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Upper Lewis River Watershed Analysis

Gifford Pinchot National Forest
Mount St. Helens National Volcanic Monument

February, 1995

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List of Maps

List of Figures

List of Preparers

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CHAPTER I INTRODUCTION

Management direction for the National Forest lands comprising the Upper Lewis River watershed (Map 1, Vicinity Map) are set forth in the Gifford Pinchot National Forest Land and Resource Management Plan, 1990, hereafter referred to as the 1990 GPNF Forest Plan. On April 13, 1994, the 1990 GPNF Forest Plan was amended by the Secretary of Agriculture as documented in 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 is frequently called the President's Forest Plan. The Record of Decision (ROD) and its 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 provide extensive management direction, including land allocations, that comprise a comprehensive ecosystem management strategy. A major part of this strategy is the Aquatic Conservation Strategy (ROD, page B-9) which has four components (ROD, Page B-12):

1. Riparian Reserves
2. Key Watersheds
3. Watershed Analysis, and
4. Watershed Restoration

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

1. It is a Key Watershed (ROD, page B-18)
2. It is known to contain high priority watershed restoration needs associated with relatively high road densities and unstable ground, and
3. A watershed-scale analysis is needed to support proposed timber sales, timber stand improvement, and trail reconstruction work.

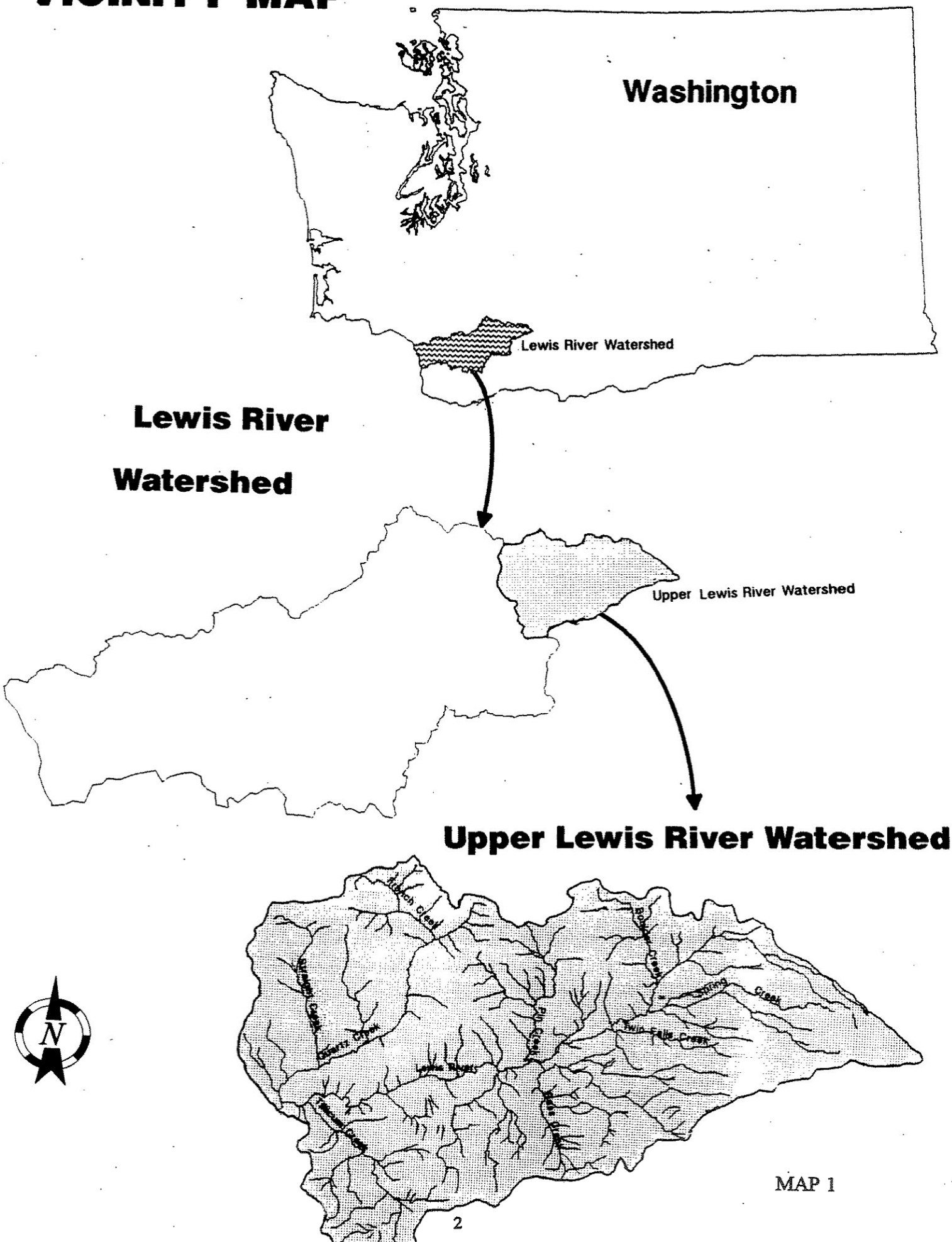
The **purpose** of this watershed analysis is to 1) develop and document an understanding of the ecological structures, functions, processes and interactions occurring within the Upper Lewis River watershed, and to 2) identify desired conditions, trends, and restoration opportunities.

The responsible official for individual, site specific projects will use this landscape scale analysis to help decide if a particular proposal or management action meets the Aquatic Conservation Strategy objectives (ROD, page B-11).

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

The scope of the analysis was defined through a process of reviewing and questioning what is currently known about the area. The team began with a broad list of key questions that were reviewed for 1) relevance to the Upper Lewis watershed, and 2) the likelihood of

VICINITY MAP



MAP 1

Reports from the Technical Specialists which elaborate the detail of their analyses are filed in the Upper Lewis River Watershed Analysis File. This File is available at the Mount St. Helens National Volcanic Monument Headquarters, 42218 NE Yale Bridge Rd, Amboy, WA 98601 and can be obtained by contacting Rick Turnbull at 360-750-3900.

answering the key question with existing data. This allowed focusing of the analysis process. It identified important information needs to be filled through the analysis and also highlighted data gaps that were outside the scope of the analysis. As the process progressed and information was gathered, some of the key questions were further refined and revised. A list of the key questions used in this analysis is provided in appendix A.

This report is organized to help readers understand how the ID team assembled and analyzed available information and arrived at conclusions and recommendations.

- Chapter II shows the Upper Lewis River Watershed's setting, i.e. basic information about land, water, vegetation, wildlife, and transportation. Applicable land allocations from the 1990 GPNF Forest Plan and the ROD are also displayed.

- Chapter III describes the current conditions in the watershed relating to ecological components and processes being examined.

- Chapter IV shows some of what is known or suspected about past conditions which have led to the present.

- Chapter V addresses the trends, i.e. the progression of conditions from the past, through the present, and into the future. The trends lead to a listing of concerns in the following chapter.

- Chapter VI lists the ecological concerns and conditions which warrant management attention in the future.

- Chapter VII shows the types of project opportunities for restoring the watershed and producing desired commodities and services.

- Chapter VIII lists data gaps and needs for further information.

- Appendix A, contains the key questions used to focus the analysis.

CHAPTER II DESCRIPTION OF THE SETTING

The Upper Lewis River Watershed is located in the southern half of the Gifford Pinchot National Forest between Mount St. Helens and Mount Adams.

The watershed covers 75,200 acres and stretches from the Mt. Adams summit on the east to the Tillicum Creek and Platinum Creek drainages in the west (see Map 1, Vicinity Map). The watershed ranges in elevation from 1,800 feet to 11,800 feet, with over 70 percent of the area above 3,000 feet.

Water Features

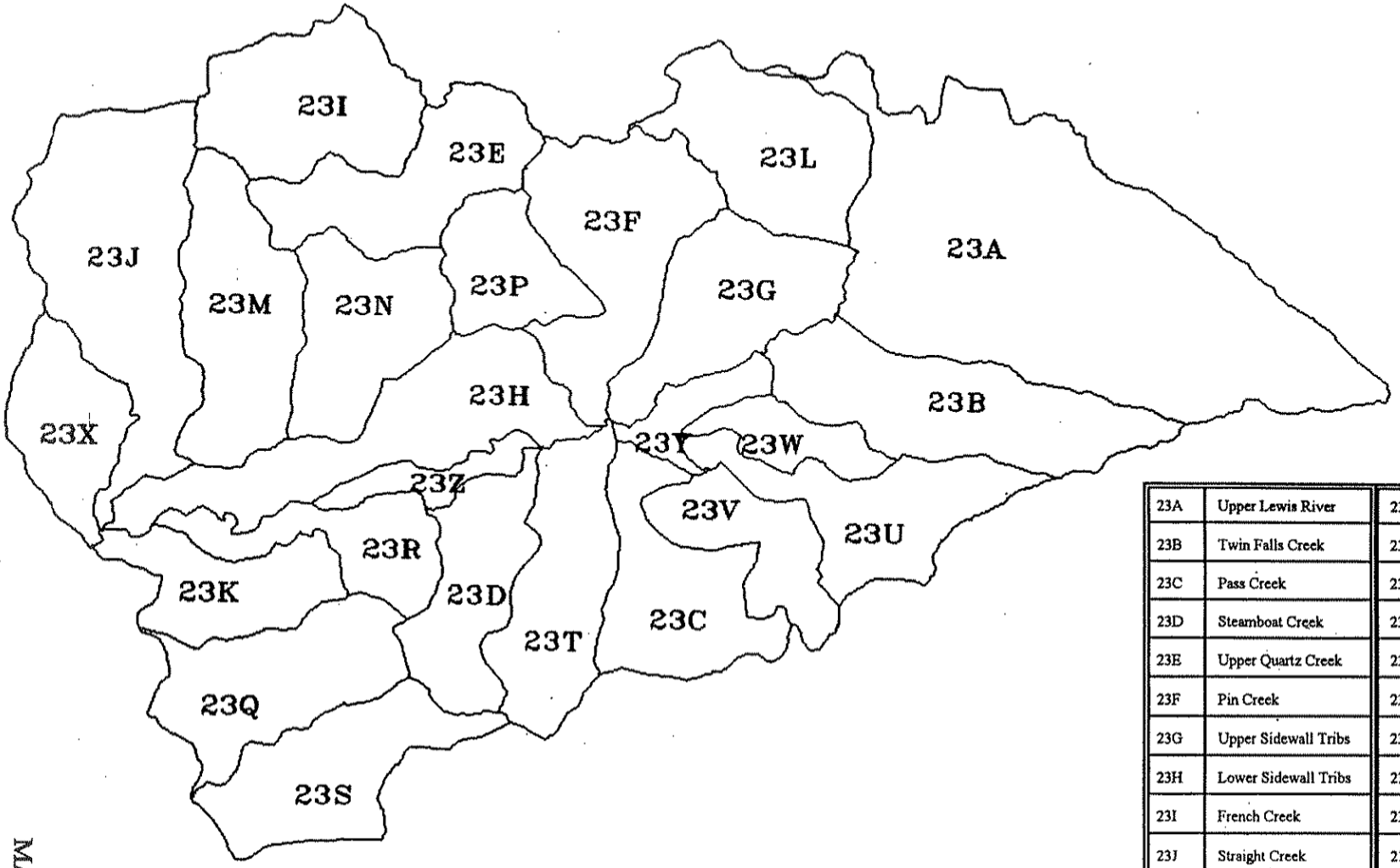
The Upper Lewis Watershed contains 25 sub-basins (see Map 2, Sub-basins). Approximately 329 miles of streams lie within those 25 sub-basins. The watershed has about 17,800 acres of riparian habitat associated with the streams. Stream types range from relatively large, fish-bearing Class I and II streams to smaller, seasonal, intermittent, feeder tributaries in the upper reaches of the drainages (Class IV). The following is a breakdown of stream class types and adjacent riparian areas within this watershed (see MAP 3, Stream Classes).

Class I and II fish-bearing	35%
Class III	35%
Class IV	30%

The Aquatic Conservation Strategy of the President's Forest Plan establishes certain lands as Riparian Reserves (ROD, page B-12). Riparian Reserves include land adjacent to streams as well as wet, moist, and unstable ground. Map 4, Riparian Reserves shows the network of riparian reserves in the watershed. These areas amount to:

Streams:	17,800 acres
Wet/Moist/Unstable	13,400 acres
Total Riparian Reserves	31,200 acres

