facilities, State Highway 504, and virtually all trails in the watershed. The only areas remaining unaffected by the blast are portions of the Green River Valley, the Vanson Peak area, and a portion of the area drained by the South Fork Toutle River.

A debris avalanche, resulting from the collapse of the north slope of Mount St. Helens, swept through the Spirit Lake basin, and down the North Fork Toutle River. The natural dam impounding Spirit Lake was raised by several hundred feet. US Geological Survey geologists and the Corps of Engineers worried that when the water level reached the top of the dam, it would collapse causing catastrophic flooding of the Toutle River Valley and Longview. As a temporary control measure a 50-inch diameter pipeline was

constructed over the debris avalanche, and water was pumped from Spirit Lake into the headwaters of the North Fork Toutle River. To permanently stabilize the water level in Spirit Lake an 8,900 foot long drainage tunnel was bored through the south flank of Coldwater Peak, allowing water to escape into South Coldwater Creek and Coldwater Lake. Special hardened spillways were constructed at Coldwater Lake and Castle Lake to control down cutting.

Since the construction of Coldwater Ridge Visitor Center and Johnston Ridge Observatory, use of the area has grown to about 1.5 million visitors a year. Road 99 on the south fringe of the watershed receives an additional 330,000 visitors each year. The upper Green River valley, near Ryan Lake, is popular for hunting and attracts equestrians to the Green River Horse Camp, the only campground in the watershed.

Since the 1980 eruption, the Spirit Lake Memorial Highway (504) has been constructed along the north flank of the Toutle River Valley to provide access to newly created Coldwater Lake, the Coldwater Ridge Visitor Center, and Johnston Ridge Observatory. A network of trails has also been re-established in the Mount Margaret and Vanson Peak areas. The Boundary trail was re-routed along the crest of Mount Margaret. The Truman Trail, which crosses the Spirit Lake Basin and connects the end of Road 99 with the Boundary trail, was established.



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

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

1. Watershed Restoration
 - Road decommissioning/weatherization
 - Slope Stabilization
 - Road Weatherization
2. Small tree thinning
3. Emergency repair of roads and other flood repair work
4. Mitigation of impacts from Recreation Use (Trails, Camping at Lakes)
5. Trail Construction/Connection and Access
6. Research, monitoring, data gathering, and associated access
7. Interagency erosion monitoring on the Toutle, at Castle Lake, and the Spirit Lake Tunnel

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

- **Mass Wasting:** The Upper Toutle River has numerous landslides and debris flows within its boundaries. Management activities along with the 1980 eruption of Mount St. Helens have activated or worsened a number of these features, sometimes impacting streams.
- **Surface Erosion From Roads:** Surface erosion from roads has been a source of sediment entering streams in the watershed.
- **Surface Erosion from Upland Slopes:** The tephra deposits from the 1980 eruption are highly erosive especially on the steeper slopes and where vegetation was destroyed.

- **Fire:** In the past, large catastrophic fire has been a change agent at the landscape (watershed) scale.
- **Sensitive and C-3 Plant Species:** The watershed contains known and suspected populations of at least four sensitive plant species and one C-3 fungus species.
- **Vegetation Structure and Composition:** The 1980 eruption created a large, unfragmented expanse of early seral habitat, providing an opportunity to understand how volcanic activity affects species diversity and distribution.
- **Habitat Condition for TES Animal Species:** The watershed contains habitat that is suitable or potentially suitable for threatened, endangered, and sensitive species including northern spotted owl, bald eagle, peregrine falcon, gray wolf, and Larch Mountain salamander.
- **Habitat Condition for Survey and Manage (C-3) Species:** The watershed contains suitable, or potentially suitable habitats for C-3 species including Van Dyke's salamander and forest bats. These habitats and species were significantly impacted by the 1980 eruption..
- **Hydrologic Changes:** Past disturbances such as wildfire and volcanic eruption may have influenced basin hydrology by increasing peak flows during fall and winter storms and by decreasing summer low flows. Human activities have occurred throughout the watershed and may influence the timing and quantity of runoff as well.
- **Water Quality and Key Habitat Attributes for Resident and Anadromous Salmonids:** Road building, dams, volcanic eruption, and fire regimes, 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 and high water temperatures may be affecting fish habitats.
- **Completion of Trail System and Trail Connectors:** The comprehensive management plan for the Mount St. Helens National Volcanic

Monument prescribed a network of trails to replace those lost during the May 18, 1980 eruption. Additional trail construction is proposed in the Gifford Pinchot National Forest Land and Resource Management Plan. Most replacement trails have been constructed, but a few remain to be built. In addition, the need for trail connections has become evident, through lack of trail use and/or poor access to the start of trails.

- **Recreational Road Access:** The comprehensive management plan for the Mount St. Helens National Volcanic Monument and the Gifford Pinchot National Forest Land and Resource Management Plan directed construction of recreational facilities in and adjacent to Mount St. Helens National Volcanic Monument (NVM). Pre-existing roads, as well as newly constructed roads provide access to these recreation sites. In some cases roads exist which are not needed for recreational or administrative access. These unneeded roads are sometimes poorly maintained, resulting in environmental damage due to erosion and sedimentation. In other instances they create opportunities for unwanted dispersed camping or user generated trailheads. Roads not needed for recreational or administrative access could be decommissioned.
- **Resource Impacts from Recreation Use:** At some locations, dispersed camping and equestrian use may be affecting riparian areas and water quality.

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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 and Physical Processes

Mass Wasting

Mass wasting within the Upper Toutle Watershed is characterized by three main forms and processes: (1) large, slow-moving, deep-seated landslides, (2) debris torrents/flows, and (3) shallow, rapid mantle failures. All have occurred in both managed and natural areas. In the blast area, the number of debris torrents and shallow mantle failures have increased significantly since the 1980 eruption of Mount St. Helens. The loose tephra deposited on the steep slopes does not have the cohesiveness to stay in place during heavy storm events. As this loose tephra fails it can cause

failure into the underlying mantle as well.

Parts of the area have been mapped as unstable and potentially unstable as can be seen in Figure 10. Table 1 shows a breakdown of unstable and potentially unstable acres (and percent of total acres) by sub-basin. Sub-basin 5 has the greatest instability at about 28 percent. The next highest at 13 percent is greater than it should be because the mapping needs updating to remove the South Toutle drainage from the unstable listing. This drainage is considered stable but would have a higher-than-normal erosion potential as some of the flow deposits are moved down stream.

The storm events during the winter of 1995/96 increased the number of debris torrents in many of the drainages, especially the upper Green River and Coldwater areas. Many of these debris torrents scoured the channels to bedrock.

Table 1. Amounts of Unstable and Potentially Unstable Ground by Sub-Basin

Sub-basin	Total Acres of Sub-basin	Unstable Ground (Acres)	Potentially Unstable Ground (Acres)	Total Acres of Unstable & Pot. Unstable	Percent of Sub-basin
1	11,292	302	447	749	6.63%
2	26,199	1	1183	1184	4.52%
3	1,954	0	141	141	7.22%
4	17,223	1748	533	2281	13.24%
5	3,865	88	1002	1090	28.20%
6	7,757	292	273	565	7.28%
7	5,088	155	14	169	3.32%
8	17,815	140	467	607	3.41%
9	18,363	36	159	195	1.06%
Total	109,557	2762	4219	6981	6.37%



Upper Toutle River

Unstable and Potentially Unstable Areas

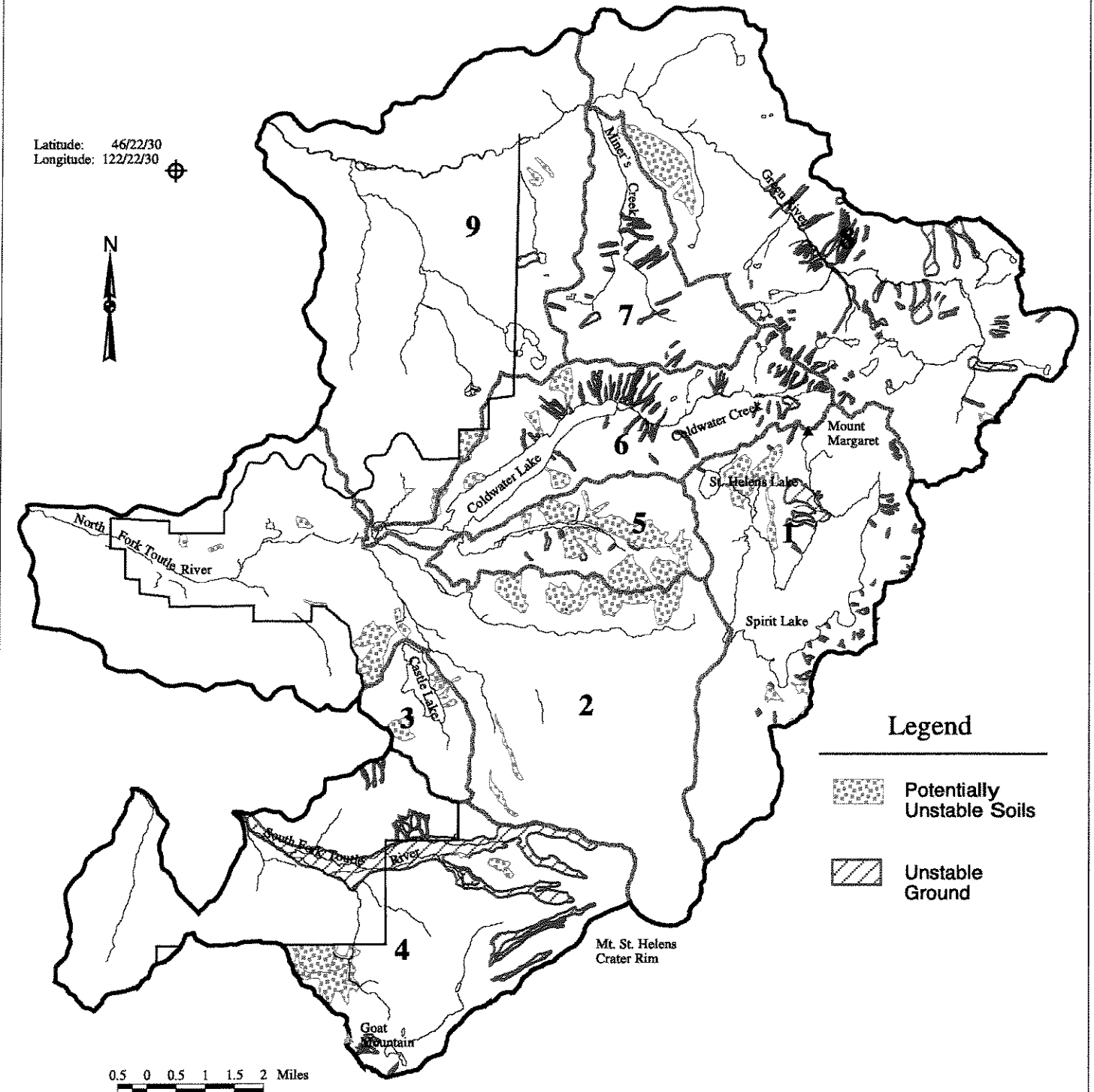


Figure 10. Areas mapped as unstable and potentially unstable ground. Areas of overlap should be considered as unstable.



These areas may be presently considered stable, but a continual buildup of new material at the headwalls of these channels will eventually be moved down slope during a future large storm event. The channels that were not scoured to bedrock still have the potential to move material downstream during high runoff periods either by debris torrents or less dramatic erosional processes.

One of the largest mass wasting events in recorded history was the initial landslide that occurred on Mount St. Helens just prior to the eruptive blast. This slide was triggered by an earthquake on the over-steepened slope. Steam and magmatic explosions began due to the pressure release behind the slide scarp and the resultant blast moved over 2.5 cubic kilometers of material as far as 22 kilometers to the west and 8 km north. The resultant deposits have blocked drainages creating new lakes (Castle and Coldwater) and raised lake levels (Spirit Lake). These blockages are loose unconsolidated material that could be catastrophically released under the right conditions. Castle Lake is being continually monitored for groundwater levels to determine the potential for failure. Circumstances such as high runoff, seismic activity or other factors could create an unstable condition and cause a large landslide/mudflow to move down the Toutle valley. Even though the level of Spirit Lake is controlled by a tunnel that drains into South Coldwater Creek, erosion of deposits in the main Toutle River continues and could eventually erode back to a point where Spirit Lake may over top the blockage and regain its original channel. This could cause a mass blockage failure or perhaps simply redirect the drainage back to its pre-eruption location. The timing of this possible change is not known, but it could be up to hundreds of years in the future.

Erosional Processes

Erosional processes have been major contributors to sediment routing since the 1980 eruption. Loose ash and tephra on the steep slopes of the watershed have continually been affected by rain and wind. Evidence of this is more pronounced during large storm events or spring runoff of snow melt. As the new vegetation strengthens its foothold this erosion will lessen until the next eruptive event adds more ash and tephra to the landscape.

The amount of ash and tephra from eruptive events also influences the vegetation. In areas where these

deposits are greater than eight inches in depth, vegetation growth is diminished or the plants could be killed. This is a somewhat arbitrary figure as all vegetation types will be affected differently depending upon the circumstances. Shallow ground vegetation will be buried and may be killed or it might, over time, work its growth to the new surface. Larger shrubs and trees can also be affected by eight-inch depths by slowing their growth or death. These effects have not been clearly evident from the 1980 eruption because the greater impacts of the lateral blast destroyed almost all the vegetation outright. If the blast had been vertical the effects of ash and tephra deposits would have been more obvious. Today, the loose ash and tephra are continually being eroded by rain and wind.

Tephra has not been the only erosional material that has affected this watershed. The pyroclastic flows and mudflows have also undergone major changes since being deposited in 1980. Through the actions of water and wind, these deposits, especially noticeable in the main Toutle valley, have been mobile. Over the last 15 years, the upper portions of the main Toutle River have noticeably eroded (over ten feet) in some areas. This will presumably continue until either the material consolidates to a point that erosion will be minimal or the grade of the river flattens. This rate of erosion is extreme and has caused river traffic problems downstream in depositional areas, even as far as the Columbia River. The South Fork of the Toutle has also shown the same erosional problems. The upper portion of the Green River has also been affected but to a lesser extent than the Toutle or South Fork.

Sediment routing from roads in the watershed have had discernable but lesser effects than the other erosional processes. Since the 1980 eruption, the existing road system has undergone major changes. Many of the original roads were eliminated or rendered completely unusable. Major access into the area is now limited to newly-constructed or reconstructed roads of a relatively high standard. The new road system has reduced the amounts of sediment that could be routed to streams to minimal levels.

Fire History

Since the mid-1800's, no large fires of catastrophic intensity have burned within the boundaries of the Upper Toutle River watershed. In the fall of 1974, a

fire of approximately 300 acres (but of relatively low intensity) burned in the vicinity of Elk Lake which is located within the Upper Green River sub-basin. This fire was human-caused and burned mainly in areas that had been previously harvested by the Forest Service and private land owners.

Numerous small fires ranging from 0.1 to 0.5 acres in size have also occurred within the watershed since the Forest Service started keeping records in the early 1900's. The vast majority (82 percent) of these fires were human-caused and associated with recreation activities in the Spirit Lake basin. The few lightning fires that are documented occurred in the higher elevation in the Mount Margaret area north of Spirit Lake.

The eruption of Mount St. Helens in May of 1980 also burned and destroyed many thousands of acres across the watershed. The effects of this eruption and accompanying ash-fall was equivalent to the large catastrophic fires that burned in the watershed in prehistoric times.

Figure 6 shows fires that have been documented by the Forest Service in the Upper Toutle River watershed from 1970 to present. This includes the fire started by the 1980 eruption of Mount St. Helens.

Since the eruption many years will pass before human-caused fires once again become a concern. At the present time, visitors are limited to a trail system that only accesses the most devastated areas of the watershed. These areas are characterized by the lack of fine fuels needed for fire ignition. Although overnight stays are presently not allowed (reducing the chances that visitors might need fire for warmth and cooking), by 1998 visitors will again be permitted to camp overnight in the Mount Margaret Backcountry area.

Vegetation

Stand Composition

The vegetation of the Toutle River watershed has been categorized into six vegetation zones (Figure 7. Vegetation Zones) based on plant species present, their proportions, and potential vegetation. The Western Hemlock zone is generally the most productive for growing trees, followed by the Pacific Silver Fir zone, and the Mountain Hemlock/Subalpine Fir zone. Table 2 shows the amounts of each vegetation zone in the watershed, and Table 3 shows the breakdown of these zones by sub-basin.

Table 2. Vegetation Zones in the Toutle River Watershed. Calculations exclude non-National Forest Lands

Vegetation Zone	Acres	Percent of Watershed
Western Hemlock	5,432	7
Pacific Silver Fir	38,050	48
Mountain Hemlock	735	1
Shrubland	572	1
Water	4,003	5
Non-Forest	29,868	38

Table 3. Vegetation Zones in the Toutle River Watershed by Sub-basin. Calculations exclude non-National Forest lands.

Sub-basin	Acres	Western Hemlock	Pacific Silver Fir	Mountain Hemlock	Shrubland	Water	Non-Forest
1	11,292	Tr.	5,597	Tr.	45	2,648	3,002
2	19,434	2,583	959	0	77	24	15,011
3	1,950	330	1,131	0	0	276	213
4	8,496	0	4,091	0	355	8	4,240
5	3,865	Tr.	2,259	0	0	0	1,606
6	7,523	1,600	1,634	0	0	787	3,539
7	3,146	137	4,794	0	6	13	119
8	16,247	114	14,588	735	73	142	1,747
9	1,348	2,998	2,998	0	15	105	394

Stand Structure

From an ecological/functional perspective, stand structure is often more informative than stand age or seral 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.

For ease of interpretation, structure stages are combined into seven groups based on ecological functions at a more coarse scale. Table 4 lists the percent of grouped structure stages within the watershed by sub-basin. Non-National Forest lands are excluded because of a lack of data.

Table 4. Percent Grouped Vegetation Structure Stages by Sub-basin. Calculations exclude non-National Forest Lands.

Sub-Basin	Acres National Forest	Grass/ Forb/ Seedling	Open Sap/Pole/ Sm Tree	Closed Sap/Pole/ Sm Tree	Lg Tree Single Layer	Lg Tree Multi Layer	Hard-wood	Non-Forest
1	11,292	45%	4%	0	0	0	0	51%
2	18,655	4%	15%	0	0	0	0	81%
3	1,950	60%	15%	0	0	0	0	25%
4	8,703	31%	4%	8%	0	30%	2%	53%
5	3,865	58%	Tr.	0	0	0	0	42%
6	7,560	17%	26%	0	0	0	0	57%
7	5,088	1%	84%	1%	0	11%	0	3%
8	17,402	30%	20%	18%	Tr.	21%	0	11%
9	4,181	Tr.	79%	8%	0	Tr.	0	12%
Total	78,697	20%	21%	5%	1%	9%	Tr.	44%

Non-forest lands are comprised of rock, dry meadows and wetlands. After the eruption of Mount St. Helens in 1980, areas with deep tephra deposits were classified as non-forest. Most of this area is now occupied by forb, shrub, and tree species and should be reclassified as shrub/seedling. Late-successional forest, which is represented by the large tree structure stages comprises about 10 percent of the watershed.

Figure 11 depicts the distribution of structure stages throughout the watershed. Large contiguous areas of non-forest and early-seral structural stages are obvious where the 1980 eruption of Mount St. Helens occurred. Private and State lands within the blast zone of the eruption were planted in the 1980's, and are primarily in open to closed sapling/pole structure stages. Private land within the watershed outside of the blast zone has also been harvested within the last twenty-five years. There is very little mature forest left outside of the National Forest, and where it does occur it's in small isolated stands.

A large patch of mature/old growth timber, consisting of about 3,600 acres, can be found on National Forest in the Green River drainage in Sub-basin 8. The patch is on the north-facing slope on the south side of the river, and extends across the floodplain to the base of the south-facing side of the drainage. The majority of

the south-facing side is in closed small tree structure stage, apparently the result of a fire. This timber patch is in the legislated National Volcanic Monument, so it is not subject to timber harvest.

Another more fragmented patch of mature to old growth timber can be found in the southwest part of the watershed just north of Goat Mountain. These stands are fragmented by past timber harvest, wetlands, and the effects of past eruptions. This fragmented pattern continues south into the adjacent Kalama Watershed.

About 75 percent of the watershed exhibits the effects of the 1980 eruption, being in early successional stages or non-forest condition.

Stream Riparian Reserves

Stand structure and composition within stream Riparian Reserves has also been altered largely by the 1980 eruption, but also by timber harvest and fire. Fifty-three percent of the stream Riparian Reserves on National Forest are in early to mid-successional stages, 9 percent is in a late-successional stage, less than one percent are in hardwoods, and 37 percent is non-forest. There are no figures available for private or State land, however the condition on these lands is predominately

Upper Toutle River

Grouped Vegetation Structure Stages

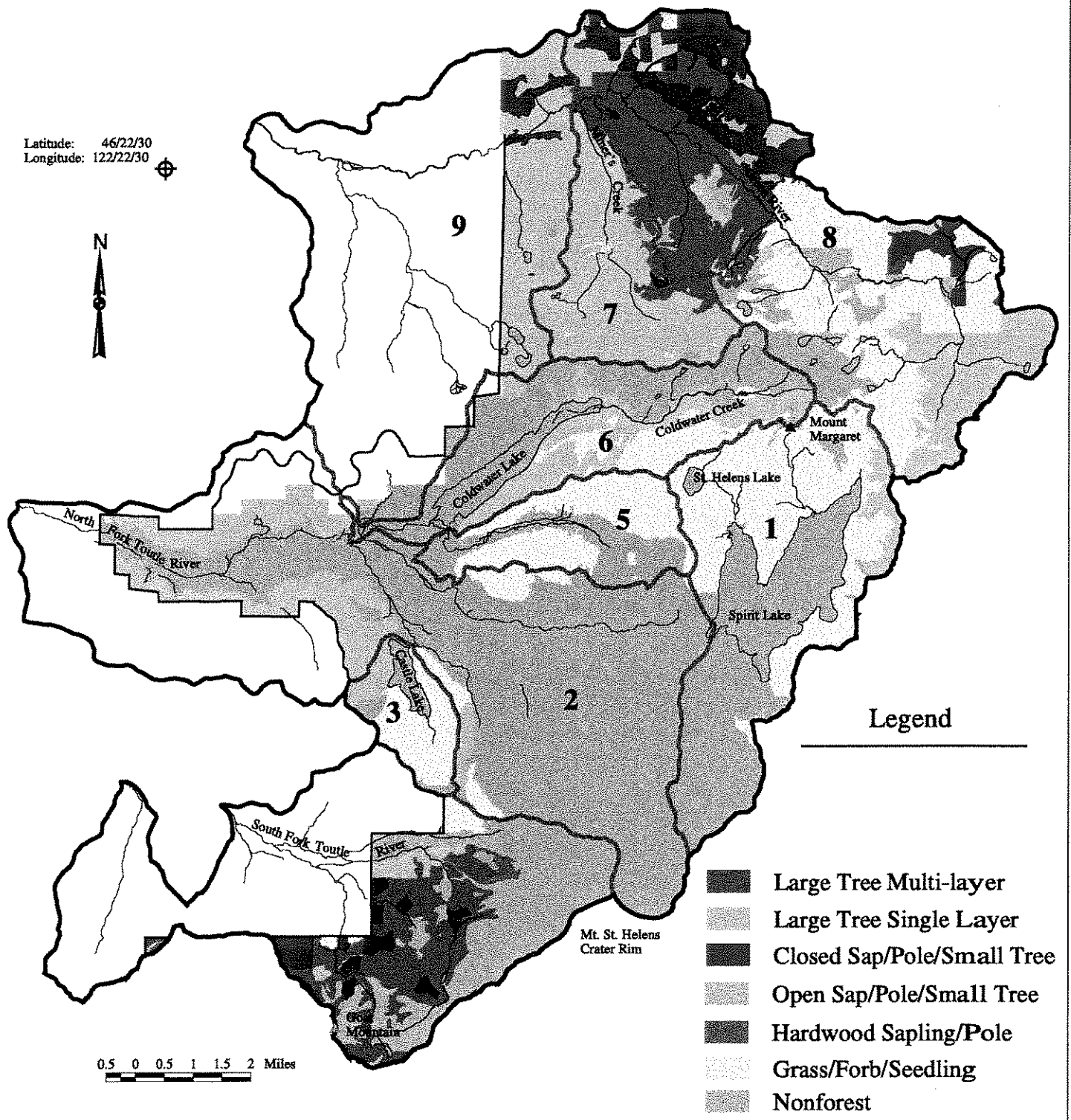


Figure 11. Grouped Vegetation Structure Stages in the Upper Toutle River Watershed. Only National Forest lands are classified into Structure Stages.



early-successional as well. Because of efforts to salvage and replant following the eruption, there is significantly more area in open and closed sapling stands on private and State land than on National Forest. Since the legislated Monument was not replanted, it will take considerably longer before mature timber develops in the Riparian Reserves on

National Forest land in the blast zone than it will for non-federal lands.

Table 5 lists grouped structure stages within stream Riparian Reserves, and Table 6 shows structure stages by sub-basin.

Table 5. Grouped Stream Riparian Reserve Vegetation Structure Stages. Figures exclude non-National Forest Lands.

Total Riparian Reserve Grouped Structure Stages	Acres	Percent
Grass/Forb/Seedling	4,887	25%
Open Sapling/Pole/Small Tree	4,630	23%
Closed Sapling/Pole/Small Tree	1,011	5%
Large Tree Single Layer	20	Tr.
Large Tree Multi-Layer	1,843	9%
Hardwoods	38	Tr.
Non-Forest	7,290	37%
Riparian Reserve Total	19,719	

Table 6. Percent Grouped Vegetation Structure Stages of Stream Riparian Reserves by Sub-basin. Figures reflect only National Forest Lands.

Sub-basin	Stream Riparian Reserve	Grass/Forb/Seedling	Open/Sap/Pole/Sm Tree	Closed Sap/Pole/Sm Tree	Lg Tree Single Layer	Lg Tree Multi Layer	Hard-wood	Non-Forest
1	2,575	64%	4%	0	0	0	0	32%
2	3,568	6%	22%	0	0	0	0	72%
3	550	70%	20%	0	0	0	0	10%
4	2,366	2%	3%	11%	0	31%	2%	52%
5	1,118	46%	0	0	0	0	0	54%
6	2,059	16%	32%	0	0	0	0	52%
7	1,290	3%	87%	Tr.	0	8%	0	2%
8	5,112	33%	19%	13%	Tr.	19%	0	16%
9	1,080	Tr.	79%	10%	0	Tr.	0	10%
Total	19,719	25%	23%	5%	Tr.	9%	Tr.	37%



Upper Toutle River

Grouped Vegetation Structure Stages of Stream Riparian Reserves

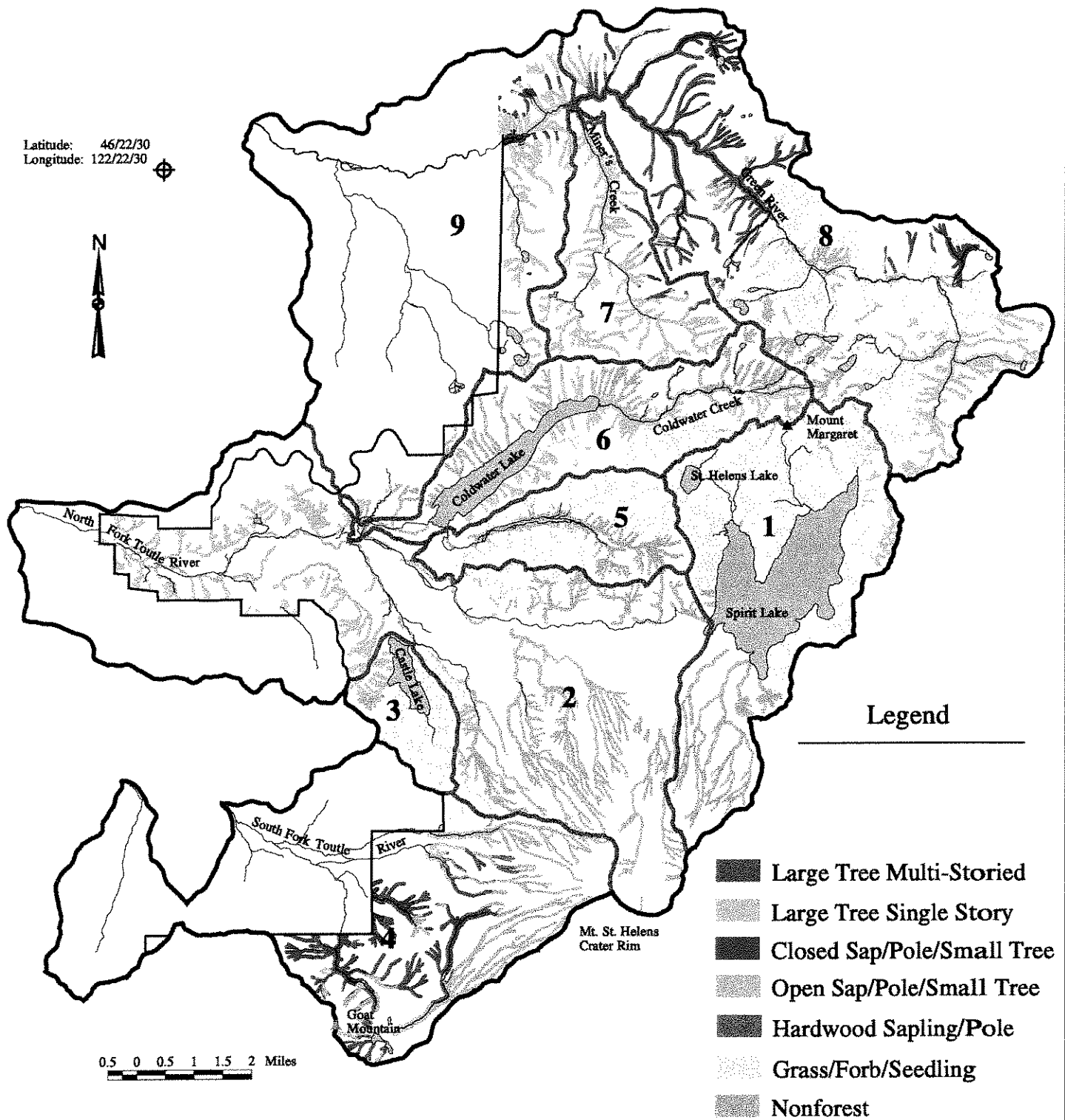


Figure 12. Stand structure and composition within the Stream Riparian Reserves have been influenced by volcanism, wildfire, and harvest activities.



