United States
Department
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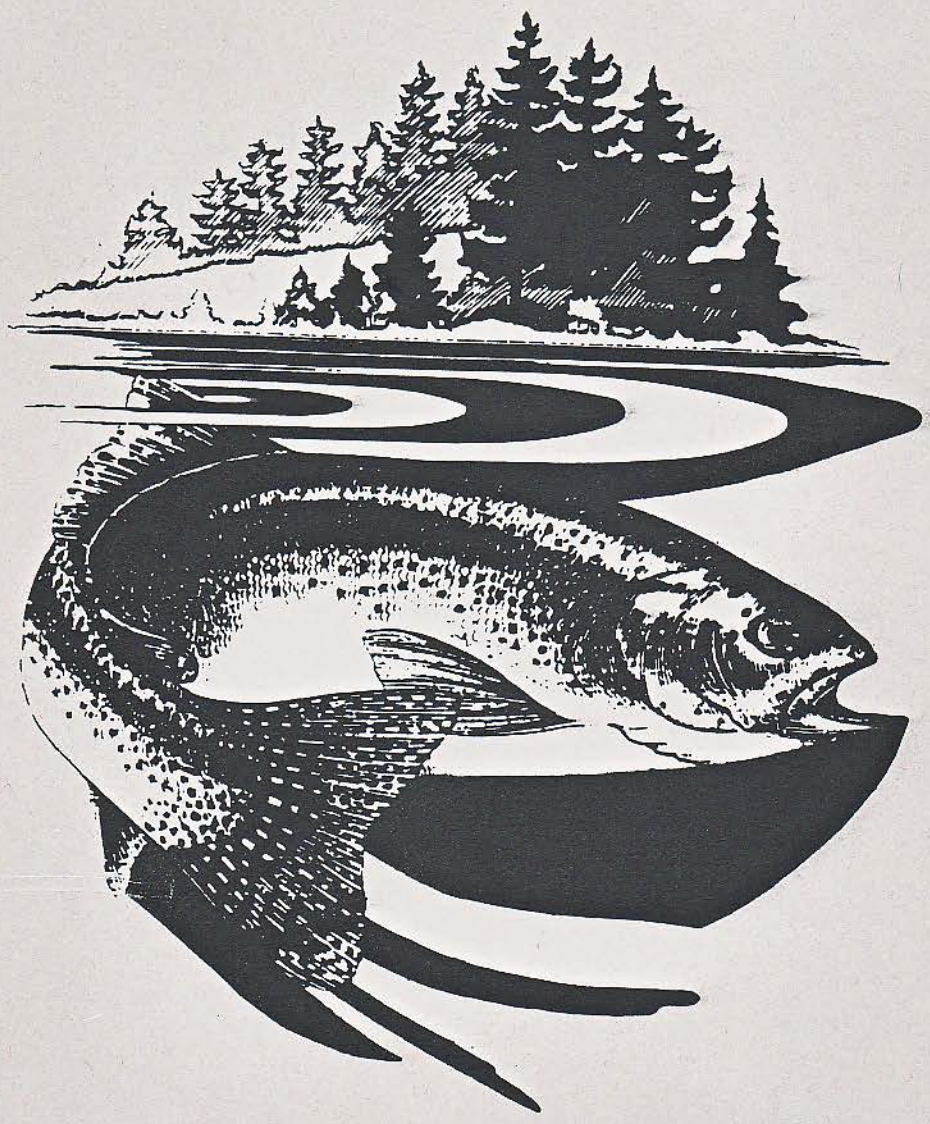
Forest Service

Pacific
Northwest
Region

1995

Upper Lewis River Watershed Analysis
(Second Iteration)

Gifford Pinchot National Forest
Mount St. Helens National Volcanic Monument



July, 1998

Upper Lewis River Watershed Analysis

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

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EXECUTIVE SUMMARY

Introduction

The 75,494-acre Upper Lewis River Watershed is comprised entirely of National Forest lands. The area has been divided into 25 sub-basins for analysis by an interdisciplinary team.

In this second iteration of analysis, the following twelve issues are analyzed: Mass Wasting; Surface Erosion from Roads; Fire History; Vegetation Structure and Composition; Stream Riparian Reserve Fragmentation and Riparian Habitat; TES and C-3 Plants, Lichens, Bryophytes and Fungi Species; Habitat Condition for TES Animal Species, Habitat Condition for Survey and Manage (C-3) and Cavity-Dependent Species; Hydrologic Changes; Water Quality and Key Habitat Attributes for Resident Salmonids; Completion of Trail System and Trail Connections; and Timber Harvest Expectations.

Characterization

The Upper Lewis River and its tributaries drain the western slopes of Mount Adams and the immediately adjacent lands to the west.

The Upper Lewis River watershed developed primarily from volcanic and glacial geologic processes and has been shaped by wind and rain erosional processes. Heavily influenced by the eruptive history of Mount Adams, the watershed can be divided into three geomorphic sub-regions ranging in age from 0.25 million to 25 million years. Glacial activity and earthquakes have resulted in substantial areas of unstable ground. Elevations range from 1,800 feet at Upper Falls to 11,800 feet at the summit of Mount Adams. Drained by the North Fork of the Lewis River and its headwater tributaries, the watershed is vegetated by coniferous forest plant associations which provide habitat for 239 wildlife species.

Wildfire has been a major disturbance factor in the forest landscape although an extremely infrequent event. Since the mid-1800's, no large fires of catastrophic intensity have burned in the Upper Lewis River watershed area.

Current Conditions

Unstable and potentially unstable ground is mapped throughout the watershed, with 14 sub-basins having greater than 29 percent of their area occupied by lands in these categories. The other 11 sub-basins have considerably less unstable ground. Surface erosion from roads is a concern in sub-basins with relatively high road densities, however, hillslope erosion is a minor consideration in the watershed. Erosion rates have diminished greatly in the past decade due to reductions in the amounts of timber harvested and associated road construction, improved construction techniques , and watershed restoration (road decommissioning) projects.

The Lewis River basin in general, was hard hit by the floods of November, 1995 and February, 1996. Due to the deep snowpack that was present in the basin, however, most of the damage occurred in the lower elevations, below 2000 feet. The snowpack acted as a "reservoir" in the upper elevations, storing the meltwater temporarily. Since the majority of the Upper Lewis is high elevation, it did not receive as much damage as the Middle and Lower Lewis Watersheds.

Since the mid-1800's, no large fires of catastrophic intensity have burned in the Upper Lewis. Much of the watershed (42 percent) is in the large tree multi-layer structure stage and stretches from the foothills of the Mount Adams Wilderness Area west. Over half of the 17 percent in the open sapling/pole structure stage are the result of timber harvest, and represent young stands. The rest is in the Mountain Hemlock vegetation zone found on the middle slopes of Mount Adams and other high elevation sites. A number of special status plants are present.

Five animal species which are federally-listed as threatened or endangered, as well as a number of sensitive species, C-3 species, and high interest species, are known to, or are likely to, occur in the Upper Lewis. These include the northern spotted owl, bald eagle, peregrine falcon, gray wolf, grizzly bear, wolverine, Larch Mountain and Van Dyke's salamanders, great gray owl, and four bat species. Of the 22 spotted owl activity centers located within the watershed, nine are located within the Matrix allocation. Chance sightings of bald eagles have occurred in the watershed, although

no formal surveys have been conducted. Bald eagles are commonly seen downstream, but due to a lack of habitat their use of the watershed is most likely limited to winter foraging on carrion. There are no known active peregrine falcon eyries in the watershed although four sub-basins contain numerous cliffs that appear to be suitable nest sites. One reliable gray wolf sighting was reported in 1992.

None of the sub-basins show peak flow increases (compared to a fully-forested condition) of more than 10 percent. Eleven 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, brook trout, mountain whitefish, largescale suckers, and sculpin. Because of barriers represented by three hydroelectric dams downstream anadromous fish are not present in the watershed.

There are 15 water quality monitoring stations within the Upper Lewis River Watershed which have been active for varying lengths of time since 1974, but long-term records are rare. Two of the 14 stations that collected water temperature data had instantaneous maximum stream temperatures that exceeded 16° Celsius, possibly exceeding State Water Temperature Standards. No water-quality-impaired stream segments in the analysis area are identified on the Washington State 303 (d) list.

Road densities in the Upper Lewis average 2.17 miles per square mile for the entire area, with nine sub-basins exceeding the "red flag" density of 3.0 miles per square mile.

Most visitors to the watershed (over 360,00 in the past five years) come for recreation purposes: to camp and view the scenery, to use the trails, or to hunt big game. Situated near urban populations, trail use is heavy, especially by equestrians. Summer time use of the three developed campgrounds is heavy. Dispersed campsites are also heavily used, particularly at favored hunting camp locations in the late fall.

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 to a much lesser degree by 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 construction of Merwin, Yale, and Swift dams.

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

Nine dominant processes affecting the watershed's ecosystem are identified: volcanic and seismic activity, glaciation, 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 (recreation). 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 Lewis River Watershed

Restoration Activities	**Priority**	**Number of Sub-basins**
Road Decommissioning	High	10
Road Weatherization	Moderate	8
Stream Enhancement	Moderate	9
Erosion Control/Slope Stabilization	High	7
Silvicultural Treatments to Accelerate Development Of Sapling/Pole Stands	Moderate	13
Road to Trail Conversions	Moderate	6

Monitoring Activities	**Number of Sub-basins**
Stream Temperature	7
Stream Surveys	7
Lake Surveys	2
Phase II Road Condition Surveys	7
Potential Peregrine Falcon Nest Sites	4
No. Spotted Owl Activity Centers in LSR	9
Lynx	7
Great Gray Owl	2
Updating the GIS Database	25

Commodities and Development	**Number of Sub-Basins**
Opportunities for Timber Harvest	7
Re-opening the Lewis River Trail	8

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 Lewis 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 Lewis River Watershed was selected for analysis at this time because:

1. the watershed was first analyzed in its entirety in 1995, and since that time, a flood occurred and a number of timber sales and other management activities have been planned and implemented within the watershed boundaries. The watershed analysis process itself has evolved to higher levels of detail and has become more comprehensive than in 1995. For these reasons the Monument has decided to conduct a "second iteration" of the Upper Lewis River Watershed Analysis.

2. it is known to contain high priority watershed restoration needs, and

3. a watershed-scale analysis is needed to develop strategies for dealing with timber management activities, trail development, various flood damage repair projects, monitoring, 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. Much of the damage to the affected areas in the Upper Lewis River Watershed has been inventoried. This information was available to the team that conducted the watershed analysis reported in this document.

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 Lewis 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).

Vicinity Map

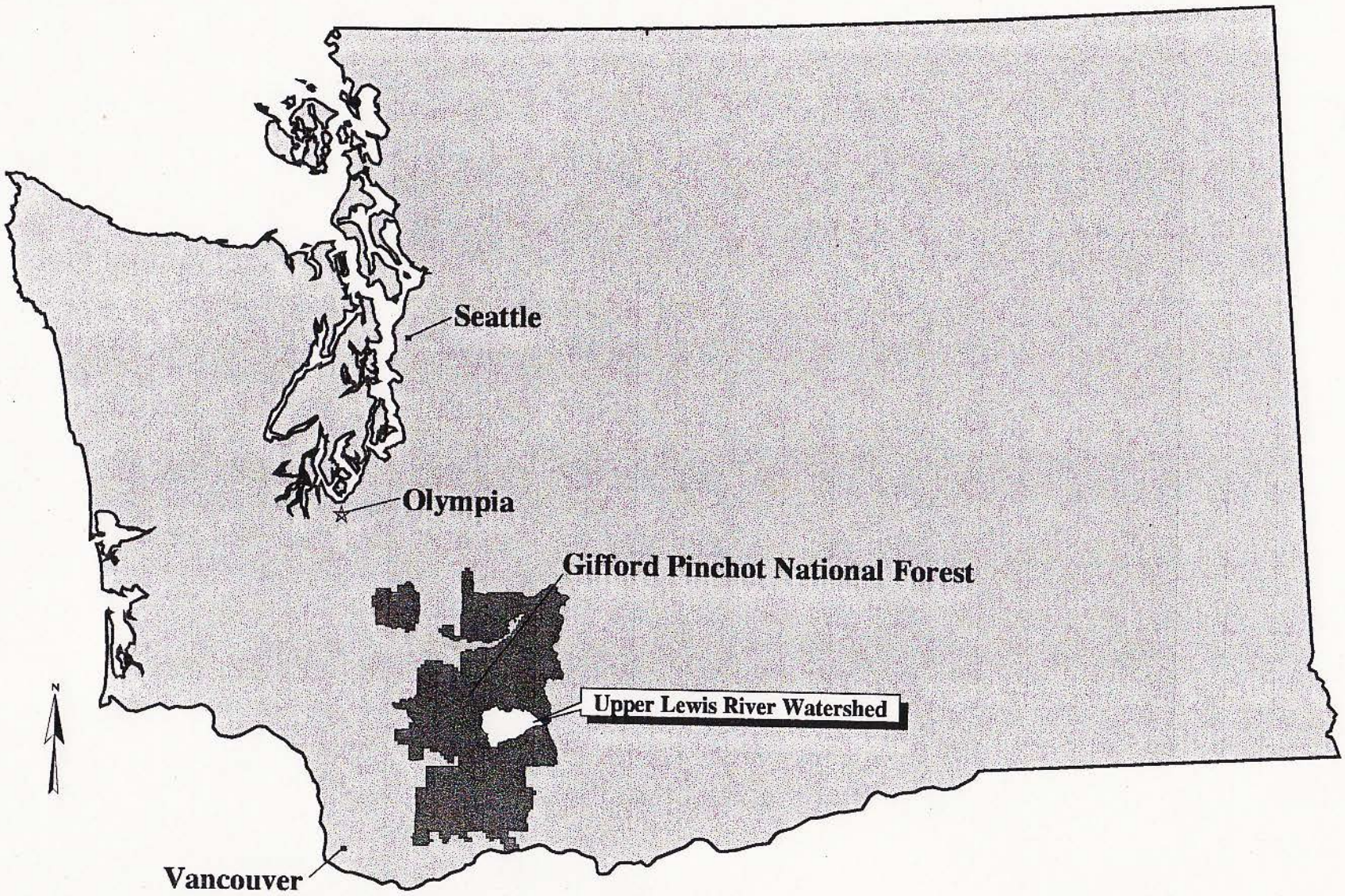


Figure 1. Vicinity Map. The Upper Lewis River Watershed is located in the southwest corner of the State of Washington.

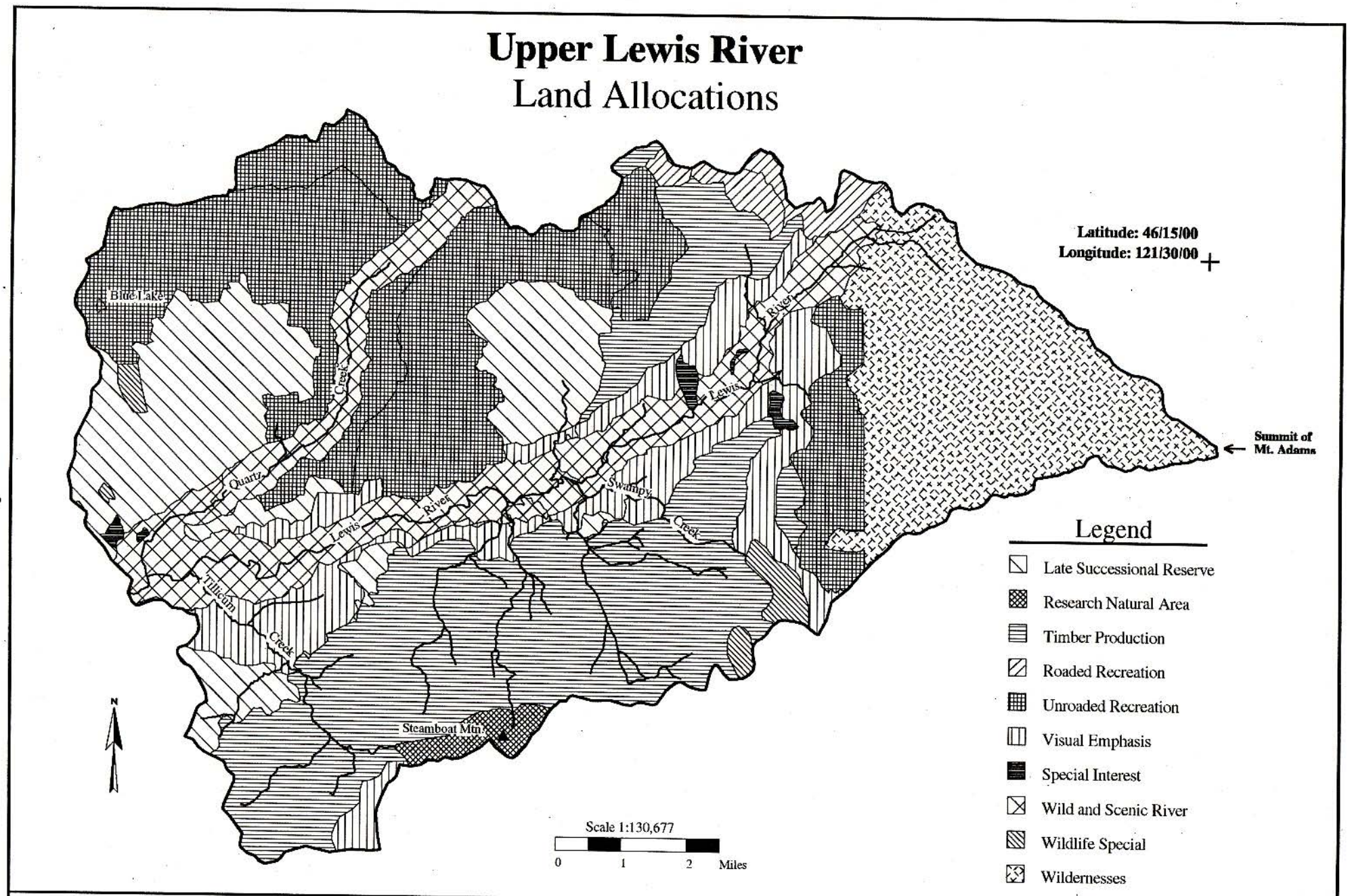


Figure 2. National Forest land within the Gifford Pinchot National Forest is assigned to various Management Area Categories (MACs). Each MAC has a goal or management emphasis.

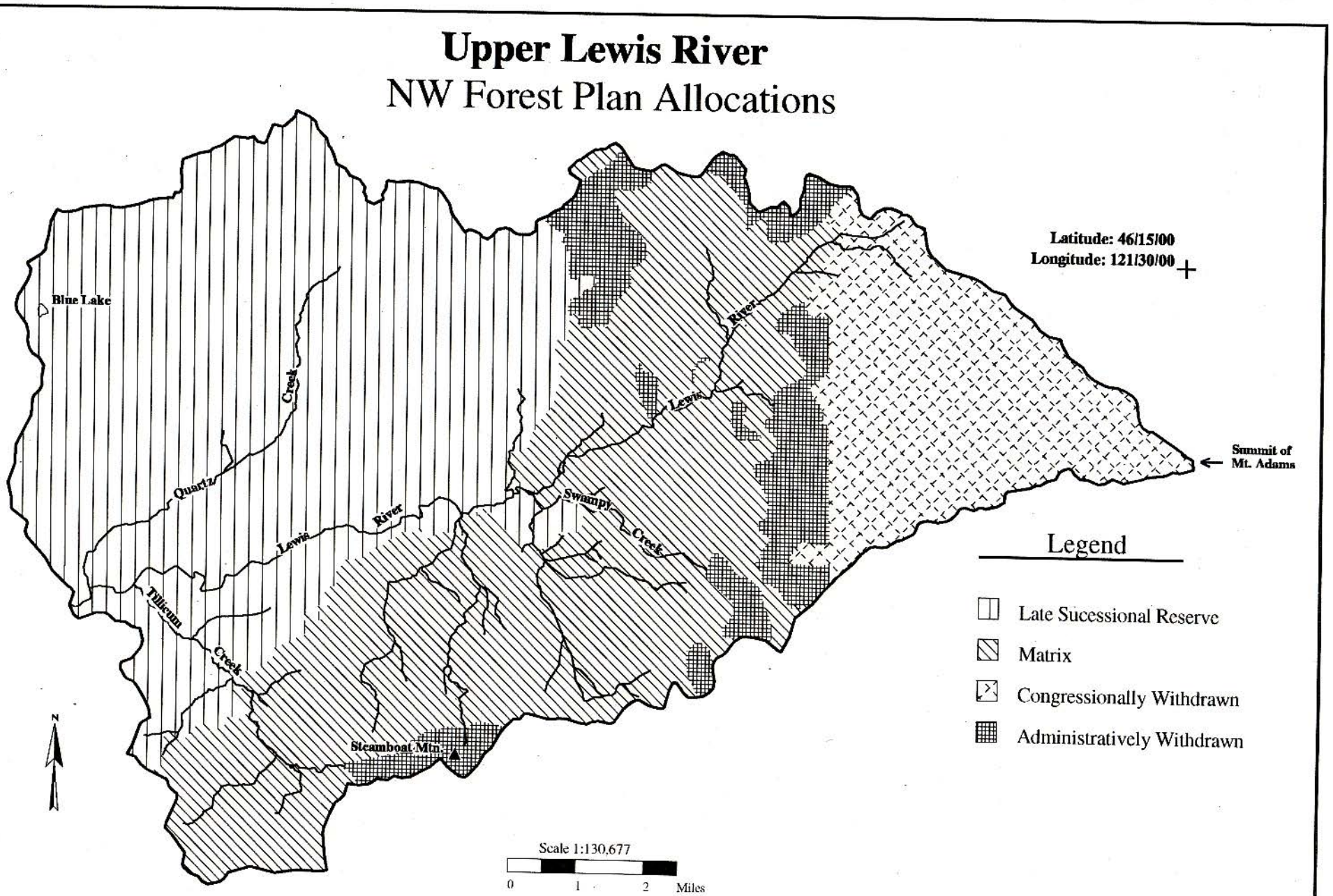


Figure 3. Under the Northwest Forest Plan, all federally administered lands within the range of the northern spotted owl are assigned to specific land allocations.

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

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

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

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

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

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

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

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

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

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

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 Lewis River basin. The Upper Lewis River is a relatively small watershed that occupies a portion of the Lewis River basin. See Figure 1, Vicinity Map in the Introduction.

The Upper Lewis River Watershed Analysis Area (hereafter referred to as the Upper Lewis) encompasses an area of National Forest lands within the Lewis River basin including some of its tributary streams. The Upper Lewis includes lands drained by Twin Falls Creek, Pass Creek, Steamboat Creek, Quartz Creek, Pin Creek, French Creek, Straight Creek, Tillicum Creek, Boulder Creek, Snagtooth Creek, Deer Creek, Surprise Meadow, Strawberry Creek, Poison Creek, Swampy Creek, North Fork Pass Creek, Platinum Creek, and the upper reaches of the Lewis River.

The analysis area is divided into 25 sub-basins (Figure 4, Sub-Basins Map). Table 1 shows the sub-basin sizes and designations.

Table 1. Sub-Basin Designations

Number	Acres	Name	Number	Acres	Name
23A	12,067	Upper Lewis River.	23N	2,358	Middle Quartz Creek
23B	2,343	Twin Falls Creek	23P	1,716	Deer Creek
23C	3,071	Pass Creek	23Q	3,032	Middle Tillicum Creek
23D	2,226	Steamboat Creek	23R	1,278	Surprise Meadow
23E	3,693	Upper Quartz Creek	23S	2,866	Upper Tillicum/Strawberry
23F	3,747	Pin Creek	23T	3,186	Poison Creek
23G	2,199	Upper Sidewall Tributaries	23U	2,159	Swampy Creek
23H	4,704	Lower Sidewall Tributaries	23V	1,583	N. Fork Pass Creek
23I	2,251	French Creek	23W	3,219	N. Fork Swampy Creek
23J	4,834	Straight Creek	23X	842	Platinum Creek
23K	2,311	Lower Tillicum Creek	23Y	924	Upper Frontwall Tributaries
23L	3,577	Boulder Creek	23Z	1,523	Lower Frontwall Tributaries
23M	3,785	Snagtooth Creek	**TOTAL**	**75,494**	

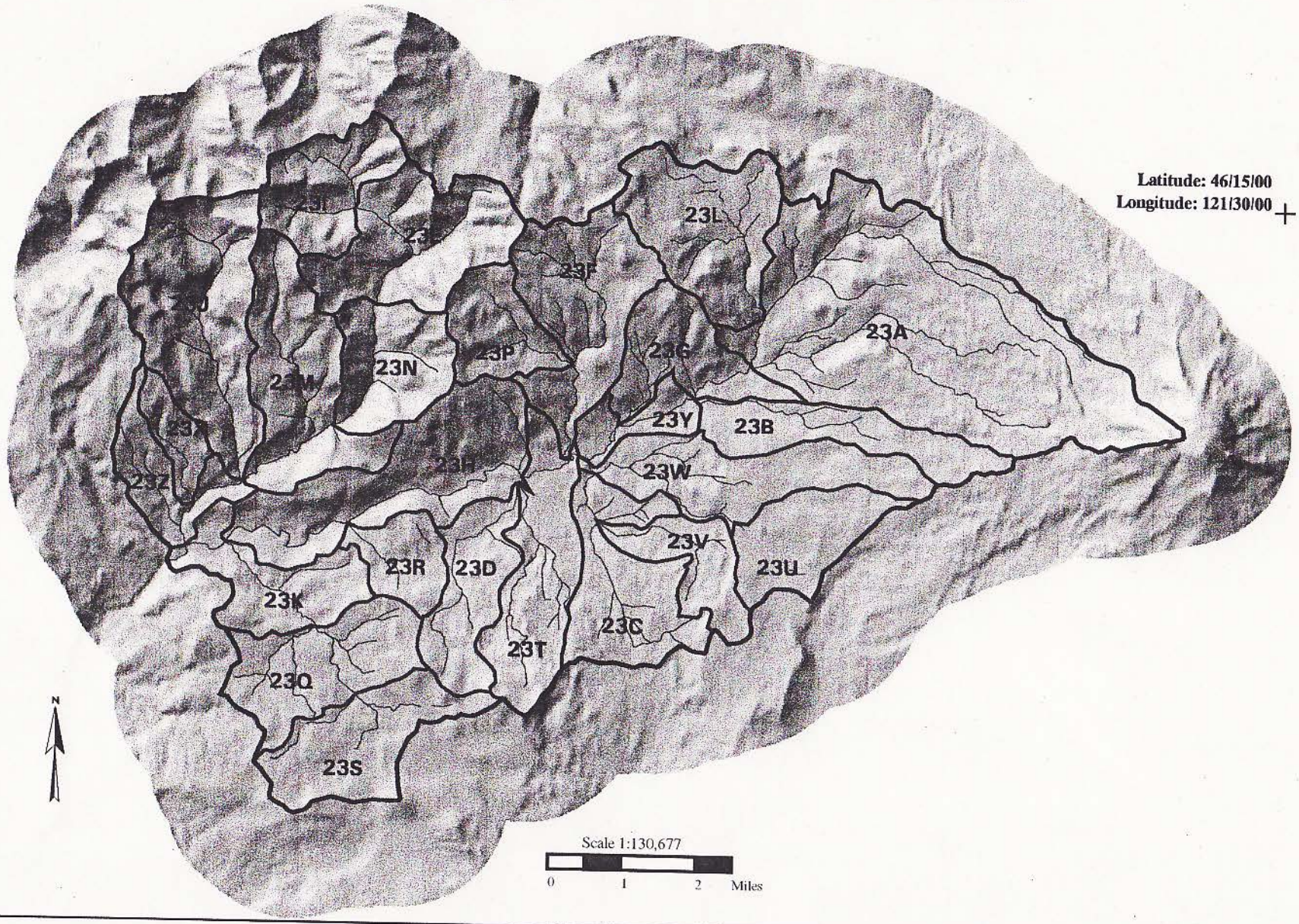


Figure 4. Sub-basins. For this analysis, the 75,494-acre Upper Lewis River Watershed is divided into 25 sub-basins.

The Upper Lewis covers 75,494 acres and ranges in elevation from 1,800 feet at Upper Falls to 11,800 feet at the summit of Mount Adams. All of the land, water, plants, animals, and people within this area make up the Upper Lewis ecosystem.

Geology, Soils, Erosion Processes

The Upper Lewis Watershed developed from volcanic and glacial processes along with the erosional processes of wind and rain. The watershed can be divided into three geomorphic sub-regions based on the geologic processes involved. The eastern portion of the watershed has been greatly influenced by the volcanic and glacial activity from Mount Adams. The flows in this area date to about 250,000 to 400,000 years of age. The area north of the Lewis River is characterized by steep and relatively old andesitic and pyroclastic flow deposits while the area south of the Lewis River consists of more gentle unstable sedimentary deposits with numerous wetlands. These areas have been dated in the range of 25 to 17 million years of age. These broad generalities can be seen on Figure 5 which shows the surficial geology of the area.

Glacial activity has had a significant effect on the landscape. Two major glacial periods have been mapped in the watershed, "Hayden Creek" dated approximately 130,000 to 150,000 years before the present and "Evans Creek" dated about 24,000 to 13,000 years ago. The glacial deposits in the eastern portion of the watershed are very compact and have a tendency to give perched groundwater levels. This can be seen in the numerous springs found in the area. Glaciers coming from Mount Adams and out of the Indian Heaven area scoured and smoothed the landscape until it reached defined channels such as the Lewis river. In the Lewis River they scoured and over-steepened the slopes. Over-steepened slopes are more noticeable downstream, in the Middle Lewis area, than in the Upper Lewis, but glaciation has caused some of the stability problems along the river. Many of the potentially unstable soils in areas along the river and side streams are of glacial origin.

The Upper Lewis watershed contains some of the largest deep-seated landslides on the Forest. The largest originated at Steamboat Mountain and flowed all the way to the Lewis River. The cause of these large landslides is not known, but one plausible theory suggests they were initiated by earthquake. It is believed a major earthquake occurred in the northwest about 600 years ago. This earthquake had the potential to trigger earth movement in areas that were already somewhat unstable. Minor movement of these deep-seated slides still occurs, with some smaller and shallower slides included within them moving at a greater rate. The large slides are probably not affected by the human activities which have taken place over the last 50 years. However, some of the shallower slides within them have been affected by management actions.

Fire History

Wildfires have been a major natural disturbance factor in the forest landscape of the Upper Lewis River Watershed. Fire has been an integral part of the ecosystem, affecting wildlife habitat, vegetation dynamics, soil properties and watershed hydrology. Large, although very infrequent, high intensity, stand replacement fires appear to have occurred prior to European settlement throughout the watershed as was common over much of the western Cascades of the Pacific Northwest. Since the mid-1800's, no large fires of catastrophic intensity have burned in the Upper Lewis River watershed area.

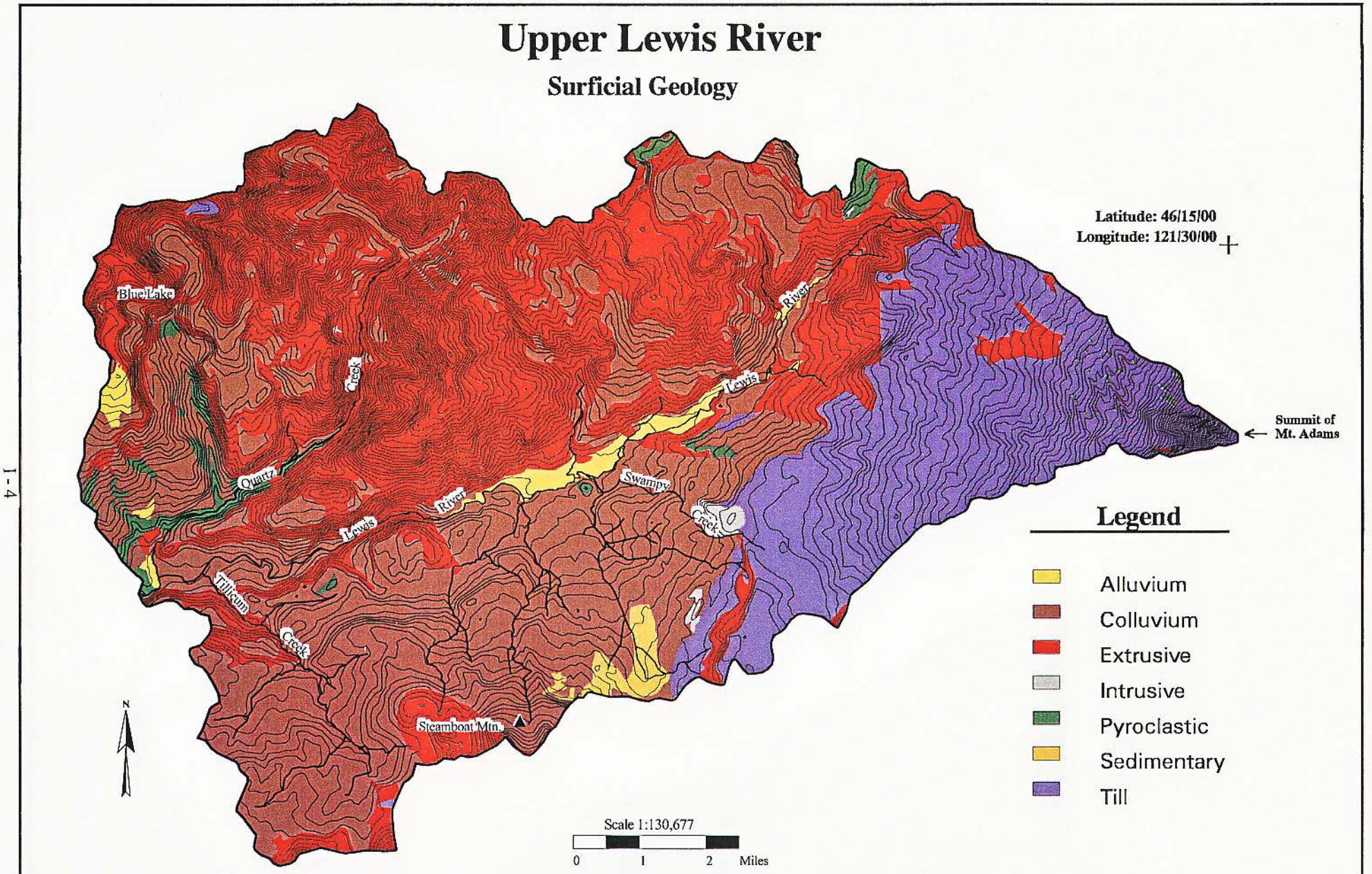


Figure 5. Surficial geology of the Upper Lewis River watershed. Three main geologic units describe the watershed.

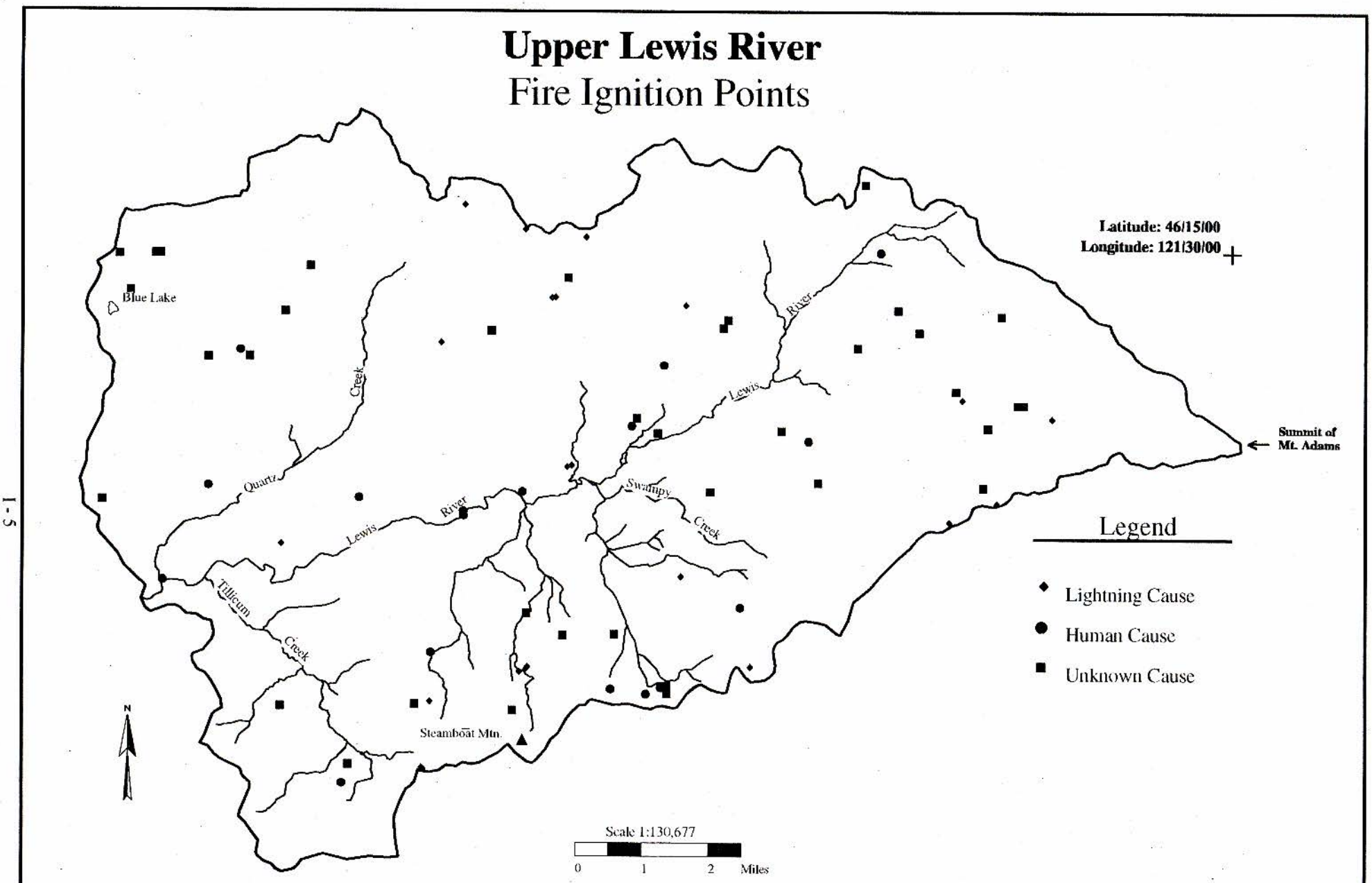


Figure 6. Fire ignitions recorded by the Forest Service in the Upper Lewis River Watershed from 1970 to present.

Vegetation

Because of the high elevations of much of the Upper Lewis Watershed, the majority of the vegetation is in the Pacific Silver Fir vegetation zone (69 percent). Ten percent are in the Mountain Hemlock zone, four percent are alpine, and only eight percent are in the Western Hemlock Zone. Six percent are non-forest and include volcanic outflow from recent eruptions of Mount Adams. The remaining three percent are wetlands and water (Figure 7. Ecoclasses). Vegetative patterns have historically been shaped by large-scale disturbances such as fire and periodic eruptions of Mount Adams. Recently, staggered-setting timber harvest has changed the distribution of vegetation, creating a mosaic of open patches across the landscape. Five species of sensitive (TES) plants and three species of Survey and Manage (C-3) strategy 1 (manage known sites) lichens are found in the watershed. Three Botanical Special Interest Areas for vascular plants and one Botanical Special Interest Monitoring Area for an aquatic lichen are present in the watershed. A portion of the Steamboat Research Natural Area including a recent 40-acre addition also lie within the Upper Lewis.

Terrestrial Animals and Habitats

The Upper Lewis Watershed contains potential habitat for 239 species of terrestrial vertebrates (USDA 1995). Forty-three of these species are snag dependent and 63 species are associated with dead and down woody material. Three introduced species, wild turkey, bullfrog, and Norway rat, are thought to inhabit the watershed. The populations of approximately 50 species that may exist in the watershed are believed to be declining.

The watershed contains potentially suitable habitat for five Federally listed species, two Region 6 sensitive species, eight Survey and Manage species, and a number of high interest species.

Threatened and Endangered Species

Potential habitats exist for the following five Federally listed species: northern spotted owl, bald eagle, peregrine falcon, gray wolf and grizzly bear.

Twenty-two northern spotted owl home ranges are known to exist in the watershed. Suitable habitat, primarily old-growth/late successional (LSOG) stands, is highly fragmented in the western and eastern portions of the watershed (Figure 15). The largest contiguous blocks of LSOG habitats are in the Lewis LSR and Mount Adams Wilderness. Sixty-five (49,245 acres) percent of the watershed is within management allocations not scheduled for timber harvest.

Habitats for other federally listed species are believed to exist in the watershed. Only opportunistic sightings of bald eagles have occurred, and no sightings of either peregrine falcons or grizzly bears. A highly reliable sighting of two gray wolves in Sub-basin 23J (Straight Creek) was reported in 1992. Because the gray wolf has very large home ranges, an occasional sighting of an individual may be rare but possible. The likelihood of either a gray wolf or grizzly bear permanently occupying the watershed is extremely low.

Sensitive Species

Potential habitats exist for the wolverine and Larch Mountain salamander, Region 6 sensitive species. Similar to the gray wolf and grizzly bear the wolverine has a large home range, uses a variety of habitats and is extremely sensitive to human disturbance. Therefore, the occasional use of the watershed by an individual is probably rare but is highly possible. Similar to the wolf and grizzly bear, the likelihood of an individual occupying the watershed is low.

Survey and Manage (C-3 Species)

Potential suitable habitats exist for eight Survey and Manage species: Larch Mountain Salamander, Van Dyke's salamanders, great gray owl, lynx, Townsend's big eared bat, silver-haired bat, long-eared myotis, fringed myotis, and long-legged myotis.

Both Larch Mountain and Van Dyke's salamanders have been located within several sub-basins in the watershed. Suitable habitats for both species are suspected to exist throughout most of the watershed. The majority of the known sightings occurred in LSOG forest.

Suitable habitats exist for both the great gray owl and lynx. Both species have very unique habitat requirements, with very limited amounts present in the Upper Lewis. Because no historic sightings of either species exist for the watershed, it is not known whether either species is present.

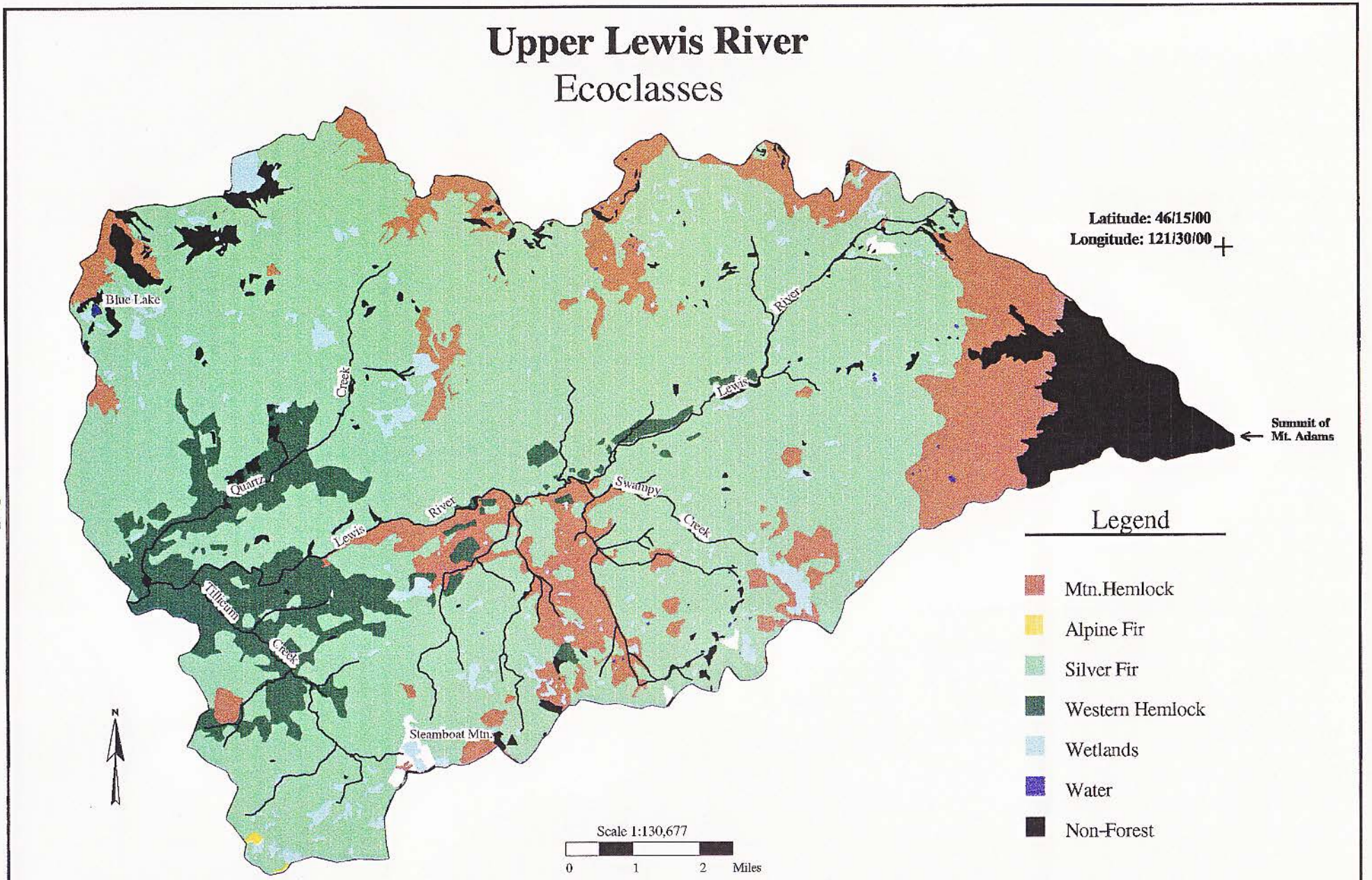


Figure 7. Vegetation Zones (Ecoclasses) of the Upper Lewis River Watershed.

A Townsend's big eared bat hibernaculum exists in Sub-basin 23Z. No recorded sightings of the other four bat species exist for the watershed. In general, caves buildings and mines are used for winter roosts, while bark crevices, bridges, caves, and mines are commonly used as summer roosts. The watershed contains a very limited number of caves. Most of the sub-basins offer adequate snag habitat with the exception of Sub-basin 23X (Figure 21). The watershed offers excellent foraging habitat for bats because numerous wetlands are present and because a large percentage of the watershed contains riparian habitat.

"Other High Interest Species"

Potential habitats exist for a number of "high interest species." These species are not Federally listed nor are they Region 6 sensitive species, but they are still given additional management considerations (GPLMP 1995). This group includes snag-dependent species, goshawks, deer, and elk.

Potential habitats exist for 43 snag-dependent species which include the black-backed, hairy, and pileated woodpeckers. All sub-basins contain enough snag habitat to support cavity excavators above 40 percent of their maximum potential populations with the exception of Sub-basin 23X.

Serval goshawk nests are present in the watershed. The goshawk is also a species that is very closely associated with LSOG habitat.

Elk and deer are commonly seen throughout the Upper Lewis. However, very little ungulate winter range exists. The numerous meadows and smaller wetlands create ideal conditions for calving, fawning and wallowing.

Water Features and Hydrologic Processes

General physical characteristics.

The Upper Lewis River watershed is a Tier 1 Key Watershed. The river originates on the northwest flank of Mount Adams and flows west through the center of the analysis area. Major streams and lakes in the Upper Lewis River analysis area include Tillicum Creek, Quartz Creek, Pin Creek, Boulder Creek, Steamboat Creek, Swampy Creek, and Blue Lake. In general, the analysis area can be divided at the Lewis River into two distinct areas hydrologically. Streams north of the river tend to be very steep gradient (10 percent and greater) and high energy due to the steep, dissected topography. Streams south of the river tend to be gentle gradient (2-10 percent) and the terrain contains numerous wetlands due to the gentle topography.

In the Upper Lewis River Watershed, the average annual precipitation ranges from 90 to 130 inches. The nearest stream gaging station to the analysis area is located on the Lewis River just upstream from Swift Reservoir, which is approximately 15 miles downstream from the area. The maximum yearly flow of record at this station ranges from 2,490 cubic feet per second (cfs) in water year 1977 (on March 7, 1977) to 27,000 cfs in water year 1934 (on December 21, 1933) and water year 1974 (on January 16, 1974). A water year extends from October 1 to September 30. This station operated from 1928 to 1977 before gaging operations were discontinued due to unknown reasons.

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 Lewis Watershed in two categories, those associated with streams and wetlands, and those lying on unstable ground.

Water Quality

No water-quality-impaired stream segments in the analysis area are identified on the Washington State 303 (d) list.

There are 15 water quality monitoring stations within the Upper Lewis River Watershed which have been active for varying lengths of time since 1974. The majority of these stations were established for project monitoring and collected data for one to three years (14 of the 15 stations), so long-term records are rare. These stations collected water temperature and turbidity data only. Two of the 14 stations that collected water temperature data had instantaneous maximum stream

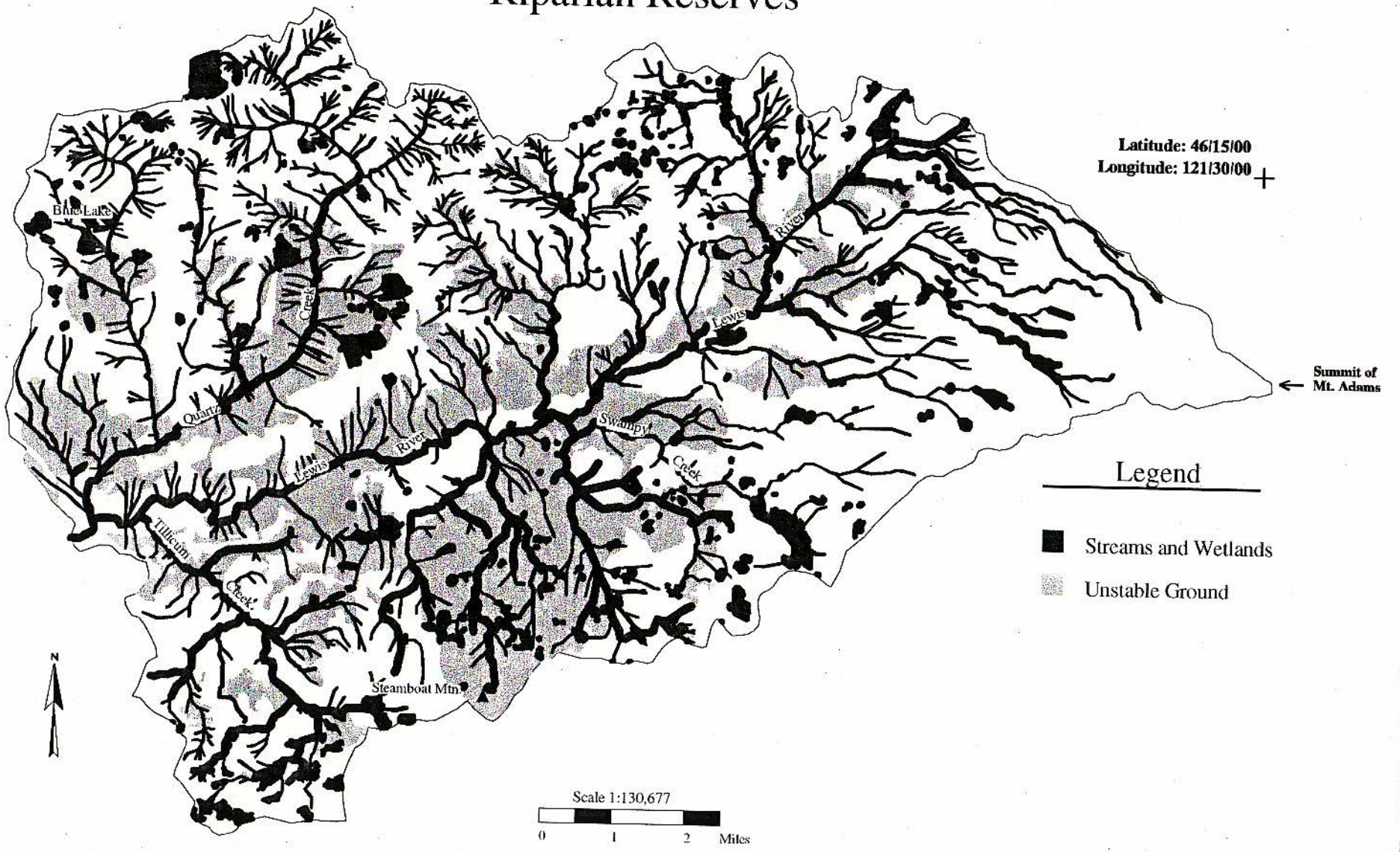


Figure 8. Riparian Reserves within GPNF lands provide an area along all streams, wetlands, ponds, lakes, and unstable and potentially unstable areas where riparian-dependent resources receive primary emphasis.

temperatures that exceeded 16° Celsius, possibly exceeding State Water Temperature Standards. These stations were on Straight Creek and Quartz Creek.