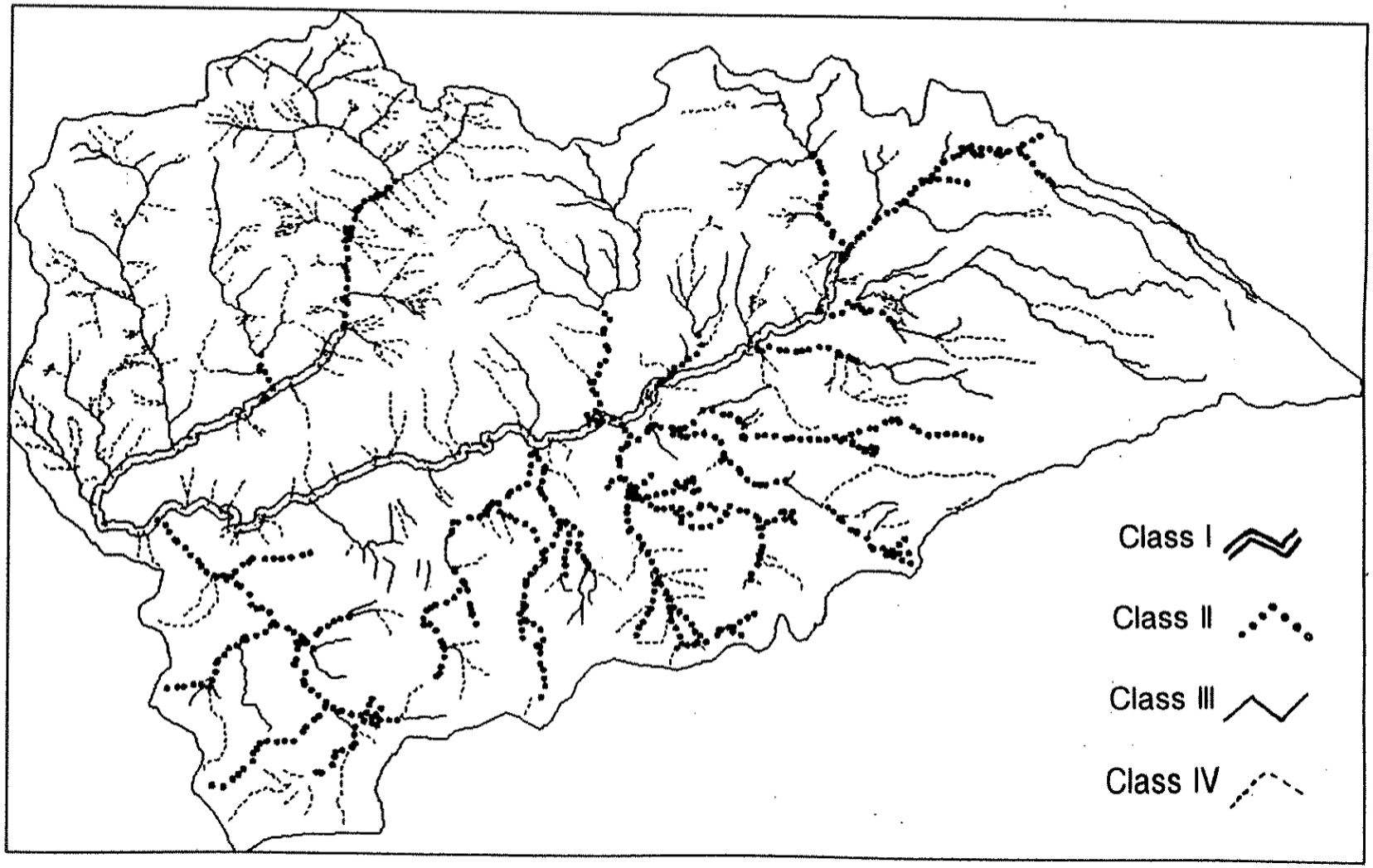
Sub-basins



23A	Upper Lewis River	23N	Middle Quartz Creek
23B	Twin Falls Creek	23P	Deer Creek
23C	Pass Creek	23Q	Middle Tillicum Creek
23D	Steamboat Creek	23R	Surprise Meadow
23E	Upper Quartz Creek	23S	Up. Tillicum/Strawberry
23F	Pin Creek	23T	Poison Creek
23G	Upper Sidewall Tribs	23U	Swampy Creek
23H	Lower Sidewall Tribs	23V	N. Fk. Pass Creek
23I	French Creek	23W	N. Fk. Swampy Creek
23J	Straight Creek	23X	Platinum Creek
23K	Lower Tillicum Creek	23Y	Upper Frontwall Tribs
23L	Boulder Creek	23Z	Lower Frontwall Tribs
23M	Snagtooth Creek		

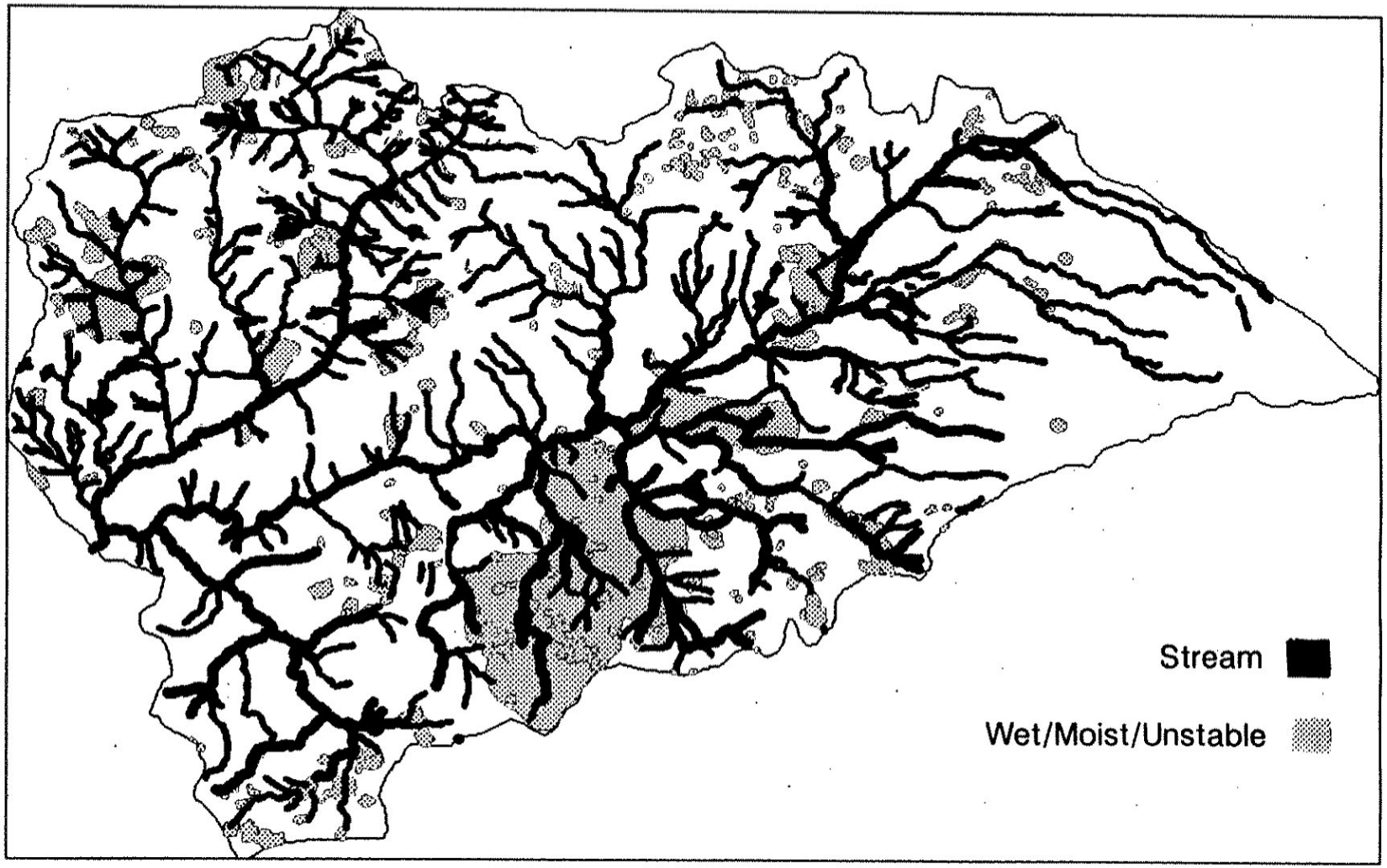
MAP 2

Stream Classes



MAP 3

Riparian Reserves



MAP 4

Vegetation

Plant Community Summary:

Vegetation Zone	Watershed Acres (%)	Major Species Overstory	Understory
Western Hemlock (low elevations)	6,768 (9%)	Western hemlock, Douglas-fir, Western red cedar	huckleberry, salal, Oregon grape, vine maple
Pacific Silver Fir (mid elevations)	58,656 (78%)	Douglas-fir, Western hemlock, Pacific silver fir	huckleberry, Oregon grape, beargrass
Mountain Hemlock & Subalpine Fir (high elevations)	7,520 (10%)	Pacific silver fir,	huckleberry, bear-grass, Cascades azalea
Nonforest/Shrub	2,256 (3%)	Species data unavailable	
Total	75,200 (100%)		

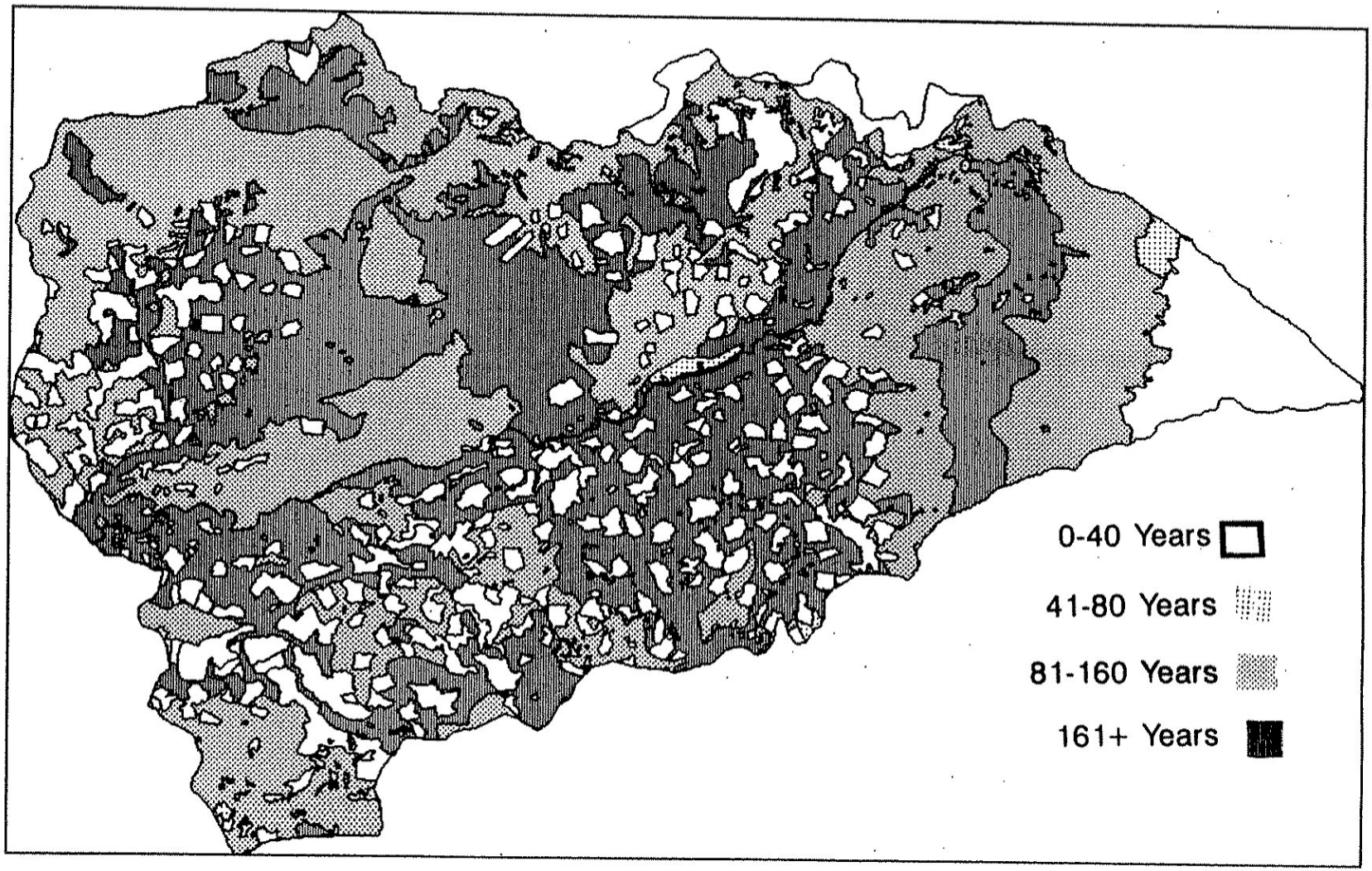
Seven Sensitive plant species have been located within the Western Hemlock, Pacific Silver Fir, and Mountain Hemlock zones. These include Green-fruited sedge, Intermediate bladderwort, Fringe pinesap, Branching montia, Bog microseris, Lance-leaved Moonwart, and Moonwart.

Forested Areas: Age Class Summary

Age Class (years)	Acres	Percent of Watershed
Non-Forest	2,258	3%
0-40	12,486	17%
41-80	618	1%
81-160	31,079	41%
161+	28,759	38%
Total	75,200	100%

The distribution of these age classes is shown on Map 5, Age Classes.

Age Classes



MAP 5

Spotted Owl Habitat

Approximately 70 percent of this watershed is comprised of suitable spotted owl habitat, of which 50 percent is considered nesting/roosting/foraging habitat and 20 percent is dispersal habitat. The remaining 30 percent of the watershed is considered non-suitable habitat.

Roads

The Upper Lewis River watershed contains 236 miles of roads (density of 2.01 miles per square mile), and 51 miles of trails. The roads within this watershed include local, low-use roads, collector roads, and arterial highways. The majority are local roads. Road densities are greater south of the Lewis River than they are in the north due to the concentration of timber harvest and local road construction in that area (see Map 6, Roads and Managed Stands).

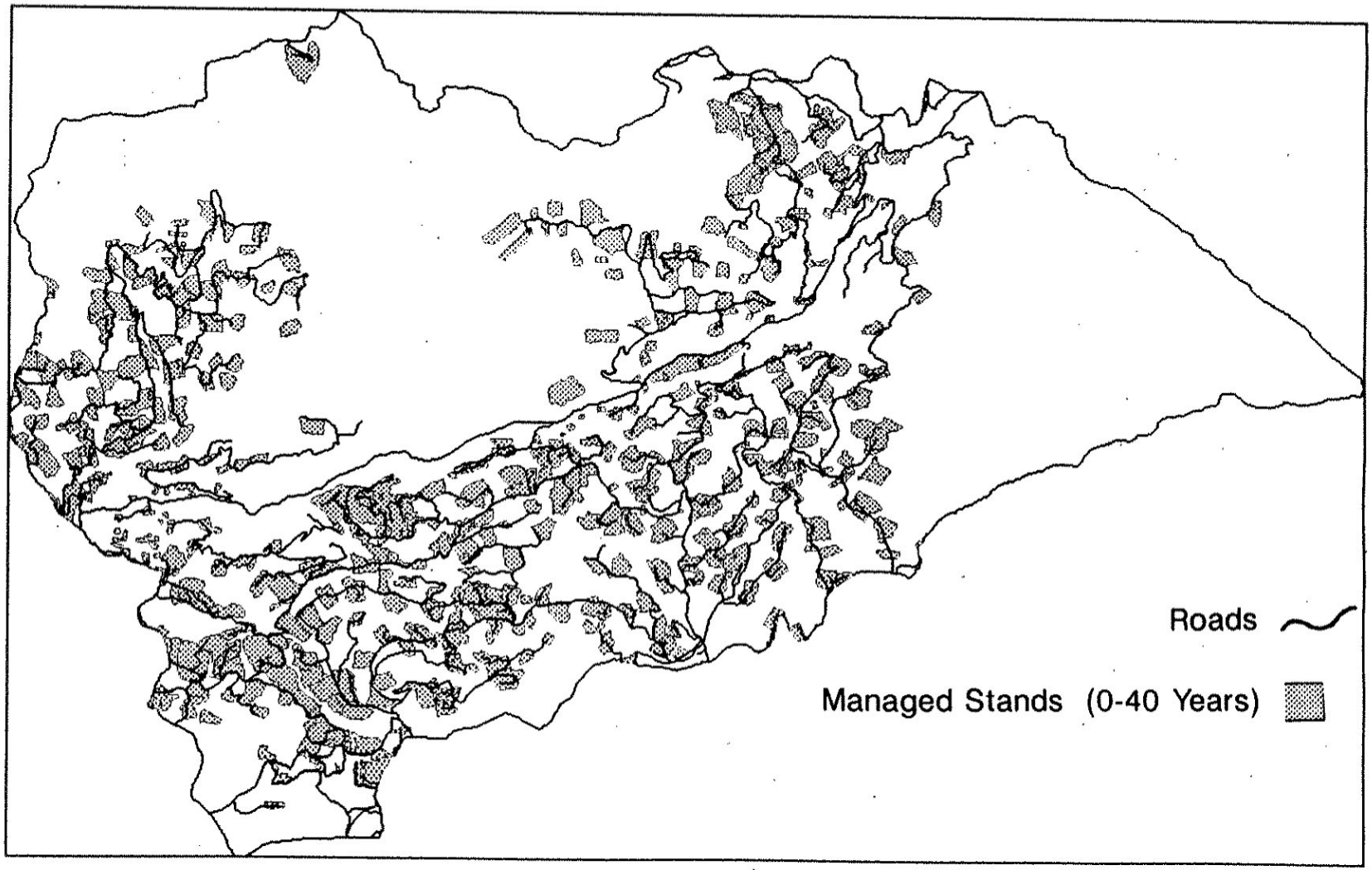
President's Forest Plan

Lands in the Upper Lewis Watershed are allocated as follows in the Presidents Forest Plan:

Late Successional Reserves	32,993 acres	44%
Matrix	30,837 acres	41%
Wilderness	10,634 acres	14%
Research Natural Area	736 acres	1%
Total	75,200 acres	100%

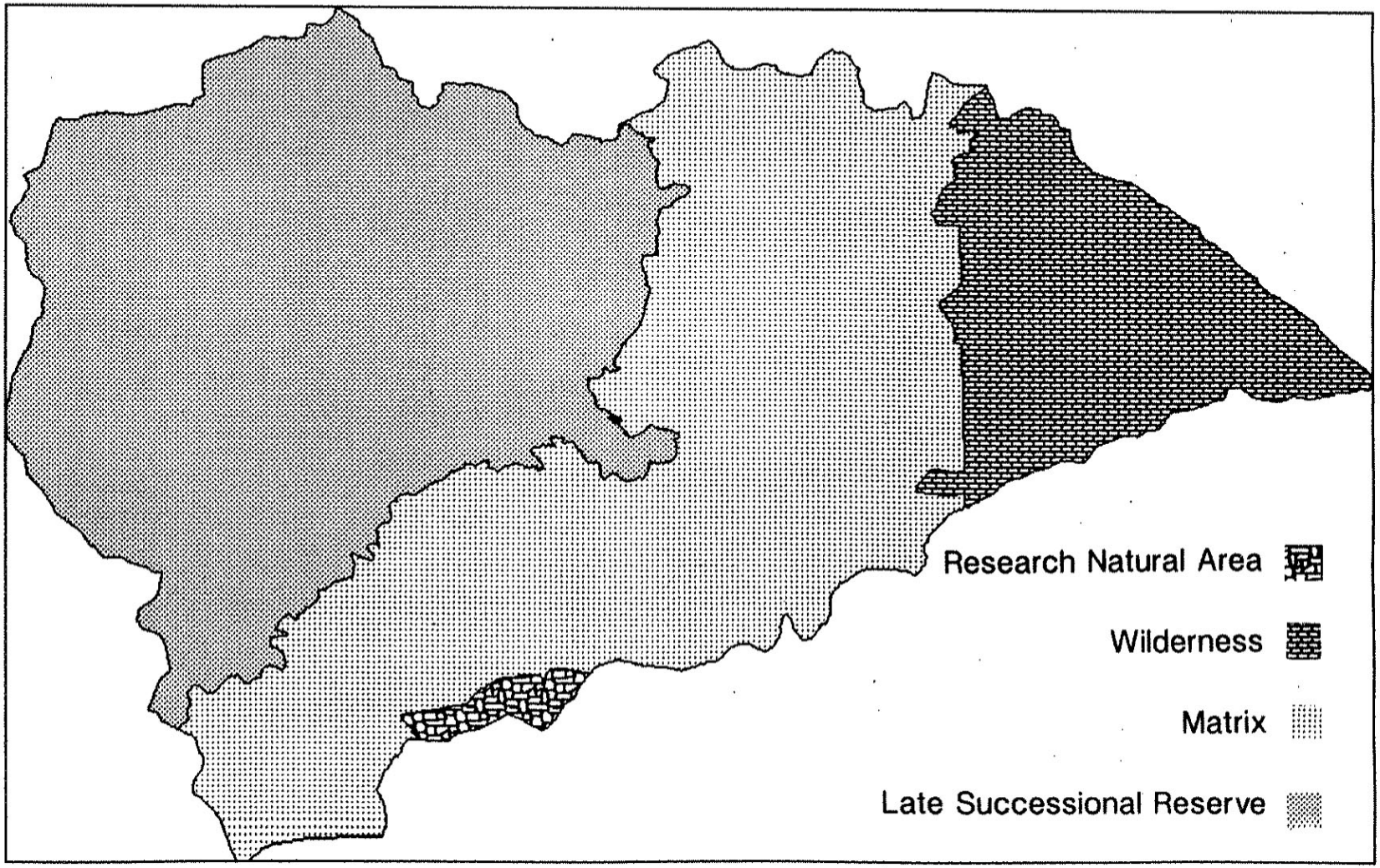
The distribution of these allocations is shown on Map 7, President's Forest Plan Allocations.

Roads and Managed Stands



MAP 6

President's Forest Plan Allocations



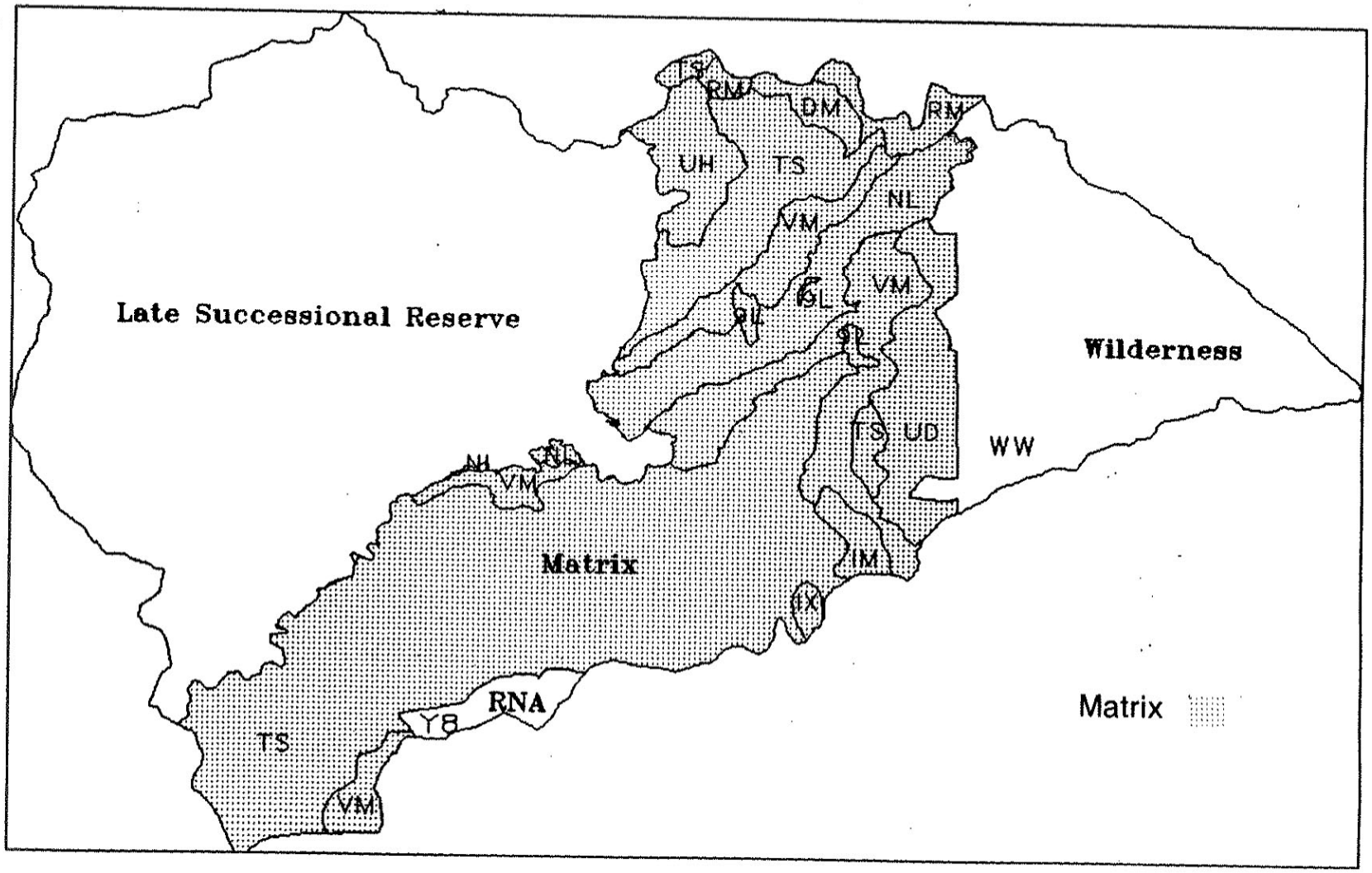
MAP 7

1990 Gifford Pinchot National Forest Plan

The 1990 GPNF Forest Plan allocates lands by various Management Area Categories (MACs) (see page Plan IV-91). The MACs are shown on Map 8, Gifford Pinchot National Forest Land Management Plan Allocations In The Matrix. Note that the MACs are not shown for the area covered by the Late Successional Reserve (LSR) allocation from the President's Forest Plan. The LSR allocation supersedes the 1990 GPNF Forest Plan MACs in this area. The following is a list of the MACs and their reference codes within the Upper Lewis Watershed.

Timber Emphasis - TS
Visual Emphasis - VM
Roaded Recreation - RM, DM
Unroaded Recreation - UH, UD
Wild/Scenic River - NL
Wildlife Special - IM, IX
Research Natural Area - Y8
Wilderness - WW
Special Interest - 9L

Gifford Pinchot National Forest
Land Management Plan Allocations
In The Matrix



MAP 8

CHAPTER III - CURRENT CONDITIONS

Unstable Areas/Mass Wasting and Surface Erosion

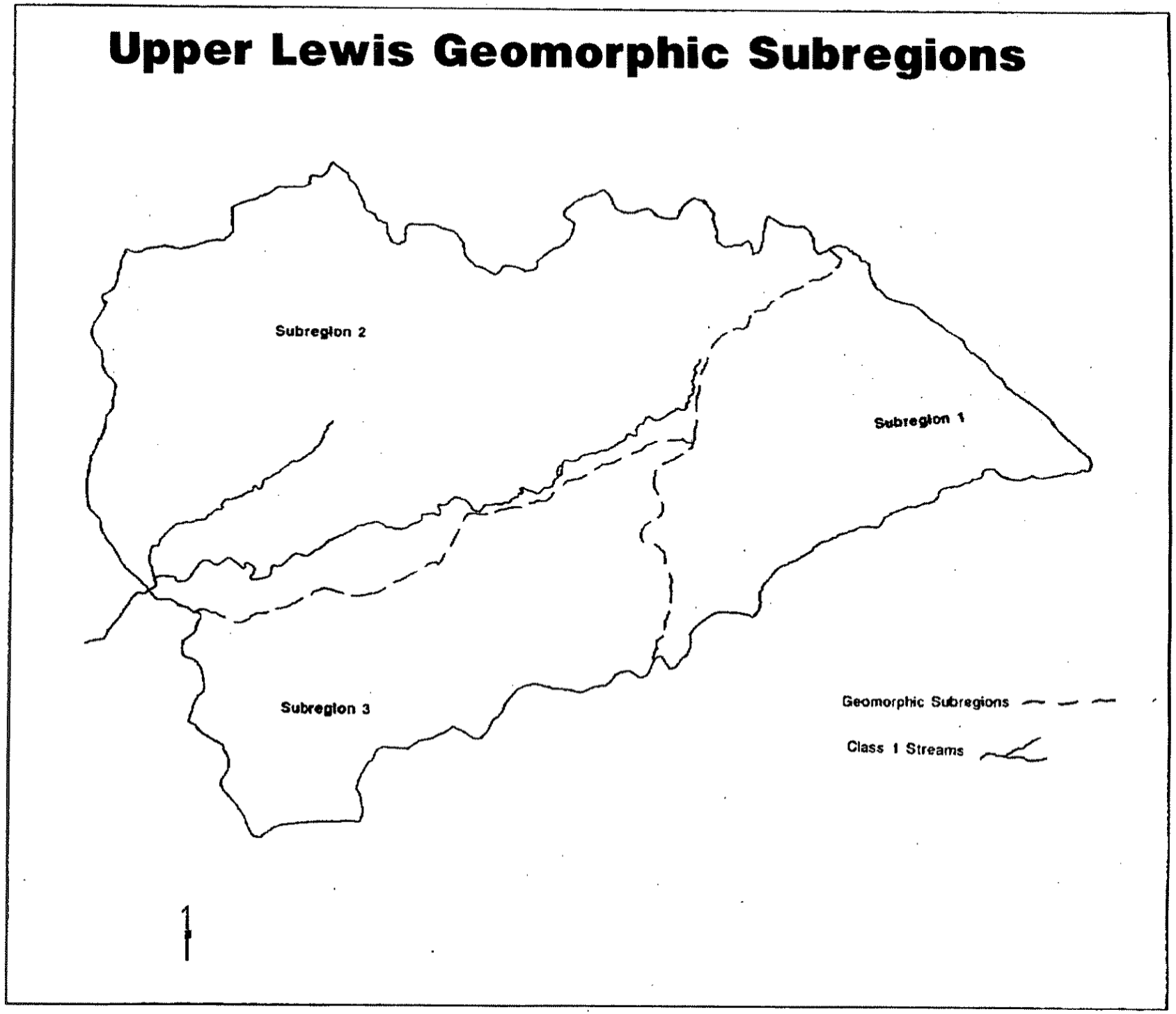
The Upper Lewis River drainage can be divided into 3 geomorphic sub-regions as shown on Map 9, Upper Lewis Geomorphic Sub-regions. The sub-regions are described as 1) recent volcanic/ glacial deposits - flanks of Mt. Adams; 2) steep, older andesitic and pyroclastic flows; and 3) unstable sedimentary deposits / wetland dominated.

The recent volcanic /glacial deposits on the flanks of Mt. Adams are moderate to gentle slopes with few areas of instability or surface erosion problems. The steep, older andesitic and pyroclastic flows consist of the area from the flood plain of the Lewis River North to the top of the drainage. The materials here are interbedded andesitic and pyroclastic flows. There are numerous shallow failures within this area that have been mapped through air photo interpretation, previous mapping and ground verification. Surface erosion especially on the steeper ground and in areas where ground cover has been removed is a concern. See Map 10, High Surface Erosion Potential. The third area is south of the Lewis River flood plain and is characterized by large deep seated slides with numerous active shallower slides within the area of mass movement. See Map 11, Landslide Inventory Map.