Goat Marsh Research Natural Area

The Goat Marsh Research Natural Area (RNA) is in the southern portion of the watershed. The Research Natural Areas are preserved for the following reasons:

1. baseline areas against which effects of human activities can be measured,
2. sites for study of natural processes in undisturbed ecosystems, and
3. gene pool preserves for all types of organisms, especially rare and endangered types.

This Goat Marsh RNA was established on May 24, 1974. This area was selected because it represents an array of mountain wetland communities, including marshlands, swamps, bogs and ponds; and xeric noncommercial lodgepole pine forests which characterize youthful pyroclastic flows, mudflows, and alluvial surfaces associated with Cascadian volcanoes. (Franklin et al. 1979). The RNA also preserves the finest known stand of noble fir for scientific and educational purposes.

The greatest natural disturbances in the area have been caused by pyroclastic flows and the history of beaver

activity, which has changed the pattern of the aquatic communities. A 10-acre portion of a clearcut that was harvested in the mid-1960s intrudes on the northwest boundary of the RNA. Currently recreational use by people hunting and fishing in the RNA has the greatest potential for human-caused disturbance in the interior of the RNA.

The Goat Marsh RNA consists of a total 1,195 acres. Of this 442 acres are wetlands, 388 acres are pyroclastic forests dominated by lodgepole pine, 70 acres are lower slope forests dominated by noble fir, 285 acres are steep slope forests dominated by Pacific silver fir and western hemlock, and 10 acres that have been clearcut.

TES Plants

Of the 35 TES vascular plant species either documented or suspected to occur on the Mount St. Helens administrative unit, four species have been found in the Toutle River watershed (Table 7).

Table 7. Documented and Suspected TES Plant Species

Species	Federal Status	State Status	C-3 Status	Toutle River	MSH Unit	Sub-Basins
<i>Agoseris elata</i>	-	S	-	-	Sus	
<i>Botrychium lanceolatum</i>	-	S	-	D	D	4
<i>B. lunaria</i>	-	S	-	-	D	
<i>B. minganense</i>	-	S	-	-	Sus	
<i>B. montanum</i>	-	S	-	-	Sus	
<i>B. pinnatum</i>	-	S	-	D	D	4
<i>Carex atrata</i> var. <i>erecta</i>	-	S	-	-	D	
<i>C. densa</i>	-	S	-	-	Sus	
<i>C. interrupta</i>	-	D	3	-	D	
<i>C. scopulorum</i> v <i>prionophylla</i>	-	S	-	-	Sus	
<i>Chrysolepis chrysophylla</i>	-	S	-	-	D	
<i>Cicuta bulbifera</i>	-	S	-	-	Sus	

Species	Federal Status	State Status	C-3 Status	Toutle River	MSH Unit	Sub-Basins
<i>Cimicifuga elata</i>	-	T	2	-	Sus	
<i>Corydalis aquae-gelidae</i>	-	T	2	-	D	
<i>Cypripedium fasciculatum</i>	-	T	2	-	Sus	
<i>Epipactus gigantea</i>	-	S	-	-	Sus	
<i>Githopsis specularioides</i>	-	S	-	-	Sus	
<i>Liparis loeselii</i>	-	E	-	-	Sus	
<i>Luzula arcuata</i>	-	S	-	-	Sus	
<i>Microseris borealis</i>	-	S	-	-	Sus	
<i>Mimulus suksdorfii</i>	-	S	-	-	Sus	
<i>Montia diffusa</i>	-	S	-	-	D	
<i>Ophioglossum vulgatum</i>	-	T	-	-	Sus	
<i>Orobanche pinorum</i>	-	S	-	D	D	4
<i>Parnassia fimbriata v</i>	-	S	-	-	Sus	
<i>Pedicularis rainierensis</i>	-	S	-	-	Sus	
<i>Platanthera sparsiflora</i>	-	S	-	-	Sus	
<i>Pleuricospora fimbriolata</i>	-	S	-	D	D	4
<i>Poa nervosa v nervosa</i>	-	S	-	-	Sus	
<i>Polemonium carneum</i>	-	T	-	-	Sus	
<i>Polystichum californicum</i>	-	S	-	-	Sus	
<i>Saxifraga debilis</i>	-	S	-	-	Sus	
<i>Sisyrinchium sarmentosum</i>	-	T	2	-	D	
<i>Utricularia intermedia</i>	-	S	-	-	Sus	
<i>Veratrum insolitum</i>	-	S	-	-	Sus	

State/Federal Status: T = Threatened E = Endangered S = Sensitive

Occurrence: D = Documented
Sus = Suspected

C-3 Status: 1 = Manage known sites
2 = Survey prior to activities & manage sites
3 = Conduct extensive surveys and manage sites
4 = Conduct general regional surveys

Botrychium lanceolatum (Lance-leaved moonwort)
Commonly found in sandy to loamy well-drained meadows, with at least 15 percent bare ground exposed. This species is also known from wet, mossy benches in mature western red-cedar forests, mossy talus slopes near creek drainages, mixed mature coniferous forests, alpine meadows, roadbeds, and disturbed areas.

Botrychium pinnatum (Northern moonwort)
Habitats include moist coniferous forest, mossy talus slopes under mixed deciduous and coniferous cover, subalpine meadows, and disturbed areas.

Orobanche pinorum (Pine broomrape)
Open woods from lowlands to moderate elevations. Parasitic on the roots of oceanspray (*Holodiscus discolor*) and occasionally manzanita and madrone.

Pleuricospora fimbriolata (Fringed pinesap)
Found in the duff and humus layer in shaded coniferous forests from southern Washington to California. Typically occurs in late-successional stands.

C-3 Plants

Very little of the watershed has been surveyed for plant species listed as Survey and Manage in the Northwest Forest Plan. However one species from this list has been documented in the watershed at four sites in sub-basin 4. The species is *Oxyporous nobilissimus* (Noble

polypore). To protect populations of this species in management allocations open to timber harvest or other development activities, the Northwest Forest Plan requires establishment of management areas of all useable habitat up to 600 acres around the populations until the sites can be thoroughly surveyed and site-specific measures prescribed.

Two of the sites are in Goat Marsh RNA near the northern edge, and two sites are in Section 11 north of Goat Marsh. The latter two sites are in Matrix allocation.

Habitat Conditions for Terrestrial Animals

The watershed contains habitat suitable for a total of 256 wildlife species. There is potential habitat for four Federally listed threatened or endangered species, three Forest Service sensitive species, and seven Survey and Manage (C-3) species.

Federally Listed Animal Species

Four Federally listed threatened or endangered species that may be found in the watershed are listed in the table below.

Table 8. Federally listed animal species which are known or suspected to occupy the watershed

Common Name	Species Name	Federal Listing	Documented Sighting in Watershed	Probability of Occurrence in Watershed
Northern spotted owl	<i>Strix occidentalis caurina</i>	threatened	yes	high
Bald eagle	<i>Haliaeetus leucocephalus</i>	threatened	yes	high
Peregrine falcon	<i>Falco peregrinus</i>	endangered	yes	moderate
Gray wolf	<i>Canis lupus</i>	endangered	yes	low

High - Suitable habitat present. Confirmed sighting.

Moderate - Suitable habitat present. Species presence possible but not confirmed.

Low - Habitat conditions marginal. Species presence not confirmed.

Northern spotted owl - There are three spotted owl activity centers in the Toutle River Watershed. Two of these, numbers 101 and 104 are located within the Legislated Monument. The third, number 125 is located in Matrix. Number 125 was established before 1994, and as such a 100-acre core of suitable habitat has been designated around this activity center. Additionally, even though 101 is located within the Legislated Monument, much of the habitat within the pair's home range is in Matrix. However, under the Northwest Forest Plan, since the amount of late-successional habitat in the watershed is less than 15 percent (and likely to remain that way for some time) there will be no further harvest of late-successional stands. There may be opportunities to commercially thin young stands within the home ranges of these two owl pairs, which could improve habitat in the long-term.

Activity center 101 was first established in 1980 when a spotted owl pair was located at the site, but reproduction was not confirmed. Owls were found at this site throughout the 1980's and reproduction was

confirmed in 1982, 1983, 1986 and 1987. The last survey was in 1992, when a single bird was located.

Activity center 104 was established in 1979 when a single spotted owl was located at the site. Surveys were conducted throughout the 1980's with reproduction confirmed only in 1987 and 1989. This center has not been surveyed since 1989.

Activity center 125 was established in 1991 when a pair was located, but reproduction was not confirmed. Surveys were conducted in 1992 and 1994. Owls were located each time, but no reproduction was confirmed.

Table 9 displays the acres of nesting, foraging, and dispersal habitat for spotted owls and the percentage within each sub-basin. The acreage figures reflect private land as well National Forest. (Based on aerial photos and flights over the watershed it is assumed that there is no suitable spotted owl habitat on private land in the watershed.)

Table 9. Abundance of Owl Habitat in each Sub-basin

Sub-basin (acres)	Nesting Habitat acres/percent	Foraging Habitat acres/percent	Dispersal Habitat acres/percent	Unsuitable Habitat acres percent
1 11,292	0	0	0	11,292 100%
2 26,199	0	0	0	26,199 100%
3 1,954	0	0	0	1,954 100%
4 17,223	2,362 14%	169 1%	294 2%	14,398 84%
5 3,865	0	0	0	3,865 100%
6 7,757	0	0	0	7,757 100%
7 5,088	558 11%	42 1%	11 Tr.	4,477 88%
8 17,815	3,595 20%	2,154 12%	511 3%	11,555 65%
9 18,363	21 Tr.	0	0	18,342 99+%
TOTAL 109,557	6,536 6%	2,365 2%	816 1%	99,840 91%

Figure 13 displays the distribution of suitable spotted owl habitat in the watershed. The patches of suitable habitat in the watershed are widely separated due to the effects of the 1980 eruption. This expanse of early successional habitat is a barrier to spotted owl movement between the two suitable patches. In addition to being isolated from each other, these patches are somewhat isolated from other large tree habitat in adjacent watersheds. The large patch in the Green River drainage is relatively unfragmented however, and located about one mile from the Quartz Late-successional Reserve (LSR). While there has been only one spotted owl activity center established in this patch, it's possible that additional owls may nest there. Although not connected to the LSR by suitable habitat, it's likely that mobile species such as spotted owls could move between this patch and the LSR.

The habitat patch in the southern portion of the watershed is more fragmented by both timber harvest and past volcanic activity. This habitat is connected to other habitat in the Kalama Watershed, however even when considered together, this habitat is not high quality because it is fragmented and well isolated from other suitable habitat within the landscape.

A majority of the suitable spotted owl habitat in the watershed is within the National Volcanic Monument and the Goat Marsh Research Natural Area.

Bald Eagle - The bald eagle is an opportunistic scavenger/predator. The key to their occupying an area is the presence of a large body of water, large trees for nesting and roosting, and freedom from excessive human disturbance (USDI 1986). Chance sightings of bald eagles have occurred in the watershed, although no formal surveys have been conducted. Bald eagles are commonly seen during the spring near the wetlands southwest of Coldwater Lake. It is likely that they also forage at Coldwater Lake. Absence of large trees or snags that could function as perch and roost sites probably makes it unlikely that the area would attract a large number of eagles.

Peregrine Falcon - There are no known active peregrine falcon eyries in the watershed. There have been reports of sightings of peregrines during the time of the year when they would be migrating, and may have been passing through the area. The peregrine is almost exclusively dependant on high sheer cliffs for nest sites, and their diets consist primarily of small birds. Suitable cliffs overlooking lakes and riparian

areas that are supporting high numbers of passerine birds would be most likely nest sites.

There have been reports of prairie falcons in the watershed. These birds have been observed preying on small birds, and may nest in the watershed. Prairie falcons also nest on cliff sites, but will use lower and less sheer cliff site than will peregrine falcons.

The legislated Monument contains numerous cliffs that appear to be suitable nest sites. Cliffs can be found overlooking all of the major lakes, and throughout the Mount Margaret Backcountry. These sites are protected from most management activities except for trail construction and associated recreational activity. Hiking trails that are used during the nesting season that are too close to the base, or more importantly, to the tops of suitable cliffs would discourage nesting by peregrine falcons.

Gray Wolf - There has been one reported wolf sighting in the watershed. The sighting was made in 1992 but could not be confirmed to be a wolf. The key elements in suitable habitat for wolves are a sufficient year-round prey base (ungulates and alternate prey), suitable den and rendezvous sites, and sufficient space with minimal human disturbance.

The 1980 eruption increased the remoteness of much of the watershed by reducing road density. Monument regulations that restrict the number of visitors in the Mount Margaret Backcountry, as well as restricting hiking to established trails also helps to reduce human presence in portions of the legislated Monument. The limiting factor for most of the watershed is probably prey base. For the private and State land in the watershed, the limiting factor is the amount of human disturbance associated with high road densities.

Prey Base - Elk and deer can be found in fairly high numbers in portions of the watershed, such as along the Toutle River, however they are not well distributed throughout the watershed due to lack of cover and forage in a large part of the blast zone. The areas where elk and deer are more likely to be found because cover still exists are also areas that receive more use by people, such as the Goat Marsh area, the Toutle River drainage, and private timberlands on the western portion of the watershed.

The watershed contains only 144 acres of designated winter range on National Forest, however elk winter in



Upper Toutle River

Spotted Owl Cover Type

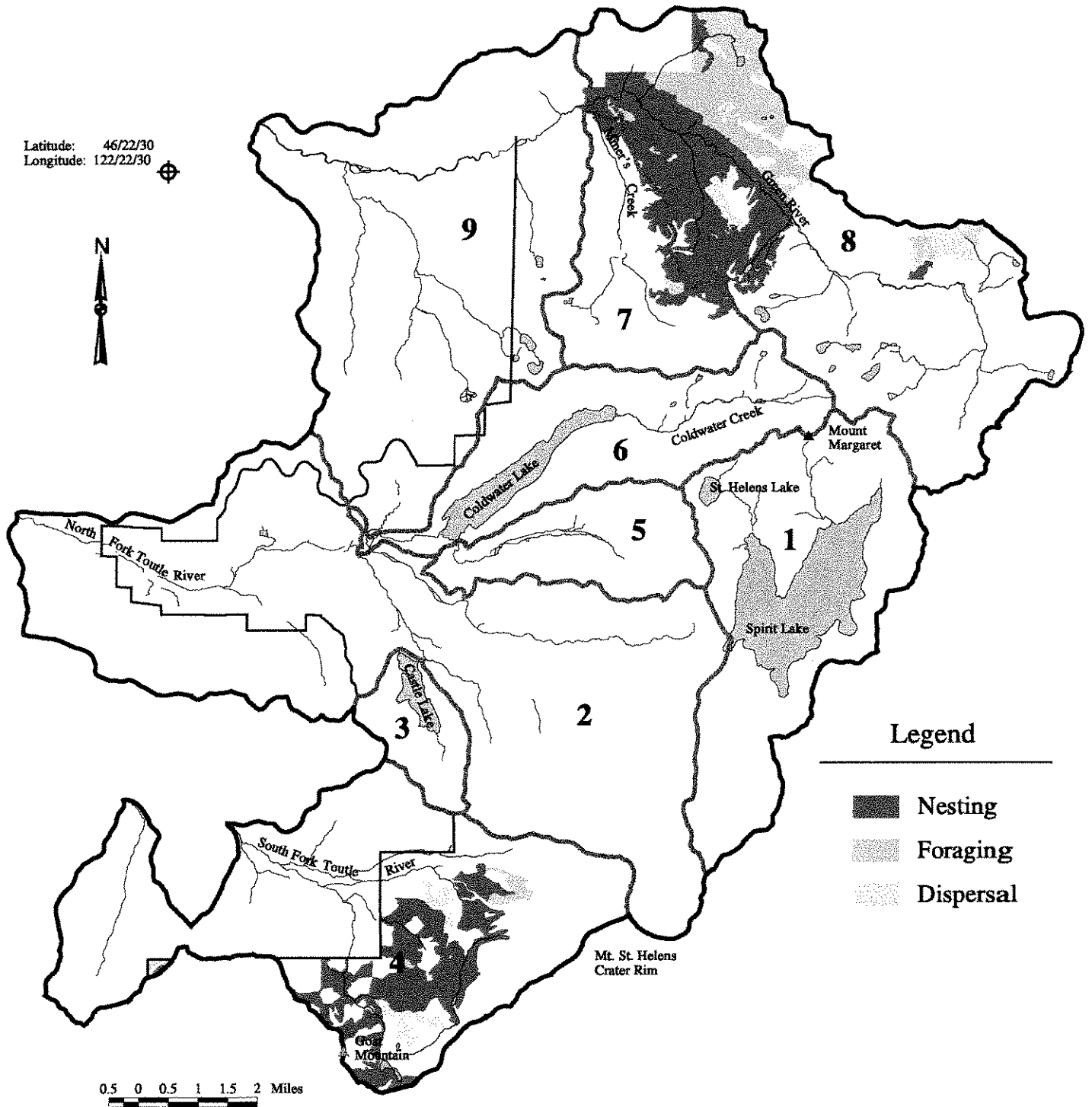


Figure 13. Distribution of northern spotted owl habitats within the Upper Toutle River Watershed.



the Toutle River valley at least as far up as Coldwater Lake.

Seclusion - Fredrick (1991) reported that wolf populations ceased to breed and were rapidly extirpated when road densities exceed 0.94 miles per square mile. Table 18 (page III-38) displays the miles of road per square mile in each sub-basin. The road density on private land is quite high, but fairly low on National Forest because of the presence of the Monument. The sub-basins with high road density are those that contain private land in the western half of the watershed. The National Forest land in the watershed has an average of less than 1.0 mile of road per square mile.

Den and Rendezvous Sites - Chapman and Feldhamer (1982) reported that wolf dens are usually located on slopes, ridges, or other high ground near a source of water. Wolves may also use abandoned beaver lodges, hollow logs, rock crevices or surface depressions. Rendezvous sites are used after pups leave the den, but are not yet old enough to hunt with the adults. A factor common to both den and rendezvous sites is that they are located far from trails and open roads.

Numerous potential den and rendezvous sites can be found in the legislated Monument due to the low road density, and restrictions on off-trail travel. However the lack of vegetative cover and low prey base populations in these areas reduces the likelihood that

these areas would be used by wolves, especially a breeding pair. In the future as habitat improves for large ungulates, and if the management of the legislated Monument does not change, conditions for wolves will improve.

Grizzly Bear - Grizzly bears are not listed as a species that is suspected to occur in this watershed because habitat is marginal, and populations within the State are quite low even where habitat is considered suitable. There have been no reported sightings. As with gray wolf, habitat for grizzly bears is marginal because of a limited prey base and limited cover in the portions of the watershed that are not roaded. The roaded areas of the watershed would be avoided by grizzly bears. As described for gray wolf, habitat conditions will improve as vegetation in the legislated Monument recovers.

Sensitive Animal Species

Potentially suitable habitat exists in the watershed for three Forest Service listed sensitive species. Actions carried out by the agency must not contribute to a trend toward Federal listing as threatened or endangered, or cause a loss of viability of sensitive species populations. The table below lists the sensitive species that may occur in the watershed.

Table 10. Sensitive Animal Species which are Known or Suspected to Occur in the Watershed

Common Name	Species Name	Documented in Watershed	Probability of Occurrence in Watershed
Wolverine	<i>Gulo gulo</i>	No	Low
Common loon	<i>Gavia immer</i>	Yes	High
Larch Mountain salamander	<i>Plethodon larselli</i>	No	Moderate

High - Suitable habitat present. Confirmed sighting.

Moderate - Suitable habitat present. Species presence possible but not confirmed.

Low - Habitat conditions marginal. Species presence not confirmed.

Wolverine - The wolverine is similar to the gray wolf in that it has a very large home range, uses a variety of habitats, depends on large ungulates for at least part of its food supply, and is extremely sensitive to human disturbance. Because of its large home range, it is possible that if wolverines exist on the Gifford Pinchot National Forest, that they would make use of portions of the watershed. As with gray wolf, wolverines are probably most likely to use areas that receive little human use, such as the Mount Margaret Backcountry, and the Falls Creek Area. As vegetation in the area devastated by the 1980 eruption continues to develop, conditions for wolverines will improve as long as management of the Monument remains consistent, and recreation use in backcountry areas does not significantly increase. As vegetation increases in the devastated area there will be an increase in the number of small animals that would be preyed upon by wolverines, as well as large ungulates.

Common loon - Common loons have been sighted in the watershed at Spirit Lake and just outside the watershed at Meta Lake, but it is unknown if any loons nest in the watershed. For nesting, the common loon selects lakes or rivers with deep water, and with vegetation that reaches the waterline to protect the nest. For feeding, the bodies of water must support an adequate supply of small fish, be deep enough for the loons to dive to escape predators, and be long enough that it can take flight (about 1/4 mile).

The larger lakes that are in the blast zone, such as Coldwater, and Spirit Lakes still lack the required vegetation at the shorelines to support nesting loons. Foraging at Coldwater Lake is possible, however fish

populations in Spirit Lake are quite low. It's likely that the individuals seen were migrants. Nesting conditions will improve as vegetation regrows around these lakes, and fish populations increase, making it more likely that loons will inhabit the watershed in the future.

Larch Mountain salamander - There have been no sightings of this species in the watershed, however suitable habitat exists on the north slope of Goat Mountain in the RNA, and in the timber stands in the Green River drainage. Surveys in these areas have not been conducted.

The Larch Mountain salamander is typically associated with steep wooded talus slopes that include large amounts of decaying plant material and little soil. They have also been found in late-seral forest where there is no talus, but stands where it is found nearly always contain a few very large Douglas fir trees and snags. The stands in the watershed that are most likely to support this species are protected within the Legislated Monument and the RNA. If populations exist in these areas it is not likely that they would be affected by management activities.

Survey and Manage Animal Species (C-3)

Habitats exist in the Toutle River Watershed which are potentially suitable for seven vertebrate C-3 species. One of these species, the Larch Mountain salamander, is discussed above. Table 11 lists the remaining six species that could be in the watershed.

Table 11. Survey and Manage Species (C-3) That May Occur in the Watershed.

Common Name	Species Name	Documented sighting in watershed	Probability of occurrence in watershed
Van Dyke's salamander	<i>Plethodon vandykei</i>	Yes	High
Great gray owl	<i>Strix nebulosa</i>	No	Moderate
Silver-haired bat	<i>Lasiorycteris noctivagans</i>	No	Moderate
Long-eared myotis	<i>Myotis evotis</i>	No	Moderate
Long-legged myotis	<i>Myotis volans</i>	No	Moderate
Fringed myotis	<i>Myotis thysanodes</i>	No	Moderate

High - Suitable habitat present. Confirmed sighting.

Moderate - Suitable habitat present. Species presence possible but not confirmed.

Low - Habitat conditions marginal. Species presence not confirmed.

Van Dyke's salamander - The Van Dyke's salamander is considered to be one of the most aquatic of the woodland salamanders. They are typically found in splash zones of creeks or waterfalls under rocks or woody debris, or under logs and loose bark on logs near water. When they are not found in association with water, they are usually on north-facing slopes with a thick cover of mosses.

Several populations have been found in association with some of the lakes and streams in the Mount Margaret Backcountry, and on the southeast side of Spirit Lake (C. Crisafulli pers. com. 1997). Many areas of the watershed have still not been surveyed, so it's likely that this species may occur in other areas as well. It is apparent that these salamanders survived the 1980 eruption in many areas by being under ground and under snow. The known populations in the watershed are protected from most management activities, however this species must be considered when planning new trails. Planning new trails to stay well away from creeks and waterfalls will help to preserve habitat.

Great gray owl - Great gray owls are found in a wide variety of habitat types, but are rare on the Gifford Pinchot National Forest. Most nests are located in

mature or old growth conifer or deciduous timber near large meadows or created openings. They forage primarily in large meadows or other openings, and feed on voles and pocket gophers mainly.

The area around Goat Marsh in the RNA appears to be suitable great gray owl habitat. There are old growth and mature timber stands adjacent to the large marsh/meadow that would support an abundant prey base. In addition to the meadow, openings created by past timber harvest have provided other foraging areas. This area appears to be the only suitable habitat in the watershed, and it's unlikely that great gray owls would nest elsewhere within the watershed. Since the suitable habitat is in the RNA, it is protected from management activities that would reduce its quality.

Forest bats - There are no recorded sightings of the four forest bat species in the watershed. Three of the bats use a wide variety of habitats including caves, forest edges, cliffs, and man-made structures such as bridges and buildings. The silver-haired bat is the only species primarily associated with forest structures. Table 12 outlines the various foraging zones and roost structures used by each species.

Table 12. Forage and Roost Habitats Used by Survey and Manage Bat Species.

Common Name	Foraging Zone	Winter Roosts	Day and Night Roosts
Silver-haired bat	Forest and meadow openings	Unknown	Loose bark, bark crevices, woodpecker holes, limbs against trees, and building sides
Long-eared myotis	forest and meadow openings	caves, mines, and buildings	loose bark, stumps, buildings, mines, caves, bridges, and talus slopes
Fringed myotis	forest and meadow openings, riparian zones	buildings, rock crevices, and mines	bridges, mines, caves, buildings, and snags
Long-legged myotis	forest and meadow openings, riparian zones	caves, and cracks, crevices and holes in trees	caves, and cracks and crevices in trees.

The watershed lacks any known significant caves, mines, or man-made structures that would be suitable as winter roosts for bats. However there are many areas that could be summer roost sites. Rock outcrops, cliffs, snags, bridges, and old growth forest can be found in various parts of the watershed. Potential sites that could support these species include Goat Marsh RNA, cliffs and outcrops near riparian areas in the blast zone that support abundant insect populations, patches of standing dead trees in the blast zone (sub-basins 7 and 8), and old growth and mature timber in the Green River drainage. There are concrete bridges along Highway 504 in the Monument that may be suitable roost sites.

Other High Interest Species

Mountain goats

Before the 1980 eruption, a small herd of mountain goats inhabited portions of the Mount Margaret Backcountry. The herd had been started by transplanting animals into the area and numbered only about 15 animals. The herd was killed by the eruption. There have been sightings made east of the watershed in the Muddy River and Upper Lewis River Watersheds. These sightings may represent individual migrants from occupied habitat to the northeast such as Goat Rocks Wilderness.

The scarcity of vegetation in areas of the watershed formerly occupied by the mountain goats, makes it unlikely that it could currently support a herd. As vegetation increases over the next 10 to 20 years, the area could again become suitable. There are no plans to reintroduce goats to the Mount Margaret Backcountry because the objective for management of the legislated Monument is to allow plant and animal populations to recover naturally. If goat populations to the east remain viable and individuals continue to migrate out of the herd, it's possible that mountain goats will eventually repopulate the watershed.

Hydrologic Processes

The closest gaging station to the Upper Toutle River Watershed Analysis Area is located approximately 27 miles downstream. The average monthly discharges for the Toutle River near Silver Lake measured at this gaging station are displayed in the table below. The

highest instantaneous discharges and associated floods occur between November and February. An analysis of streamflow data found that 91 percent of the time the highest instantaneous flow for each year happened between November and February. These high flows are usually associated with rain-on-snow precipitation events.

Table 13 - Average Monthly Discharge from the Toutle River near Silver Lake.

Month	Discharge (cfs)
October	1048
November	2594
December	3591
January	3395
February	2957
March	2655
April	2433
May	2214
June	1746
July	912
August	522
September	579

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 discharge resulting from vegetation removal. As recommended in the procedure, a two-year storm was modeled for the analysis. Note that this analysis does not include information on private or State land due to the lack of GIS vegetation data.