Water Quantity

The majority of the Upper Lewis Watershed Analysis Area is above the transient or rain-on-snow zone. The transient snow zone is subject to frequent snow accumulation and rapid melting due to exposure to storms. Approximately 15 percent of the Upper Lewis River Watershed (11,331 acres) is in the transient snow zone (1800-3200 feet elevation) and 55 percent of the area (41,511 acres) is in the snow dominated zone. The other 30 percent is mostly in the highland area above the snow dominated zone.

The Upper Lewis Watershed has had extensive timber harvest and road building in some sub-basins. This human activity may have increased peak flows in these areas, when compared to a fully forested, unroaded condition. The following sub-basins have increased peak flow concerns due to roading activities: Sub-basin 23C, 23D, 23G, 23K, 23Q, 23R, 23S, 23V, and 23Z.

1996 Flood

The Lewis River basin in general, was hard hit by the floods of November, 1995 and February, 1996. Due to the deep snowpack that was present in the basin, most of the damage occurred in the lower elevations, below 2000 feet. The snowpack acted as a "reservoir" in the upper elevations, storing the meltwater temporarily. Since the majority of the Upper Lewis is high elevation, it did not receive as much damage as the downstream Middle and Lower Lewis Watersheds.

Fifty-seven flood damage sites, consisting primarily of road and slope failures, are located in the Upper Lewis Watershed. Of these 57 sites, 23 occurred in the transient snow zone and 34 occurred in the snow dominated zone. This equates to 2.0 flood damage sites per 1000 acres of area in the transient snow zone and 0.8 flood damage sites per 1000 acres of area in the snow dominated sites, or over two times the amount of sites in the transient snow zone when normalized by basin area.

Aquatic Animals and Habitat

The Upper Lewis River Watershed (a Tier 1 Key watershed) has approximately 468 miles of stream; 19 miles are Class I, 56 miles are Class II, 112 are Class III, and 281 are Class IV (Figure 9). Rainbow trout (*Oncorhynchus mykiss*), cutthroat trout (*Oncorhynchus clarki*), brook trout (*Salvelinus fontinalis*) and sculpins (*Cottus* sp.) are the most common fishes found in the streams and lakes. Spring and fall chinook (*Oncorhynchus tshawytscha*), early and late returning coho (*Oncorhynchus kistuch*), and summer and winter steelhead (*Oncorhynchus mykiss*) occur in the Lewis River below Merwin dam which is 55 miles downstream from the analysis area. Stream survey data exists for 54 miles within this watershed; however, only 37.8 miles of this data is suitable for analysis using standards developed by the Columbia River Basin Policy Implementaion Guide (CRBPIG) (USDA FS 1991).

The seven day average maximum water temperature in the Lewis River was below the State Water Quality standard of 16 degrees Celsius (60.8 degrees Fahrenheit); however, maximum temperatures exceed this standard for short periods of time. The seven day average maximum water temperature for Quartz Creek went above 16 degrees Centigrade in July of 1977 and 1979 and in August of 1978. 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 414 road/stream crossings, which, when divided by 468 stream miles equates to 0.88 crossings per mile of stream.

Only 14 percent of the Riparian Reserves along streams have undergone timber harvest in the past 50 years. In harvested areas, fewer numbers of remaining large conifer trees within the Riparian Reserves decreases the amount of instream large woody debris which decreases habitat for aquatic organisms.

A bull trout population resides in Swift Reservoir for the majority of the year and then migrates to Pine and Rush Creeks to spawn. Pine and Rush Creeks are 15 and 10 miles downstream from the analysis area, respectively. Bull trout have been listed under the Endangered Species Act as a "Threatened" species.

Six lakes are located within the Upper Lewis River watershed analysis area: Sheep, Crystal, Little Fish, Meadow, Lake Camp, and Blue Lakes (Figure 25). Brook trout are know to be present in Little Fish Lake; fish presence is unknown in the other lakes. Lake

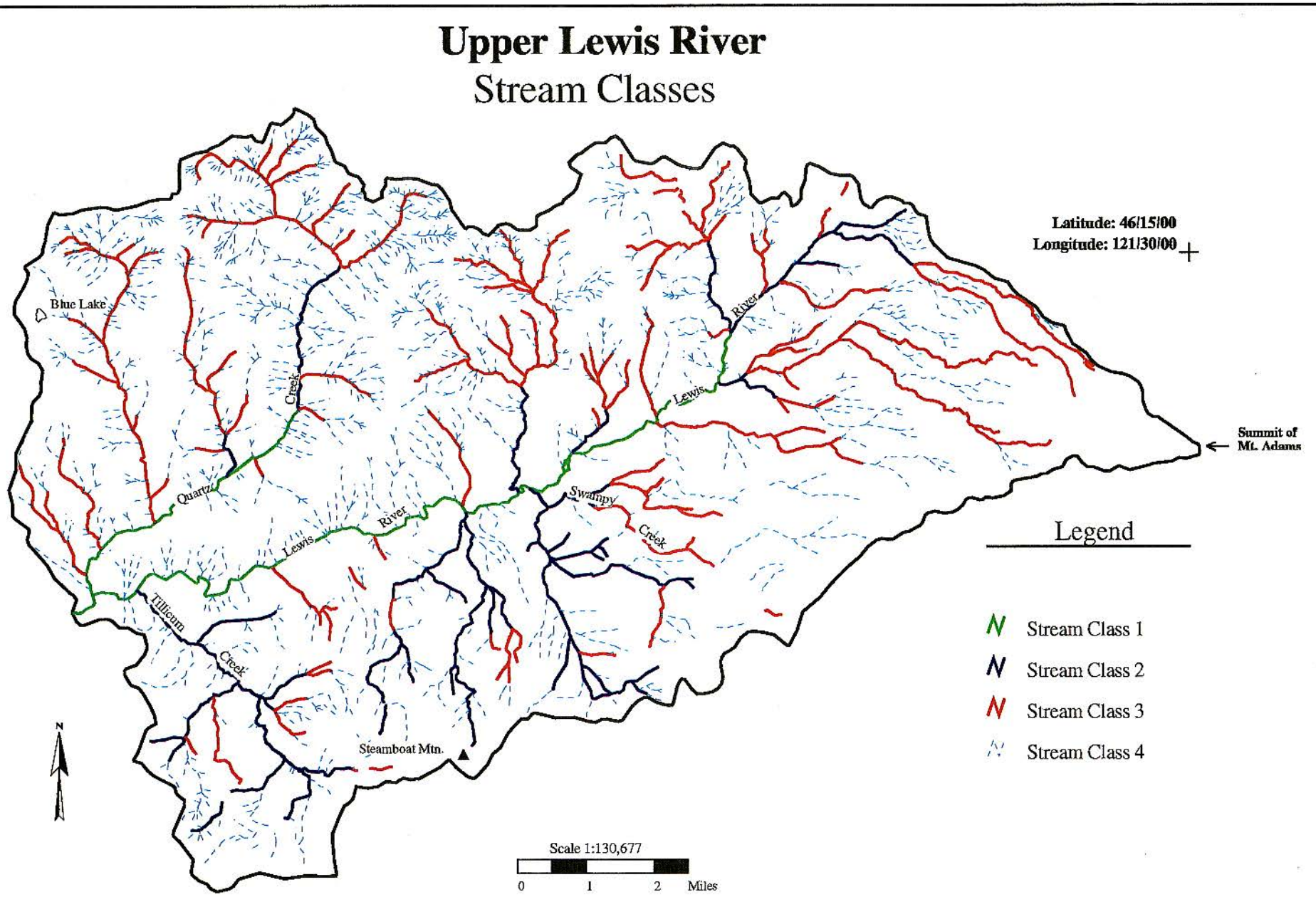


Figure 9. Stream segments have been grouped according to their size and presence of beneficial uses. These groups, referred to as stream classes, range from Class I which is a large perennial stream to Class IV which is a small intermittent stream.

surveys to identify fish habitat condition have not been completed on any of these lakes.

Quartz Creek is a major tributary to this section of the Lewis River. The middle and upper portions of this sub-basin have had little to no timber harvest. These portions lie within the Dark Divide Roadless Area and in the Late Successional Reserve (LSR). Conducting a stream survey on Quartz Creek would provide valuable local information with which to compare other Lewis River stream survey data with the standards outlined in the CRBPIG. The CRBPIG standards were developed across different types of geographic areas.

Human Uses

Overall, the area within the Upper Lewis River watershed has seen a long history of human use. Areas that we now call "Wilderness" were once intensively used and even managed by Indian people. The general routes of travel used prehistorically appear generally to be in the same location as the earliest historic routes. In the more distant past, the hunting of large mammals, fishing, and the quarrying of stone for tools were important activities on the Forest, and in the more recent past huckleberries, beargrass, cedar bark, and other plant foods and medicines were sought on Mount Adams' slopes. The history of the watershed is dominated by grazing and mining.

Incidental timber harvest occurred within this watershed for hundreds of years to provide timbers for structures, mining and other incidental human needs. Forest management on National Forest lands began in the late 1940's. Because access into the area was limited, logging operations in the 1950's and 1960's were confined to several hundred acres. Intensive timber management began in the 1970's with the harvest of over 1500 acres. Logging increased in the 1980's with over 2000 harvest acres, and is expected to return to approximate 1970 levels in the current decade. Until adoption of the Northwest Forest Plan in 1994, intensive forest management activities have utilized almost exclusively clearcutting harvest methods followed by planting, thinning, and other stand tending activities.

Recreational use consists of camping, hunting, trail use, berry picking, and wilderness travel. Three popular campgrounds are found in the watershed, the Lewis River Horse Camp near Quartz Creek, Twin Falls Campground along the upper Lewis River, and Tillicum Campground near Squaw Butte in the southern corner of the watershed. The Lewis River Horse Camp provides parking and camping facilities for horse riders using the Lewis River and Quartz Creek Trails. Twin Falls Campground is a fee campground operated under special use permit by a concessionaire. Several camp sites provide tent camping on both sides of the Lewis River. Tillicum Campground is located adjacent to the huckleberry picking area of Indian Heaven, and while it attracts use throughout the season, the area is particularly popular at the end of summer when berries begin to ripen.

The Mount Adams Wilderness occupies the upper portion of the watershed, with its western boundary following a line roughly parallel to Road 23. The Wilderness is managed to maintain wilderness values, with hiking and horse use permitted on most trails. The Pacific Crest National Scenic Trail crosses the western slope of Mount Adams from north to south, attracting much attention from hikers. Though use is generally discouraged, the Riley Camp Trail is a popular access route between Road 23 and the Pacific Crest Trail. Several climbing routes ascend the western slopes of Mount Adams, but due to long approaches and technical difficulty, are less popular than the south side route.

The Dark Divide Roadless Area occupies the northern portion of the watershed, where most of the trails in the watershed are found. The Quartz Creek Trail follows Quartz Creek from Road 90, and the Lewis River Horse Camp, upstream to the Boundary Trail. The French Creek, Quartz Butte, and Snagtooth Trails branch from the Quartz Creek Trail providing opportunities for horses and hikers to disperse, or make long loops. These trails are open to horses, hikers and mountain bikes, but closed to motorized use. Motorized trails in the watershed include the Table Mountain, Boundary, and Summit Prairie Trails. See Figure 33 in Chapter III.

Hunting is a popular recreational activity in the fall. Hunting for elk and deer attract the largest number of hunters, with smaller numbers seeking bear, cougar and grouse. A range of easily accessible to remote hunting areas are found in the watershed. The Dark Divide Roadless area and Mount Adams Wilderness provide remote hunting opportunities, while the heavily roaded areas near Steamboat Mountain satisfy "road hunters".

The Lewis River Horse Camp was constructed with the assistance of an IAC (Interagency Committee for the

Outdoors) grant, and donation of volunteer labor by area horse clubs. The campground was developed to allow removal of horses from Lower Falls Campground, where mixing horses with other campers created conflicts. Since horse use is so popular and facilities are limited, the need for additional horse trails is obvious. One means of providing additional horse trails is through road decommissioning. Certain roads have been identified for conversion to horse trails.

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 79 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 Lewis River Watershed Analysis. Accordingly, the types of future projects needing a watershed-scale perspective include:

1. Restoration Projects
   - Road Closures/Decommissioning
   - Slope Stabilization/Erosion Control
   - Road Weatherization
   - Roads to Trails Conversions
   - Young Stand Treatments in Riparian Reserves and Uplands
   - In-stream Channel Work

2. Timber Harvest (sales) - Regeneration as well as thinning

3. Stand Tending for timber management purposes such as precommercial thinning

4. Upgrading/Revitalizing Main Use Roads

5. Monitoring

6. Trail Development - Connections and loops

7. Upgrade Twin Falls Campground

A total of twelve issues will be addressed in the Upper Lewis River Watershed Analysis. These issues are:

- **Mass Wasting:** The Upper Lewis Watershed has many landslides and debris torrents within its boundaries. A few very large, deep-seated and slow moving landslides are present. These larger features are probably not greatly affected by human activities, but within these landslides there are numerous shallower and active landslides that can be affected by management actions. A number of landslides are moving sediment and large woody debris directly into the stream system.

- **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.

- **Fire:** In the past, large catastrophic fire has been a change agent at the landscape (watershed) scale.

- **Vegetation Structure and Composition:** Historically the Upper Lewis Watershed has had a high proportion of large, contiguous multi-layer stands and large, contiguous single layer fire regeneration stands with relict pockets of old growth that survived the fires. Within the past 60 years timber harvest activities have increased the amount and distribution of single layer stands beyond historic levels. These younger stands are distributed in small patches across the landscape, functionally fragmenting larger contiguous stands. This has diminished the diversity and distribution of some plants, lichens, fungi, bryophyte, and animal species and their habitat in some areas.

- **Stream Riparian Reserve Fragmentation and Riparian Habitat**: Stream riparian areas provide habitat for wildlife, plants, lichens, fungi, and bryophytes, and provide corridors for wildlife migration and plant dispersal. Some critical components of terrestrial habitat within Stream Riparian Reserves have been altered by fragmentation due to wildfire, past eruptions of Mount Adams, and timber management activities. This has influenced the capacity of these ecosystems to provide effective habitat for riparian dependent species, and other species that may use Stream Riparian Reserves as corridors between larger habitat blocks. Disruption of connectivity between these areas can potentially result in species isolation. This can lead to undesirable changes in species composition, use, and ecosystem functions within Riparian Reserves and the watershed as a whole.

- **TES and C-3 Plants, Lichens, Bryophytes and Fungi Species:** *Botrychium lunaria*, *B. pinnatum*, *Microseris borealis*, and *Montia diffusa*, Washington State Sensitive (TES) vascular plants, are present within the watershed. *Pleuricospora fimbriolata*, a Washington State Watch species, is also present at several sites. There are three Botanical Special Interest Areas in the watershed, which are managed to monitor the designated plant species. These include the five acre *Montia diffusa* Botanical Special Interest Area Unit #1113 (MAC (Management Area Category 9L), and two 20 acre *Pleuricospora fimbriolata* sites; Botanical Special Interest Areas Units #1108 (MAC AA) and Unit #3161 (MAC UH). An additional 29 TES plant species are suspected to occur within the watershed, based on suitable habitat. Less than about 10 percent of the watershed has been surveyed for TES species.

  Hydrothyria venosa and *Leptogium rivale*, Survey and Manage (C-3) Category 1 (manage known sites) and 3 (conduct extensive surveys and manage sites) aquatic lichens, are present at several locations within the watershed. *Pseudocyphellaria rainierensis*, a Survey and Manage Category 1, 2 (conduct surveys before ground-disturbing activities) and 3 epiphytic lichen, is also present within the watershed. Twenty-two other Survey and Manage Category 4 (conduct general regional surveys) lichens are documented or suspected to occur in the watershed. Virtually none of the watershed has been surveyed for C-3 species. In particular, the Late Successional Reserve, Steamboat Research Natural Area and Mount Adams Wilderness Area should be surveyed for C-3 species because these areas are presumed to be repositories of these species.

  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 suitable, or potentially suitable habitats for threatened, endangered, and sensitive species including the northern spotted owl, peregrine falcon, gray wolf, grizzly bear, bald eagle, and wolverine. Historic fires, road construction, and timber harvest, has increased the degree of forest fragmentation. Road development has also resulted in an increased human presence. The decrease in contiguous forest and the ever increasing human presence has affected the habitat for these species.

- **Habitat Condition for Survey and Manage (C-3) and Cavity-Dependent Species:** The watershed contains suitable, or potentially suitable habitat for C-3 species North American lynx, forest bats, Van Dyke's salamander, Larch Mountain salamander, and cavity-dependent species. These habitats may be affected by future projects. Habitat for cavity excavators has been impacted by historic fires and past regeneration harvesting.

- **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 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, flooding and fire, combined with timber harvest 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, brook trout, and cutthroat trout. State water quality regulations are in place to protect existing and designated uses of water (i.e., beneficial uses). A major flood event has also occurred since the first iteration, so we have a baseline to compare some of these parameters before and after the flood. Due to time and analysis information limitations the focus will be on fish spawning and rearing.

- **Completion of Trail System and Trail Connections:** Over the past thirty years, large numbers of roads have been built in the watershed. From a recreational perspective these have both provided access to camp sites, and at the same time decimated the previous trail system. The Gifford Pinchot Land and Resource Management Plan addresses this problem by proposing the re-establishment of certain former trails, or development of new trails to form an integrated network. Since the plan was approved, additional trail needs have been identified near the Lewis River Horse Camp. Through a third process, the Gifford Pinchot National Forest Access and Travel Management Plan, certain roads were identified for conversion to trails. These projects and plans have not been integrated into a single trail management strategy for the area.

- **Timber Harvest Expectations**: Timber harvest expectations in the Upper Lewis River watershed for the decade following the Record of Decision (ROD) for the Northwerst Forest Plan range from 1,000 to 1,700 acres. Since 1994, when the ROD was signed, all or parts of ten timber sales have been sold or are planned for sale. As of this date, depending on what alternatives are selected for the 1998 timber sale program, it is likely that between 1,300 and 1,500 acres will be logged this decade . Additional acres may be scheduled for 1999 and beyond if this watershed analysis indicates further opportunities.

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 Lewis River Watershed is characterized by three main processes: large, slow moving ,deep-seated landslides; debris torrents/flows; and shallow rapid mantle failures. All have occurred both in managed and "natural" areas.

Much of the area has been mapped as unstable and potentially unstable (Figure 10). Table 2 gives a break down of unstable and potentially unstable acres by sub-basin and percent of unstable and potentially unstable area by sub-basin. The total acres of unstable plus potentially unstable ground, and the percentage of the watershed area they represent, are shown in the last two columns. A number of very large, deep-seated landslides are located in the watershed; portions of these landslides could be considered stable and while other portions remain unstable.

Erosional Processes

Of the various surface erosional processes at work in the watershed, sediment routing from roads is the most influential. Native surface roads usually supply the most sediment, with aggregate surfaced roads ranking second and asphalt roads producing the least. The amount of sediment that is routed to streams is dependent on various factors such as surfacing type, distance to streams, vegetative cover on the fill and cutslopes, grade of the road, insloping/outsloping, traffic, maintenance, culvert spacing and storm intensity. A lack of information precludes completing a quantitative analysis showing the amount of sediment produced from roads in this watershed.

Most sediment eroding from roads occurs during the construction phase and within the first few years thereafter. Vegetation regrowth on the cuts and fills after construction slows the amount of sediment movement considerably. Grading the roads for maintenance will also increase sediment movement along the road system.

The map showing sub-basins with higher potential of surface erosion (Figure 11) is based mostly on the road densities of each sub-basin.

Surface erosion from hillslopes is a minor problem in the watershed and occurs mostly where skid roads and landings provide direct access to stream channels. Because of relatively gentle sideslopes, much of this watershed can be managed using ground-based equipment so care needs to be practiced in the location and construction of these facilities.

Prior to the 1960's, the road system was not well developed and probably did not appreciably affect the amount of sediment routing to streams. From the 1960's through the early 1990's, the amount of sediment delivered greatly increased due to large road construction increases. During the latter part of this period, the rate of sediment delivery tapered off due to improved road construction techniques used in the late 1980's and early 1990's. Toward the middle of the 1990's, road construction was greatly dimished due to reduced timber harvest. From the middle 1990's and into the forseeable future, sediment input is expected to diminish even more because of the strong emphasis upon road decommissioning, weatherizing, and closure activities.

Table 2. Amounts of Unstable and Potentially Unstable Ground by Sub-basin

Sub-basin	Total Acres in Sub-basin	Unstable Ground (Acres)	Percent of Sub-basin Unstable	Potentially Unstable Ground (Acres)	Percent of Sub-basin Potentially Unstable	Total Acres	Percent of Total
23A	12,067	187	1.55%	928	7.69%	1,115	9.24%
23B	2,343	23	0.98%	361	15.41%	384	16.39%
23C	3,072	1,078	35.09%	271	8.82%	1,349	43.91%
23D	2,224	476	21.40%	332	14.93%	808	36.33%
23	3,692	206	5.58%	106	2.87%	312	8.45%
23F	3,751	20	0.53%	554	14.77%	574	15.30%
23G	2,197	174	7.92%	319	14.52%	493	22.44%
23H	4,705	142	3.02%	1,887	40.11%	2,029	43.12%
23I	2,252	232	10.30%	0	0.00%	232	10.30%
23J	4,835	687	14.21%	110	2.28%	797	16.48%
23K	2,311	37	1.60%	743	32.15%	780	33.75%
23L	3,576	116	3.24%	261	7.30%	377	10.54%
23M	3,788	219	5.78%	1,053	27.80%	1,272	33.58%
23N	2,358	301	12.77%	1,381	58.57%	1,682	71.33%
23P	1,716	80	4.66%	549	31.99%	629	36.66%
23Q	3,033	35	1.15%	662	21.83%	697	22.98%
23R	1,278	98	7.67%	726	56.81%	824	64.48%
23S	2,866	70	2.44%	102	3.56%	172	6.00%
23T	3,186	2,584	81.10%	271	8.51%	2,855	89.61%
23U	2,159	0	0.00%	0	0.00%	0	0.00%
23V	1,583	139	8.78%	555	35.06%	694	43.84%
23W	3,220	753	23.39%	208	6.46%	961	29.84%
23X	841	5	0.59%	416	49.46%	421	50.06%
23Y	924	101	10.93%	255	27.60%	356	38.53%
23Z	1,524	91	5.97%	752	49.34%	843	55.32%
Total	75,501	7,854	10.40%	12,802	16.96%	20,656	27.36%

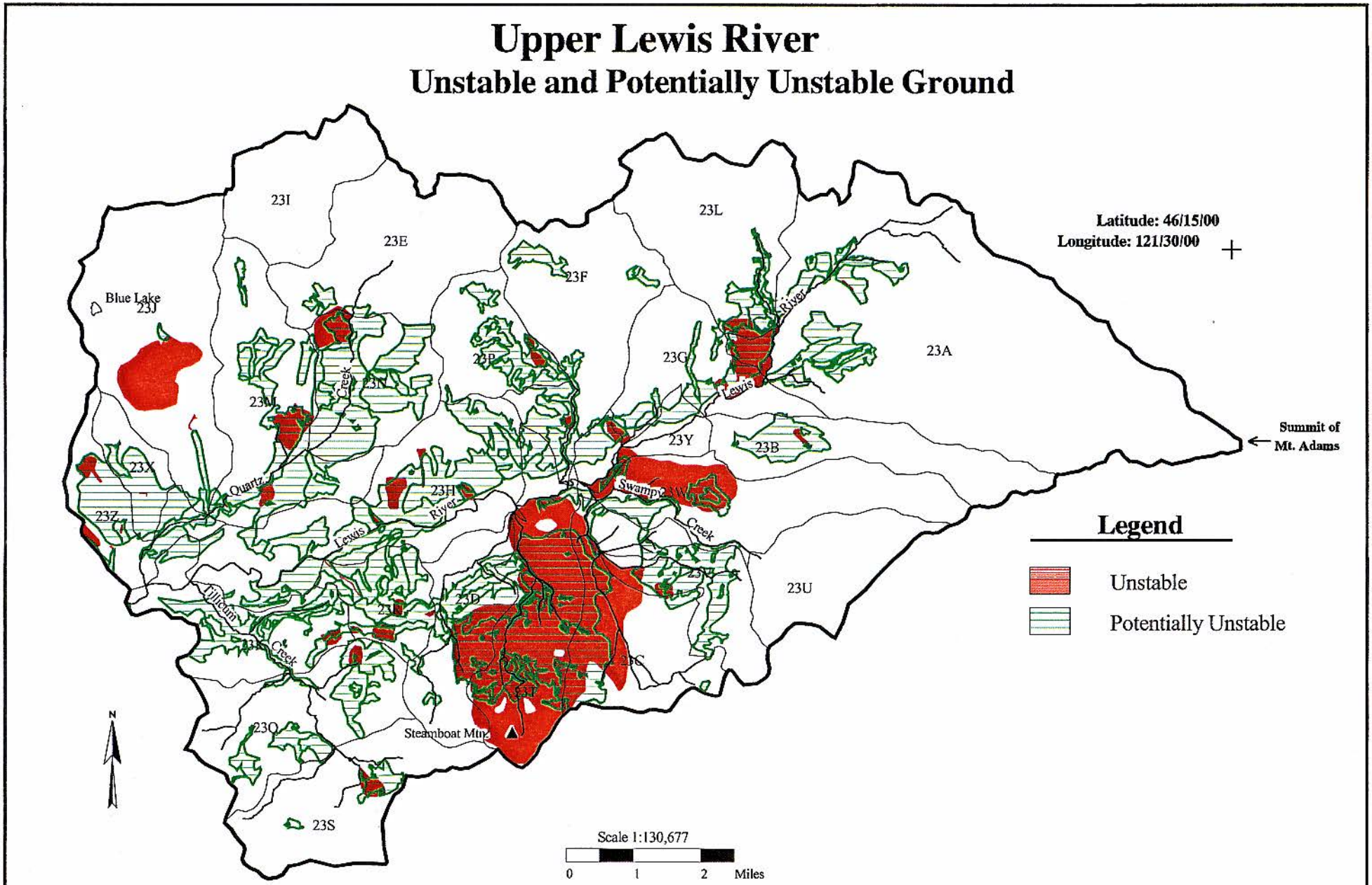


Figure 10. Areas mapped as unstable and potentially unstable ground. Areas of overlap should be considered as unstable.

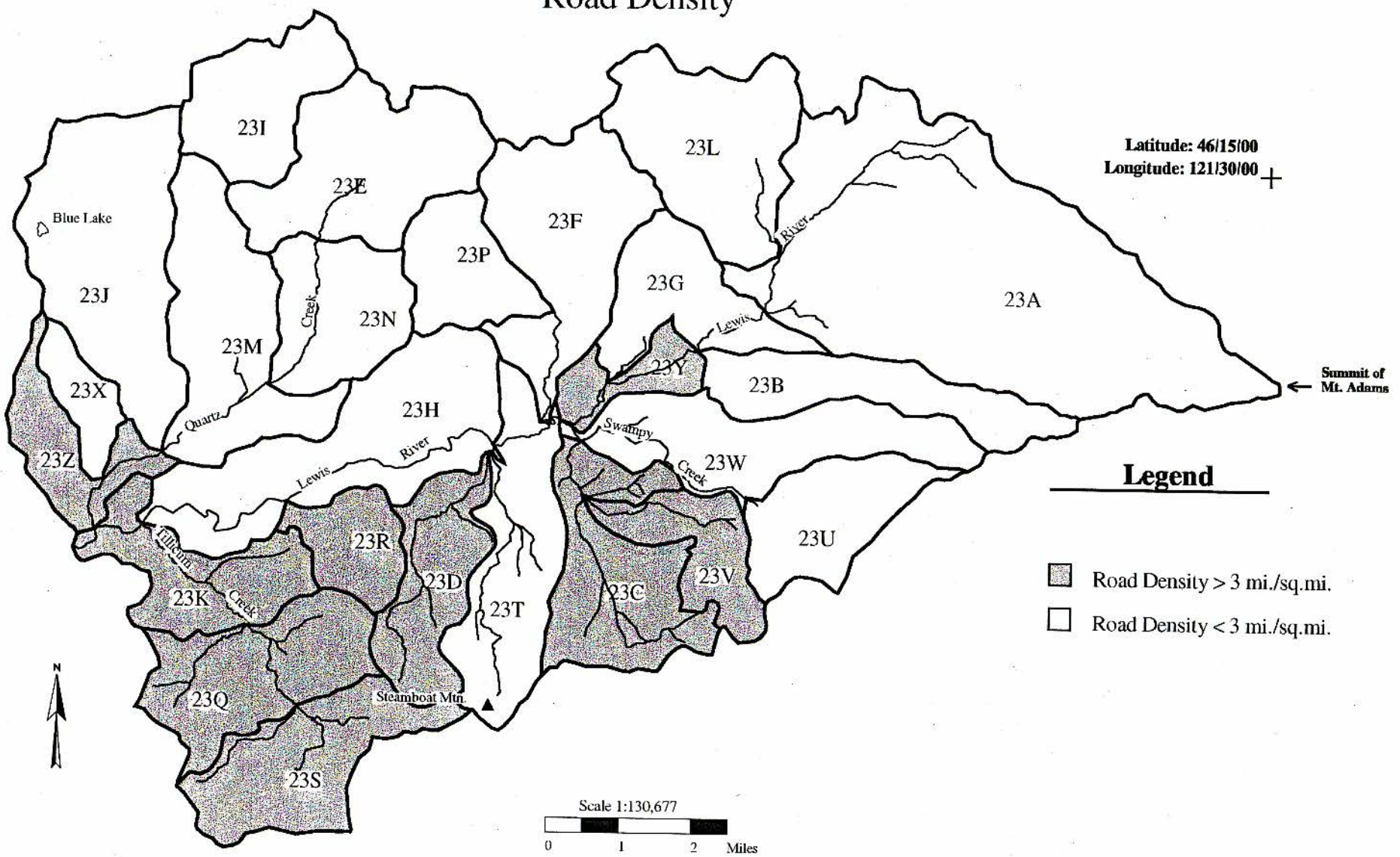


Figure 11. Upper Lewis River watershed sub-basins with road densities greater than 3.0 miles per square mile.

Fire History

Two distinct fire regimes are found within the Upper Lewis Watershed:

- Large, stand replacement fires, burning an average of 4,000 to 5,000 acres every 400 to 500 years.
- Relatively frequent, low severity, low mortality fires, common in mid- to higher-elevation areas and in valleys protected from east winds.

Most recent fires, whether caused by humans or lightning, have been small (less than 0.25 acres) and infrequent (less than 3 fires per year). Approximately 65 percent of fire ignitions during the period 1970 to 1997 were caused by lightning. This is well above the forest average of 45 percent. This higher percentage is due to the higher elevations associated with this watershed. Approximately two-thirds of the human-caused fires can be attributed to abandoned campfires which in most cases occurred in dispersed recreation sites. Resource damages were minimal as 95 percent of these fires burned less than one-tenth of an acre. The few large fires which did occur were within the boundaries of the Mount Adams Wilderness where resource loss was minimal, and there was in fact a benefit to the wilderness values of the area.

Table 3 shows fire frequency for the total area of the watershed. Fire frequency is described as the mean number of fire events during a given time period. In the case of the Upper Lewis River watershed the time period used to develop the frequency of fire events was 28 years, 1970 to 1997.

Table 3. Fire Frequency - 1970 to 1997

	Number of Fires	Percent of Fires	Frequency per Year
Lightning	51	65	1.82
Human	29	35	1.04
Total	80	100	2.86

Figure 6 displays the recorded fire ignitions which occurred within the Upper Lewis River watershed from 1970 to 1997 that required suppression action.

The Upper Lewis River Watershed lies within the area that has been classified as having characteristics of three Fire Groups as described in Fire Ecology of the Mid-Columbia published in 1994. These Fire Groups are: Group 8 - Warm, Moist Western Hemlock and Pacific Silver Fir; Group 9 - Dry Western Hemlock and Westside Douglas-fir; and Group 10 - Upper Subalpine and Timberline Forest. Plant associations and characteristics for each Fire Group are as follows:

Group 8 - Warm, moist western hemlock and Pacific silver fir associations. Sites which most often experience stand replacing fire but can experience a mix of underburning and stand replacing fire in younger stands at the landscape level.

Group 9 - Dry western hemlock and westside Douglas-fir associations. Sites which appear to have mostly underburned prior to the period of fire exclusion.

Group 10 - Upper subalpine and timberline forests.

Under the current stand conditions in the watershed, stand replacement, i.e extensive tree mortality, will only occur during large, intense, crown-consuming fires. With these types of fires, most of the active burning occurs during one to three 24-hour burning periods. Low rates-of-spread and low fire line intensities are the predominate fire characteristics. Although low fire intensities will usually cause only minor resource damage, prolonged smoldering fires can create a high severity burn under the right conditions, i.e. extremely dry fuel conditions and low humidities. High intensity fires, on the other hand, depend on extreme winds, prolonged drought, or both. The highest fire danger for the watershed occurs from mid-August through October.

Vegetation

Stand Composition

The vegetation of the Upper Lewis Watershed has been categorized into six ecoclasses (Table 4, Ecoclasses in the Upper Lewis Watershed), based on plant species present, their proportions, and potential vegetation. A small portion (less than one percent) is uncategorized due to missing data. The Western Hemlock zone is typically more productive for growing trees, followed by the Pacific Silver Fir and the Mountain Hemlock Zones. Because much of this watershed is at high elevations, most of the landscape is in either the Pacific Silver Fir vegetation zone (69 percent), the Mountain Hemlock zone (10 percent) or alpine (four percent). About six percent are non-forest and include volcanic outflow from historic eruptions of Mount Adams, and three percent are wetlands and water. Only eight percent are in the Western Hemlock Zone. Table 5 (Ecoclasses by Sub-Basin) shows the breakdown of ecoclasses within each sub-basin.

Table 4. Ecoclasses (Vegetation Zones) in the Upper Lewis River Watershed.

Vegetation Zone	Acres	Percent of Watershed
Western Hemlock	5,683	8%
Pacific Silver Fir	52,254	69%
Mountain Hemlock	7635	10%
Alpine	3117	4%
Wetlands and Water	1973	3%
Non-Forest (including blast zone)	4,461	6%
Missing Data	371	<1%
TOTAL:	**75,494**	**100%**

Table 5. Ecoclasses (Vegetation Zones) in the Upper Lewis River Watershed by Sub-basin

Sub-basin	Acres	Western Hemlock	Pacific Silver Fir	Mountain Hemlock	Alpine	Wetlands & Water	Non-Forest
23A	12,067	-	5,584	2,109	1,019	164	3,121
23B	2,343	-	1,530	338	376	14	85
23C	3,071	21	1,971	978	-	57	44
23D	2,226	120	1,715	358	-	31	2
23E	3,693	-	3,074	29	468	49	73
23F	3,747	12	3,041	142	464	23	65
23G	2,199	108	1,858	11	33	53	6
23H	4,704	760	3,355	515	-	15	59
23I	2,251	-	1,673	1	205	183	189
23J	4,834	320	3,430	1	406	207	470
23K	2,311	1,479	823	-	-	5	4
23L	3,577	-	2,831	550	35	99	60
23M	3,785	1,053	2,570	-	-	33	126
23N	2,358	2	1,950	109	-	257	40
23P	1,716	-	1,546	167	-	3	-
23Q	3,032	562	2,335	122	-	11	2
23R	1,278	441	699	64	-	74	-
23S	2,866	-	2,307	98	28	260	2
23T	3,186	124	1,904	975	-	117	66
23U	2,159	-	1,413	564	-	181	1
23V	1,583	-	1,400	86	-	65	32
23W	3,219	8	2,751	394	8	47	11
23X	842	66	729	-	44	3	-
23Y	924	147	749	22	-	-	6
23Z	1,523	459	1,017	-	31	5	11
TOTAL:	**75,494**	**5,683**	**52,254**	**7635**	**3117**	**1973**	**4461**

* 371 acres (less than 1%) of the vegetation zone data are missing.

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 (Appendix E. Stand Structure Definitions). For ease of interpretation, structure stages are combined into seven groups based on ecological functions at a more coarse scale.

Much of the watershed (42 percent) is in the large tree multi-layer structure stage and stretches from the foothills of Mount Adams Wilderness Area west (Table 6. Vegetation Structure Stages). Over half of the 17 percent in open sapling/pole are the result of timber harvest, and represent young stands. The rest is in the Mountain Hemlock vegetation zones found on the middle slopes of Mount Adams and other high elevation sites. These are mature stands that generally do not achieve large size due to environmental limitations. Another 17 percent are in closed sapling/pole. These are primarily natural regeneration stands following fire, although a small portion are regeneration plantations following timber harvest. Nine percent is in non-forest, much of which is in the alpine area of Mount Adams Wilderness. Eight percent is grass/forb/seedling, nearly all of which are very young plantations resulting from timber harvest. Six percent are in large tree single-layer. These stands are probably the result of the Lewis River Fire of the late 1800's. About one percent of the data on structure stages are missing. Table 7 lists the percent of grouped structure stages within the watershed by sub-basin, and Figure 12 (Grouped Vegetation Structure Stages) shows how these structure stages are distributed across the landscape.

Table 6. Vegetation Structure Stages

Structure Stage	# Acres	Percent	Grouped Structure Stage	# Acres	Percent
Grass/Forb	5,826	8	Grass/Forb/Seedling	6,377	8
Shrub/Seedling	0				
Remnant Forest	551	<1			
Open Sapling/Pole	6,814	9	Open Sapling/Pole/Small Tree	13,230	17
Open Small Tree	6,416	8			
Closed Sapling/Pole	2,289	3	Closed Sapling/Pole/Small Tree	12,779	17
Closed Small Tree	10,490	14			
Large Tree Single-Layer	4,513	6	Large Tree Single-Layer	4,513	6
Large Tree Multi-Layer	31,328	42	Large Tree Multi-Layer	31,328	42
Hardwood Sapling/Pole	0		Hardwoods	0	0
Hardwood Shrub/Seedling	0				
Hardwood Trees	0				
Wetlands	1,854	3	Non-Forest	6,397	9
Water	37	<1			
Rock	4,506	6			
Missing Data	873	1	Missing Data	873	1
Totals	75,494	100%		75,494	100%

Table 7. Percent Grouped Vegetation Structure Stages and Percent Harvested by Sub-basin

Sub-Basin	Acres	Percent Harvested	Grass/ Forb/ Seedling	Open Sap/Pole/ Sm Tree	Closed Sap/Pole/ Sm Tree	Lg Tree Single Layer	Lg Tree Multi Layer	Non-Forest	No Data
23A	12,067	2	1	26	9	-	36	27	1
23B	2,343	14	6	29	8	-	53	4	-
23C	3,071	29	18	9	10	-	59	3	1
23D	2,226	41	22	18	8	-	51	1	-
23E	3,693	<1	-	19	23	22	32	3	-
23F	3,747	10	17	28	18	1	32	2	1
23G	2,199	28	20	9	44	2	23	3	-
23H	4,704	7	3	4	54	1	36	2	-
23I	2,251	5	-	13	11	31	28	17	-
23J	4,834	18	8	27	6	5	41	14	-
23K	2,311	26	9	14	17	7	53	-	-
23L	3,577	25	16	20	37	3	19	5	2
23M	3,785	18	12	6	9	27	42	4	-
23N	2,358	<1	1	-	1	44	43	13	-
23P	1,716	6	10	9	-	4	77	-	-
23Q	3,032	44	18	27	20	-	35	-	-
23R	1,278	46	9	34	4	-	48	6	-
23S	2,866	19	7	6	54	-	25	8	-
23T	3,186	27	11	11	5	-	66	6	1
23U	2,159	17	2	19	2	-	68	9	-
23V	1,583	29	14	14	6	-	60	6	-
23W	3,219	22	9	16	4	-	67	2	3
23X	842	37	11	31	43	2	13	-	-
23Y	924	23	9	4	34	-	52	-	-
23Z	1,523	38	14	26	11	18	31	1	-
Total	75,494	17	8	17	17	6	42	9	1

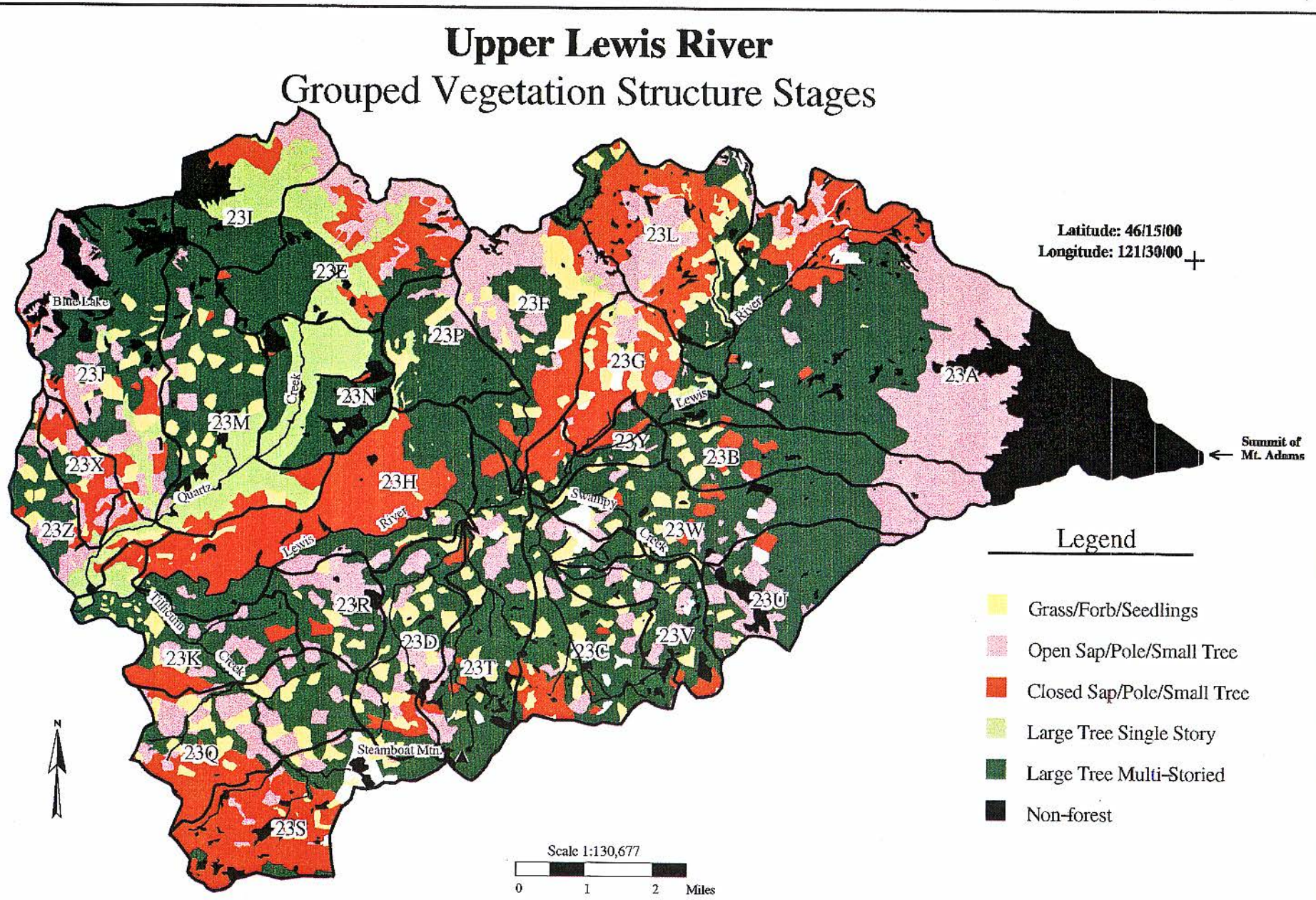


Figure 12. Vegetation Structure Stages characterize vegetation by similar structural attributes.

Stream Riparian Reserves

Riparian areas are recognized as important habitat for many different plants and animals. Stream riparian reserves provide large woody debris input that stabilizes in-stream sediment flow and creates fish habitat. Designated Riparian Reserves with appropriate habitat also serve as migration corridors for plants and animals. Because stream riparian areas often are not destroyed by wildfire, these habitats are often refugia of old-growth associated species.

Within the watershed, the different proportions of stream riparian reserve structure stages are similar to structure stages in other areas of the watershed (Table 8. Grouped Stream Riparian Reserve Vegetation Structure Stages). Forty-six percent are in large tree multi-layer, 16 and 14 percent are in closed sapling/pole/small tree and open sapling/pole/small tree respectively, ten percent are large tree single layer, and 7 percent each are grass/forb/seedling and non-forest.

Table 8. Grouped Stream Riparian Reserve Vegetation Structure Stages in Upper Lewis Watershed.

Total Stream Riparian Reserve Grouped Structure Stages	Acres	Percent
Grass/Forb/Seedling	1060	7
Open Sapling/Pole/Small Tree	2167	14
Closed Sapling/Pole/Small Tree	2344	16
Large Tree Single Layer	1464	10
Large Tree Multi-Layer	6893	46
Non-Forest	1077	7
Missing Data	122	<1
Acres Harvested in Stream Riparian Reserves	2052	14
Total Stream Riparian Reserve	15,127	100

Stand structure and composition within Stream Riparian Reserves has historically been altered by fires, but more recently has been changed by timber harvest activities. Table 9 (Percent Grouped Vegetation Structure Stages of Stream Riparian Reserves by Sub-basin) shows structure stages within stream riparian reserves in each sub-basin, and includes the percent of each sub-basin's stream riparian reserve that has been harvested. The following sub-basins have had over 25 percent of their stream riparian reserves harvested: Steamboat Creek (23D), Upper Sidewall Tributaries (23G), Middle Tillicum Creek (23Q), Surprise Meadow (23R), North Fork Pass Creek (23V), Platinum Creek (23X), and Lower Frontwall Tributaries (23Z).

Table 9. Percent Grouped Vegetation Structure Stages of Stream Riparian Reserves by Sub-basin.

Sub-basin	Acres Stream Riparian Reserve	Percent Stream Riparian Reserve Harvsted	Percent Grass/ Forb/ Seedling	Percent Open/ Sap/Pole/ Sm Tree	Percent Closed Sap/Pole/ Sm Tree	Percent Lg Tree Single Layer	Percent Lg Tree Multi Layer	Percent Non-Forest	Percent Missing Data
23A	2,309	<1	1	28	12	-	44	14	1
23B	345	10	2	28	8	-	60	2	-
23C	766	21	16	4	6	-	69	4	1
23D	524	33	18	14	6	-	62	<1	-
23E	856	0	-	17	29	24	29	1	-
23F	822	9	18	29	6	2	43	1	1
23G	476	31	16	1	48	1	20	5	8
23H	1,026	3	2	3	50	<1	42	4	-
23I	575	6	-	13	14	37	25	11	-
23J	813	12	6	16	3	11	46	19	-
23K	553	17	7	10	8	11	64	1	-
23L	688	22	17	16	35	13	13	6	-
23M	684	8	6	3	2	44	37	8	-
23N	549	0	-	-	-	60	22	18	-
23P	354	10	9	8	-	2	81	-	-
23Q	708	35	18	17	13	-	51	1	-
23R	212	37	6	25	6	-	49	14	-
23S	510	13	5	6	51	-	21	12	5
23T	770	21	7	8	6	-	75	4	1
23U	186	17	-	19	4	-	52	25	-
23V	290	29	14	16	-	-	67	3	-
23W	482	14	12	1	1	-	79	4	3
23X	156	37	18	20	39	6	18	-	-
23Y	214	20	8	1	16	-	75	-	-
23Z	332	26	8	19	3	37	30	3	-
Totals	15,127	14%	7%	14%	16%	10%	46%	7%	<1%

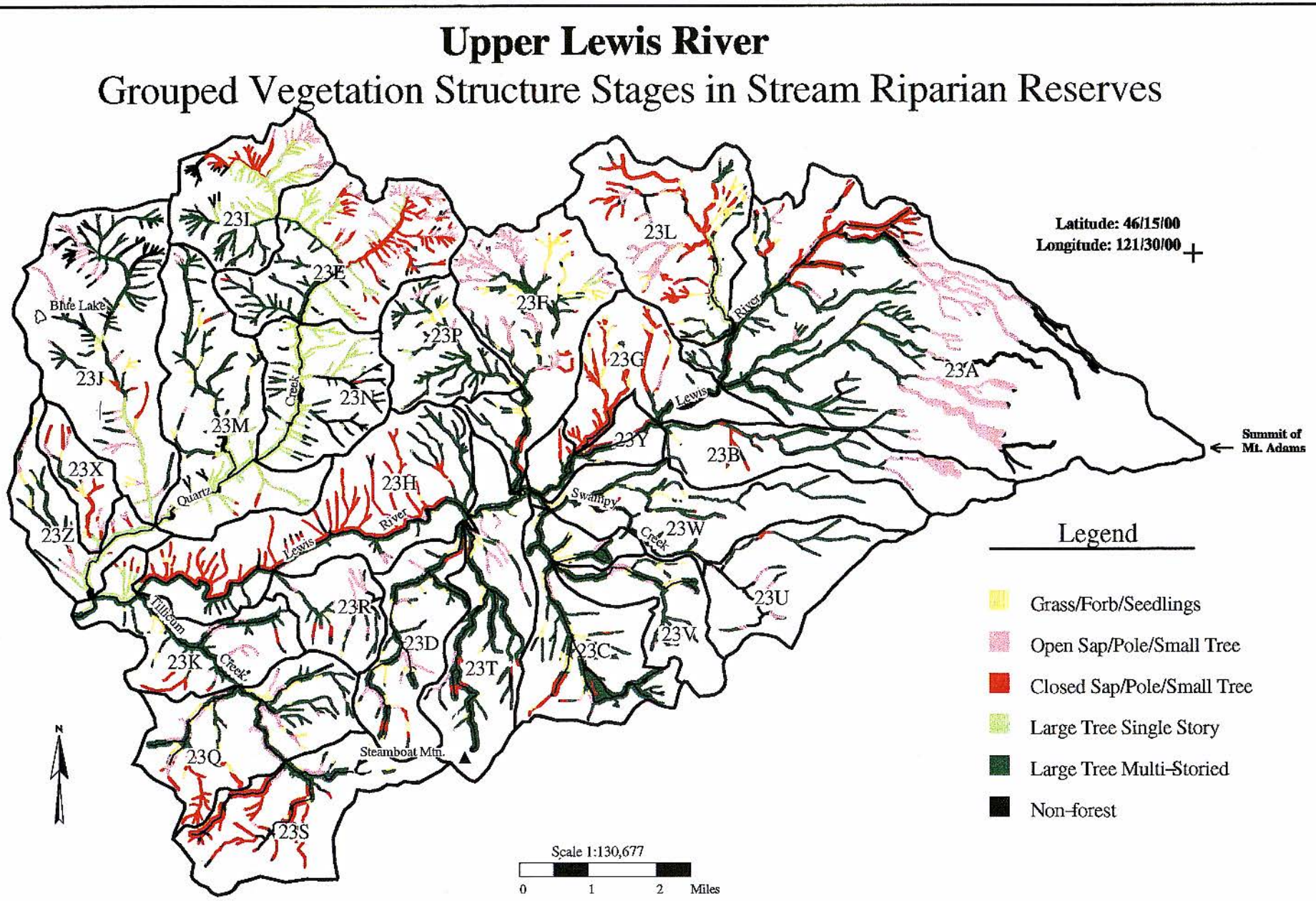


Figure 13. The variation in stand structure and composition within Stream Riparian Reserves is a result of changes in elevation and climate as well as natural and human-caused disturbance.