Slope instability in the Lewis River Basin has been split into various types, including:

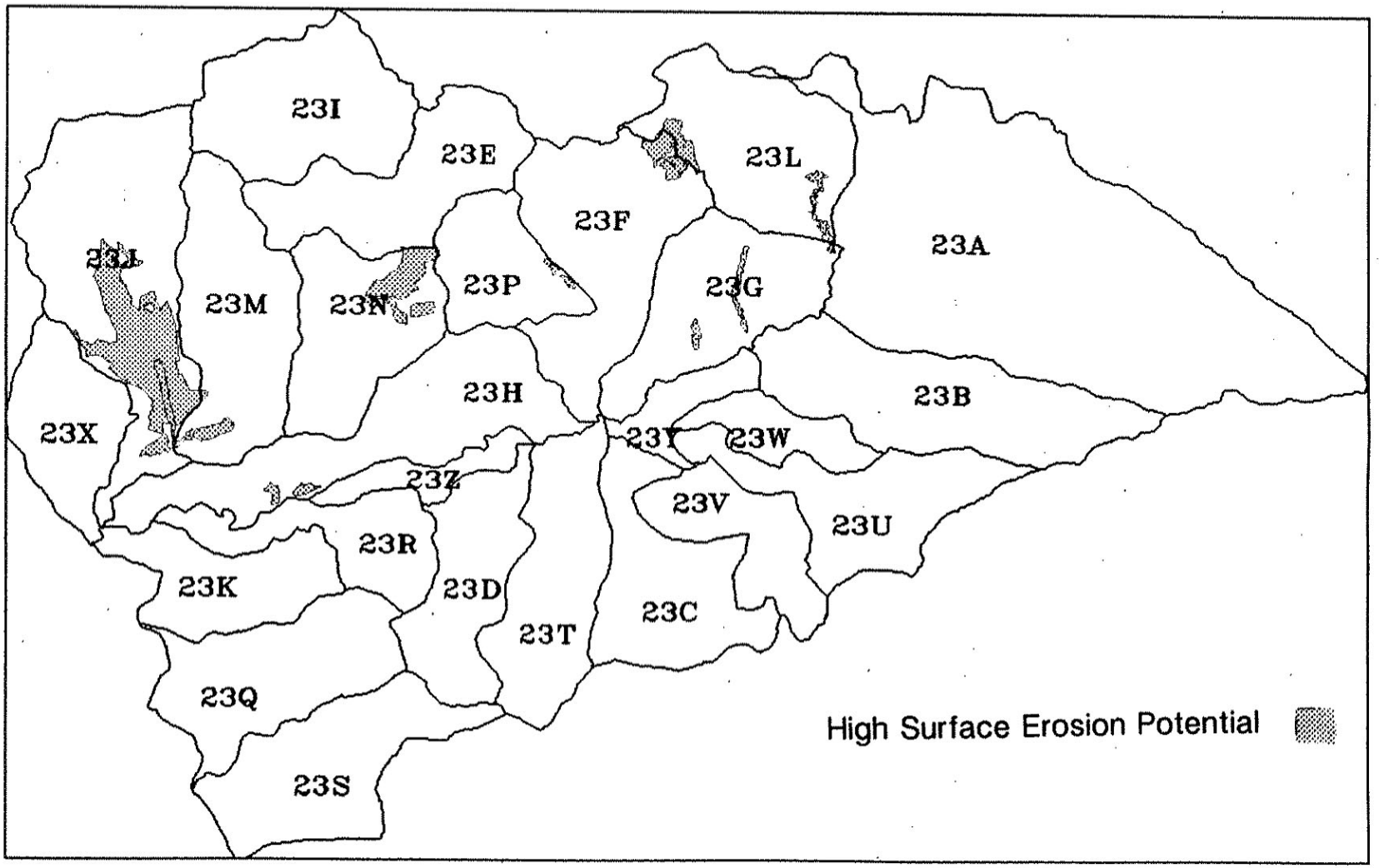
1. Slides; active and formerly active
2. Flows (debris flows and torrents)
3. Avalanche
4. Road related (sidecast, fill and cutslope).

Road instability such as fill and sidecast failures in the watershed create sedimentation problems especially during large storm and rain on snow events. A detailed road inventory is ongoing to provide data needed to better evaluate the effects of roads on streams.


Upper Lewis Geomorphic Subregions
Subregion 2
Subregion 1
Subregion 3
Geomorphic Subregions
Class 1 Streams

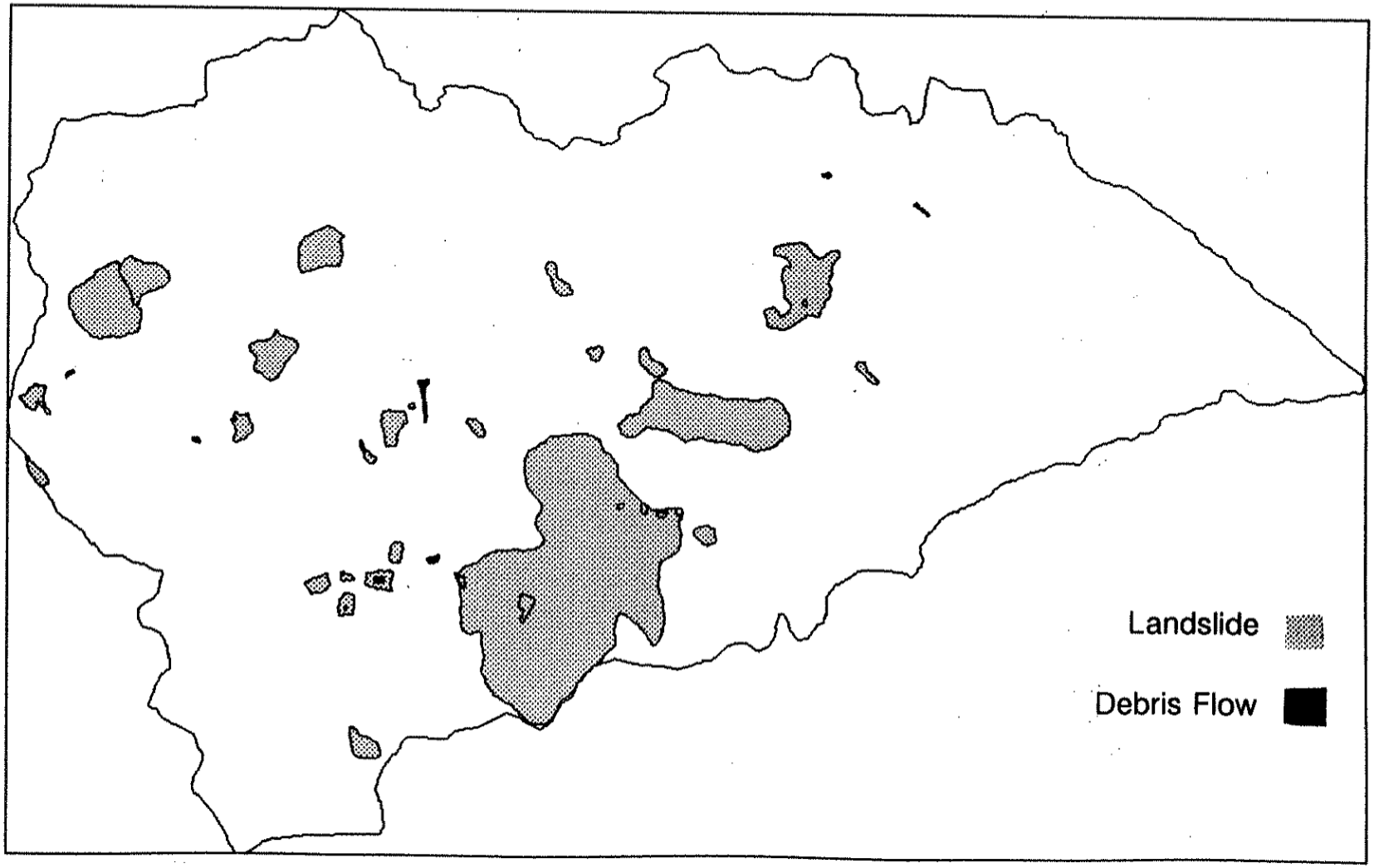
MAP 9

High Surface Erosion Potential



MAP 10

Landslide Inventory



MAP 11

Unstable Channels

The majority of stream channels in the analysis area are characterized as "transport" reaches, having relatively high gradients and confined channels that tend to move input variables such as wood, water, and sediment through quickly (see Figure 1, Transport vs. Response Reaches). Changes to the amounts of these input variables are most noticeable at low gradient, less confined sections (called "response" reaches) of the Lewis River upper basin.

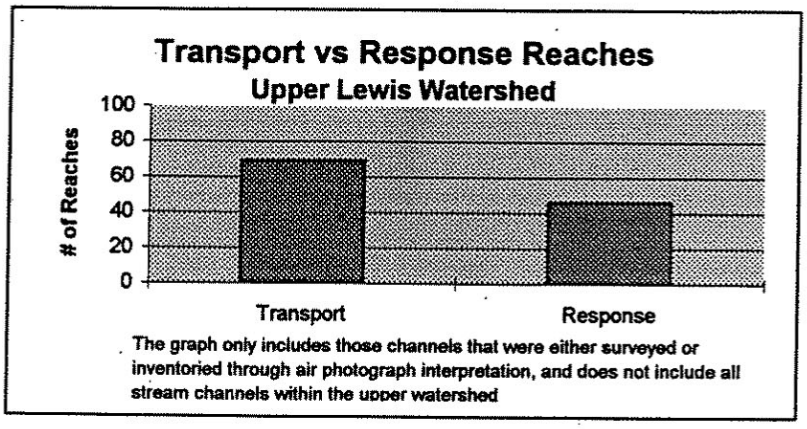


Figure 1 Transport vs. Response Reaches

The following observations of response reaches were made from pre-1959, 1959-1979, and 1979-1984 aerial photos:

- 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.

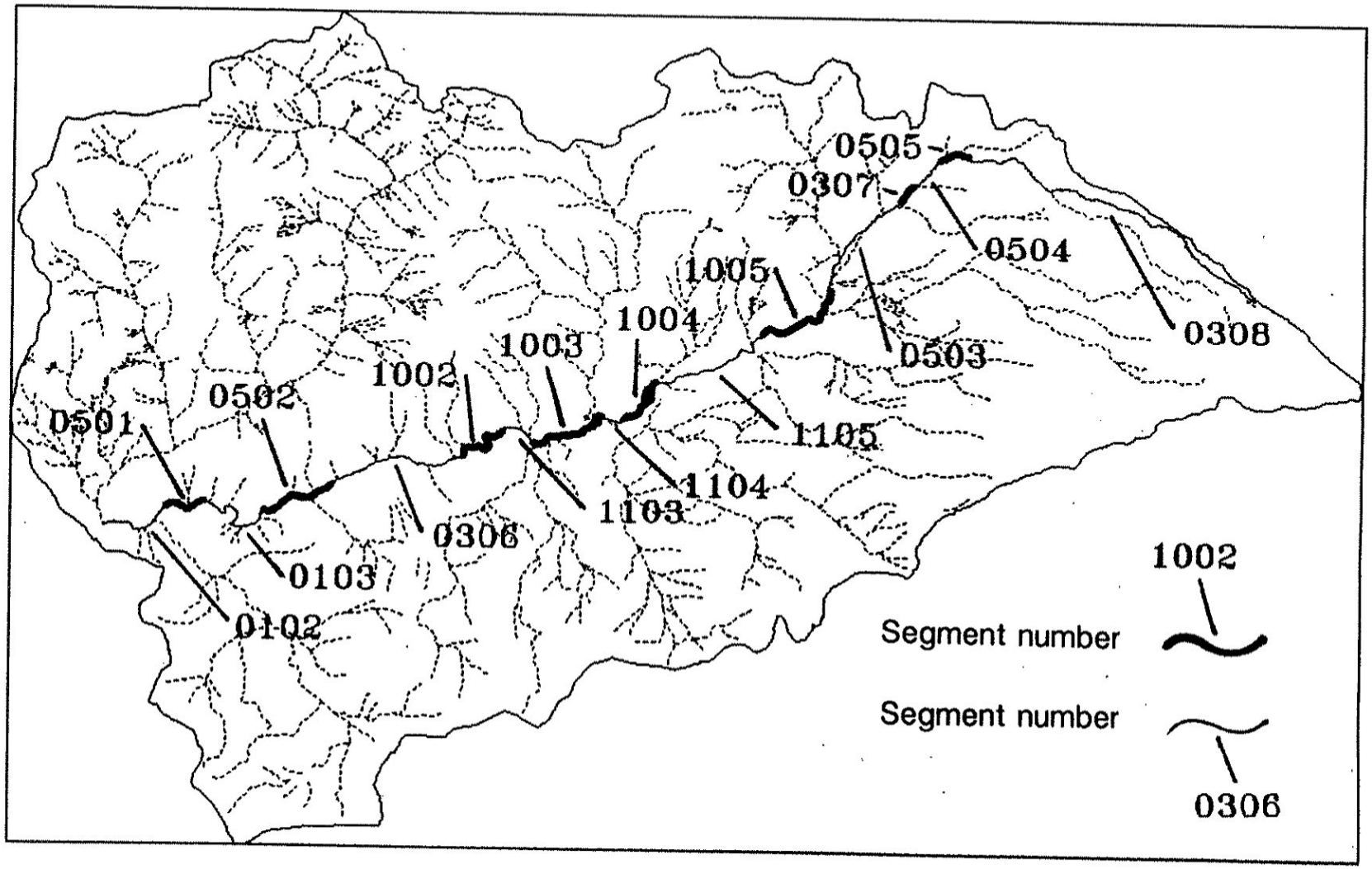
- Reach #1003 (See Map 12, Lewis River Stream Segments) on the Lewis River is recovering very slowly from a large pulse of sediment that occurred in the 1970's. This slow recovery may be due in part to continued sediment contribution from roads in the Steamboat Creek, Poison Creek, Pass Creek, and Swampy Creek areas.

- 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 recovering very slowly from a large pulse of sediment that occurred in the 1970's.

- Reach #1002 (See Map 12, Lewis River Stream Segments) 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.

Lewis River Stream Segments



MAP 12

In addition to observations made from air photos concerning current 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 channels on the Forest, due mostly to unstable lower and upper banks.

- 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.

Peakflow

A qualitative peakflow analysis was conducted according to the Gifford Pinchot National Forest Watershed Analysis Handbook. The procedure assigns a "level of concern" and "sensitivity" to the sub-basins in the watershed. The level of concern uses current vegetative conditions and amount of compaction as a measure of humans' ability to increase peakflows. The sensitivity portion of the analysis uses basin elevation and aspect to determine the likelihood of that basin having rain on snow events.