The table below displays sub-basins that currently have peak flows that are increased by more than 10 percent when compared to a fully forested condition (see Figure 14, Peak Flow). This value is used by the State

of Washington to indicate areas that have a possibility for adverse effects due to peak flow increases and need further, detailed analysis.

Table 14. Peak Flow Increases

Sub-basin	Peak Flow Increase
1	5%*-10%**
3	8%*-16%**
5	6%*-13%**
7	6%*-14%**
9	7%*-15%**

* - peak flow increase for an average two year storm
 ** - peak flow increase for an unusually strong two year storm

All of the sub-basins listed in the table above are in the area that was severely affected by the 1980 eruption of Mount St. Helens. These areas are still recovering from the loss of vegetation from the blast on National Forest and non-National Forest land as well as from associated timber salvage on non-National Forest land.

It is important to note that these peak flow values probably underestimate the current peak flow increase from loss of vegetation, due to questionable vegetation mapping. Large areas of deposited tephra in the blast zone were mapped as "rock" and thus considered non-forested in the peak flow modeling (up to 80% of some sub-basins). Since these areas were non-forested, they were not part of the modeled peak flow change. These areas will probably have tree cover at some point in the future, so the designation as non-forested is questionable and has probably underestimated the current peak flow increase when compared to a fully forested condition.

Another component of the peak flow analysis is calculating 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" (Wemple et al, 1996). The following table displays sub-basins where roads have increased the length of stream miles by 25 percent or more (see Figure 14, Peak Flow).

Table 15. Extension of Stream Channel Network by Roads

Sub-basin	Percent increase
2	30%
4	44%
9	63%

A large flood event affecting a majority of the analysis area occurred in February, 1996. The magnitude of this flood and full extent of the damage are still being investigated at the time of this report. Preliminary information from aerial photographs and some field visits indicate numerous new landslides occurred in the blast area. As more information becomes available, it will be added to the analysis file and included in future iterations of analysis.

Aquatic Animals and Habitat

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, and aerial photograph interpretation. Existing habitat conditions were evaluated using the following aquatic habitat attributes: (1) pieces of in-channel large woody debris (LWD) per mile, (2) potential recruitment of LWD, (3) primary pools per mile, (4) water temperature, (5) channel widening, (6) bank erosion, and (7) aquatic habitat fragmentation. A brief discussion of the processes that are affecting the aquatic environment is included at the end of this section.

Upper Toutle River Peak Flow

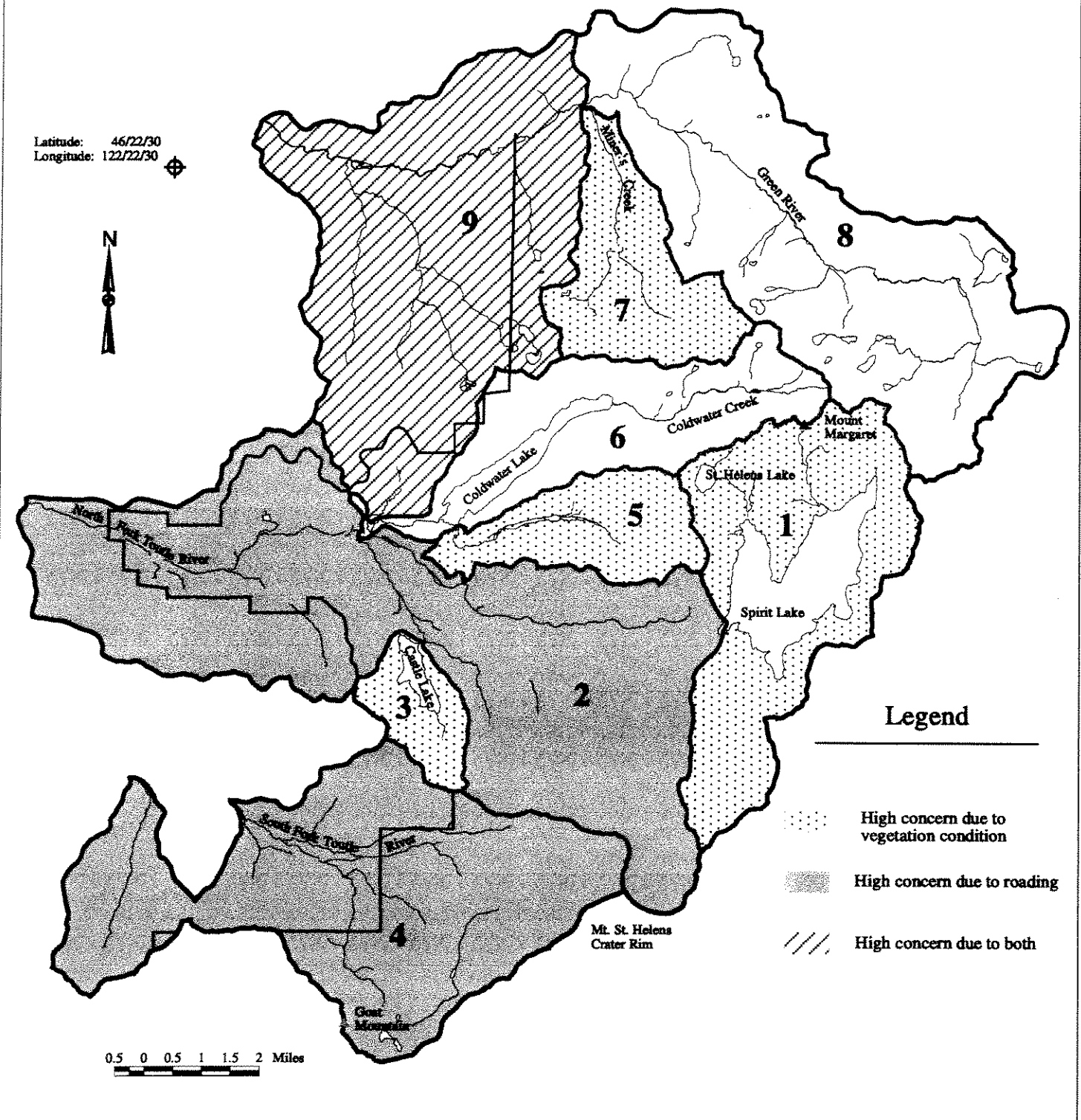


Figure 14. Areas of high peak flow concern in the Toutle River Watershed. These are defined as sub-basins with peak flow increases greater than or equal to 10 percent due to vegetation removal, sub-basins that have increased channel length by at least 25 percent from roading, or areas that meet both of these criteria.

Stream habitat surveys have been completed on approximately 11.6 miles of stream. Fish currently occupy approximately 48 miles of stream on National Forest land within the watershed (Figure 9). 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 the species that are present in this watershed are displayed in Table 17.

Dispersed camping and equestrian use in various areas of the watershed are compromising the quality of riparian areas, particularly around Deadman's Lake and Blue Lake. Water quality in these lakes and their inlet and outlet streams may be decreased due to erosion caused by the use of spur trails (non-system trails off of the main trail) by horses and people which go down to lake shores for watering purposes or viewing. During the 1994 Blue Lake survey, biologists noted areas with high horse use (i.e., hay left near lake's edge, muddy banks with horse hooves). In a 1994 visit to Deadman's Lake, biologists noted extensive camping damage within the riparian area and horse feed around the lake shore.

The Mount Margaret Backcountry (MMBC) is an area within the blast zone of Mount St. Helens (around Grizzly, Obscurity, Venus, St. Helens, Snow, Island, Holmstedt, Panhandle, Boot, and Coldwater Lakes) in which a trail system and designated campsites are located. It is scheduled to open for visitors during the summer of 1998. The Mount Margaret Backcountry Management Plan outlines the spectrum of recreational uses for the area. Eight lakes within the MMBC are included in the monitoring and adaptive management

study (Taken from USDA 1993):

St. Helens and Boot Lakes are set aside as areas for long-term research. These lake basins will remain closed to public access and will serve as controls for the purpose of long-term comparative studies.

Grizzly Lake basin will be open for day-use only with relatively easy access by developed hiking trail; Venus, Lower Venus and Holmstedt Lake basins will be open for day use only by untrailed cross-country travel.

Obscurity, Snow, Shovel, and Panhandle Lakes will be managed as destination recreation sites with overnight camping by permit in designated sites only.

Coldwater Lake is designated for day use only and has road and trail access; Castle Lake is designated for dispersed camping with trail access only.

Fish distribution and abundance

Resident fishes within Toutle River Watershed streams include rainbow trout, cutthroat trout, lake trout, brown trout, and sculpin (Table 16 and Figure 15). Fishes within the Toutle River Watershed are managed by the Washington Department of Fish and Wildlife.

Table 16. Fish Populations and Fish Stocking in Streams and Lakes within the Toutle River Watershed
(from Weinheimer, John and Bob Lucas. 1997. Unpublished data, Washington Department of Fish and Wildlife)

Lake	Location (*=Inside Monument)	Current Fish Spp.*	Last Stocking Date/Fish Spp.*	Stream Class/ Acreage	Value for Fishing	Other
Blue	08N-4E-13*	Searun ONCL	1989/TLCT	8.0 ac	High	Catch & Release Only
Boot	10N-5E-25	No Fish	1979/ONCL	16.1 ac	Not allowed	No stocking allowed; No public access
Castle	09N-4E-23*	ONMY	Not Stocked	200.0 ac	High	

	Location (*=Inside Monument)	Current Fish Spp.*	Last Stocking Date/Fish Spp.*	Stream Class/ Acreage	Value for Fishing	Other
Coldwater	10N-5E-23*	ONMY, ONCL,	1989/ONMY	805.0 ac	High	
Deadman's	10N-5E-01*	SAFO	unknown	34.0 ac	High	
Deer	10N-5E-9*	unknown	unknown	2.5 ac	unknown	
Elk	10N-5E-19	SAFO, TLCT, SATR	unknown	30.5 ac	unknown	
Fawn	10N-4E-25	SAFO	1973, 1976, 1979, 1989/TLCT	23.6 ac	unknown	
Forest	10N-5E-19	SAFO, TLCT	1989, 1991/TLCT	8.0 ac	unknown	
Goat Marsh	08N-4E-23*	SAFO	1979/TLCT	13.0 ac	High	
Grizzly	10N-6E-30*	No Fish	1979/TLCT	8.0 ac	N/A	No stocking allowed
Hanaford	10N-5E-19	TLCT, SAFO	1989, 1991, 1993/TLCT	7.0 ac	Moderate	
Heart	10N-5E-27*	No Fish	None	5.0 ac	unknown	No stocking allowed
Holmstedt	10N-5E-24*	unknown	1989/TLCT	18.0 ac	Not allowed	Research Lake
Island	10N-5E-15*	TLCT	1979/ONMY	11.0 ac	Low	No stocking allowed
Lonesome	10N-5E-18	unknown	unknown	5.0 ac	unknown	
Lower Venus	10N-5E-14*	ONMY	1989/TLCT	8.0 ac	Low	
Obscurity	10N-6E-19*	SAFO	1973/ONCL	7.0 ac	unknown	No stocking allowed
O'Conner	10N-5E-15*	TLCT	1992/TLCT	4.0 ac	High	Stocking allowed
Panhandle	10N-5E-24*	SAFO	1979/TLCT	15.1 ac	Low	No stocking allowed
Shovel	10N-5E-24*	SAFO	1979/TLCT	5.0 ac	Low	No stocking allowed
Snow	10N-5E-23*	No Fish	1976/ONCL	4.8 ac	N/A	No stocking allowed
Spirit	09N-5E-15*	ONMY	1979/ONMY, ONCL	2650.0 ac	Not Allowed	No stocking allowed
St. Helens	10N-5E-34*	SANA	1979/ONCL	79.0 ac	Not Allowed	No stocking allowed
Strawberry	10N-6E-28*	SAFO	1952/SAFO	10.0 ac	Moderate	Stocking is allowed

	Location (*=Inside Monument)	Current Fish Spp.*	Last Stocking Date/Fish Spp.*	Stream Class/ Acreage	Value for Fishing	Other
Tradedollar	10N-5E-18	TLCT	1988, 1991, 1993/TLCT	15.0 ac	unknown	
Vanson	11N-5E-27*	SAFO		10.0 ac	unknown	
Venus	10N-5E-14*	ONMY	1989/TLCT	21.0 ac	Moderate to Low	Rainbow are self- reproducing
Stream						
Bear	09N-5E-03*	ONMY	None			
Castle	09N-4E-03*	ONMY+, ONCL	1988/WSH below lake	II-IV	unknown	
Coldspring	08N-4E-23*	ONMY+, ONCL	1988/WSH	II-IV	unknown	
Coldwater	10N-5E-30*	ONMY+, ONCL, TLCT	1988/WSH below lake	II-IV		
Disappointment	08N-4E-04	ONMY, ONCL	unknown	II-IV	unknown	No stocking
Elk	09N-4E-05*	ONMY+, ONCL	unknown	II-IV	unknown	No stocking
Falls	10N-5E-04*	ONCL	unknown	II-IV	unknown	No stocking
Green	11N-4E-32*	ONMY++, ONCL	SSH	I-IV	Moderate	
Grizzly	10N-6E-20*	unknown	unknown	III-IV	None	No stocking
Jackson	09N-4E-08*	unknown	unknown	III-IV	unknown	No stocking
Maratta	09N-4E-03*	ONMY+, ONCL	1988/WSH	II-IV	unknown	
Miner's	11N-5E-32*	ONMY+, ONCL	unknown	II-IV	unknown	No stocking
North Fork Toutle		ONMY+, ONCL	1988/WSH	I-IV	Moderate	
Sheep Canyon	08N-4E-02*	unknown	unknown	III-IV	unknown	No stocking
Shultz	10N-4E-03	ONMY+, ONCL	unknown	II-IV	unknown	No stocking
South Coldwater	09N-4E-01*	ONMY, ONCL, TLCT	unknown	II-IV	unknown	No stocking

	Location (*=Inside Monument)	Current Fish Spp.*	Last Stocking Date/Fish Spp.*	Stream Class/ Acreage	Value for Fishing	Other
South Fork Toutle		ONMY+, ONCL	unknown	I-IV		
Studebaker	09N-5E-18*	ONMY, ONCL	unknown	II-IV	unknown	
Trouble	09N-3E-36	ONMY+, ONCL	unknown	II-IV	unknown	

*Fish Species Codes:

TLC=Twin Lakes Cutthroat Trout

ONMY= *Oncorhynchus mykiss* (Rainbow Trout)

ONCL= *Oncorhynchus clarki* (Cutthroat Trout)

SAFO= *Salvelinus fontinalis* (Brook Trout)

WSH= *Oncorhynchus mykiss* (Winter Steelhead)

SSH= *Oncorhynchus mykiss* (Summer Steelhead)

SATR= *Salmo trutta* (Brown Trout)

SANA= *Salvelinus namaycush* (Lake Trout)

*Stream most likely contains rainbow trout; although steelhead are possible due to stocking or migration.

**Contain both steelhead and rainbow trout.

Upper Toutle River

Fish Distribution

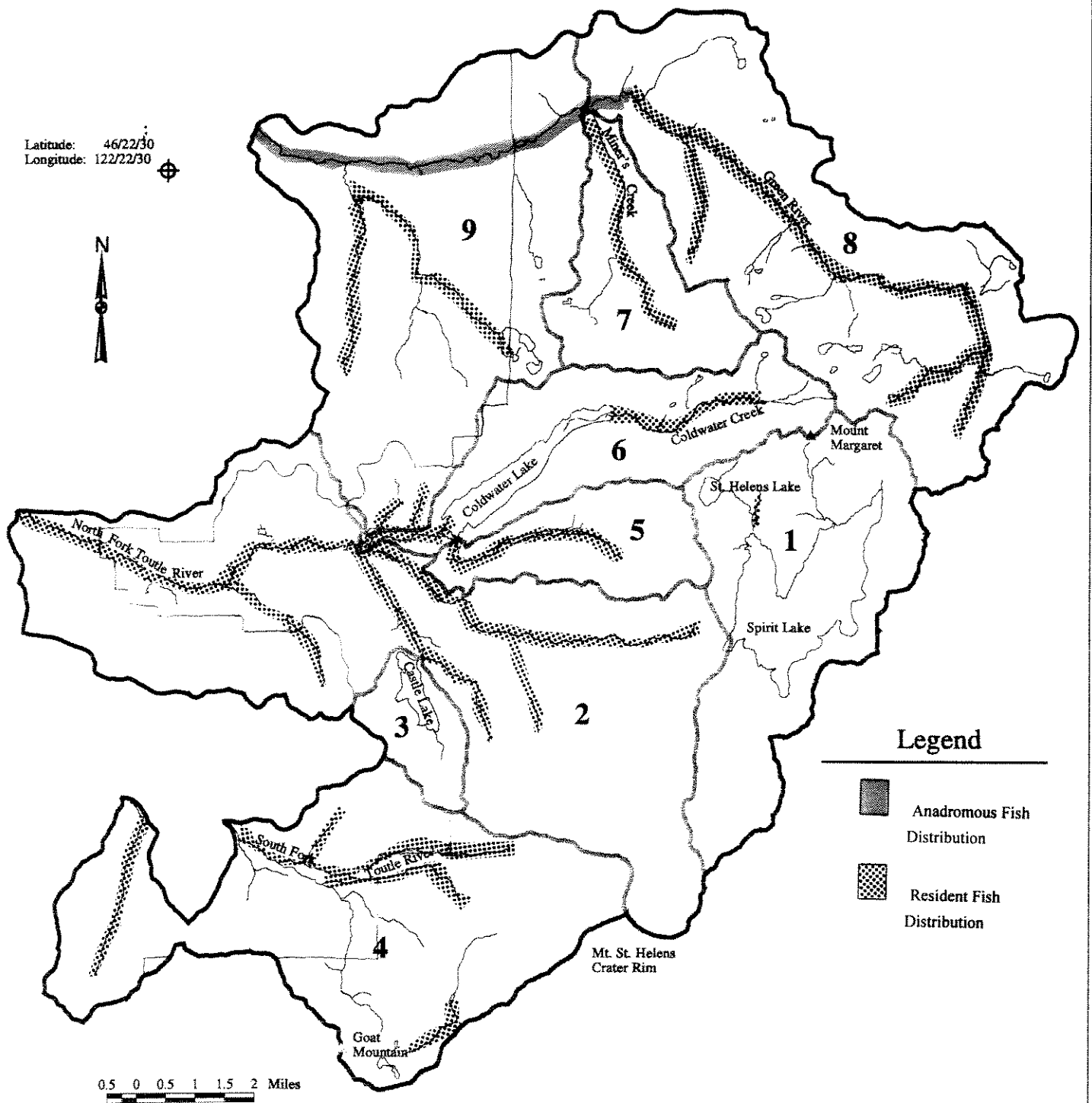


Figure 15. Toutle River Watershed distribution of resident and anadromous fishes. Resident fishes include rainbow, cutthroat, brown, lake and eastern brook trout; anadromous fishes include coho salmon and winter steelhead.

Table 17. Optimum Habitat Condition Factors for Fishes, by Life Stage

Organism/ Life Stage	Cutthroat Trout	Rainbow Trout	Brook Trout	Sculpin	Lake Trout	Brown Trout
Distribution	Throughout basin	Throughout basin	Throughout basin	Throughout basin	St. Helens Lake	Elk Lake
Spawn Season	Spring (Feb.-Mar)	Spring (Feb.-Mar)	Fall (Sept. - Oct.)	Late Spring Sex. Mature 2 yrs old	Fall (Sept. - Nov.)	Fall (Oct. - Dec.)
Temp	6.1-17.2 °C	2.2-20 °C	4.5-10 °C	Not Available	10°C	10°C
Habitat Factors	cover, cold water, substrate 1.3-10 cm. quantity pools, volume pools	cover, cold water, substrate 1.3-10 cm	Tied to springs/upwelling	Under stones in swift water	Substrate consists of gravel, boulders of rubble along exposed shorelines of lakes	Gravels between 0.25 - 3 inches in diameter. Springs or seeps are necessary for eggs to survive winter water temperatures.
Rear Season	April - January	April - January	Nov. - Aug.	Not Available	Year Round in Lake	Year Round
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.	Not Available	Remain in shoals for 1 month, then move into deeper, colder waters. Feed mainly on aquatic insects.	Can tolerate higher water temperatures than other trout. Feed on blackflies, mayflies or stoneflies.
Adult	Year Round	Year Round	Year Round	Year Round	Year Round in Lake	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	Streams and Lakes with stable bottoms. Feed primarily on aquatic insects, can eat salmon fry	Deep, cold water. They are omnivorous, eating annelids, crustaceans, insects, fishes and small mammals.	Can tolerate higher water temperatures than other trout. Lives in deep pools or lakes, nocturnally feeds upon small fish.

Table 17 (Cont'd). Optimum Habitat Condition Factors for Fishes, by life stage.

Organism/ Life Stage	Coho Salmon	Winter Steelhead
Distribution	Up to RM 25 of Green River; lower 7.3 miles of river within analysis area.	Up to RM 21.5 of Green River, lower 3.9 miles of river within analysis area.
Spawn Season	September-January	March-May
Temp	4.4 - 9.4 °C	3.9 - 9.4°C
Habitat Factors	≥ 18 cm deep, water velocity of 30-91 cm/sec., substrate of 1.3-10.2cm in size	≥ 24 cm deep, water velocity of 40-91 cm/sec., substrate of 0.6-10.2 cm in size.
Rear Season	Spring (April-June)	April - January
Habitat Factors	Pool habitats, cover, side channels, beaver dams, woody debris.	Riffle and pool habitats, cover, woody debris.
Adult	August-December	December-April
Habitat Factors	associated with cover, cold water, spawning gravels.	cover, cold water, spawning gravels.

Anadromous fishes within Toutle River Watershed streams include coho salmon and winter steelhead (Figure 15). Coho salmon spawn within the lower 7.3 miles of the Green River within the analysis area. Green River winter steelhead (a wild population and classified as a distinct stock based on geographical isolation of the spawning population) spawn within the lower 3.9 miles within the analysis area. According to the Washington Department of Fish and Wildlife's 1992 Washington State Salmon and Steelhead Stock Inventory, the numbers of both of these stocks of anadromous fish are depressed. Natural spawning for coho salmon is presumed to be low and juvenile production is below stream potential. Winter steelhead numbers are depressed due to degraded habitat conditions and elevated stream temperatures from the eruption (WDFW 1992).

There are a number of natural lakes in this area. Some were formed by or severely affected by the 1980 eruption of Mount St. Helens (i.e., Coldwater Lake, Castle Lake, Spirit Lake). Except for Meta, Venus, Lower Venus, Strawberry, Blue and Deadman's Lakes, these water bodies receive relatively low recreation use (Figure 9). No fish stocking is allowed in Meta, Obscurity, Panhandle, Shovel, Spirit, St. Helens, Boot, Holmstedt, Snow, Grizzly, and Heart Lakes because of their location within the legislated National Volcanic Monument and due to their scientific importance in the study of recovery processes. According to Washington Department of Fish and Wildlife records, rainbow trout and brook trout are in a majority of the lakes (Table 16). Fish were stocked in Coldwater Lake in 1989 (USDA 1989).

Prior to the eruption, Spirit Lake was a popular recreational fishing destination. It was planted with 25,000 rainbow trout annually, and steelhead and coho salmon migrated to Spirit Lake to spawn. During the eruption, the water from Spirit Lake was forced up onto the hillslopes by mudflows. The mudflows settled in the lake basin, raising the bottom of the lake by 300 feet. The water ran down from the hillslopes into the new lake basin, carrying with it debris and blown down trees which today, (17 years later) still cover a large portion of the lake's surface. Gases from the eruption removed all oxygen from the water in Spirit Lake killing every living creature. Eventually, bacteria re-oxygenated the water

which has allowed colonizers, such as amphibians and aquatic insects, to re-establish themselves in the lake. In 1993, biologists from the Department of Fish and Wildlife, using gill nets, caught a rainbow trout. Genetic analysis showed this fish ("Harry") to be of a wild stock. In 1994, biologists from the Monument and from the Department of Fish and Wildlife caught another rainbow trout. "Harriet" was found to have similar DNA to WDFW Cowlitz River stocks. This fish could have descended from tributaries which feed into Spirit Lake. In 1997, Monument personnel and WDFW biologists found a third rainbow trout, "Helen." Genetic analysis is being performed at this time. All three fish were big and healthy, feeding on aquatic insects and possibly amphibian larvae. Fish stocking is currently banned in Spirit Lake and there are no plans to open this lake to fishing due to its importance for scientific research.

The North Fork Toutle River is a major drainage of the analysis area, all of which has been severely affected by the eruption. Castle Creek, Jackson Creek, and Studebaker Creek are its tributaries. The main stem was impacted by mudflows which traveled down its length from the May 18, 1990 eruption of Mount St. Helens. Road density in this sub-basin (2) is 1.79 miles/square mile of area (This number includes all National Forest and DNR land and uses USFS and DNR road layer data).

The South Fork Toutle River is another large tributary to the Toutle River and its tributaries include Trouble Creek, Coldspring Creek, Disappointment Creek, and Sheep Canyon Creek. Mudflows from the eruption also traveled down a portion of the South Fork Toutle River. Road density in this sub-basin (4) is 3.49 miles/square mile of area (This number includes all National Forest and DNR land and uses USFS and DNR road layer data).

The Green River, a third major drainage in this area, drains 24,577 acres of land, including four tributaries: Miner's Creek, Shultz Creek, Falls Creek and Grizzly Creek. These five drainages were also affected by the eruption, but to a lesser degree than the previously mentioned drainages; they do have erosion of ash and pumice occurring.

Road densities in these sub-basins range from 0.92 miles/square mile in the Upper Green River (Sub-basin 8), 1.83 miles/square mile in Miner's Creek (Sub-basin 7), and 6.16 miles/square mile in the Lower Green River (Sub-basin 9). There was also a significant amount of past timber harvest in these sub-basins. Sub-basin 8 contains 19 active and inactive mines on USFS land.

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 channels through a variety of mechanisms (i.e., landslides, transport from upstream areas, and direct entry from adjacent sideslopes). Management activities and natural processes affect the effectiveness of these natural delivery mechanisms and the longevity of wood in the system. For example, harvest within the riparian zone reduces the amount of available wood supply for direct entry from adjacent slopes.

The USDA Columbia River Policy Implementation Guide of 1991 (CRBPIG) identifies standards for quantities of (LWD) in Western Cascade streams to provide quality salmonid habitat. The streams' existing condition, identified in 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 of LWD 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 15 percent of the surveyed stream segments are rated as poor, approximately 65 percent are rated as fair, and 20 percent are rated as good (Figure 16). All of the reaches of the Green River that rated as "Good" were located within the blast zone, not in the sections with standing old growth timber adjacent to the stream; these standards may not truly reflect this area's natural stream conditions.

Basins having greater than 25 percent of their streamside riparian areas in grass/forb - small tree

structure stages are considered to have low potential for LWD recruitment because of the relatively long time needed for young conifer trees along the streams to mature and grow more dense. Vegetation structure was used to evaluate this watershed (instead of harvested riparian reserves) because the majority of the area is within the blast zone of Mount St. Helens. The 25 percent level was based on harvest levels determined using GIS data for National Forest land and an "ocular estimate of harvest" on privately-owned lands. Figure 17 displays the sub-basins having low potential for LWD recruitment.

Primary Pools per Mile

Pools provide (1) thermal refuge for aquatic organisms dependent on cool stream temperatures, (2) protective cover for rearing, and (3) 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 microhabitats 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 identifies 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 based on width; 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 20 percent of the surveyed streams are rated as poor, approximately 19 percent are rated as fair, and approximately 61 percent are rated good. (Figure 18).