All Riparian Reserves

In addition to the Stream Riparian Reserves which surround wetlands and streams, Riparian Reserves are designated around unstable or potentially unstable areas. There are an additional 18,000 acres (24 percent) of designated Riparian Reserve because of unstable ground. This total network of Riparian Reserves comprise 44 percent of the watershed. Over half of the Riparian Reserves is in large tree structure stages, a third is younger, natural stands and approximately 17 percent is in plantations (Table 10). Some Riparian Reserves can, depending on their location, site characteristics, and distribution within the watershed, provide valuable habitat and migration corridors for plants and animals.

Table 10. Grouped Total Riparian Reserve Vegetation Structure Stages in Upper Lewis Watershed

Total Riparian Reserve Grouped Structure Stages	Acres	Percent
Grass/Forb/Seedling	2782	8
Open Sapling/Pole/Small Tree	4266	13
Closed Sapling/Pole/Small Tree	5341	16
Large Tree Single Layer	15142	46
Large Tree Multi-Layer	2648	8
Non-Forest	2700	8
Missing Data	325	<1
Acres Harvested in Riparian Reserves	5695	17
Total Riparian Reserve	33204	100

The structure stage composition of all riparian reserves is similar to other parts of the watershed, with similar types and rates of disturbance. The amount and type of habitat in these reserves varies by sub-basin (Table 11). Over half of the sub-basins have greater than 50 percent of all riparian reserves in the large tree structure stage.

Table 11. Percent Total Riparian Reserve Structure Stage by Sub-Basin

Sub-basin	Acres Total Riparian Reserve	Percent Total Riparian Reserve Harvsted	Percent Grass/ Forb/ Seedling	Percent Open/ Sap/Pole/ Sm Tree	Percent Closed Sap/Pole/ Sm Tree	Percent Lg Tree Single Layer	Percent Lg Tree Multi Layer	Percent Non-Forest	Percent Missing Data
23A	3521	2	1	21	12	-	51	13	1
23B	716	22	3	18	19	-	58	2	-
23C	1849	25	17	6	12	60	-	4	1
23D	1177	42	21	20	4	-	52	-	3
23E	1037	0	-	15	24	23	32	5	-
23F	1321	6	13	26	10	2	45	2	1
23G	876	22	15	1	40	4	29	6	4
23H	2588	3	1	3	58	-	36	2	-
23I	773	5	-	10	11	28	21	30	-
23J	1718	22	10	25	3	8	35	20	-
23K	1101	20	8	11	10	6	64	1	-
23L	1268	18	14	12	35	8	20	11	-
23M	1617	12	10	3	6	48	28	6	-
23N	1952	0	-	-	-	44	41	15	-
23P	767	4	5	6	1	1	87	-	-
23Q	1236	35	18	17	15	-	49	1	-
23R	930	46	10	32	3	-	47	8	-
23S	1113	12	3	3	48	-	14	21	10
23T	2935	27	10	12	5	-	66	6	1
23U	487	9	-	19	1	-	41	38	-
23V	961	33	14	18	1	-	59	8	-
23W	1297	21	14	7	1	-	68	5	5
23X	481	37	10	28	42	3	16	1	-
23Y	515	15	5	1	43	-	50	-	-
23Z	969	36	15	22	10	18	34	2	-
Total	33205	17	8	13	16	11	42	8	1

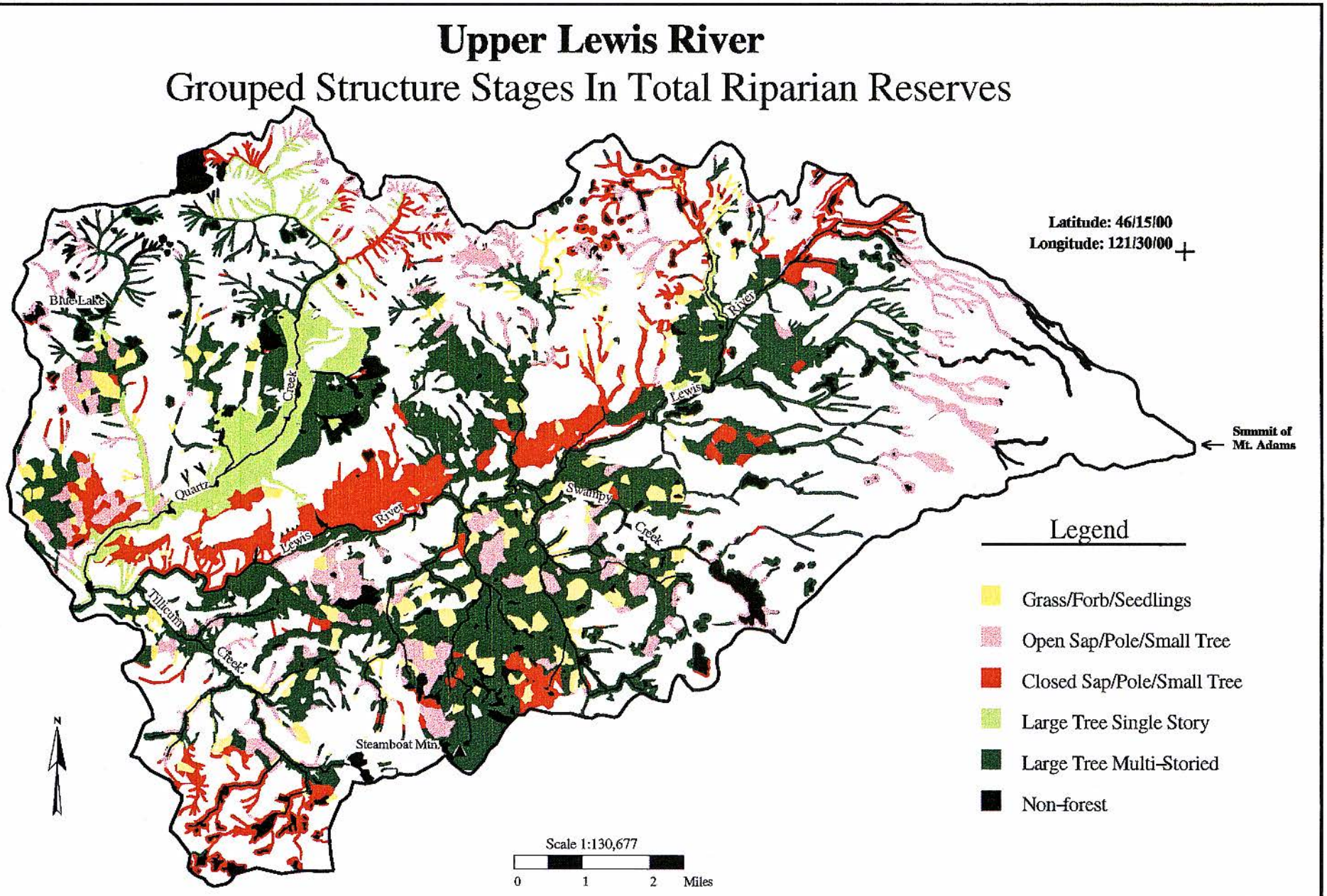


Figure 14. The Riparian Reserves constitute a large portion of the Upper Lewis River watershed.

Mount Adams Wilderness Area

Mount Adams Wilderness Area occupies the eastern-most portion of the Watershed, and is largely in the alpine and Mountain Hemlock vegetation zones. It is under the jurisdiction of Mount Adams Ranger District.

Steamboat Mountain Research Natural Area

Steamboat Mountain Research Natural Area is near the southwest corner of the Watershed and is administered by Mount Adams Ranger District. It is primarily in the Pacific Silver Fir and Mountain Hemlock zones, and includes large multi-storied and small sub-alpine trees. The boundaries for this RNA were recently reallocated to reflect geographic and other easily recognized landscape features such as roads and now include approximately 40 acres of Mount St. Helens NVM lands previously designated as Matrix.

TES Plants

Forests in Region 6 manage vascular and other plants based on the Regional Sensitive Plant List, which includes Federal, Washington, Oregon and Northern California State listed plants, and most C-3 species. The Regional list is currently under revision. Because the list has historically included Federal and State lists, our current working list follows the document prepared by Washington Natural Heritage Program, which includes Washington State species as well as those with Federal protection under the Endangered Species Act (Washington Natural Heritage Program 1997).

A number of special status vascular plants are present in the Watershed. They are *Botrychium lunaria, B. pinnatum, Microseris borealis, Montia diffusa, Carex interrupta* and *Pleuricospora fimbriolata.* Four Botanical Special Interest Areas are administrated to monitor viability of some of these populations. These include the five acre *Montia diffusa* Botanical Special Interest Area Unit #1113 (MAC (Management Area Category) 9L), and three 20 acre *Pleuricospora fimbriolata* sites; Botanical Special Interest Area Unit # 1107 (MAC 9L), #1108 (MAC AA) and Unit #3161 (MAC UH). *Utricularia intermedia,* a Washington State Sensitive plant, was erroneous reported in this watershed. While it is not known to occur in the watershed, there is a high likelihood that it is present in some of the meadows. Several unusual plant habitats, Mulligan, Surprise and Swampy Meadows, are present. These meadows also provide valuable habitat for elk and other animals.

Table 12. Documented and Suspected TES Plant Species

Species	Federal Status	State Status	C-3 Status	Upper Lewis	MSH Unit	Sub-Basins
Agoseris elata	-	S	-	Sus	Sus	
Botrychium lanceolatum	-	S	-	Sus	D	
B. lunaria	-	S	-	D	D	23K (Lower Tillicum)
B. minganense	-	R2	-	Sus	Sus	
B. montanum	-	W	-	Sus	Sus	
B. pinnatum	-	S	-	D	D	23T (Poison Ck)
Carex heteroneura[1]	-	S	-	Sus	D	
C. densa	-	S	-	Sus	Sus	
C. interrupta	-	W	3	-	D	
C. scopulorum v prionophylla	-	W	-	Sus	Sus	

Species	Federal Status	State Status	C-3 Status	Upper Lewis	MSH Unit	Sub-Basins
Chrysolepis chrysophylla	-	S	-	Sus	Sus	
Cicuta bulbifera	SoC	T	-	Sus	Sus	
Cimicifuga elata	SoC	T	2	-	Sus	
Corydalis aquae-gelidae	SoC	T	2	Sus	D	
Cypripedium fasciculatum	SoC	T	2	Sus	Sus	
Epipactus gigantea	-	S	-	Sus	Sus	
Githopsis specularioides	-	S	-	Sus	Sus	
Howellia aquatilis	T	T	-	Sus	Sus	
Liparis loeselii	-	E	-	Sus	Sus	
Lomatium bradshawii	E	E	-	-	Sus	
Luzula arcuata	-	S	-	Sus	Sus	
Microseris borealis	-	S	-	D	D	23L (Boulder Ck)
Mimulus suksdorfii	-	S	-	Sus	Sus	
Montia diffusa	-	S	-	D	D	23J (Straight Ck)
Ophioglossum pusillum[2]	-	T	-	Sus	Sus	
Orobanche pinorum	-	S	-	Sus	D	
Parnassia fimbriata v hoodiana	-	S	-	Sus	Sus	
Pedicularis rainierensis	-	S	-	Sus	Sus	
Platanthera sparsiflora	-	S	-	Sus	Sus	
Pleuricospora fimbriolata	-	W	-	D	D	Botanical Special Interest Areas in 23H & 23Z
Poa nervosa[3]	-	S	-	Sus	Sus	
Polemonium carneum	-	T	-	Sus	Sus	
Polystichum californicum	-	S	-	Sus	Sus	
Saxifraga rivularis[4]	-	S	-	Sus	Sus	
Sisyrinchium sarmentosum	SoC	T	2	Sus	D	
Utricularia intermedia	-	S	-	Sus	Sus	
Utricularia minor	-	R1	-	Sus	D	

Species	Federal Status	State Status	C-3 Status	Upper Lewis	MSH Unit	Sub-Basins
Veratrium insolitum	-	S	-	-	Sus	

Federal/State Status:
T = Threatened E = Endangered S = Sensitive W = Watch
SoC = Species of Concern R1 = need more field work to assess rarity
Species of Concern: Species which is not recognized in the Endangered Species Act, and which does not formally receive any of the protections of the Act. Conservation measures are voluntary and encouraged.
Watch Species: Plant taxon that is more abundant and/or less threatened in Washington than previously assumed.
Occurrence: D = Documented
Sus = Suspected
Former Names: [1] *Carex atrata* var. *erecta* [2] *Ophioglossum vulgatum* var *pseudopodum* [3] *Poa nervosa* var *nervosa*
[4] *Saxifraga debilis*
C-3 Status: 1 = Manage known sites 2 = Survey prior to ground disturbing activities & manage sites
3 = Conduct extensive surveys & manage sites 4 = Conduct general regional surveys

***Botrychium lunaria* (Moonwort)**
Typically found in deep shaded forests at low to mid elevations. Known from diverse habitats including subalpine meadows, alluvial terraces, and old-growth western hemlock/grand fir forests.

***Botrichium pinnatum* (Northern Moonwort)**
On moist to dry sites at elevations between 2100 and 6500 feet. Habitats include moist coniferous forests, mossy talus slopes under mixed deciduous and coniferous cover, subalpine meadows, and disturbed areas.

***Carex interrupta* (Green-fruited sedge)**
Along sandy or rocky riverbanks, in streambeds, and open wet places at lower elevations.

***Microseris borealis* (Bog microseris)**
Sphagnum bogs and wet to moist meadows.

***Montia diffusa* (Branching montia)**
Suspected in moist woods at lower elevations, often appearing after forest fires.

***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, Lichens, Fungi and Bryophytes

Five species of Survey and Manage (C-3) Strategy 1 (manage known sites) lichens (*Dendriscocaulon intricatulum, Hydrothyria venosa, Leptogium rivale, Loxosporopsis corallifera,* and *Pseudocyphellaria rainierensis*) are present in the watershed, 16 category 4 species are present, and a number of other species are suspected to occur (Table 13). A proposed Botanical Special Interest Area has been established to monitor viability of three populations of the aquatic lichen *Hydrothyria venosa* on Snagtooth and Platnum Creeks (sub-basin 23J). Monitoring and in-stream transplantation were mitigation measured implemented for a road decommissioning project that involved culvert removal and potential impact to downstream lichens (Derr 1998).

Table 13. C-3 Survey and Manage Lichens Documented or suspected to occur in the Upper Lewis Watershed, Mt. St. Helens Administrative Unit, or Gifford Pinchot National Forest (X = Documented Presence)

SPECIES	Survey & Manage Strategy	ULWA	MSHNVM	GPNF
Leafy (arboreal) Lichens				
Hypogymnia duplicata	1,2,3			
Tholurna dissimilis	1, 3			X
Rare Nitrogen-fixing Lichens				
Dendriscocaulon intraculatum	1,3	X	X	X
Lobaria hallii	1, 3		X	X
Lobaria linita	1,2,3			
Nephroma occultum	1, 3		X	X
Pseudocyphellaria rainierensis	1, 2, 3	X	X	X
Aquatic Lichens				
Dermatocarpon luridum	1,3		X	X
Hydrothyria venosa	1,3	X	X	X
Leptogium rivale	1,3	X	X	X
Rare Rock Lichens				
Pilophorous nicricaulis	1,3			X
Sticta arctica	1,3			
Rare Oceanic Influenced Lichens				
Hypogymnia oceanica	1,3			
Oceanic Influenced Lichens				
Loxosporopsis corallifera (formerly *Loxospora* sp nov.)	1,3	X	X	X

SPECIES	Survey & Manage Strategy	ULWA	MSHNVM	GPNF
Nitrogen-fixing Lichens				
Lobaria oregana	4	X	X	X
Lobaria pulmonaria	4	X	X	X
Lobaria scrobiculata	4	X	X	X
Nephroma bellum	4	X	X	X
Nephroma helveticum	4	X	X	X
Nephroma laevigatum	4	X	X	X
Nephroma parile	4	X	X	X
Nephroma resupinatum	4	X	X	X
Pannaria saubinetti	4	X	X	X
Peltigera collina	4	X	X	X
Peltigera neckeri	4			
Peltigera pacifica	4			
Pseudocyphellaria anomala	4	X	X	X
Pseudocyphellaria anthraspis	4	X	X	X
Pseudocyphellaria crocata	4	X	X	X
Sticta fuliginosa	4	X	X	X
Sticta limbata	4		X	X
Pin Lichens				
Calicium viride	4			X
Riparian Lichens				
Cetrelia cetrarioides	4		X	X
Collema nigrescens	4			X
Leptogium saturninum	4		X	X
Leptogium teretiusculum	4			X
Platismatia lacunosa	4	X	X	X
Ramalina thrausta	4			
Usnea longissima	4	X	X	X

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

The vascular plant *Allotropa virgata* (category 1 & 2) is present in the watershed, and a number of other species are suspected to occur (Table 14). The watershed has not been surveyed for bryophytes or fungi.

Table 14. C-3 Vascular Plants Suspected or Documented in the Upper Lewis River Watershed

Species	Federal Status	State Status	C-3 Status	ULW	MSH Unit
Allotropa virgata	-	-	**1,2**	**S**	**D**
Arceuthobium tsugense	-	-	1,2	S	D
Botrychium minganense	-	S	1,2	S	D
B. montanum	-	S	1,2	S	D
Coptis asplenifolia	-	S	1,2	S	S
C. trifolia	-	-	1,2	S	S
Corydalis aquae-gelidae	-	T	1,2	S	S
Cypripedium fasciculatum	-	T	1,2	S	S
C. montanum	-	M3	1,2	S	S
Galium kamtschaticum	-	S	1,2	S	S
Habenaria orbiculata	-	M3	1,2	S	S

Habitat Conditions for Terrestrial Animals

Based on the existing vegetation and vegetation structures, the Upper Lewis Watershed contains habitats that could support approximately 239 animal species (GPNF 1995). Potential habitats exist for five federally listed species, two Forest Service sensitive species, and eight Survey and Manage (C-3) species.

Fires, timber harvesting, and road construction have all shaped the forest conditions that exist in the watershed today. Late-successional/old-growth (LSOG) habitat in the watershed is found in primarily two large patches separated by fragmented forest. These two patches provide high quality habitat for the spotted owl and other LSOG associated species. The watershed also contains five cliffs sites that could serve as suitable nesting habitat for the peregrine falcon. Habitat conditions for the gray wolf, grizzly bear, and wolverine in the Lewis Late-Successional Reserve (LSR) portion of the watershed will improve over time. However, it is not known whether these latter three species will ever permanently occupy the area. Known populations of Larch Mountain and Van Dyke's salamanders exist and suitable habitat for the great gray owl and possibly five forest bat species are believed present.

Federally Listed Animal Species

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

Table 15. Federally listed species 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	*Strix occidentalis caurina*	threatened	yes	high
Bald eagle	*Haliaeetus leucocephalus*	threatened	yes	high
Peregrine falcon	*Falco peregrinus*	endangered	no	moderate
Grizzly Bear	*Ursus arctos*	threatened	no	moderate
Gray wolf	*Canis lupus*	endangered	yes	high

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 - For this assessment the northern spotted owl was used as an indicator of species associated with LSOG habitats. The overall habitat condition for the northern spotted owl should also serve as an indication of the conditions for other LSOG associated species such as the northern goshawk, fisher and American Marten.

Twenty-two northern spotted owl activity centers are within the Upper Lewis Watershed (Table 16). Nine of these activity centers are found in the Matrix allocation. A 100-acre LSR was established around each of the nine sites (Figure 15).

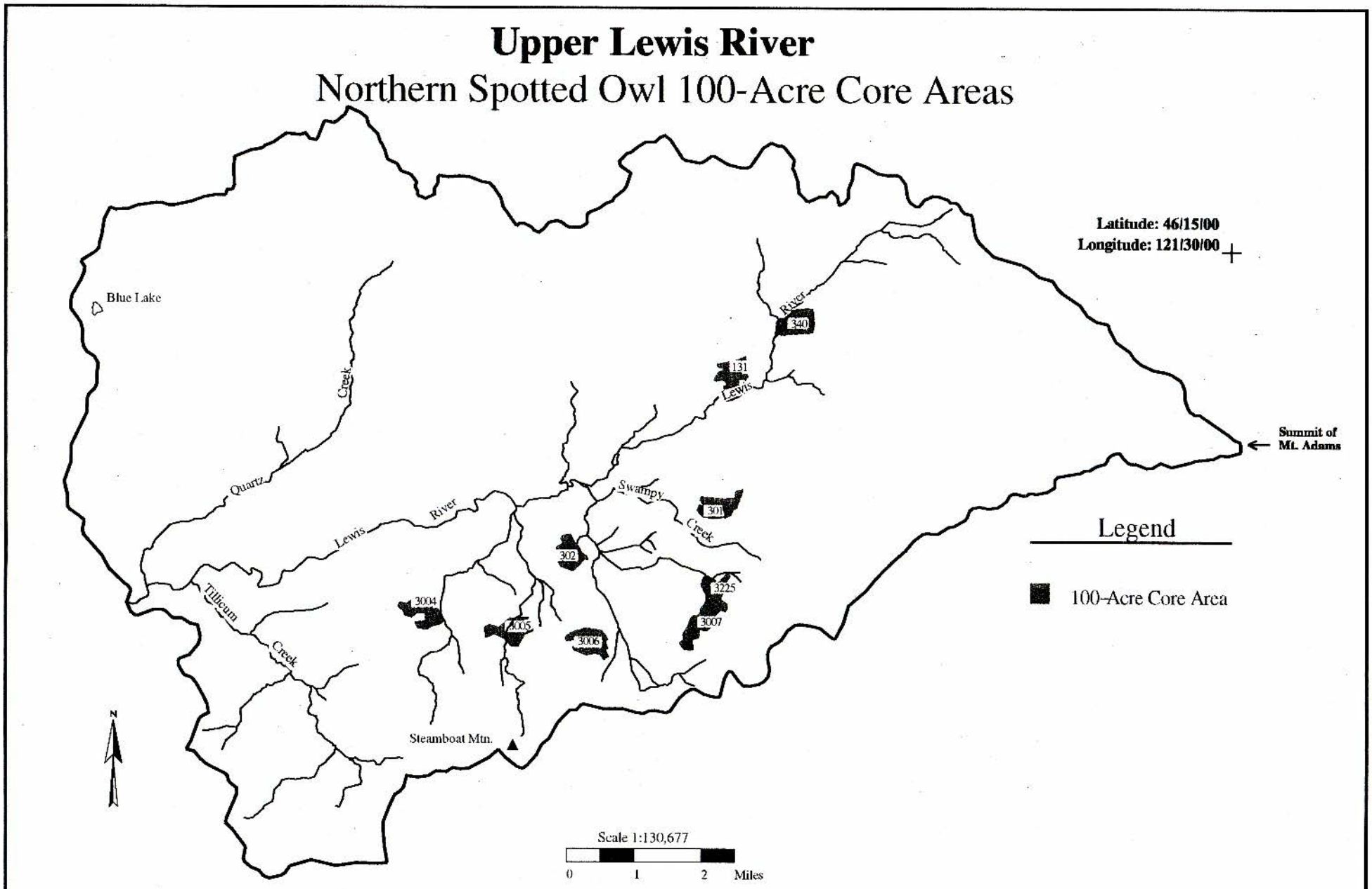


Figure 15. Displayed are the Northern spotted owl 100-acre LSR. One hundred acres of the best northern spotted owl habitat is retained as close to the nest site or owl activity center as possible for all known (as of January 1, 1994) spotted owl activity centers found in the Matrix and Adaptive Management Areas.

Activity centers are typically an area of concentrated use by an owl(s) or a nest site center. Table 16 displays the acres of suitable habitat within owl home ranges that occur in the watershed.

Northern spotted owl habitat is divided into three categories: suitable, dispersal and unsuitable habitats. Suitable habitat is all inclusive and provides for all of the owls' life needs (that is, nesting, roosting, foraging and dispersing). These forest stands range from classic old-growth to fire-regenerated forest stands whose trees have an average diameter at breast height (d.b.h.) of at least 16 inches but may lack trees more than 21 inches d.b.h. Dispersal habitat is used by owls while moving from one area of suitable habitat to another (USDA 1993). The average tree diameter at breast height in dispersal habitat stands is at least 11 inches. Dispersal habitat usually lacks the large diameter trees and the snags that are normally required for owl nesting.

Complete northern spotted owl surveys have not been conducted in the watershed since 1995, except for approximately 500 acres in association with the Tile Timber Sale. Three complete surveys were conducted in 1997 and three are planned for the summer of 1998 (See Tile TS analysis file for survey results).

Normally, an owl activity center is considered active if occupancy is verified within five years of previous detection. Three of the Upper Lewis's owl sites were considered inactive (Table 16). Although owl sites #111 and #1213 were considered inactive, because both are located in a Late Successional Reserve (LSR), there is a high chance of reoccupancy.

Table 16. Acres of suitable habitat within 0.7 and 1.82 miles of a spotted owl home range center. Number in bold print indict acres within a home range below a minimum viability threshold and these site centers may no longer be occupied. Complete surveys were last conducted in the watershed in 1995.

Activity Center	Management Allocation	Suitable Habitat within 0.7 miles	Suitable Habitat 1.82 miles
110	LSR	606	4,002
111	**LSR**	**419**	**4,005**
112	LSR	658	4,068
113	LSR	955	3,929
114	LSR	903	5,353
119	LSR	917	5,274
120	LSR	962	5,471
126	LSR	902	4,843
127	LSR	566	3,139
132	Matrix	1,666	10,140
133	LSR	907	4,616
301	Matrix	689	4,459
302	Matrix	577	4,534
303	LSR	711	3,976
327	LSR	630	4,388

Activity Center	Management Allocation	Suitable Habitat within 0.7 miles	Suitable Habitat 1.82 miles
340	Matrix	857	4,934
1015	LSR	805	4,671
1114	LSR	739	3,136
1213	**LSR**	**312**	**1,862**
3004	Matrix	575	4,127
3005	Matrix	695	3,360
3006	Matrix	662	3,725
3007	Matrix	596	3,394
3009	CWA	955	3,544
3225	**Matrix**	**626**	**2,645**

The overall distribution of suitable and dispersal habitats within the watershed is shown in Figure 16. Outside of reserved area lands, suitable and dispersal spotted owl habitats, or as it will be referred to collectively as dispersing habitat, will be managed to provide conductivity between LSRs. Currently within the watershed, dispersing habitat is fragmented in the Matrix and western portions of the Lewis LSR. Contiguous blocks of dispersing habitat are found in the eastern part of the Lewis River LSR and Mount Adams Wilderness (Figure 17).

Table 17 displays the acres of dispersing habitat in each sub-basin. Areas outside the large reserves provide critical links between the reserves. Evidence has shown that spotted owl and other highly mobile LSOG-associated species do not always follow linear corridors while dispersing (USDA 1992). These species, instead, tend to disperse randomly.

For spotted owls it has been shown that over a given area if 50 percent of the land base has an average forest stand diameter at breast height of 11 inches and a minimum canopy closure of 40 percent (50-11-40 rule) then the area should provide sufficient dispersing opportunities. A Northwest Forest Plan (ROD pg-30) analysis determined dispersing avenues could be maintained without meeting the "50-11-40" requirements, due to the acreage of late-successional and other reserves being well distributed in the Matrix. Moreover, the reserves are closer together than previously planned.

The "50-11-40" analysis was applied here to provide an indication of the dispersing habitat condition. Table 17 shows that Sub-basin 23A is the only sub-basin not meeting the "50-11-40" rule. A large portion of this sub-basin flanks the upper elevations of Mount Adams and will not develop into suitable habitat. So, the chances of the sub-basin ever providing an adequate level of dispersing habitat are unlikely. The assessment of dispersing habitat suggests that all sub-basins within the watershed are providing adequate dispersal options.

Table 17. This table displays acres and percent of owl dispersing habitats by sub-basin. Sub-basin 23A contains less than 50 percent dispersing habitat for spotted owls and late-successional/old growth associated species. Suitable and dispersal habitats were consolidated and called dispersing habitat.

Sub-basin (acres)	Dispersing Habitat acres/percent		Unsuitable Habitat acres percent	
23A (12,067)	5,424	45%	6,579	55%
23B (2,343)	1,253	53%	1,091	46%
23C (3,072)	2,120	75%	941	30%
23D (2,224)	1,270	57%	953	43%
23E (3,692)	3,175	72%	517	14%
23F (3,751)	3,115	83%	657	18%
23G (2,197)	1,529	70%	668	30%
23 H (4,705)	4,377	94%	301	6%

23 I (2,252)	**1,811**	**80%**	**441**	**20%**
23 J (4,835)	**3,185**	**65%**	**1,650**	**34%**
23 K (2,311)	**1,711**	**74%**	**599**	**26%**
23 L (3,576)	**2,429**	**68%**	**1,145**	**32%**
23 M (3,788)	**2,955**	**79%**	**787**	**21%**
23 N (2,358)	**2,278**	**97%**	**80**	**4%**
23 P (1,716)	**1,457**	**84%**	**258**	**15%**
23 Q (3,033)	**1,680**	**55%**	**1,352**	**44%**
23 R (1,278)	**853**	**67%**	**424**	**33%**
23 S (2,866)	**1,915**	**67%**	**171**	**6%**
23 T (3,186)	**2,177**	**68%**	**1,010**	**32%**
23 U (2,159)	**1,594**	**73%**	**564**	**34%**
23 V (1,583)	**1,018**	**64%**	**534**	**34%**
23 W (3,220)	**2,202**	**68%**	**1,018**	**37%**
23 X (841)	**484**	**58%**	**357**	**42%**
23 Y (924)	**794**	**86%**	**130**	**14%**
23 Z (1,524)	**893**	**58%**	**631**	**41%**
TOTAL			**22,858**	**30%**

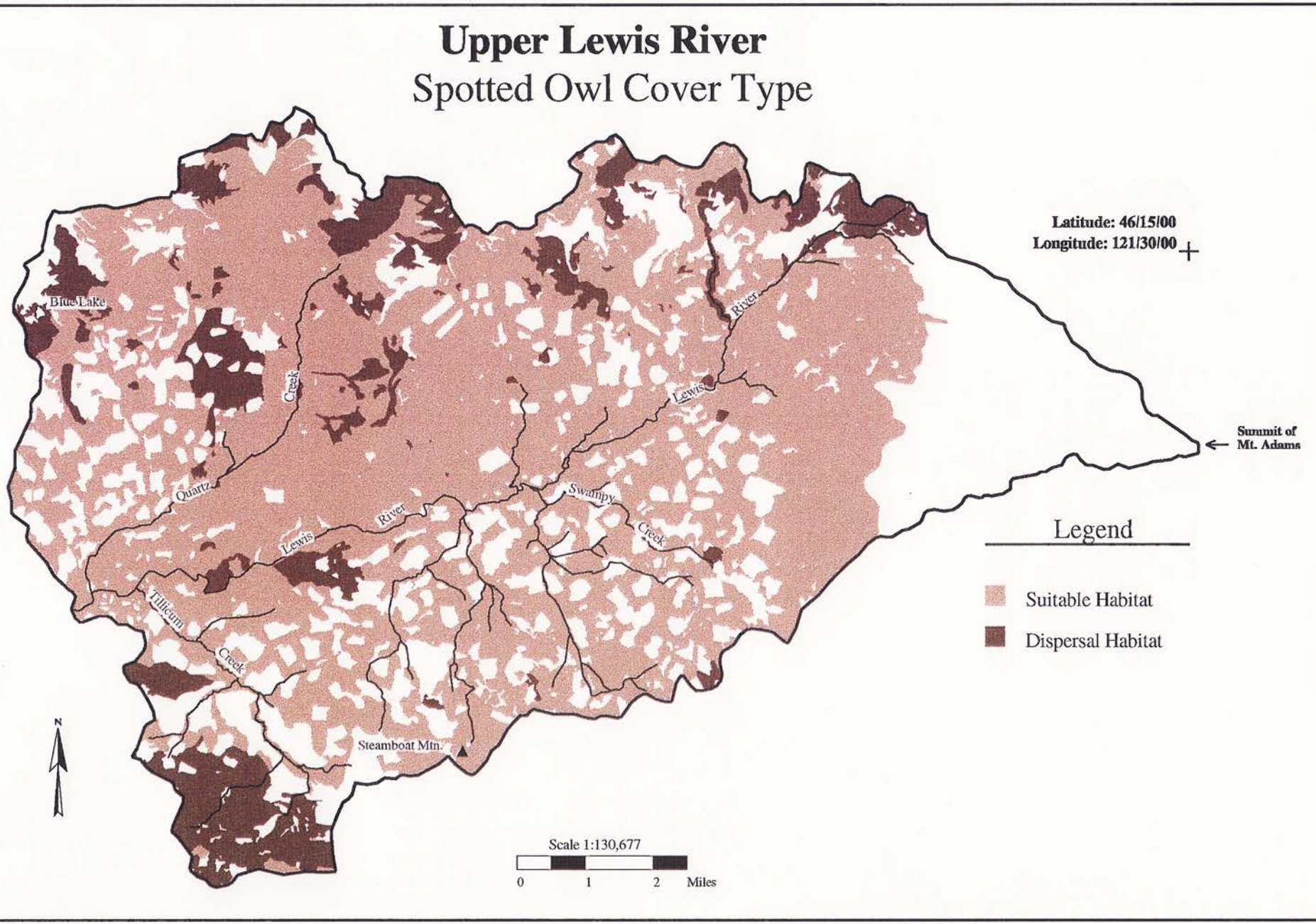


Figure 16 Displayed is the distribution of northern spotted owl habitats (Suitable, dispersal and unsuitable) within the Upper Lewis Watershed.

More specifically, one function of the Riparian Reserves interspersed throughout the Matrix is to provide dispersal avenues between large reserve blocks (Figure 8). Use of Riparian Reserves for dispersing will become even more critical as a large percentage of the Matrix is harvested. The quantity of dispersing habitat in not very abundant in Sub-basins 23B, 23D 23Q, 23X, and 23Z. These five sub-basins contain only slightly more than 50 percent dispersing habitat, and furthermore have less than 70 percent large tree/small tree structural stages in the Riparian Reserves. An assumption was made for this analysis that sub-basins containing less than 50 percent dispersing habitat and less than 70 percent large tree/small tree stage structural stages in the Riparian Reserves may limit dispersal options for LSOG associated species. Although no sub-basins are below these two thresholds, dispersal habitat in these five sub-basins is not very abundant..

The Upper Lewis contains several management allocations: Matrix, Late-Successional Reserve (LSR), Congressionally Withdrawn Area (CWA) and Administratively Withdrawn Area (AWA) and Adaptive Management Area (AMA) each having uinque management directions (ROD). Figure 17 displays the distribution of spotted owl habitats within the management allocations. Only forest stands in the Matrix allocation are scheduled for some type of timber harvest.

Table 18. Distribution of spotted owl habitat within Northwest Forest Plan management allocations. Sixty-five percent of the suitable spotted owl habitat is found in management allocations not scheduled for timber harvest.

Owl Habitat	LSR		Matrix		CWA		AWA		AMA	
	Acres	percent	Acres	percent	Acres	percent	Acres	percent	Acres	percent
Suitable Habitat (43,907)	21,953	**49%**	14,621	**33%**	3,155	**7%**	4,157	**9%**	21	**<1%**
Dispersal (7,873)	4,273	**54%**	2,536	**32%**	437	**5%**	617	**8%**	10	**<1%**
Unsuitable (23,313)	6,820	**29%**	8,655	**37%**	6,999	**30%**	834	**3%**	5	**<1%**
Total (75,093)	33,046	**44%**	25,812	**34%**	10,591	**14%**	5,608	**7%**	36	**<1%**

The percent of spotted owl habitat varies within each allocation. More than 60 percent (49,245) of the watershed is within a reserve allocation and 65 percent (29,265 acres) of these reserved lands are classified as suitable spotted owl habitat. The forest Matrix covers 34 percent (25,812 acres) of the watershed and contains 33 percent (14,621 acres) of the suitable spotted owl habitat. It is important to recognize that the Matrix Allocation also contains a network of Riparian Reserves (14,000 acres) that are not scheduled for timber harvest.

Critical Habitat for the Northern Spotted Owl - In January 1992, the U. S. Fish and Wildlife Service designated lands as critical habitat for the northern spotted owl throughout its range. The Record of Decision for the Northwest Forest Plan directed that site-specific considerations of critical habitat in the matrix are evaluated through watershed analysis and addressed in area-specific plans. There are approximately 27,201 acres of designated northern spotted owl critical habitat (CHU WA-38) in the upper Lewis River Watershed (Figure 17).

The Lewis LSR exceeds areas designated as critical habitat in the watershed both in physical area and habitat. The Lewis LSR within the watershed alone protects more than 3,500 more acres of suitable habitat than the CHU within the watershed. Furthermore, AWA and CWA land allocations provide for additional protected habitat acreage, up to 10,900 acres. Within the CHU itself, more than 95 percent of suitable habitat

is in the protective land allocations. The remaining 4 percent is located within the matrix portion of the CHU.

However, an analysis based on quantity estimates as above may be misleading because we would expect to find more area within LSRs by virtue of their large size. Some measure of habitat quality at a landscape scale may be a better parameter to compare critical habitat and LSR functioning. This is because of past management actions (such as timber harvest) which fragmented late-successional and old-growth forests throughout the watershed before the Northwest Forest Plan. Such descriptions of forest fragmentation are not readily recognized in analysis based strictly on habitat quantity. An analysis of suitable interior habitat would be a better method to assess spotted owl habitat quality. This is because the greater the degree of fragmentation that has occurred, the less suitable interior habitat that would be available.

A draft landscape nesting potential model developed by the U.S. Fish and Wildlife Service was used to determine habitat quality (N. Darby per. com. 1998). The model buffers suitable spotted owl habitat stands 325 feet (100 m) from openings to generate a layer depicting suitable interior habitat (1993). The amount of suitable interior habitat available within a 0.784 mile radius circle from any particular point across the landscape are summarized. The 0.784 mile radius was used because it represents the core area of use by nesting spotted owls.. The results are then reclassified to depict areas where the amount of suitable interior habitat is less than and greater than 360 acres. Areas with greater than 360 acres are considered high nesting potential areas. The threshold level of 360 acres was derived from Johnson (1993) who noted when suitable interior forest fell below 360 acres within a 0.784 mile radius circle, no spotted owls were present.

So, from this draft model it was determined where suitable habitat is of sufficient quantity and quality in the CHU. The CHU within the watershed encompasses 48 percent of the high nesting potential areas found in the entire watershed. Only five percent of high nesting potential areas fall within the matrix portion of the CHU. The Lewis LSR within the watershed encompasses 55 percent of the high nesting potential areas. When AWA and CWA are included as land allocations in the watershed, 71 percent of the high nesting potential areas are under some level of protection from harvest. In addition, the LSR, AWA and CWA land allocations help better preserve the remaining dispersal corridor of high nesting potential areas available between the Lewis and Gotchen LSRs.

A critical link that was not ideally provided for between CHU WA-38 and CHU WA-42. CHU WA-42 encompasses the Gotchen LSR.

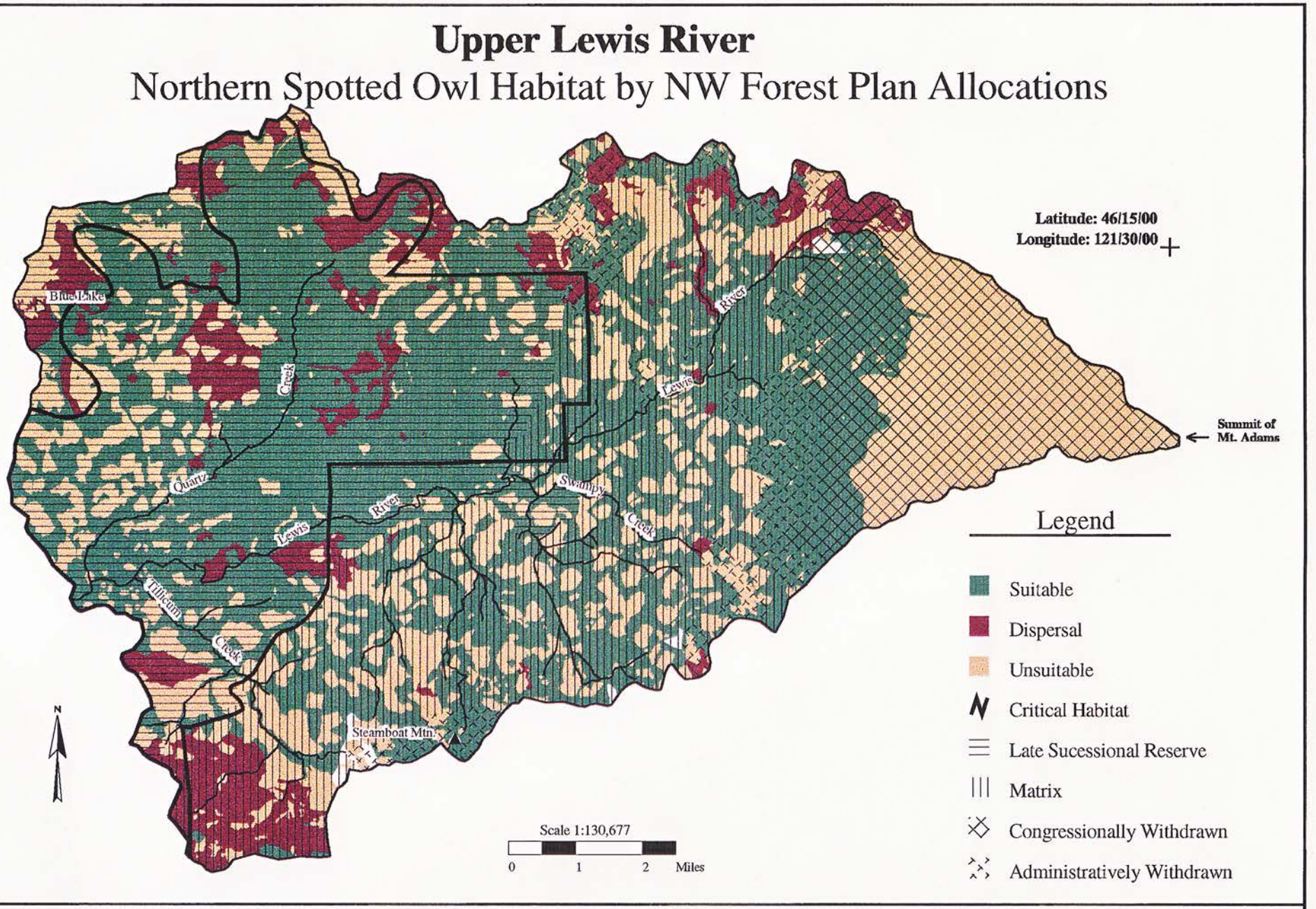


Figure 17. Displayed is the distribution of northern spotted owl habitats within the various Northwest Forest Plan management allocations. High levels of fragmentation are present in the Matrix and western section of the Lewis LSR. The largest block of contiguous suitable habitat is located in the Mount Adams Wilderness and eastern part of the Lewis LSR.

Bald Eagle - Chance sightings of bald eagles have occurred in the watershed, although no formal surveys have been conducted. 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 form excessive human disturbance (USDI 1986). Dave Andersen (pers. comm.) an area biologist for the Washington Department of Fish and Wildlife believed the Upper Lewis Watershed was not very conducive for bald eagle nesting. The area lacks an abundance of spring and summer prey necessary for eagle diets. The three major falls above Swift Reservoir (e.g., Lower, Middle and Upper Falls), not to mention the three downstream barrier dams, probably act as migration barriers preventing the establishment of anadromous fish runs. Some portions of the watershed may provide limited winter foraging opportunities: winter ungulate carrion. The lower elevation corridor along the Lewis River receives concentrated elk use during the winter. Bald eagles may exploit winter killed elk along this narrow strip of winter range (See Figure 18 for map of ungulate winter range occurring in the Upper Lewis Watershed).

Peregrine Falcon - There are no known active peregrine falcon eyries in the watershed. However, no formal surveys have been conducted. The peregrine falcon is almost exclusively dependent on high sheer cliffs for nest sites and their diets consist primarily of birds. Typically, nests are found on inaccessible cliff ledges usually near water (USDA 1982). Several sub-basins have high cliffs that could possibly provide nesting opportunities: 23I, 23J, 23L and 23T. None of the sites are known to have had traditional or historical use and were not identified in the Peregrine Recovery Plan as locations for possible re-introductions. All sites are in management allocations not scheduled for timber harvest. Recreational use or lack of available prey species may make these potential sites unsuitable.

Gray Wolf and Grizzly Bear - In 1992 a reliable visual sighting of two gray wolves was made in Sub-basin 23J (Straight Creek). Occasionally, undocumented and unconfirmed visual sightings have occurred throughout the watershed as well. No confirmed grizzly bear sightings have occurred in the watershed. The Upper Lewis is not in a gray wolf or grizzly bear recovery zone.

The key elements in suitable habitat for wolves and grizzly bears are a sufficient year-round prey base (ungulates and alternate prey), suitable den and rendezvous sites (wolf), and sufficient space with minimal human disturbance.

No formal surveys have been conducted for either species. The likelihood of either species permanently occupying the watershed is very low. The large blocks of mature forest in the Lewis LSR and Mount Adams Wilderness Area offer some level of seclusion from human disturbance making chance sightings of either species high.

Prey Base - Fundamental to wolf survival is a healthy ungulate population. Amendment 11 predicts the goal of managing Roosevelt elk (*Cervus elaphus)* at the 1990 habitat capacity level and increasing black-tailed deer (*Odocoileus hemionus)* numbers can be achieved by maintaining 44 percent optimal thermal cover in deer and elk winter range. Optimal thermal cover conditions are generally found in those late successional / old-growth forest with multi layered canopies and at least 70 percent canopy cover (Brown 1985).

Within the Upper Lewis deer and elk (ungulates) biological winter range covers approximately 4 percent (3,192 acres) of the watershed (Figure 18). This area is primarily found along the Lewis River and Quartz Creek. The winter range boundary does not stop at the watershed boundary to the west but extends well into the Middle Lewis Watershed along the Lewis River. Generally, ungulate biological winter range is found at lower elevations (less than 2,200 feet) and is very closely associated with the western hemlock zone. Table 19 lists the amount of forage and cover present.

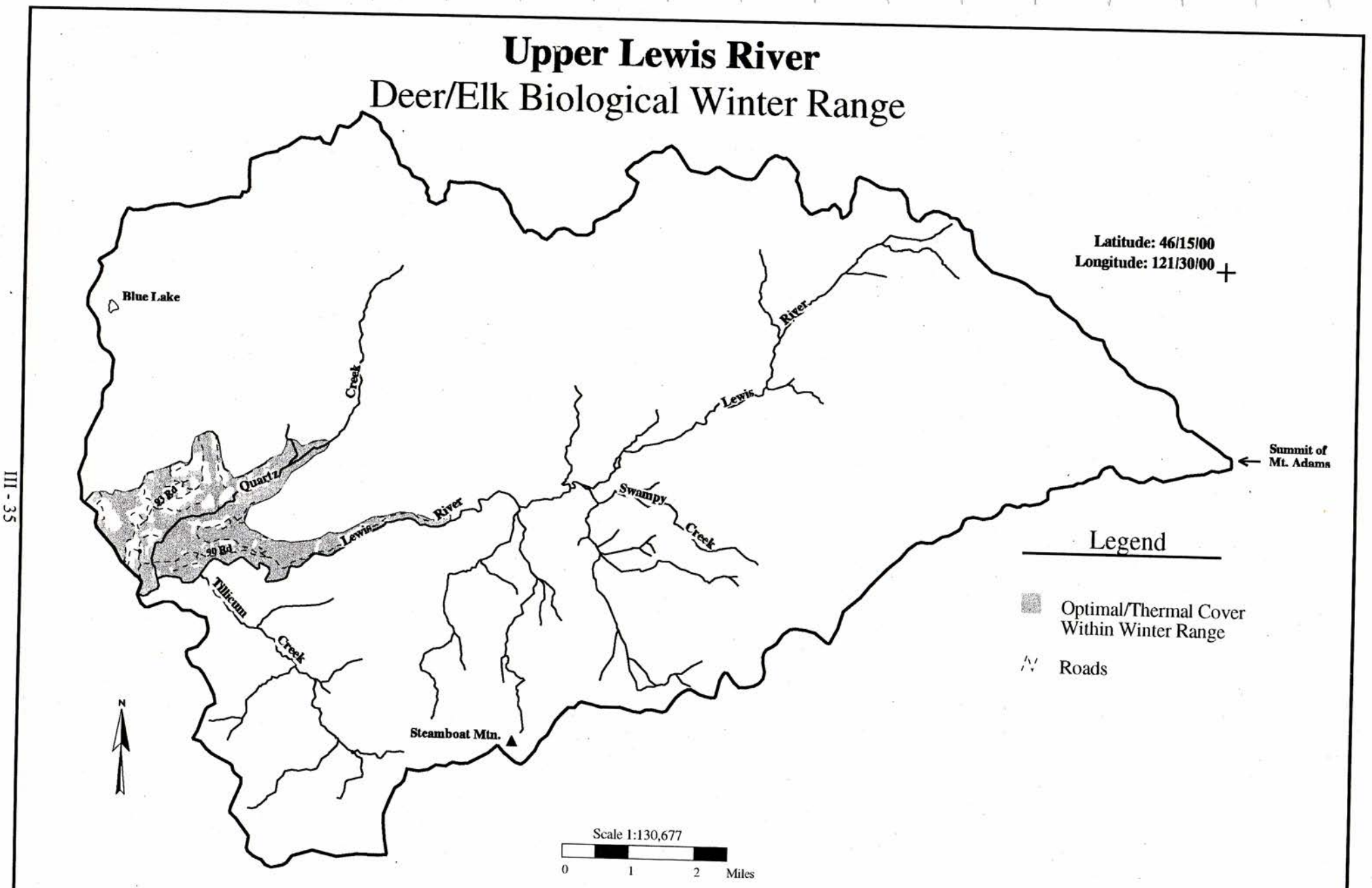


Figure 18. Displayed is the optimal thermal cover distribution and road locations with ungulate biological winter range. Biological winter range contains 38 percent optimal thermal cover. Road density within winter range is 3.6 miles per square mile.

Den and Rendezvous Sites and Security - No current or historic den or rendezvous sites are known to exist in the watershed for either wolves or grizzly bears. Fredrick (1991) reported that wolf populations ceased to breed and were rapidly extirpated when road densities exceed 0.94 miles per square mile. The degree of seclusion (lack of human presence) also affects the likelihood of a suitable site serving as a den and/or rendezvous site. Chapman and Feldhamer (1982) reported that wolf dens are usually located on slopes, ridges, or other high ground near a source of water. Rendezvous sites are used after pups leave the den but are not yet old enough to hunt with the adults. Both den and rendezvous sites are located far from trails and open roads.

Ruediger and Mealey (1978) suggested total road densities greater than one mile per square mile were detrimental to grizzly bear. Grizzly bear dens are found in areas that will be well covered with a blanket of snow to minimize the loss of warm air and that will provide security for the winter (IGBC 1993). These sites are normally at high elevations away from development or human activity.

Currently the Upper Lewis watershed has 232 miles of road, equaling a density of 1.9 miles per square mile. Table 29 displays road densities by each sub-basin. Road densities are low (below 1.0 mile per square mile) in Sub-basins 23A, 23E, 23I, 23N, and 23P. These four of the five sub-basins make up a part of Lewis River LSR and offer some security from human disturbance. These areas could contain suitable habitat for wolf dens and rendezvous site.