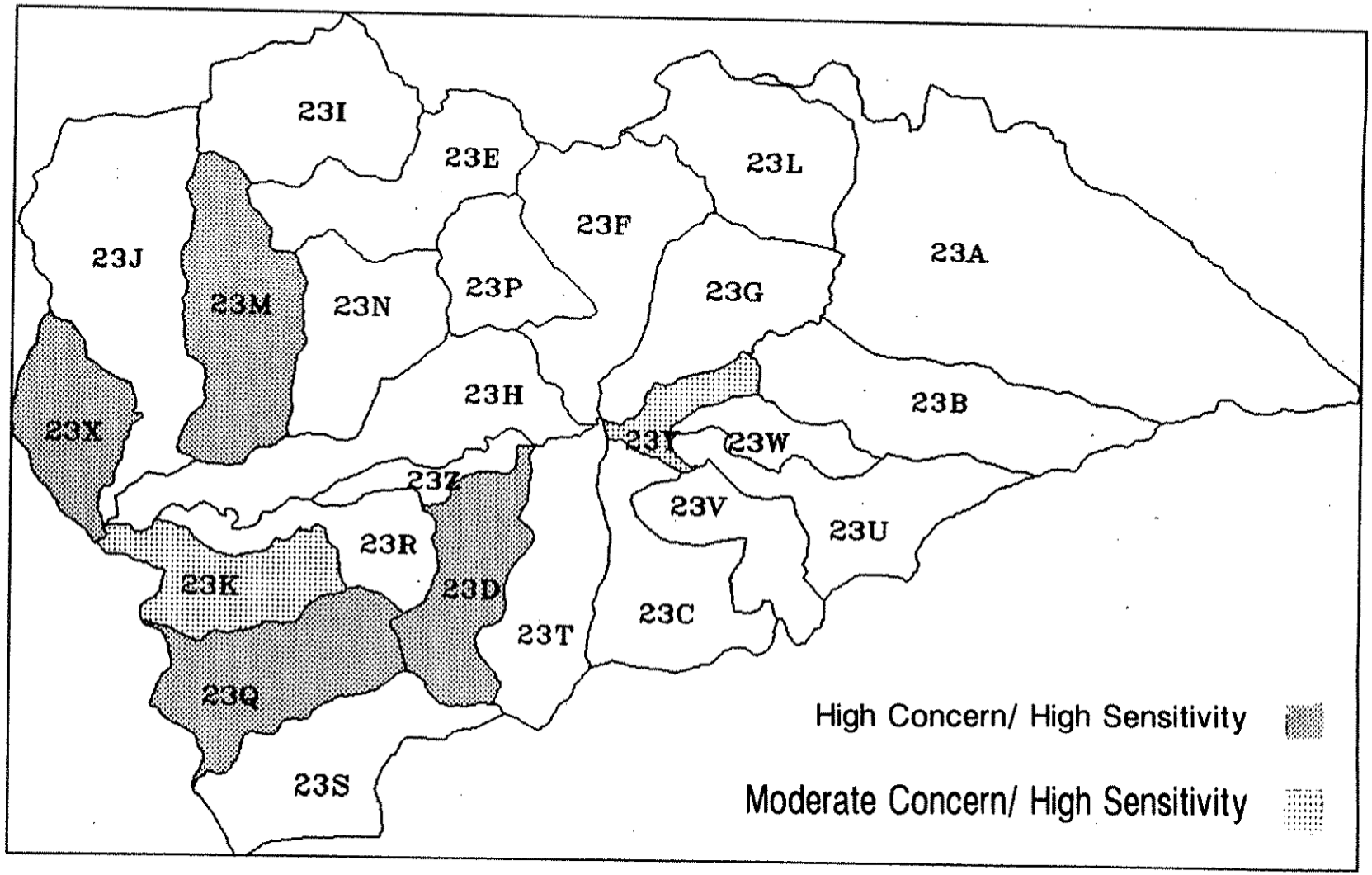
Following are results of this analysis.

- Sub-basins 23D, 23Q, 23M, and 23X have a high level of concern due to past timber harvest and road construction, and a high sensitivity due to basin elevation and aspect (see Map 13, Peak Flow).

- Sub-basins 23D and 23X have unstable channels (see channel section) that may be sensitive to increased peakflow.

- Sub-basins 23K and 23Y have a moderate level of concern due to past timber harvest and road construction, and a high sensitivity due to basin elevation and aspect (see Map 13, Peak Flow).

Peak Flow



MAP 13

Another component of the peakflow analysis is the extension of the stream channel network by roads and ditchlines in roads. These factors may increase peakflows through road cutslope interception of subsurface flow and routing it to surface waters using road ditchlines as pseudo-channels. The following increases in the channel network were calculated.

- Sub-basin 23C had a 12-30% increase in length of the stream channel network due to roads
- Sub-basin 23D had a 12-30% increase in length of the stream channel network due to roads
- Sub-basin 23V had a 15-37% increase in length of the stream channel network due to roads
- Sub-basin 23W had a 13-32% increase in length of the stream channel network due to roads

Vegetation Age Class/Pattern Distribution/Diversity

The primary difference between the past and present forest succession in the Lewis River watershed is the distribution of disturbance over the watershed. Historic disturbances have been large scale (over 5000 acres) and catastrophic in their effects. These large scale disturbances have generally been contiguous over the landscape with long time periods (centuries) in between

During the last fifty years, timber harvest and road construction have systematically created many small openings totaling approximately 12,000 acres.

Map 14, Vegetation Zones shows the four vegetation zones in the Upper Lewis River watershed.

Western Hemlock Zone (9% of the watershed) includes the Lewis River valley and adjacent low elevation slopes. This zone is the most productive for vegetative growth.

Pacific Silver Fir Zone (78% of the watershed) includes the mid to upper elevations.

Mountain Hemlock and **Subalpine Fir Zones** (total about 10% of the watershed).

Approximately 3% of the watershed is in nonforest/shrub lands.

The pattern, structure, and composition of vegetation in the watershed have been shaped mostly by historic wildfire and by timber harvest since the 1960's.

Approximately 84% of the watershed includes natural stands over 80 years in age which were originated from wildfires. In the Western Hemlock and Pacific Silver Fir zones these

natural stands tend to cover broad, contiguous areas. The Mountain Hemlock and Subalpine Fir zones have had more isolated fires, and natural stands are much smaller in scale. Natural stands tend to be structurally-complex, with remnants from previous stands including green trees, standing dead trees, and down logs.

Since the 1960's, approximately 17% of watershed forested lands have been clearcut and regenerated.

Sub-basins having more than 25 percent of their area in managed stands (less than 40 years of age) include:

23R Surprise Meadow (95 percent)
23Z Lower Front Wall (54 percent)
23Q Middle Tillicum Creek (44 percent)
23D Steamboat Creek (40 percent)
23X Platinum Creek (38 percent)
23C Pass Creek (28 percent)
23T Poison Creek (27 percent)
23V North Fork Pass Creek (27 percent)

The managed stands developed from harvest and broadcast burning contain small amounts of large-size green trees, snags and down logs.

Approximately 40 percent of the watershed includes stands over 160 years in age.

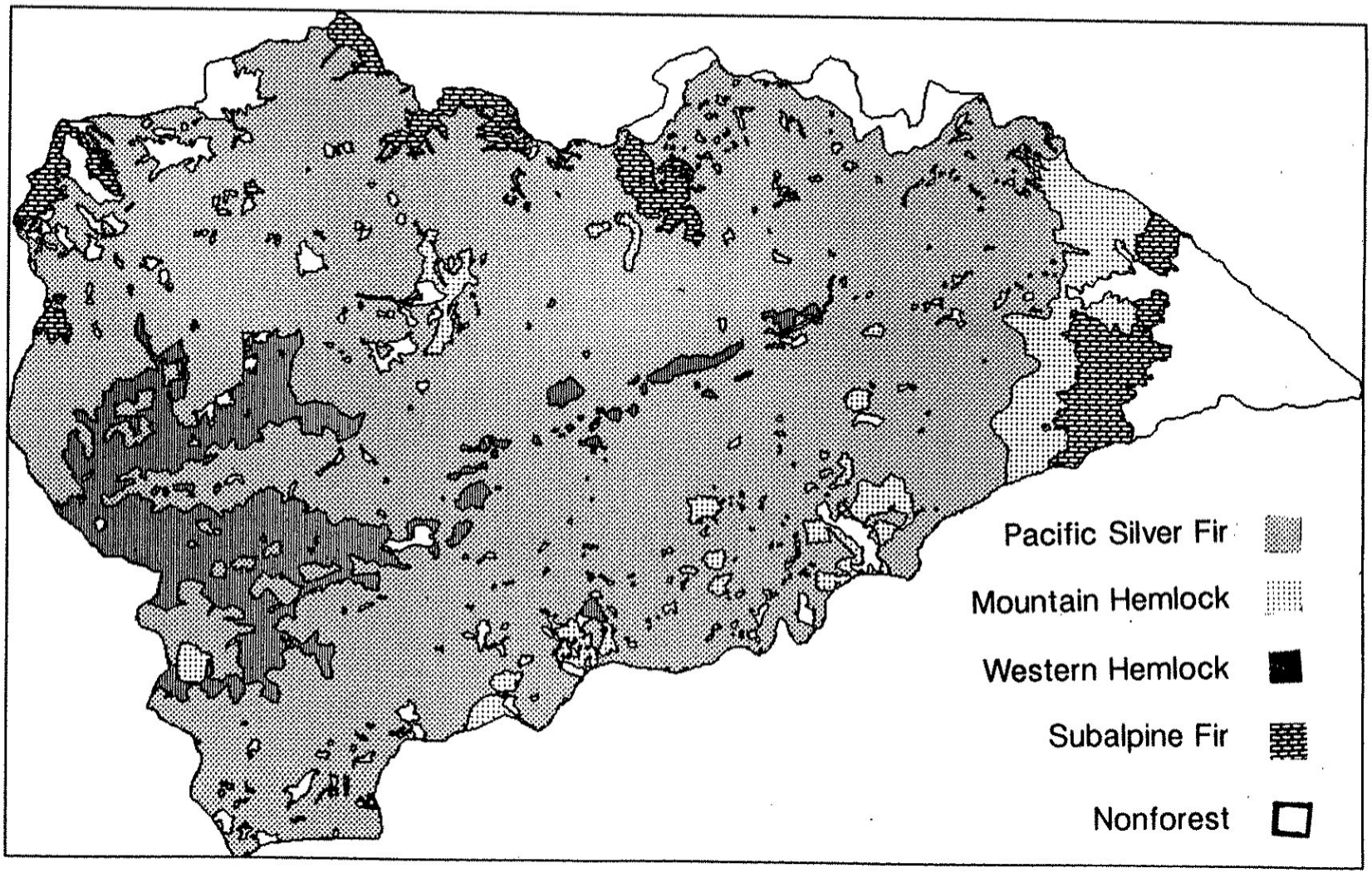
There are several stands of very old, large trees distributed throughout the lower and mid slopes of the watershed. These trees are 500+ years old and have diameters reaching 80+ inches. The most prominent of these diverse old stands occur in the Poison Creek, Quartz Creek, and Pass Creek sub-basins and along the Lewis River valley bottom.

Approximately 5% of the watershed consists of specialized botanical areas including talus, rock outcrops, wetland meadows and marshes. There is a large contiguous area north and west of Steamboat Mountain that is unstable and active and has a high number of small drainages and springs. This area contains stands of Western red cedar, Engleman spruce, and Western white pine. The subalpine and mountain hemlock zones also contain many unique plant microsite communities.

Noxious and other non-native weeds (tansy ragwort, Canada thistle, and others) have been identified in many of the timber harvest areas and along the roads. Many of these have become established and are spreading through natural means such as by wind and by wildlife.

Vegetation in the riparian reserves has been shaped mainly by mass movement, channel disturbances and high water levels. Recently disturbed areas tend to have high proportions of red alder, black cottonwood and other hardwood trees and shrubs.

Vegetation Zones



MAP 14

Along the Lewis River and around larger tributaries and lakes, the riparian influence on vegetation ranges up to hundreds of feet. In the upper reaches of Class III and IV streams terrestrial plant communities are often dominant right to the channel edge.

Geologically unstable areas (such as the large area north and west of Steamboat Mountain) generally support unique plant communities. The frequent movement and associated high water table allow competitive advantage to early successional and water-associated species. Western red cedar and Englemann spruce are commonly found on many of these unstable sites.

Threatened, Endangered, and Sensitive Plants

No populations of rare or endangered plant species are known to exist in the Upper Lewis River Watershed. Of the fifty-two species currently on the Gifford Pinchot's National Forest list of sensitive plants, over half of these species have potential to occur on the watershed. Populations of the following seven species have been documented in the watershed: Green-fruited sedge, Intermediate bladderwort, Fringe pinesap, Branching montia, Bog microseris, Lance-leaved moonwart, and Moonwart.

Wildlife

Approximately 252 terrestrial vertebrates and aquatic amphibians are believed to spend a portion of time in the Upper Lewis River Watershed. These species were grouped into life history guilds base on similar landscape habitat use patterns (Mellen et.al 1993) (see analysis file for guilds). Information is not available to verify the actual presence of all species. Because the spatial relationship model was not available, existing acres for each life history guild were not calculated. However, habitat for several guilds were subjectively assessed using five general habitat types as follows:

Habitat Type	Acres	Percent of Watershed
Early Seral Forest	12,742	17
Mid-Seral Forest	30,515	40
Late Seral Forest	27,713	37
Riparian Habitat	14,000	19
Special Habitat	6,218	8

Note: These habitat types overlap to some degree so the total will not equal 75,200 acres nor will percentages equal 100.

Habitat Condition

Early seral forest covers 17 percent of the Upper Lewis Watershed. Early seral forest stands range from 0-40 years and with an average stand diameter from 0-9 inches. Because of the relative abundance of small patches of early seral forest, (< 60 acres) ample habitat for species such as common garter snake, Pacific jumping mouse, and white crown sparrow is available. The existing condition is not conducive, however, to species like badgers, merlin falcons, and magpies which require larger patches of early seral forest (> 60 acres).

Mid-seral forest covers about 40 percent of the Upper Lewis Watershed. Mid-seral stands range from 41-160 years with an average stand diameter of 10-20 inches. This habitat type is relatively abundant for species such as brown creeper, hermit warbler and Townsend's warbler.