Survey data for South Fork Coldwater Creek (0.82 miles) could not be assessed due to the lack of quantitative data; however, the surveyor did note that fish habitat was fair in all reaches of stream. There were large amounts of large woody debris

Upper Toutle River

Large Woody Debris Ratings by Stream Reach

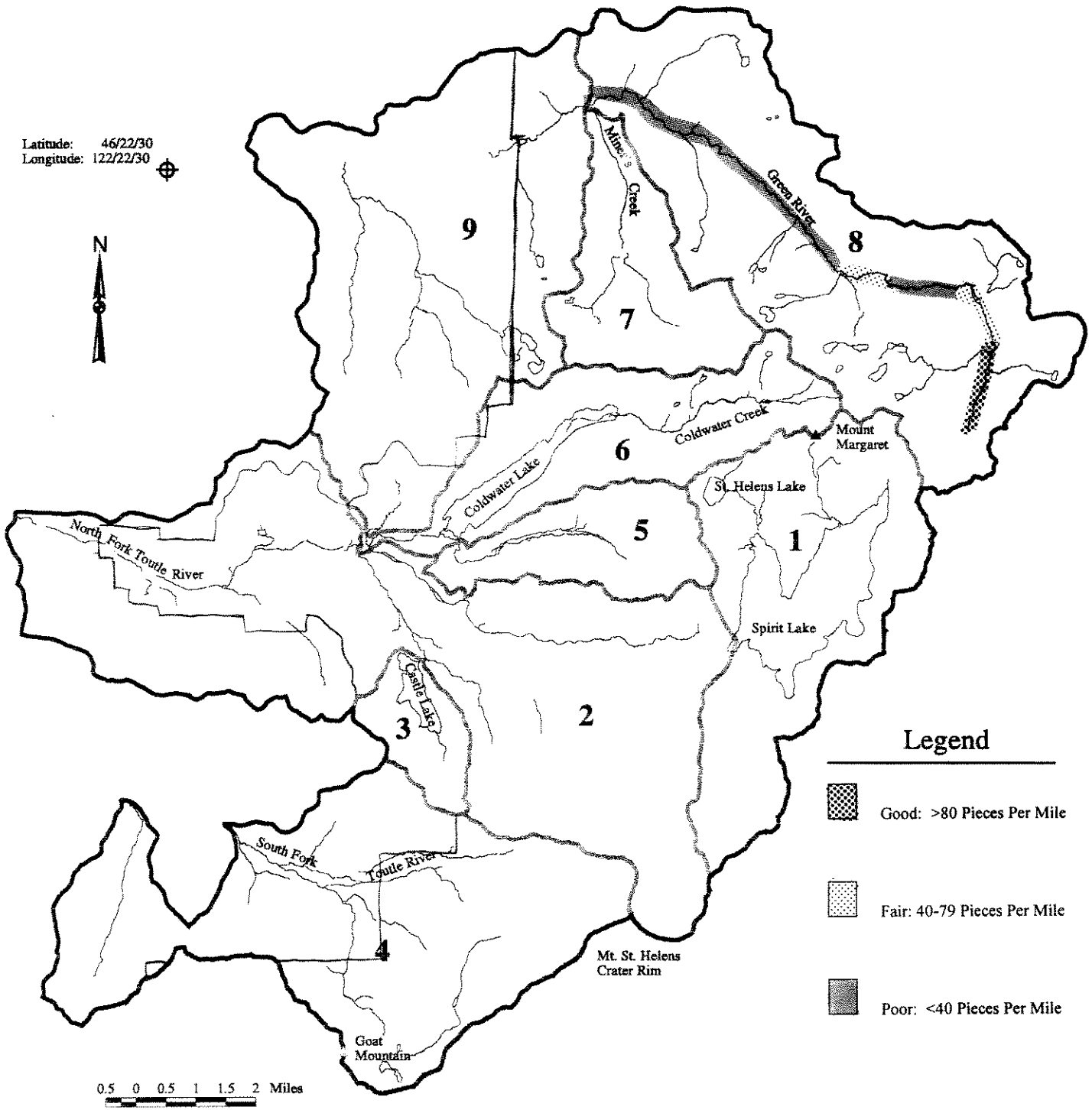


Figure 16. Large Woody Debris (LWD) ratings per mile for the surveyed stream in the Toutle River Watershed.

Upper Toutle River

Large Woody Debris Recruitment Potential

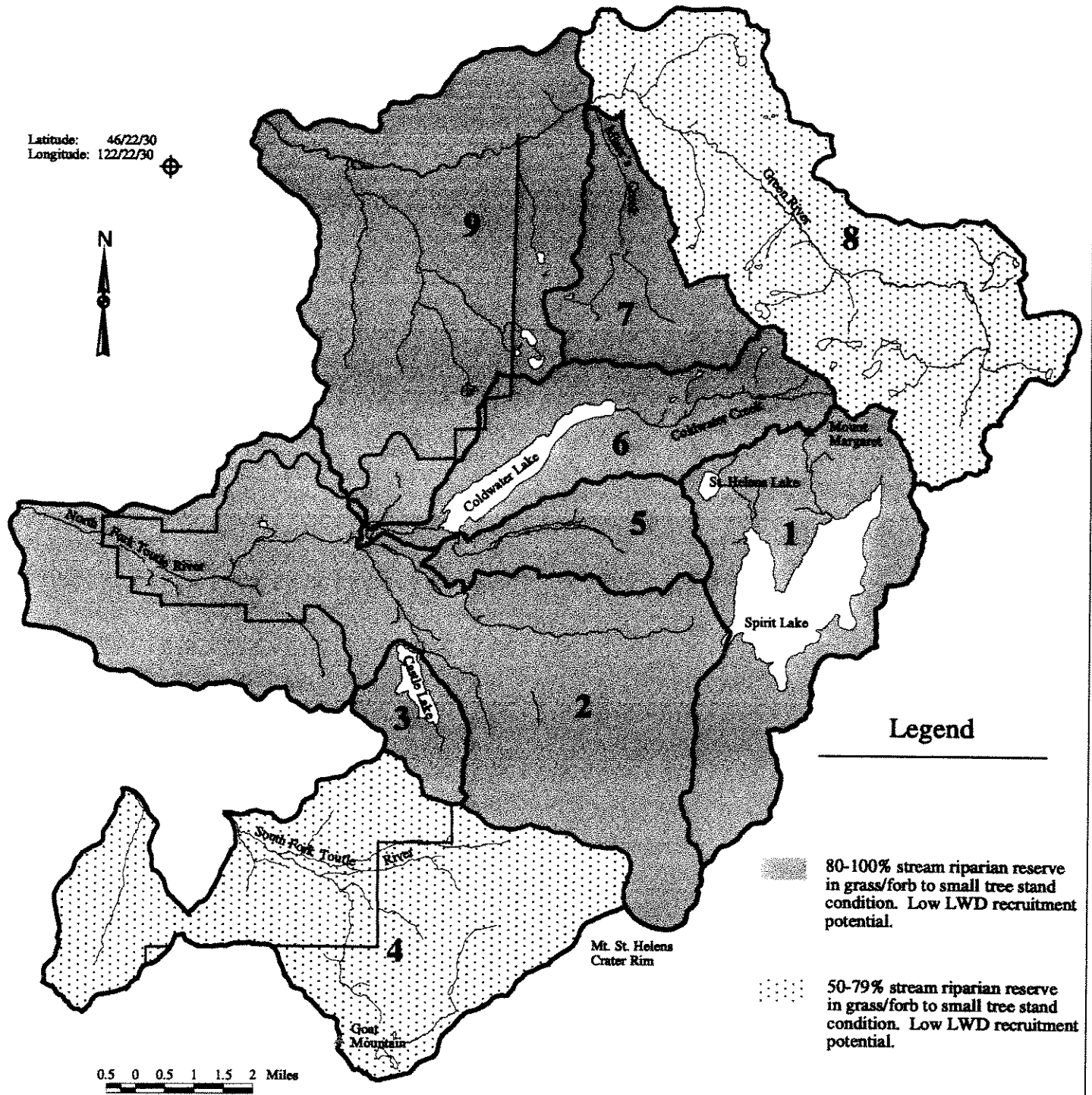


Figure 17. Amount of stream riparian reserves which are in a grass/forb to small tree stand condition within Toutle River Watershed sub-basins. Those sub-basins which have greater than 30 percent of streamside riparian reserve harvested are also classified as having low potential for large woody debris (LWD) recruitment.

Upper Toutle River

Stream Segment Ratings for Primary Pools per Mile of Stream

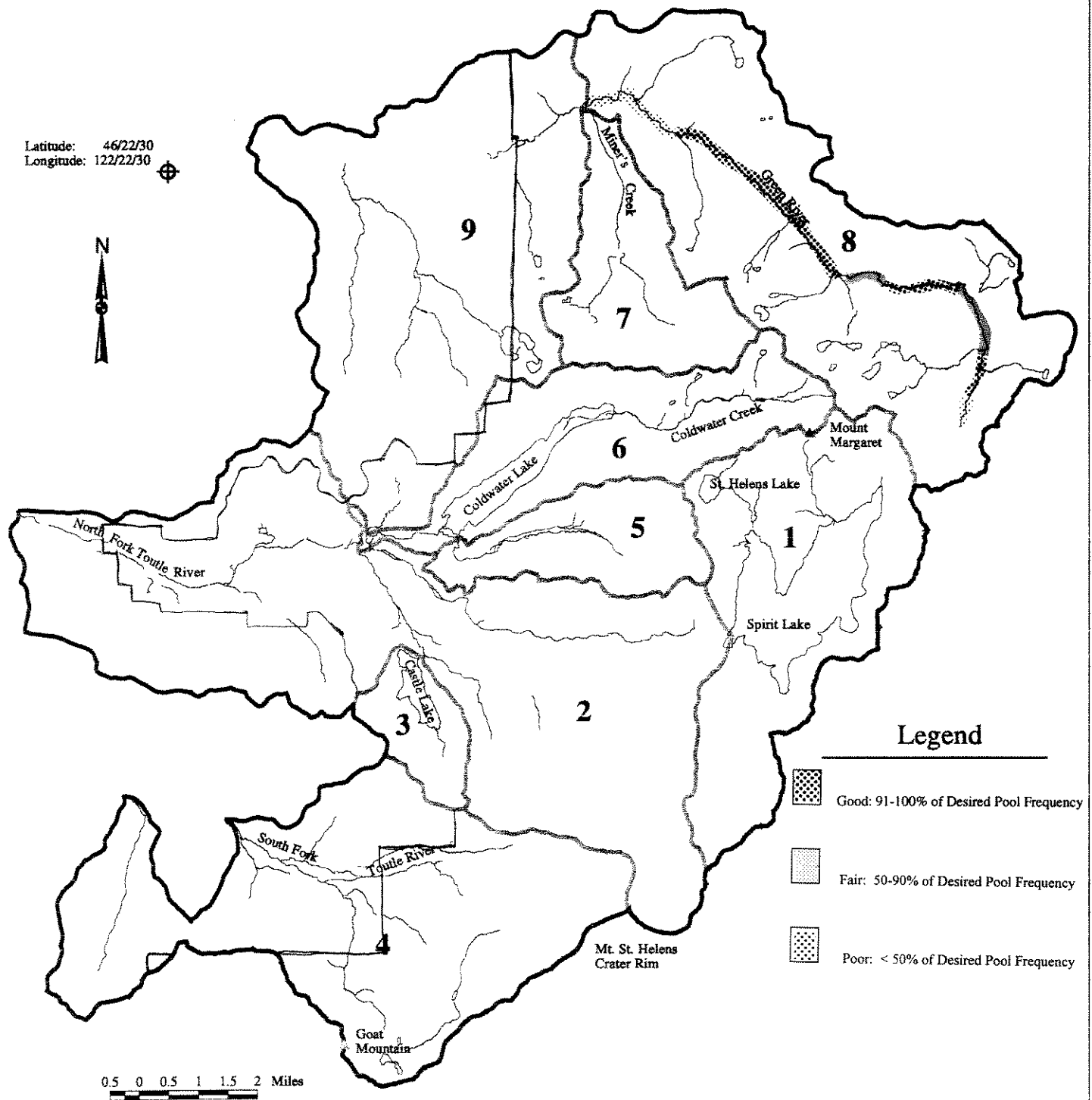


Figure 18. Primary pools per mile ratings for the stream surveyed in 1993 in the Toutle River Watershed.

(pieces were greater than 10 feet in length and greater than 12 inches in diameter), limited amounts of spawning gravel, minimal amounts of fines, low quantity of pool habitat, and little to no vegetative cover.

Stream Temperature

Stream water temperature is a major factor influencing the composition and productivity of aquatic ecosystems. Fish, aquatic macroinvertebrates, 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 moving to optimum habitat within the channel. Long term changes or peaks in water temperature may directly alter the established patterns of the salmonid populations.

There are 43 water quality monitoring sites within the Upper Toutle River Watershed which have been active for varying lengths of time since 1975. The majority of these sites have collected "grab samples" for extensive chemical analyses only after the 1980 eruption, so long-term records are rare. Only one of these stations appears to have collected water temperature data for any length of time. The Toutle River Baseline station collected data from 1975 until 1979; then the site was covered by a massive landslide from the eruption. The station was never reestablished. The State Standard for maximum daily water temperature of 16 degrees Celsius was equaled or exceeded 100 times at this site between 1975 and 1979. One water-quality-impaired stream segment on the Toutle River is presently identified on the Washington State 303 (d) list. The segment is located downstream from the analysis area and exceeded State water temperature standards eight times between 1/1/88 and 1/1/92. The 303(d) list is required under the Clean Water Act and is used by the State to set environmental priorities for action and to chart water quality trends.

Although no stations have collected continuous stream

temperature readings in the area since the eruption, it is anticipated that streams are exceeding State Water Temperature Standards (16 degrees C) due to several factors. These include loss of riparian vegetation in tributary streams, channel widening from the mudflows that traveled down the North and South Forks of the Toutle River, and channel widening from introduction of large amounts of tephra. Stream water temperature is a major factor influencing the composition and productivity of aquatic ecosystems.

Aquatic Habitat Fragmentation

Roads have been identified as an important factor in the decline of fish populations. The aquatic system is fragmented by culverts that do not pass fish, and/or other road crossings that alter the flow of LWD and sediment through the 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 19 displays the road network and class 1-4 streams. Sub-basin stream crossings range from one to 777 stream crossings. There are a total of 1882 stream crossings within the Toutle River Watershed (Table 18).

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 fisheries biologists. Currently, mean road density in the Toutle River Watershed is 1.83 miles per square mile. Individual sub-basin road densities range from 0.04 up to 6.16 miles per square mile (Table 18 Road Densities, etc.). Figure 20 highlights those sub-basins that exceed 3.0 miles per square mile.

The Riparian Reserve aquatic habitat fragmentation index is used as an indicator of the impact that the aquatic system has received from increased road building. The index is based upon the number of road crossings over streams, normalized by stream length in each sub-basin. The Toutle River Watershed aquatic habitat fragmentation values were divided into thirds (low, medium, and high values) to evaluate the fragmentation across the entire watershed. Medium (greater than 0.35 road/stream crossings per stream mile) and high (greater than 2.32

Upper Toutle River

Road Crossings of Streams

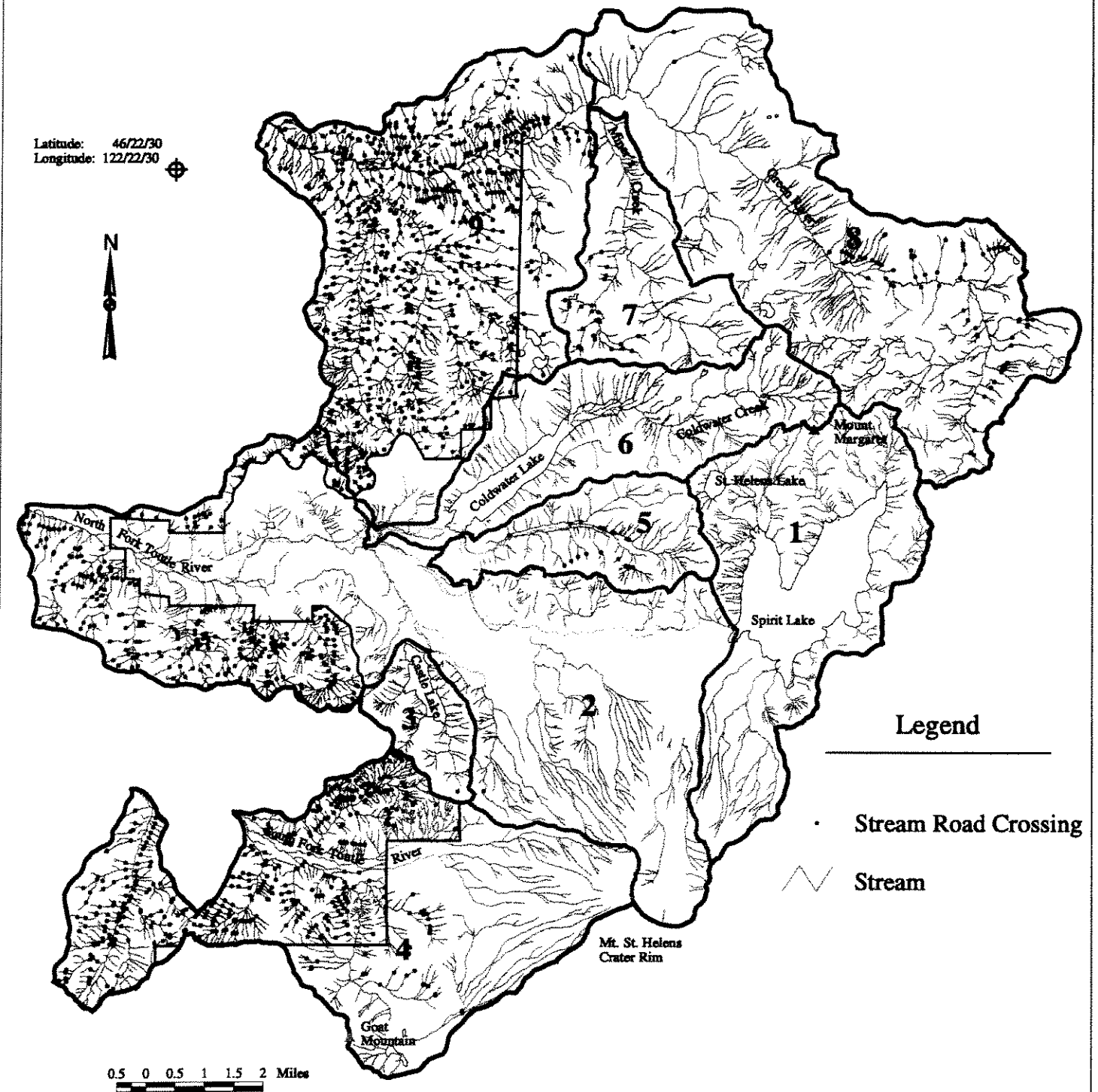


Figure 19. Display of where the road network crosses Class I-4 streams in the Toutle River Watershed. Stream Classes pertain to National Forest land only.

Upper Toutle River

Road Density

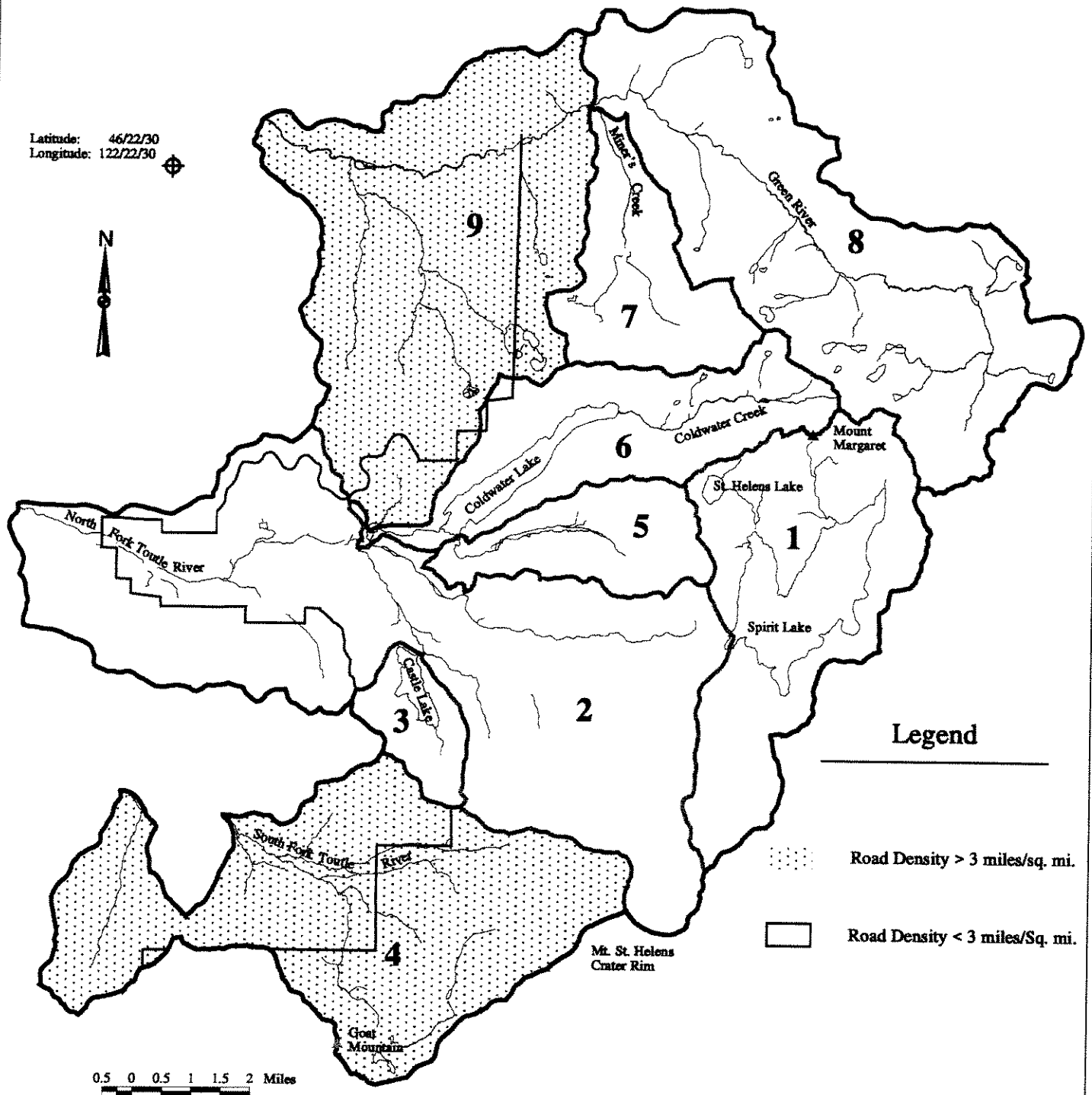


Figure 20. Toutle River Watershed sub-basins with road densities greater than 3.0 miles per square mile.

Table 18 - Toutle River Watershed Road Densities, Stream Crossings, and Aquatic Habitat Fragmentation Indices by Sub-basin.

Watershed Number	Miles of Roads	Road Density	Number of Stream Crossings	Miles of Stream	Road Crossings per Stream Mile
1	0.78	0.04	2	118	0.17
2	73.10	1.79	385	246	2.51
3	2.69	0.88	1	21	0.05
4	94.00	3.49	540	233	2.32
5	5.65	0.94	21	53	0.40
6	5.09	0.43	4	95	0.04
7	14.50	1.83	27	58	0.47
8	25.5	0.92	72	207	0.35
9	176.60	6.16	830	251	3.31
Totals	397.91	1.83	1882	1283	1.47

road/stream crossings per stream mile) aquatic fragmentation values are highlighted in Figure 21. Sub-basin 9 has the highest value: 3.31 crossings/mile of stream. This watershed (18.4 acres) with only 251 miles of stream has 830 stream/road crossings.

Stream Channels

Stream reaches in the Upper Toutle River Watershed Analysis area can be classified based on similar physical characteristics and placed into three major groups: erosion, transport and response. "Response" reaches have low gradients and are less confined sections that tend to be more sensitive to changes in the amount of input variables such as wood, water, and sediment. Consequently, these response reaches tend to degrade easily and take longer to recover from disturbances than erosion and transport reaches.

Erosion-type channels usually have relatively steep gradients and are actively down cutting at various rates due to underlying geology and other physical characteristics. They are also travel paths for up slope mass wasting events (debris torrent areas). Some channels with more gentle gradients can be defined as erosional reaches if they have high rates of bank cutting. 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. Many of the sidewall and headwall streams in the Upper Toutle area are erosional or transport reaches, while the major streams such as the North and South Fork Toutle River and the Green River are composed primarily of response reaches. More specific channel information is displayed below.

The following observations were made from aerial photos, maps, and field visits:

- The North and South Forks of the Toutle River carried mudflows from the eruption of Mount St. Helens. The eruption changed the channel types for both of these streams from a meandering single "C" type channel with some braiding to a braided "D" type channel. The eruption dramatically increased the width of these streams.
- Most other streams in the analysis area are located in the blast zone of the 1980 eruption of Mount St. Helens. Most vegetation was blown down and varying depths of blast deposits covered these streams. Salvage logging in the blast zone has

removed much of the LWD in areas outside the National Volcanic Monument.

- A massive landslide from the eruption dammed up South Fork Castle Creek and Coldwater Creek, creating Castle Lake and Coldwater Lake.

Human Use

The Spirit Lake Basin and the crater of Mount St. Helens is the location of nearly a dozen ongoing research projects. Studies focus on geological and hydrological activity associated with the eruption and vegetative recovery in a large area sterilized by the heat of pyroclastic flows and a large debris avalanche. The basin is closed to camping and visitor use is restricted to hiking on the Truman, Windy, and Loowit Trails

Recreational use is now the dominant activity in the watershed and is expected to remain so in the future. This is consistent with a national trend of increased demand for recreation opportunity and use of the National Forest System. Scientific studies continue but are at a significantly reduced level compared to the time immediately following the 1980 eruption.

The watershed is divided from south to north into three use-zones. The southern zone, immediately north of Goat Marsh, is heavily forested with western hemlock, noble fir, Douglas fir, and other minor species. The area is particularly noted for its stands of noble fir which are reported to be the densest found anywhere in the world. Some experts claim the volume of timber per acre (about 300,000 board feet) is exceeded only in northern California stands of coastal redwood. Hiking and equestrian trails in this area are very popular as is Blue Lake, a short 1/4 mile hike from the trailhead.

The central zone is found entirely within the Mount St. Helens devastated area and extends from near timberline on the southwest side of the volcano, across the Spirit Lake Basin, to the northern end of the Mount Margaret Backcountry above the Green River. The area is characterized by blown down forest, a debris avalanche, and lofty barren mountain ridges. A series of glacial tarn lakes dot the area in the vicinity of Mount Margaret, popular for fishing, camping and hiking. The crater of Mount St. Helens, the Lava Dome, and Spirit Lake are found in this area. Natural regeneration of vegetation is common in the devastated area, creating expanses of wildflowers,

deciduous trees, and young recovering forest.

The north zone, along and north of the Green River, is vegetated by forest which is unaffected by the eruption of Mount St. Helens. Large old growth forest along the Green River attracts the attention of many hikers. Horse use is popular in the area, particularly in the fall during elk hunting season. Several outfitter-guides establish hunting camps, providing service to clients. This activity is controlled under Forest Service special use permits. While outfitter-guides are controlled in number and location of their camps, non-commercial use of the area is not restricted. Vanson Lake and Deadman's Lake are destination points for many summer hikers who enjoy fishing from their shores and the availability of nearby camp sites.

The Upper Toutle River Watershed is popular for recreational day use. Developed recreation sites are found along the Spirit Lake Memorial Highway (SR-504), and along Forest Roads 99 and 26. Popular destinations include the Coldwater Ridge Visitor Center, Coldwater Lake, and the Johnston Ridge Observatory. The Hoffstadt Bluff Viewpoint, owned by Cowlitz County and the Forest Learning Center operated by Weyerhaeuser Timber Company are found just outside the National Monument boundary along SR-504. Nearly two thirds of the three million annual visitors to the National Volcanic Monument travel enter the area on SR-504. The Washington State Department of Transportation keeps SR-504 plowed throughout the winter providing year-round access to Johnston Ridge Viewpoint at the end of the highway.

Forest Road 99, accessing the watershed from the east side of the devastated area, is open to visitors during the summer months when roads are free of snow. An average of 700,000 visitors each year travel to Windy Ridge Viewpoint at the western road terminus. During the winter the only access to the FR-99 road is by snowmobile or on foot from the Wakepish Snowpark at the intersection of FR-99 and FR-25.

The Green River Trail, the Ryan Lake Interpretive Site, and the Green River Horsecamp are found along the Green River. The horse camp and interpretive site are located outside the boundary of the legislated monument, but provide trail access to equestrian trails in the Vanson Peak, Deadman's Lake area. Trails in the northern end of the watershed (outside the devastated area) are open to horse use. Trails within the National Volcanic Monument devastated area are

closed to stock use to prevent the introduction of exotic plant seeds through waste. Alternate access points to trails in the Vanson Peak area include the Goat Mountain Trailhead, Vanson Peak Trailhead, the Green River Trailhead (west side of Monument), and the Goat Creek Trailhead.

A network of hiker trails are located in the Mount Margaret area, frequently referred to as the "Mount Margaret Backcountry". The area is open to day use. Starting in the summer of 1998 overnight camping will be allowed for hikers who first obtain a permit. Camping will be permitted only at designated sites, which have been selected to minimize damage to riparian areas and research sites. The limited number of campsites necessitates pre-assignment of camp sites to make sure hikers have a spot when they arrive.

The Comprehensive Management Plan (CMP) for the Mount St. Helens National Volcanic Monument and the Gifford Pinchot National Forest Land and Resource Management Plan prescribed recreation development and trail construction. Most of these facilities have been completed with the exception of a new equestrian-hiking trail between Huckleberry Saddle and the Kalama Horse Camp and completion of the Independence Pass Trail between the Smith Creek Trailhead and the Independence Pass Trailhead. Completion of the Independence Trail will provide a trail loop around the Spirit Lake Basin and provide connection of the Smith Creek and Harmony Trails with the remainder of the trail network.