Sub-basin 23A also contains many small wetlands and part of the sub-basin is above 3000 feet. These conditions could offer suitable habitat for grizzly bear denning.

Although, the listed sub-basins may contain some suitable conditions for both species, the likelihood of a wolf pack or grizzly bear permanently occupying the watershed is very low. Both species require a large expanse of seclusion from human interaction, and it is not certain whether the surrounding areas meet this requirement.

Sensitive Animal Species

Habitats that are potentially suitable exist in the Upper Lewis Watershed for two sensitive species: the wolverine *(Gulo gulo)* and Larch Mountain Salamander. The common loon *(Gavis immer)* was initially considered in this analysis but was eliminated because of the lack of suitable habitat. There are six lakes present in the Upper Lewis Watershed but all are either too shallow or small to provide suitable habitat. See section on aquatic animal and habitat for a description of lakes. The Larch Mountain salamander is discussed in the Survey and Manage species section. 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 for this and all sensitive species populations.

Wolverine - No documented sightings of the species have occurred in the watershed. The wolverine is similar to the gray wolf in that it has a very large home range, uses a variety of habitats, depends on ungulates for at least part of its food supply, and is extremely sensitive to human disturbance. Wolverine habitat is generally characterized by its remoteness from humans and human developments (USDA 1994). Because of their large home range, it is possible that wolverines exist on the Gifford Pinchot National Forest and may temporarily use of portions of the watershed. Areas most likely to provide at least temporary habitat for wolverines are the Mount Adams Wilderness (Sub-basin 23A) and the Dark Divide Roadless Area (Quartz Creek) (23E, 23I, 23N and 23P). As road closures continue in the Lewis River LSR the chances will improve for wolverine occupation.

Survey and Manage Animal Species (C-3)

Habitats that are potentially suitable exist in the Upper Lewis River for eight vertebrate Survey and Manage species. Survey and manage or C-3 species receive additional management consideration because preliminary habitat assessments predicted low viability if only the reserve network was established (ROD Pg C-4). Table 20 lists the eight species.

Potentially suitable habitats exist for several mollusc species that are also categorized Survey and Manage. No know sightings exist, but no formal surveys have been conducted. More information on these species will become available as survey that must precede the design of all fiscal year 1999 ground disturbing projects are implemented.

Table 20. Survey and Manage Species (C-3) which are Known or Suspected to Occur in the Watershed.

Common Name	Species Name	Documented sighting in watershed	Probability of occurrence in watershed
Larch Mountain Salamander	*Plethodon larselli*	Yes	High
Van Dyke's salamander	*Plethodon vandykei*	Yes	High
Great gray owl	*Strix nebulosa*	No	Moderate
Lynx	*Felis canadensis*	No	Low
Townsend's big eared	*Coreorhinus townsendi*	Yes	High
Long-eared myotis	*Myotis evotis*	No	Moderate
Long-legged myotis	*Myotis volans*	No	Moderate
Fringed myotis	*Myotis thysanodes*	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.

Larch Mountain and Van Dyke's Salamander - Larch Mountain salamanders have been found in several sub-basins within the Upper Lewis including 23D, 23E, 23J, 23M, 23N, and 23Z (Pers. Com. C. Crisfulli 1998). Van Dyke's salamanders were also located in Sub-basins 23E, 23J and 23N.

In the Washington Cascade range, Larch Mountain salamanders inhabit forest talus or boulder fields, cave entrances and mature and old-growth forest. They can be found on steep slopes (greater than 40%) under Douglas-fir bark that has fallen to the forest floor. This species can also be found near streams, but where the vegetation is clearly an upland association (D. Olson et al. 1996 in prep).

The Van Dyke's salamander is considered 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. Since 1994, surveys have been conducted for both species in association with planned timber sales in sub-basins 23A, 23B, 23C, 23F, 23G, 23L, 23V, 23U, 23Y, and 23W.

Great gray owl - No historic sightings of great gray owls have occurred in the watershed. Great gray owls are found in a variety of habitat types, but seem rare on the Gifford Pinchot National Forest. Within the range of the northern spotted owl, great gray owls are found where the following habitat charactistics exist: late successional/old-growth forest or forest with remnant old trees and snags near (less than 1000 feet from) a natural or manmade meadow greater than ten acres in size and at an elevation of more than 3,000 feet (USDA 1995). Great gray owls tend to forage in meadows and other openings and feed primarily on voles and pocket gophers. Most nests are found in mature or old growth conifers or deciduous timber near large meadows or created openings.

Four meadows within Sub-basins 23S and 23U were identified as suitable habitat for great gray owls (Figure 19). Adjacent to these meadows/marshes there are old-growth and mature forest stands that may support an abundance of small mammals, the prey base for the great gray owl. In addition to the meadows, openings created by past timber harvest have provided other foraging opportunities. These areas may be the only suitable habitat in the watershed, and it is unlikely that great gray owls would nest elsewhere within the Upper Lewis.

Lynx - No documented sightings of lynxes have occurred in the watershed. Lynxes are rare within the range of the northern spotted owl, occurring primarily in the Okanogan area of Washington. The WDFW (1993) reported that lynx use a mosaic of forest types,

from early successional to mature coniferous and deciduous. Habitat suitability rests overwhelming on whether or not the habitat provides snowshoe hares as a food source. This species is also known to occupy areas above 4,000 ft elevations in Washington.

Approximately 2,354 acres of suitable lynx habitat exist in the watershed. These areas are characterized by five clusters spread across the watershed (Figure 21) and are located in Sub-basins 23A, 23B, 23E, 23J, 23M, 23N, and 23T. Only sixteen of these acres were of breeding quality.

Forest bats - Several Townsend's big-eared bat hibernacula are located in Sub-basin 23Z. The sites are found in caves (Wiggins Pit, Tree Pit, Wolff Pit and Silver Cave) formed by welded tuff that opened during a massive land slide (USDA unpublished). No documented sightings of the other four forest bat species have occurred in the watershed.

Table 21 outlines the various foraging zones and roost structures used by each species. Three of the four latter species use many habitats including caves, forest edges, cliffs, and man-made structures such as bridges and buildings for maternity colonies. The silver-haired bat is the only species primarily associated with forest structures. Many of these species use ponds, wetland, and riparian zones for foraging as well. Sub-basins 23A, 23C, 23D, 23L, 23R, 23S, 23U and 23V contain many wetlands providing ample foraging opportunities.

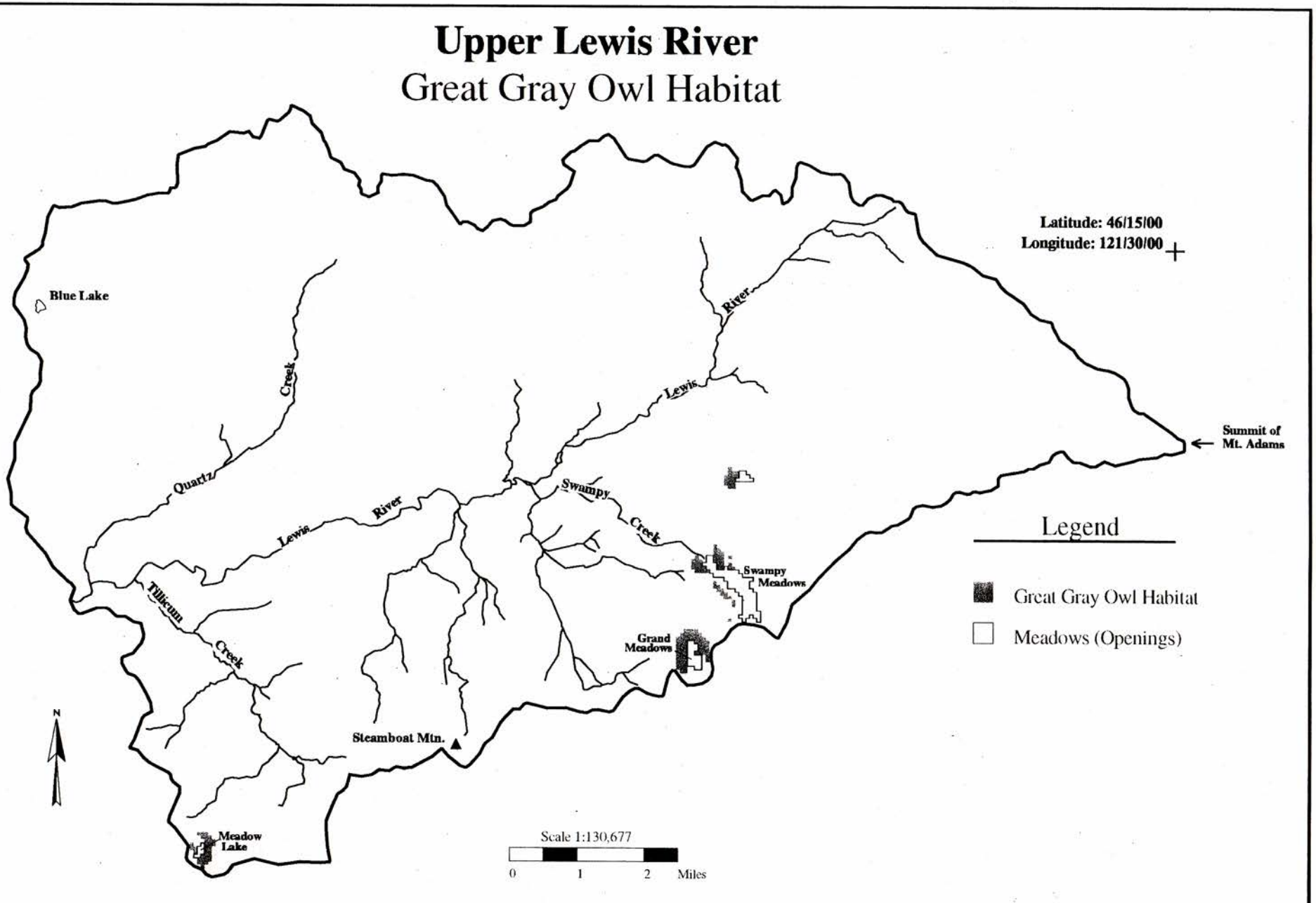


Figure 19. Displayed is the distribution of great gray owl suitable habitat in the Upper Lewis Watershed. The four meadows that serve as suitable habitat are located in Sub-basins 23S and 23U.

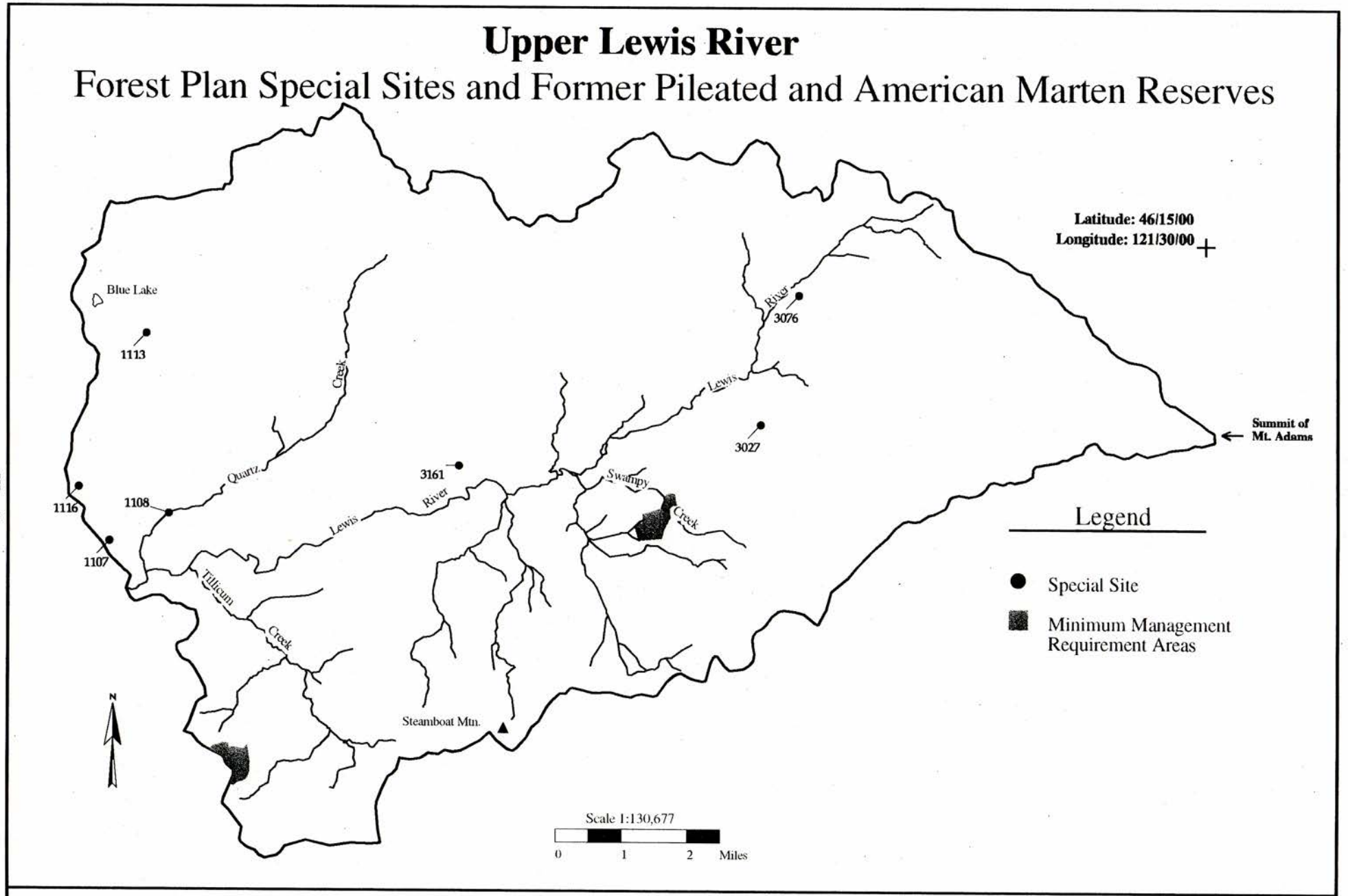


Figure 20. Displayed are the locations of botanical and former pileated and American Marten Reserves (MMRs) in the Upper Lewis Watershed.

Cavity Excavators - Many cavity excavator sightings have occurred in the watershed. Potential habitats exist for 43 snag-dependent species that include the black-backed, hairy, and pileated woodpeckers. Brown (1985) reported that snag densities are directly proportional to cavity excavator populations.

The potential population of cavity excavators was estimated by using a habitat analysis model to measure snag densities (GPNF 1997). The habitat capability, or potential population, for cavity excavating birds were estimated for each sub-basin in the analysis area. Only snags at least 20 feet tall and 17 inches in diameter at breast height were used in the assessment. Tree structure stages within each ecoclass was used to determine the number of snags present that were of this size and height (GPNF 1991). Based on snag densities, an index was used to calculate the habitat capability for each sub-basin. Sub-basin 23X was the only sub-basin whose habitat capability was less than 40 percent. Sub-basins 23G, 23L, 23Q, and 23S had enough snag habitat to provide for cavity excavators slightly below or above the 50 percent level. Figure 22 shows the position in the watershed where these five sub-basins are found.

This assessment indicates snags are well distributed throughout the watershed, although some sub-basins may have low numbers. The snag densities in each of the sub-basins also, to some degree, reflects the abundance of dead and down woody material present.

Goshawks - Goshawks have been sighted in various locations and at least one nest is known to exist in the watershed. The nest was first sighted in 1981 and a pair was last verified at the site in 1997. This species typically is associated with LSOG forest. The current conditions of LSOG forest were described under the northern spotted owl section.

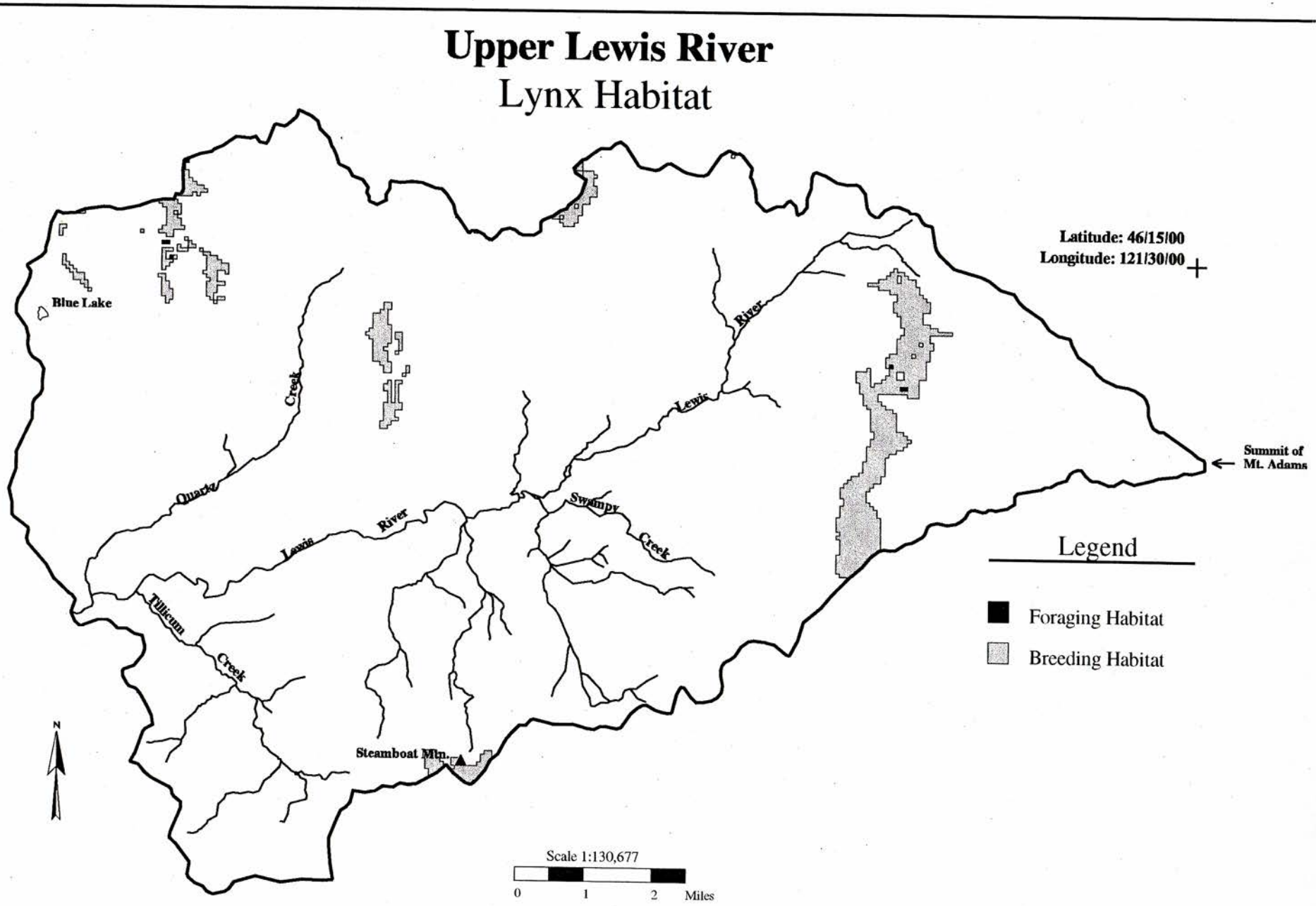


Figure 21. Displayed is the distribution of lynx foraging and breeding habitat in the Upper Lewis Watershed. Only sixteen acres were classified as breeding habitat.

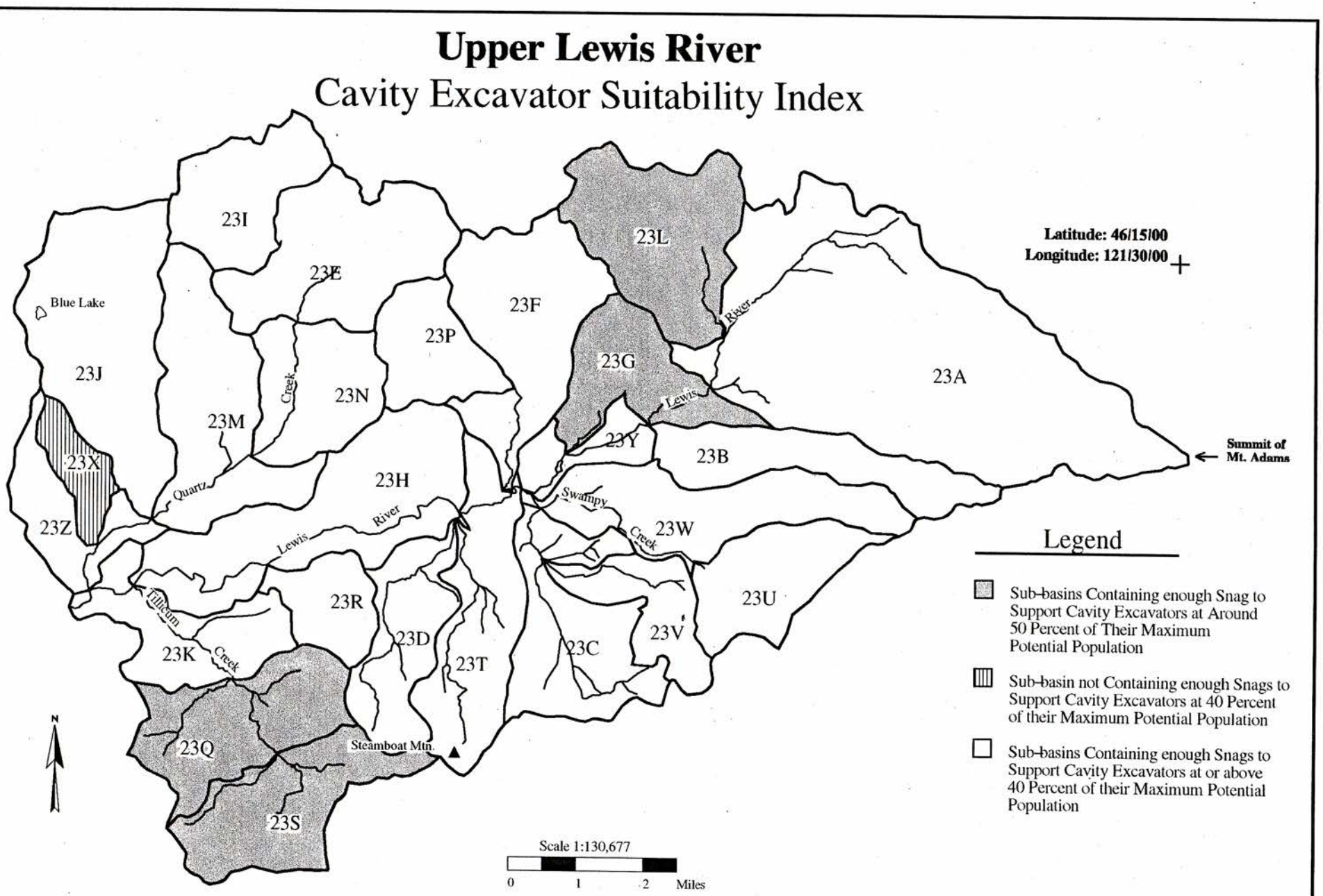


Figure 22. Results from the habitat analysis conducted on the Upper Lewis Watershed, indicated snag distribution is adequate, with exception of a few sub-basins. The snag density in Sub-basin 23X will support cavity excavators at 37 percent of their maximum potential population. Sub-basins 23G, 23L, 23Q and 23S contain enough snags to support excavators around 50 percent of their maximum potential population.

Hydrologic Processes

The closest gaging station to the Upper Lewis River Watershed Analysis Area is located on the Lewis River approximately 15 miles downstream from the area. This station operated between 1927 and 1977 and is no longer being maintained. The average monthly discharges for the Lewis River above Muddy River gaging station are displayed in Table 22. The highest average monthly discharges are associated with spring snowmelt and associated runoff. An analysis of streamflow data found that the highest instantaneous flow and associated floods for each year happened 75 percent of the time between November and February. These high flows are usually associated with rain-on-snow precipitation events.

Table 22. Average Monthly Discharge from the Lewis River above Muddy River.

Month	Discharge (cfs)
October	671
November	1447
December	1747
January	1548
February	1438
March	1306
April	1741
May	2141
June	1708
July	760
August	425
September	368

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 to identify areas that may be of concern for fish habitat (areas of frequent channel bed scour).

Table 23 below displays current peak flow increases when compared to a fully forested condition (see Figure 20, Peak Flow). None of the sub-basins currently have peak flows that have increased by more than 10 percent. 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 warrant a more detailed flow analysis to determine if these adverse conditions are present.

Table 23. Peak Flow Increases

Sub-basin	Peak Flow Increase	Sub-basin	Peak Flow Increase
23A	5%	23N	1*-2%**
23B	3*-4%**	23P	1*-3%**
23C	3*-7%**	23Q	4*-9%**
23D	4*-9%**	23R	4*-8%**
23E	1*-3%**	23S	2*-5%**
23F	2*-6%**	23T	3*-6%**
23G	3*-8%**	23U	1*-3%**
23H	1*-2%**	23V	3*-6%**
23I	1*-4%**	23W	2*-5%**
23J	3*-7%**	23X	4*-8%**
23K	3*-6%**	23Y	2*-4%**
23L	3*-7%**	23Z	4*-8%**
23M	3*-7%**		

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

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). Table 24 displays sub-basins with associated extension of the stream channel network (see Figure 20, Peak Flow). The lower value in Table 24 represents a modeled culvert spacing of 200 feet while the higher value represents a modeled culvert spacing of 500 feet. Current road condition surveys are lacking in the analysis area for specific culvert spacing distances, but an analysis of 9009 culverts located on the Gifford Pinchot National Forest found an average culvert spacing of 551 feet. It should be noted that culvert spacing is highly variable and depends on a number of factors including road gradient, geology and road construction type. Sub-basins where roads have increased the length of stream miles by 25 percent or more for the 500 foot culvert spacing are highlighted in gray as areas of concern.

Table 24 - Extension of Stream Channel Network by Roads

Sub-basin	Channel Extension Increase	Sub-basin	Channel Extension Increase
23A	4-10%	23N	0%
23B	6-15%	23P	0%
23C	12-30%	23Q	13-32%
23D	14-35%	23R	13-32%
23E	0%	23S	14-35%
23F	1-3%	23T	11-28%
23G	15-36%	23U	4-9%
23H	9-23%	23V	16-41%
23I	1-2%	23W	10-26%
23J	4-10%	23X	5-13%
23K	13-33%	23Y	6-15%
23L	8-19%	23Z	16-40%
23M	2-5%		

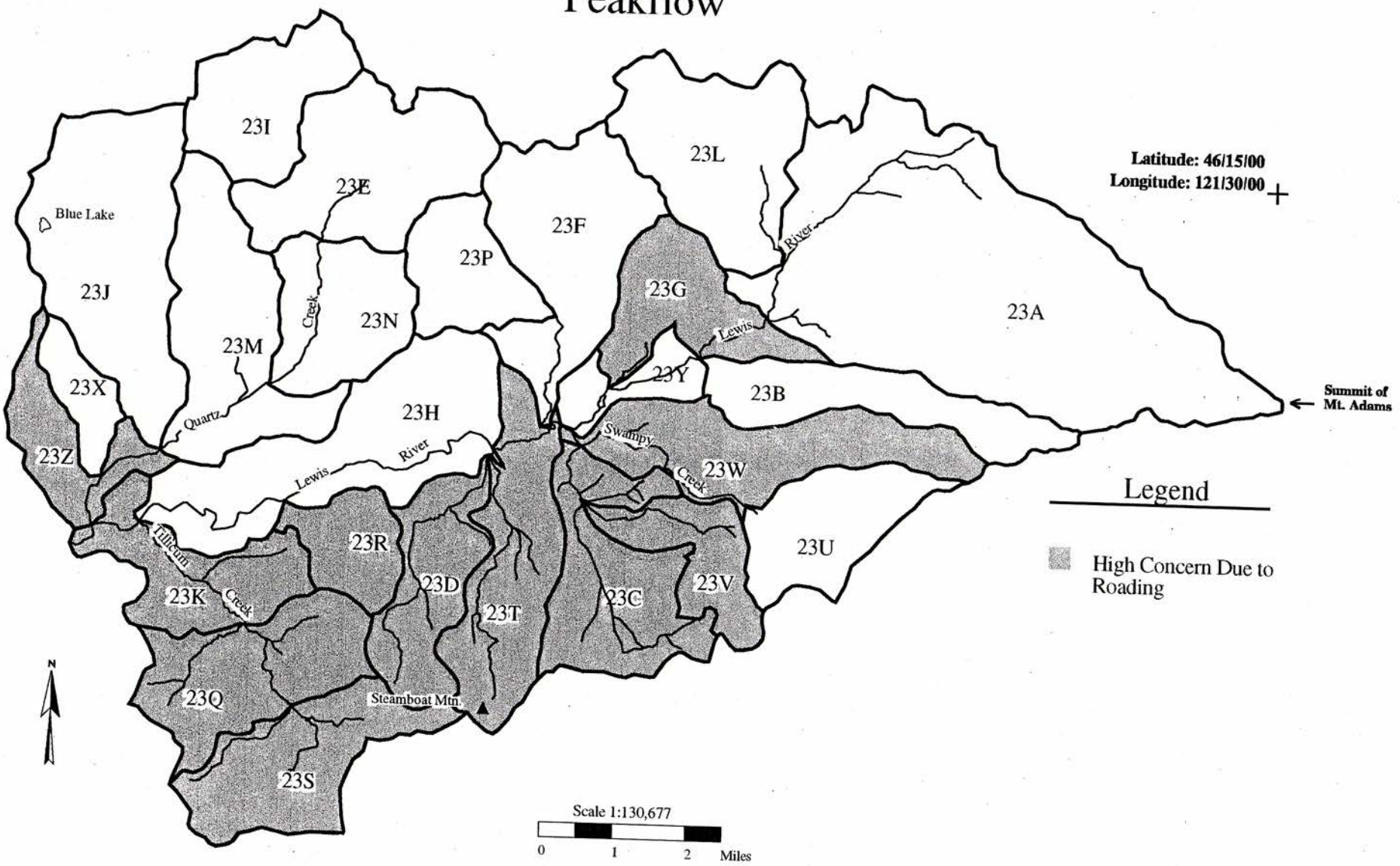


Figure 23. Areas of peak flow concern in the Upper Lewis River watershed. These are defined as sub-basins that have increased channel length by at least 25 percent from roading. No sub-basins had peak flow increases greater than 10 percent due to vegetation removal.

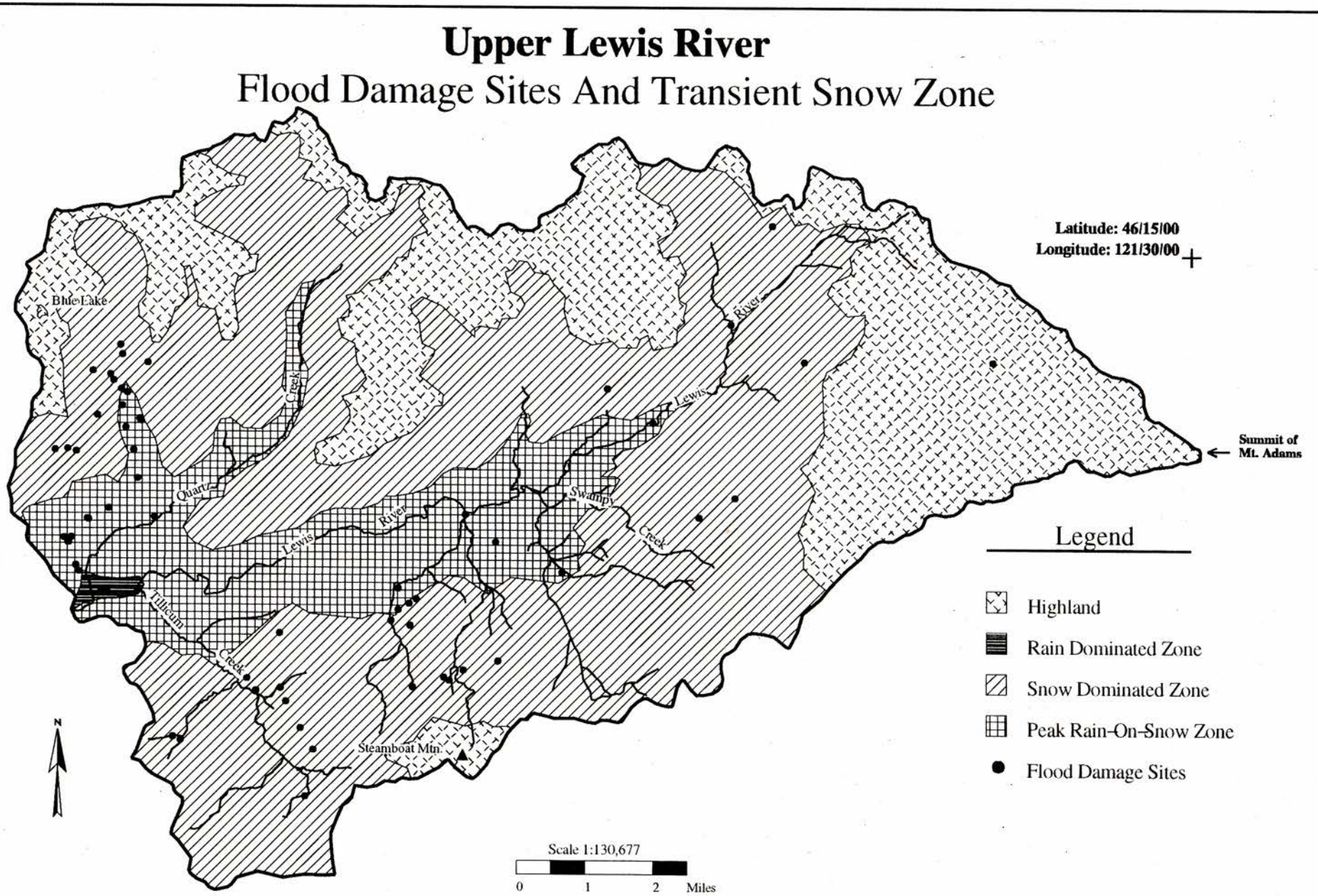


Figure 24. Areas of damage from the 1996 flood event and the different precipitation zones.

1996 Flood

The Lewis River basin in general, was hard hit by the floods of November, 1995 and February, 1996. Due to the deep snowpack that was present in the basin, most of the damage occurred in the lower elevations, below 2000 feet. The snowpack acted as a "reservoir" in the upper elevations, storing the meltwater temporarily. Since the majority of the Upper Lewis is high elevation, it did not receive as much damage as the Middle and Lower Lewis Watersheds.

Fifty-seven flood damage sites are located in the Upper Lewis Watershed. These damage sites consist primarily of road and slope failures. Of these 57 sites, 23 occurred in the transient snow zone and 34 occurred in the snow dominated zone. This turns out to be 2.0 flood damage sites per 1000 acres of area in the transient snow zone and 0.8 flood damage sites per 1000 acres of area in the snow dominated zone, or over two times the amount of sites in the transient snow zone when normalized by basin area. The transient snow zone as defined by the State of Washington and damage sites resulting from the February, 1996 flood are shown on Figure 24.

Anticipated Changes and Trends

Following are anticipated hydrologic changes and trends utilizing information for projects that are either under contract or are currently being planned for implementation. These include timber sales described in the vegetation section on pages 76-85. Also considered in this analysis are road decommissionings that are under contract (Louie/Rosey timber sales, 9343 road) or are in the planning stages (Alpha, Beta/Omega timber sales). Values in Table 25 below that are in parenthesis represent any change from the current conditions displayed in the section above.

Table 25. Anticipated Hydrologic Changes and Trends

Sub-basin	Peak Flow Increase - Projects Under Contract	Peak Flow Increase - Projects Under Contract & Planned	Sub-basin	Peak Flow Increase - Projects Under Contract	Peak Flow Increase - Projects Under Contract & Planned
23A	5%	5%	23N	1-2%	1-2%
23B	3-4%	4-5% (+1%)	23P	1-3%	1-3%
23C	4-8% (+1%)	4-8% (+1%)	23Q	4-9%	4-9%
23D	4-9%	4-9%	23R	4-8%	4-8%
23E	1-3%	1-3%	23S	2-5%	2-5%
23F	2-6%	2-7% (+1%)	23T	3-7% (+1%)	3-7% (+1%)
23G	3-8%	4-8% (+1%)	23U	1-3%	2-4% (+1%)
23H	1-2%	1-2%	23V	3-7% (+1%)	3-7% (+1%)
23I	1-4%	1-4%	23W	2-5%	3-6% (+1%)

Sub-basin	Peak Flow Increase - Projects Under Contract	Peak Flow Increase - Projects Under Contract & Planned	Sub-basin	Peak Flow Increase - Projects Under Contract	Peak Flow Increase - Projects Under Contract & Planned
23J	3-7%	3-7%	23X	4-8%	4-8%
23K	3-6%	3-6%	23Y	2-4%	2-5% (+1%)
23L	3-7%	3-7%	23Z	4-8%	4-8%
23M	3-7%	3-7%			

None of the sub-basins have peak flows that have increased by more than 10 percent after all projects have been implemented.

Anticipated changes in the extension of the stream channel network by roads and ditch lines in roads are displayed in Table 26 below. Sub-basins where roads have increased the length of stream miles by 25 percent or more are highlighted in gray as areas of concern.

Table 26. Projected Channel Extension Changes

Sub-basin	Channel Extension - Current Condition 1998	Projected to 2000 After Completion of Projects Under Contract	Projected to Beyond 2000 After Completion of Projects Under Contract and Planned	Sub-basin	Channel Extension - Current Condition 1998	Projected to 2000 After Completion of Projects Under Contract	Projected to Beyond 2000 After Completion of Projects Under Contract and Planned
23A	4-10%	4-10%	4-10%	23N	0%	0%	0%
23B	6-15%	6-15%	4-10%	23P	0%	0%	0%
23C	12-30%	12-29%	12-29%	23Q	13-32%	13-32%	12-30%
23D	14-35%	14-35%	14-35%	23R	13-32%	13-32%	13-32%
23E	0%	0%	0%	23S	14-35%	14-35%	14-35%
23F	1-3%	1-3%	1-3%	23T	11-28%	11-28%	11-28%
23G	15-36%	15-36%	15-36%	23U	4-9%	4-9%	4-9%
23H	9-23%	9-23%	9-23%	23V	16-41%	12-30%	9-22%
23I	1-2%	1-2%	1-2%	23W	10-26%	10-26%	10-26%
23J	4-10%	4-10%	4-10%	23X	5-13%	5-13%	5-13%
23K	13-33%	13-33%	13-33%	23Y	6-15%	6-15%	6-15%
23L	8-19%	8-19%	5-12%	23Z	16-40%	15-38%	15-38%
23M	2-5%	2-5%	2-5%				

Reductions in stream channel extension would result from implementation of projects currently under contract or being planned in the Upper Lewis River analysis area. Reductions in three of the sub-basins from work under contract (23C, 23V and 23Z) and 6 sub-basins from work under contract and being planned (23B, 23C, 23L, 23Q, 23V and 23Z) would occur. This would help restore a more natural hydrologic regime in these areas by re-establishing more natural, unobstructed flow paths for surface water and reducing surface compaction.

Aquatic Animals and Habitat

This discussion will focus on the limited aquatic information that is available, primarily fish habitat and distribution data, and aerial photograph interpretation. Information on aquatic organism populations is lacking. 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.

Stream habitat surveys have been completed on approximately 37.8 miles of stream. Fish currently occupy approximately 75 miles of stream on National Forest land within the watershed (Figure 22). 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 fish species that are present in this watershed are displayed in Table 28.

There are six lakes within the Upper Lewis River Watershed analysis area: Blue Lake, Little Fish Lake, Meadow Lake, Crystal Lake, Sheep Lake, and Lake Camp. The latter three lakes all lie within the Mount Adams Wilderness area. Brook trout are known to occur in Little Fish Lake, which was stocked by the Washington Department of Game in 1987. There have been no lake surveys conducted on any of these lakes; therefore, habitat conditions are unknown.

Fish distribution and abundance

Resident fishes within Upper Lewis River Watershed streams include rainbow trout, cutthroat trout, brook trout, and sculpin (Figure 22). Fishes within the Upper Lewis River Watershed are managed by the Washington Department of Fish and Wildlife.

Table 27. Fish Populations and Fish Stocking within Streams and Lakes within the Upper Lewis River Watershed.

Fish Populations						
	Location	**Current Fish Spp.***	**Last Stocking Date/Fish Spp.***	**Stream Class/ Acreage**	**Value for Fishing**	**Other**
Lake						
Blue Lake	09N-08E-30	unknown	unknown	9.0 ac	unknown	
Crystal Lake	08N-10E-04	unknown	unknown	1.0 ac	unknown	
Lake Camp	08N-10E-08	unknown	unknown	1.0 ac	unknown	
Little Fish Lake	08N-09E-29	SAFO	1987	3.0 ac	unknown	
Meadow Lake	07N-08E-04	unknown	unknown	1.0 ac	unknown	
Sheep Lake	08N-10E-05	unknown	unknown	1.0 ac	unknown	
Stream						
Big Springs	09N-09E-35			II & III		
Boulder	09N-09E-26	ONCL		II & III		
Deer	09N-09E-32			III		

Fish Populations

	Location	Current Fish Spp.*	Last Stocking Date/Fish Spp.*	Stream Class/ Acreage	Value for Fishing	Other
French	09N-08E-24			III		
Lower Tillicum	08N-08E-28			II		
Mutton	09N-10E-30			III		
Noname	09N-09E-36			II & III		
North Fork Swampy	08N-09E-09	ONCL		II		
Pass	08N-09E-08	ONCL		II		
Pin	08N-09E-08	ONCL		II & III		
Platinum	08N-08E-07			III		
Poison	08N-09E-07	ONCL		II		
Quartz	08N-08E-18	ONCL		I, II & III		
Riley	09N-09E-36			III		
South Fork Pass	08N-09E-28	ONCL		II		
Steamboat	08N-09E-07	ONCL		II		
Straight	08N-08E-08			III		
Strawberry	08N-08E-34	ONCL		II		
Swampy	08N-09E-08	ONCL		II & III		
Tillicum	08N-08E-17	ONCL, SAFO		II & III		
Twin Falls	08N-09E-03			III		
Upper Lewis River	08N-08E-18	ONCL, SAFO		I & II		
Upper Tillicum	08N-08E-34	ONCL, SAFO		II		

*Fish Species Codes:

ONMY= *Oncorhnychus mykiss* (Rainbow Trout)
ONCL= *Oncorhynchus clarki* (Cutthroat Trout)
SAFO= *Salvelinus fontinalis* (Brook Trout)

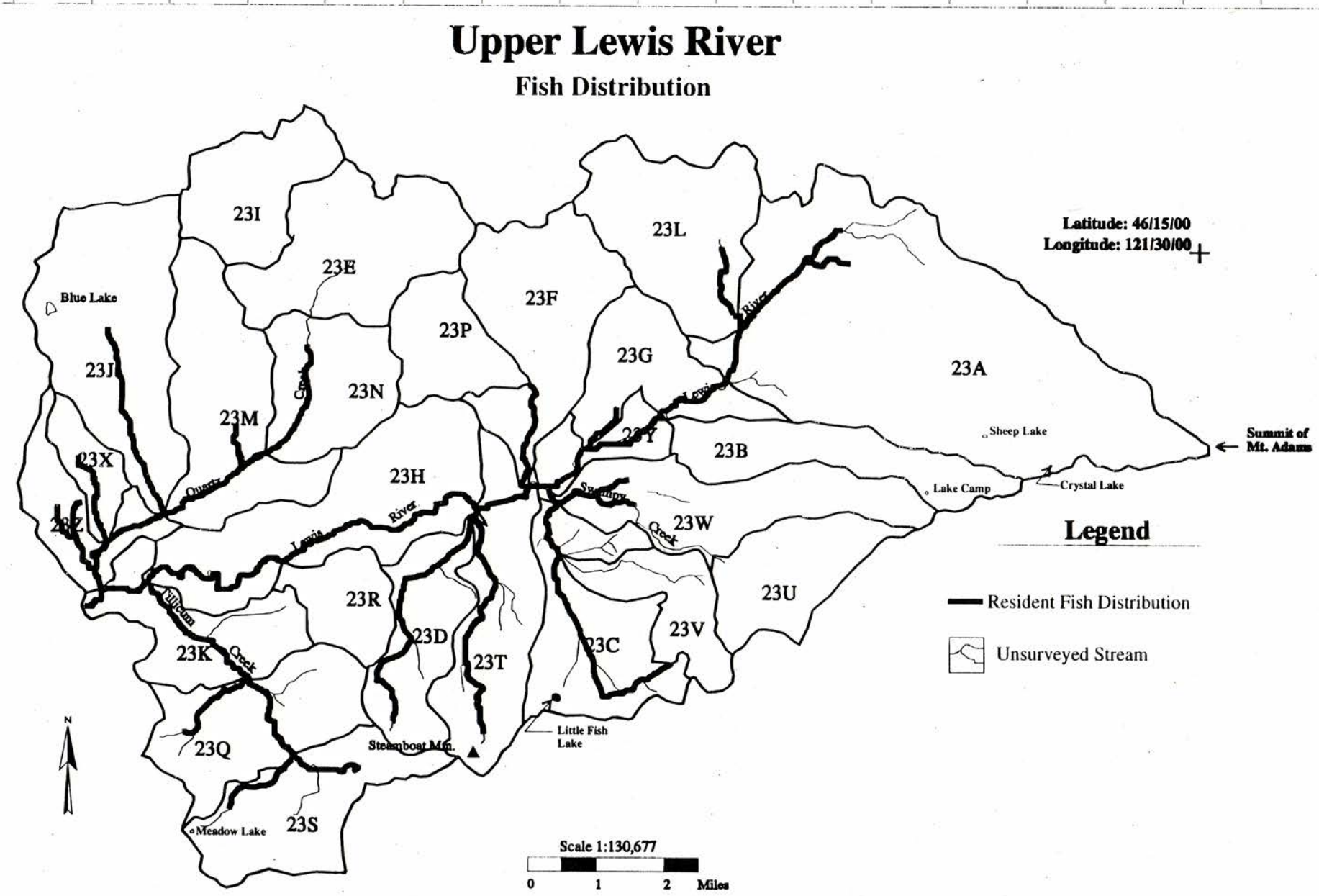


Figure 25. Upper Lewis River Watershed distribution of resident fishes. Resident fishes include rainbow, cuttthroat, and eastern brook trout.

Table 28. Optimum Habitat Condition Factors for Fishes, by life stage (Wydoski and Whitney 1979)

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

Anadromous fish distribution was dramatically reduced below Lower Falls by the construction of Merwin dam in 1935 which cut off 55 miles of mainstem habitat and numerous miles of 2nd and 3rd order tributary habitat (downstream of the analysis area). Downstream of Merwin dam the following anadromous fish species are present: spring and fall chinook, early and late returning coho, and summer and winter steelhead trout. A population of bull trout (*Salvelinus confluentus*) exists within Swift Reservoir and migrate to Pine and Rush Creeks to spawn; this population uses habitat downstream of the analysis area. The eruption of Mount St. Helens in 1980 altered some portions of the basin, but left most of it relatively intact. The flood of 1996 also altered some of the habitat conditions within the analysis area. Most of the effects of the 1996 flood occurred downstream of the planning area. There is little to no data on the effects of the 1996 flood on aquatic habitat due to the lack of survey information prior to and after the flood event occurred.

No stocking has occurred in any of the six lakes since 1987. No stocking is planned due to the limited fishing value of these lakes.

Quartz Creek is a major drainage of the analysis area. The northern part of the Quartz Creek basin is mostly undisturbed because of the land allocations: Late Successional Reserve and Dark Divide Roadless Area. Road densities in this sub-basin is range from 0.0 to 2.2 miles per square mile of area. It has not been surveyed to assess aquatic habitat parameters.

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 Basin 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 53 percent of the surveyed stream segments are rated as poor, approximately 16 percent are rated as fair, and 31 percent are rated as good (Figure 23). The standard of 80 pieces of wood per mile have been set at the Regional level, however, no watershed or basin wide analysis has been completed to verify the appropriateness of these standards for this area. The stream channels in this area are high to medium gradient channels that transport wood and sediment fairly quickly. A standard of 80 pieces of wood per mile may be too high, based on the channel morphology of this watershed.

Sub-basins having greater than 25 percent of their streamside riparian areas harvested 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. The harvest level was determined using GIS data for National Forest. Figure 24 displays the sub-basins having low potential for LWD recruitment.

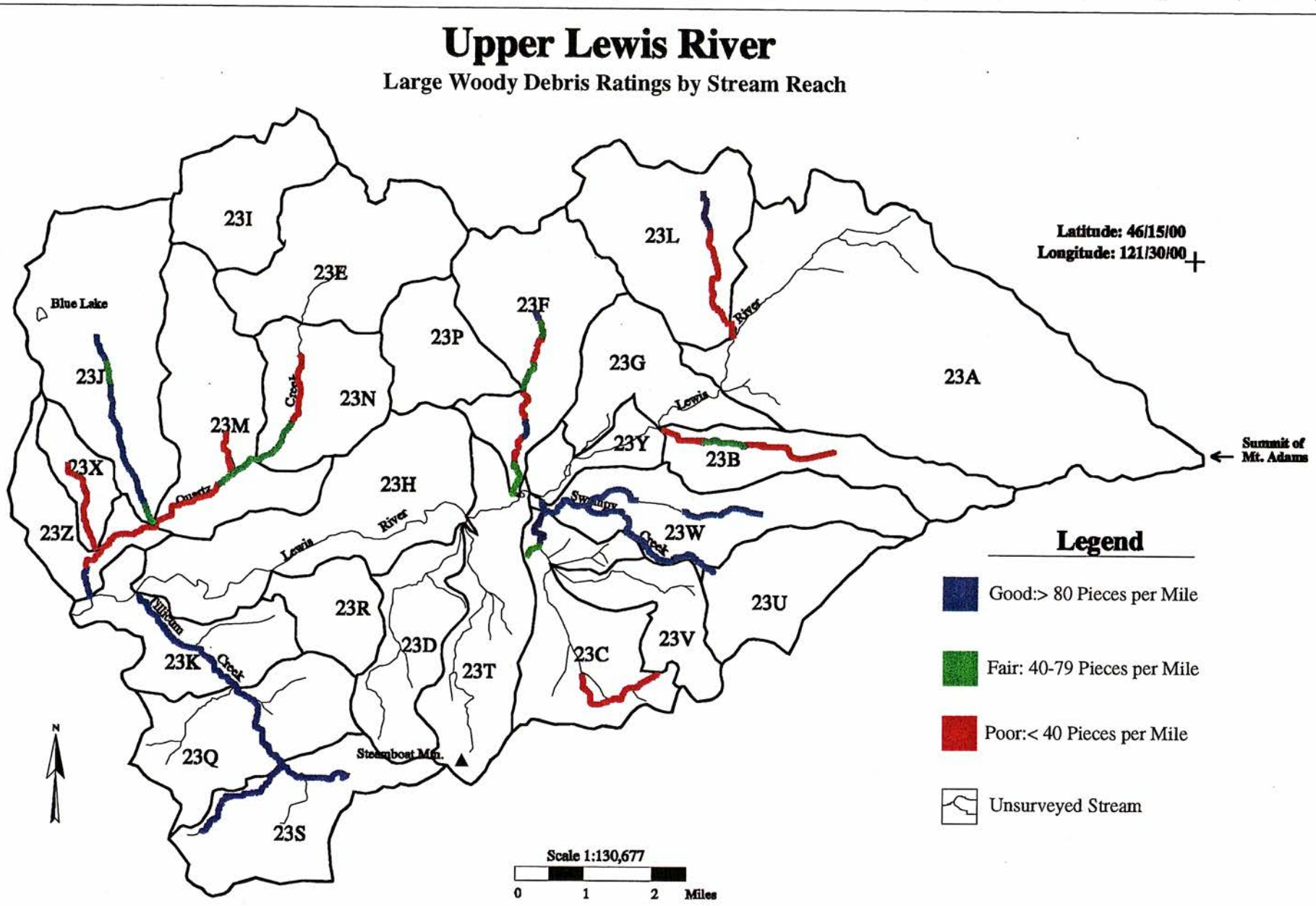


Figure 26. Large Woody Debris (LWD) ratings per mile for streams surveyed through 1997 in the Upper Lewis River Watershed.