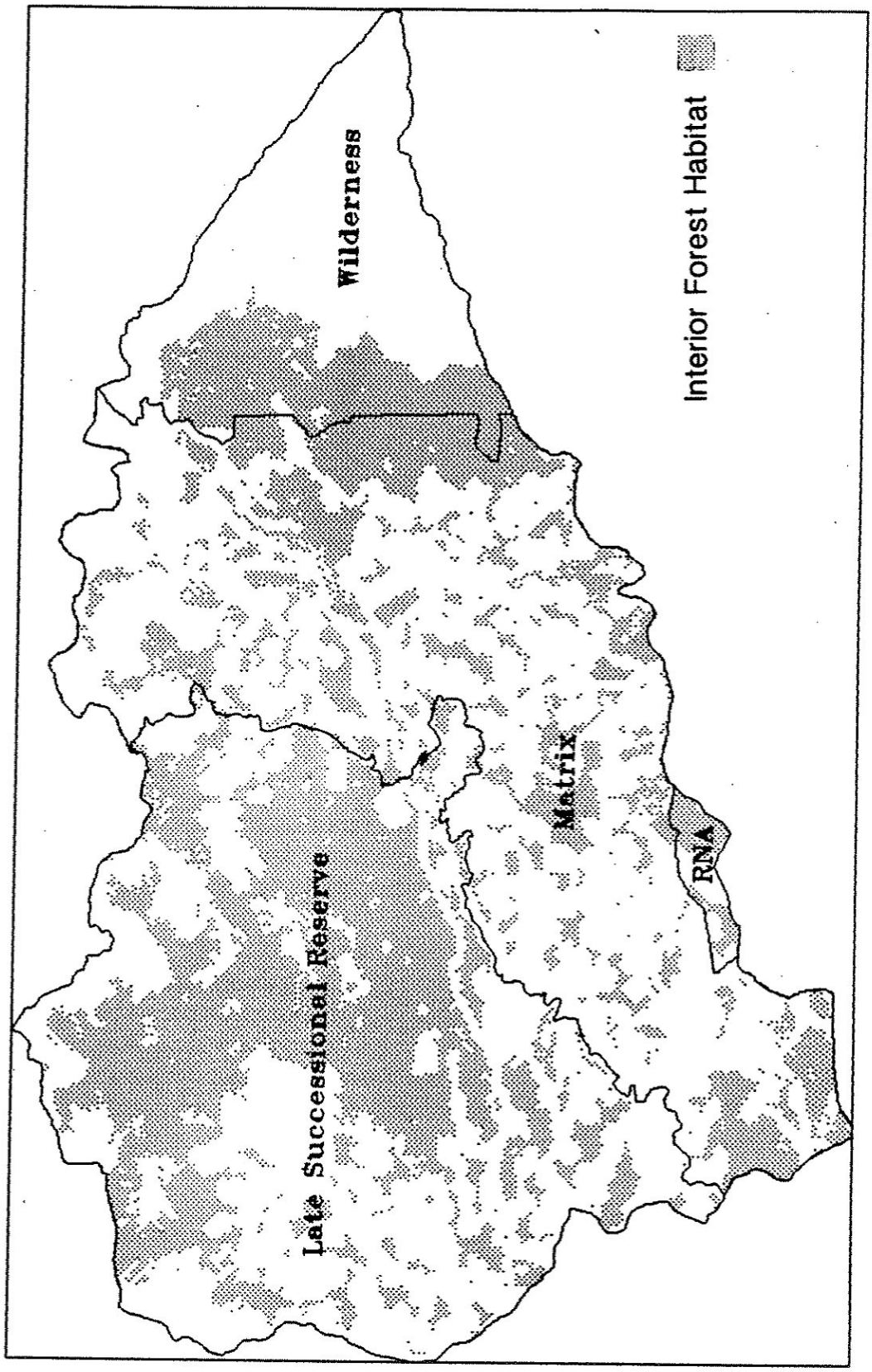
Late seral forest covers about 37 percent of the Upper Lewis Watershed. Late seral forest stands are 161+ years with an average stand diameter greater than 21 inches. Much of the late seral habitat in this watershed has been fragmented over the last several decades through timber harvesting and road construction. So, even though a relatively high percentage of late seral forest exists, its spatial distribution has decreased its overall effectiveness. As a result, there is abundant level of habitat for species associated with late seral forest with small and medium home ranges (e.g. northern flying squirrel, Pacific slope flycatcher). But habitat for those species with large home ranges, including spotted owl, pileated woodpecker, northern goshawk, America marten, fisher, California wolverine and barred owl, may be limited in the Upper Lewis River waters as well as the Lewis River basin.

Interior forest habitat has undergone conversion that has left it highly fragmented. The vast majority of the interior habitat is located within designated reserves (late successional reserves, wilderness) with relatively small blocks existing in the forest matrix. See Map 15, Interior Forest Habitat.

Riparian habitat covers about 19 percent of the watershed and consists of early, mid and late seral forest. Four sub-basins (23D, G, T, and V) within the Upper Lewis Watershed are providing less than adequate riparian habitat for species such as the red legged frog, Cascade torrent salamander, and Van Dykes salamander. (An assumption was made that if 80% of the riparian stands were late seral forest then an adequate level of habitat would be available.)

Several special habitats were identified in the Upper Lewis Watershed which include wetlands, talus slopes, rock outcropping and cliffs. These habitats are important to the conservation of several endangered and sensitive species. Worth noting are the cliffs in sub-basin 23L Boulder Creek that could potentially serve as nesting habitat for peregrine falcon and caves in sub-basin 23X Platinum Creek that serve as a hibernaculum for Townsend's big-eared bat.

Interior Forest Habitat



MAP 15

Populations

The Upper Lewis River provides important habitat for species associated with late seral forest including the spotted owl, Larch Mountain salamander, Townsend's big-eared bat and possibly gray wolves.

The Upper Lewis Watershed has not been completely surveyed for spotted owls. So the total owl population within the watershed is unknown. However, 24 owl site centers are recognized (15 sites in the LSR portion of the watershed, 9 sites in the forest matrix). Two owl home ranges, one located in the LSR (sub-basin 23M Snagtooth Creek) and the other in Matrix (sub-basin 23U Swampy Creek), are below "take" thresholds set by the USDI Fish and Wildlife Service. These owls do not have enough high quality habitat within their home ranges to remain a viable, successfully reproducing pair. Map 16, Spotted Owl Habitat, shows the distribution of spotted owl habitat within the watershed. Furthermore, 1374 acres of Critical Habitat Unit WA-38 overlaps forest matrix in sub-basins 23F, G and Y.

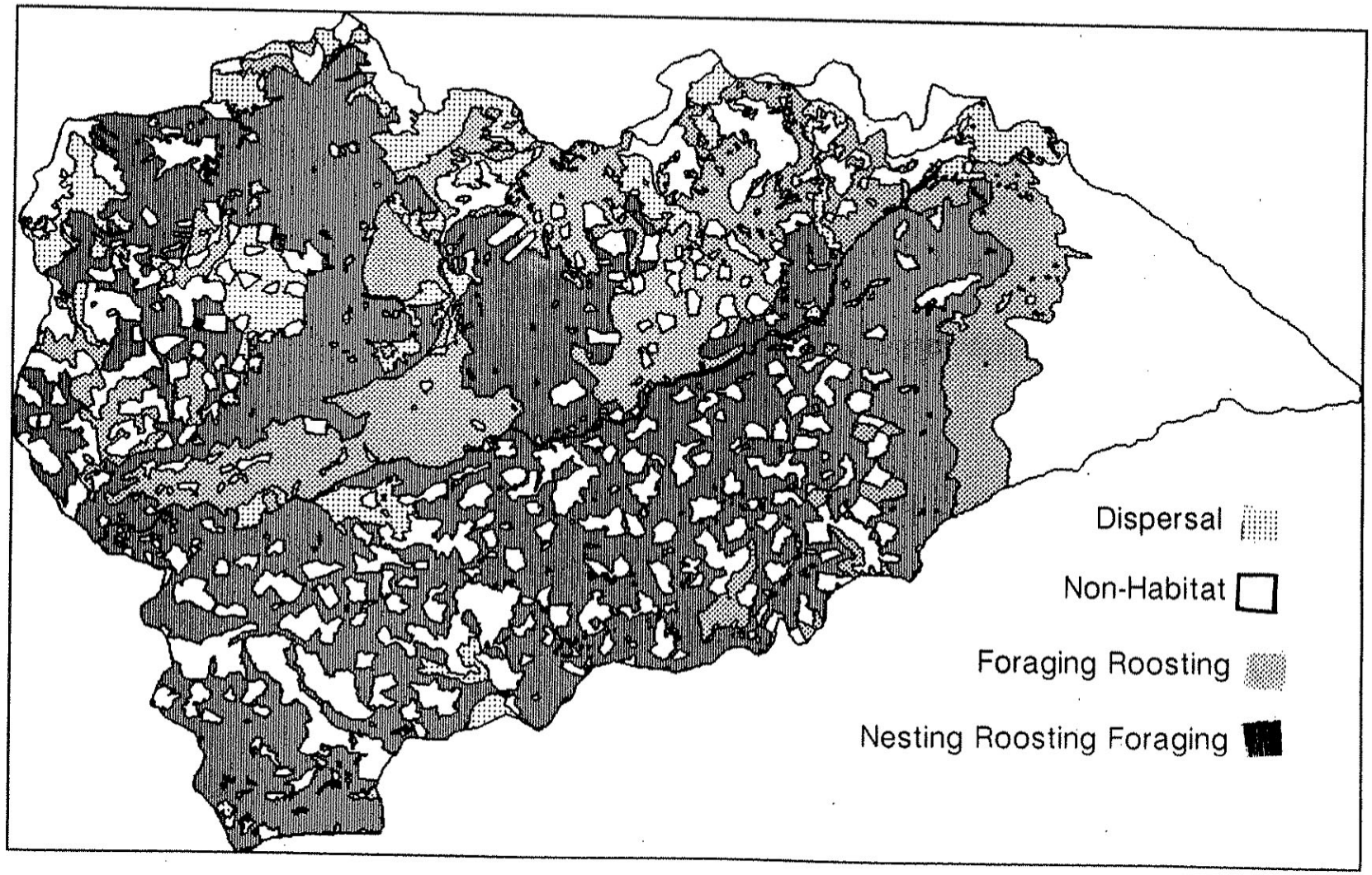
The entire Upper Lewis River Watershed provides dispersal opportunities for late seral associated species. The watershed serves as a connection between a large LSR (RW-149) (i.e. >10,000 acres), the Mt. Adams Wilderness and two smaller LSRs (RW-150 and LSR-RW-151) that lie to the south of Mt. Adams. Between 70 and 80 percent of the watershed is comprised of trees at least 11 inches in diameter in stands having a canopy closure of at least 40 percent.

Surveys conducted from 1992-1994 located several populations of both Larch Mountain and Van Dykes salamander (Crisafulli, 1994 unpublished). Individuals were found in following sub-basins: 23D Steamboat Creek, 23E Upper Quartz Creek, 23J Straight Creek, 23M Snagtooth Creek, and 23N Middle Quartz Creek. Additionally, in 1992 a highly reliable visual sighting of two gray wolves was made in sub-basin 23J Straight Creek of the Upper Lewis Watershed.

Aquatic Habitat

In much of the Lewis River basin, anadromous fish distribution was dramatically reduced by the construction of Merwin dam in 1935 which cut off 53 miles of mainstem habitat and numerous miles of 2nd and 3rd order tributary habitat. Downstream of Merwin dam the following anadromous species are present: spring and fall chinook , early and late returning coho , and summer and winter steelhead. A population of bull trout exists in Swift reservoir and uses upstream tributaries for spawning and rearing. This population is thought to be declining. However, there is a need to assess the population abundance to document this belief (M.Faler, pers. comm). Stream temperatures are one factor that could be contributing to the decline of bull trout since several streams above the reservoir have exceeded the state water quality standard of 58 degrees. The eruption of Mount. St. Helens in 1980 altered some portions of the basin dramatically while leaving others relatively untouched. The areas affected by the eruption are still recovering.

Spotted Owl Habitat



MAP 16

The Upper Lewis River is a 3rd. order stream with 25 sub-basins. It has one major tributary (Quartz Creek) which contains six of the sub-basins (E, I, J, M, N, & X). Of the 25 sub-basins, portions of 16 sub-basins covering 11 streams and 34.5 miles have been surveyed for aquatic habitat characteristics.

There is a total of 329 miles of streams mapped in the upper watershed, of those 86 miles support fish populations (see Map 3, Stream Classes). The remaining stream miles do not support fish for a variety of reasons including: gradient barriers, barriers to distribution and lack of habitat.

Habitat conditions for fish were evaluated using the following three aquatic habitat attributes: stream temperature, primary pools per mile, and pieces of large woody debris (LWD) per mile. Habitat conditions for aquatic species other than fish were not evaluated due to a complete lack of data.

Primary Pools

In the Upper Lewis watershed, 69 percent of the surveyed stream segments rated poor, 28 percent fair, and 3 percent good for primary pools per mile. All of the surveyed segments in four of the sub-basins, totaling 13 miles of habitat, rated poor (23J, M, N, and X). The segments rated as "good" include approximately 1.0 mile of habitat on four separate streams. See Map 17, Primary Pool Rating.

Large Woody Debris

Three of the surveyed sub-basins meet the standard of 80 pieces of large woody debris (LWD) per mile (23K, Q, and S), and 90 percent of three sub-basins are rated as poor (23F, L and X). The remaining sub-basins have a mixture of segments ranging from poor to good.