The Castle Lake Trail leads from the Loowit Trail, 3.9 miles to the shore of Castle Lake, which is famous for its large fish. This is the only trail route to the lake but is seldom used by hikers due to its length and its remote intersection with the Loowit Trail on the northwest side of Mount St. Helens. The Hummocks Trail is located on the north side of the Toutle River, less than 1.5 miles away, making it a logical access point for Castle Lake; however, off-trail cross country hiking is currently prohibited on the debris avalanche.

Road access to recreation sites, trailheads, and points of interest was defined by the CMP. These roads are an intergral part of recreation development and are to be retained for long term use. Many are paved while others are gravel surfaced. All receive levels of use much higher than normally expected on national forest travelways and thus require higher-than-normal levels of maintenance.

Table 19. Roads Needed to Provide Long-Term Access to Recreation Sites in the Watershed.

Road Number
FR- 8123
FR-99
FR-26
FR-2612
SR-504
RD-3250
RD-2500
FR-2516

A number of forest roads exist inside and outside the National Volcanic Monument which are not needed for recreational access and receive little or no maintenance. Unmaintained roads pose a high risk of washout and fill failure when culverts or other drainage structures become plugged. Some of these roads are already blocked by slides or washouts, while others are open to traffic. These low standard roads contribute to increased water flow and sediment input to streams. Some of these roads were previously closed with berms but have since been illegally re-opened by users. The unneeded roads tend to create undesirable environmental impacts by reductions in water quality and encouraging vehicles in areas designated for non-motorized use .

Table 20. Roads Not Needed for Recreational Access

Road Number	Estimated Length (Miles)
FR 2516-074	2.43
FR 2516-082	1.20
FR 2516-083	0.15
FR 2600-142	0.30
FR 2612 West of Green River Horse Camp	3.01
FR 2612-020	1.90
FR 2612-029	0.87
FR 2612-036	1.07
FR 2612-131	0.51
FR 2612-637	1.41
FR 8123-170	0.14
FR 8123-171	1.92
FR 8123-173	0.67
FR 8123-175	0.43
FR 8123-176	0.51
FR 8123-177	0.86
FR 8123-179	0.25
FR 8123-? Unnumbered spurs below 8123 west of the Sheep Canyon Trailhead	1.28
Unnumbered spurs below SR-504 between Elk Rock and Coldwater Ridge Visitor Center	3.40

Upper Toutle River

Roads, Trails and Recreation Sites

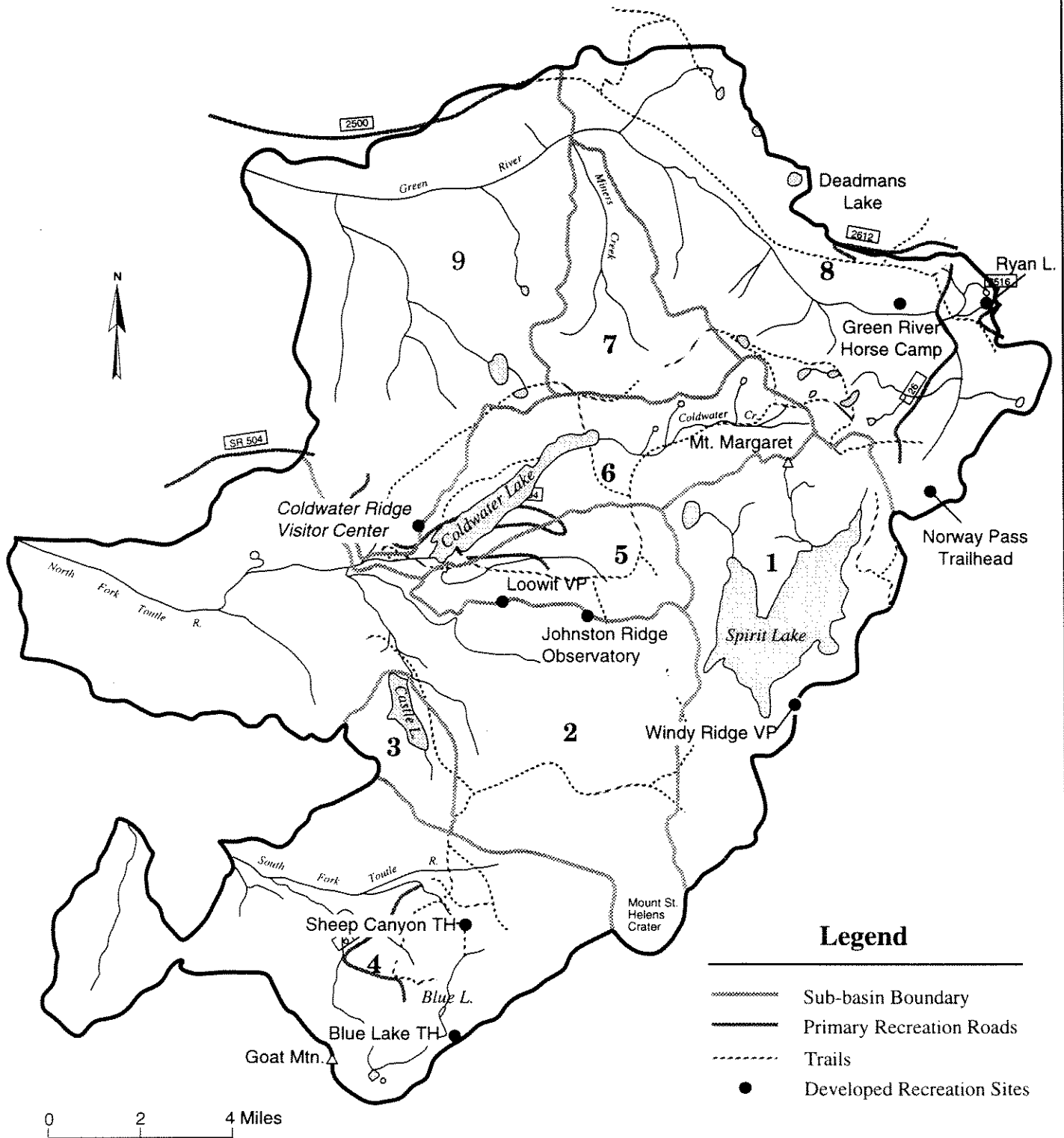


Figure 22. The Upper Toutle Watershed receives over two-million visitors each year. A combination of developed sites, roads and trails provide a variety of recreation opportunities. Horse riding, hiking, hunting, viewing scenery, visitor centers, and summer interpretive programs are particularly popular. Fishing is permitted in certain streams and lakes.



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

The processes of volcanism, glaciation, deposition, mass wasting and erosion have had the most effect on shaping the landscape as we see it today. Glacial activity over the past 200,000 years has shaped the landscape to the steep uplands and the flatter lowlands of many of the sub-basins in the watershed. The deposition of ash and tephra on these steep slopes has created areas where mass wasting is now very active. The evolution of Mount St. Helens started about 40,000 years ago, and the landscape is still changing.

Past eruptions from Mount St. Helens (over the last 12,000 to 18,000 years) have deposited much of the soil we see today. Within the watershed two eruptive events have influenced the watershed by the amount of tephra and ash deposited. These are labeled the Yn and

Wn by Crandell and Mullineaux. The Yn eruptive phase occurred about 3400 years ago. Layer Yn is a coarse thick bed that extends mainly north-northeast from the volcano. It is about 15 inches in depth at a distance of 30 miles from the summit of the volcano. Tephra layer Wn probably erupted around 450 years ago and deposited up to 15 inches of material at a distance of 20 miles from the mountain. Eruptive sequences of between 150 and 600 years over the last 4000 years have also deposited varying amounts of ash and tephra which has influenced vegetation growth. Table 21 shows the eruptive periods and dormant periods of Mount St. Helens over the past 40,000 years. Throughout this time period, the landscape has changed dramatically. Only over the last 3000 to 4000 years has the shape of the land as we saw it prior to 1980 developed. The 1980 eruption again drastically changed the landscape that was well known since human activity in the area began.

Prior to the time of human influences in the area natural processes have been very active. In addition to volcanic and glacial activity, fire has had a role in shaping the landscape. Large hot fires remove the vegetation which in turn makes the soils more susceptible to mass wasting and erosion.

Table 21 - Summary of Eruptive History of Mount St. Helens

Eruptive Period or Dormant Interval	Approximate age	Tephra Unit	Other eruptive products (not including lahars)
1980		Not yet designated	Dome & deposits of lateral blast
Dormant	~130 years		
Goat Rocks	200 to 150	T	Dome and Lava Flow
Dormant	~200 years		
Kalama	500 to 400	X & W (includes Wn)	Pyroclastic, Dome & Lava flows
Dormant	~700 years		
Sugar Bowl	1150		Dome, pyroclastic & deposits of lateral blast

Eruptive Period or Dormant Interval	Approximate age	Tephra Unit	Other eruptive products (not including lahars)
Dormant	~600 years		
Castle Creek	>2200 to 1700	B	Lava Flows, Pyroclastic & Dome
Dormant	~300 years		
Pine Creek	3000 to 2500	P	Pyroclastic and Domes
Dormant	~300 years		
Smith Creek	4000 to 3300	Y (includes Yn)	Pyroclastic
Dormant	>4000 years		
Swift Creek	13000 to >8000	J & S	Pyroclastic and Domes
Dormant	~ 5000		
Cougar	20,000 to 18,000	K & M	Pyroclastic, Dome and Lava Flows
Dormant	~15,000		
Ape Canyon	~40,000 to ~35,000	C	Pyroclastic flows

Fire Ecology

Fire frequency and intensity for the Upper Toutle River watershed is best described as “episodal” as compared to “cyclic”. This description is common for most western Cascade Mountain areas. In general, fires occur frequently in a constant, cyclical pattern. Within this pattern, large, catastrophic fire events are very infrequent and occur only when weather conditions such as prolonged drought, strong winds and low humidity are present. Also, large catastrophic fires (or groups of fires) will be spaced randomly and are called episodic types of events.

The Upper Toutle River watershed is characterized by “Group Zero - Miscellaneous Special Habitats,” one of the Fire Groups identified in Fire Ecology of the Mid-Columbia published in 1994.

Fire Group Zero

Fire Group Zero is classified as areas of extensive rock, sand, or ash with varying amounts of vegetation. In the

Upper Toutle River watershed this is predominantly the area that was devastated by the 1980 eruption of Mount St. Helens. These sites may support a crown fire under extreme conditions, but otherwise would not support a surface fire that spreads much beyond the point of origin.

Fire Management Considerations

Group Zero sites burn poorly under normal summer weather conditions. These sites can serve as natural boundaries between fire management zones.

Vegetation

The Upper Toutle River watershed lies in the Riffe River basin. According to REAP (Diaz & Apostol 1992), four hundred to one hundred and fifty years ago, the Riffe River basin was covered with broad continuous conifer stands of varying age classes. Large-scale disturbances were created by fires, floods, and the eruption of Mount St. Helens. These

continuous stands were characterized by diverse species composition and 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 Riffe River basin, late-successional vegetation covered between 22 and 55 percent, and early to mid-successional vegetation covered between 8 and 40 percent of the area.

These different successional stands were probably not evenly distributed within the Riffe River basin and varied between watersheds depending on the distribution and frequency of disturbance. The presence of an active volcano provided a permanent source of disturbance within a portion of the Riffe River basin which likely resulted in higher levels of younger aged stands and/or non-forested land in watersheds close to the volcano. Because both wildfire and volcanic eruptions occurred infrequently, with no predictable time frame, cycle, or magnitude, the age class distribution within the basin likely fluctuated over long periods of time.

Habitat Conditions for Terrestrial Animal Species

Volcanic activity in the watershed has been a significant factor in determining the types and distribution of habitat long before the 1980 eruption. In addition, large prehistoric fires that likely occurred would have had similar, but probably shorter-term effects. These natural disturbances would have created (and continue to create) large blocks of early seral habitat. Indications are that the previous several eruptions of Mount St. Helens occurred about every 150 to 200 years, and ash fall from even minor eruptions can cause tree mortality. Depending on the severity of the disturbance, the parts of the watershed affected may not have had time to develop true old growth habitat before the next disturbance started the process over.

Disturbances that create large blocks of early seral habitat result in increases of species that require that type of habitat. Since the 1980 eruption, bird species normally associated with drier open habitat east of the Cascades, such as horned lark and savannah sparrow, have been found in the devastated area. Similar influxes of open-habitat species would have occurred in the past as well. As more advanced seral stages develop these

open habitat species guilds would have given way to others that use closed small tree habitat, and eventually late-seral species. It is likely that at any given time the watershed would have contained large blocks of habitat in many different seral stages, and supported a wide diversity of species guilds.

The lateral blast of the last eruption may have had a larger more severe impact on soil and vegetation than what occurred in previous eruptions by incinerating or blowing over trees on such a large area. The existing pattern in the Toutle River Watershed is probably similar to what has occurred in the past, however the current condition is probably at one extreme end of the range of natural variability.

Hydrologic Processes and Changes

According to streamflow records from the Toutle River near Silver Lake, major flood events occurred on the Toutle River in 1910, 1972 and 1977. The pre-1910 floods were probably associated with rain-on-snow precipitation events that coincided with major fires or volcanic eruption. This was probably the primary mechanism for large scale floods in the past. REAP suggests that historically, the portion of the entire river basin that was disturbed at any one time ranged between four and eight percent. Since the Upper Toutle River Watershed has been more frequently affected by volcanic eruption than adjacent areas, it is expected to have a higher percentage of disturbance at any one time.

Due to the lack of roads in this area, road construction's contribution to peak flow increases was not a factor prior to the 1930's.

Aquatic Animals and Habitat

Historical aquatic habitat and population information in this basin is poorly documented. Distribution of anadromous and resident fishes has been altered by road construction, by the eruption, and by deteriorated natural habitat requirement factors, such as elevated water temperature in the Toutle River Watershed.

No reference information is available for the number of pieces of LWD or pools per mile. The Regional Ecosystems Assessment Project (REAP) includes historic ranges for pools per mile for the Upper Toutle River area. Historical values for pool frequency ranged

from 25-60 pools per mile in the Riffe River basin of which the Upper Toutle River is part of. Given the management activities that occurred after disturbances (eruption, fires, floods), such as snag removal, salvage logging and stream clean-out, and the natural decay of LWD pieces, we can assume that reference conditions for pool frequency and pieces of LWD per mile were higher than present day conditions.

Stream Channels

Stream channels in the Upper Toutle Watershed Analysis Area have been subjected to a natural disturbance regime consisting of fires, floods, and repeated volcanic eruption. This has led to channels that probably had a high rate of disturbance frequency in this area. These channels are also very sensitive to disturbance and slow to recover from those disturbances due to channel type.

Stream Temperature

Historical stream temperature data in this basin is lacking. The Regional Ecosystems Assessment Project (REAP) includes historic ranges of maximum stream temperature for the Upper Toutle River area. The Upper Toutle River are is located in the Riffe River Basin and ranges between 13 to 19 degrees Celsius. It can be assumed that stream temperature increases probably coincided with loss of riparian vegetation and/or channel widening associated with large fires, floods, and volcanic eruption. As mentioned in the stream channel section, the natural rate of disturbance was probably frequent in this area. The cycle of stream temperature increase (and recovery for streams) in this area followed accordingly.

Human Use

The watershed has seen a long history of human use (see the discussion in Chapter I beginning on page I-9), but the largest changes were triggered by the 1980 eruption of Mount St. Helens. The eruption erased most signs of human activity in the central portion of the watershed starting at the crest of Mount St. Helens and extending northward to the Green River Valley. This area was alternately blasted, scoured, and in some areas

sterilized by the heat and force of the eruption. The only areas to escape devastation are in the vicinity of Goat Marsh to the south and the Vanson Peak, Deadmans Lake area in the north. Most of the watershed is now included within the boundaries of the Mount St. Helens National Volcanic Monument.

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CHAPTER V INTERPRETATION

Introduction

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 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 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 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 new 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 the loose tephra deposits on steep slopes. The other factor is the 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. Erosion rates in the northern part of the watershed have had a

marked increase since the eruption of Mount St. Helens in 1980. This is the result of large amounts of tephra and ash being deposited and the lack of vegetation to hold it in place especially in the blast area. 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 to a minimum.

Fire

Volcanic activity surpasses fire as the major disturbance process in the Upper Toutle Watershed although there is a history of numerous small fires that have caused alterations to the landscape. This change in vegetative cover due to volcanic and fire activity has greatly reduced the cover for wildlife species, increased stream temperatures due to lack of stream cover/shading, and caused a decrease in large woody debris recruitment potential over the long term.

Timber Management

Intensive timber harvesting in this watershed began in the early 1950's and has continued through the last four decades. The objective of forest management on both federal and non-federal lands has been to increase conifer growth by clearcutting slow growing, older forest stands and replacing them with faster growing, young conifers. Harvest units on federal lands tended to be smaller than on non-federal harvest areas and were usually dispersed in small patches across the landscape. Commonly, little or no vegetation was left along streams. Subsequent reforestation and stand-tending operations were implemented with the objective of increasing the growth rate and numbers of trees.

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". Compaction from roads can reduce

permeability, consequently increasing surface water flow that is routed to surrounding streams. Some culverts do not allow fish passage resulting in fragmentation of fish habitat. Roads and culverts can block not only upstream migration of resident and anadromous 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.

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 subsurface 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 fish 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 each year. Principal activities include viewing scenery, hiking, horseback riding, mountain biking, mountain climbing, hunting, and camping. The establishment of the Mount St. Helens National Volcanic Monument in 1982, following the cataclysmic volcanic eruption of 1980, brought world-wide, as well as local attention to the area. Visitor facilities have been built along Road 99, State Highway 504, and the Ryan Lake area. A system of new trails were developed to replace those lost during the volcanic eruption mostly within the devastated area.

Visitor use of the area has increased from approximately 500,000 visitors annually before 1980 to an average of 2.5 million in 1996. Most use takes place during the summer vacation season between Memorial Day and Labor Day, and is accounted for by day-visitors viewing scenery. Hunting and hunting-related camping is concentrated in the fall, mostly during October and the first half of November. The total number of camp sites in the watershed decreased due to the eruption, forcing use into the area near Goat Marsh and around Vanson Peak and Deadmans Lake.

SECTION 2 INTERPRETATION

The following pages provide a systematic interpretation of the issues that were analyzed in this iteration of the Upper Toutle River watershed analysis. This interpretation is presented one issue at a time, each led off by a summary paragraph. Then, in a similar series of paragraphs, 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. For clarity and to avoid unnecessary duplication, some of the issues listed in Chapter II are combined in this discussion. 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. The shallow rapid landslides and debris torrents have shown increased intensities since the eruption of Mount St. Helens in 1980, and they are even more prevalent after major storm events such as the event of February 1996. This has been especially evident in the Coldwater and Green River drainages. Future landslides especially the shallow rapid type and debris torrents are likely to occur for many years because the watershed is typified by deep, loose unconsolidated tephra deposits lying on very steep slopes. The areas within the legislated monument will see little impact from management activities because development will be tightly controlled. The National Forest land outside the monument will have some management activity, most of which will be to enhance old growth habitat and rehabilitate the watershed. Both will improve the area's stability.

Comparing Current Conditions with Reference Conditions

Management Activities

Management activities have influenced the area by introducing recreational opportunities as well as producing commodities for outside markets (timber and other special products). Today, the prevalent uses are: recreation of the National Forest lands and timber production on the private lands. These activities will not replicate the reference conditions (natural state), but due to its status as a national monument the National Forest is being managed to reduce impacts of the recent past. Natural events will continue, including the mass wasting and erosion seen since the eruption. The loose unconsolidated material left from 1980 will continue to move and erode. This recent volcanic event gives a good indication, by what we see today, of how the watershed has probably reacted in the past.

Soils

The tephra deposits from the recent eruption have created new soils of varying thicknesses. Being of similar origin, these soils retain the same characteristics as the soils that existed before. The deposits are coarse

grained (with some finer material) throughout most of the watershed. The unconsolidated coarse tephra deposits on steep slopes will continue to be a problem.

Water

Throughout the watershed, changes in precipitation levels over time will affect the potential for mass wasting. The permeability of the soils and rock indicate (by raising or lowering the groundwater levels) how the ground will be affected. The higher the groundwater, especially on steeper ground, the more likely mass wasting will occur.

Comparing Current Conditions with Management Objectives and Desired Future Conditions.

Current management objectives in most of the watershed meet the desired future conditions by managing for a natural condition within the National Forest. Due to restrictions on how the area will be managed, activities, even in the areas outside the legislated monument, will have to be carefully controlled. Privately-owned lands outside the National Forest are managed much differently by enhancing site productivity for future timber management.

To meet the ROD standards, unstable and potentially unstable lands have been placed in Riparian Reserves. These areas can be managed only if technical expertise is used to determine a specific area is actually stable.

Issue No. 2: EROSIONAL PROCESSES

Summary

Volcanic activity from Mount St. Helens has had a major impact on the area from about 40,000 years ago up to the present. Over the past 4000 years, this activity has occurred in cycles of 150 to 600 years. As shown by the 1980 eruption, this can radically change the landscape. The pyroclastic flows and mudflows not only remove anything 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. The tephra deposits (airborne) leave unconsolidated material on the steep slopes which will gravitate downslope by erosional processes.

Management activities such as road construction and timber harvest have provided areas of potential sediment movement to streams. This has been reduced significantly since about 1982 after much of the salvage logging was completed and the National Volcanic Monument was created. Privately-owned lands are of highest concern from roading; however, the amount of activity here will be minimal for many years, until the young stands of trees again grow to marketable size.

Comparing Current Conditions with Reference Conditions

Volcanic

The whole watershed has been affected by volcanic activity, both in the recent and more distant past. The volcanic features that have most affected the watershed are pyroclastic flows (mudflows) and the tephra deposits of ash and pumice. These features greatly increase debris torrents, shallow rapid landslides, and the potential for surface erosion.

Glacial

In the past, glacial activity has carved much of the landscape especially in the higher elevations of Sub-basins 1, 2, 4, 5, 6, and 8. With the loss of about 1200 feet from the top of the volcano, glaciers were destroyed or greatly diminished. Today, glaciers are

receding and their activity is minimal.

Management Activities

Road construction and timber harvest in the watershed are at a minimal level compared to the 1960's and 70's. Road construction in the recent past has probably increased the amount of sediment movement to streams due mostly from poor road construction practices, sidecast of waste material, high use of the road systems by heavy equipment and trucks, use of the roads during the wet seasons and the type of surfacing used on the roads. Since the eruption this trend has diminished and will continue downward as roads are decommissioned (especially on national forest land).

Comparing Current Conditions with Management Objectives and Desired Future Conditions

Roading

New roading within the watershed will be minimal in the National Forest due to restrictions on activities in the Monument. Reconstruction of existing roads or decommissioning roads will meet the Aquatic Conservation Strategies as outlined in the Record of Decision. Areas outside the National Forest will probably undergo more scrutiny based on the State forest practices act. These actions are aimed toward minimizing the amount of sediment delivered to streams.

Fire

Current management objectives in the watershed are to suppress large-scale fires which would otherwise remove vegetation thereby increasing sediment movement to streams.

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

Summary

Many TES plants and C-3 plants, lichens, mosses and fungi are associated with specific habitats such as stream and wetland riparian areas and late-successional stands. Disturbance, primarily from volcanic activity, has resulted in a decrease in habitat for many TES plants and C-3 plants, lichens, bryophytes and fungi in this watershed. This could adversely impact population viability and dispersal processes for some species.

Comparing Current Conditions with Reference Conditions

Reduced Late-Successional and Stream Riparian Reserve Habitat

The watershed as a whole provides minimal habitat conditions for TES and C-3 species dependent on older forest conditions. Over 90 percent of this watershed is early seral or non-forested. Only 10 percent of the watershed, located in Sub-basins 4, 8 and a portion of 7 is late-successional habitat. Only 9 percent of the stream Riparian Reserves are late-successional. Because this watershed is adjacent to an active volcano, it is possible that over long time periods, the current age class distribution could be within historic conditions. If so, it is likely that the current vegetation represents an extreme condition within this natural range. Harvest operations have reduced the numbers of logs and snags below reference conditions. Habitat for many of the TES plants, lichens, mosses and fungi would consequently vary through time as the amount and distribution of late-successional habitat changed within the watershed.

Population Viability and Dispersal Capabilities

Outside of the undisturbed portions of this watershed, the population viability and dispersal capability for many of the TES and C-3 species is very low. The four sensitive plant species and the one C-3 species known

to be present in this watershed are all located within Sub-basin 4 where the majority of the late-successional habitat is located.

TES and C-3 species populations would naturally vary with the episodic nature of disturbance within this watershed. Very little is known about the population dynamics of these species. Whether the present populations are within the historic reference range for this watershed is unknown.

Comparing Current Conditions with Management Objectives and Desired Future Conditions

Reduced Late-Successional and Stream Riparian Reserve Habitat

Habitat conditions for TES and C-3 species dependent on late-successional and/or undisturbed stream Riparian Reserve habitat is limited throughout most of this watershed. Outside of the existing undisturbed, late-successional habitat in Sub-basins 4, 8 and a portion of 7, it will take over a hundred years to develop additional late-successional habitat. Within the NVM, it may take centuries. Although past reforestation in Sub-basins 2, 4, 7, 8 and 9 helped to accelerate succession, many of these forests may be harvested before they reach late seral conditions. The development of snags and logs will take decades to centuries.

Population Viability and Dispersal Capabilities

Outside of the existing undisturbed, late-successional habitat in Sub-basins 4, 8 and a portion of 7, this watershed has little opportunity for increasing the population viability and dispersal capabilities for TES and C-3 species dependent on late-successional and/or undisturbed riparian habitat. The existing undisturbed habitat in the Goat Marsh RNA, matrix, and NVM provide unique and extremely valuable habitat in an otherwise highly disturbed watershed.

Issue No 4: VEGETATION STRUCTURE AND COMPOSITION

Summary

Vegetation conditions have been shaped primarily by volcanic eruptions and timber harvest. The eruption of Mount St Helens buried, burned, or blew over forested stands and initiated early seral conditions across most of this watershed. Salvage operations outside of the Mount St. Helens NVM in Sub-basins 2, 4, 7 and 9 removed standing dead trees (snags) and down coarse woody debris (logs). Subsequent reforestation converted these areas into forest plantations. Along the northern- and southern-most edges of the watershed in Sub-basins 4 and 8, some additional clear cutting converted older forests into young managed stands. Most of the lands currently managed for timber production are in non-federal ownership.

Comparing Current Conditions with Reference Conditions

Proportion of Age Classes

This watershed is not within the reference range described in the REAP. However, because this watershed is adjacent to an active volcano, it is possible that over time periods longer than those described by the REAP report, the current age class distribution could be within historic conditions. If so, it is likely that the current vegetation represents an extreme condition within this natural range. An estimated 50 percent (including federal and non-federally owned lands) is currently in early to mid-successional forest and an additional 35 percent is comprised of non-forested lands. Forty six percent of the federally owned lands are early successional and 44 percent non-forested. Almost all of this land was initiated through volcanic eruption. When the eruption occurred, a large portion of the area was classified as non-forest. Many of these acres are now occupied by forb, shrub, and tree species and should be reclassified as shrub/seedling.

Distribution of Structure Stages Across the Watershed

The distribution of structure stages is similar to reference range conditions. Large, contiguous areas of

similar structure and age exist within the watershed. Fragmentation occurs only in within the northern-most and southern-most portion of the watershed

Diversity of Species and Structure

This watershed is dominated by early seral vegetation communities. The diversity of plant species and structures associated with older successional forests or with a mix of older and younger stands is lacking within this watershed.

This watershed is unique in its inclusion of large areas of young developing forest initiated through a recent volcanic eruption. Successional development within the NVM is progressing without "management." In some areas within the NVM, clearcutting prior to the eruption removed snags and logs which would have been otherwise present.

Less than 15 percent of the watershed is being managed for timber production. Because many of these lands were salvaged and planted after the eruption, the diversity of these stands is less than in the NVM. Snags and logs were removed and the species composition and stand structure controlled to meet timber production objectives.

Past logging operations have likely resulted in this watershed being outside the reference range for structural diversity.

Comparing Current Conditions with Management Objectives and Desired Future Conditions

Proportion of Age Classes

Late-successional stands comprise 10 percent of the watershed, and approximately 18 percent of the total forested acres within the watershed. If the non-forested lands were re-classified to more accurately reflect what is now growing within the blast zone, the percentage of late-successional stands would fall below the 15 percent required in the Northwest Forest Plan. Almost all of these stands are 200 years or older. Approximately 87 percent of the existing late-successional stands are within the Mount St. Helens NVM/Goat Marsh RNA. The remaining stands are

within the Matrix. The total additional acreage needed to meet the minimum 15 percent can not be calculated until the vegetation data is updated. It will be many hundreds of years before many of the younger stands within the Monument reach late-successional conditions. Stands within matrix are also very young and will take over one hundred years to develop late-successional characteristics.

Roughly 85 percent of the watershed is within the Mount St. Helens National Volcanic Monument. The vegetation objective in the Monument is to allow succession to progress without significant human intervention. This objective is being met.

Distribution of Structure Stages Across the Watershed

The limited amount of late-successional forest which exists is located in two fairly contiguous blocks within the watershed (Sub-basins 4, 8 and 7). The eruption of Mount St. Helens eliminated most of the late-successional stands which might have provided habitat connectivity within or between adjacent watersheds.