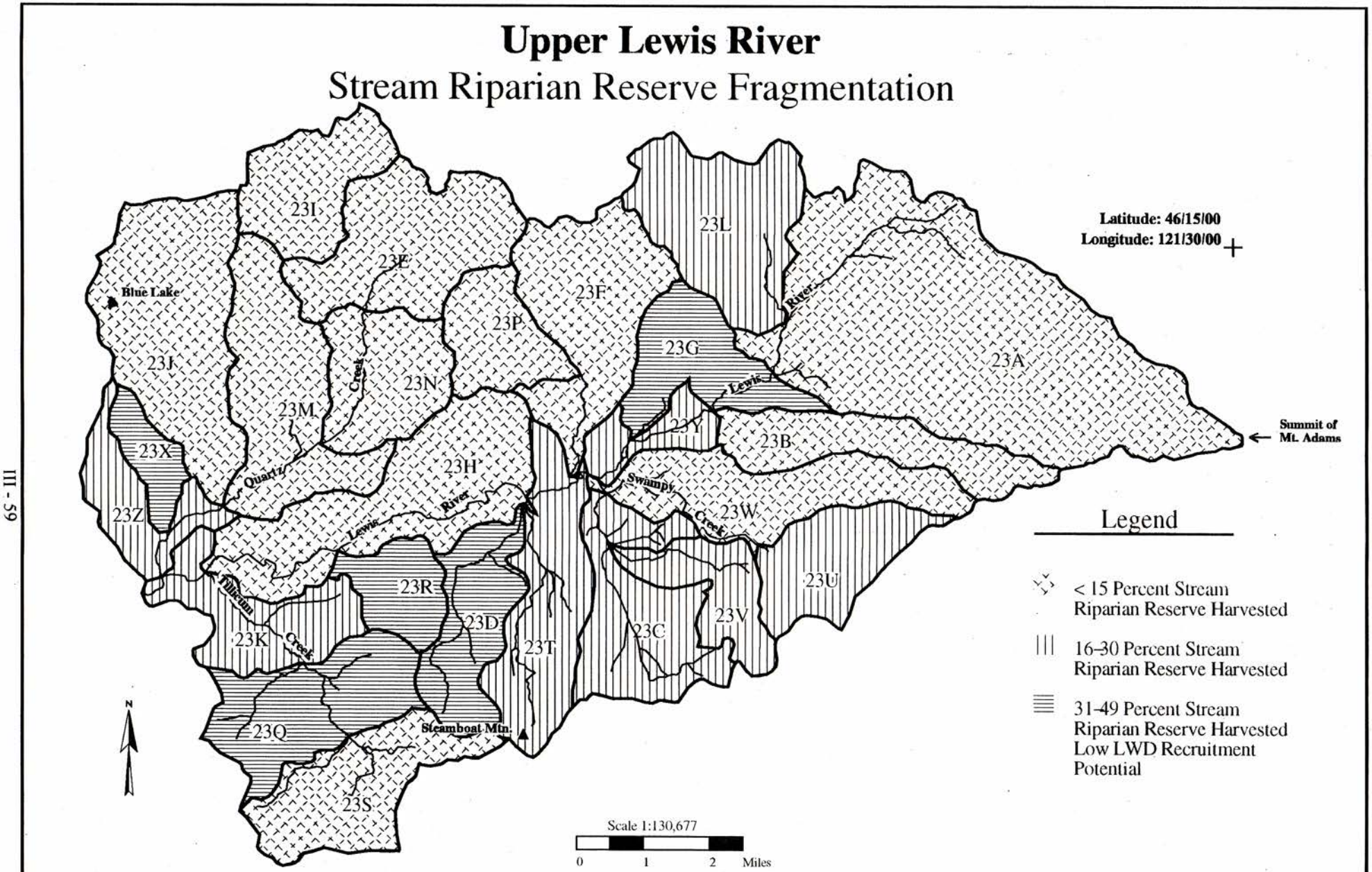


Figure 27. Amount of stream riparian reserves which have been harvested within Upper Lewis River Watershed sub-basins. Those sub-basins which have greater than 30 percent of streamside riparian reserve harvested are also classified as having low potential for large woody debris (LWD) recruitment.

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 70 percent of the surveyed streams are rated as poor, approximately 26 percent are rated as fair, and approximately 3 percent are rated good. (Figure 25). Standards for the number of pools per mile have been set at the Regional level, however, no watershed or basin wide survey has been completed to verify the appropriateness of these standards for this area. The stream channels in this area are medium to high gradient streams with many small pocket pools that may not meet the requirements of a primary pool as identified in the stream survey protocol. The standard is based on the width of the stream channel, however, stream gradient and channel morphology are not considered.

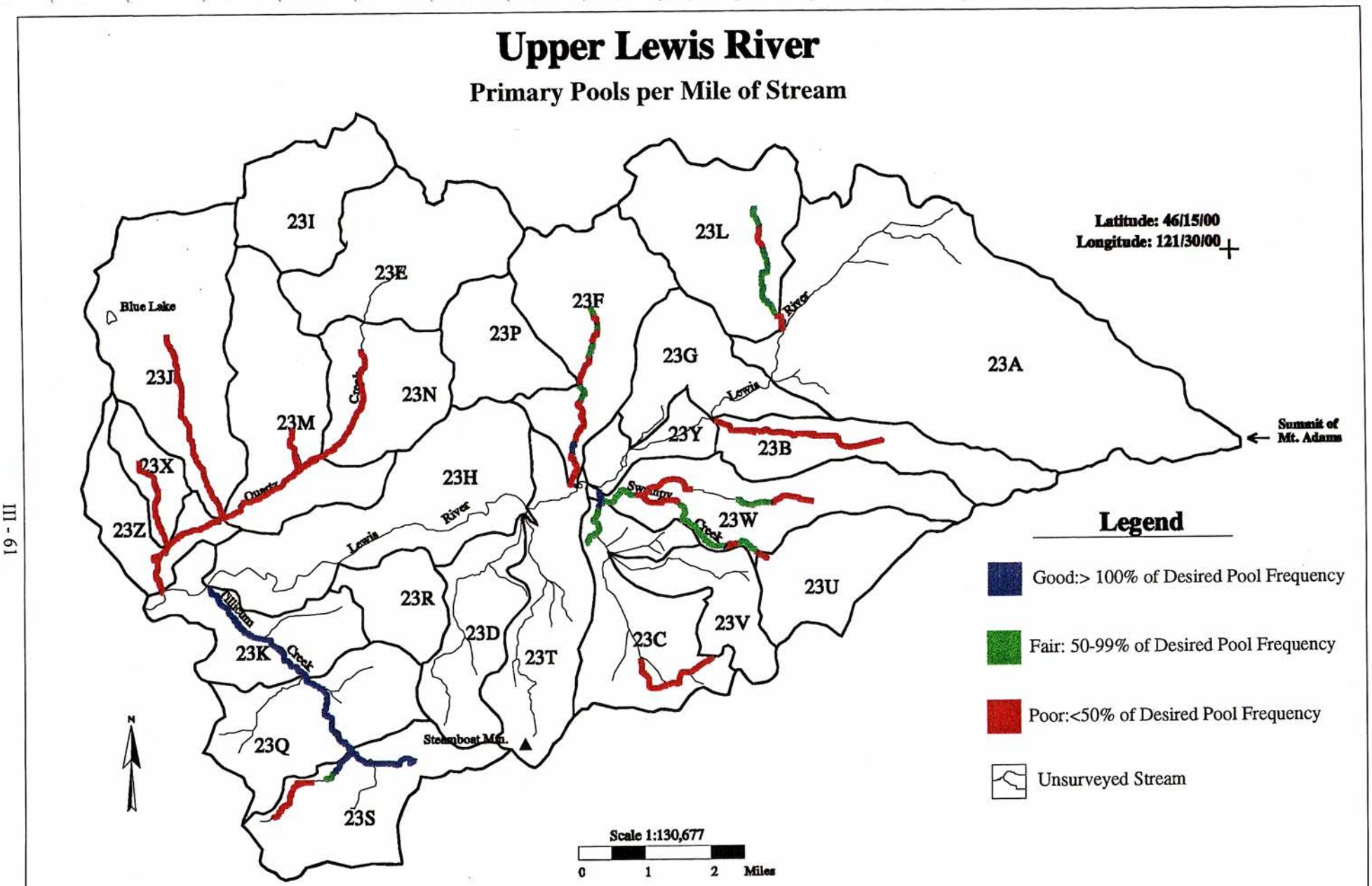


Figure 28. Primary pools per mile ratings for streams surveyed through 1997 in the Upper Lewis River Watershed.

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 15 water quality monitoring stations within the Upper Lewis River Watershed which have been active for varying lengths of time since 1974. The majority of these stations were established for project monitoring and collected data for 1 to 3 years (14 of the 15 stations), so long-term records are rare. These stations collected water temperature and turbidity data only. Two of the 14 stations that collected water temperature data had instantaneous maximum stream temperatures that exceeded 16° Celsius, possibly exceeding State Water Temperature Standards. These stations were on Straight Creek (1 time in 2 years of operation) and Quartz Creek (89 times in 14 years of operation). No water-quality-impaired stream segments in the analysis area are identified on the Washington State 303 (d) list.

Figure 29 shows the locations of these monitoring stations and the sites that exceeded 16° Celsius.

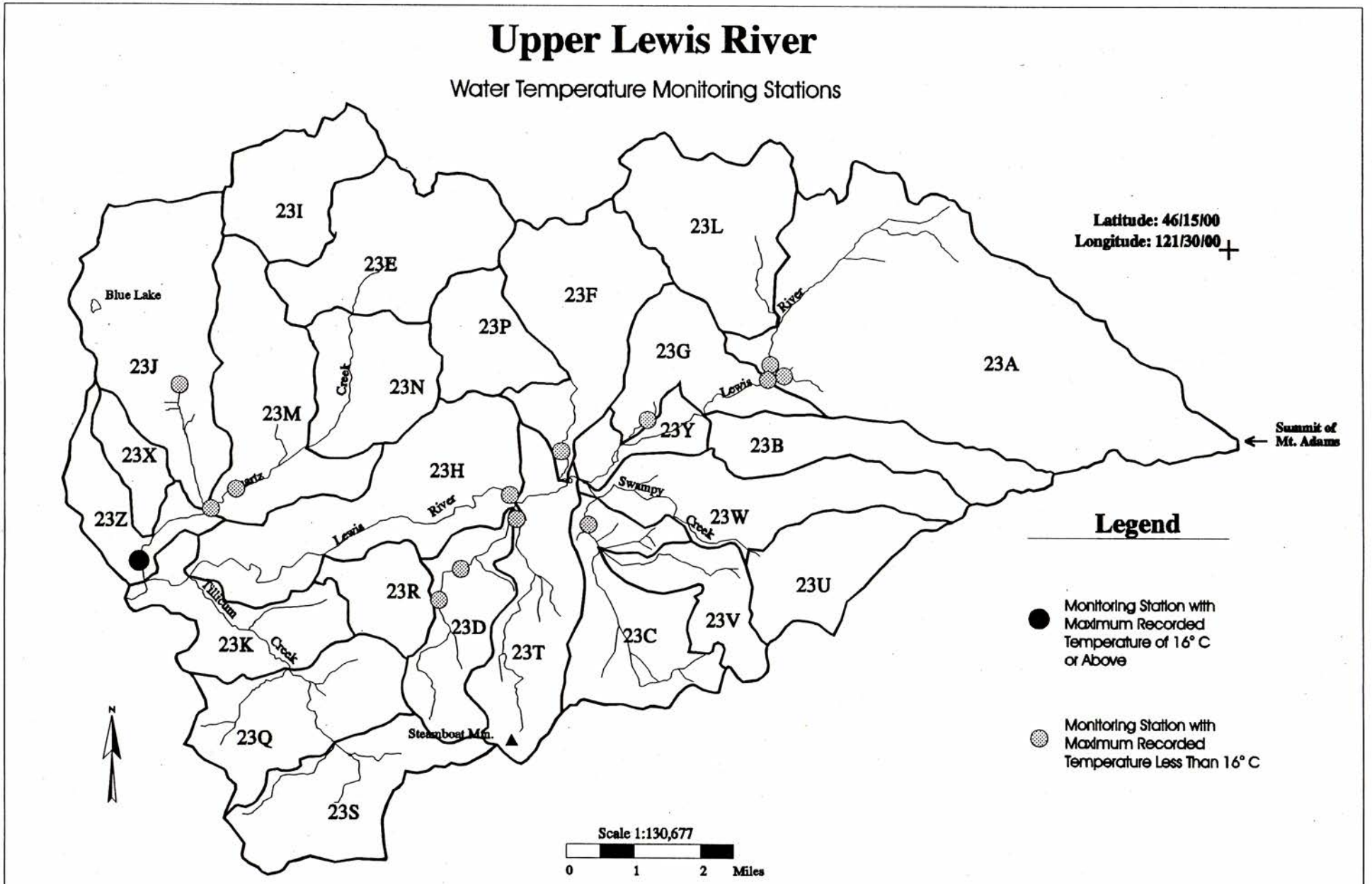


Figure 29. Monitoring stations where water temperature measurements were recorded. Sites have been grouped as those with temperatures less than 16 degrees Centigrade and those with temperatures equal to or greater than 16 degrees Centigrade (may not meet State standard). Most sites have limited data (station was operational for only one to two years.

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 30 displays the road network and Class 1 through IV streams. Road/stream crossings range in number from zero to 39 in the watershed's sub-basins. There are a total of 414 stream crossings within the Upper Lewis River Watershed (Table 29).

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 Upper Lewis River Watershed is 2.2 miles per square mile. Individual sub-basin road densities range from zero up to 4.1 miles per square mile (Table 29 Road Densities, etc.). Figure 11 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 Upper Lewis River Watershed aquatic habitat fragmentation values were divided into thirds (low, medium, and high values) to evaluate the fragementation across the entire watershed. Medium (0.72 to 1.43 road/stream crossings per stream mile) and high (greater than 1.44 road/stream crossings per stream mile) aquatic fragmentation values are highlighted in Figure 29.

North Fork Pass Creek, sub-basin (23V), is a highly fragmented watershed, with the highest sub-basin fragmentation index value of 2.14. This watershed (1583 acres) with only 7 miles of stream has 15 stream/road crossings. The lower portion of the Quartz Creek watershed (23Z) had high sub-basin fragmentation of 2.1 road/stream crossings per stream mile. Upper Tillicum Creek/Strawberry Creek (23S) also had a high sub-basin fragmentation of 1.85 road/stream crossings per stream mile.

Table 29 - Upper Lewis River Watershed Road Densities, Stream Crossings, and Aquatic Habitat Fragmentation Indices by Sub-basin.

Sub-basin Number	Miles of Roads	Road Density	Number of Stream Crossings	Miles of Stream	Road Crossings per Stream Mile
23A	17.7	0.9	33	63	0.52
23B	5.1	1.4	9	11	0.82
23C	18.3	3.8	27	17	1.59
23D	14.4	4.1	24	13	1.85
23E	0.1	0.0	0	35	0
23F	6.5	1.1	5	28	0.18
23G	9.1	2.6	15	13	1.15
23H	15.2	2.1	39	32	1.22
23I	0.8	0.2	2	24	0.08
23J	13.2	1.5	28	33	0.85
23K	12.6	3.5	26	15	1.73
23L	11.3	2.0	23	23	1.0
23M	12.9	1.3	6	22	0.27
23N	0.3	0.0	0	20	0
23P	0.0	0.0	0	14	0
23Q	15.4	3.2	32	19	1.68
23R	8.3	4.1	12	7	1.71
23S	13.6	3.0	24	13	1.85
23T	12.3	2.5	25	17	1.47
23U	4.5	1.3	4	8	0.5
23V	9.4	3.8	15	7	2.14
23W	12.8	2.6	18	13	1.38
23X	4.4	1.8	4	6	0.67
23Y	5.7	4.0	4	5	0.8
23Z	8.5	3.4	21	10	2.1
Totals	232	2.17 (Mean)	414	468	1.02 (Mean)

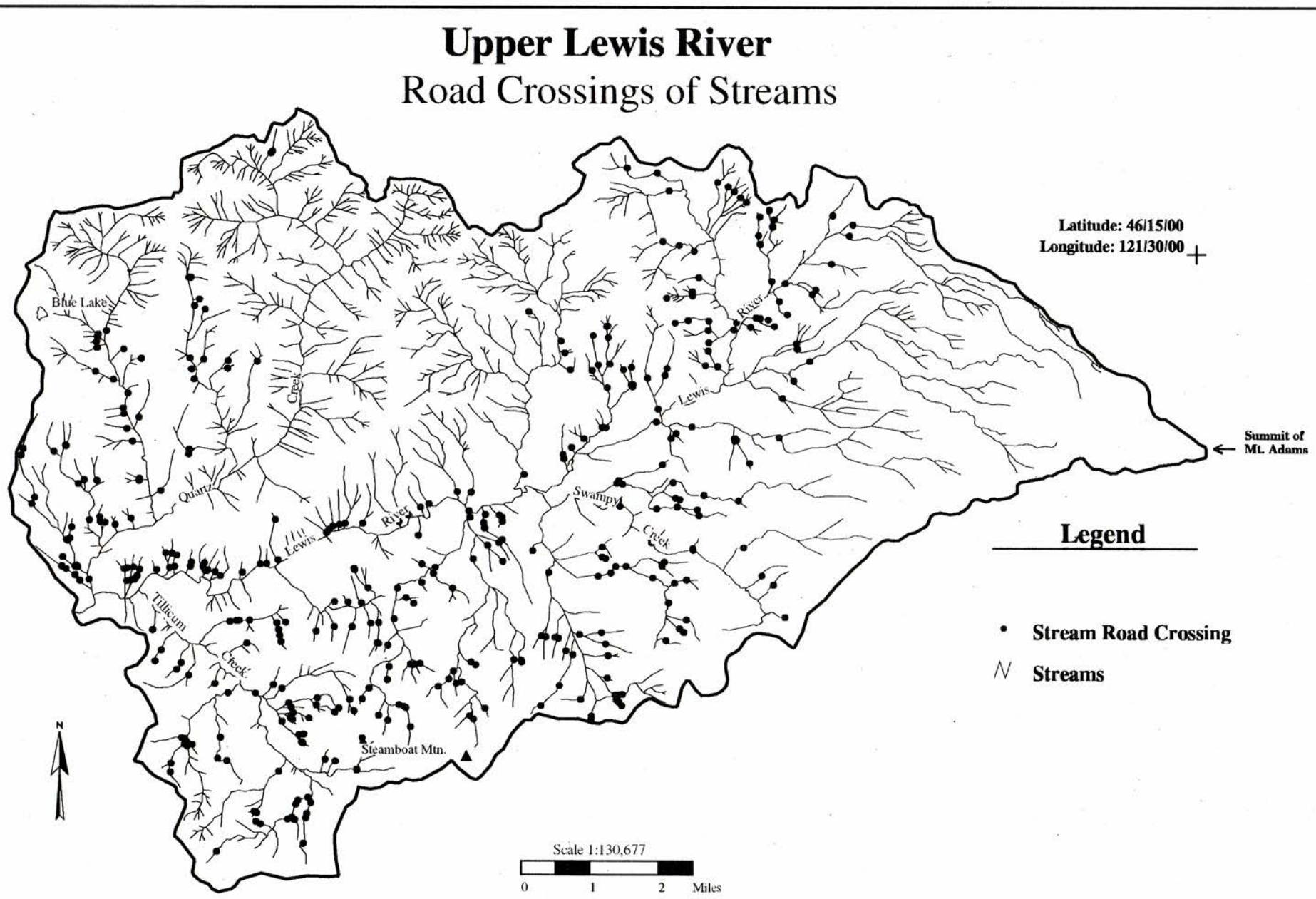


Figure 30. Display of where the road network crosses Class I - IV streams in the Upper Lewis River Watershed.

Upper Lewis River
Habitat Fragmentation

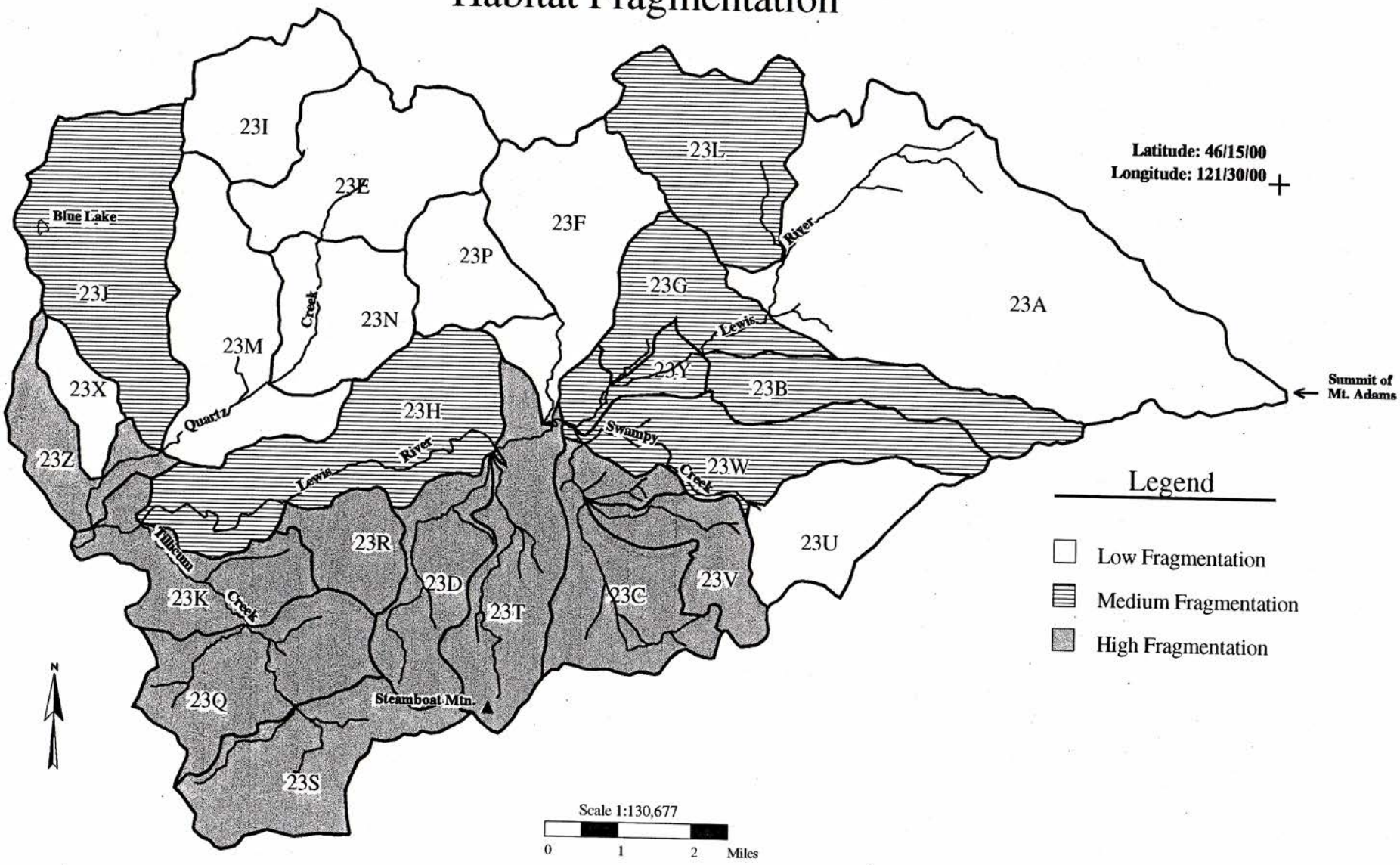


Figure 31. Upper Lewis River Watershed sub-basin stream fragmentation values. Low ratings are values which range from 0.0-0.71 crossings per stream mile. High ratings are values which range from 1.43-2.14 crossings per stream mile. Ranges were arbitrarily set by dividing the stream fragmentation values of the entire Upper Lewis River Watershed into thirds.

Anticipated Changes and Trends

The following information forecasts the anticipated changes (from current conditions) to the road densities and aquatic habitat fragmentation data based on projects that are under contract. There are several roads that are under contract to be decommissioned within the next year. Road density will temporarily increase in Sub-basin 23A with the construction of a temporary road for the Page Timber Sale. Road densities will decrease in 23C, 23J, 23V, and 23W through road decommissionings in contract. Aquatic habitat fragmentation will decrease in Sub-basins 23C, 23V, and 23Z with the implementation of projects under contract.

Table 30. Changes from the current conditions in aquatic habitat fragmentation and road densities through implementation of road decommissioning projects under contract

Watershed Number	Miles of Roads	Road Density Decrease-Projects under Contract and Planned	Number of Stream Crossings Decrease-Projects under Contract and Planned	Miles of Stream	Road Crossings per Stream Mile Decrease-Projects under Contract and Planned
23A	17.7	1.0* (+0.1)	33	63	0.52
23B	5.1	0.8 (-0.6)	6 (-3)	11	0.55
23C	18.3	3.6 (-0.2)	26 (-1)	17	1.53
23D	14.4	4.1	24	13	1.85
23E	0.1	0.0	0	35	0
23F	6.5	1.1	5	28	0.18
23G	9.1	2.6	15	13	1.15
23H	15.2	2.1	39	32	1.22
23I	0.8	0.2	2	24	0.08
23J	13.2	1.2 (-0.3)	28	33	0.85
23K	12.6	3.5	26	15	1.73
23L	11.3	1.7 (-0.3)	15 (-8)	23	0.65
23M	12.9	1.3	6	22	0.27
23N	0.3	0.0	0	20	0
23P	0.0	0.0	0	14	0
23Q	15.4	3.2	30 (-2)	19	1.58
23R	8.3	4.1	12	7	1.71
23S	13.6	3.0	24	13	1.85
23T	12.3	2.5	25	17	1.47
23U	4.5	1.1 (-0.2)	4	8	0.5
23V	9.4	1.9 (-1.9)	8 (-7)	7	1.14
23W	12.8	2.3 (-0.3)	18	13	1.38
23X	4.4	1.8	4	6	0.67
23Y	5.7	4.0	4	5	0.8
23Z	8.5	3.4	20 (-1)	10	2.0
Totals	232	2.02 (Mean)	392	468	0.95 (Mean)

* This sub-basin will temporarily increase in road density due to 0.1 miles of temporary road construction.

Stream Channels

Stream reaches in the Upper Lewis River Watershed Analysis area can be classified based on similar physical characteristics and placed into three major groups: erosion, transport and response.

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. "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. Many of the sidewall and headwall streams in the Upper Lewis area are erosional or transport reaches, while the Lewis River is composed primarily of transport and response reaches. More specific channel information is displayed below.

The following observations were made from aerial photos, maps, and field visits. Post 1996 flood aerial photography was not available for this analysis, so observations do not reflect changes resulting from this event.

- All response reaches in the Lewis River are currently in some phase of recovery and adjustment to sediment pulses from past flood events. They are adjusting primarily by channel narrowing, riparian vegetation encroachment, and/or downcutting.
- In 1989, reach #1003 (see Figure 30) on the Lewis River is recovering very slowly from a large pulse of sediment that occurred in the 1970's. This slow recovery may be due in part to continued sediment contribution from roads in the Steamboat Creek, Poison Creek, Pass Creek, and Swampy Creek areas.
- In 1989, the lower portion of Quartz Creek is adjusting to sediment pulses from 1970's flood events by channel narrowing and/or downcutting. The lower portion of Pin Creek is also recovering very slowly from a large sediment pulse that occurred in the 1970's.
- Reach #1002 on the Lewis River currently has low amounts of in-channel LWD compared to pre-1959 conditions due to channel downcutting that has perched the wood on terraces above the channel.

In addition to observations made from air photos concerning stream channel conditions, the following conditions were noted from stream survey data.

- Due to a variety of natural physical characteristics including unstable landforms, some stream channels south of the Lewis River are very unstable. Selected reaches on Poison Creek, Steamboat Creek, Pass Creek, North and South Fork Swampy Creek are some of the most unstable channel on the Forest, due mostly to unstable lower and upper streambanks. These reaches include: #0407-S.Fk. Swampy Creek; #0524, #0525, #0414-Poison Creek; #0413-Steamboat Creek; #1012-Pass Creek.
- Due to channel scour and deposition from a debris torrent that started in a timber harvest unit, the lower portion of Platinum Creek has poor channel stability.

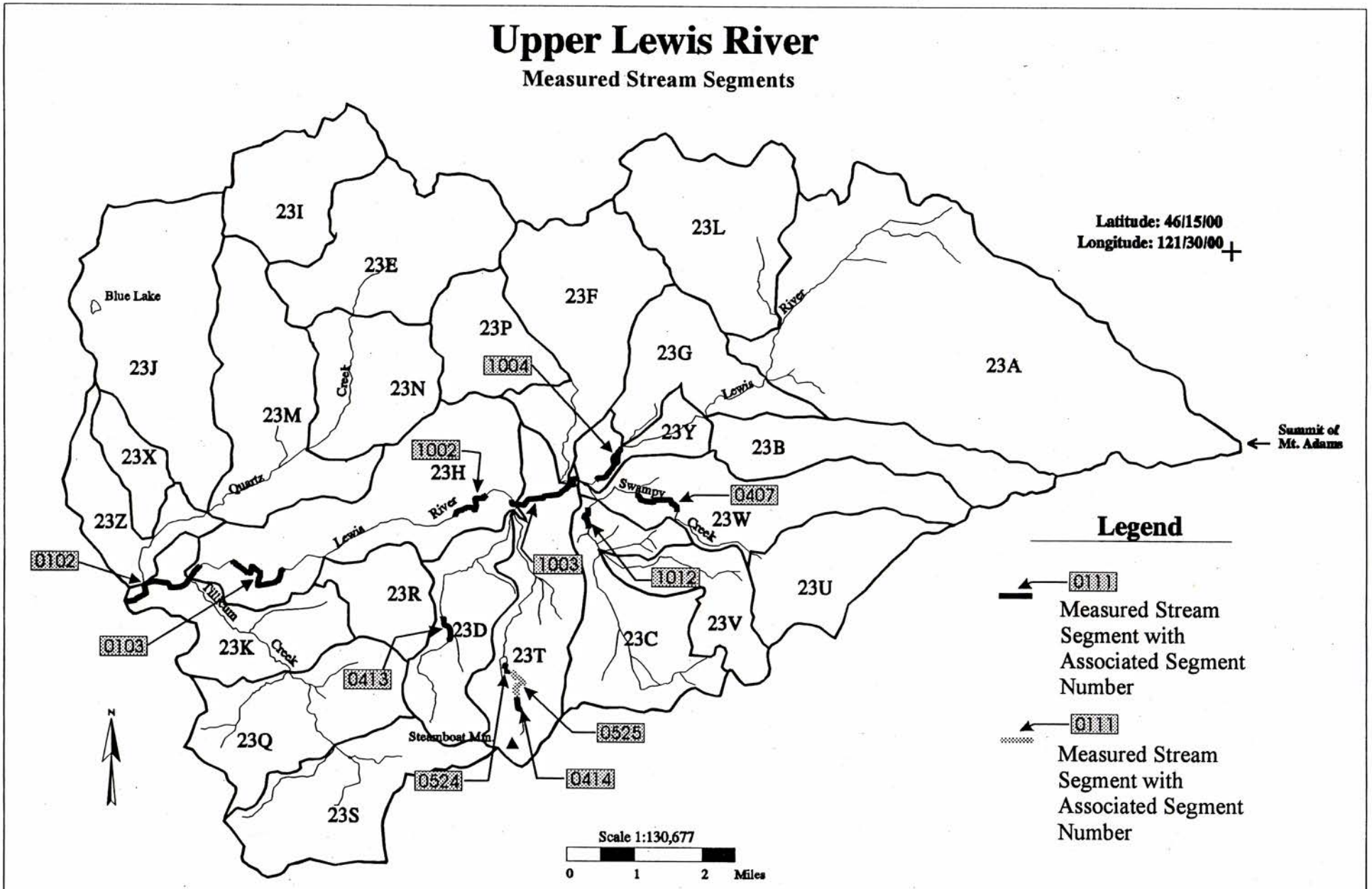


Figure 32. Stream segments that were analyzed using historic air photos. These include known or suspected response reaches and segments with poor channel stability.

Recreation Use

Recreational use consists of camping, hunting, trail use, berry picking, and wilderness travel. Three popular campgrounds are found in the watershed, the Lewis River Horse Camp near Quartz Creek, Twin Falls Campground along the upper Lewis River, and Tillicum Campground near Squaw Butte in the southern corner of the watershed.

Twin Falls Campground is a fee campground operated under special use permit by a concessionaire. The campground is popular because of its small size and attraction of fishing in the Lewis River. Twin Falls, on Twin Falls Creek, immediately above its confluence with the Lewis River, is a scenic attraction. A user trail leads the short distance between the campground and the falls.

Ten camp sites, five on either side of the Lewis River, provide tent camping. A lack of parking at camp sites precludes use by motor homes and trailers. Road 88251 provides access to the southern half of the campground, with the Lewis River blocking access from the north. This road was once the primary north-south route across the forest, with a bridge spanning the Lewis River at the campground. The long stringer bridge was removed, and not replaced, when it became rotted and unsafe for continued vehicle use. When the bridge was removed it divided the campground into two. Road 88251 is now is poor condition, and because of the difficulty in locating the southern portion of the campground, it is infrequently used. Plans call for installing a foot bridge near the former road bridge location, and providing walk-in camping to the southern half of the campground. All access would then be provided by Road 90580. This will allow Road 88251 to be decommissioned.

Tillicum Campground is located adjacent to the huckleberry fields of Indian Heaven, and while it attracts use throughout the season, it is particularly popular at the end of summer when berries begin to ripen. The campground is equipped with a piped water system, pit toilets, fire rings, and picnic tables. A Forest Service campground host stays at the campground during the summer months, greeting visitors, and providing routine campground maintenance.

The Lewis River Horse Camp is the newest campground addition in the area. Constructed through partnership with the State of Washington and area horse clubs the camp provides a horse-only campground. At the campground is day-use parking for vehicles pulling horse trailers, a two stall composting toilet, horse watering trough, and ten camp sites with picnic tables, fire rings, and horse tie racks. Water for human use must be brought to the site by visitors since a well drilled at the site was found to have water with an arsenic content too great for human use.

The campground also serves as a trailhead for the Quartz Creek Trail. A short connector trail leads between the day-use parking area and the Quartz Creek Trail. Additional trailhead parking can be found along Road 90 for hikers and mountain bikers. Horse users can gain access to both the Quartz Creek Trail and the Lewis River Trail from the campground. Demand for horse trails in the area exceeds trail availability. The Gifford Pinchot National Forest Access and Travel Management Plan proposes converting a number of area roads into trails, thus expanding the trail system.

Table 31. Roads Identified through the Access and Travel Management Plan for Conversion to Trails or Closing of Roads to Benefit Trails.

Road Number	Length (Miles)	Action	Trail Benefitting from Action	Open To
2400271	2.0	Roads to Trails	Squaw Trail	Horse, Hiker Mountain Bike
9000520	0.7*	Closed/All Traffic	Lewis River Trail	Horse, Hiker, Mtn. Bike
9075000	0.3	Decommission	Summit Prairie , Quartz Butte Trails	Horse, Hiker Mtn. Bike, Motorcycle
9331000	0.8	Roads to Trails	Stabler Camp, Basin Camp Trails	Horse, Hiker, Mtn. Bike
9337000	.5	Roads to Trails	Stabler Camp Trail	Horse, Hiker Mtn. Bike, Motorcycle
9338000	1.3	Roads to Trails	Stabler Camp Trail	Horse, Hiker Mtn. Bike, Motorcycle
9388080	1.2	Roads to Trails	Stabler Camp Trail	Horse, Hiker Mtn. Bike, Motorcycle

6.1 Miles of New Trail to be Added

*Will not add to trail length

With the addition of the 6.1 miles of trail listed in Table 31 above, horses riders will be able to disperse up slope and to the west, reducing impact on the Lewis River and Quartz Creek Trails, which are the only ones currently accessible from the horse camp.

The Lewis River Trail once continued up the Lewis River past Pin Creek to Twin Falls Campground and intersected with the Table Mountain Trail. Segments of this trail were destroyed during the construction of Road 90. The Forest Plan calls for the re-establishment of this portion of the Lewis River Trail to provide trail connections, disperse use, and create loop opportunities. A short spur trail is also proposed to provide viewing of Pin Creek Falls, about 700 feet north of Road 90.

The Mount Adams Wilderness occupies the upper portion of the watershed, with its western boundary following a line roughly parallel to Road 23. The wilderness is managed to maintain wilderness values with hiking and horse use permitted on most trails. The Pacific Crest National Scenic Trail crosses the western slope of Mount Adams from north to south attracting much attention from hikers. Though use is generally discouraged, the Riley Camp Trail is a popular access route between Road 23 and the Pacific Crest Trail. Several climbing routes ascend the western slopes of Mount Adams, but due to long approaches and technical difficulty are less popular than the south side route.

Table 32. Existing Trails Located in the Upper Lewis River Watershed

Trail Name	Length in Watershed	Open To
Boundary Trail	7.5	Horse, Hiker, Mtn. Bike, Motorcycle
Boulder Trail	0.5	Horse, Hiker, Mtn. Bike, Motorcycle
Basin Camp Trail	1.5	Horse, Hiker, Mt. Bike
Crab Trail	1.0	Horse, Hiker, Mtn. Bike, Motorcycle
Craggy Peak Trail	1.5	Horse, Hiker, Mtn. Bike, Motorcycle
Squaw Trail	1.0	Horse, Hiker, Mtn. Bike
Riley Camp Trail	1.25	Horse, Hiker
Table Mountain Trail	7.3	Horse, Hiker, Mtn. Bike, Motorcycle
Pacific Crest Trail	9.0	Horse, Hiker
French Creek Trail	3.3	Horse, Hiker, Mt. Bike
Snagtooth Trail	2.0	Horse, Hiker, Mtn. Bike, Motorcycle
Snagtooth Trail	2.8	Horse, Hiker, Mt. Bike
Quartz Creek Trail	9.6	Horse, Hiker, Mt. Bike
Quartz Creek Butte Trail	1.5	Horse, Hiker, Mt. Bike
Summit Prairie Trail	9.0	Horse, Hiker, Mtn. Bike, Motorcycle
Stabler Camp Trail	0.75	Horse, Hiker, Mtn. Bike, Motorcycle

59.5 Miles of Existing Trail in Watershed

The Dark Divide Roadless Area occupies the northern portion of the watershed where most of the trails in the watershed are found. Refer to Figure 31. From Road 90 and the Lewis River Horse Camp, the Quartz Creek Trail follows Quartz Creek northward up the drainage to the Boundary Trail. The French Creek, Quartz Butte, and Snagtooth Trails branch off from the Quartz Creek Trail providing opportunities for horses and hikers to disperse, or make long loops. These trails are open to horses, hikers and mountain bikes, but closed to motorized use. Motorized trails in the watershed include the Table Mountain, Boundary, and Summit Prairie Trails.

Hunting is a popular recreational activity in the fall. Hunting for elk and deer attract the largest number of hunters, with smaller numbers seeking bear, cougar and grouse. A range of easily accessible to remote hunting areas are found in the watershed. The Dark Divide Roadless area and Mount Adams Wilderness provide

remote hunting opportunities, while the heavily roaded areas near Steamboat Mountain satisfy "road hunters". Many hunters prefer to camp at dispersed sites rather than in developed campgrounds. Most camps are established along logging roads, on old spurs, and abandoned log landings. Use of these camps is seasonal, corresponding primarily with deer and elk hunting seasons.

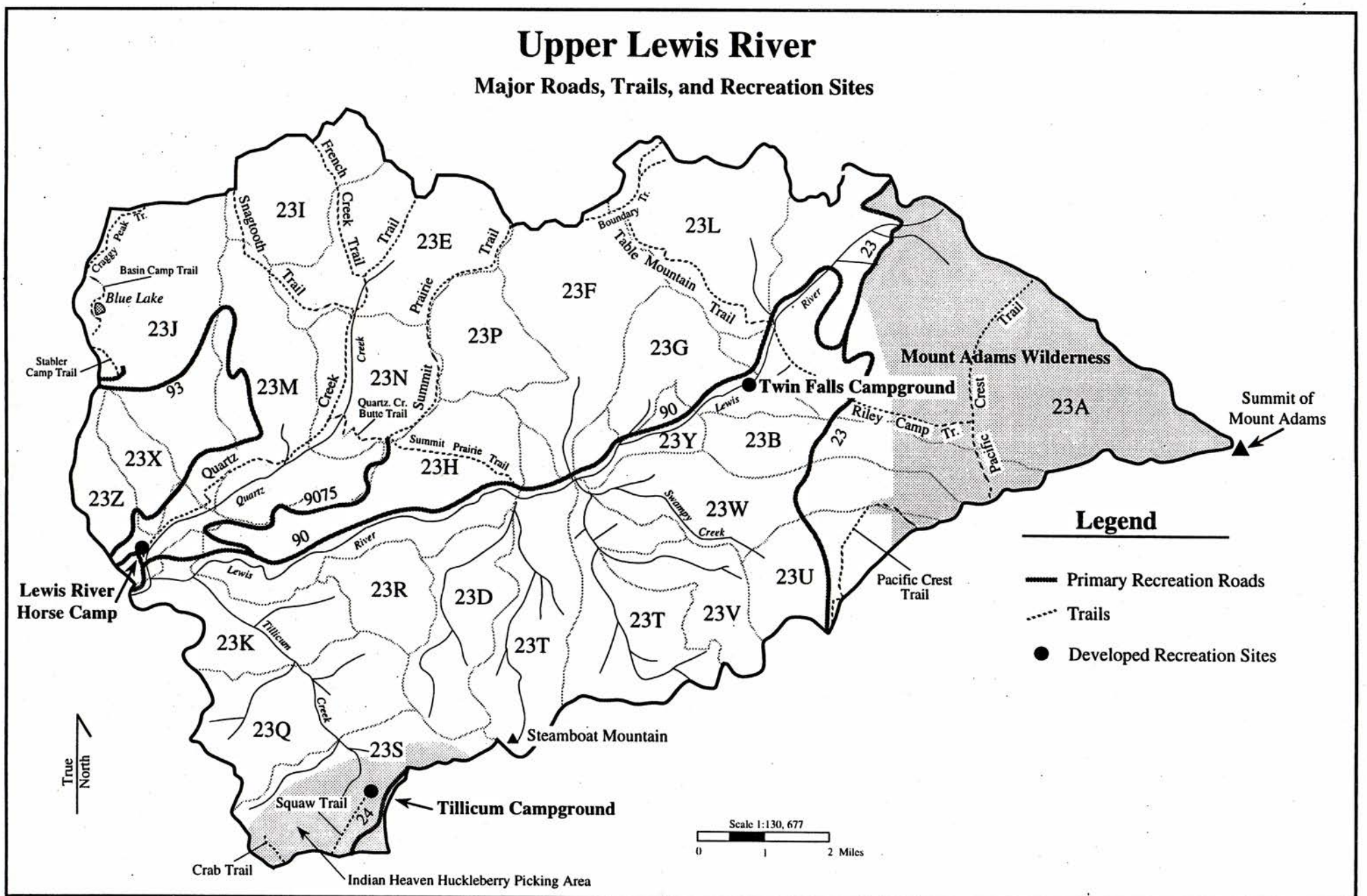


Figure 33. The Upper Lewis River Watershed provides opportunities for camping, hunting, fishing and huckleberry picking. Three developed campgrounds are found in the area, the Lewis River Horse Camp, Twin Falls Campground, and Tillicum Campground. Fifty Nine miles of trail are found in the watershed, providing opportunities for horse riding, hiking, mountain biking, and motorcycle riding. The Mount Adams Wilderness is found at the head of the watershed.

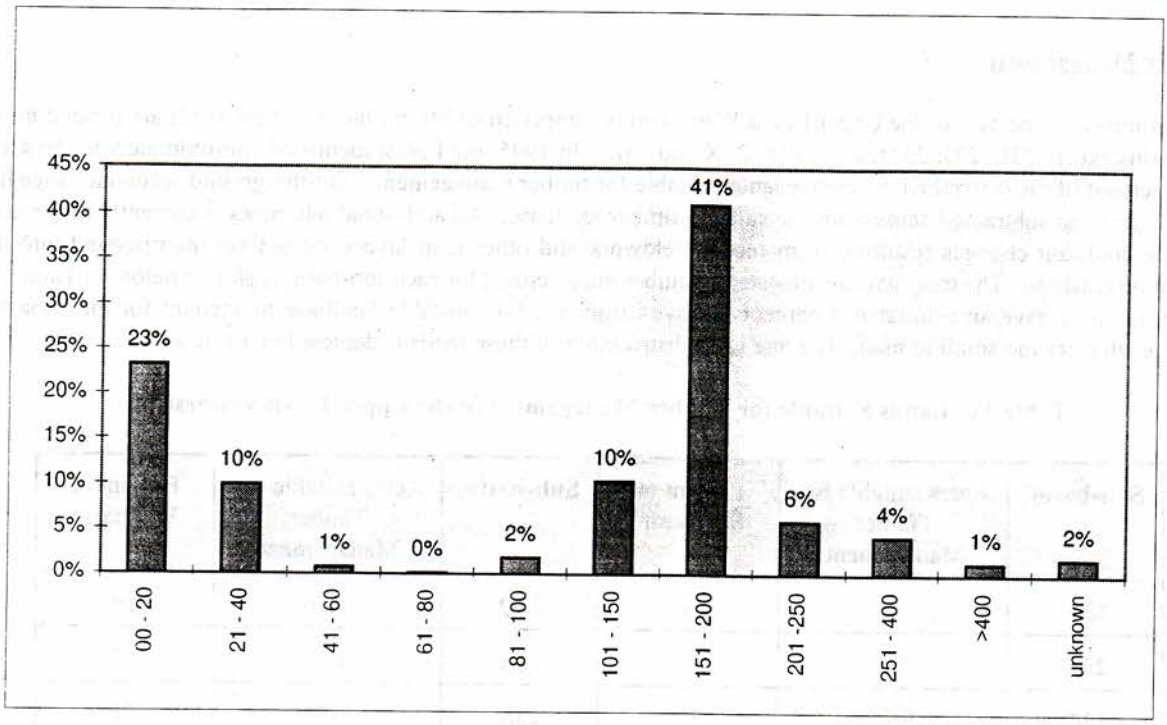
Timber Management

Approximately 34 percent of the Upper Lewis Watershed is comprised of Matrix lands These lands are located in all sub-basins except 23E, 23J, 23M, 23N, 23P, 23X and 23Z. In 1995, the Forest identified approximately 9,450 acres or 12 percent of the watershed as matrix lands suitable for timber management. On-the-ground reconnaissance has since added and subtracted acres from the suitable timber landbase. An additional 640 acres is currently mapped as suitable land, but changes resulting from recent fieldwork and other map layers are not yet incorporated into the vegetation database. The total acreage allocated to timber management for each sub-basin is shown below in Table 33. These numbers have an estimated 9 percent removed from the GIS suitable landbase to account for the Riparian Reserves that are too small to map. The age class distribution of these lands is depicted in Table 34.

Table 33. Lands Suitable for Timber Management in the Upper Lewis Watershed

Sub-basin	Acres suitable for Timber Management	Percent of Sub-basin	Sub-basin	Acres suitable for Timber Management	Percent of Sub-basin
23A	700	6	**23Q**	1056	39
23B	376	18	**23R**	173	15
23C	964	35	**23S**	1316	51
23D	878	44	**23T**	56	2
23F	212	6	**23U**	397	20
23G	1002	51	**23V**	304	21
23H	97	2	**23W**	795	27
23K	31	2	**23Y**	352	42
23L	1329	41	**Totals**	10038	13%

Table 34. Age Class of Lands Suitable for Timber Management in the Upper Lewis Watershed



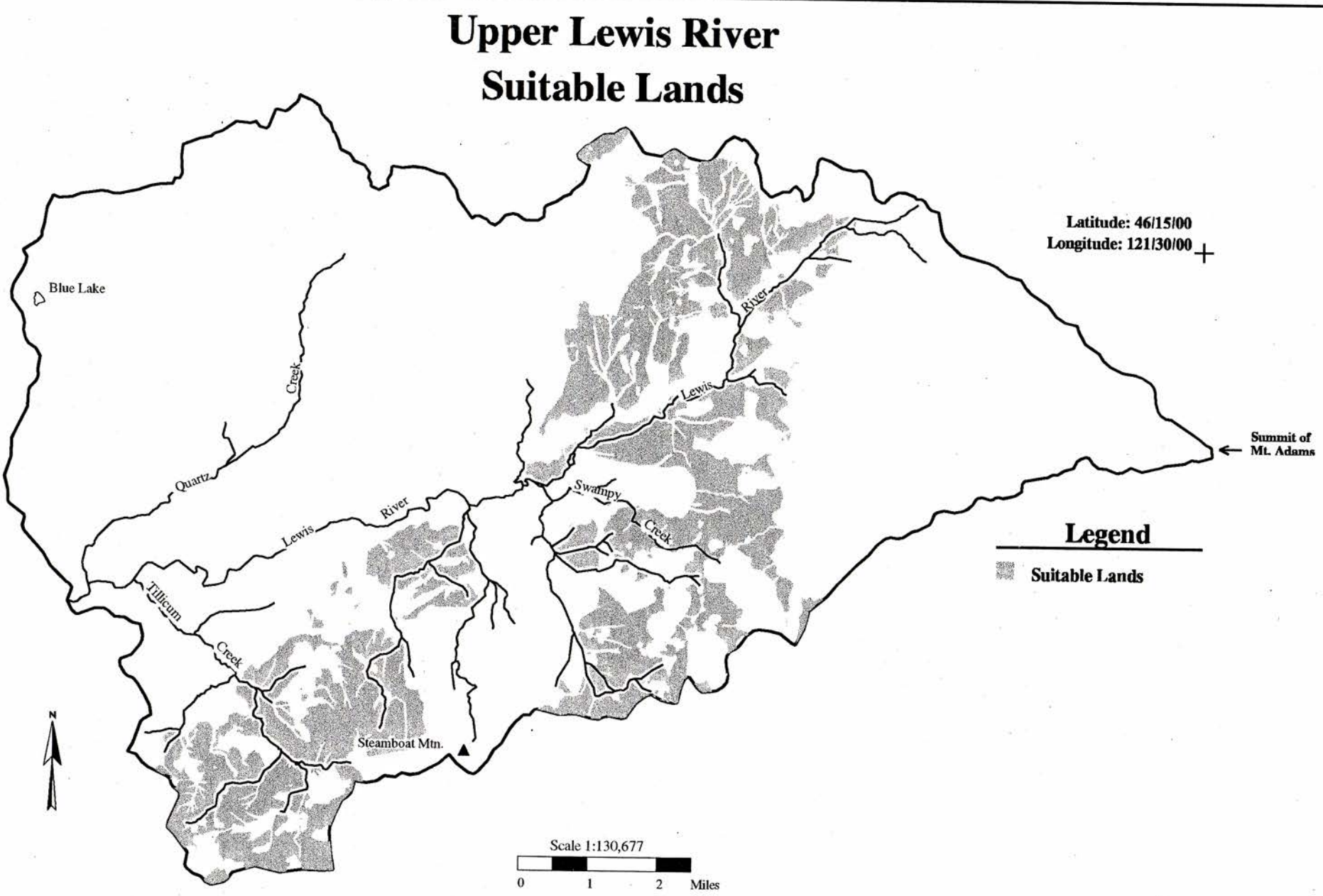


Figure 34. These are the areas within the watershed where timber management is an objective.