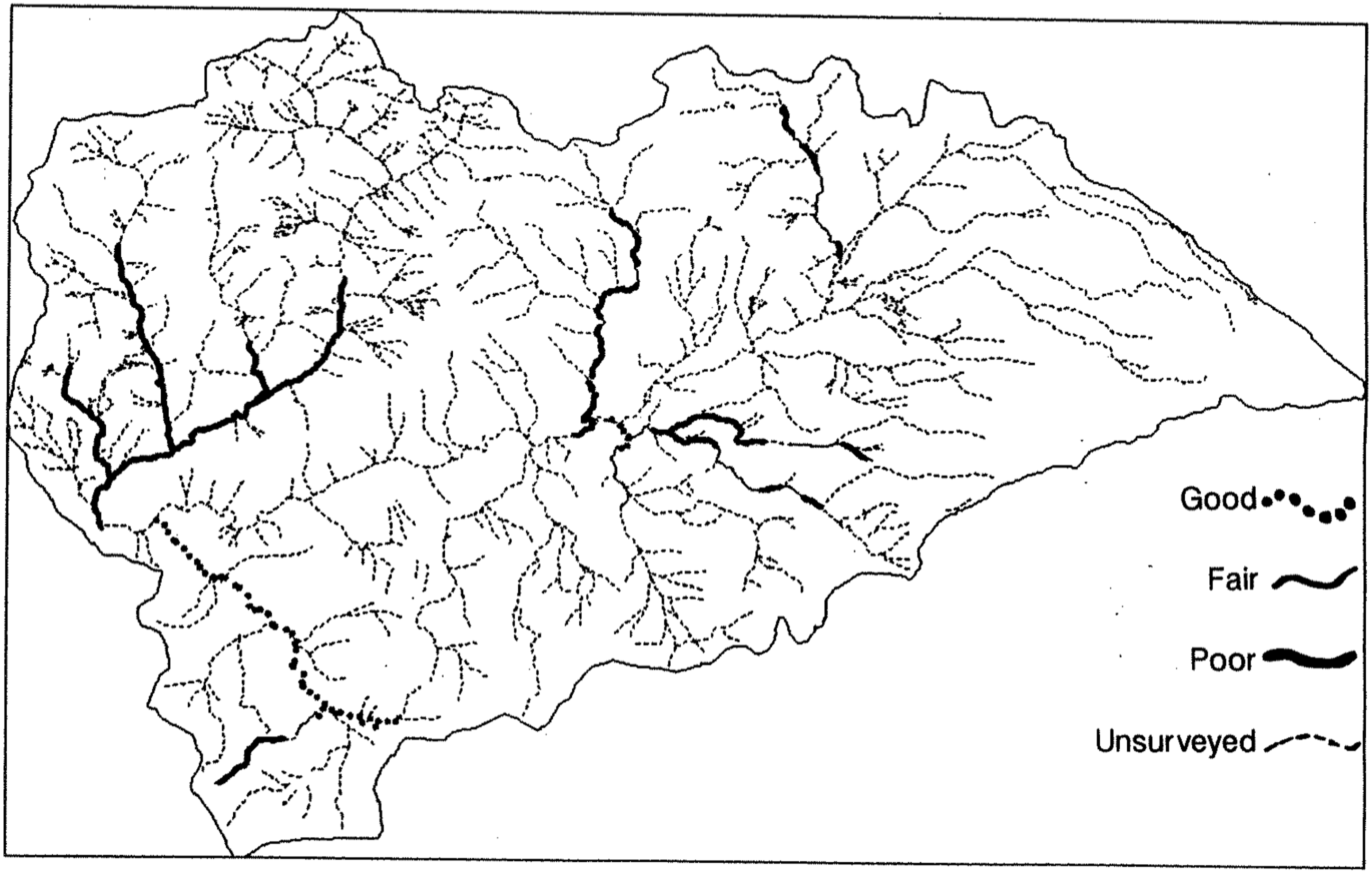
Forty-eight percent of surveyed stream segments are rated "poor" and have less than 40 pieces of LWD per mile that meet the size standard. Seventeen percent are rated "fair" and have 41-79 pieces of LWD per mile. Thirty-four percent are rated good and meet or exceed the standard (Map 18, Large Woody Debris Rating).

Water Temperature

Stream water temperature is a major factor influencing the composition and productivity of aquatic ecosystems.

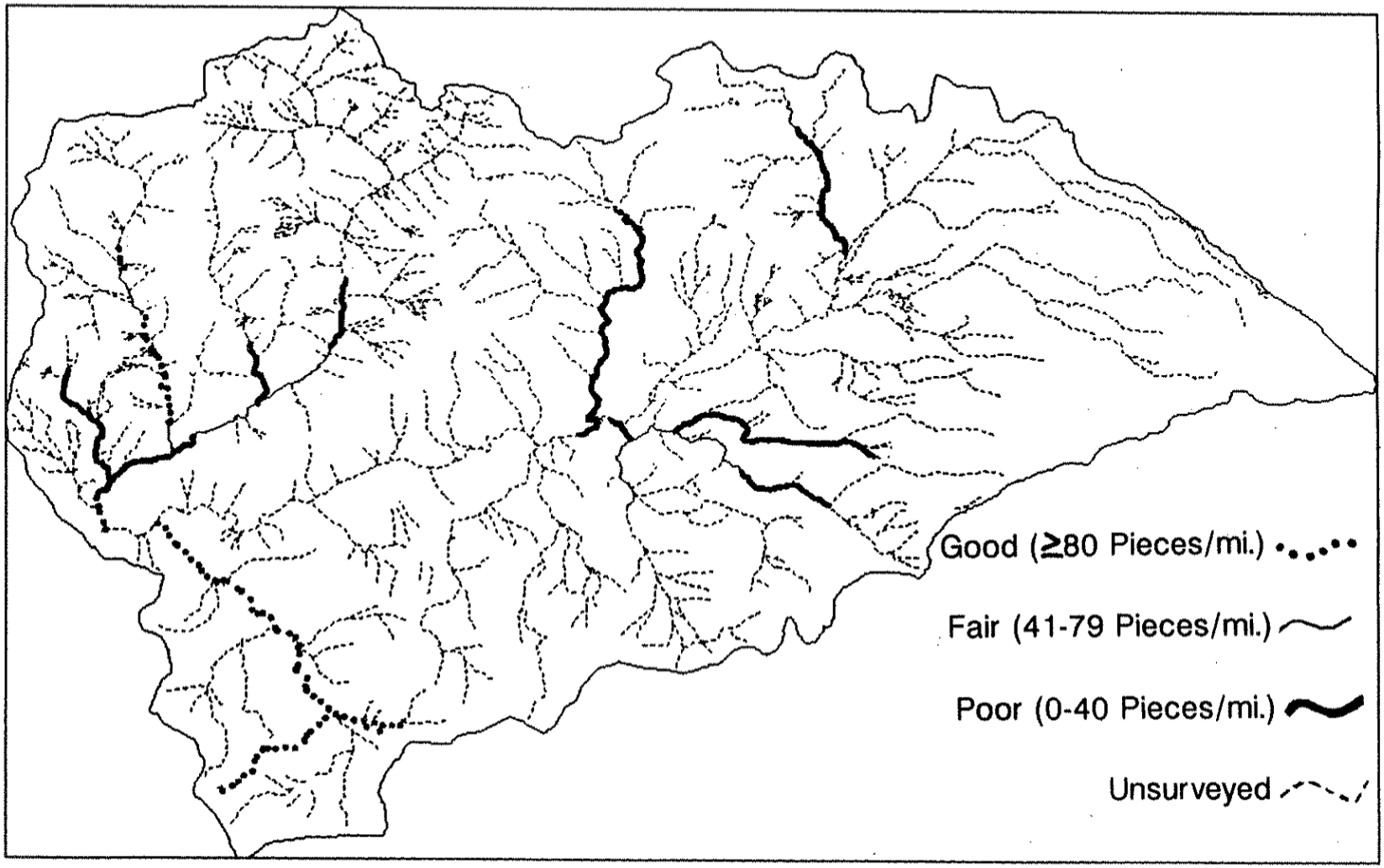
Stream temperature monitoring was initiated in 1975 at the Quartz Creek Station and in 1976 at the Lewis River Station (just downstream from the analysis area). It continued until 1988 when funding was stopped. The data collected has numerous gaps and occasionally an entire year is missing. The analysis was done with the most complete data sets available for the low flow period of June - September. Maximum 7-day average temperatures were calculated for these years to assess impacts to aquatic organisms (Figure 2, Maximum 7-day Average Temperature for Quartz Creek, and Figure 3, Maximum 7-day Average

Primary Pool Rating



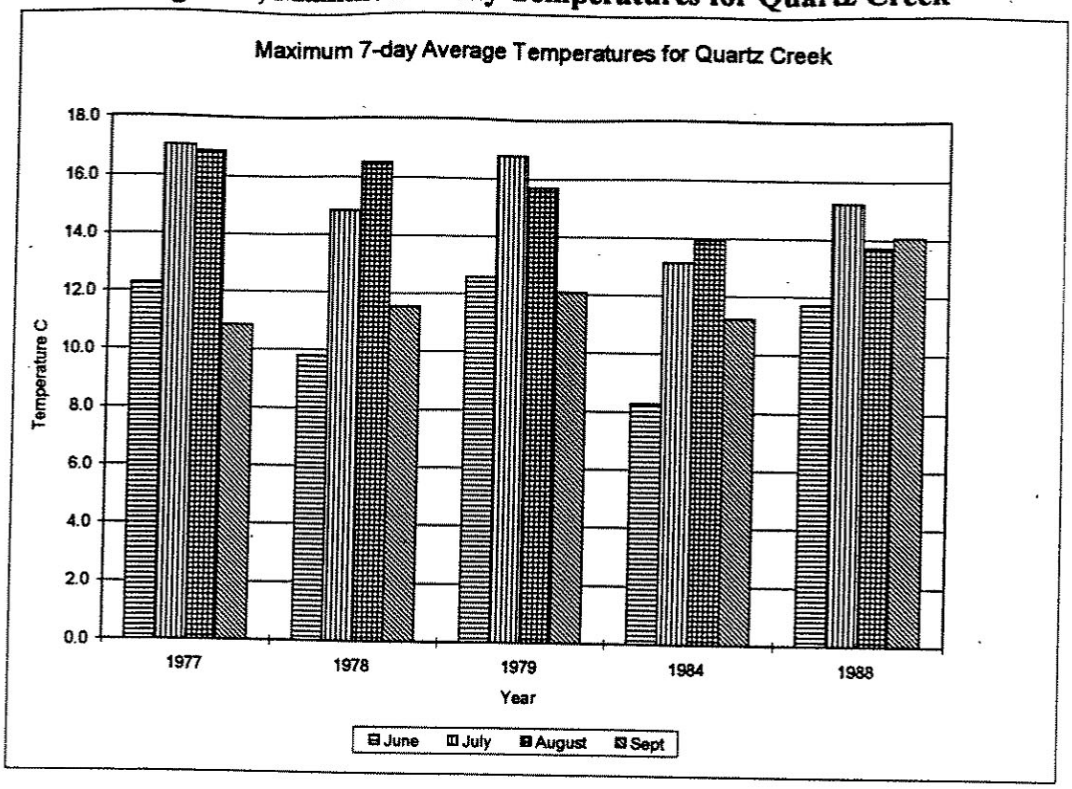
MAP 17

Large Woody Debris Rating



MAP 18

Figure 2, Maximum 7-day Temperatures for Quartz Creek



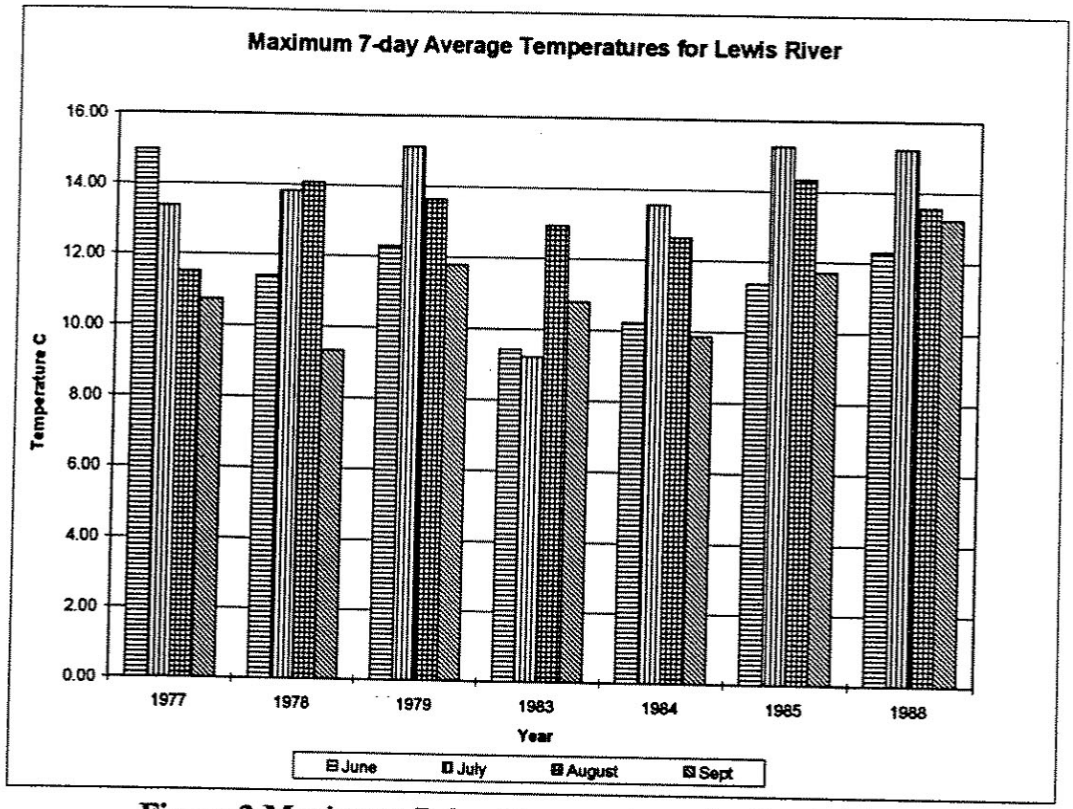


Figure 3 Maximum 7-day Temperatures for Lewis River

Temperature for Lewis River). The Quartz Creek drainage indicates a pattern of exceeding the State standard; however, it falls within the historic range of natural conditions for the Lewis basin for maximum daily stream temperatures (REAP 1993).

Low levels of shade produced by relatively young riparian vegetation in individual sub-basins may be contributing to increased temperatures. For instance, in sub-basin 23X, more than 40 percent of the riparian reserve vegetation falls in age Class I, 0-40 years (Map 19, Riparian Zone Age Classes).

Results from stream temperature monitoring are displayed on Figure 4, Lewis River Stream Temperature, and Figure 5, Quartz Creek Stream Temperature. These graphs show the number of days the maximum daily stream temperature exceeded 16 C, which is the State of Washington water quality standard. It is important to note that these results reflect the minimum number of days the standard was exceeded due to the lack of complete data sets for many of the years.

It is difficult to draw conclusions about cause/effect relationships with respect to stream temperature for the following reasons: 1) a large amount of missing data (only 1 year of complete record out of 13 years of operating the monitoring stations) 2) lack of other monitoring stations in the watershed (only the Quartz Creek station is in the analysis area) and 3) site specific riparian shade data is not available. It is important, however, to note that state standards were still being exceeded at both monitoring sites as late as 1988.

Turbidity

Turbidity is a water quality standard in the State of Washington. It is used as a surrogate for suspended sediment on National Forest lands.