Diversity of Species and Structure

Because older forests are lacking, the diversity of species and structure associated with these late-successional stands is less than desired within the watershed. It will be hundreds of years before this element of diversity is restored within the watershed.

Issue No. 5: HABITAT FOR THREATENED, ENDANGERED, SENSITIVE, C-3 ANIMAL SPECIES AND MOUNTAIN GOATS

Summary

Disturbances resulting from the 1980 eruption of Mount St. Helens and timber harvest have resulted in significantly reduced habitat for species dependent on mature timber cover. Approximately 10 percent of the watershed is late-successional habitat. About 87 percent of the existing late-successional habitat in the watershed is within the National Volcanic Monument, Research Natural Area, and a 100-acre area withdrawn for spotted owls.

The Upper Toutle River Watershed contains habitat for several species Federally listed as threatened or endangered, Forest Service sensitive species, and C-3 species. Late-successional habitat in the watershed is located in two large patches that are separated by the extensive devastated area north of Mount St. Helens. Both of these patches have supported spotted owls. The watershed contains cliff sites that could be suitable for peregrine falcons. Habitat conditions for gray wolf, grizzly bear, bald eagle, wolverine, common loon, and mountain goats will improve as the devastated area continues to recover. The watershed contains known populations of Van Dyke's salamander and suitable habitat for great gray owl and forest bats.

Comparing Current Conditions with Reference Conditions

Conditions for Species Requiring Large Blocks of Late-Successional Habitat

Because of its proximity to an historically active volcano and due to the effects of large fires that probably occurred there, the percentage of the watershed in late-successional habitat may never have been high. In addition, the percentage would have varied widely at any point in history depending on the severity and extent of the last disturbance event. Due to the effects of the 1980 eruption, and harvest on Federal and private land, the current amount of late-successional habitat available is probably near the lower extreme of the historic range of variability.

Currently the habitat patches available for these species are widely separated by unsuitable habitat, and

individuals would not be able to move between them. The northern patch in the Green River drainage consists of about 3,600 acres, is relatively unfragmented and connected by dispersal habitat to the Quartz Late-Successional Reserve to the north. The southern portion of the Quartz LSR consists of closed small tree habitat between 90 and 150 years old. The large tree patch in the legislated Monument may serve as an important extension of the LSR.

The other patch in the southwest portion of the watershed is smaller and more fragmented. It has a history of supporting spotted owls and is adjacent to suitable habitat in the Kalama watershed, but when viewed on a landscape scale this habitat is not significant because of the fragmentation, small size of these patches, and long distance to other suitable habitat.

Since much of the Federal land in the watershed is in areas closed to timber harvest, there will be a gradual increase in suitable habitat as forest succession proceeds. Stands on private land in the watershed are likely to be managed on short rotations and never will support late-successional species.

Conditions for Species Requiring Seclusion from Human Disturbance (Gray Wolf, Grizzly Bear, Wolverine)

The road and trail density in the watershed is higher than reference conditions, but opportunities for seclusion increased when the 1980 eruption left large areas unroaded. However the areas that have the lowest road density are also the areas that probably support the lowest prey densities for these species (devastated area north of the volcano).

Since much of the Federal land in the watershed is in areas closed to timber harvest and other management activities, there will be a gradual increase in vegetative cover as forest succession proceeds. Because of this, conditions for prey species will improve.

Conditions for Van Dyke's and Larch Mountain Salamander

Habitat for the known Van Dyke's salamander populations was significantly altered by the 1980 eruption which destroyed all tree cover; however, cover and moisture requirements are still being met at these sites by large woody debris and boulders along streams. There may have been other populations of both these species that could not survive the effects of the eruption. Known and suspected suitable Larch Mountain salamander habitat in the watershed is primarily located in the National Volcanic Monument and the Research Natural Area, so this habitat will be protected.

Conditions for Species Requiring Structures for Nesting or Roosting

The watershed contains potentially suitable cliff nest sites for peregrine falcons as well as roost sites for bats in the form of rock outcrops, snag patches in the northern fringe of the devastated area, mature timber patches, and bridges. There are few if any roosts or perches for bald eagles around Coldwater Lake and along the Toutle River. These areas are within the legislated Monument and are not likely to be affected by management activities.

Conditions for Great Gray Owls

Current conditions for great gray owls are probably somewhat improved from reference conditions. The nesting and foraging opportunities in what is now the Research Natural Area would have been similar to the current condition, but relatively small openings created by timber harvest around the RNA has increased areas available for foraging.

Since the RNA is not available for timber harvest, in the absence of fire or other large disturbance, habitat suitability there will remain the same. The watershed contains less than 15 percent late-successional habitat, and under the Northwest Forest Plan regeneration harvest is not an option. Because of this, there will be a gradual decline in openings suitable for foraging.

Conditions for Mountain Goats

Whether mountain goats inhabited the watershed before animals were artificially transplanted there is unknown. Given the fact that individual mountain goats are occasionally sighted just east of the watershed, it's likely that they would have utilized suitable habitat in the watershed as well. The 1980

eruption not only destroyed the small resident herd, it also wiped out the forage and thermal cover on their range. The area formerly occupied by mountain goats could not currently support a herd year-round; however, as this area recovers from the effects of the eruption, habitat will improve.

Comparing Current Conditions with Management Objectives and Desired Future Conditions

Late-successional Habitat

The management direction and desired future condition in each fifth field watershed is to have at least 15 percent of the area of the watershed in late-successional conifer stands. Currently about 10 percent of the Upper Toutle River watershed is in late-successional stands. As vegetation recovers from the effects of past timber harvest and the volcano there will be a gradual increase in conifer cover. Because of restrictions on regeneration harvest, stands that are currently in the small tree structure stage could develop into late-successional habitat.

Conditions for Species Requiring Seclusion from Human Disturbance

The management objectives for the legislated Monument allow human use of the area in ways that do not interfere with the natural recovery and study of the ecosystem. Currently access by people to much of the legislated Monument is restricted due to requirements to hike only on established trails. The number of overnight campers allowed in the Mount Margaret backcountry will be limited when the area is opened to that type of use. There are no new roads required or anticipated within the Monument. Road density within the watershed can be reduced by identifying and decommissioning roads that are no longer needed for recreational access or other management activity. Locations of proposed new trails would have to be analyzed in the site-specific NEPA process, and effects to potential habitat would be determined and mitigated at that time.

Conditions of Threatened, Endangered, Sensitive and C-3 Species

The management objectives and desired future condition of the legislated Monument are generally consistent with maintaining and improving habitat for these species by allowing the ecosystem to recover

naturally while limiting human access to approved trails, visitor centers, and the few roads. However it will take longer for habitat to become suitable for some species in the area devastated by the 1980 eruption because certain management actions are not allowed. Examples are replanting that could restore lakeshore and streamside riparian vegetation, and cover and forage for large ungulates on uplands. Artificial perches for bald eagles can not be constructed at Coldwater Lake, and the lakes can not be stocked with fish.

Likewise, conditions in the Research Natural Area will remain essentially unchanged. Habitat for great gray owl and Larch Mountain salamander will remain unmanaged.

Due to requirements in the Northwest Forest Plan, Matrix land will be managed to produce large trees until at least 15 percent of the area of the watershed has grown into late-successional stands. Fragmentation of the late-successional stands in the southern portion of the watershed will be reduced.

Issue No. 6: HYDROLOGIC CHANGES

Summary

In general, sub-basins within the analysis area are recovering from the 1980 eruption of Mount St. Helens. Analysis found that 55 percent of the sub-basins in the area have increased peak flows of 10 percent or greater due to loss of the mature conifer vegetation component. This degree of impact is probably underestimated due to the designation of a majority of the blast deposit as "rock". This area has not lost its capacity to grow coniferous vegetation due to the eruption, and in fact, it currently has numerous coniferous seedlings growing throughout. Roding has also contributed to increased peak flows by increasing stream lengths in the watershed by 0 to 63 percent, thus contributing more surface water to streams. The majority of roding is located on non-National Forest land.

Comparing Current Conditions with Reference Conditions

Peak Flow Increase - Vegetation Related

Currently, 47 percent of the Upper Toutle River Analysis Area is in early successional timber stands compared to a range of 3 to 42 percent (USDA, 1993) of the Riffe Watershed historically. As discussed above, the current percentage in early successional stands is probably underestimated due to the designation of a majority of the blast deposit as "rock". This area has not lost its capacity to grow coniferous vegetation due to the eruption. In Sub-basins 1, 3, 5, 7 and 9, peak flow increases for the 2-year flow event are 10 percent or greater when compared to a fully forested condition. This area is recovering as conifers grow to larger sizes in the sub-basins.

Peak Flow Increase - Road Related

Currently, 1640 miles of stream channel are found in the analysis area compared to 1283 miles historically. The extra 357 miles are due to extension of the stream channel network by roding, primarily interception of sub-surface flow and routing of road surface runoff. The largest increase in the stream channel network is in Sub-basins 2, 4 and 9. The number of miles of streams is increasing due to increasing road miles that cross streams.

Comparing Current Conditions with Management Objectives and Desired Future Conditions

Peak Flow Increase - Vegetation Related

The following management objectives are related to peak streamflow. "The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected" (ROD B11). "The distribution of land use activities, such as timber harvest or roads, must minimize increases in peak flows" (ROD B9). The amount of increased peak flow, if any, that has resulted from vegetation loss is unknown due to the lack of definitive research in this area. The current condition is probably consistent with management objectives for sub-basins mentioned in the previous section due to these changes resulting from natural events (volcanic eruption), not human caused.

Peak Flow Increase - Road Related

Management objectives relating to this factor are the same as those mentioned in the previous paragraph. It is unknown how the current condition compares to the management objectives due to the lack of knowledge about the amount of increased peak flow, if any, that has resulted from the extension of the stream channel network.

Issue No. 7: KEY HABITAT ATTRIBUTES FOR SALMONIDS

Summary

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

The eruption of Mount St. Helens, 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 with 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, how the dominant processes are affecting the attribute, and how the attribute is changing (or expected to change with current management policies).

Comparing Current Conditions with Reference Conditions

In-Channel Large Woody Debris (LWD)

The eruption of Mount St. Helens, and subsequent salvage logging, and timber harvest prior to the eruption within the riparian zone, has removed LWD from stream channels. Stream survey data was collected in Sub-basin 8 and in that sub-basin, LWD is below natural levels due to management activities and natural disturbances. The amount of LWD will increase as the natural recovery process takes place and as the Northwest Forest Plan is implemented,

riparian areas will continue to mature into a late successional forest.

Large Woody Debris (LWD) Recruitment Potential

In all sub-basins (1-9) the eruption has left LWD recruitment potential outside of the range of natural conditions as identified by the Columbia River Basin Policy Implementation Guide. Decades are needed for young conifer trees along the streams to mature and grow into trees of adequate size for LWD in stream channels. The potential for LWD recruitment is being maintained/increased as the natural recovery process occurs and as the Northwest Forest Plan is implemented, riparian areas will continue to mature into a late successional forest.

Primary Pools Per Mile

In Sub-basin 8 (the only sub-basin with stream survey data), the processes of erosion and a lack of LWD has left the primary pools per mile outside the range of natural variability as identified by REAP, 1993. The watershed is maintaining/increasing pools as the natural recovery process occurs and as the Northwest Forest Plan is implemented, riparian areas will continue to mature into a late successional forest.

Stream Temperature

In the North Fork, South Fork, mainstem Toutle Rivers, and their tributaries, exposed channels (due to volcanic eruption, timber harvest and road building) have left stream temperatures probably within a range of reference conditions during periods of large scale volcanic disturbance. With decades of recovery from the eruption and implementation of Riparian Reserves, temperatures are decreasing as canopies develop and mature.

Aquatic Habitat Fragmentation

In sub-basins 2, 4, and 9 aquatic habitat fragmentation has increased through: 1) road building without fish passage, and 2) road maintenance removes LWD at crossings, so the flow of LWD through the system has decreased. Fragmentation is decreasing as the Northwest Forest Plan is implemented and roads are decommissioned and culverts replaced. The amount of LWD flowing through the system will be

maintained or slightly increased.

Stream Channel Sediment

In the North Fork, South Fork and mainstem Toutle River, one process is affecting stream channel sediment. Volcanic eruption inputs large amounts of tephra into stream systems consistent with past large volcanic eruptions. Recovery from eruption is slow as vegetation returns.

Comparing Current Conditions with Management Objectives and Desired Future Conditions

In-Channel Large Woody Debris (LWD)

The CRBPIG's objective is greater than 80 pieces of wood per mile that are greater than 50 feet long and 24 inches in diameter at breast height. Of the total length of surveyed streams, 15 percent are outside the management objectives (i.e., have a poor rating).

Large Woody Debris (LWD) Recruitment

Riparian areas are not currently supplying amounts and distributions of LWD sufficient to sustain physical complexity and stability. Aquatic Conservation Strategy Objectives (ROD B-11).

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 within management objectives for the North Fork, South Fork and mainstem Toutle River due to temperature increases from "natural causes" (volcanic eruption).

Primary Pools per Mile

The desired number of pools per mile is established by the CRBPIG and relates to the average wetted width of the channel (CRBPIG 1991). Of the total length of stream surveyed, 20 percent is outside the management objectives (i.e., has a poor rating).

Aquatic Habitat Fragmentation

The objective(s) are: Provide and maintain fish passage at all road crossings of existing and potential fish-bearing streams (ROD S&G's C-33). New road/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.

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 primarily to volcanic eruption. Other sources of sediment include roads and some harvest units.

Issue No. 8: COMPLETION OF TRAIL SYSTEM AND TRAIL CONNECTORS

Summary

The Comprehensive Management Plan for the Mount St. Helens National Volcanic Monument prescribed a network of trails to replace those lost during the May 18, 1980 eruption. Additional trail construction is proposed in the Gifford Pinchot National Forest Land and Resource Management Plan. Most replacement trails have been constructed, but a few remain to be built. In addition, the need for trail connections has become evident, through lack of trail use and/or poor access to locations where trails start.

Comparing Current Conditions with Reference Conditions

Trails Remaining to be Constructed

The only trail remaining to be constructed is a segment of the Independence Pass Trail No. 227 between the Donnybrook Viewpoint and the Independence Pass Trail Trailhead in Sub-basin 1. Construction of this remaining segment will complete the last trail identified for construction in the Gifford Pinchot National Forest Land and Resource Management Plan inside the National Volcanic Monument.

Trail Connectors Needed

Castle Lake Trail No. 221 originates at a point on the Loowit Trail, and descends to the northeast corner of Castle Lake, in Sub-basin 3. Use of this trail is discouraged by the isolated starting point of the trail, so most hikers choose to walk cross country or descend a vehicle-access road to the lake. One fatality has occurred, when a hiker in transit from the lake after dark fell from a cliff. To avoid similar instances, and improve trail usage, an extension of the Castle Lake Trail is proposed between Castle Lake and Hummocks

Trail. Area usage would remain constant or increase slightly with this improved access. Forging of the Toutle River would be necessary to reach Castle Lake, which would limit the times of year when the trail would be usable. The new trail segment would cross Sub-basin 2 to reach the Hummocks Trail.

Comparing Current Conditions with Management Objectives and Desired Future Condition

Trails Remaining to be Constructed

Currently a gap exists in the Independence Pass Trail between Donnybrook Viewpoint and the Independence Pass Trailhead. The objective of this trail is to create hiking and Spirit-Lake-viewing opportunities along the Road 99 corridor and a loop hike around the crest of the Spirit Lake basin.

Trail Connectors Needed

Currently the Castle Lake Trail ends at Castle Lake. This trail would be extended northward to the Hummocks Trail No. 229. A ford would be provided for crossing the Toutle River, limiting the seasons when the trail could be used. The trail would be constructed to avoid research plots and riparian areas to the extent possible. In the future, the trail would provide relatively easy and safe trail access to Castle Lake, and the Loowit Trail from the vicinity of Coldwater Lake. No connection through this area exists presently. This new trail segment would be an extension of the Castle Lake Trail and would be designated with the same trail number.

Issue No. 9: RECREATIONAL ROAD ACCESS

Summary

The Comprehensive Management Plan for the Mount St. Helens National Volcanic Monument and the Gifford Pinchot National Forest Land and Resource Management Plan directed construction of recreational facilities in and adjacent to Mount St. Helens NVM. Pre-existing roads, as well as newly constructed roads, provide access to these recreation sites. In some cases roads exist which are not needed for recreational or administrative access. These unneeded roads are sometimes poorly maintained, resulting in environmental damage due to erosion and sedimentation. In other instances they create opportunities for unwanted dispersed camping or user generated trailheads. Roads not needed for recreational or administrative access are candidates for decommissioning.

Comparing Current Conditions with Reference Conditions

Roads Needed for Recreation Access

The only roads needed for recreational access are those leading to developed recreation sites and trailheads. Table 19, in Chapter III lists those necessary roads. These roads are needed for long-term recreational access and use of national forest lands by the public.

Roads Not Needed for Recreation Access

In Chapter III, Table 20 lists roads not needed for recreational access. While these roads may not be needed for recreational purposes, they may be of value for other administrative uses or to provide access to scientific study plots.

Comparing Current Conditions with Management Objectives and Desired Future Condition

Roads Needed for Recreation Access

In Sub-basins 4 and 8 recreation-access roads received significant damage from the flood of February 1996. At that time, and in some instances until 1997, road access was lost due to that damage. Both the public and Forest Service management personnel expressed concern about road repair and whether all roads were

needed for future purposes. Many of the roads were constructed for logging operations which are now completed. Some roads will be needed in the future, while many others may not. The identification of necessary long-term recreational access routes helps define which roads will be kept, repaired, and maintained. Those roads listed in Table 19 will be repaired and retained in service for recreational access.

Roads Not Needed for Recreation Access

Once roads needed for long-term recreation access are identified, by definition all remaining roads are potentially available for decommissioning. Some of these remaining roads are needed for other purposes, such as administrative access or tree stand improvement. The benefits of eliminating unneeded roads include reducing road maintenance costs, reducing storm runoff and sedimentation, and improving water quality. Some of these roads were once closed with berms, but many closures have been dug through or otherwise illegally reopened by users. If decommissioned, these roads would be closed by culvert removal, scarification, and/or pulling back road fills, followed by revegetation. In Sub-basins 2, 4, and 9, over 19 miles of road have been identified for potential decommissioning.

Issue No. 10: RESOURCES IMPACTS FROM RECREATION USE

Summary

Recreational use along the shores of lakes and streams can damage vegetation subsequently causing erosion. This is particularly noticeable near camp sites and areas where fishing and day use takes place. Recreationists are attracted to water, either for picnicking, fishing, watering horses, collecting camp water, or swimming.

Controlling recreation use near water is challenging for two reasons, it is very attractive to visitors, and most areas of the Monument are patrolled only occasionally. This makes enforcement of rules difficult. Without intense patrolling, keeping people away from water is nearly impossible. Mitigation must depend on hardening of the sites or creation of special access points. User trails have been noticed on the shore of Deadmans Lake and Blue Lake, but some use has occurred at nearly every lake in the watershed. While current impacts are relatively isolated, impacts may increase in the future, and should be monitored.

heavier impacts are noticed, or anticipated in certain areas, it may be desirable to either harden trail surfaces near lakes and/or provide restricted access on boardwalks or special pathways.

Comparing Current Conditions with Reference Conditions

Prior to 1980, Blue Lake received little use. Following the eruption of Mount St. Helens large numbers of people were attracted to the area with recreational use in the watershed jumping from 500,000 visitors per year to over 2,000,000. While much of this increase is concentrated at the visitor centers, a significant increase in trail use has also taken place, bringing more people each year to lake shores, and streams. This increase is expected to continue, with the future potential of heavier impact to riparian areas.

Comparing Current Conditions with Management Objectives and Desired Future Condition

Presently recreational impacts are limited to a few sites on lake shores. Increases in vegetative loss may create impacts in water quality. In the future it would be desirable to maintain impacts at current levels. If

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 was conducted in three dimensions of the ecosystem: aquatic, terrestrial, and social/economic. The synthesis for each of these three dimensions is presented in its own separate package consisting of an explanation, a table showing the location (sub-basins) of conditions of concern, and a map which shows the locations of important features. The three synthesis packages are followed by Table 25, Aquatic, Terrestrial, and Social and Economic Synthesis by Sub-Basin, which shows in which sub-basins the ecosystem elements of concern from all three syntheses occur. This provides readers with an over-all view of the watershed and highlights those sub-basins with the greatest number of elements.

Aquatic Synthesis Explanation

For the aquatic synthesis process, ecosystem elements having linkages are combined to identify critical zones within the watershed. 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 mapped polygons overlap identify important zones because here we currently have high surface erosion rates and stream channels are likely being degraded from sediment input.

Other relevant information is shown on the synthesis map and in the aquatic 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 are considered to be in extremely poor condition for fish; (3) areas that have increased peak flows from vegetation loss and roading; and (4) areas with high surface erosion from roads, areas with high channel bank erosion rates due to mudslides, or areas that have high rates of erosion due to debris torrents, shallow/rapid landslides, or upslope surface erosion of tephra.

Summary

As described in the current condition section, the

entire analysis area has been and continues to be profoundly influenced by the 1980 eruption of Mount St. Helens. The lateral blast and associated deposits destroyed most of the existing vegetation and “set the clock back” to predominately pioneer type plant species. Consequently, this area will not provide important aquatic components like LWD, for centuries. The eruption also sent mudflows down the North and South Fork Toutle Rivers (Sub-basins 2, 4 and 5), depositing material that is still eroding and contributing sediment into these river systems.

Sub-basins 2, 4, and 9 are areas that have had considerable damage associated with the 1980 eruption and have high road densities that fragment the aquatic environment and introduce additional sediment into the system. These sub-basins have high levels of aquatic fragmentation and low LWD recruitment potential making them poor sources of large wood for the North Fork, South Fork, mainstem Toutle, and Green Rivers. They also have a high sediment concern due to deposition of tephra, high road densities, and channel erosion of mudflow deposits.

Two areas (located along the Green River and Goat Marsh) have been identified as currently containing the only potential large woody debris in the analysis area. These blocks are shown on the aquatic synthesis map.

Table 22 - Aquatic Synthesis of Upper Toutle River Watershed. Sub-basins are listed in general order of concern.

Sub-basin	High Frag. and Low LWD Recruitment Potential	High Risk of Increased Peakflow	High Sediment Concern	Extremely Poor Fish Habitat Conditions
9*	X	B	R	
4*	X	R	C,R	
2*	X	R	C,U	
8			U	X
7		V	U	
5		V	C	
6			U	
3		V		
1		V		

* - Sub-basin has incomplete data due to private land

For "High Sediment Concern"; R=concern due to surface erosion from roads; U=concern due to upslope erosion; C=concern due to channel erosion from mudflows

For "High Risk of Increased Peak Flow"; V=concern due to vegetative conditions; R=concern due to roading; B=concern due to both roading and vegetative conditions

Terrestrial Synthesis Explanation

Volcanic eruptions, timber harvest, and road construction are both natural and human-caused processes which have altered the landscape of the Toutle River watershed. The combination of these disturbances, but primarily the 1980 eruption, has left a majority of the watershed in an unfragmented early-successional habitat condition, with widely separated late-successional patches in the north and south ends. A majority of the late-successional habitat is in allocations that restrict timber harvest.

The watershed contains or is suspected to contain suitable habitat for several Federally listed, Region 6 sensitive, and C-3 species. Animal species include northern spotted owl, bald eagle, peregrine falcon, gray wolf, wolverine, common loon, great gray owl, Van Dyke's and Larch Mountain salamander, and forest bats. Plant species are lance-leaved moonwort, northern moonwort, pine broomrape, fringed pinesap, and noble polypore.

The large tree patches in the watershed may provide key habitat for species closely associated with late-successional forest such as northern spotted owl. The patch in the Green River drainage appears to have habitat connections for mobile species to the Quartz Late-successional Reserve. These patches, as well as the northern fringe of the blast zone, are where the largest snags at the highest densities can be found.

Sub-basins 1, 3, 5, 6, and 8 have road densities of less than one mile per square mile, having the potential to offer seclusion to animal species that are highly sensitive to human disturbance. While Sub-basins 2 and 7 have road densities of greater than one mile per square mile, the majority of the road miles are in the western portions of the sub-basins, leaving significant portions unroaded. These areas in the future may play a key role in maintaining healthy ungulate populations.

All of the known sensitive and C-3 plant sites are in Goat Marsh Research Natural Area and in Matrix land in Sub-basin 4.

Two areas within the watershed provide unique vegetation conditions. The Mount St. Helens National Volcanic Monument was designated by Congress as a unique area where natural succession could continue essentially unimpeded after volcanic eruption. Goat Marsh Research Natural Area was established because it represents an array of mountain wetland communities; xeric lodgepole pine forests which characterize youthful pyroclastic flows, mudflows, and alluvial surfaces associated with volcanoes; and unique old growth noble fir forest. Both areas are extremely valuable for ongoing research and education.

Table 23. Terrestrial Synthesis

Sub-basin	Sub-basins with Road Density > 1 mi/sq mi	Sub-basins without Significant Late-successional Habitat	Sub-basins with Known Sensitive and C-3 Plant Populations	Sub-basins with Known Van Dyke's Salamander Populations
1		X		X
2	X	X		
3		X		
4	X		X	
5		X		
6		X		
7	X			
8				X
9	X	X		

Upper Toutle River

Terrestrial Conditions

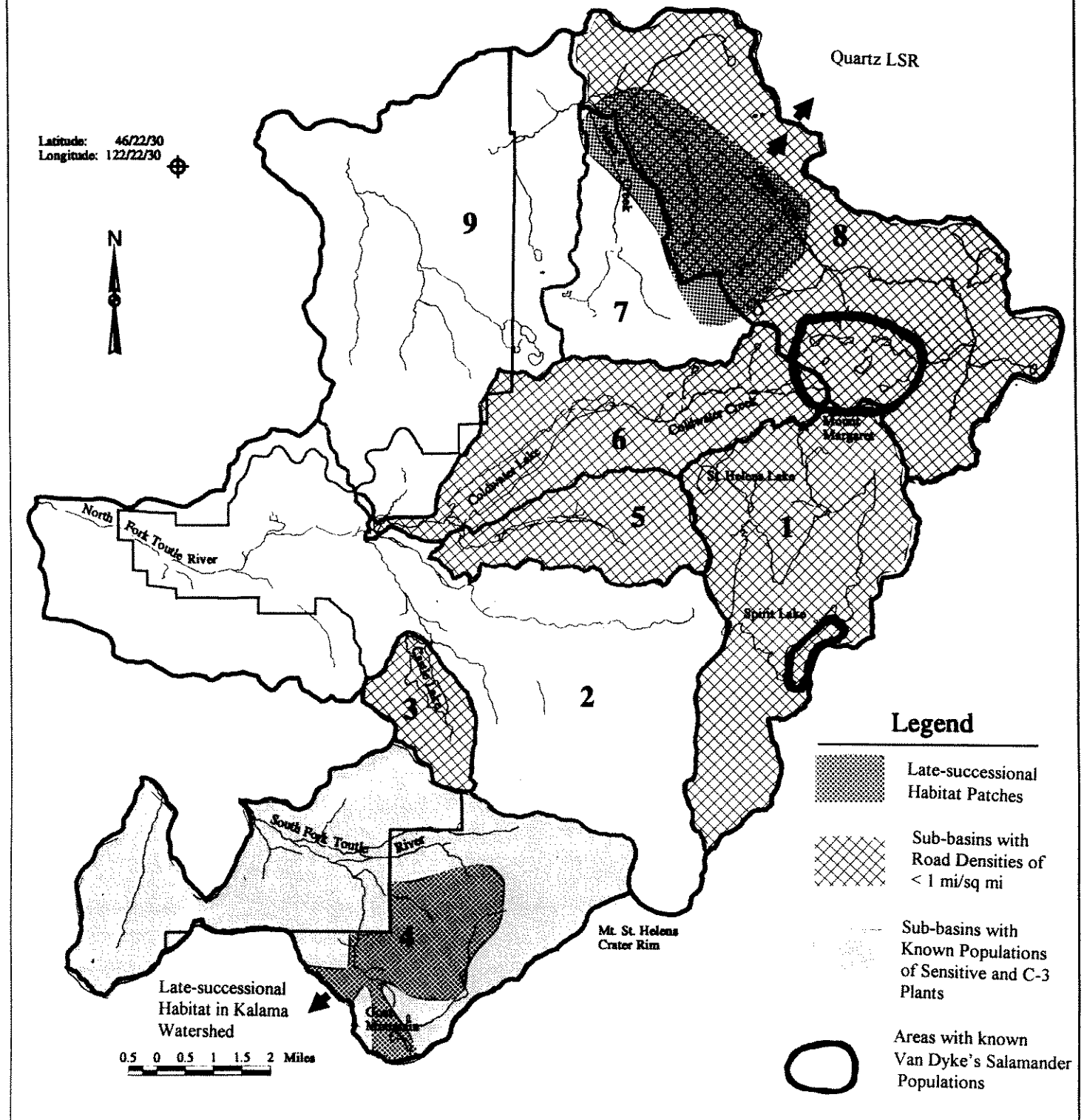


Figure 24. A cluster of sub-basins have road densities of less than one mile per square mile. Much of the eastern portions of Sub-basins 2, 4, and 7 are also largely unroaded. Late-successional patches are not connected within the watershed but are connected to habitat in adjacent watersheds. Sub-basin 4 contains known Sensitive and C-3 plant populations.