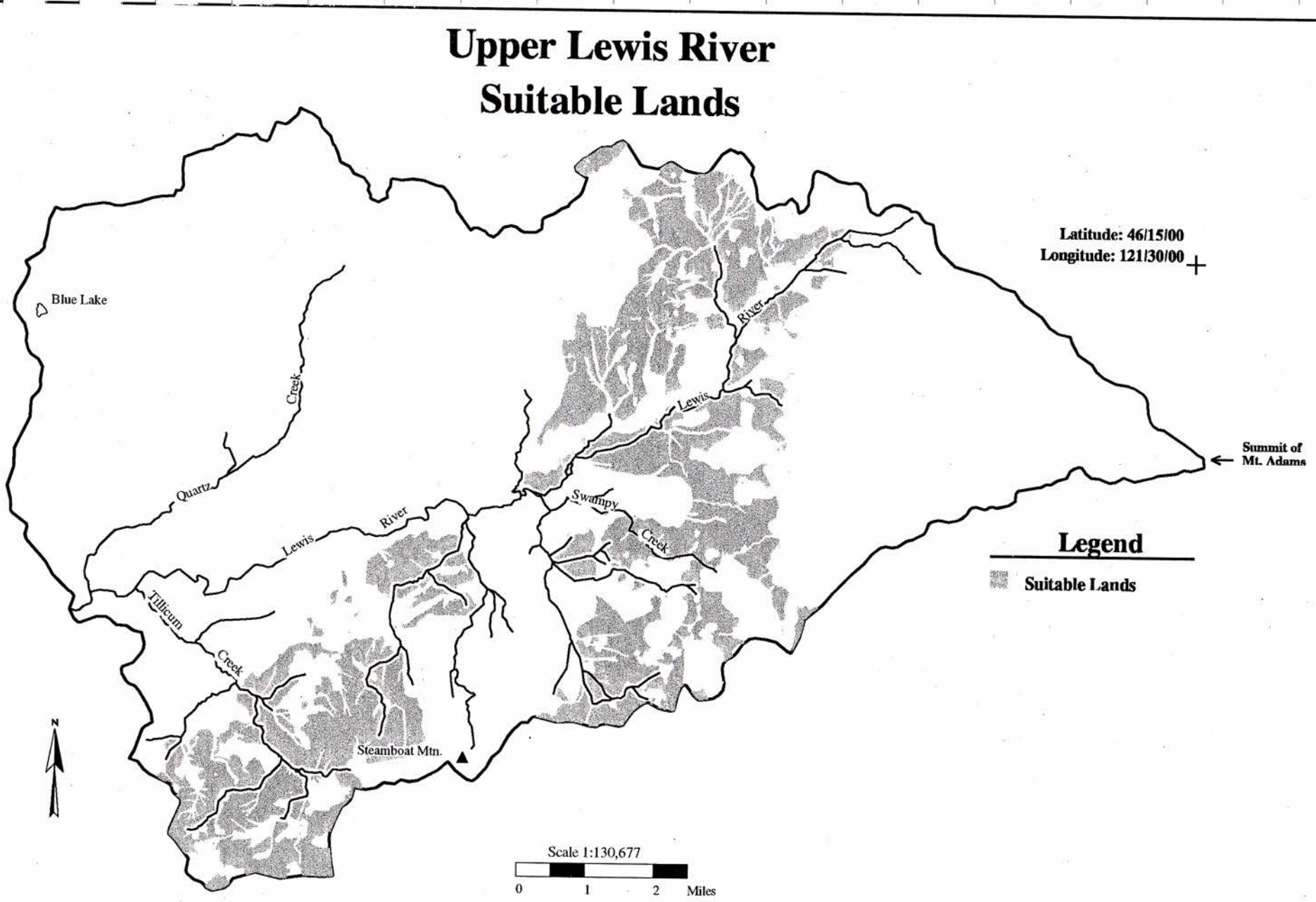


Figure 34. These are the areas within the watershed where timber management is an objective.

Approximately 16 percent of the Upper Lewis Watershed has been regenerated through timber harvest. Figure 33 shows how these acres are distributed through the watershed. Table 7 shows the percent harvested in each sub-basin. Ten percent of these regenerated lands are now within the matrix, and 6 percent in the LSR. About half of the 7,500 acres of plantation within the Matrix are now in Riparian Reserves. Approximately one third of the lands suitable for timber management have been regenerated.

The Upper Lewis Watershed contains approximately 18 percent of the total matrix lands within the Mount St Helens Administrative Unit, and 30 percent of the lands currently available for regeneration harvest. In 1997, it was estimated that up to 1600 acres, or 2 percent of the watershed, could be regenerated this decade in this watershed and meet the Standards & Guidelines of the Northwest Forest Plan (NFP). Since the date the Forest Plan was amended to meet the expectations of the NFP, ten timber sales have proposed cutting units in the Upper Lewis Watershed. An estimated 578 acres have been cut or are now under contract to be harvested. An additional 711 to 938 acres are pending, awaiting decisions which could select proposed harvest units. These sales will harvest roughly 13 to 14 percent of the lands currently suitable for timber management. Additional information on these sales is included in the next section of this chapter.

PSQ (Probable Sale Quantity) modeling provides an estimate only. Information from this watershed analysis is needed to help define whether there are additional timber opportunities in this watershed, where they are, or whether additional timber harvesting should be deferred.

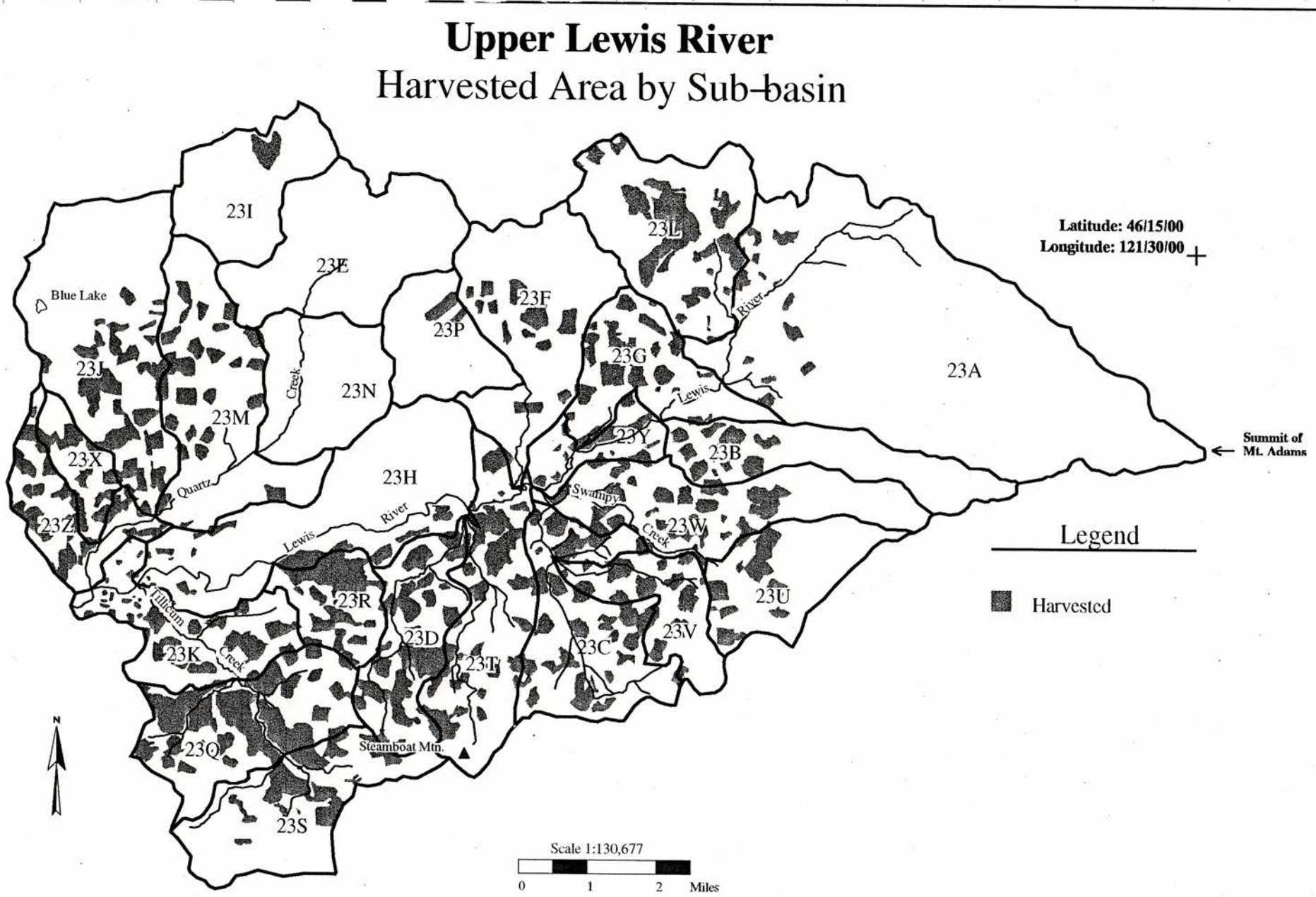


Figure 35. Past harvesting occurred throughout most of the watershed. Most of these areas were clearcut and subsequently managed for future timber production.

Anticipated Changes & Trends

Planned Timber Sales

There are approximately 508 acres of timber sales under contract within the Upper Lewis Watershed which have not yet been harvested. Although the P/B and Page Timber Sales are currently in default status, it is anticipated they will be reoffered without additional changes. Harvest operations in these five timber sales is expected to occur between 1998 and 2002. Table 35 summarizes timber sales under contract by sub-basin and cutting prescription.

Table 35. Timber Sales Under Contract by Sub-basin

Sub-basin	Sale Name	Cutting Prescription	Acres
23A	P/B, Page	HLR	27
23C	Page	HLR	23
23G	P/B	HLR	128
23K	Tile	HHR	15
23Q	Tile	GS HHR	10 27
23R	Tile	HLR	19
23S	Skeeter	HLR HMR HHR HTH	64 26 6 40
23T	Louie-Rosey	HLR	14
23U	Page	HLR	34
23V	Page Louie-Rosey	HLR	51
23W	Page	HLR	24
Totals			508

HLR = Regeneration harvest with 15-20% retention,
HMR = Regeneration harvest with 20-40% retention,
HHR = Regeneration harvest with 40-60% retention,
HTH = Commercial thinning

In addition to the above sales under contract, there are five additional sales currently being planned and analysed in Environmental Assessments. Since no Decicion Notice has been issued for these sales, it is not yet known which sub-

basins, how many acres, or what cutting prescriptions will be utilized. Table 36 provides a likely range of acres and prescriptions which might be implemented.

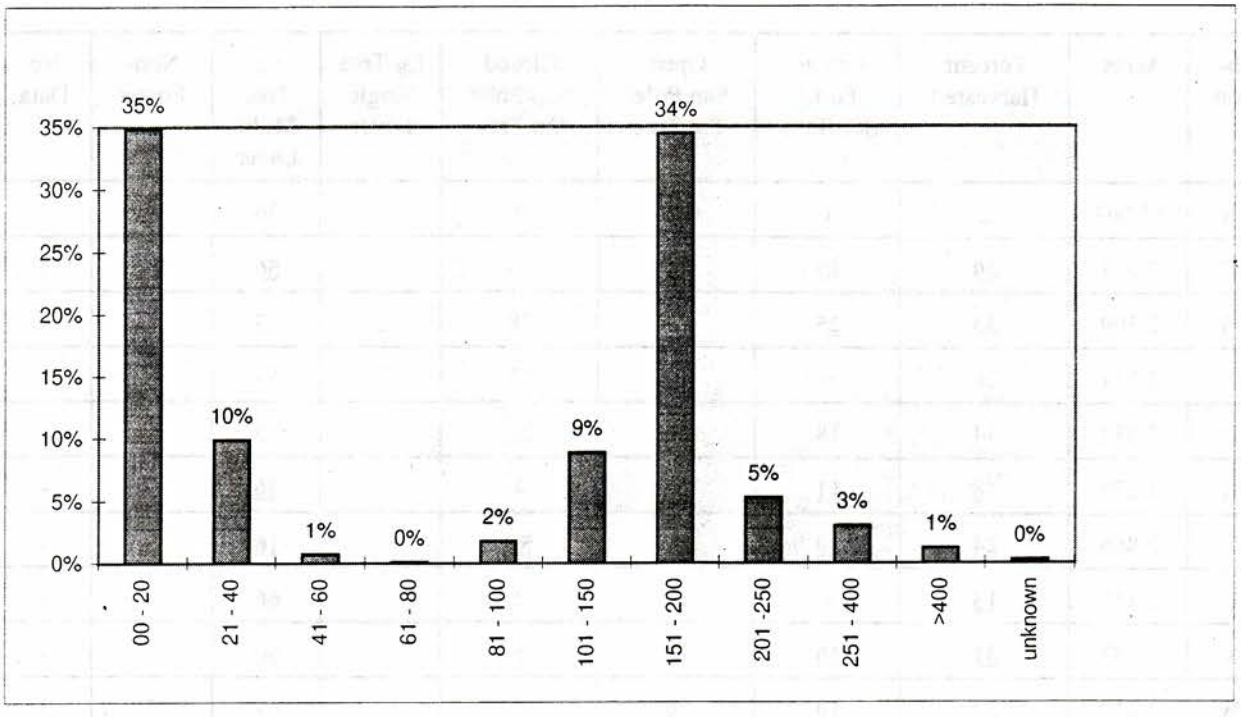
Table 36. Timber Sales Currently Being Analysed in Environmental Assessments.

Sub-basin	Sale Name	Cutting Prescription	Acres
23A	Alpha	HLR HMR	28 109 - 232
23B	Omega	HLR HMR	23 - 36 68 - 70
23C	Beta Lock	HLR HHR HTH	0 - 19 84 19
23F	Alpha	HLR HHR	55 0 - 13
23G	Alpha Omega	HLR HHR	6 30
23L	Alpha	HLR HMR	77 21
23S	Swell	HMR	9
23U	Omega	HLR HMR	0 - 42 37
23V	Beta	HHR	0 - 10
23W	Beta	HLR HHR	7 93 - 98
23Y	Omega	HLR HMR	10 35
Totals			711 - 938

HLR = Regeneration harvest with 15-20% retention
HMR = Regeneration harvest with 20-40% retention
HHR = Regeneration harvest with 40-60% retention
HTH = Commercial thinning

Table 37 shows the age class distribution of lands suitable for timber harvest after the sales under contract and proposed sales pending a Decision Notice have been harvested. The significant increase of acres between 0 and 20 years of age clearly shows that a large portion of this watershed has been harvested in the last two decades. Since this watershed has a higher percentage of older stands within the Matrix as compared to many of the other watersheds, the number of harvest acres is propotionately greater.

Table 37. Age Class of Lands Suitable for Timber Management in the Upper Lewis Watershed after the Timber Sales under contract and Proposed Sales Pending a Decision Notice are logged.



The Till Timber Sale is proposed in Sub-basins 23D, 23R and 23S. This sale is in the very early stages of planning and as a result no reliable numbers are available for this watershed analysis. The sale will be located primarily in sub-basin 23S. This watershed analysis will be used to further refine the Till timber sale proposal.

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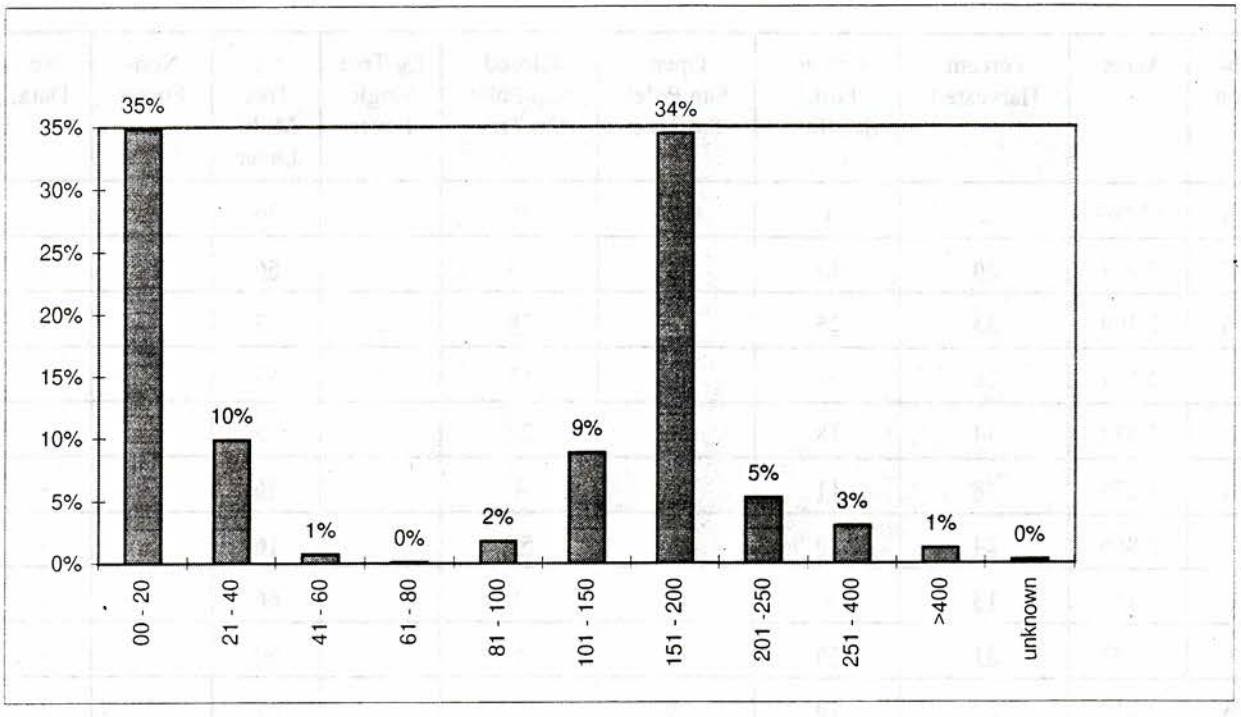

The Till Timber Sale is proposed in Sub-basins 23D, 23R and 23S. This sale is in the very early stages of planning and as a result no reliable numbers are available for this watershed analysis. The sale will be located primarily in sub-basin 23S. This watershed analysis will be used to further refine the Till timber sale proposal.

Anticipated Changes in Structure Stages Resulting From Planned Timber Sales

Once the timber sales currently under contract (Louie-Rosey, Page, P/B, Skeeter, Tile) are logged, the following changes in structure stages will occur. Table 38 shows sub-basins affected by harvest and the percent distribution of structure stages within the sub-basin. Percentages which would change are highlighted and underlined. The new totals for the entire watershed are listed at the bottom of Table 38. The percent harvested will increase by one percent for the whole watershed, but the percentages for grouped structure stages will remain the same as shown in Table 7 under Current Conditions.

Table 38. Percent Grouped Structure Stages after harvest of units under contract

Sub-Basin	Acres	Percent Harvested	Grass/ Forb/ Seedling	Open Sap/Pole/ Sm Tree	Closed Sap/Pole/ Sm Tree	Lg Tree Single Layer	Lg Tree Multi Layer	Non-Forest	No Data
23A	12,067	2	1	26	9	-	36	27	1
23C	3,071	**30**	**19**	9	10	-	**56**	3	1
23G	2,199	**33**	**25**	9	**38**	2	23	3	-
23K	2,311	26	9	14	17	7	53	-	-
23Q	3,032	44	18	27	20	-	35	-	-
23R	1,278	**48**	**11**	34	4	-	**46**	6	-
23S	2,866	**24**	**10**	**8**	**52**	-	**16**	8	-
23U	2,159	**18**	**4**	19	2	-	**66**	9	-
23V	1,583	**31**	**16**	14	6	-	**60**	6	-
23W	3,219	22	**10**	16	4	-	67	2	3
Totals for the watershed		**18**	8	17	17	6	42	9	1

Given the range of acres and prescriptions shown in Table 38 for upcoming planned timber sales, the following changes in structure stages would occur after the harvest of sales currently under contract and the Alpha, Beta, Omega, Swell, and Lock Timber Sales. Cumulative changes from sales under contract and planned timber sales are highlighted and underlined.

Table 39. Percent Grouped Structure Stages after Harvest of Units Under Contract and the Proposed Alpha, Beta, Omega, Swell and Lock Timber Sales.

Sub-Basin	Acres	Percent Harvested	Grass/ Forb/ Seedling	Open Sap/Pole/ Sm Tree	Closed Sap/Pole/ Sm Tree	Lg Tree Single Layer	Lg Tree Multi Layer	Non-Forest	No Data
23A	12,067	**3-4**	**2-3**	26	9	-	**34-35**	27	1
23B	2,343	**18-19**	**7-10**	29	8	-	**51-58**	4	-
23C	3,071	**33-34**	**19**	**10**	**9**	**3**	**53**	3	1
23F	3,747	**12**	**19**	28	**17**	1	32	2	1
23G	2,199	**35**	**26**	**10**	**37**	2	23	3	-
23K	2,311	26	9	14	17	**8**	**52**	-	-
23L	3,577	**27**	**18**	20	**35**	3	**17**	5	2
23Q	3,032	44	18	27	20	**1**	**34**	-	-
23R	1,278	**48**	**11**	34	4	-	**46**	6	-
23S	2,866	**24**	**10**	**8**	**52**	-	**22**	8	-
23U	2,159	**20-22**	**6-8**	19	2	-	**62-64**	9	-
23V	1,583	**31**	**16**	14	6	**0-1**	**57-58**	6	-
23W	3,219	**25-26**	**10**	16	4	**3**	**64**	2	3
23Y		**28**	**14**	4	34	-	**47**	-	-
Totals for the watershed		**19**	**9**	17	17	6	**41**	9	1

Total harvest acres for the watershed after sales under contract and sales pending a decision are implemented would be an increase from the current 17 percent to 19 percent. This harvest will result in a corresponding decrease in the Large Tree Multi-storied stucture stage from 42 to 41 percent and an increase in Grass/Forb/Seedling structure stage from 8 to 9 percent. Although individual sub-basins will change, the overall percentages for the other structure stages will remain the same as the current condition (Table 7).

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, seismicity, glaciation, deposition, mass wasting and erosion have had the most effect on shaping the landscape as we see it today. Volcanic, glacial and seismic activity are natural events which have affected the landscape over long periods of time and will continue to occur. Deposition, mass wasting and erosion are continually occurring with effects more evident with activities that occur today. These are also natural processes that will continue to occur but their effects can be either increased or decreased by management activities.

Volcanism in the area has not only originated from the past eruptions of Mount Adams itself but from various other volcanic centers in the area, such as Indian Heaven and other vents near Mount Adams. Even though Mount Adams has not erupted in the last few thousand years, some of its hydrothermal vents emit sulferous gases. The probability of an eruption is low, but there are more likely events such as debris torrents and lahars occurring due to the altering of the rock that makes up the mountain. This altered and weakened rock on the steep upper slopes of the mountain can collapse and form debris avalanches which can transform into lahars that flow further down valleys. Such events were noticed in the fall of 1997 on the south west and east sides of the mountain. In the past, these debris avalanches have moved up to 35 miles down valley.

Seismic activity (earthquakes) can initiate landslides in the area. This is one theory as to why there are the large deep seated landslides on the south side of the Lewis River. A large earthquake between 400 and 600 years ago in the northwest is thought to have initiated some of the large landslides in the Columbia Gorge. This could have been the same time period that the large slide from Steamboat Mountain originated. There is no actual data on the date of this slide's occurrence.

Glaciation has also shaped the landscape in the past and will probably do so again in the future when the earth enters the next cooling period. The last ice advance occurred between 20,000 and 10,000 years ago. During this time, ice from Mount Adams and the Indian Heaven area moved into the Lewis River area leaving the uniform slopes on Mount Adams and helping to carve the Lewis River Valley.

Deposition, mass wasting and erosion can have positive effects such as the movement of large woody debris into streams or the build-up of gravels that could enhance fish spawning areas. Detrimental effects from these same processes can include removal of spawning areas, filling them in with fine sediments, or cutting off or rerouting streams.

Fire History

Native American use of fire (to maintain hunting and berry gathering areas, to create and maintain travel routes and additionally as defense mechanisms) is known to have been extensive. Historically, human ignition of the forest, both intentional and accidental, is presumed although documentation is limited.

While fires and timber harvest have been the primary forces of landscape-scale change within the watershed other factors have had effects over time. These include wind, insects, and disease. These agents cause mortality of single or small groups of trees, thus benefiting vegetative growth near the forest floor.

Analysis of aerial photography of the watershed indicates that large-scale, catastrophic fires have occurred. Vegetation mapping places the time of these fires to approximately 150 to 300 years before present. No large-scale, catastrophic fires have taken place within the watershed since the European settlement of the Pacific Northwest beginning the early 1800's, although four small crown, stand replacement fires occurred did occur. These all burned in the Upper Lewis River sub-basin (23A) located on the western flanks of Mount Adams. These fires were lightning caused and burned less than 100 acres.

Vegetation

Stand Structure and Composition

According to the Regional Ecology Assessment Report (REAP 1993), the Lewis River Basin was historically covered with broad continuous conifer stands of varying age classes. These 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 late-successional vegetation covered between 45 percent and 70 percent, and early to mid-successional vegetation covered between 30 percent and 55 percent of the Lewis River Basin.

Table 40 lists current proportions of different age classes within the watershed. Using this information, 41 percent of the watershed is currently over 161 years old, which includes mature and late-successional stands. Table 6 (Vegetation Structure Stages) shows the current structure stages of vegetation, which can be used to suggest the ecological functions of vegetation on the landscape. Using the structure stages, 48 percent of the watershed is in large single and multiple layered tree stands and about nine percent are in small tree structure stages in the Mountain Hemlock zone, which are older small trees at the threshold of their ecological tolerance. In particular, the large tree multi- layered vegetation and Mountain Hemlock habitat are both probably functioning as late-successional habitat. This puts about 58 percent of the watershed in functional late-successional conditions, which are within the estimated reference conditions suggested by the REAP document.

Table 40. Current Proportions of Tree Age Classes in the Upper Lewis Watershed

Age Classes	Present Percentage
1 (0-80 Years)	17%
2 (81-160 Years)	36%
3 (Over 161 Years)	41%
No Data Available	6%

Riparian Areas

Historically, between 50 percent and 85 percent of the stream riparian areas within the Lewis River Basin stream riparian areas were in late successional stands (REAP 1993). Migration corridors along stream riparian areas for plants and animals were intact because they rarely burned. Currently, about 46 percent of the Upper Lewis River Watershed stream riparian areas are in multi-layered large tree stands, which function as late successional habitat. Another 10 percent are in large tree single-layered habitat, which provide some functional habitat for some old-growth species. Fourteen percent are in small trees, much of which is high elevation Mountain Hemlock and alpine habitat, and probably functions in much the same capacity as it did in reference conditions. This puts 60 percent of the stream riparian reserves in functional conditions similar to late-successional conditions, with up to an additional 10 percent providing some late-successional functions for some species. While the overall stream riparian reserves appear to be functioning similar to those suggested in the REAP document, some areas of the watershed may have functionally impaired stream riparian reserves.

Habitat Conditions for Terrestrial Animal Species

Little information is available about the past species richness and abundance in the Upper Lewis Watershed. Historically, animal habitats in the watershed included a variety of timber age classes that occurred in large blocks that were the result of large scale stand replacing fires and volcanic activity. Late-successional habitat likely constituted 40 to 70 percent of the watershed at any one time. Forest stands of various age classes would have occurred in large blocks that provided more interior habitat than what exists today. Early- and mid-successional stands likely contained remnants of the previous stand, including large old live trees, and large snags and down logs in various decay stages.

The past habitat spatial distribution was probably very different than what it is today. Historic fire patterns indicate that late seral forest was probably more contiguous and located in larger blocks. Similarly the mid-late and early forest were probably arranged in large clumps, instead of the small scattered patches that exist today.

This vegetation pattern would have favored interior species over edge species, especially those with large

home ranges. Populations of late seral terrestrial species such as the spotted owl, fisher, and northern goshawk were most likely more abundant. Species such as elk, black-tailed deer, and great horned owl would probably have been less common.

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

Hydrologic Processes and Changes

According to streamflow records from the Lewis River above Muddy River and the Lewis River at Ariel, major flood events occurred on the Lewis River in 1933, 1972, 1973 and 1974. The pre-1972 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 the historic range of basin disturbance for the entire Lewis River Basin ranged between four and five percent.

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

Aquatic Animals and Habitat

Aquatic Animals

Historical aquatic habitat and population information in this basin is poorly documented. Distribution of resident fishes has been altered by road construction. Although Lower Falls on the Lewis River (downstream of the analysis area) was a migration barrier to anadromous fishes, the construction of Merwin dam in 1935 which blocked approximately 55 miles of mainstem habitat and numerous miles of tributary habitat for anadromous fishes.

Large Woody Debris (LWD) and Pools

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 Lewis River area. Historical values for pool frequency ranged from 25 to 60 pools per mile in the Lewis River basin. Currently, 64 percent of streams surveyed fall within this range of pools per mile. Given the management activities that occurred after disturbances (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 east of Mount St. Helens 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 moderate frequency of disturbance in this area.

An examination of historic air photos (1959) revealed channel conditions in the upper Lewis River Watershed when very limited timber harvest and road building activities were present. By comparing the 1959 aerial photos with other taken in 1979 and 1989, a progression of conditions was interpreted. The following channel related items were noted in the first iteration of Watershed Analysis for the upper Lewis River area.

- Recent river terraces appeared in all response segments in the Lewis River in the 1959 air photos. This indicates flood event(s) caused significant channel aggradation (deposition) prior to land management activities.
- Channel widening and associated aggradation resulting from the floods of the 1970's seemed to be roughly equivalent in size and extent to older flood deposits noted in the 1959 photos. The extent of channel changes resulting from the 1996 flood is not known at this time due to lack of recent aerial photographs.
- The amount of LWD in the Lewis River has remained relatively low throughout the photo sequence. The exception is segment 1002, which lost in-channel LWD due to channel downcutting.
- Recent deposition was noted in the 1959 air photos in the lower sections of Boulder Creek, Pin Creek, and Quartz Creek, probably corresponding to older flood event(s) mentioned above.

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- Lewis River segments 1003, 0103, and 0102 experienced channel widening from the 1970's flood events. Segment 1003 increased in width from 63 feet in 1959 to 122 feet in 1979, a result of increased sediment input.

- Lewis River segments 1004 and 1002 have been getting narrower since 1959. Segment 1002 was 175 feet in 1959, 122 feet in 1979, and 84 feet in 1989.

Stream Temperature

Historical stream temperature data in this basin is lacking. The Regional Ecosystems Assessment Project (REAP) suggests that historic maximum stream temperatures for the entire Lewis River basin ranged between 14 and 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.

Past Human Uses

Prehistoric Subsistence and Land Use Patterns

During recent years a number of sites on the Gifford Pinchot National Forest have been the subject of archaeological investigations. One of these sites, the Council Lake site, is located within the Upper Lewis River drainage, and another two, the Lower Lewis River Falls and Pointless sites, are located within two miles of the watershed boundary. Information from these excavated sites helps to provide a context for understanding sites located within the watershed.

The Lower Lewis River Falls site is located at a waterfall which once served as a natural barrier to migratory salmon. A relatively large lithic assemblage dominated by expedient, unifacial flake tools has been recovered from test excavations undertaken on three separate terraces at the site. The majority of the assemblage was recovered from beneath a primary deposit of Mount St. Helens Ye tephra, dating to approximately 3500 B.P. (Gowan and McClintock 1993). Flotation analyses of samples recovered from the site have yielded salmonid scales, along with burned fish bones.

The Pointless site is a low density lithic scatter located at a stream confluence, near the White Salmon/Lewis River watershed divide. Tool stone material in use at the site appears to have been locally procured, possibly in the stream bed itself (Mack 1993). The assemblage was recovered from below a primary deposit of Mount St. Helens tephra set Y, dated to approximately 3500 years B.P, Tools in the assemblage consist entirely of utilized flakes.

The Council Lake site is located at the southern end of Council Lake, and it appears that the majority of materials recovered at the site were procured from nearby quarries on Council Bluff. The assemblage is dominated by products of the earlier stages of lithic reduction. The majority of cultural material was recovered from beneath Mount St. Helens tephra set Y, indicating that it pre-dates 3500 years B.P.

Within the watershed boundary, several other prehistoric sites have been documented. These include prehistoric sites near Mosquito Lake, near Surprise Meadow, at three locations in the Boulder Creek drainage, and near Deer Creek. These sites are primarily low density lithic scatters, situated in a variety of environmental settings. Their locations and assemblages are consistent with a model of seasonal transhumance by small hunting and gathering groups, who move into the higher elevations out of low elevation winter residences, following resource availability. The variety of resources utilized is probably reflected in the variety of environmental settings in which the sites are found.

Overall these sites suggest a broadly similar pattern of human use within this portion of the Gifford Pinchot National Forest, which in itself is similar to that seen throughout the central Cascades at this time period. This pattern is one of repeated seasonal occupation by small groups, beginning approximately 7000 years ago and continuing into the historic period. A disruption in occupation may have occurred in parts of the southern Washington Cascades, due to the effects of the ca. 3500 B.P. eruption of Mount St. Helens, which deposited a thick layer of tephra (Ye and Yn) over parts of the area. It has been suggested that this Smith Creek eruptive period (set Y) of Mount St. Helens was devastating enough to have led to abandonment of the area and a hiatus in human occupation throughout the southern Washington Cascades, between approximately 3500

and 2000 B.P. (Lewarch and Benson 1991; McClure 1992). Occupations dating to 2000 B.P. and later in the southern Washington Cascades are generally limited use locations, exhibiting a low diversity of tool types, usually consisting of debitage, cores, and a limited variety of chipped stone tools.

Historic Native Americans Subsistence and Land Use Patterns

The people who occupied this area during historic and late prehistoric times included the Sahaptin-speaking Klickitat, Yakama, Tailtmapam, Wyam and Tenino Indians, as well as the Chinookan-speaking Wishram and Wasco Indians. It has been noted by several ethnographers (Gibbs 1855:407; Ray 1974:258) that the term "Klickitat" was often used generically by groups living west of the Cascades to apply to any Sahaptin-speaking Indian. The Taitnapam, along with the Lewis River Cowlitz, were Sahaptin-speaking groups occupying the Upper Cowlitz and Lewis River drainages. The linguistic affiliation of this group is thought to be the result of the westward drift of Sahaptin speech over the Cascades into what was originally Coast Salish territory. This drift has been attributed to the effect of westward-trending marriages (Jacobs 1931: 95-96). The Salish-speaking Cowlitz were centered in the Cowlitz River valley, and they occupied much of the interior of southwest Washington. The territories of many of these groups overlapped and were used in common, making the designation of "tribal" boundaries difficult if not impossible.

The settlement pattern of the native populations in this area involved winter residence in semi-permanent villages situated in sheltered locations along either a major river or tributary, and seasonal camping at root digging grounds, fishing stations, and hunting and berrying locales (Ray 1939). The seasonal salmon runs along the Columbia and its major tributaries formed the emphasis of their subsistence economy, but people took advantage of a wide variety of plant and animal resources throughout the year. After about A.D. 1750, this collecting strategy was succeeded in some parts of the plateau by an increasing dependence on hunting with equestrian mobility (Schalk and Cleveland 1983).

It was usually during the late summer and fall that people moved into the mountains, folowing the ripening berries. Camps, consisting of extended families, were dispersed across the uplands. One type of shelter used was the conical mat house, later replaced by the more typical Plains tipi-like structure. At the culmination of the berry season people would congregate at social gathering sites to meet with other bands before the upcoming isolation of winter.

Periodic hunting and fishing took place thoughout the summer. Deer, elk, bear and mountain goat are the species most frequently mentioned, but a wide variety of animals and birds were hunted, both for meat and fur. These include grouse, duck, quail, rabbit, squirrel, beaver, otter, and racoon. Wolf, fox and cougar were taken for their fur.

Deer could be taken in the winter close to village locations, but elk and bear were primarily taken in the mountains during the berry season (Spier and Sapir 1930:181). Hunting was accomplished primarily with the bow and club, but also thorugh the use of pit fall traps, and by driving animals along their runs to waiting hunters. Deer and elk were taken by groups of hunters with bows who would make a stand on the runway along which the animals regularly passed. Other hunters would then drive the animals towards them. Bear, cougar, wolf, fox and other animals were caught in deadfall traps. Snares were used for smaller animals.

A Yakama Indian recounted a story to Lucullus McWhorter in 1927 (told in Hines 1992:273) of group hunting by the Yakamas in an area that may have been within the Upper Lewis watershed. The place was called *Sac-look-las,* meaning "hair cropped in front", and was located 15 miles west of Mount Adams. It was referred to as a "table-rock hunting ground", being a forested area surrounded by cliffs, with only two or three places where deer could pass up or down. Two men considered good with the bow or gun were stationed on either side of these paths, and drivers would beat through the timber and frighten the deer, who would break for the paths. Dogs were also used in routing the game. It is likely that the area referred to is Table Mountain.

Aside from fruits, nuts and game animals, a variety of other plants were collected while in the mountains. These include the bark of the western redcedar, which was used to make folded barkbaskets, cedar root and beargrass, which were used in the manufacture of coiled baskets; kinnickinnick leaves for smoking; and a variety of plants collected for medicinal purposes.

Berry Picking A variety of warm season resources were available within the watershed, including huckleberries, strawberries, elderberries, raspberries, blackberries, gooseberries, currants, salmon berries, chokecherries, service berries, black lichen, white bark pine nuts, trout, salmon, and animals such as deer, elk, bear and grouse. Huckleberries are notable in that they were available in quantities suitable for collection as a stored food, and they could be dried to a raisin-like state. There are several references in the ethnographic literature to huckleberry collection and processing in the area around Mount Adams. According to Curtis (1911:5-6), no fewer than eighteen kinds of berries were commonly used as food by the Yakama, and huckleberries were considered the most important. The Yakama and Klikcitat gathered them in quantity on the slopes of Mount Adams. The berries were picked, dried, packed in bags and brought back to villages for winter consumption. Murdock (1980:13 1) states that certain bands of the Tenino went to the Mount Adams area in summer to gather berries and pine nuts, hunt deer and elk, and lay in a supply of dried berries and smoked meat for winter. He described a connecting trail through Klicklat territory heading to Mount Adams, used by the Wyam and John Day subtribes of the Tenino.

Techniques used by the Indians in this area to process huckleberries have been described in several sources (Filloon 1952, French 1965, Briley 1986, Hunn 1990, Schuster 1975, Martin 1979, Stabler 1910). One method involved spreading the berries out to dry on mats in the sun; another involved spreading the berries on a rack built over a fire pit; and the third involved drying the berries on mats in a trench in front of a smoldering log. Sometimes berries that were log-fire dried were spread on mats in the sun to complete the drying process.

Huckleberries grow best in high elevation areas that have been burned over by forest fires (Minore et al. 1979). Ecologically these huckleberry fields are seral, being temporary stages in the natural succession from treeless burn to climax forest (Minore 1972). The maximum amount of berries is produced a few years after establishment of the field, with production gradually declining as other shrubs and trees begin to dominate the site. Without the intervention of fire, the huckleberies are eventually crowded out by competing vegetation. Since about 1910 modern fire protection and control techniques have severely curtailed the role of fire in influencing the ecology of forest landscapes. Prior to this time it is likely that Indians purposefully maintained large burns either by leaving their drying logs smoldering after leaving the berry fields or by directly setting fire to berry patches at the end of the berry season.

Plummer (1900), in an early report for the United States Geological Survey, discussed the various causes of forest fires in what is now the Gifford Pinchot National Forest. He wrote that "Indians also start fires for the purpose of promoting the growth of huckleberries, blackberries and raspberries, and also to drive game." (1900:135). According to French (1957) the Indians in this area considered trees to be like weeds overrunning their huckleberry fields. The solution to this problem was to start fires under controlled conditions. French reports that a "common technique for increasing the probability that a fire would indeed occur was to leave the log burning that had served as the reflector during the course of the heat drying of huckleberries" (1957:3). Recent interviews with elderly Yakama informants corroborate this, providing descriptions of how one or two men were chosen specifically for the task of staying behind to burn the fields. These men were chosen for their knowledge, because not only did they have to burn the fields, they also had to call on the rain and thunder to put the fire out. The informants stressed that this was not done every year, but only when needed. Accepting that local Indians most likely used fire as a tool for enhancing huckleberry production, it is also likely that the locations of huckleberry fields would simply shift as naturally-occurring fires opened up new areas, and older burns reforested.

In August of 1878 Francis Marion Streamer joined a group of Yakama Indians travelling to huckleberry fields on Mount Adams, and he describes the expedition in some detail (Briley 1986:57-61). The berry fields to which they were heading were located on the northwest slopes of Mount Adams, near a lake. Streamer's description of the camp provides one of the better indications that we have as to the intensity of human (and equestrian) use of these huckleberry fields. When they reached "Ollala Camp", Streamer noted "There are now over one thousand ponies and nearly 200 Indians - and there will be as many more before the week..." He described these Indians as being from the Yakama area, as well as from areas along the Columbia River stretching from Bonneville to Roosevelt. To give some idea of the quantities of berries picked, Streamer

describes how his group alone dried 10 bushels of huckleberries (approx. 90 gallons), and that they planned on selling these along with fresh berries at the Dalles. He commented that the larger group heading to the Dalles had nearly a half ton of dried and fresh berries. These quantities are all the more impressive in consideration of Hunn's estimate that drying the berries reduces the water content and thus the weight by 70 percent (1990:132).

In September of 1890, C. E. Rusk made a circuit of Mount Adams along with his mother Josie and his twelve year-old sister Leah. They camped with a groups of Indians at a "huckleberry patch" on the northwest side of Mount Adams, probably close to Streamer's "Ollala Camp". Rusk states:

> The huckleberry patches northwest of Mount Adams and along the slopes of the Cascade Range draw hundreds of Indians each summer... The squaws devoted their time assiduously to picking and drying the luscious berries; but their lords and masters spent most of their waking hours in gambling, horse-racing, and hunting. (Rusk 1978:49)

Although Rusk was traveling in the opposite direction to Streamer, the trail that Rusk followed around the mountain on the west side is probably the same trail followed by Streamer's group as they were heading to the huckleberry fields. Based on a map of Rusk's route, within the watershed boundary this trail appears to be located in the same general location as the Pacific Crest National Scenic Trail. Rusk discusses the origin of the trail they followed, stating "All of the trails on Mount Adams, at that time, were Indian trails ..".

In 1923, Lucullus McWhorter (recounted in Hines 1992:293-304) recorded a story told by Charley Olney, who in August of 1869 had travelled by horseback from the Yakama Reservation to join his family at a berry patch on the north west side of Mount Adams. He stopped at a berry camp along the way, which was located about a half mile from the head of a lake. Olney said the camp was called *em-Mow-wee,* which means "Little Island", and he said it was a camp of the Thap'panish people. Their berry patch was located a short distance northeast of the camp. According to McWhorter's footnotes, the name *em-Mow-wee* refers to the buttes where large huckleberries grow among the small scattering trees. He stated that it ' has ever been a noted camping place of the Indians during the berry season (Hines 1992:340). Virginia Marting told Mount Adams District Ranger Jim Bull in 1979 that the name for Council Bluff was "Maui Maui" which means "Little Island". Council Lake may have been the lake Olney was referring to.

Another source which gives names and general locations for Indian camps utilized during the historic period in the Mount Adams area is Click Relander, a Yakima Valley resident who interviewed Yakama informants in the 1950's (Relander 1959). In interviews with three elderly Yakama men in 1959, Relander documented the names and general locations of four camps and huckleberry fields on the western slopes of Mount Adams, "where most of the berries were gathered in the old days". Although the exact locations of these camps have not been verified, it is likely that at least some of them are located within the upper Lewis River watershed. One of these sites, called *Sach a lux,* or *Sac-look-las,* is also listed as a noted hunting ground of the Yakamas.

Archaeological remains of a huckleberry processing camp has been identified in the Swampy Meadows area. This site contains features such as berry drying trenches and possibly **tipi** rings.

Peeled Cedar The association of peeled cedar sites with former huckleberry fields and camps has been documented in other parts of the Forest, most notably in the Red Mountain area in the southern part of the Indian Heaven Wilderness, in the Sawtooth Berry Fields, and on Little Huckleberry Mountain. Use of these areas as huckleberry fields has been documented archaeologically, through ethnographic sources, and through the recollections of living Indian people. Peeling dates from these peeled cedar sites correspond to the dates of use of these particular huckleberry fields. It is possible that peeled cedar sites without obvious associations are located near former huckleberry fields which have since reforested.

Within the watershed boundary a total of 1410 peeled cedar trees have been documented, in 58 clusters or sites. Peeling dates have been determined through tree ring counts in five of these sites, and the thirty peeling dates range from A.D. 1803 to A.D. 1922, with a mean date of A.D. 1844. The peeled trees appear to cluster along at least two major travel corridors, one being a north-south route along the headwaters of the Lewis River, and the second being the route of the Post and Case/Stabler Camp Trails (Tillicum Creek). Those

along the Lewis River headwaters are actually along a travel corridor that seems to follow the route of the old N123, the road from Trout Lake to Randle. These trees are most likely associated with huckleberry camps on the north and northwest sides of Mount Adams. The peeling dates from these sites cluster between A.D. 1803 and 1847. Peeling dates from sites along the Post and Case/Stabler Camp Trail route cluster between A.D. 1816 and 1885. They may be associated with huckleberry camps located along an old burn shown on the 1899 Rainier Forest Reserve map, which extends from the area around Sawtooth Mountain northwest to the Spencer Meadow area.

Other Site Types Other types of sites which have been documented within the watershed boundary include two probable human burials, one located near the headwaters of the Lewis River and the other in the vicinity of Swampy Meadows. These sites may be associated with huckleberry camps in that area.

The ethnographic pattern indicated for the southern part of the Gifford Pinchot National Forest is one of warm season use. The collection and processing of various plant foods was the primary focus of activities, along with opportunistic use of game animals and fish. Within the watershed boundary, huckleberries were intensively utilized, both as an over-winter staple and as an item of trade. It is likely that Indians used fire as a tool to "manage" huckleberry fields, in order to enhance their productivity. The distribution and density of peeled cedar sites are one indicator of the location and intensity of use of former huckleberry fields, as well as indicating general routes of travel. Based on a variety of historic sources, it is likely that the intensity of human use of certain parts of the watershed was much greater in the past than it is today. This is particularly true for areas that are in what is now the Mount Adams Wilderness.

Historic Land Use

Historic land uses include sheep grazing, dating back to the 1880's, trapping, and mining. Many of the trails followed by the early sheepherders were the same as those used by the Indians. Gold, platinum, and coal were mined within the watershed boundary. The Quartz Creek area in particular was mined heavily during the Depression.

Conclusion

Overall, the area within the Upper Lewis River watershed has seen a long history of human use. Areas that we now call "Wilderness" were once intensively used and even managed by Indian people. The general routes of travel used prehistorically appear generally to be in the same location as the earliest historic routes. In the more distant past, the hunting of large mammals, fishing, and the quarrying of stone for tools were important activities on the Forest, and in the more recent past huckleberries, beargrass, cedar bark, and other plant foods and medicines were sought on Mount Adams' slopes. The history of the watershed is dominated by grazing and mining.

Recreation Use

The construction of Road 90 in the late 1960's and early 1970's allowed easy recreational access to the upper Lewis River Drainage. The construction of logging roads provided increased opportunities for big game hunting in the fall. While road construction opened the area to more visitors, it also segmented many of the trails which once provided the only means of access. Over the past two decades the entire Lewis River Corridor has become increasingly popular for camping, hiking and horse-back riding. Refer to Figure 33 on page III-75.

In 1982 the Lower Falls Campground was expanded, from 20 to 46 campsites, and the Lewis River Horse Camp (10 sites) was constructed along Road 93, near Quartz Creek, to accommodate increasing recreation demand by horse users. (The Lower Falls Campground is just outside this watershed but the visitors it attracts have a large impact on Upper Lewis River Watershed use.) Near Road 90, in the upper portion of the watershed, lies Twin Falls Campground, with 10 sites available for walk-in camping. Tillicum Campground (40 sites) in the southern portion of the watershed is popular particularly in the fall when many visitors arrive to pick huckleberries. Other adjacent campgrounds include Council Lake, and Tachlakh, South and Saddle. These campgrounds provide "bedrooms" for many visitors who hunt, hike, ride horses, fish, and drive for pleasure in the Upper Lewis River Watershed.

Camping demand is greatest between the 4th of July weekend, and Labor Day. During this time it is common for all camp sites to be occupied on weekends,

and many times on weekdays, particularly during August. When the campgrounds are full, many campers overflow into dispersed camp sites and any wide spot where a vehicle can be pulled off the road. In the late fall, camping by hunters is concentrated in the dispersed sites, rather than the campgrounds, so they can be near their hunting areas.

Road 90, and the Lewis River corridor, is sometimes referred to as "The Valley of the Falls". The Lewis River is a proposed national wild or scenic river because of its many waterfalls, old growth forests, and high scenic quality. Many waterfalls are accessible by trail, while others can be found only by the select few who accept the challenge of cross-country travel and orienteering. Over the past five years, traffic counters show Road 90 has averaged 361,724 visitors. Most visitation occurs during the summer months between early June and late September, making Road 90 one of the most traveled routes on the forest.

The Dark Divide Roadless Area is an attraction in the watershed, particularly that portion found along Quartz Creek. The Quartz Creek, Summit Prairie, French Creek, Boundary, Snagtooth, and Quartz Creek Butte Trails traverse the Dark Divide, and are all accessed by the Quartz Creek Trail. The Lewis River Horse Camp, located near the Quartz Creek Trailhead allows easy access to the Dark Divide, and many days of riding by equestrians.

Hunting is a popular activity in the watershed, particularly during big-game season in the fall. Hunters use developed campgrounds, but about 50 percent of all camps are set up at dispersed sites on old landings and at wide places along roads where vehicles can be parked. Hunters traditionally use large canvas wall tents, equipped with wood stoves, but are increasingly using travel trailers and motor homes.

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 have been occurring in the watershed and surrounding areas for the last 30 million years. Mount Adams has gone through numerous eruptive phases to become the shield volcano seen today. The Indian Heaven area has also gone through many eruptive phases. Seismic events may have initiated some of the large deep seated landslides in the watershed. Over the last 15,000 years, there have been numerous tephra falls, debris flows and lava flows. The most hazardous condition for the near future would probably be from debris flows off Mount Adams.

Glaciation

Glacial activity has affected the watershed during at least two periods over the last 200,000 years. The most recent was between 20,000 and 12,000 years ago. During this period glaciers extended from Mount Adams and out of the Indian Heaven area.

Erosion

The erosion processes in the watershed are controlled by such factors as slope, water, soil type, and the kind of management activities that occur in the area. The main erosion concern in the watershed is associated with road construction. As construction techniques have evolved over the last 30 years this problem has lessened, but it is still a factor for improvement. Regardless, erosion is also a natural process that will continue. Stream bank failures will continue to supply sediment to the stream systems.

Fire

Volcanic activity surpasses fire as the major disturbance process in the Upper Lewis River 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 recrtuitment potential over the long term.

Timber Management

Intensive timber harvest began in the 1940's and has continued up through the 1990's. Until the last few years, harvest operations relied almost exclusively on clearcutting because it was the most economical method to harvest and mange subsequent plantations. The vegetative composition and structure of harvested lands was controlled to maximize the number and growth of conifer trees, and as a result, the variability of species and stand structures that are typically found in natural stands are now absent within managed stands. Buffers along streams and wet areas were often non-existent.