Recreation Synthesis Explanation

The synthesis table and map show the primary recreation issues related to the watershed: completion of trail system and trail connectors, recreational road access, and resource impacts from recreation use.

The Comprehensive Management Plan for the Mount St. Helens National Volcanic Monument prescribed a network of trails to replace those lost during the May 18, 1980 eruption. Additional trail construction was proposed in the Gifford Pinchot National Forest Land and Resource Management Plan. Most replacement trails have been constructed, but a few remain to be built. In addition, the need for trail connections has become evident, through lack of trail use and/or poor access to the starting point of trails.

Analysis shows that a two mile segment of the Independence Pass Trail remains to be constructed between the Donnybrook Viewpoint and Independence Pass Trailhead. Also a trail segment needs to be added to the Castle Lake Trail between Castle Lake and the Hummocks Trail. This segment is needed to address safety and resource protection concerns created by cross-country travel by users from nearby roads and the lake.

The Comprehensive Management Plan for the Mount St. Helens National Volcanic Monument and the Gifford Pinchot National Forest Land and Resource Management Plan directed construction of

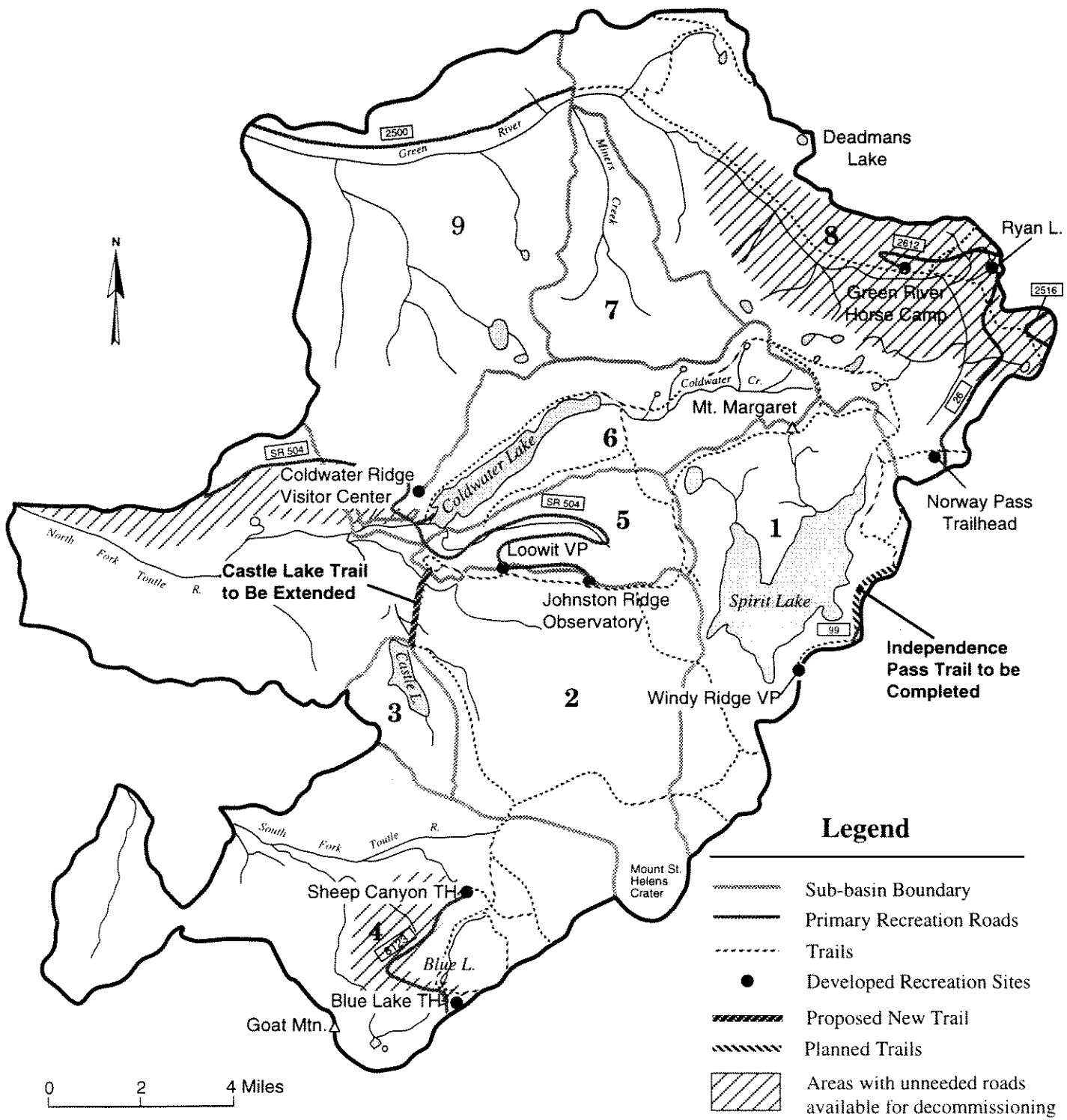
recreational facilities in and adjacent to Mount St. Helens NVM. Pre-existing roads, as well as newly constructed roads provide access to these recreation sites. In some cases roads exist which are not needed for recreational or administrative access. These unneeded roads are sometimes poorly maintained, resulting in environmental damage due to erosion and sedimentation. In other instances they create opportunities for unwanted dispersed camping, or user generated trailheads. Roads not needed for recreational or administrative access are available for road decommissioning. The synthesis map shows roads needed for recreational road access, and areas where roads exist that are not needed. An environmental assessment of little used roads will be needed before any decommissioning decision is made. While not needed for recreational access, some roads may be needed for future timber management or other purposes.

At some locations, particularly Blue Lake and Deadmans Lake, camping and lake shore use may be adversely affecting riparian areas and perhaps water quality. These impacts are relatively limited at present but may increase over time with use and increasing numbers of recreational visitors. These areas may need monitoring and future management action to limit disturbance. An in-depth analysis of each site would be needed to determine appropriate courses of action.

Table 24. Social and Economic (Recreation) Synthesis

Sub-Basin	Completion of Trail System and Trail Connectors	Roads Needed for Continued Recreation Access	Roads Available for Decommissioning	Resource Impacts from Recreation Use Affecting Riparian Areas
1. Spirit Lake	X	X		
2. Upper North Fork Toutle River	X	X	X	
3. Castle Lake				
4. South Fork Toutle River				
5. South Coldwater Creek		X	X	X
6. Coldwater Lake				
7. Miners Creek				
8. Upper Green River				
9. Lower Green River		X	X	X

Upper Toutle River Recreation Synthesis



Legend

- Sub-basin Boundary
- Primary Recreation Roads
- Trails
- Developed Recreation Sites
- Proposed New Trail
- Planned Trails
- Areas with unneeded roads available for decommissioning

Figure 25. Synthesis of data showing areas with roads available for decommissioning (see table 20 for a listing of roads). Also shown are newly proposed trails, and those remaining to be constructed by the Gifford Pinchot National Forest Land and Resource Management Plan.

Table 25. Aquatic, Terrestrial, Social and Economic Synthesis by Sub-basin

Sub-basin	NWFP Allocations	Aquatic				Terrestrial				Social and Economic			
		High Fragmentation and Low LWD Potential	High Risk of Increased Peak Flow	High Sediment Concern	Extremely Poor Fish Habitat Conditions	Sub-basins with Road Density Greater Than 1 Mi/Sq Mi	Sub-basins Without Significant Late-Successional Habitat	Known Sensitive and C-3 Plant Populations	Known Van Dyke's Salamander Populations	completion of Trail System and Trail Connectors	Roads Needed for Continued Recreation Access	Roads Available for Decommissioning	Resource Impacts from Recreation Use Affecting Riparian Areas
1. Spirit Lake	NVM		V				X		X	X			
2. Upper N. Fork Toutle Rv.	NVM, PVT	X	R	C,U		X	X		X	X	X		
3. Castle Lake	NVM		V				X						
4. S. Fork Toutle Rv,	PVT, NVM, MAT, RNA	X	R	C,R		X		X					
5. S. Coldwater Cr.	NVM		V	C			X			X	X	X	
6. Coldwater Lake	NVM, PVT			U			X						
7. Miners Cr	NVM, PVT, MAT		V	U		X							
8. Upper Green River	NVM, MAT, PVT			U	X				X				
9. Lower Green River	PVT, NVM, MAT	X	B	R		X	X			X	X	X	

X= Sub-basins of Concern
 C= From Stream Channel & Bank Erosion, U= From Upslope Erosion
 R= From Roads, V= From Vegetation Conditions
 B= From Roads & Vegetation



Upper Toutle River Sub-Basins

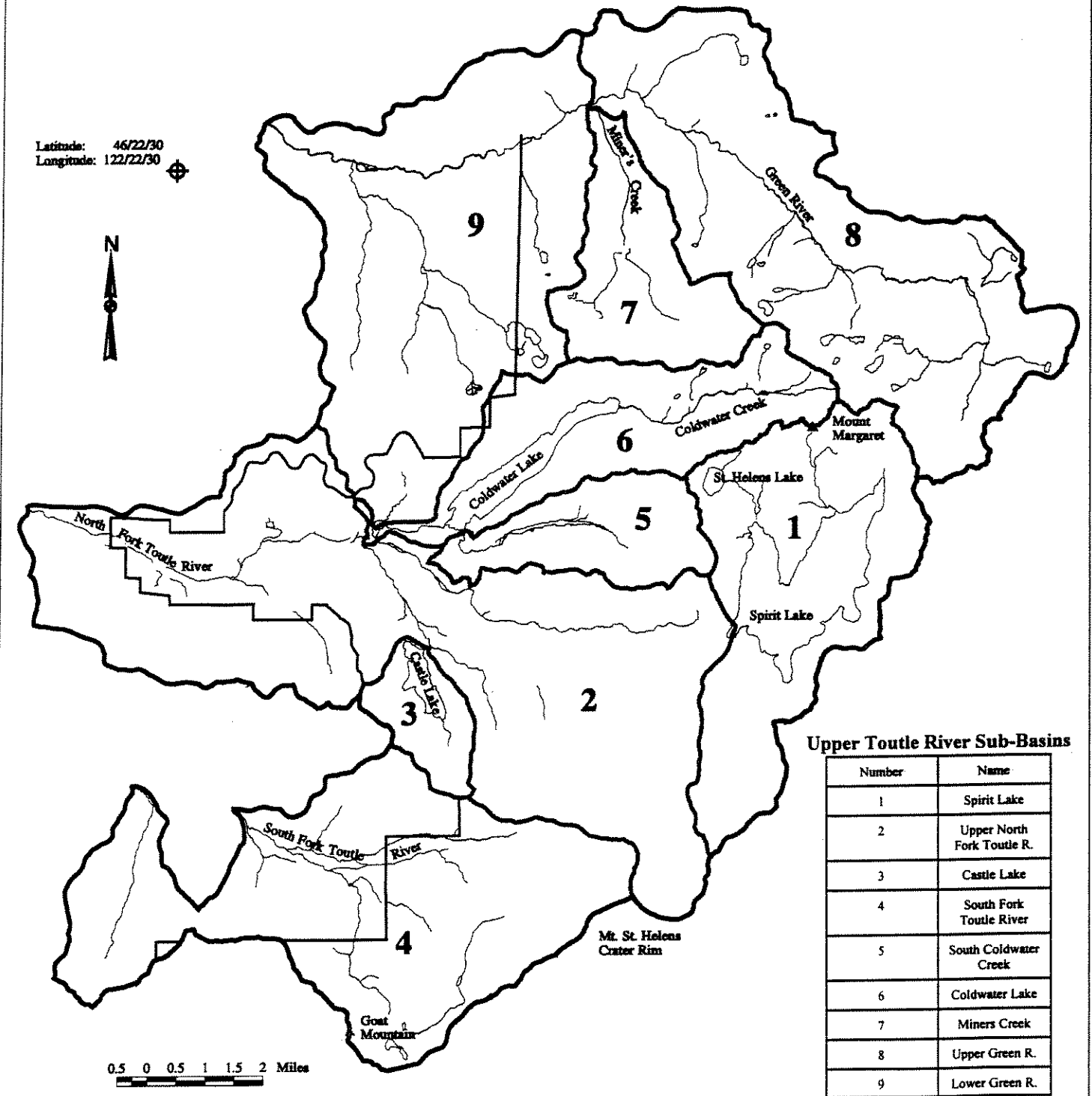


Figure 4. Sub-basins. For this analysis, the 109,577-acre Upper Toutle River Watershed is divided into nine sub-basins.

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 1997 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).

It is expected that during the next decade the Forest can expect increased use primarily by middle-aged and older users with advanced education and higher disposable incomes, who will be looking for a greater variety of activities (Porter, December 1993).

The Forest Service anticipates an increase in illegal dumping, drug manufacturing, crime, and conflict between users. 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 additional regulations, and more closely control harvests on national forest land.

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

CHAPTER VI RECOMMENDATIONS VI-1

Restoration Activities

Road Decommissioning. VI-2
Road Weatherization. VI-3
Recreational Road Access. VI-4
Stream Enhancement. VI-6
Erosion Control/Slope Stabilization. VI-7
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Monitoring Activities

Recreation Use VI-10
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Stream Temperature. VI-12
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Commodities and Development

Completion of Trail System and Trail Connectors. VI-19
Opportunities for Timber Harvest. VI-20

Recommendations Table. VI-21



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 18 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	Recreational Road Access
Moderate	Stream Enhancement
Moderate	Erosion Control/Slope Stabilization
Moderate	Resource Impacts from Recreational Use
High	Protection of Late-Successional Stands

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.

The locations of recommended activities (by sub-basin) are shown in Table 27. 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 it 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.

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). Coniferous trees 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. The action 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.

Sub-basins on National Forest lands that are a high priority for this treatment include 2 (North Fork Toutle River sub-basin); 4 (South Fork Toutle River sub-basin); and 9 (Lower Green River sub-basin). Priority areas were identified as those places where multiple road related concerns exist. These include sub-basins that had high aquatic fragmentation, high road densities, high surface erosion, adjacent beneficial uses, sub-basins in winter range with road densities greater than 1.7 miles per square mile, and road related peak flow concerns.

Among restoration recommendations for the watershed, road decommissioning 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 when funding becomes available to initiate the projects.

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 eliminating traffic, 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 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 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 on National Forest lands that are a high priority for this treatment are located in Sub-basin 2 (North Fork Toutle River sub-basin); 4 (South Fork Toutle River sub-basin); and 9 (Lower Green River sub-basin).

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 to realize as vegetation becomes established 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 would result from vehicle use on these roads. The time line for achieving these benefits is dependent on availability of restoration funding.

Restoration Activity

RECREATIONAL ROAD ACCESS

A. What is it?

Within the watershed certain roads are needed to provide access to recreation sites, these are listed in Table 19, Chapter III. Others are needed to provide administrative access to research sites or for timber management activities. Many roads, once used for logging, are no longer needed and are available for decommissioning. Final determination of roads for decommissioning will require analysis beyond the scope of this watershed analysis, but areas and certain candidate roads have been identified (Table 20, Chapter III). While a number of roads are identified, it is also apparent that some unnumbered roads may also exist in the watershed, as appear on aerial photographs. A complete analysis of roads to be decommissioned must also take these into account, since many appear to have been inadequately closed in the past, and may require additional work to prevent future erosion problems.

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

Roads create a variety of impacts including development of unwanted dispersed camp sites, unauthorized off-road vehicles routes, increases in peak runoff, erosion, sedimentation of streams, visual impact, and degraded water quality. Decommissioning and revegetation of roads allows a reversal of these impacts and enhances watershed recovery while reducing road maintenance costs.

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

As funding becomes available roads will be evaluated in Sub-basins 2, 4, and 8 for decommissioning. Roads in Sub-basin 8 will receive the highest priority, followed by 2, and 4. See the synthesis map for more detailed locations. Initial analysis shows the roads identified in Chapter III fall into the following priorities:

Table 26. Road Priority for Decommissioning

ROAD NUMBER	SUB-BASIN	PROBABLE STATUS
FR-2516-074	8	Not Needed
FR-2516-082	8	Not Needed
FR-2516-083	8	Not Needed
FR-26-142	8	Not Needed
FR-2612 West of Green River H.C.	8	Probably Needed
FR-2612-020	8	Probably Needed
FR-2612-027	8	Not Needed
FR-2612-028	8	Not Needed

ROAD NUMBER	SUB-BASIN	PROBABLE STATUS
FR-2612-036	8	Not Needed
FR-2612-130	8	Not Needed
FR-2612-131	8	Not Needed
FR-2612-637	8	Not Needed
FR-8123-170	4	Not Needed
FR-8123-171	4	Not Needed
FR-8123-173	4	Not Needed
FR-8123-177	4	Not Needed
FR-8123-179	4	Not Needed
FR-8123-? Unnumbered spurs below 8123 west of the Sheep Canyon Trailhead	4	Not Needed
Unnumbered spurs below SR-504 between Elk Rock and Coldwater Ridge V.C.	2	Not Needed

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

Over the next few years, 1997 through 2001, and perhaps beyond, funding will be made available for road decommissioning. Once funding is available roads

in each of the sub-basins will receive detailed analysis through the environmental analysis process. Those roads which are no longer needed will be decommissioned and/or converted to trails as appropriate.

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 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). This activity may be appropriate in Sub-basin 8 (Green River) and Sub-basin 4 (South Fork Toutle River). These sub-basins or portions proposed for treatment are outside of the legislated Monument.

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 these sub-basins 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 bioengineering techniques such as planting trees and shrubs, live fascine bundles and live staking, erosion control blankets, hydromulching, and installing live cribwalls.

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

Sediment regimes that more reflect historic conditions are restored.

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. These sub-basins or portions proposed for treatment are outside of the legislated Monument only.

This treatment is a priority in Sub-basin 8 (Upper Green River) and in Sub-basin 4 (South Fork Toutle River).

Among restoration recommendations for the watershed this is given a moderate priority although individual projects may have a high priority based on site specific conditions.

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

Benefits relating to reducing surface erosion and mass wasting: It will take three to five years after project implementation begins 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 when restoration funding becomes available.

Restoration Activity

RESOURCE IMPACTS FROM RECREATION USE

A. What is it?

Equestrian and hiker foot traffic to lake shores have developed non-system trails which has destroyed riparian vegetation. These "trails" are degrading the aesthetics, causing bank erosion, and compromising the water quality of lakes within this watershed.

User developed, non-system trails are found at Blue Lake and Deadmans Lake. These trails go down to the water's edge and have developed over time by the use of anglers, hikers, equestrian riders to water their horses, and camping near the lakeshores. Accumulations of horse manure, straw, and trash present environmental and health problems at some heavily used sites.

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

The objective of this recommendation is to reduce the impact of shoreline use by visitors. Trail use is a recognized use of national forest lands, and is permitted when impact is within an acceptable range. Reducing the impact may involve restricting movement of people and livestock near the shoreline, posting special rules, or limiting access to the shoreline to one designated location. Other lakes will be monitored over time to see if similar actions may be needed elsewhere.

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

Two areas have been identified as posing damage to wildlife habitat and impact to water quality. Use of these sites, listed below, will be modified or eliminated.

1. Blue Lake. The first priority will be Blue Lake (Sub-basin 4, South Fork Toutle River) because of the heavy use it receives from being close to Road 8123. Plans may include the development of a watering trough system, installation of a fence and planting the riparian area with local cuttings to re-establish vegetation on those user developed trails.
2. Deadmans Lake. The second priority will be Deadmans Lake (Sub-basin 8, Upper Green River) since it receives lower levels of visitation being approximately five miles from the nearest trailhead. Plans may include the development of a watering trough system, installation of a fence and planting the riparian area with local cuttings to re-establish vegetation around the lake.

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

Timing of the projects will be dependent upon the availability of funding for restoration activities. When funds become available, work will be completed within one season.

Restoration Activity

PROTECTION OF LATE-SUCCESSIONAL STANDS

A. What is it?

The Northwest Forest Plan specifies a standard to maintain at least 15 percent of each fifth field watershed in late-successional stands. Non-forest lands, such as rock and open water are not considered when computing the percentage. About 38 percent of the watershed was classified as non-forest after the 1980 eruption, when in fact it is capable of growing forest, although it is in a very early successional stage and recovery will be very slow. This amount of misclassified "non-forest" however, gives the impression that the amount of late-successional forest on lands capable of growing forest is higher than 15 percent.

Since the percentage of the watershed comprised of late-successional stands (defined as conifer stands in the Large Tree structure stage) is approximately 10 percent, all existing Large Tree stands should be protected.

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

Isolated, remnant old-growth patches are ecologically significant by functioning as refugia for a host of old-growth associated species, particularly those with limited dispersal capabilities that are not able migrate across large landscapes of younger stands. Isolated patches will function as refugia where old-growth associated species are able to persist until conditions become suitable for their dispersal into adjacent stands. Loss of these old-growth stands may result in local extirpation of an array of species (Northwest Forest Plan 1994).

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

Stands classified in the Large Tree structure stage in Matrix (Sub-basins 4 and 8) would be protected from timber harvest.

D. The anticipated rates and timeframes for achieving the management objectives.

It may take many decades before there is enough late-successional habitat produced in the watershed to allow harvest of existing stands in Matrix.

Monitoring Activity

RECREATION USE

A. What is it?

Monitor changes in recreation use at the Mount Margaret Backcountry lakes through use of recreational information forms which could be posted at access areas.

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

Monitoring will identify lakes where use levels are high and identify the type of recreational activity being performed at the lake (i.e. angling, camping, hiking, etc.). By monitoring the type of recreation and level of use at the lakes, strategies can be developed to accomodate this use.

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

Monitoring would be conducted year-round in Sub-basins 4 (South Fork Toutle River), 6 (Coldwater Lake), 7 (Miners Creek), and 8 (Upper Green River) once recreational information forms are developed with the assistance of the Washington Department of Fish and Wildlife.

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

Benefits would be determined by the number of forms filled out and the quality of information provided by the recreational user.

Monitoring Activity

DISPERSED CAMPING

A. What is it?

Dispersed camp sites exist throughout the watershed, primarily used by hunters, but also by hikers, and families during the summer. Dispersed camp sites have developed through the initiative of recreation users, mostly through repeated use of a location over many years. Since these sites fall outside Forest Service development standards, resource damage can sometimes take place because they are too close to streams or other sensitive areas.

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

Monitoring will identify camp sites where use levels or impacts are changing and where unacceptable environmental impacts are taking place. By monitoring

for changes in use, it will be possible to identify sites where changes in use may be needed.

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

The priority for monitoring will be in Sub-basins 4 (South Fork Toutle River), 6 (Coldwater Lake), 7 (Miners Creek), and 8 (Upper Green River). Dispersed campsites within other sub-basins should also be monitored.

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

Yearly monitoring of dispersed camping currently takes place during hunting season. This monitoring will continue.

Monitoring Activity

STREAM TEMPERATURE

A. What is it?

Monitoring is conducted to ensure that stream temperature is within State water quality standards, and if not, identify where problems exist. Pulling together existing water temperature monitoring data from other agencies and researchers working in this area would also fill in data gaps.

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.

All sub-basins are a priority for this monitoring although most of this area is within the legislated Monument which is in the process of natural recovery.

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 in prioritized order are: 7 (Miners Creek), 8 (Upper Green River), 4 (South Fork Toutle River). Streams within the remaining sub-basins should also be surveyed.

Since this type of monitoring is ongoing, there is only a medium priority to emphasize it 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 to 20 miles per year, depending on the availability of funding and management activity levels. There are approximately 36.4 miles of Class I and II streams in the Upper Toutle River Watershed sub-basins that have not been surveyed. At current funding and management activity levels these surveys could be completed within a minimum of four to seven years once funding is received.

Monitoring Activity

LAKE SURVEYS

A. What is it?

Lake surveys would collect data on the condition of aquatic and riparian habitat, and may include characterization of riparian vegetation, littoral zone type, bank stability, inlet and outlet habitat condition, substrate type, zooplankton and phytoplankton populations, water chemistry, and fish species present and their condition.

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

Collecting lake survey data would help to identify which lakes do not meet the desired condition. These lakes 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 lake survey data, and/or where there is a high likelihood of future management actions. These National Forest land sub-basins in prioritized order are: 8 (Upper Green River), 7 (Miners Creek), and 4 (South Fork Toutle River).

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

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

Lake surveys are completed at a rate of about 10 acres per year, depending on availability of funding and management activity levels. Eleven of the lakes (1,173 acres) in the Upper Toutle River Watershed sub-basins have been surveyed out of 28 lakes total (4,016 acres). At current funding and management activity levels these surveys could be completed within a minimum two to three years once funding is received.

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 completed on any roads in the watershed.

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 where the inventory would be a priority are those with high road densities, high aquatic fragmentation and high sediment concerns, specifically Sub-basin 2 (North Fork Toutle River); Sub-basin 4 (South Fork Toutle River); and Sub-basin 9 (Green River); although this inventory is a priority to conduct throughout the watershed.

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

PEREGRINE FALCON

A. What is it?

Identify and monitor potential peregrin falcon nest sites to determine whether any are occupied.

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

Establishing the existence of an active peregrine falcon eyrie would increase knowledge about the extent of the recovery of this species, as well as allowing for better decisions to be made regarding future recreation projects in the legislated Monument and other projects in surrounding areas.

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

Priority sub-basins are those that appear to have suitable cliff sites; they include Sub-basins 1, 3, 6, 7, and 8.

D. The anticipated rates and timeframes for achieving the management objectives.

Monitoring should begin as soon as funding is available. Increased knowledge gained from monitoring would be an immediate benefit.

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. A large portion of the watershed is classified as non-forest but is indeed capable of growing forests and should be reanalyzed. 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, and wetlands needs to be completed. Very little of the watershed has been surveyed for TES or C-3 species. This watershed is unique, however, in the relatively large amount of research conducted. Some of this information has been published or is otherwise available.

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

On-site collection of data or field verification of ecological conditions would help provide a better information source for the management of the

watershed. 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.

The Forest's Ecological Unit Inventory (EUI) is scheduled to be completed within 5 years. This project will map forest stands according to vegetation type, soil, and geology. Surveys for TES and C-3 species, and the location of Class IV streams and wetlands are most likely to occur in conjunction with planned projects within the area. Ongoing research within the watershed will continue to provide additional information.

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

The amount of funding available along with the scope of issues examined in later analyses will determine actual survey priorities and accomplishment levels.

Monitoring Activity

STABILITY EVALUATION OF DEBRIS BLOCKAGE AND TUNNEL

A. What is it?

Since the eruption of Mount St. Helens in 1980 there has been a concern about the potential failure of the debris blockages that created both Castle Lake and Spirit Lake. To alleviate the concern about Spirit Lake, a tunnel was drilled through Harry's Ridge from the South Coldwater Drainage to Spirit Lake. Both of these areas require monitoring to ensure the safety of the population that lives down valley. The initial investigations on Castle Lake installed numerous monitoring wells that are used to determine groundwater levels within the blockage. These levels are used in the analysis to determine the stability of the blockage. There is a need for constant maintenance of these monitoring sites. The tunnel for Spirit Lake is of similar concern because it goes through fracture zones that can move under the right conditions (seismic events, even minor ones, can damage the tunnel). If damage is not caught soon the potential for further damage could be more of a problem.

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

The monitoring of these sites is critical in providing an

early warning system for potential flooding and damage from mud and debris that would destroy much of the new vegetation that has started to re-establish down valley, to say nothing about potential public safety concerns.

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

There will be continual monitoring until further investigation determines that these sites are stable and not subject to potential failure. The sub-basins involved are 2 and 5.

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

These are high priority activities that will be needed until further investigations show the area to be stable. The tunnel will need constant maintenance and monitoring as long as it is the method used to maintain the level of Spirit Lake. As continued erosion takes place in the upper blockage area on the North Fork of the Toutle River, there is potential for it to open a new channel that would drain the lake. If this is allowed to happen, some day, the tunnel may not be needed.

Commodities and Development

COMPLETION OF TRAIL SYSTEM AND TRAIL CONNECTORS

A. What is it?

The Comprehensive Management Plan for Mount St. Helens and the Gifford Pinchot National Forest Land and Resource Management Plan prescribed a network of trails to replace those lost in the watershed to the 1980 eruption of Mount St. Helens. One trail, the Independence Pass Trail has a segment remaining to be constructed. Also, due to environmental and public safety concerns it has become apparent the Castle Lake Trail needs to be extended from the lake to the Hummocks Trail to provide improved access.

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

The completion of the Independence Pass Trail in Sub-basin 2 will integrate trails along Road 99 and allow loop hiking opportunities for the first time around the Spirit Lake Basin. The trail will also provide hiking opportunities between Road 99 viewpoints, allowing visitors to take short scenic hikes, combined with car shuttles.

The Castle Lake Trail extension should eliminate the need for cross-country travel to access the lake. This travel is both dangerous (one fatality has occurred) and damaging to the environment when user-generated

trails develop. The addition of this trail segment will control travel routes and provide safer access to the lake. An improvement over the existing situation is expected.

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

The Independence Pass Trail (Sub-basin 1) and the Castle Lake Trail (Sub-basin 2) will be added to the regional list of trail capital investment projects. As funding becomes available the projects will be laid out, surveyed and submitted to contracting for construction. The Independence Pass Trail will be the first priority, followed by the Castle Lake Trail extension.

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

Timing of the projects will be dependent upon the availability of funding for capital investment projects. The projects will be submitted to the regional list during 1997. Once funding is available the projects will take place over a three year period. Trail planning, survey and design, and construction are normally funded on a one-year sequence for each step.

Commodities and Development

OPPORTUNITIES FOR TIMBER HARVEST

A. What is it?

Timber harvest is a scheduled activity within the Matrix, on lands that are designated suitable for timber management and where stands are old enough to provide a commercial product. Approximately 1 percent of this watershed meets this criteria. Because this watershed is deficit in late-successional forest, existing older forest stands need to be protected. Only 0.1 percent of the watershed is available for harvest.

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

Timber offered will provide commodities for human use, as well as other social and economic benefits. Harvest prescriptions should be designed to accelerate the development of older forest conditions.

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

Approximately 150 acres of mid-mature forest (100 to 150 years of age) is located in Sub-basin 8 along the northeast edge of the watershed. Opportunities for commercial thinning and/or the creation of small openings may be feasible. Potentially there could be 1 MMBF at best. The technical, economic and biological feasibility of harvesting these stands should be field verified. Access to these stands is through the GPNF North Skill Center and could logically be combined with a proposed sale north of the Toutle watershed.

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

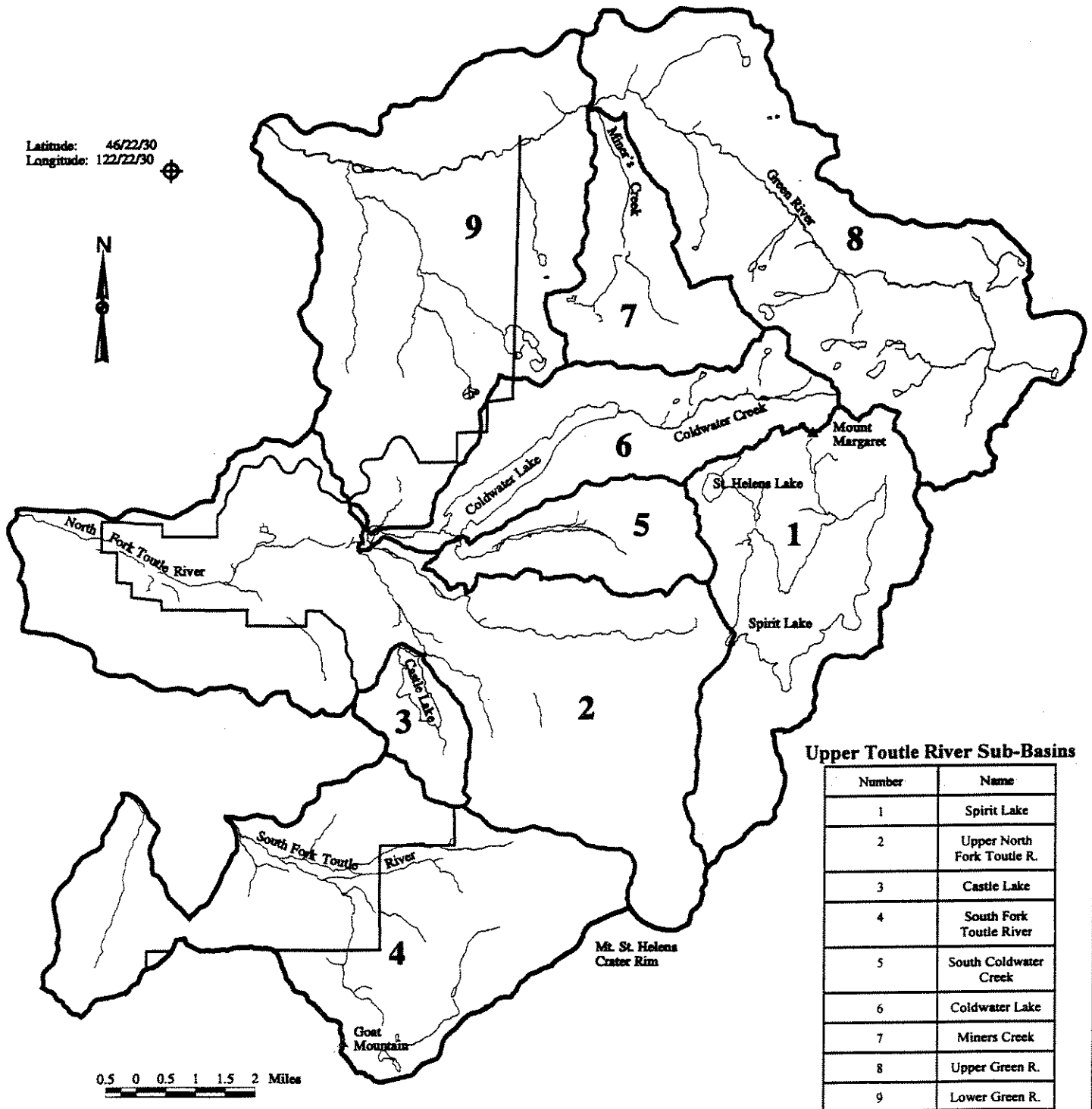
The opportunity exists for a very limited amount of timber harvest this decade.

Table 27. Recommendations by Sub-basin

Sub-basin	NWFP Allocations	Restoration								Monitoring						Commodities & Development			
		Road Decommissioning	Road Weatherization	Recreational Road Access	Stream Enhancement	Erosion Control/Slope Stabilization	Resource Impacts From Recreational Use	Protection of Late-Successional Stands	Recreation Use	Dispersed Camping	Stream Temperature	Stream Surveys	Lake Surveys	Phase II Road Condition Surveys	Potential Peregrine Falcon Nest Sites	Verification of Ecological Inventory Data	Castle Lake/Spirit Lake Blockages	Completion of Trail Systems and Trail Connectors	Opportunities for Timber Management
1. Spirit Lake	NVM									X				X	X	X	X		
2. Upper N. Fork Toutle Rv	NVM, PVT	X	X	X							X		X		X	X	X		
3. Castle Lake	NVM										X			X	X	X			
4. S. Fork Toutle Rv,	PVT, NVM, MAT, RNA	X	X	X	X	X	X	X	X	X	X	X	X		X				
5. S. Coldwater Cr.	NVM										X				X	X			
6. Coldwater Lake	NVM, PVT								X	X	X			X	X				
7. Miners Cr	NVM, PVT, MAT								X	X	X	X	X		X	X			
8. Upper Green River	NVM, MAT, PVT			X	X	X	X	X	X	X	X	X		X	X			X	
9. Lower Green River	PVT, NVM, MAT	X	X								X		X		X				



Upper Toutle River Sub-Basins



Upper Toutle River Sub-Basins

Number	Name
1	Spirit Lake
2	Upper North Fork Toutle R.
3	Castle Lake
4	South Fork Toutle River
5	South Coldwater Creek
6	Coldwater Lake
7	Miners Creek
8	Upper Green R.
9	Lower Green R.

Figure 4. Sub-basins. For this analysis, the 109,577-acre Upper Toutle River Watershed is divided into nine sub-basins.



APPENDIX A

GLOSSARY



APPENDIX A 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.

Aquatic Conservation Strategy (ACS): Nine objectives which were...."developed to restore and maintain the ecological health of watersheds and aquatic ecosystems contained within them on public lands. The strategy would protect salmon and steelhead habitat on federal lands managed by the Forest Service and Bureau of Land Management within the range of Pacific Ocean anadromy" (ROD 1994).

Biological Winter Range - an area usually at lower elevations, used by deer and elk during the winter months. Usually this range is much more clearly defined and smaller than summer range

Boreal Forest - primarily northern spruce forest.

Carrying Capacity - the maximum number of organisms that can be supported in a given area of habitat at a given time

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

Class I - IV Streams: A classification system which defines streams as:

Class I: Perennial or intermittent streams that provide a source of water for domestic

use; are used by large numbers of fish for spawning, rearing, or migration; and/or are major tributaries to other Class I streams.

Class II: Perennial or intermittent streams that are used by moderate though significant numbers of fish for spawning, rearing or migration; and/or may be tributaries to Class I streams or other Class II streams.

Class III: All other perennial streams not meeting higher class criteria.

Class IV: All other intermittent streams not meeting higher class criteria.

Columbia River Policy Implementation Guide (CRBPIG): 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.

DBH: Diameter of a tree at breast height.

DNR: Washington Department of Natural Resources.

Endangered - any species in danger of extinction throughout all or a significant portion of its range excluding insects which the secretary determines to be pests

Facine Bundles: Small bundles of plant material such as willows that are laid along slope contours to stabilize erosional areas.

Fecundity - number of young produced in a given population.

GPNF - Gifford Pinchot National Forest.

GPNFLRMP, LRMP - Gifford Pinchot National Forest Land and Resource Management Plan.

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

Large Woody Debris (LWD): Pieces of wood within the active channel that are equal to or greater than 24 inches in diameter at the large end and are equal to or greater than 50 feet in length

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..

Live Staking: Stakes made out of plant material such as willows that are pounded into erosional areas. These stakes then grow and stabilize the areas.

Management Area Category (MAC) - Land management allocation from the Gifford Pinchot National Forest Land and Resource Management Plan. Each MAC has a goal or management emphasis.

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.

MMBF - Million board feet. A board foot is a unit of wood volume measuring one inch by 12 inches by 12 inches.

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.

MSHNVN, NVM - Mount St. Helens National Volcanic Monument.

Opportunistic - chance event or sighting

Optimal Thermal Cover - habitat for deer and elk which has tree overstory and understory, shrub and

herbaceous layers; the overstory canopy generally exceeding 70 percent crown closure and dominant trees generally exceed 21 d.b.h; provides snow intercept, thermal cover, and maintenance

Northwest Forest Plan - See ROD.

Northwest 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 (MAT) - 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.

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.

REAP (Regional Ecosystem Assessment Project): USDA. 1993. A First Approximation of Ecosystem Health, National Forest Lands, Pacific Northwest Region.

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.

Rendezvous site - areas used by wolf pups while adults are away hunting, once pups have left the den.

ROD - Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl. April 1994. The ROD and 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 are collectively known as the **Northwest Forest Plan**, formerly known as the President's Forest Plan.

Seclusion - areas where humans have minimum influence; lacking human presence.

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.

Sensitive Species - those species identified by the Regional Forester for which population viability is a concern, as evidenced by: a significant current or predicted downward trend in population numbers or density; or a significant current or predicted downward trend in habitat capability that would reduce a species' viability.

Snag - standing dead tree.

Stochastic - random, uncertain; involving a random variable.

Subsoilers: are large shanks attached to a tool bar mounted to the rear of a crawler tractor.

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

Threatened - any species likely to become endangered in the foreseeable future throughout all or a significant portion of its range

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
REFERENCES



APPENDIX B REFERENCES

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APPENDIX C
ISSUES AND KEY QUESTIONS



APPENDIX C ISSUES AND KEY QUESTIONS

Issue: Mass Wasting

The Upper Toutle Watershed has many landslides and debris torrents within its boundaries. One of the largest landslides to occur was the initial slide of Mount St. Helens during the May 18, 1980 eruption. This moved upwards to one square kilometer of material into the Toutle drainage system. The impact of 1980 tephra deposits and loss of timber from the blast has increased the potential for mass wasting in much of the watershed. Management activities such as salvage logging after the 1980 eruption may have contributed to the increased amount of movement seen in the watershed.

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. With what physical characteristics are mass wasting features associated?
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 movement?

Issue: Surface Erosion from Roads

In the past, surface erosion from roads has contributed sediment to streams. Most sediment is transported during the new road construction activity and within the first two to three years thereafter. After this time,

vegetative growth on the cut and fill slopes help alleviate the problem, but in areas near stream crossings erosion can continue to influence stream habitat for many years. Poor construction practices in the past have created numerous problem areas where fill slope failures have recently (directly and indirectly) moved sediment into many streams. This type of sediment movement was especially evident during the large storm events of 1995 and 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?
7. What are the types and amounts of sediment contributions from forest practices?

Issue: Surface Erosion from Upland Slopes

The tephra deposits and blast area created by the eruption in 1980 has left varying amounts of loose unconsolidated material on the entire watershed. This material is highly erosive especially on the steeper slopes and where vegetation was destroyed. Recent storm events have given a good picture of the erosive properties of these deposits.

Key Questions:

1. What areas of the landscape are susceptible to surface erosion?
2. What areas are susceptible to development activities?
3. What surface erosion processes are active and how are they distributed across the landscape?
4. How have the rates, frequencies and processes of surface erosion changed with management activities?
5. What are the relative amounts and types of sediment contributions from natural events and from development activities?

Issue: Sensitive and C-3 Plant Species

The watershed contains known populations of four plant species listed as Sensitive, and a fungus species that is on the Survey and Manage (C-3) list in the Northwest Forest Plan. Current guidelines for management of populations of the fungus species, (*Oxyporus nobilissimus*) require a buffer of 640 acres around the populations. Since the majority of the watershed has not been surveyed for these and other listed species, there is a possibility that other populations exist.

Key Questions:

1. Which sensitive and C-3 plants are present, and where?
2. Which sensitive and C-3 plants are likely to occur, and in which habitats?

Issue: Vegetation Structure and Composition

The watershed has been significantly impacted by the 1980 eruption of Mount St. Helens. The eruption created a large, unfragmented expanse of early seral habitat. While this type of disturbance has happened

periodically through history, and the current condition may be within the historic range of variability, it is important to understand how species diversity and distribution have been affected.

Key Questions:

1. What are the present vegetation structures and compositions?
2. How are the vegetation structures distributed across the landscape?
3. What percentage of the watershed is in late-successional habitat?
4. What is the vegetation structure and composition of the Riparian Reserves?

Issue: Habitat Condition for TES Animal Species

The watershed contains habitat that is suitable or potentially suitable to threatened, endangered and sensitive species including northern spotted owl, bald eagle, peregrine falcon, gray wolf, and Larch Mountain salamander. Future projects in the watershed have the potential to affect habitat for these species.

Northern Spotted Owl

1. Where are spotted owl activity centers located in the watershed? In which Forest Plan allocations are they located?
2. How many acres of suitable habitat are there in the watershed, and what is the distribution of the habitat?
3. Are the remaining suitable habitat patches connected to suitable habitat in adjacent watersheds?

Bald Eagle

1. Are there known historical or current bald eagle nests or winter roosts in the watershed?

Peregrine Falcon

1. Are there suitable cliff sites in the watershed? Have nesting surveys been conducted at any of these sites?

Gray Wolf

1. What is the density and distribution of roads in the watershed?
2. Are there potential den and rendezvous sites in the watershed?
3. What is the condition of prey base populations?

Larch Mountain Salamander

Are there known populations in the watershed, and if so are they located in areas that could be affected by future projects?

Issue: Habitat Condition for Survey and Manage (C-3) and Cavity-Dependent Species

The watershed contains suitable or potentially suitable habitat for C-3 species including Van Dyke's salamander and forest bats, and for cavity-dependent species. These habitats may be affected by future projects. Habitat for cavity-excavating and cavity-dependent species was significantly impacted by the 1980 eruption.

Van Dyke's Salamander

1. Are there known Van Dyke's salamander populations in the watershed?
2. Are any of these sites located in areas that could be affected by future projects?

Forest Bats

1. Are there bridges or caves in the watershed

that could be suitable roost or hibernation sites?

2. Where are the likely important foraging areas in the watershed?

Issue: Hydrologic Changes

Past disturbances such as wildfire and volcanic eruption 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 streamflow regimes? There 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, dams, volcanic eruption and fire regimes, 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 and high water temperatures may be affecting habitats for rainbow trout, sculpins, suckers and cutthroat trout. 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 per mile, stream temperature, channel configuration, sediment?
3. Are these habitat variables of concern given the current condition? If so, where are these areas of concern?
4. Is there any high quality and or unique habitat located in the analysis area (spawning, rearing, holding etc...)?
5. 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?
6. Where are the current sources of large woody debris? What were the past sources of large woody debris?
7. Does canopy closure within the riparian reserve network maintain appropriate stream

temperatures for aquatic species?

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

Issue: Completion of Trail System and Trail Connections

The comprehensive management plan for the Mount St. Helens National Volcanic Monument prescribed a network of trails to replace those lost during the May 18, 1980 eruption. Additional trail construction was proposed in the Gifford Pinchot National Forest Land and Resource Management Plan. Most replacement trails have been constructed, but a few remain to be built. In addition, the need for trail connections has become evident, because of a lack of trail use and/or poor access to the start of trails.

Key Questions:

1. Which trails remain to be constructed?
2. Are there trails with poor access which are deteriorating through lack of use?
3. Are trail connections needed to improve use of certain trails?

Issue: Recreational Road Access

The comprehensive management plan for the Mount St. Helens National Volcanic Monument and the Gifford Pinchot National Forest Land and Resource Management Plan directed construction of recreational facilities in and adjacent to Mount St. Helens NVM. Pre-existing roads, as well as newly constructed roads provide access to these recreation sites. In some cases roads exist which are not needed for recreational or administrative access. These

unneded roads are sometimes poorly maintained, resulting in environmental damage due to erosion and sedimentation. In other instances they enable unwanted dispersed camping and/or user-generated trailheads. Roads not needed for recreational or administrative access could be decommissioned.

Key Questions:

1. Which roads are needed for recreational or administrative access?
2. Which roads could be decommissioned?

Issue: Resource Impacts from Recreation Use

Dispersed camping and equestrian use in various areas of the watershed may compromise the quality of riparian areas. Water quality in lakes and/or streams may be decreased due to erosion caused by the use of spur trails (non-system trails off the main trail) by horses and people which go down to lake shores for watering purposes or viewing. Dispersed camping within 100 feet of water may also decrease water quality from human waste and trash entering these water systems.

Key Questions:

1. Which lake shores have damage from foot/horse traffic?
2. Where are dispersed campsites within 100 feet of lakeshores?
3. Are there alternative places for watering horses?
4. Are there ways to maintain water quality and allow dispersed camping?



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

Geology and Erosion Processes - by Jim Chamberlin, Geologist

Issue: Riparian Reserve Mass Wasting

Confidence: Moderate to High

Discussion: After reviewing the map it was determined that there were some errors in the mapping. The mud flow deposits from Mount St. Helens that flowed down the South Fork Toutle River should be considered stable and removed from the data layer. This will remove a portion of the unstable ground from the riparian reserve. The stream portion of these areas will still be buffered.

Data Gaps:

Continual updating of the unstable ground needs to be done as new data is identified.

Issue: Riparian Reserve - Wetlands

Confidence: Moderate

Discussion: The wetlands mapping was taken from the soils resource inventory and the vegetation layer. There have been some discrepancies between these layers that need to be worked out. The vegetation layer has some wetlands identified that are not on the ground. Remapping or attributing these areas will have to be done before the next iteration of this watershed analysis.

Data Gaps:

Double checking the layers for accuracy needs closer scrutiny.

Issue: Erosion from Roads

Confidence: Low

Discussion: The modeling to determine areas of surface erosion from roads uses many factors that are estimated because the actual data is not available. The traffic factor is high in the ranking and does not utilize the surfacing type very well. This would show that paved roads that have a lot of traffic would have higher erosion rates than they actually do. This is being looked into for future analysis. Due to the lack of information in this watershed, especially on the privately-owned land, the analysis was based mostly on road densities.

Data Gaps:

Condition surveys of the road network needs to be completed to obtain the best information to put into the program.

Terrestrial Vegetation Analysis - By Sue Macmeeken, Silviculturist and Chiska Derr, Botanist

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, with some supplementary interpretations based on aerial photographs and timber harvest records. The GIS vegetation layers were created primarily from 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. These data are incomplete, contain many gaps, and are at a very coarse scale that is limited in its applicability. 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: Information about non-timber production vegetation structure and composition is very weak. The GIS vegetation layer was constructed primarily through aerial photo interpretation and supplemented by field examination collected in conjunction with timber sale planning activities. After the eruption of Mt. St. Helens, large portions of the watershed were classified from aerial photos as non-forest. Most of these areas are now occupied by forb, shrub, and tree species, and should be re-classified as forested. The GIS database has not been updated..

Data Gaps:

- * Non-forested lands needs to be re-evaluated and where the potential to grow trees exist, these lands should be re-classified as early seral.
- * almost none of the GIS stand structure data were field verified
- * almost none of the GIS stand composition (ecoclass) data were field verified
- *very few comprehensive plant inventories have been conducted

Issue: Stream Riparian Reserve Fragmentation

Confidence: LOW

Discussion: The Stream Riparian Reserves within this watershed have been shaped by a complex combination of processes, including volcanic activity and timber harvest. Historically, most stand structure and composition data was collected in conjunction with timber inventory. Consequently, Stream Riparian Reserve vegetation structure and composition was usually lumped with upland vegetation, and is not depicted in vegetation structure stage GIS layers. As a result, data on actual stand structure, hardwood components, large woody debris recruitment potential, and suitability of riparian habitat to serve as dispersal corridors for plant and animal species is lacking. An analysis of aerial photographs to evaluate Stream Riparian Reserve habitat and fragmentation would supplement available information, and should be done during project level analyses. This level of analysis was unfeasible given the timeline for the watershed analysis process.

Data Gaps:

*stand structure and composition data within Stream Riparian Reserves is not available from GIS because this information has been lumped with upland vegetation conditions

*there was not enough time to interpret aerial photographs for information about Stream Riparian Reserve habitat, structure, composition, and functions

*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

Issue: TES and C-3 Species

Confidence: LOW

Discussion: The lack of data on TES and C-3 bryophyte, lichen, fungi and vascular plant species constitutes a data gap.

Data Gaps:

* few general surveys for TES and C-3 species have been conducted

* No surveys have been completed on non-federal lands

* ecological and distributional data are lacking for TES and C-3 species

Terrestrial Species Analysis - by Mitch Wainwright, Wildlife Biologist

Confidence in Analysis - Moderate to High

Issue: Habitat conditions for threatened, endangered, sensitive, and C-3 species

Discussion: My confidence in the acreage figures of the different vegetation structure stages, the foundation for determining species presence and assessing habitats within the watershed is moderate to high. While ground-truthing for much of the data has not been done, it is evident from aerial photos and a flight over the watershed that the data is fairly accurate. A major exception is with the portions of the watershed that were classified as non-forest in the devastated area that will eventually support forest stands again.

My confidence in road density data is moderate. It's likely that there are roads that are no longer driveable on private land as well as National Forest, but the assumption was made in the analysis that all roads were open and driveable.

Data Gaps: Few surveys for TES or C-3 species have been conducted, and most reported sightings are accidental. Exceptions to this are surveys conducted for spotted owls and for Van Dyke's salamander. However the spotted owls sites have not been reverified for three to five years. There is no information for great gray owl, forest bats, or Larch Mountain salamander.

Hydrologic Condition - by Mark Kreiter, Hydrologist

Confidence in analysis - Low

Limitations of the analysis - Limitations of this analysis include:

- The entire analysis was modeled using GIS data. No field verification of vegetation data was conducted to determine the accuracy of the information. The majority of the blast deposits were mapped as "non-forested" which is incorrect because most of these areas will eventually be covered in a coniferous forest. This miscalculation results in underestimating the true increase in peak flow.
- Coefficients for the model were regional coefficients in some cases. Using coefficients that are not generated from the analysis area lowers the model's 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 two-year flood. This is rarely true in this area.
- The peak flow portion of the beneficial use analysis could not address channel bed scour quantitatively, which is very important in determining quality of spawning and rearing habitat.
- Confidence is low for analysis in Sub-basins 2, 4 and 9 because the DNR model only considered National Forest land due to lack of vegetation data for private and other land in the geographic information system database.
- The stream and road layer for non-National Forest land did not match those same layers on the National Forest. The non-National Forest data probably overestimated the miles of stream while the National Forest data probably underestimated the miles of stream and roads.

Data Gaps

- There is a need for field verification of the vegetation layer to improve the accuracy of the data. The blast deposits that are mapped as “non-forested” need to be re-evaluated as to the accuracy of this designation.
- 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 and more site specific information concerning culvert spacing can be used in the extension of the stream channel mileage model.
- A detailed review of the location of Class IV streams is needed.
- There is a need to collect vegetation data (crown closure, DBH, tree species) for non-National Forest lands.

Implications for Management:

Management decisions relating to activities such as restoration or timber harvest may 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.

Key Aquatic Habitat Attributes, and Aquatic Habitat Fragmentation

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).

It should also be noted that the watershed boundary was inaccurate in that it excluded Deadman’s Lake. It was analyzed in the fisheries and recreation report due to the concerns associated with the lake.

LWD/Mile - by Deborah Haapala, Fisheries Biologist

Confidence in analysis: Low

Limitation of the Analysis include:

Data for this analysis came from the district’s stream survey files and database. Data are only available on 24 percent (11.6 miles) of fish bearing streams in the watershed on National Forest lands. 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 to moderate 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 Deborah Haapala, Fisheries Biologist

Limitation of the Analysis include:

Recruitment potential of LWD was based the percent streamside riparian area in grass/forb to small tree stand condition instead of percent harvested due to the effects from the eruption. GIS data were used for National Forest lands and DNR lands. The confidence in this portion of the analysis is low due to the fact that no field verification of vegetation data was done to determine the accuracy of the information. Although the majority of the blast deposits were mapped as "non-forested", these acreages were calculated into the analysis. Due to the lack of field verification, the overall confidence for LWD recruitment potential on National Forest and non-National Forest lands is low.

Data Gaps:

- Stream surveys cover primarily fish bearing sections of stream. Class IV channel tributaries and many Class III tributaries are not surveyed. Only 24 percent of all the fish-bearing streams in the watershed have been 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.
- Little 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 Deborah Haapala, Fisheries Biologist

Confidence in analysis - Low

Limitation of the Analysis include:

Data for this analysis came from the district's stream survey files and database. Data are only available on 24 percent (11.6 miles) of fish bearing streams in the watershed on National Forest lands. 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 to moderate 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.
- Some 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

Limitations of the analysis - Limitations of this analysis include:

Channel typing was not done for this analysis, consequently relationships between hillslope and channel processes were poorly refined. Reference conditions were not well established due to the lack of information.

Stream temperature analysis only used existing data available at the time of the analysis. This was limited to one station in the analysis area.

Data Gaps:

Channel typing data was not available for a majority of the streams in the analysis area.

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 may 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 Deborah Haapala, Fisheries Biologist

Confidence in analysis - Low

Limitation of the Analysis include:

This analysis was done using GIS data for road/stream crossings from both Forest Service and DNR databases. 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 databases. The analysis divided the Toutle River Watershed into thirds to assign values into the low, medium, and high categories. However, there is no basis for these values in the literature.

Data Gaps:

- The stream and road layer for non-National Forest land did not match those same layers on the National Forest. The non-National Forest data probably overestimated the miles of stream while the National Forest data probably underestimated the miles of stream and roads.
- 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.

Analysis of Recreation-Related Issues - by Jim Nieland, Recreation Planner

Confidence: Moderate to High

Issue: Recreational Road Access

Discussion: Roads identified for long-term recreational use are easy to identify. Roads available for potential decommissioning are less easy to identify. Detailed analysis of the roads shown in Table 26, Chapter VI will be necessary before final decommissioning decisions are made. The roads shown on the table are likely to be available for decommissioning in the manner identified.

Data Gaps:

* In examining aerial photographs it soon became apparent roads existed in the watershed that do not appear on current road inventories. As a result, the tables are not complete, and there appear to be formerly closed roads that will require additional decommissioning work.

* Only a cursory analysis of roads available for decommissioning was conducted. Detailed consideration of possible future uses was not conducted. This analysis will need to be completed before a final decision can be made.

APPENDIX E

VEGETATION STAND STRUCTURE DEFINITIONS



APPENDIX E STAND STRUCTURE DEFINITIONS FOR THE GIFFORD PINCHOT NATIONAL FOREST

Chiska Derr, Mount 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 data base 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 feet 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 feet 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 percent to 40 percent 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 percent to 40 percent cover) that are dominated by sapling and pole-sized conifers of 4.5 feet tall up to 9 inches 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 percent to 100 percent cover) that are dominated by sapling and pole-sized conifers of 4.5 feet tall up to 9 inches 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 percent 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 percent canopy cover provide dispersal habitat for spotted owls. Stands with 60-70 percent canopy closure provide thermal cover.**

Closed Small Tree

Early to mid seral. **Coniferous** stands with 70 percent 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 percent and 100 percent) 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 percent and 100 percent) 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 percent 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 percent potential plant cover. Can provide travel corridors and connectivity between habitats.

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