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

Issue No. 1: MASS WASTING

Summary

All of the large landslides in the watershed are naturally occurring. Many of the debris flows and shallower landslides occur during major natural events but may be initiated or intensified by management activities. Examples of this are very evident from the storm events that occurred in the winter of 1995 and 1996. Many instances of mass movement during this time were road related or involved roads in their pathway.

Comparing Current Conditions with Reference Conditions

Management Activities

Road construction and timber harvest have been the major activities that have taken place in this watershed. Most of this activity has occurred in the southern part of the watershed. Clearcutting has had a tendency to increase groundwater levels which has increased peak flow. These higher groundwater levels can increase the potential for ground movement especially on steep slopes. What has been seen in these areas are increased road failures and some shallow failures from timber harvest. Slope movement is a natural process that can be affected by management activities. It is not known if this increase from management activity is beyond the natural range of variability because the control of fires has probably alleviated much of the slope movement attributed to large wildfires in the past.

Soils

Soils retain most of their characteristics over time in the area in which they are developed or deposited. Where ground based equipment is used for management activities there is a tendency to see these soils compacted which reduces the site productivity of the land.

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 that mass wasting will occur.

Comparing Current Conditions with Management Objectives and Desired Future Conditions.

Current management objectives in the watershed are for watershed restoration, mixed timber harvest and retention, recreation and other activities. The desired future condition would be reduce the amount of management related stability concerns and manage for what will occur naturally.

To meet the Northwest Forest Plan objectives and aquatic conservation strategy objectives the unstable and potentially unstable lands have been placed in Riparian Reserves. Any management activity proposed for these areas will have to be reviewed by a technical specialist to determine if the specific area is of concern or not.

Issue No. 2: EROSIONAL PROCESSES

Summary

Over the past 50 years, road construction has had a tendency to increase sediment routing into streams. Most of this increase occurs in the first two to five years after construction begins or until an increase in vegetation on the fills and cutslopes reduces soil movement. The amount of sediment attributable to roading depends on many variables which makes it difficult to quantify how much sediment is routed from roads to streams. Models are available, but the information from road surveys is usually insufficient to produce useful results.

Natural processes such as volcanism and glaciation along with wind and rain will continue to act on the landscape.

Comparing Current Conditions with Reference Conditions

Management Activities

Road construction and timber harvest have been reduced from the levels seen in the 1980's. Road construction techniques have also improved considerably since the earlier years, so roads constructed today are generally produce less sediment routing than the roads built in the past. Poor construction techniques such as sidecasting material during construction and maintenance have been a major source of sediment moving to streams. High traffic use during wet seasons causes additional damage to the road system, especially the native surface roads, and to a lesser extent, the aggregate roads. Sub-basins 23C, 23D, 23K, 23R, 23V, 23Y, and 23Z have the highest road densities with most of these roads being aggregate or native surfaced roads.

Volcanism

Volcanic activity has not played a role in the watershed for several hundred years, but the potential for debris torrents or eruptions from Mount Adams or the Indian Heaven area is still a concern. A paper published by the USGS shows some of the volcanic hazards of the Mount Adams region. **(U.S. Geological Survey. 1995. OF 95-92)** Areas of concern lay in the eastern third of the watershed and down the Lewis River. (Sub-basins 23A, 23B, 23W, 23U, 23G, and 23Y.

Glaciation

In the past, glacial activity has shaped much of the landscape. Glaciers still exist on Mount Adams but have been receding over the last several thousand years. Until the next cold period begins, glacial activity will not have much influence on the watershed.

Wind, Rain and Fire

Wind, rain and fire are also natural processes that erode the land. These processes are continuous and are dependent on various factors affecting the intensity and amount of sediment movement.

Comparing Current Conditions with Management Objectives and Desired Future Conditions

Roading

New roading in the watershed will be minimal and its location and construction will be planned to minimize any potential conflict. Reconstruction of existing roads and decommissioning roads which are no longer necessary will meet the Aquatic Conservation Strategy Objectives outlined in the Northwest Forest Plan.

Fire

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

Issue No. 3: VEGETATION STRUCTURE AND COMPOSITION

Summary

Vegetation conditions have been shaped by natural topography, climate and disturbance. Almost half of the watershed is comprised of the Large Tree Structure Stage, primarily in the Pacific Silver Fir Vegetation Zone. The flanks of Mount Adams and other high elevation peaks in the watershed are occupied by sparsely vegetated areas (typed as non-forest) and open sub-alpine, or mountain hemlock plant communities. Initiation of young seral vegetation has been primarily through wildfire and timber harvest. Wildfires created a few large areas of younger forest whereas timber harvest has created small openings scattered across the watershed. Approximately 17 percent of the watershed has been harvested.

Comparing Current Conditions with Reference Conditions

Proportion of Age Classes

Approximately 58 percent of the watershed is probably functioning as late-successional habitat.
This watershed is therefore within the "average" reference conditions described in the REAP report. The REAP report describes the Lewis River Basin as having 40 to 70 percent late-successional forest. This older forest was probably not evenly distributed across the River Basin but varied depending on the occurrence of wildfire, volcanic eruption, flooding and landslides. As time progresses, barring a catastrophic stand replacing disturbance event, a greater proportion of this watershed will be comprised of older forest.

Distribution of Structure Stages Across the Watershed

There are still large contiguous areas of similar structure and age within this watershed that resemble the pattern which would have been created by natural disturbance. Timber harvest activities in the last few decades have begun to fragment this habitat and create small patches of early seral habitat which would not have occurred naturally. Where these harvest units occur outside of the Matrix, it will take more than a century for these openings to develop into late-successional habitat.

Diversity of Species and Structure

Forest stands that have been harvested and subsequently managed for timber production typically have less plant diversity than stands initiated from natural disturbance. These stands lack the large standing and down woody structure which is left after natural disturbance. Because the species composition and structure of live vegetation has been controlled to meet management objectives, these stands are more homogenous than stands initiated from other forms of disturbance..

Comparing Current Conditions with Management Objectives and Desired Future Condition

Proportions of Age Classes

Most of this watershed is managed to maintain the characteristics of older or naturally developing forests. Over half of the Late-Successional Reserve is comprised of the Large Tree Structure Stage. Through time, the amount of older forest will likely increase. The Wildlife, Recreation, Special Interest Areas and the RNA areas all contain a mix of structure stages which also will likely develop into older forest types. The wilderness is dominated by rock and more open forest conditions. . The character of the wilderness is likely to persist. About 12 percent of the watershed is Matrix ground, suitable for timber management. Through time, these lands will become increasingly dominated by early seral vegetation. Almost half of the Matrix lands are now comprised with Large Tree Structure Stages.

Distribution of Structure Stages Across the Watershed

The older forest will continue to be concentrated in the northwestern and eastern most parts of the watershed.

Diversity of Species and Structure

Outside the Matrix, on lands where succession is allowed to progress with relatively little human influence, the diversity of plant species and forest structures will become increasingly dominated by those associated with older forests. On Matrix lands, species composition and structure will continue to be managed to meet timber management objectives and Standards and Guidelines of the Northwest Forest Plan.

Issue No. 4: STREAM RIPARIAN RESERVE FRAGMENTATION AND RIPARIAN HABITAT

Summary

Mapped Stream Riparian Reserves comprise approximately 20 percent of the watershed. Over fifty percent of these Reserves are in the Large Tree Structure Stages. Roughly 14 percent of the Stream Riparian Reserves have been harvested.

Comparing Current Conditions with Reference Conditions

The REAP report characterizes the Stream Riparian Reserves within the Lewis Watershed as having between 50 to 85 percent late-successional forest. Younger plant communities were most likely initiated through flood, erosion and occasional wildfire. The Stream Riparian Reserves in this watershed are at the very low end of this reference range. Almost three quarters of the sub-basins have more than 50 percent of the Stream Riparian Reserves in Large Tree Structure Stages. Only three sub-basins have Stream Riparian Reserves with less than 30 percent Large Tree Structure Stage. Six sub-basis have Stream Riparian Reserves where greater than 25 percent has been harvested. Harvest operations and subsequent management activities in these harvested areas have likely resulted in a structure and species composition that is different than would have occurred under natural disturbance regimes.

Through time, since harvest operations will rarely occur within Stream Riparian reserves, a greater proportion of these Reserves will be comprised of older forest.

Comparing Current Conditions with Management Objectives and Desired Future Condition

Riparian Reserves are intended to provide a network of habitat to serve as migration corridors across larger landscapes for both plants and animals. For the most part, these Reserves should be dominated by older forest with younger forest occurring as the result of natural disturbance. Management activities are allowed if they conserve, protect or enhance riparian habitat and other aquatic resources.

The Stream Riparian Reserves in the Upper Lewis River Watershed are, for the most part, functioning as intended by the Northwest Forest Plan. Although fragmentation caused by timber harvest has disrupted these corridors in almost all sub-basins, two thirds of the sub-basins have Stream Riparian Reserves where harvested lands constitute 25 percent or less of the total Reserve. Where harvesting has occurred, it typically crosses only a short stretch of Reserve.

Issue No. 5: TES AND C-3 PLANTS, LICHENS, BRYOPHYTES, AND FUNGI SPECIES

Summary

Many TES and C-3 plants, lichens, bryophytes and fungi are associated with specific habitats such as stream and wetland riparian areas and late-successional stands. Existing large single and multiple layered tree stands, and the older high elevation Mountain Hemlock habitat probably function as late-successional habitat, and are within the range of historic variation estimated in the REAP document. Mulligan, Surprise and Swampy Meadows, and some of the other smaller, unnamed meadows and wetlands also provide valuable habitat for some TES plants.

Comparing Current Conditions with Reference Conditions

Using structure stage estimates, 48 percent of the watershed is in large tree single and multiple layered tree stands, and about nine percent are in small tree structure stages in the Mountain Hemlock zone, which are older small trees at the threshold of their ecological tolerance. In particular, the large tree multi layered vegetation and Mountain Hemlock habitat are both probably functioning as late-successional habitat. This puts about 58 percent of the watershed in functional late-successional conditions, which are within the estimated reference conditions (45 to 70 percent) suggested by the REAP document. However, since this watershed is not within the immediate Mount St. Helens zone of influence, historic levels of late-successional habitat were probably closer to 70 percent than 45 percent.

Comparing Current Conditions with Management Objectives and Desired Future Conditions

Habitat for TES and C-3 species dependent on late-successional and/or undisturbed stream Riparian Reserve habitat and wetlands and meadows is present and well distributed across the landscape in this watershed. Sub-basins with over 25 percent of their stream Riparian Reserves harvested (Steamboat Creek (23D), Upper Sidewall Tributaries (23G), Middle Tillicum Creek (23Q), Surprise Meadow (23R), North Fork Pass Creek (23V), Platinum Creek (23X), and Lower Frontwall Tributaries (23Z)) are areas where stream Riparian Reserve habitat restoration and enhancement activities could be focused.

Issue No. 6: HABITAT FOR THREATENED, ENDANGERED, SENSITIVE, SURVEY AND MANAGE, AND OTHER HIGH INTEREST ANIMAL SPECIES

Summary

Timber harvest and road construction have reduced habitat for species dependent on Late Successional/Old-growth species. About 65 percent of the existing late-successional habitat in the watershed is within land management allocations withdrawn from scheduled timber harvest.

The Upper Lewis Watershed contains habitat for five federally listed species, two Forest Service sensitive species, and eight Survey and Manage species. The two large blocks of LSOG found in the watershed support both northern spotted owls and other LSOG associated species. Habitat conditions for gray wolves, grizzly bears, and wolverines, in the Lewis Late Successional Reserve (LSR) will continue to improve over time. The watershed contains five cliff sites that could provide suitable habitat for peregrine falcon nesting. It is not known whether either species will actually occupy the area. Known populations of Larch Mountain and Van Dyke's salamander exist in the watershed, and suitable habitats for great gray owl and possibly five forest bat species are present as well.

Comparing Current Conditions with Reference Conditions

Habitat Conditions for federally listed and others species associated with Late Successional / Old-Growth Habitats (LSOG): Northern Spotted Owls, Fishers, Goshawks

Currently approximately 42 percent of the forest stands in the Upper Lewis are considered LSOG forest. Sixty-five (49,245 acres) percent of the watershed is in a management allocation withdrawn from scheduled timber harvesting. Because these allocations are withdrawn from scheduled timber harvest, through time, young stands will develop and mature gradually increasing the acreage of LSOG forest.

Currently two large blocks of LSOG forest exist in the watershed. These areas are separated by the forest Matrix. Harvest units approximately 40 acres in size dot the Matrix .

Riparian Reserves both, stream and upland, zigzag through the Forest Matrix connecting the Lewis River LSR and Mount Adams Wilderness. The Riparian Reserve network covers approximately 44 percent of the watershed. Fifty-two percent of the riparian network consists of the large tree structure stage. Several sub-basins contain less than 70 percent dispersing habitat in their Riparian Reserves. This could hinder dispersal between large reserves.

Currently, the percent of LSOG existing in the watershed is within the natural range of variability. However, spatial distribution of LSOG is probably different. Historically disturbance events were believed to be of catastrophic intensity and covered thousands of acres at a time. Riparian areas, especially along stream banks, were probably less susceptible to large scale fire, one of the primary disturbance agents, because of their mesic conditions. In comparison, today's disturbances occur on a smaller scale and do not create the large patches that were present in the past. Overall, the percentage of LSOG habitat would have varied widely at any point in time, depending on the severity and extent of a disturbance event.

Habitat Conditions for Federally Listed and other Species Highly Sensitive to Human Disturbance (Gray Wolf, Grizzly Bear, Wolverine)

Prey Base The condition of deer and elk winter range within the watershed is considered marginal. Ungulate biological winter range contains 38 percent optimal thermal cover. The open road density in winter range is 3.7 miles per square mile. These conditions greatly reduce the chances of wolves permanently occupying the area.

Den and Rendezvous Sites and Security Currently the Upper Lewis has a road density of 1.9 miles per square mile and a trail density of 0.5 miles per square miles. Sub-basins that are largely reserved land have the lowest road densities. Recent flooding (1996) closed many roads through road slumps, debris slides and washouts. The current road density level within the watershed is probably a deterrent to permanent use by gray wolves, grizzly bears and wolverines.

Historically, the watershed contained no roads; however, road construction was accelerated over the last few decades. Before this time, access through the watershed was by trails. The limited access probably provided more security for species such as gray wolves grizzly bears and wolverines.

Conditions for Federally Listed and Other Species Requiring Unique Structures for Nesting or Roosting

The watershed contains cliffs that could potentially provide suitable nesting habitat for peregrine falcons. No known sites in the watershed would serve as winter roost or nest sites for the bald eagle. These conditions probably have not changed much from historic time, except the vegetation distribution surrounding these structures.

Habitat Conditions (Unique) for Survey and Manage Species: Larch Mountain Salamander, Van Dyke's Salamander, Great Gray Owl and Lynx.

Habitats for both the Larch Mountain and Van Dyke's salamander have been altered through activities such as tree harvest, road construction, trail construction and quarry development. Suitable habitats are suspected to exist throughout the watershed. Larch Mountain and Van Dyke's salamander were primarily found in the Lewis LSR.

Historically, habitat conditions for the Larch Mountain and Van Dyke's salamander are not well known. It is suspected that conditions were probably more favorable in the past. Although, stand replacement events, such as fires, wind storms, and floods occurred, following these events, much of the woody structure remained in place.

Four meadows exist in the watershed that contain suitable nesting and foraging habitats for the great gray owl: Swampy Meadows and three unnamed meadows. The nesting and foraging opportunities in the four meadows are probably similar to the reference condition, but small openings created by timber harvest have increased the areas available for foraging.

Lynxes are rare within the range of the northern spotted owl, occurring primarily in the Okanogan area of Washington. Approximately 2,354 acres of suitable Lynx habitat exist in the watershed. These areas are characterized by five clusters spread throughout the watershed. Only sixteen of these acres were considered breeding quality habitat. It is unknown if historically the watershed contained more or less boreal forest (that is lodgepole pine, subalpine fir or mountain hemlock), the preferred habitats of the lynx. Past excessive trapping of lynx and incidental mortality of lynx from hunting of other species has decreased the population and may have been detrimental to the local lynx population in Washington (ROD C-47).

Habitat conditions of caves, mines, bridges and snags

Very few mines and bridges are known to exist in the Upper Lewis Watershed. One cave is occupied by the Townsend's big-eared bats. No other hibernaculum or maternity colonies have been documented in the watershed. Historical conditions were probably similar. There is no evidence showing caves were more or less abundant in the past.

An initial snag assessment shows that snags are well distributed throughout the watershed, although activities that require the removal of snags have taken place. This snag removal has created a snag deficiency in Sub-basin 23X.

Historically, snags were probably more abundant since snag removal did not follow a disturbance event.

Comparing Current Conditions with Management Objectives and Desired Future Conditions

Habitat Conditions for federally listed and other species associated with LSOG: Northern Spotted Owls, Fishers, Goshawks Late-successional / Old-Growth Habitat

Under the current Forest plan the remaining LSOG habitat is managed according to its associated land allocation. Large Reserves are managed to promote the growth and development of LSOG habitats. Riparian Reserves were established to provide a LSOG dispersal link between large reserve areas. Managing Matrix

lands consists of several management goals, one being to provide for a sustainable level of wood fiber. Interspersed throughout the Matrix are Riparian Reserves and special LSOG buffers established for Survey and Manage plant and animal populations. In addition, each (fifth field) watershed must contain at least 15 percent of the area in LSOG habitat.

Currently about 42 percent of the Upper Lewis watershed is covered by late-successional stands. Sixty-five percent of the LSOG forest occurs in management allocations withindrawn from timber harvest. As harvested and newly regenerated forest stands in the LSR develop in size and structure, the LSOG in the reserve allocations will steadily increase. Because LSOG forests in the Matrix are managed primarily for wood fiber production, the amount of LSOG forest will decline and then level off. Forest stands harvested in the Matrix will retain some LSOG structure (a minimum of 15 percent in each harvest unit) but the goal of managing this allocation is not to recreate LSOG characteristics in the future.

The current management direction will aid in the enhancement of LSOG forest in the LSR and in creating a forest mosaic of young and medium aged stands in the Matrix. Late successional / old-growth species especially those with large home ranges (northern spotted owl, goshawk, fisher) will primarily occupy the LSRs and move between reserves through the Riparian Reserves networks..

Conditions for Species Requiring Seclusion from Human Disturbance

Current management direction specifies: road densities in deer and elk winter range should average 1.7 miles per square mile; road densities in LSRs should be reduced and there should be no net increase for roads in Tier I Key Watersheds. In addition, for winter range, the Forest goal is to maintain 44 percent of forest stands in optimal thermal cover.

Winter range in the watershed currently has a road density of 3.6 miles per square mile. The road densities for the portion of the Lewis LSR and of the Tier I Key Watershed occupied by the Lewis Watershed is not known. However, some roads were either decommissioned, are under contract for closure or proposed for closure by the Alpha, Beta/Omega Timber Sales.

Road densities in the watershed will continue to decrease mainly in the LSR portion. These reductions will help increase the suitability of the area to provide habitat for species highly sensitive to human disturbance.

Conditions for Survey and Manage

Both the Larch Mountain and Van Dyke's salamanders are Component 2 Survey and Manage species. Surveys must precede the design of all ground-disturbing activities that will be implemented in 1997 or later. Once a population of either species is found, the site and the extent of the population must be included in a protection buffer. Stream Riparian Reserve buffers will also play an important part in the management of the Van Dyke's salamander (considered a semi-aquatic species).

Similar to the Survey and Manage amphibians, surveys must precede those projects planned that could affect bat maternty colonies and hibernaculum: caves, mines and bridges. Surveys must also precede projects that could affect great gray owl nesting habitat: LSOG forest or forest with remnant old growth and snags near (less than 1,000 feet) a meadow or manmade meadow greater than ten acres in size and at an elevation of more than 3,000 feet (Forest Plan 1995).

Projects that could degrade suitable habitat for Survey and Manage species will primarily occur outside of reserved lands. Degradation of suitable habitats will primarily occur though regeneration harvesting and road building. Because surveys are required for these species and appropriate buffers placed around the population once it is found, populations for Survey and Manage species should stabilize at present levels.

This differs for reserved lands. An emphasis is placed on accelerating the growth and development of young stands into LSOG forest. Few projects will be proposed that could involve the removal of habitats used by these species. Habitat conditions should improve over time as young stands mature.

The lynx is a Component 3 (extensive surveys) Survey and Manage species and, as such, specific surveys before ground-disturbing activities are not a requirement. Instead, surveys will be conducted according to a schedule that is most efficient, and sites will be identified for protection then (ROD C-5).

Lynx suitable habitat within the Upper Lewis

Watershed is found in reserves not scheduled for timber harvest (Figure 20). Connectivity between these suitable habitat patches will be provided by the Riparian Reserve buffer. As a result, there should be no decline in suitable lynx habitat. The Forest in 1998 will begin a survey program that will help determine lynx distribution across the forest.

Conditions for "Species of Interest"

An assessment conducted for this analysis indicated that snag levels and distribution were adequate in each sub-basin except Sub-basin 23X. Snag levels are expected to change very little in reserved (not scheduled for timber harvest) lands. Snags levels in the Matrix are expected to decline for the most part, but only to a level that would support cavity excavators at 40 percent of their maximum potential population. For the black-backed and white-headed woodpeckers, sufficient snag habitat will be maintain to support 100 percent of their maximum potential population .

Issue No. 7: HYDROLOGIC CHANGES

Summary

Analysis found that none of the sub-basins in the area have predicted increased peak flows of 10 percent or greater due to loss of the mature conifer vegetation component. Roading may be contributing to increased peak flows by increasing stream lengths in the watershed by 0 to 41 percent, possibly contributing more surface water to streams.

Comparing Current Conditions with Reference Conditions

Peak Flow Increase - Vegetation Related

Currently, 17 percent of the Upper Lewis River Analysis Area is in early successional timber stands compared to a range of 8 to 18 percent (USDA, 1993) of the Lewis River Watershed historically. Modeled peak flow utilizing the DNR model indicate that increases are below the 10 percent level and have a low sensitivity rating. Several sub-basins including 23D, 23Q and 23R are currently at 9 percent when compared to a fully forested condition.

Peak Flow Increase - Road Related

Currently, approximately 529 miles of stream channel are found in the analysis area compared to 458 miles historically. The extra 71 miles are due to extension of the stream channel network by roading, primarily interception of sub-surface flow and routing of road surface runoff. The largest increase in the stream channel network are in Sub-basins 23C, 23D, 23G, 23K, 23Q, 23R, 23S, 23V and 23Z. 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). Modeled peak flow utilizing the DNR model indicate that increases are below the 10 percent level and have a low sensitivity rating. Several sub-basins including 23D, 23Q and 23R are currently at 9 percent. The current condition is probably consistent with management objectives for sub-basins mentioned in the previous section.

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. 8: WATER QUALITY AND KEY HABITAT ATTRIBUTES FOR RESIDENT SALMONIDS

Summary

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

Floods, 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)

Floods, timber harvest/management activities within the riparian zone, has removed LWD from stream channels. Stream survey data was collected in Sub-basins 23B, 23E, 23F, 23L, and 23X and in those sub-basins, LWD is below standards and guidelines 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 sub-basins 23D, 23G, 23Q, 23R, and 23X past timber harvest 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-basins 23B, 23E, 23F, 23L, 23S, 23W, and 23X 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

The Regional Ecosystems Assessment Project (REAP) suggests that historic maximum stream temperatures for the entire Lewis River basin ranged between 14 and 19 degrees Celsius. Stations that have been monitored indicate that stream temperatures currently fall within this range.

Aquatic Habitat Fragmentation

In Sub-basins 23C, 23D, 23K, 23Q, 23R, 23S, 23T, 23V, and 23Z aquatic habitat fragmentation has increased through road building without fish passage. 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

Many sections of the mainstem Lewis River are erosion type systems and can be affected by management activities on the landscape. Recovery from management 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 to have 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, 53 percent are outside the management objectives (i.e., have a poor rating).

Large Woody Debris (LWD) Recruitment

Riparian areas in Sub-basins 23D, 23G, 23Q, 23R, and 23X have greater than 30 percent of the Riparian Reserve harvested and 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° Celsius due to human activities (Water Quality Standards for Waters of the State of Washington). Of the 14 stations that have monitored water temperature, only the Quartz Creek station has had temperatures that exceeded 16° Celsius multiple times. This exceedence may be due to the location of the station, which is on a debris fan that has an open riparian area. Further monitoring will be necessary to refine this relationship

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, 70 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. Sources of sediment include roads and some harvest units, as well as natural geologic areas, such as in the Swampy Creek basin.

Issue No. 9: COMPLETION OF TRAIL SYSTEM AND TRAIL CONNECTIONS

Summary

The Gifford Pinchot National Forest Land and Resource Management Plan and the Gifford Pinchot National Forest Access and Travel Management Plan identify certain additions to the Forest trail system. This includes 6.1 miles of road to be converted to trail in the vicinity of the Lewis River Horse Camp, 0.75 miles of new trail construction to create connections between roads converted to trails, and approximately 12 miles of the Lewis River Trail that would be reopened or reconstructed.

The trail management objective for the Upper Lewis River Watershed is to provide dispersement and loop opportunities particularly for equestrians. The limited availability of trails in the area creates over-use on the Lewis River and Quartz Creek Trails. Existing trails provide inadequate riding opportunity for current and expected future demand.

Comparing Current Conditions with Reference Conditions

Road to Trail Conversions

The conversion of roads to trails would disperse recreational use by providing additional trails in the vicinity of the Lewis River Horse Camp. Trails would be developed along roads listed in Table 31, Chapter III. In addition, short connector trails would be constructed between road segments. These conversions would replace trail segments lost due to road building and logging activity over the past 27 years, and meet the intent of the Forest Plan in developing loop trail opportunities.

Lewis River Trail Re-opening

Approximately 12 miles of the Lewis River Trail would be re-opened between Quartz Creek and the Table Mountain Trail. Much of this trail segment was abandoned following the construction of Road 90 between 1970 and 1976. Some segments of the trail were destroyed during road construction, but about 80 percent of the original trail still exists. Existing segments would be re-opened, and connecting segments constructed, to re-establish the trail route.

Comparing Current Conditions with Management Objectives and Desired Future Conditions

Road to Trail Conversions

The management objective for the area calls for establishment, or re-establishment of trails and trail loops between the Lewis River Valley and the Boundary Trail System in higher elevations. Currently many of these links are broken due to destruction of previously existing trails by road construction and logging. As visitor use continues to increase, existing trails in the valley are coming under increasing impact from over-use. These links will be re-established through conversion of certain roads to trails. The roads planned for conversion are shown in Table 31, Chapter III.

Lewis River Trail Reopening

The Forest Plan objective for the Lewis River Trail between Quartz Creek and Table Mountain Trail is re-establishment. Much of the trail still exists but about 20 percent was destroyed during construction of Road 90. Remaining sections will be signed and reopened, and missing segments reconstructed. Putting this trail section back into service will create a continuous trail near the Lewis River between the Miller Falls Viewpoint and Table Mountain Trail, a distance of nearly 25 miles. The trail will also provide an important connecting link between trails in the Lewis River Valley and the Pacific Crest Trail 2000.

Issue No. 10: TIMBER HARVEST EXPECTATIONS

Summary

Since the implementation of the Northwest Forest Plan between 1,289 and 1,516 acres have been harvested, sold, or are currently being planned for harvest in the Upper Lewis River watershed. There are approximately 4300 additional acres that are old enough to be regenrated. These acres are primarily in sub-basins 23B, 23C, 23D, 23F, 23G, 23L, 23Q, 23S, 23V, 23W and 23Y. Past modelling efforts indicate that the sub-basins where additional regeneration harvesting is most likely to occur are 23C, 23F, 23G, 23H, 23K, 23L, 23R, 23S, 23U, and 23W. However, sales planned in these areas during the last few years have indicated that not all these sub-basins can be managed as intensively as previously estimated. Prescriptions requiring heavy forest retention were required in sub-basins 23C, 23F, 23G, 23K, 23Q, 23V and 23W, and the neccessity of restricting harvest here is a good indicator that these sub-basins have few if any additional timber opportunities. It is unlikely that any more than 400 to 550 additional acres (10 to 14 MMBF) could be harvested in this watershed this decade and still meet Forest Plan Standards and Guidelines.

As opposed to many other watersheds on the Mount St. Helens Administrative Unit where the trees are smaller, the species less desirable and access and logging systems more difficult, this watershed provides opportunities for timber sales which are more economical and profitable to the government. However, because considerable harvesting has already occurred this decade in this watershed, it may be more prudent or desirable to emphasize harvest opeartions elsewhere.

Comparing Current Conditions with Reference Conditions

Intensive timber management is a disturbance which has occurred only fairly recently in this watershed. Until the mid-1900's , large patches of younger seral stages were primarily the result of wildfire. Because fires tended to be infrequent, stand replacing, and large in size, the amount and distribution of younger seral stands fluctuated greatly through time. In the last century, timber harvest has replaced wildfire as the primary stand-replacing disturbance in the watershed. Instead of being a large episodic disturbance, timber harvest occurs systematically through time slowly converting older forest to younger forest. Because these stands are managed specifically for timber products, they have more uniform structure and species composition than stands which regenerate naturally.

Although there are significant differences between disturbance through fire and timber harvest, the concept of designating large contiguous areas as Matrix attempts to mimic a seral distribution which is typical of the Pacific Northwest. Timber harvest is proposed on only 13 percent of the entire watershed. The remainder of the watershed will be managed to conserve older forest and naturally occurring forest succession.

Comparing Current Conditions with Management Objectives and Desired Future Condition

The objective on Matrix lands is to manage forest stands outside of Riparian Reserves to provide wood products. The long-term desired condition is to maintain these areas as managed early-successional stands less than 100 to 120 years of age. After the current sold and ongoing planned timber sales are cut and regenerated, approximately half of the lands suitable for timber management will be in ages classes less than 100 years of age. If harvest rates remained the same as this decade, it would take approximately 30 years to convert the remaining older stands into young managed stands.

Interspersed with these managed stands are the Riparian Reserves which comprise roughly 44 percent of the matrix in the Upper Lewis River watershed. Thirty percent of these Riparian Reserves are currently in the Large Tree Structure Stages. Without additional stand replacing disturbance, more will grow into older forest through time. In time, barring a catastrophic stand replacing disturabnce, the Matrix lands will be a young forest with a network of older forest dispersed throughout. The entire watersed will continue to be dominated by late-successional or mature forest stands.

SECTION 3 SYNTHESIS

In the following section, information from earlier stages of the analysis is synthesized in order to further understand and discover interreationships between elements of the ecosystem. The synthesis was conducted in three dimensions of the ecosystem: aquatic, terrestrial, and social/economic (recreation). 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 44, 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 roading; and (4) areas with high surface erosion potential from roads, and response reaches.

Summary

An area comprising Upper Tillicum Creek (23Q), Surprise Meadow (23R), and Steamboat Creek (23D) has multiple aquatic resource concerns due mostly to roading. These 3 sub-basins have high road densities that fragment the aquatic environment and introduce additional sediment into the system, high concern for peak flow increase due to roading, and low LWD recruitment potential. Low LWD recruitment potential is due to past timber harvest in riparian areas adjacent to streams. Additional areas of multiple resource concerns exist in 23C, 23S, 23K and 23Z. These sub-basins have high surface erosion potential from roads, high concern for peak flow increase from roads and in the case of 23C, poor LWD and pools per mile in the stream channels.

Table 41 - Aquatic Synthesis of Upper Lewis River Watershed. Sub-basins are listed in general order of concern.

Sub-basin	High Frag. and Low LWD Recruitment Potential	IncreasedRisk of Peak flow	High Sediment Concern	Extremely Poor Fish Habitat Conditions
23C		R	R	X
23D	X	R	R	
23Q	X	R	R	
23R	X	R	R	
23W		R		X
23S		R	R	
23Z		R	R	
23K		R	R	
23B				X
23E				X
23F				X
23L				X
23M				X
23N				X
23U				X
23X				X
23Y			R	
23G		R		
23T		R		
23V		R		
23A				
23H				
23I				
23J				
23P				

For "High Sediment Concern"; R=concern due to surface erosion from roads
For "Increased Risk of Peak Flow"; R=concern due to roading

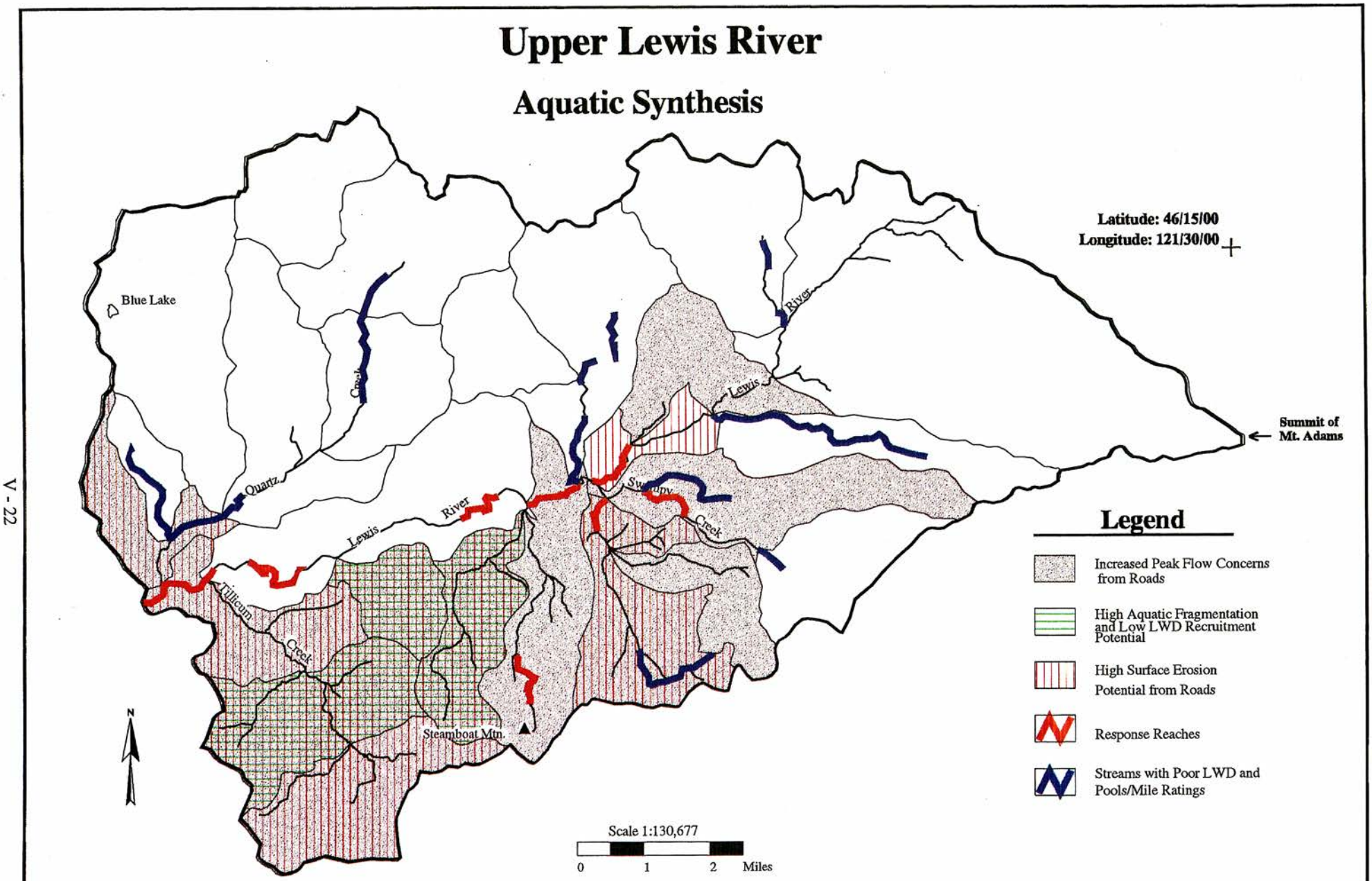

Figure 36. Synthesis of data showing sub-basins and stream reaches that have known problems, based on in-channel and up-slope conditions.

Terrestrial Synthesis Explanation

The terrestrial synthesis highlights the following: sub-basins where dispersing habitat is not very abundant, areas of concern within Critical Habitat Unit WA-38, areas where the road density in winter range is greater than 1.7 miles per square mile, sub-basins lacking snags to support cavity excavators at greater than 40 percent of their maximum potential population, and where 25 percent of the Riparian Reserve was harvested in a sub-basin.

The current level of dispersing habitat in both the upland forest stands and Riparian Reserves should allow for an unimpeded flow of species between the Lewis LSR and Mount Adams Wilderness and Gotchen LSR. In the following sub-basins, however, the quantity of dispersing habitat is not abundant: 23B, 23D, 23Q, 23X and 23Z. These five sub-basins contain slightly more than 50 percent dispersing habitat in their respective upland stands, but have less than 70 percent large tree/small tree structural stages in Riparian Reserves. An indication of limited dispersing habitat is a sub-basin containing less than 50 percent dispersing habitat in the upland forest or less 70 percent large tree / small tree structure stages in the Riparian Reserves.

The Upper Lewis Watershed contains 27, 201 acres of a spotted owl critical habitat unit (CHU). Three hundred and forty-five matrix CHU acres occur in Sub-basins 23F and 23G. Because these latter acres contribute to an area of high nesting potential in the LSR, it was designated as an "area of concern." The loss of 50 acres or more within the area of concern through timber harvest or natural disturbance would reduce the extent of high nesting potential areas that are within the Lewis LSR. Such an event could lead to an adverse effect to critical habitat under the Endangered Species Act by degrading habitat not only within the CHU but within the Lewis LSR as well. Other areas of matrix CHU within the watershed do not carry the same level of concern because there is sufficient quantity of potential nesting areas with suitable interior habitat or the area is largely protected by Riparian Reserves.

Ungulate winter range occupies portions of Sub-basins 23H, 23M and 23Z. The open road density in the winter range is 3.7 miles per square miles. The Forest goal is to manage winter-range road densities at 1.7 miles per square mile. Because winter range in the watershed is found in the Lewis LSR, it is highly unlikely that additional roads will be constructed. More likely, many of these roads will be closed through decommissioning, weatherizing or gating.

Snags are commonly removed from forest stands today during planned management activities. In comparison, past forest stand replacement events occurred. Nevertheless, dead trees remained on sites to serve as snags and eventually fall down and become down woody material. Snags and down woody material are probably less abundant today, decreasing the population of species that depend on these structures for survival.

Table 42 shows that Sub-basin 23X currently does not contain enough snag habitat to support cavity excavators 40 percent of their potential population. The availability of snags in several other sub-basins (23G, 23L, 23Q and 23S) are only supporting cavity excavators slightly above or slightly below 50 percent of their potential population (Table 42).

Because Sub-basin 23X is within an LSR no timber harvest is scheduled. Harvesting is planned in the other four sub-basins within the next four years.

Table 42. Terrestrial Synthesis in the Upper Lewis River Watershed

Sub-Basin	Areas of Concern within Critical Habitat	Road Densities >1.7 mi/sq mi in Ungulate Winter Range	Habitat Likely to Support Cavity Nesters <40% of Potential Maximum Population	Dispersing Habitat for LSOG Associated Species is Not Abundant	Sub-basins with 15% or Less Large Tree Structure	Sub-basins with >25% Riparian Reserve Harvested
23A						
23B				X		
23C						
23D				X		X
23E						
23F	H					
23G	H					X
23H		X				
23I						
23J		X				
23K						
23L						
23M		X				
23N						
23P						
23Q				X		X
23R						X
23S						
23T						
23U						
23V						X
23W						X
23X		X	X	X	X	
23Y						
23Z		X		X		X

H=High M=Moderate X=Applicable to the Sub-basin

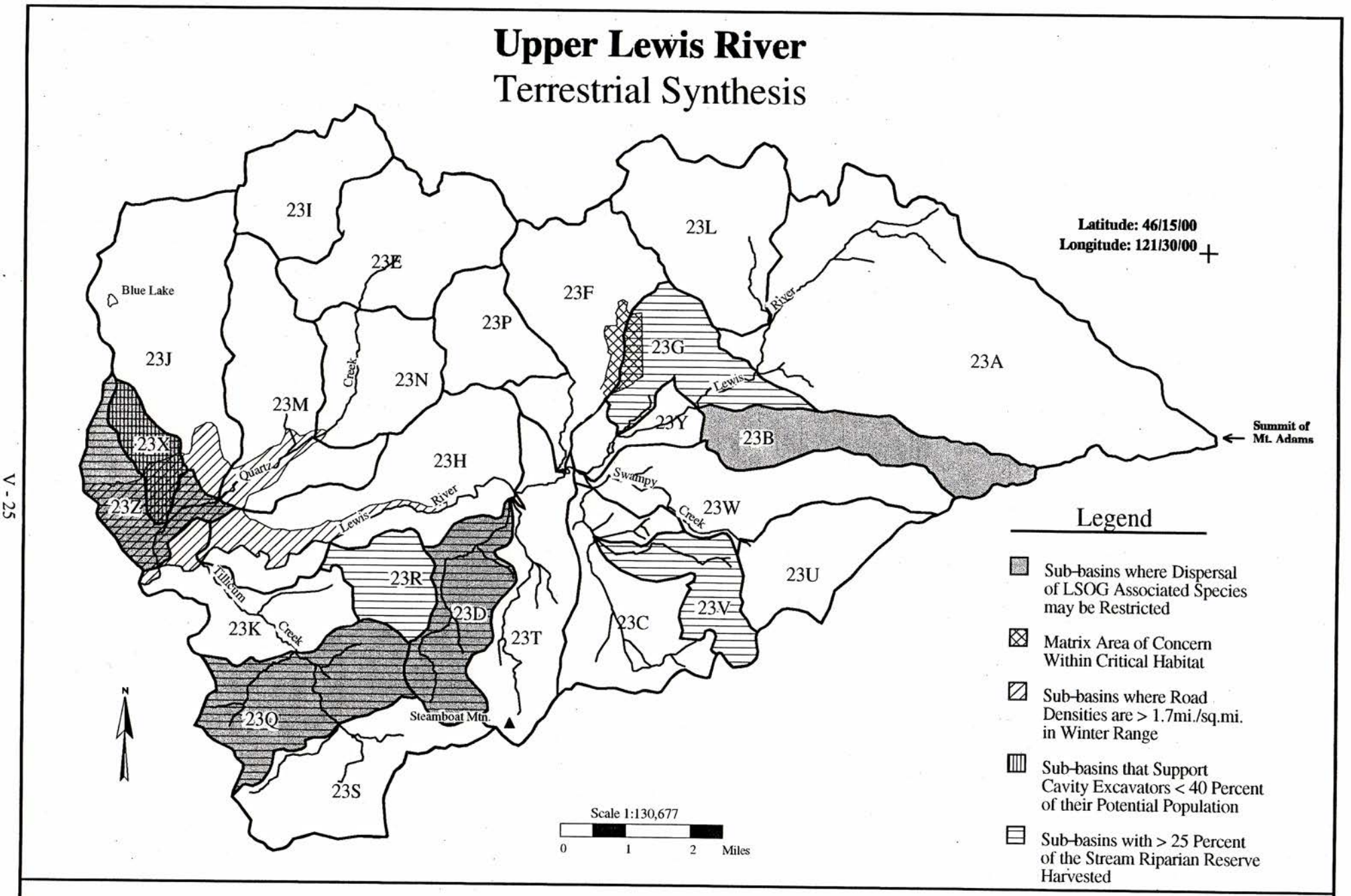

Figure 37. A synthesis of the terrestrial data shows areas of concern for LSOG associated species, ungulates, and cavity excavators.

Recreation Synthesis Explanation

The synthesis table and map show the primary recreation issues related to the watershed, completion of trail system, and trail connectors.

The Forest Plan and Gifford Pinchot National Forest Access and Travel Management Plan contain trail objectives for the Upper Lewis River Watershed. The Travel Management plan also recommends roads to be converted to trails to meet the objectives of the Forest Plan. These roads are listed in Table 31, Chapter III. The purpose of these plans is to return the trail system to conditions that existed before construction of Road 90.

The trail system would have links established between the Lewis River Trail and the Wright Meadow and Stabler Camp Trails. Also the Lewis River Trail would be re-opened to connect with the Table Mountain Trail and Twin Falls Campground. These connections will enhance the trail opportunities spreading use over more miles of trail than are currently available. Road to trail conversions will take place as part of general decommissioning of un-needed roads in the watershed.

Table 43. Social and Economic (Recreation) Synthesis.

Number	Name	Road to Trail Conversions	Trail Development or Reopening
23A	Upper Lewis River		X
23B	Twin Falls Creek		
23C	Pass Creek		
23D	Steamboat Creek		
23E	Upper Quartz Creek		
23F	Pin Creek		X
23G	Upper Sidewall Tributaries		X
23H	Lower Sidewall Tributaries	X	X
23I	French Creek		
23J	Straight Creek	X	
23K	Lower Tillicum Creek		X
23L	Boulder Creek		
23M	Snagtooth Creek		
23N	Middle Quartz Creek	X	
23P	Deer Creek		
23Q	Middle Tillicum Creek		
23R	Surprise Meadow		
23S	Upper Tillicum/Strawberry	X	
23T	Poison Creek		X
23U	Swampy Creek		
23V	N. Fork Pass Creek		
23W	N. Fork Swampy Cr.		
23X	Platinum Creek	X	
23Y	Upper Frontwall Tributaries		X
23Z	Lower Frontwall Tributaries	X	X

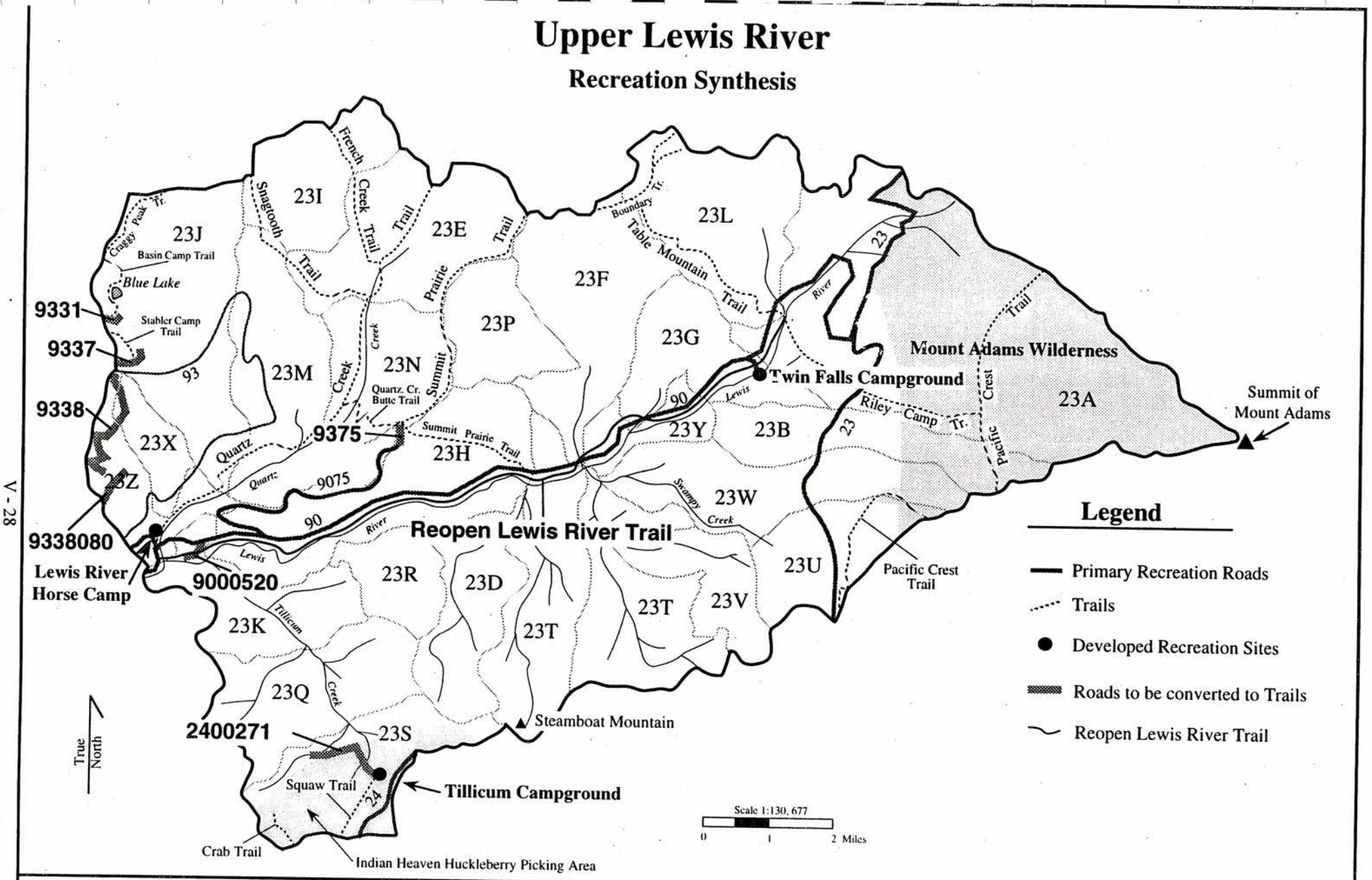

Figure 38. Synthesis data showing roads recommended for conversion to trails, and reopening of the Lewis River Trail between Quartz Creek and the Table Mountain Trail.. Conversion of roads to trails in the vicinity of the Lewis River Horse Camp would allow dispersal of horse users onto additional trails, decreasing impact to the Quartz Creek Trail, and the western continuation of the Lewis River Trail in the Middle Lewis River Watershed.

Table 44. Aquatic, Terrestrial, Social and Economic Synthesis by Sub-basin

Sub-basin		NWFP Allocations	AQUATIC				TERRESTRIAL						SOCIAL & ECONOMIC	
			High Aquatic Fragmentation & Low LWD Recruitment Potential	Increased Risk of Peak Flow	High Sediment Concern	Poor Fish Habitat Conditions	Areas of Concern within Critical Habitat	Road Densities > 1.7 mi/sq mi in Ungulate Winter Range	Habitat likely to support cavity nesters <40% of Potential Maximum Population	Dispersing Habitat for LSOG Associated Species Limited	Sub-basins with 15% or less Large Tree Structure	Sub-basins with >25% RR Harvested	Road to Trail Conversions	Trail Development or Reopening
23A	Upper Lewis River	AWA,WLD,LSR,MAT												X
23B	Twin Falls Cr	AWA,WLD,MAT				X				X				
23C	Pass Cr	LSR,MAT		R	R	X								
23D	Steamboat Cr	AWA,LSR,MAT	X	R	R					X		X		
23E	Upper Quartz Cr	LSR				X								
23F	Pin Cr	AWA,LSR,MAT				X	H							X
23G	Upper Sidewall Trib.	AWA,MAT		R			H					X		X
23H	Lower Sidewall Trib.	LSR,MAT						X					X	X
23I	French Cr	LSR												
23J	Straight Cr	LSR						X					X	
23K	Lower Tillicum Cr	LSR,MAT		R	R									X
23L	Boulder Cr	AWA,MAT				X								
23M	Snagtooth Cr	LSR				X		X						
23N	Middle Quartz Cr	LSR				X							X	
23P	Deer Cr	LSR												
23Q	Middle Tillicum Cr	LSR,MAT	X	R	R					X		X		
23R	Surprise Meadow	LSR,MAT	X	R	R							X		
23S	Up.Tillicum/Strawberry	AWA,MAT		R	R								X	
23T	Poison Cr	AWA,LSR,MAT		R										X
23U	Swampy Cr	AWA,WLD,MAT				X								
23V	North Fork Pass Cr	AWA,MAT		R								X		
23W	N. Fork Swampy Cr	AWA,WLD,LSR,MAT		R		X						X		
23X	Platinum Cr	LSR				X		X	X	X	X		X	
23Y	Upper Frontwall Trib.	LSR,MAT			R									X
23Z	Lower Frontwall Trib.	LSR		R	R			X		X		X	X	X

LSR = Late Successional Reserve
MAT = Matrix
WLD = Wilderness
AWA=Administratively Withdrawn

R = From Roads

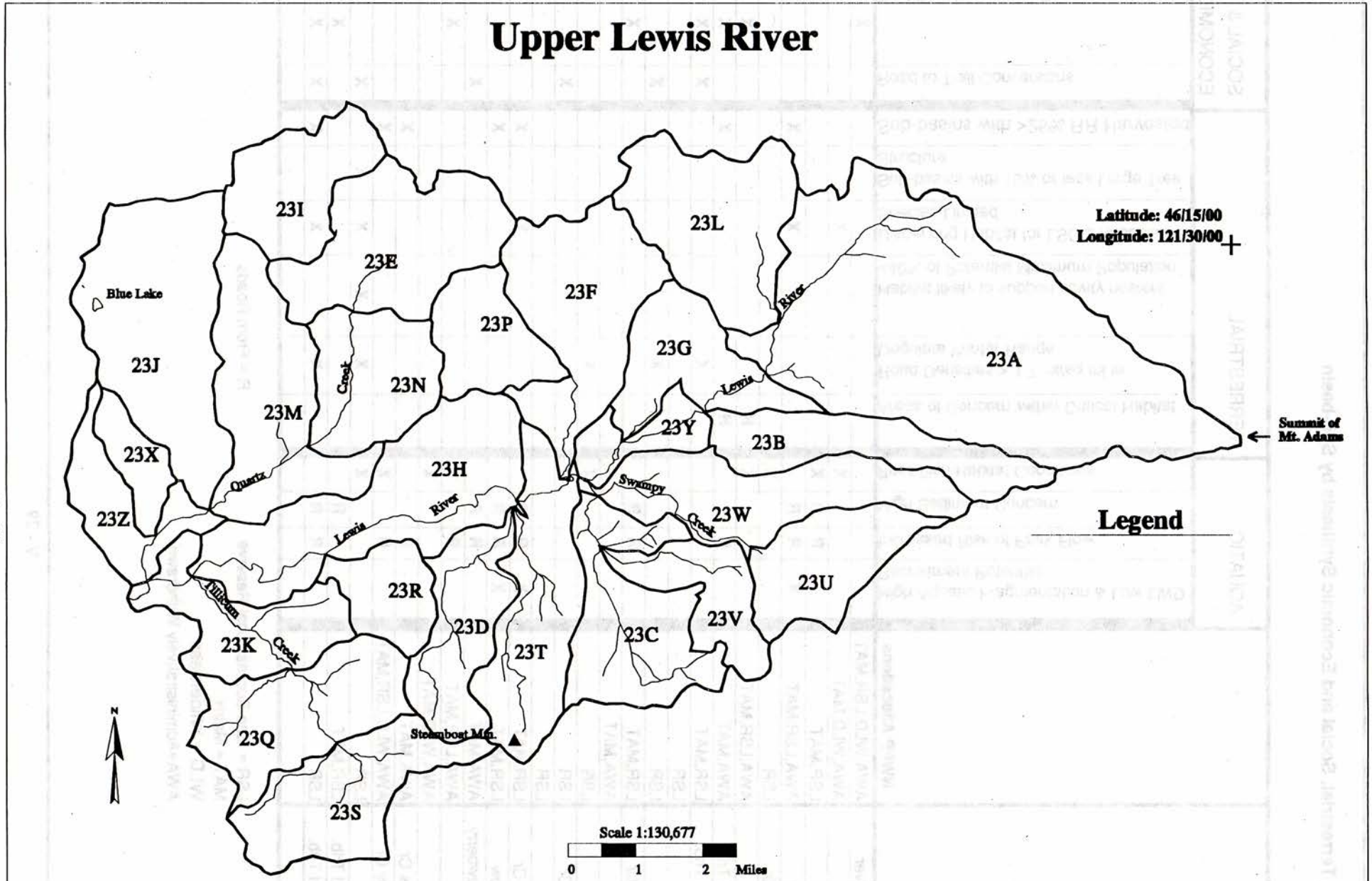

Figure 4. Sub-basins. For this analysis, the 75,494-acre Upper Lewis River Watershed is divided into 25 sub-basins.

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 accute.

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 17 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

High	Road Decommissioning
Moderate	Road Weatherization
Moderate	Stream Enhancement
Moderate	Erosion Control/Slope Stabilization
Moderate	Silvicultural Treatments to Accelerate Development of Sapling/Pole Stands
Moderate	Road to Trail Conversions

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 45. 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 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). Conifers may also be planted on these sites. Native species are preferred for re-establishment of vegetation. Finally, a closure berm is constructed to prevent vehicular access to the treated area.

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

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

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

Sub-basins that are a high priority for this treatment include 23C (Pass Creek sub-basin); 23D (Steamboat Creek sub-basin); and 23K (Tillicum Creek 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. Sub-basins that are a moderate priority for this treatment include: 23H (Lower Sidewall Tributaries), 23M (Snagtooth Creek), 23Q (Middle/Lower Tillicum Creek), 23R (Surprise Meadow), 23S (Upper Tillicum/Strawberry Creeks), 23V (North Fork Pass Creek), and 23Z (Lower Front Wall Tributaries). Priority areas were identified as those places with fewer road related concerns, such as high road densities, high aquatic fragmentation, location within the LSR, road related peak flow concerns, and/or sub-basins in winter range with road densities greater than 1.7 miles per square mile.

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. Thenefits 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 funding available later.

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 that are a high priority for this treatment are located in sub-basin 23C (Pass Creek sub-basin); 23D (Steamboat Creek sub-basin); 23K (Tillicum Creek sub-basin); 23Q (Middle/Lower Tillicum Creek), 23R (Surprise Meadow), 23S (Upper Tillicum/Strawberry Creeks); 23V (North Fork Pass Creek); 23Y (Upper Lewis River sub-basin) and 23Z (Lower Frontwall Tributaries).

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

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

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

Restoration Activity

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). The sub-basins where this activity may be appropriate is 23C (Pass Creek sub-basin); 23E (Upper Quartz Creek sub-basin); 23F (Pin Creek sub-basin); 23L (Boulder Creek sub-basin);23M (Quartz/Snagtooth Creeks sub-basin); 23N (Middle Quartz Creek sub-basin); 23W (North Fork Swampy Creek sub-basin); 23X (Platinum Creek sub-basin); and 23Z (Lower Frontwall Tributaries).

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

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

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

Restoration Activity

EROSION CONTROL/SLOPE STABILIZATION

A. What is it?

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

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

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

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

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

Sub-basins that are a priority for this treatment are: 23C (Pass Creek sub-basin); 23D (Steamboat Creek sub-basin); 23H (Lewis River sub-basin); 23K (Tillicum Creek sub-basin); 23T (Poison Creek sub-basin); 23W (Swampy Creek sub-basin); and 23Y (Lewis River sub-basin).

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

Restoration Activity

SILVICULTURAL TREATMENTS TO ACCELERATE DEVELOPMENT OF SAPLING/POLE STANDS

A. What is it?

Non-commercial Thinning: These treatments are designed to reduce the number of trees in a forest stand. Noncommercial thinning cuts trees less than 8 inches DBH and leaves them where they fall. Trees to be left in the stand usually include the largest healthiest trees plus species which occur in lesser numbers.

Fertilization: Helicopters are used to spread nitrogen fertilizer in urea form over young managed stands which have been previously thinned. Application is done in the spring or fall when temperatures are relatively cool but not during heavy rains. This would occur only on lands to be managed for timber products.

Pruning: Branches are removed from selected young conifer trees up to 18 feet from the base of the tree to increase the wood quality of trees. This would occur only on lands to be managed for timber products.

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

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

There are thousands of acres of plantation in this watershed. Some will be managed to provide timber products, but many others are now on lands being managed for resources other than timber. When these stands were established they were planted at high densities with species desirable for timber. Left untreated over time, the trees will become overcrowded and their growth will stagnate. In many cases, this situation is undesirable. Larger sized trees may be desired for future timber, for log recruitment near streams, or wildlife habitat. In areas where timber management is an objective these treatments would commonly include thinning, fertilizing and pruning. Where timber production is not an objective, thinning and/or underplanting can be used to accelerate the differentiation of tree sizes, increase species diversity, and provide larger trees faster. Structurally more diverse stands (multiple stories, deeper crowns, greater species diversity) may be more desirable as plant and wildlife habitat than the current relatively homogenous stands. Acceleration of young forest stands into mature stands can help reduce fragmentation and provide older forest habitat in both the LSR and in Riparian Reserves.

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

Noncommercial stand thinning treatments should be considered for all plantations between 10 and 20 years that have not yet been thinned. Although the emphasis is to treat plantations on lands managed for timber products, plantations in all allocations should be evaluated on the ground for treatment needs.

Sub-basins in Matrix land that have more than 50 acres of closed sapling/pole stands are: 23A, 23B, 23C, 23S, 23T, 23W.

Sub-basins where non-commercial thinning would help restore vegetative cover for hydrological restoration are 23D, 23G, 23Q, 23R, 23V, 23X, 23Z.

Sub-basins where Northern Spotted Owl dispersal habitat is not abundant, where non-commercial thinning would accelerate habitat development are: 23B, 23D, 23Q, 23X, 23Z.

Fertilization opportunities exist on Matrix lands (listed above under thinning) in sapling/pole or small tree stands between 15 and 80 years of age which have been thinned. Previously thinned units were not identified as part of this analysis. Opportunities to fertilize previously thinned or proposed thinning units will be identified as part of proposed silvicultural projects within the watershed.

Pruning opportunities will occur on Matrix lands (listed above) and will also be identified as part of proposed silvicultural projects within the watershed.

Specific interplanting and planting projects in all sub-basins should be identified as additional fieldwork or project planning occurs.

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

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

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

Restoration Activity

ROAD TO TRAIL CONVERSIONS

A. What is it?

Within the watershed certain roads have been identified by the Gifford Pinchot National Forest Travel and Access Management Plan for decommissioning and conversion to trails. These road are no longer needed for resource management use and have been identified as sources of increased runoff and sedimentation which impact watershed health. The roads identified in this section provide opportunities, through conversion to trails, to create trail loops, reconnect isolated trail segments, and disperse trail use. An objective of the Gifford Pinchot National Forest Land and Resource Management Plan calls for creating trail loops and connections. Road to trail conversion provides an opportunity to meet this objective.

Conversion of roads to trails will include reducing the width of the road, surface rock removal, scarification of compacted soil, removal of culverts, cross ditching, and in places pulling of fill slopes back onto road prisms. As road decommissioning work progresses, a narrow trail tread, about 36 inches wide, will be established on the abandoned road surface. Areas to either side of the trail tread will be revegetated.

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

Conversion of roads to trails would significantly reduce the amount of sediment reaching streams. Roads intercept rainwater and runoff, and along ditch lines direct this water to stream courses. This increases peak runoff, impacting stream courses through accelerated erosion of banks and channel beds. Roads also contribute sediment to streams as gravel surfacing is eroded and carried to stream channels by ditch runoff.

Road related impacts will start to decrease almost immediately upon decommissioning of the roads. As vegetation becomes re-established on the road beds, runoff and sedimentation rates should return to natural background levels. Where trail treads are developed on former roads, the tread will be configured to prevent channeling of runoff by establishing rolling grades. Since trails do not require ditching, interception and channeling of runoff will not occur. Even though the trail bed will be established at 36 inches wide, the maintained trail tread is expected to average 20 to 24 inches in width. The roads planned for decommissioning create openings 20 to 30 feet in width. About 6 to 7 percent of this open width will be retained as a trail, a 93 percent reduction of unvegetated ground, and a complete elimination of road runoff.

Small amounts of runoff are sometimes encountered along trails. This usually takes place where trails run for long distances down slopes, without cross drains or drain dips. Conversion of road beds to trails helps reduce the chance of unwanted runoff for two reasons. The original roads were constructed on grades usually under 15 percent; these low grades make it very easy to control runoff. Secondly, the heavy equipment used for road decommissioning can easily provide cross drains and drainage control as the conversion takes place. This will result in trails that are more effective than average in controlling runoff.

Currently the Quartz Creek Trail and Lewis River Trail are receiving heavy horse use in the vicinity of the Lewis River Horse Camp. This concentrated use is generating heavy impact to the beds of these trails. Conversion of roads to trails in the vicinity will disperse users, reducing the impact to these trails. At the same time trail users will have access to the Wright Meadow and Stabler Camp Trails for the first time since construction of Road 90. This will provide loop opportunities, and connections with the Boundary Trail at the head of the watershed.

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

First priority for road to trail conversion will take place in Sub-basins 23J, 23X, and 23Z. Sub basins 23H, 23S, and 23K will be second priority. The first objective is to provide dispersement opportunities for trail users originating from the vicinity of the Lewis River Horse Camp.

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

Over the next few years, 1998-2001, and perhaps beyond, funding will be made available for road decommissioning. Once funding is available, roads in each sub-basin will receive detailed analysis through the environmental analysis process. Those roads identified through this process will be decommissioned and/or converted to trails as appropriate.

Monitoring Activity

STREAM TEMPERATURE

A. What is it?

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

Sub-basin 23Z (Quartz Creek) is the only sub-basin with temperatures that have exceeded 16°C (State Water Quality Standard). Sub-basins 23D (Steamboat Creek), 23G (Lewis River), 23Q (Middle/Lower Tillicum Creek), 23R (Surprise Meadow), 23V (North Fork Pass Creek), 23X (Platinum Creek), and 23Z (Quartz Creek) have over 30 percent of the stream Riparian Reserve harvested. Yet, there is a high need for this type of monitoring within all sub-basins.

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.

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 sub-basins in prioritized order are: 23Z, 23M, 23N and 23E (Quartz Creek), 23L (Boulder Creek), 23S (Upper Tillicum Creek), 23U (Upper Swampy Creek), and 23Y (Lewis 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 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 availability of funding and management activity levels. There are approximately 37.2 miles of Class I and II streams in the Upper Lewis River Watershed that have not been surveyed. At current funding and management activity levels these surveys would be completed within a minimum of two to three years.

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 sub-basins in prioritized order are: 23C (Pass Creek) and 23J (Straight Creek).

Since this type of monitoring is ongoing, there is only a medium priority to emphasize 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. None of the lakes (16 acres) in the Upper Lewis River Watershed have been surveyed. At current funding and management activity levels these surveys would be completed within one to two years.

Monitoring Activity

PEREGRINE FALCON

A. What is it?

Monitor four cliff sites and determine their status to serve as peregrine falcon nest sites.

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

Monitoring of these sites will help determine if habitat is highly suitable nesting habitat or if any of the sites are active.

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

Surveys would occur in Sub-basins 23I, 23J, 23L and 23T where cliffs, potential habitats, were identified. Initially observers would watch the various cliff site and determine if sites are presently active. These observations would occur in early spring. If falcons are not observed, habitat and prey assessments should be conducted to determine level of suitability.

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

Monitoring should begin as soon as funding is available, or in coordination with habitat improvement projects that are planned within one mile of a potential nest site. Increased knowledge gained from monitoring would be an immediate benefit.

Monitoring Activity

NORTHERN SPOTTED OWL

A. What is it?

Monitor number of northern spotted owl activity centers located in the LSR portion of the watershed.

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

The objective of this monitoring is to increase knowledge of the nesting success, death rate and survival-ship ratio of northern spotted owls using the LSR. This action will validate some of the assumptions made in the Northwest Forest Plan.

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

Sub-basins where northern spotted owl activity centers occur within the LSR portion of the watershed would have the highest priority for surveys. Surveys would follow the Pacific Northwest Region protocol requiring surveys to be conducted between March and August. The surveys would occur over a two year period with three surveys occurring each year. This action should be repeated every five years

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

Monitoring should begin as soon as funding is available, or in coordination with habitat improvement projects that are planned in the reserve. Increased knowledge gained from monitoring would be an immediate benefit.

Monitoring Activity

LYNX

A. What is it?

Monitor the distribution of lynx throughout its potential range as recommended by the Northwest Forest Plan.

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

Monitoring of these sites will help determine if potential habitat is occupied by lynxes and also help in determining population distribution.

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

Surveys would occur in suitable breeding and foraging habitat. "Snare" stations will be used to determine presence or absence. Surveys will be conducted in July through August.

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

Monitoring may begin as soon as 1998 as a part of a Region 6 survey effort. Suitable habitat that is not surveyed during this initial attempt should be surveyed as funding becomes available, or in coordination with projects that are planned within in suitable habitat. Increased knowledge gained from monitoring would be an immediate benefit.

Monitoring Activity

GREAT GRAY OWL

A. What is it?

Monitor four meadows that are larger than 10 acres and determine their status to provide suitable nesting habitat for great gray owls.

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

Monitoring of these sites will help determine if any of the meadows are actively being used by great gray owls.

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

Surveys would occur around four meadows found in Sub-basins 23S and 23U. Surveying would involve following the Regional protocol for great gray owl surveys which requires two years of surveying and six complete surveys each year..

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

Monitoring in conjunction with planned activities that are within 1000 feet of one of these meadows. Increased knowledge gained from monitoring will help increase the knowledge of the distribution of this species.

Monitoring Activity

PHASE II ROAD CONDITION SURVEYS

A. What is it?

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

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

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

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

Sub-basins where the inventory would be a priority are those with high road densities, high aquatic fragmentation and high sediment concerns: 23C (Pass Creek sub-basin); 23D (Steamboat Creek sub-basin); 23K (Tillicum Creek sub-basin); 23Q (Middle/Lower Tillicum Creek), 23R (Surprise Meadow), 23S (Upper Tillicum/Strawberry Creeks); and 23Z (Quartz Creek); although this inventory is a priority to conduct throughout the analysis area.

This is high priority monitoring.

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

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

Monitoring Activity

UPDATING THE GIS DATABASE TO REFLECT CURRENT KNOWLEDGE

A. What is it?

Analysis work for project and forest-wide planning relies heavily on the information in our GIS. 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. On-the-ground reconnaissance during project planning often reveals errors or fine-tuning that needs to be recorded on one of several GIS data layers. This watershed analysis revealed that changes made during recent project planning were not all reflected in the data used for this analysis . Examples include areas that had been verified as Riparian Reserves still showing up as suitable for timber management, or polygons that had been created with no associated data.

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

Field verification and timely updating of the GIS database will help ensure more accurate project and planning analysis. Verification of locations and ecological conditions for TES species, C-3 species, streams, and wetlands will help assure compliance with the Northwest Forest Plan.

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

Surveys for TES, C-3 species and verification of wetlands, streams, and vegetation conditions will occur in conjunction with planned projects in the watershed. Verification of data is needed throughout the watershed.

Increased efforts are needed to establish a procedure to update data as changes in the field are made.

D. Anticipated rates and time frames for achieving management objectives.

Survey work will depend on available funding and scheduling of projects. Updating the GIS database to reflect fieldwork should be completed as soon thereafter as possible so the information is useable and is not lost.

OPPORTUNITIES FOR TIMBER HARVEST

A. What is it?

Timber harvest is a scheduled activity on lands designated suitable for timber management. Approximately 13 percent of this watershed is comprised of Matrix lands suitable for timber management. Most cutting prescriptions on the Gifford Pinchot NF utilize one of the following methods: HLR (regeneration harvest with 15-20 percent of the existing stand retained), HMR (regeneration harvest with 20-40 percent of the stand retained), HHR (Regeneration harvesting that retains greater than 40 percent of the stand), HTH (commercial thinning). Other incidental harvesting, such as salvage, hazard tree removal, or the removal of individual trees may occur but are not normally a part of the scheduled timber program.

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. A defined scheduled timber program is part of the Northwest Forest Plan.

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

There are limited opportunities for additional timber harvest within this watershed. Of the seventeen sub-basins (listed below in the chart) in Matrix lands, seven sub-basins were identified as having some potential for HLR or HMR regeneration harvesting within the next few years. These sub-basins are: 23A, 23B, 23H, 23L, 23S, 23U and 23Y. Harvest operations in the remaining sub-basins should be limited in acres and confined to either commercial thinning or regeneration with heavy retention. In some cases, it may be beneficial to harvest acres in a sub-basin not identified in this watershed analysis in order to facilitate road closures, decommissioning or other non-timber resource needs.

Sub-basins with very few potential acres (one or two harvest units) are listed in the following chart as having limited (L) opportunities. Moderate (M) indicates sub-basins where potential acres are between 75 and 150 acres. One sub-basin (23S) has greater than 150 potential harvest acres and is listed as having a high (H) potential for future harvest.

Best estimates of total timber available are that no more than 400 acres (between 5 and 10 MMBF) spread across these seven sub-basins could be harvested in the next few years. All of the sub-basins with identified opportunities, except 23H, have timber sales that are planned but not yet harvested.

Sub-basin	Timber Opportunity (HLR or HMR)	Remarks
23A	L	
23B	L	
23C		
23D		
23F		

Sub-basin	Timber Opportunity (HLR or HMR)	Remarks
23G		
23H	L	
23K		
23L	M	
23Q		
23R		
23S	H	Access/Roading will be a problem. Helicopter systems need to be looked at. Economics will be a problem
23T		
23U	L	
23V		
23W		
23Y	M	

D. <u>The anticipated rates and time frames for achieving the management objectives.</u>

It is anticipated that the above timber harvest opprtunities will be analyzed in detail within the next five years. As the resource condition in the above listed sub-basins change (acres harvested, roads decommissioned, vegetation development), the watershed should be re-evaluated for potential timber harvest opportunities. An updated Watersed Anaylsis should be prepared to reflect these changes.

REOPENING OF LEWIS RIVER TRAIL

A. What is it?

The Lewis River Trail was abandoned when Road 90 was constructed. Segments of the trail still exist, paralleling Road 90 and the Lewis River. In some areas long segments of trail can be found, but they are unmaintained. In other areas the construction of Road 90 destroyed the trail tread causing segmentation. Connecting links and loop trail opportunities were eliminated when this segment of trail was lost. The Gifford Pinchot National Forest Land and Resource Management Plan identifies this portion of the Lewis River Trail for reopening/re-establishment.

Currently trail users in the vicinity of the Lewis River Horse camp are limited to using either the lower Lewis River Trail or the Quartz Creek Trail. Concentrated use is causing heavy wear of the trails and creates muddy conditions in some seasons. A recreation objective for the area is to provide additional trail opportunities so use can be spread over a wider area and also create linkage to isolated trails and loop opportunities

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

Reopening the Lewis River Trail would reduce the levels of use on the lower Lewis River Trail and Quartz Creek Trails. This would reduce tread impacts and allow dispersal of users to other areas. This segment of the Lewis River Trail once connected with the Summit Prairie Trail and Table Mountain Trail providing a primary access route up the Lewis River Valley. Reopening the trail would re-establish these connections creating trail loop opportunities and a connection that could be followed from the lower Lewis River Valley to the Pacific Crest Trail.

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

The old Lewis River Trail runs approximately along Road 90. The first priority will be to evaluate these segments for future use. Segments that are usable and do not create unwanted impacts would be reopened. Where the trail was destroyed by road construction, new trail segments will be constructed to form connections. The trail runs through Sub-basins 23A, 23F, 23G, 23H, 23K, 23T, 23Y, and 23Z.

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

Once funding is available, the trail will receive detailed analysis through the environmental analysis process. Through this process it will be determined which segments will be retained and where new trail segments will be constructed.

Table 45. Recommendations by Sub-basin

Sub-basins		NWFP Allocations	RESTORATION						MONITORING								COMMODITIES & DEVELOPMENT	
			Road Decommissioning	Road Weatherization	Stream Enhancement	Erosion Control & Slope Stabilization	Silviculture Treatments in Sapling Pole Stands	Road to Trail Conversions	Stream Temperature	Stream Surveys	Lake Surveys	Phase II Road Condition Surveys	Potential Peregrine Falcon Nest Sites	No. Spotted Owl Activity Sites in LSR	Lynx	Great Grey Owl	Updating GIS Databas	Timber Harvest Opportunities	Re-opening Lewis River Trail
23A	Upper Lewis River	AWA,WLD,LSR,MAT					H								X		X	L	X
23B	Twin Falls Cr	AWA,WLD,MAT					H								X		X	L	
23C	Pass Cr	LSR,MAT	H	X	X	X	H				X	X					X		
23D	Steamboat Cr	AWA,LSR,MAT	H	X		X	M		X			X					X		
23E	Upper Quartz Cr	LSR			X					X				X	X		X		
23F	Pin Cr	AWA,LSR,MAT			X												X		X
23G	Upper Sidewall Trib.	AWA,MAT					M		X								X		X
23H	Lower Sidewall Trib.	LSR,MAT	M			X		M						X			X	L	X
23I	French Cr	LSR											X	X			X		
23J	Straight Cr	LSR						H			X		X	X	X		X		
23K	Lower Tillicum Cr	LSR,MAT	H	X		X		M				X		X			X		X
23L	Boulder Cr	AWA,MATR			X					X			X				X	M	
23M	Snagtooth Cr	LSR	M		X					X				X	X		X		
23N	Middle Quartz Cr	LSR			X									X	X		X		
23P	Deer Cr	LSR												X			X		
23Q	Middle Tillicum Cr	LSR,MATR	M	X			M		X			X					X		
23R	Suprise Meadow	LSR,MAT	M	X			M		X			X					X		
23S	Up.Tillicum/Strawberry	AWA,MAT	M	X			H	M		X		X				X	X	H	
23T	Poison Cr	AWA,LSR,MAT				X	H						X		X		X		X
23U	Swampy Cr	AWA,WLD,MAT								X						X	X	L	
23V	North Fork Pass Cr	AWA,MAT	M				M		X								X		
23W	N. Fork Swampy Cr	AWA,WLD,LSR,MAT			X	X	H										X		
23X	Platinum Cr	LSR			X		M	H	X					X			X		
23Y	Upper Frontwall Trib.	LSR,MAT		X		X				X							X	M	X
23Z	Lower Frontwall Trib.	LSR	M	X	X		M	H	X	X		X					X		X

LSR = Late Successional Reserve
MAT = Matrix
WLD = Wilderness
AWA=Administratively Withdrawn

H = High Priority
M = Medium Priority
L = Low Priority

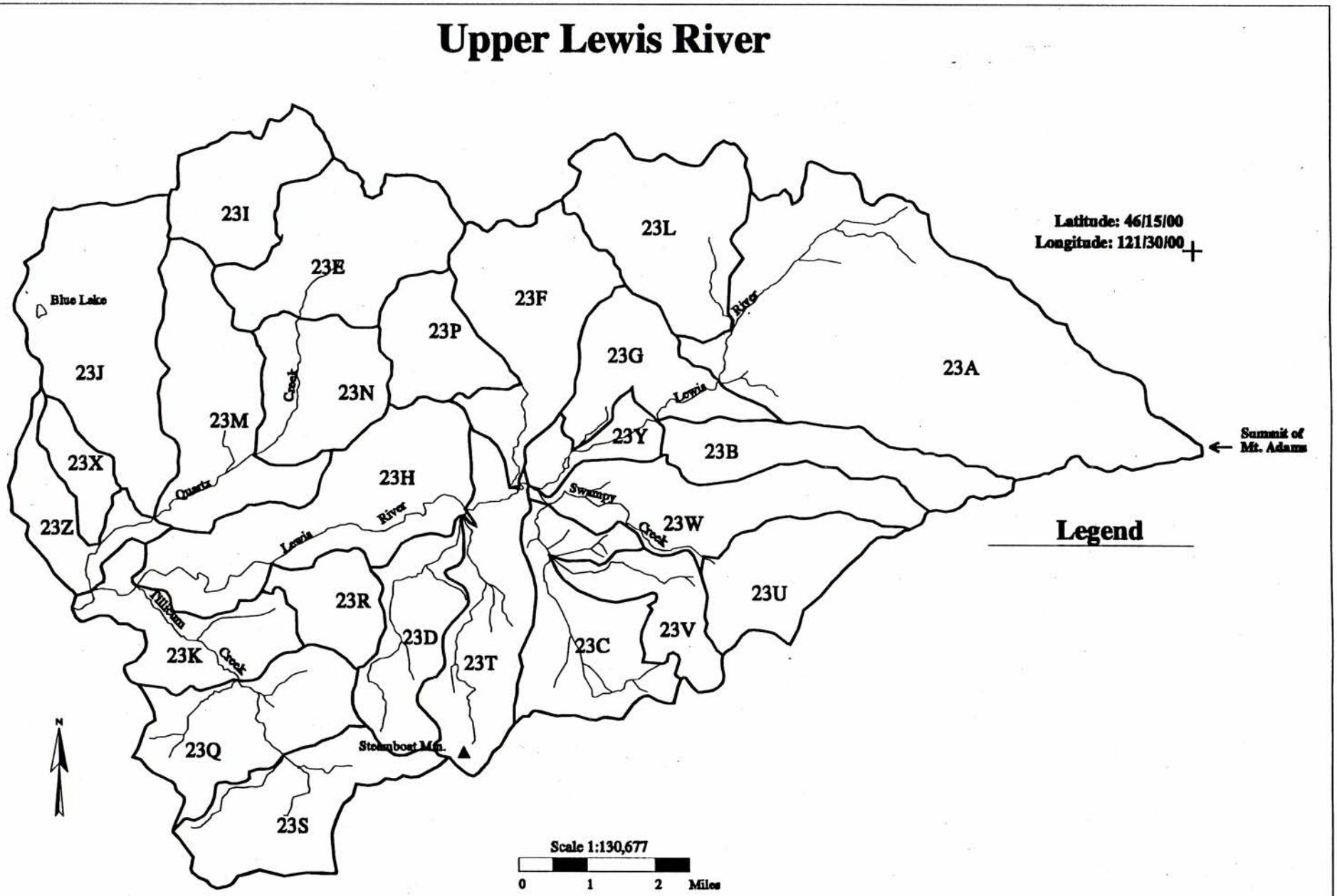

Figure 4. Sub-basins. For this analysis, the 75,494-acre Upper Lewis River Watershed is divided into 25 sub-basins.

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.

Activity Center: typically an area of concentrated use by an owl(s) or a nest site.

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

Cavity Excavator:- wildlife species, most frequently birds, that require a cavity (hole) in trees for nesting.
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.

Critical Habitat: the specific area within the geographic area occupied by a Federally listed species.

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

Eyrie: a cliff ledge used by falcons for nesting.

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 Manangement Plan.

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

Hibernacula: hibernating structure (caves, bridges, etc.) Used by bats.

Home Range: the area within which an animal conducts its activities during a defined period of time.

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

Late Successional/Old Growth (LSOG) forest: forest seral stages that include mature and old-growth age classes.

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 emphasi

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.

Maximum potential population: maximum breeding population density based on available habitat.

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.

MSHNVM, 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.

Potential population: see maximum potential population

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

Ungulate - a mammal with hooves.

Welded Tuff - Pyroclastic rock that has been welded together by weight and heat.

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

APPENDIX B

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APPENDIX B REFERENCES

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APPENDIX C

ISSUES AND KEY QUESTIONS

APPENDIX C ISSUES AND KEY QUESTIONS

ISSUE: Mass Wasting

The Upper Lewis Watershed has many landslides and debris torrents within its boundaries. A few very large, deep-seated and slow moving landslides are present. These larger features are probably not greatly affected by human activities, but within these landslides there are numerous shallower and active landslides that can be affected by management actions. A number of landslides are moving sediment and large woody debris directly into the stream system.

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?

8. Do landslides deliver large woody debris to stream channels or other waters?

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: Fire History

In the past, large catastrophic fire has been a change agent at the landscape (watershed) scale.

Key Questions:

1. Where and when have catastrophic fires occurred within the watershed?

ISSUE: Vegetation Structure and Composition

Historically the Upper Lewis Watershed has had a high proportion of large, contiguous multi layer stands and large, contiguous single layer fire regeneration stands with relict pockets of old growth that survived the fires. Within the past 60 years timber harvest activities have increased the amount and distribution of single layer stands beyond historic levels. These younger stands are distributed in small patches across the landscape, functionally fragmenting larger contiguous stands. This

has diminished the diversity and distribution of some plants, lichens, fungi, bryophyte, and animal species and their habitat in some areas.

Key Questions:

1. What are the present stand structures and compositions?

2. How do these compare with past conditions?

3. How are the vegetation structural stages distributed across the watershed?

4. Is a minimum of 15 percent of the watershed in a late-successional seral stage?

5. Which plant, lichen, fungi, and bryophyte species vulnerable to conversion of multi-layered canopies to single-layer canopies are present in the watershed?

6. What are the implications for future conditions?

ISSUE: Stream Riparian Reserve Fragmentation and Riparian Habitat

Stream riparian areas provide habitat for wildlife, plants, lichens, fungi, and bryophytes, and provide corridors for wildlife migration and plant dispersal. Some critical components of terrestrial habitat within Stream Riparian Reserves have been altered by fragmentation due to wildfire, past eruptions of Mount Adams, and timber management activities. This has influenced the capacity of these ecosystems to provide effective habitat for riparian dependent species, and other species that may use Stream Riparian Reserves as corridors between larger habitat blocks. Disruption of connectivity between these areas can potentially result in species isolation. This can lead to undesirable changes in species composition, use, and ecosystem functions within Riparian Reserves and the watershed as a whole.

Key Questions:

1. What is the current distribution of stand structural stages within Stream Riparian Reserves?

2. Where are Stream Riparian Reserves inadequate in providing dispersal habitat for species of concern?

ISSUE: TES and C-3 Plants, Lichens, Bryophytes and Fungi Species

Botrychium lunaria, *B. pinnatum*, *Microseris borealis*, and *Montia diffusa*, Washington State Sensitive (TES) vascular plants, are present within the watershed. *Pleuricospora fimbriolata*, a Washington State Watch species, is also present at several sites. There are three Botanical Special Interest Areas in the watershed, which are managed to monitor the designated plant species. These include the five acre *Montia diffusa* Botanical Special Interest Area Unit #1113 (MAC (Management Area Category 9L), and two 20 acre *Pleuricospora fimbriolata* sites; Botanical Special Interest Areas Units #1108 (MAC AA) and Unit #3161 (MAC UH). An additional 29 TES plant species are suspected to occur within the watershed, based on suitable habitat. Less than about 10 percent of the watershed has been surveyed for TES species.

Hydrothyria venosa and *Leptogium rivale*, Survey and Manage (C-3) Category 1 (manage known sites) and 3 (conduct extensive surveys and manage sites) aquatic lichens, are present at several locations within the watershed. *Pseudocyphellaria rainierensis*, a Survey and Manage Category 1, 2 (conduct surveys before ground-disturbing activities) and 3 epiphytic lichen, is also present within the watershed. **XXXX** other Survey and Manage Category 4 (conduct general regional surveys) lichens are documented or suspected to occur in the watershed. Virtually none of the watershed has been surveyed for C-3 species. In particular, the Late Successional Reserve, Steamboat Research Natural Area and Mount Adams Wilderness Area should be surveyed for C-3 species because these areas are presumed to be repositories of these species.

Key Questions:

1. Which additional TES and C-3 plants, lichens, bryophytes and fungi are present in the Upper Lewis watershed, and where?

2. Which TES and C-3 are species are likely to occur, and in which habitats?

3. Has habitat fragmentation impacted TES and C-3 population viability?

4. How can population viability of TES and C-3 species be monitored?

5. Has disruption of dispersal corridors impacted population viability?

ISSUE: Habitat Condition for Threatened, Endangered, and Sensitive Animal Species

The watershed contains suitable, or potentially suitable habitats for threatened, endangered, and sensitive species including the northern spotted owl, peregrine falcon, gray wolf, grizzly bear, bald eagle, and Larch Mountain salamander. Historic fires, road construction, and timber harvest, has increased the degree of forest fragmentation. Road development has also resulted in an increased human presence. The decrease in contiguous forest and the ever increasing human presence has affected the habitat for these species.

Key Questions:

Northern Spotted Owl:

1. Where are spotted owl activity centers located in the watershed? In which Northwest Forest Plan allocations are they located? Which of these activity centers are currently above "take" thresholds?

2. How many acres of northern spotted owl suitable habitats are there in the watershed and in each sub-basin? What is the habitat distribution?

4. What is the condition of the Riparian Reserves, dispersal avenues, between Late Successional Reserves?

5. What is the land area designated as reserves compared to critical habitat?

6. What is the habitat quality, in terms of interior forest, in reserves and critical habitat?

Bald Eagle:

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

Peregrine Falcon:

1. Are there suitable cliff sites that may serve as nest sites in the watershed?

Gray Wolf, Grizzly Bear, and Wolverine:

1. Does any part of the watershed contribute to a portion of a wolf pack's territory?

2. Are there any potential den and rendezvous sites (wolf) in the watershed?

3. What is the status of the prey base population (elk and deer)? What are the percent of optimal thermal cover and the road density in deer and elk winter range?

4. What is the watershed's road and trail density and distribution?

Common Loon:

1. Are there any large bodies of water located in the watershed that could serve as suitable habitat?

ISSUE: Habitat Condition for C-3 and Cavity Dependent Species.

The watershed contains suitable, or potentially suitable habitat for C-3 species North American lynx, forest bats, Van Dyke's salamander, Larch Mountain salamander, and cavity-dependent species. These habitats may be affected by future projects. Habitat for cavity excavators has been impacted by historic fires and past regeneration harvesting.

Key Questions:

Forest Bats:

1. Are there hibernacula, roost, or maternity sites in the watershed, and in which sub-basin are they located?

2. Are there small ponds or wetlands located in the watershed that could provide foraging opportunities for bats?

Larch Mountain Salamander:

1. Are there known Larch Mountain salamander populations in the watershed?

2. Are any of these sites located in areas that could be affected by future projects?

3. Is recreational use at these sites affecting habitat suitability?

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?

3. Is recreational use at these sites affecting habitat suitability?

Northern America Lynx:

1. Are there any lodgepole or subalpine forests located in the watershed? Which sub-basins have the highest likelihoods as serving as lynx habitat?

Cavity Excavators:

1. What is the abundance and distribution of snags?

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? Where are these influences occurring?

3. What is the history of floods and disturbance of hydrologic 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 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, flooding and fire, combined with timber harvest 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). A major flood event has also occurred since the first iteration, so we have a baseline to compare some of these parameters before and after the flood. 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, pieces of large woody debris per mile, stream temperature, channel configuration, sediment? How have these attributes changed since the first analysis?

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...)? Has this unique habitat changed since the first analysis?

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 Connectors:

Over the past thirty years, large numbers of roads have been built in the watershed. From a recreational perspective these have both provided access to camp sites, and at the same time decimated the previous trail system. The Gifford Pinchot Land and Resource Management Plan addresses this problem by proposing the re-establishment of certain former trails, or development of new trails to form an integrated network. Since the plan was approved, additional trail needs have been identified near the Lewis River Horse Camp. Through a third process, the Gifford Pinchot National Forest Access and Travel Management Plan, certain roads were identified for conversion to trails. These projects and plans have not been integrated into a single trail management strategy for the area.

ISSUE: Timber Harvest Expectations

Timber harvest expectations in the Upper Lewis River watershed for the decade following the Record of Decision (ROD) for the Northwerst Forest Plan range from 1,000 to 1,700 acres. Since 1994, when the ROD was signed, all or parts of ten timber sales have been sold or are planned for sale. As of this date, depending on what alternatives are selected for the 1998 timber sale program, it is likely that between 1,300 and 1,500 acres will be logged this decade . Additional acres may be scheduled for 1999 and beyond if this watershed analysis indicates further opportunities.

Key Questions:

1. Given the current resource concerns, accessability, and economic market, can this watershed support additional harvest acres?

2. If so, in which sub-basins?

3. If more harvest opportunities exist in this watershed, will resource concerns limit harvest prescriptions or require special mitigation?

APPENDIX D

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

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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

1. Issue: Riparian Reserve Mass Wasting

Confidence: Moderate to High

Discussion: The mapping of unstable ground is a dynamic process that should be updated as more information becomes available. The unstable portion of the mapping has been updated since the last iteration. The potentially unstable portion of the mapping still needs some updating to take into account field work for some of the timber sales that were set up over the last couple of years.

Data Gaps: Continual updating of the unstable and potentially unstable ground needs to be done as new data is identified.

2 **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, 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.

Hydrologic Condition- by Mark Kreiter, Hydrologist

3. **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 discrepencies 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.

4. Issue: Hydrologic Condition

Confidence in analysis: Moderate - 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.

- 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.

Data Gaps:

- There is a need for field verification of the vegetation layer to improve the accuracy of the data.

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

- There is a need to complete level II road surveys so possible restoration opportunities can be identified 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.

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 - by Mark Kreiter, Hydrologist; and Deborah Haapala, Fisheries Biologist

5. **Issue: LWD/Mile** - by Deborah Haapala

Confidence in analysis: Moderate

Limitations of the Analysis include:

Data for this analysis came from the district's stream survey files and database. Data are only available on 50 percent (37.8 miles) of fish bearing streams in the watershed. 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.

6. **Issue: LWD Recruitment** - by Deborah Haapala

Confidence in the analysis: Moderate

Limitation of the Analysis include:

Recruitment potential of LWD was based on the percent of streamside riparian area that had more than 30 percent harvested. 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 50 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.

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.

7. **Issue: Primary Pools/Mile** - by Deborah Haapala

Confidence in analysis - Moderate

Limitation of the Analysis include:

Data for this analysis came from the district's stream survey files and database. Data are only available on 50 percent (37.8 miles) of fish bearing streams in the watershed on National Forest lands.

Using this 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.

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.

8. Issue - **Sediment and Stream Temperature** - by Mark Kreiter

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.

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 many 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.

9. Issue - Aquatic Habitat Fragmentation - by Deborah Haapala

Confidence in analysis - Low

Limitation of the Analysis: This analysis was done using GIS data for road/stream crossings from the Forest Service database. 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 Upper Lewis 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: Information on culverts and whether they pass fish 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.

Data Gaps: Double checking the layers for accuracy needs closer scrutiny.

Terrestrial Vegetation Analysis - by Chiska Derr, Botanist

10. Issue: Stand Structure and Composition

Confidence: low to moderate

Discussion: Most data came from stand exams which were then extrapolated onto large GIS polylgons, producing generalized habitat characterizations. The GIS specialist estimated that more than half of the total Central Skills Center vegetation layer was based on photo interpretation, which has not been ground verified. Timber inventory data are not ecological data. Unfortunately, as the only data we have, they were used to make the ecological interpretations within this document. There was no ground verification of these numbers or categories for this analysis.

Data Gaps:

- none of the GIS stand structure or vegetation zone (ecoclass) data were field verified
- few comprehensive plant inventories have been conducted
- the LSR's, Mount Adams Wilderness and Steamboat Mountain RNA, which are presumed to provide habitat for old-growth associated species have not been inventoried for plants, lichens, bryophytes or fungi

11. Issue: Riparian Reserve Fragmentation

Confidence: moderate

Discussion: The nature of the data, and lack of field verification, lead to this rating. While data suggest that riparian reserves conditions are within historic ranges, they have not been evaluated to determine if this is true.

Data Gaps:

- baseline data on intact stream and wetland riparian functions are lacking for comparison with riparian areas whose functions we will be "restoring"
- baseline data on many riparian-dependent vascular plants and lichens, bryophytes and fungi species are lacking

12. Issue: TES and C-3 Species

Confidence: low to moderate

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

Data Gaps:

- LSR's, Mount Adams Wilderness and Steamboat Mountain RNA have not been inventoried
- few general surveys for TES species have been conducted
- very little of the watershed has been surveyed for C-3 species
- ecological and distributional data for TES and C-3 species is very sparse

Terrestrial Species Analysis - by Vaughan Marable, Wildlife Biologist

13. **Issue:** Habitat conditions for threatened, endangered, sensitive, C-3 species and cavity nesting species.

Confidence in Analysis - Moderate

Discussion: The foundation of these habitat assessments are habitat suitability models. Maps delineating suitable habitats for various species were developed by querying specific vegetation attributes. Data used to generate habitat suitability maps and indices were derived through the Forest's Geographic Information System (GIS). Much of the GIS vegetation data was produced through photo interpretation and very little of the data was developed through actual stand examinations.

In addition, no validation surveys have been conducted for the various models. For example, an assumption is made by many models that, among other things, population levels are based on suitable habitat availability. No surveys were conducted to verify species presence and densities.

One of the functions of Riparian Reserves is to serve as dispersal avenues for late-successional/old-growth (LSOG) associated species. Their ability to function is dependent on the availability and distribution of LSOG habitat. However, no assessment was conducted on the level of use occurring in these reserves.

Data Gaps:

-Verify accuracy of vegetation mapping.

-Validate suitable habitat assumption used for the analysis (populations levels for terrestrial species are based on suitable habitat availability).

-Determine the density of northern spotted owls in Lewis LSR portions of the watershed.

-Determine the extent the Riparian Reserves are being used as dispersal avenues between reserves.

-Verify suitability of habitats found in the watershed for the following species: great gray owl, peregrine falcon and lynx.

Recreation-Related Issues - by Jim Nieland, Recreation Planner

14. **Issue: Completion of Trail System and Trail Connectors**

Confidence: Moderate to High

Discussion: The Gifford Pinchot National Forest Land and Resource Management Plan, and the Gifford Pinchot National Forest Travel Management Plan identify certain additions to the forest trail system in the Upper Lewis River Watershed. These include conversion of roads to trail, and the reopening of the Lewis River Trail from Quartz Creek to the Table Mountain Trail. These trail projects will create opportunities to disperse equestrian use from the Lewis River Horse Camp, and enhance recreation opportunities by creating trail loops. A high level of public interest has been expressed in these trail improvements by Washington State and Northern Oregon horse clubs.

Data Gaps:

- Only a partial reconnaissance of the Lewis River Trail has been accomplished between Quartz Creek and the Table Mountain Trail. It is known that portions of the trail were destroyed during construction of Road 90. It is also known that there are significant portions which still exist but which have not been maintained since the 1960's. More inventory work will be needed prior to proposing trail reopening to determine where usable trail segments exist, and where new trail connecting segments will be required.

- Road to trail conversions have been well identified but additional field work will be required to locate connecting trail segments between converted roads.

APPENDIX E

VEGETATION STAND STRUCTURE DEFINITIONS

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DRAFT VEGETATION STAND STRUCTURE DEFINITIONS

Gifford Pinchot National Forest

July 1995

Text by Chiska Derr, John Haglund, and Ken Cosentino

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

Acceptable ecoclass codes for Grass/Forbes, Shrub/Seedling, Remnant Forest, Open and Closed Sapling/Pole, Open and Closed Small Tree, Large Tree Single Story, and Large Tree Multi-Storied are for coniferous forest only (codes that start with "C").

Grass/Forb

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

Shrub/Seedling

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

Remnant Forest (Light Forest)

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

Open Sapling/Pole

Early seral. Coniferous stands with an open canopy (0% to 40% cover) that are dominated by sapling and pole-sized conifers of 4.5 feet tall up to 9" dbh. A shrub dominant understory is common. Provides some forage and limited hiding/thermal cover. Condition may last from 8 to 20 years, sometimes longer, depending on tree crown closure and subsequent stand treatment.

Closed Sapling/Pole

Early to mid seral. Coniferous stands with a closed canopy (40% to 100% cover) that are dominated by sapling and pole-sized conifers of 4.5 feet tall up to 9" dbh. Ground vegetation dwindles during this stage as crowns of individual trees coalesce. Tree live crown ratios become reduced as lower limbs die back from lack of sunlight. Plant diversity is generally low at this stage as dense tree cover shades out many remaining pioneer species. A shift towards shade tolerant species may become more evident later in this structure stage. Structural diversity is also

quite low. The scarcity of ground vegetation limits forage, and crowded trees can reduce accessability of stand to wildlife for cover, but can provide some hiding cover. This stand condition can persist between 40 and 100 years.

Open Small Tree
Early to mid seral. Coniferous stands with less than 70% canopy closure AND meeting one of the following size criteria:
1) Ecoclass either western hemlock, Douglas-fir, western red cedar, or grand fir and dominated by trees with stand average dbh between 9 and 20.9 inches,
OR: 2) Ecoclass silver fir, mountain hemlock, lodgepole pine, park-like mountain hemlock/subalpine fir, or Engelmann spruce, with stand average dbh between 9 and 18 inches. The open canopy enhances understory development and wildlife forage and cover; these stands provide dispersal habitat for spotted owls. Stands with 60-70% canopy closure provide thermal cover.

Closed Small Tree
Early to mid seral. Coniferous stands with 70% or greater canopy closure AND meeting one of the following size criteria:
1) Ecoclass either western hemlock, western red cedar, Douglas-fir, or grand fir and dominated by trees with stand average dbh between 9 and 20.9 inch dbh,
OR: 2) Ecoclass silver fir, mountain hemlock, lodgepole pine, park-like mountain hemlock/subalpine fir, or Engelmann spruce, and stand average dbh between 9 and 18 inches. Poor understory development and tree density limit wildlife habitat usefulness, although some thermal cover and dispersal habitat for spotted owls is provided. Ground vegetation is minimal. Length of time in this condition may range from 40 to 100 years or even longer in high elevation stands.

Large Tree Single Story
Mid to late seral. Closed coniferous canopy (between 40% and 100%) with only one canopy layer AND one of the following two criteria:
1) Ecoclass either western hemlock, western red cedar, Douglas-fir, or grand fir and stand average dbh greater than 21 inches,
OR: 2) Ecoclass silver fir, mountain hemlock, lodgepole pine, park-like mountain hemlock/subalpine fir, or Engelmann spruce, and stand average dbh greater than 18 inches. These stands are the result of large-scale disturbances (fire, windthrow, volcanic activity, timber harvest). Their limited understory development, and lack of snag development and downed woody material limits their current quality as wildlife habitat (Hall et al. 1985), although they do provide thermal cover and dispersal habitat. These stands have excellent potential for restoration activities to mimic old-growth conditions.

Large Tree Multi-Storied
Mid to late seral. Closed coniferous canopy (between 40% and 100%) with two or more canopy layers AND one of two following size criteria:
1) Ecoclass either western hemlock, western red cedar, Douglas-fir, or grand fir and stand average dbh greater than 21 inches,
OR: 2) Ecoclass silver fir, mountain hemlock, lodgepole pine, park-like mountain hemlock/subalpine fir, or Engelmann spruce, and stand average dbh greater than 18 inches. Stand structure is high in these stands (various size and layers of trees, snags, down wood). Plant diversity is also high in many cases and strongly favors shade tolerant species. Stands of old-growth are included in this category. When this stand structure is present and Douglas-fir and western hemlock codominate, optimum wildlife habitat conditions can be met (Hall et al. 1986), including thermal cover, snow interception, and optimal nesting, foraging and roosting habitat for owls.

Hardwood Shrub/Seedling
Early seral, areas where ecoclass is a hardwood type ("H" codes). Does not include areas that are of coniferous forest climax that currently have an abundance of hardwoods. Dominated by hardwood species less than 4.9 inches dbh. Typically occurring on wet or bottomland soils and/or those closely associated with riparian areas and channel disturbance regimes. When alder is present, soil is enriched by nitrogen input. Provides good habitat for birds and

other small wildlife species. When deciduous shrubby hardwood pockets are interspersed within larger conifer stands, they provide valuable seasonal canopy gaps and enhance C-3 lichen and bryophyte habitat and diversity (Neitlich & McCune 1995).

Hardwood Sapling/Pole
Early seral. Areas where ecoclass is a hardwood type ("H" codes). Does not include areas that are of coniferous forest climax that currently have an abundance of hardwoods. Stands are dominated by young hardwood trees between 4.9 and 8.9 inches dbh; small conifers may be present, but are not dominant. Typically occuring 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 occuring on wet or bottomland soils and/or those closely associated with riparian areas and channel disturbance regimes. When alder are present, soil is enriched by nitrogen input. Important habitat for many neotropical migrant birds; provides ungulate forage and hiding cover. When pockets of deciduous hardwood saplings and poles are interspersed within larger conifer stands, they provide valuable seasonal canopy gaps and enhance C-3 lichen and bryophyte habitat and diversity (Neitlich & McCune 1995). Bigleaf maple host the largest biomass of canopy epiphytes in the Pacific Northwest (Pojar & MacKinnon 1994), and can function as epiphyte refugia as conifer development increases.

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

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

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

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