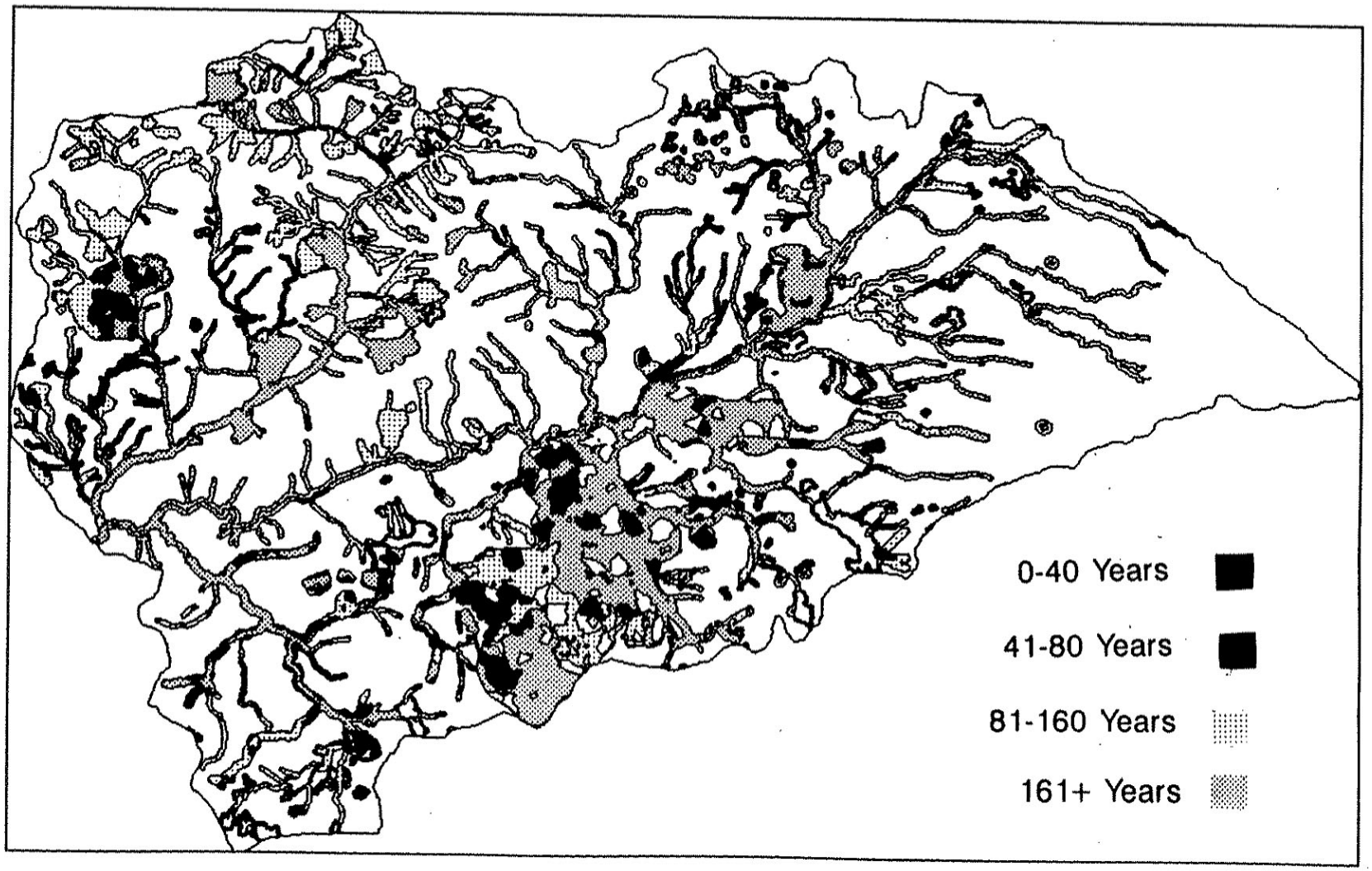
The Gifford Pinchot National Forest Land Management Plan (LMP) reported turbidity measurements taken at the same stations as stream temperature mentioned above, for the same time period. The results are listed below.

Baseline Station	Ave.NTU*	Highest NTU	% Samples>5NTU
Lewis River **	2.8	91	5
Quartz Creek	1.8	42	4

*-NTU is nephelometric turbidity units which is a measure of water clarity. The lower the NTU number, the clearer the water is.

**-Lewis River is glacially affected. It contains fine, suspended glacial flour which affects it's natural turbidity.

Riparian Zone Age Classes



MAP 19

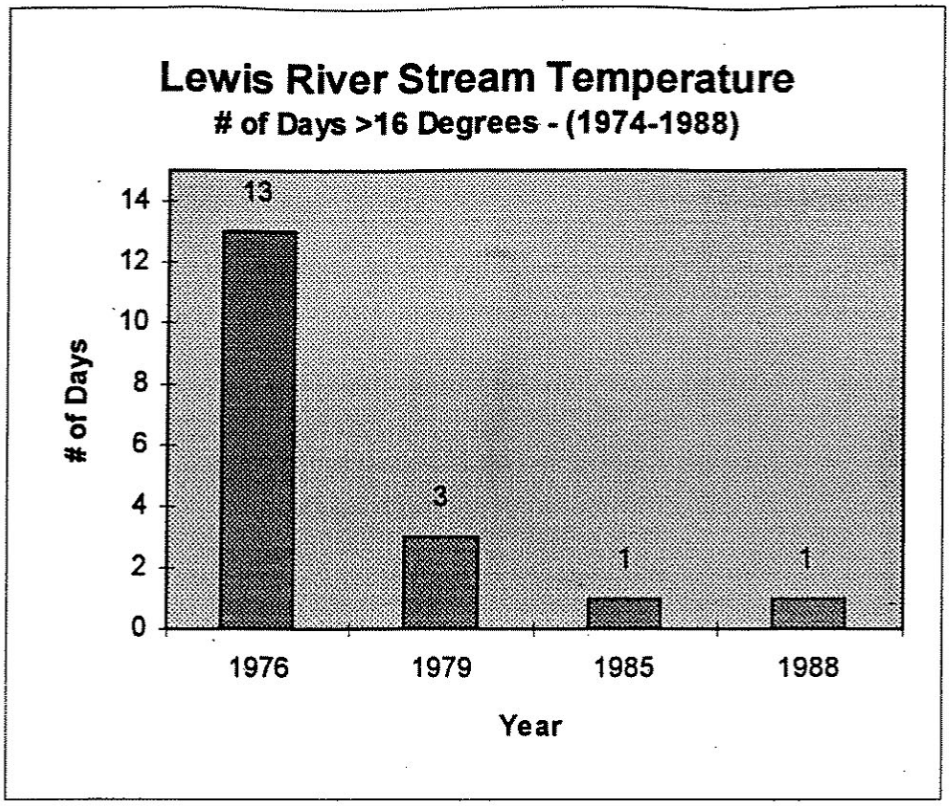


Figure 4 - Lewis River stream temperature. Graph shows number of days the daily maximum stream temperature equalled or exceeded 16°C

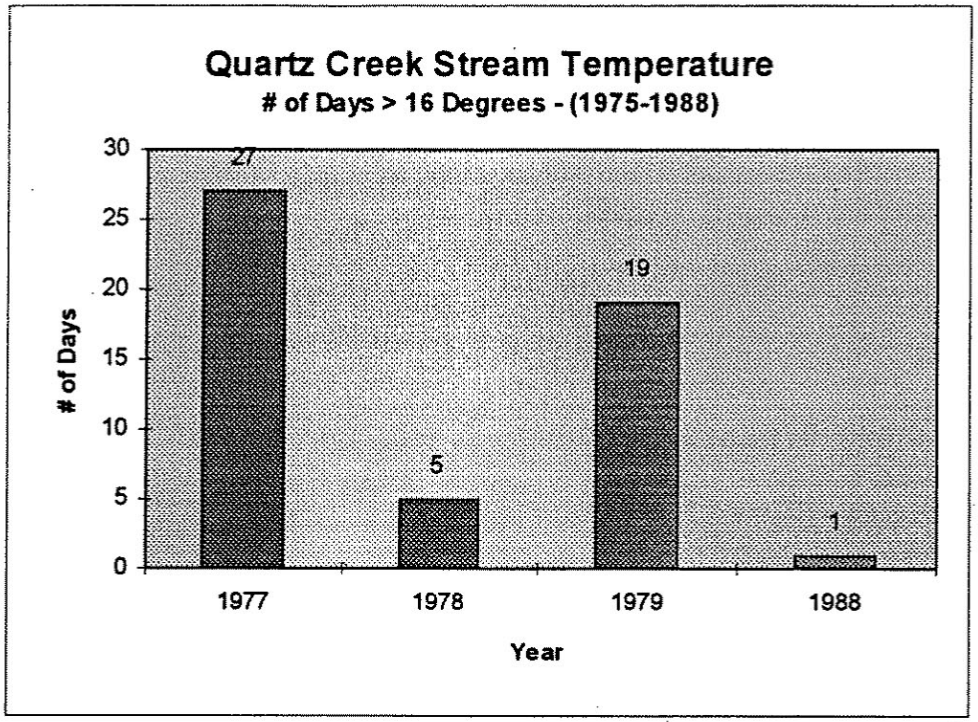


Figure 5 - Quartz Creek stream temperature. Graph shows number of days the daily maximum stream temperature equalled or exceeded 16°C.

FIGURES 4 and 5

As noted above, the Lewis River is influenced by glacial flour during melting periods, which usually coincides with the hottest days in the summer. Comparison of turbidity in the Lewis River with other glacially influenced streams on the Forest (Cispus River) indicates that the influence on turbidity is very minor. Average levels are only slightly higher than Quartz Creek (not glacially influenced) and substantially lower than the Cispus River (average turbidity of 21.1 NTU compared to 2.8 NTU for the Lewis River) which contains high levels of glacial flour.

Turbidity differences within the basin were also noted during a field visit on October 27, 1994. A large rain event was occurring at the time, and relative differences in turbidity based on ocular estimates were recorded for most of the major streams within the basin. Very turbid water was noted in the Boulder Creek, Steamboat Creek, Poison Creek, and Swampy Creek basins (see Map 20, Turbidity). A noticeable difference in the turbidity of the Lewis River was found at the confluence of Steamboat Creek. This system caused the Lewis River to become very turbid. Levels of turbidity seemed to have a relationship with road densities (See Figure 6, Road Densities by Sub-basin) and amount of unstable ground in these basins (The basins with higher road densities and more unstable ground had the most suspended sediment).

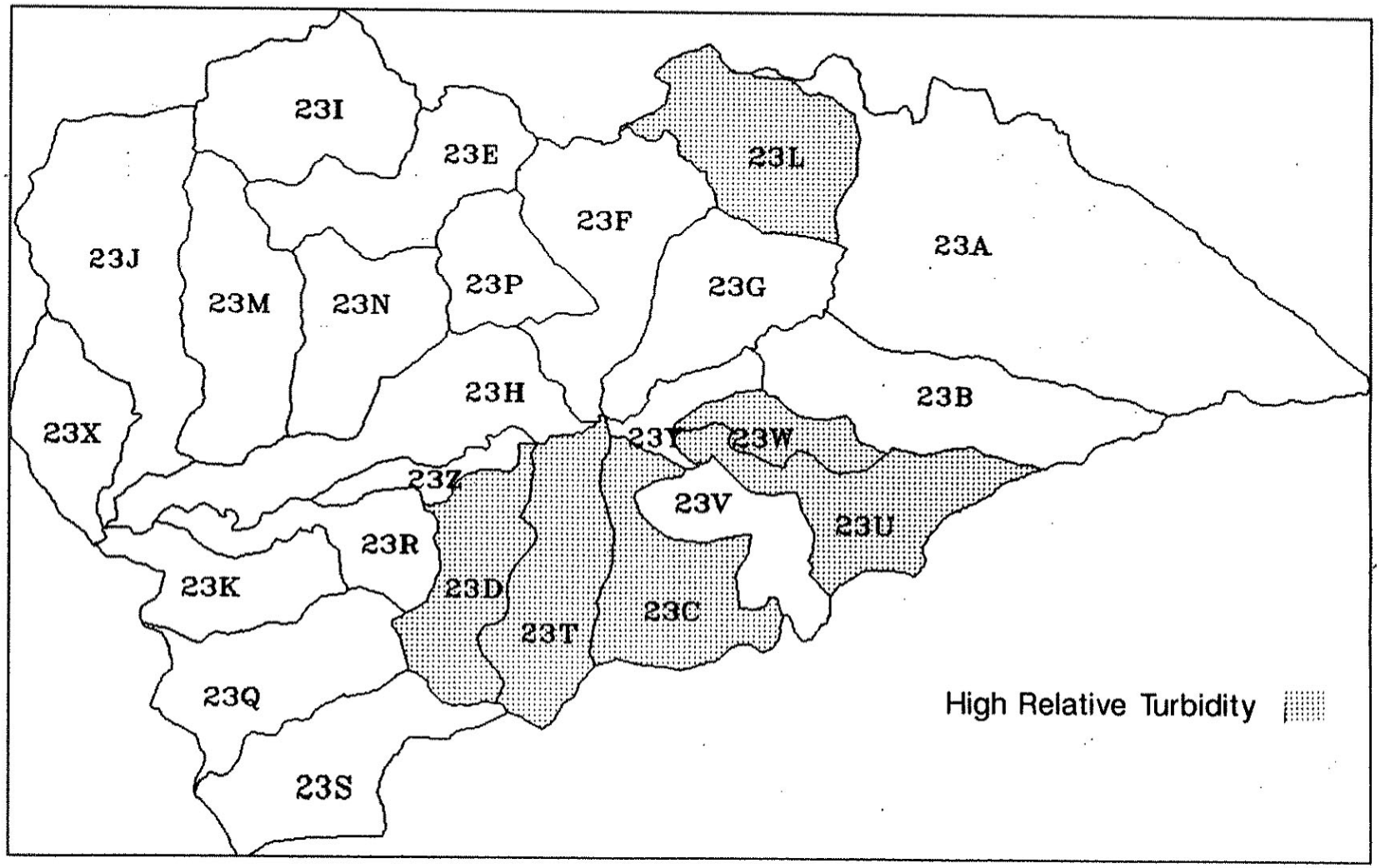
Aquatic Habitat Fragmentation

Within the Upper Lewis Watershed the aquatic habitat has been fragmented and altered by management activities such as road building. Management activities in this watershed have increased each decade since the 1950's with a peak in 1988 (See Figure 7, Harvest by Decade). Some sub-basins now have road densities that exceed 5.0 miles per square mile (See Figure 6). Roads and culverts can not only block upstream migration of resident fish, they can alter the flow pattern of large woody debris through the system and increase sediment deposition. The number of road crossings were compared to the length of fish bearing streams in each sub-basin. Sub-basins 23D, G, Q, R, U, V, and X were within the highest one third of the values which indicates they have received the most intense degree of habitat fragmentation caused by roads.

Populations

Indigenous fish stocks found in the Upper Lewis River include rainbow trout, cutthroat trout, mountain whitefish and a variety of sculpin. Brook trout were introduced into the watershed in the early 1900's through lake and stream stocking programs (J.Weinhiemer, pers. comm.).

Turbidity



MAP 20

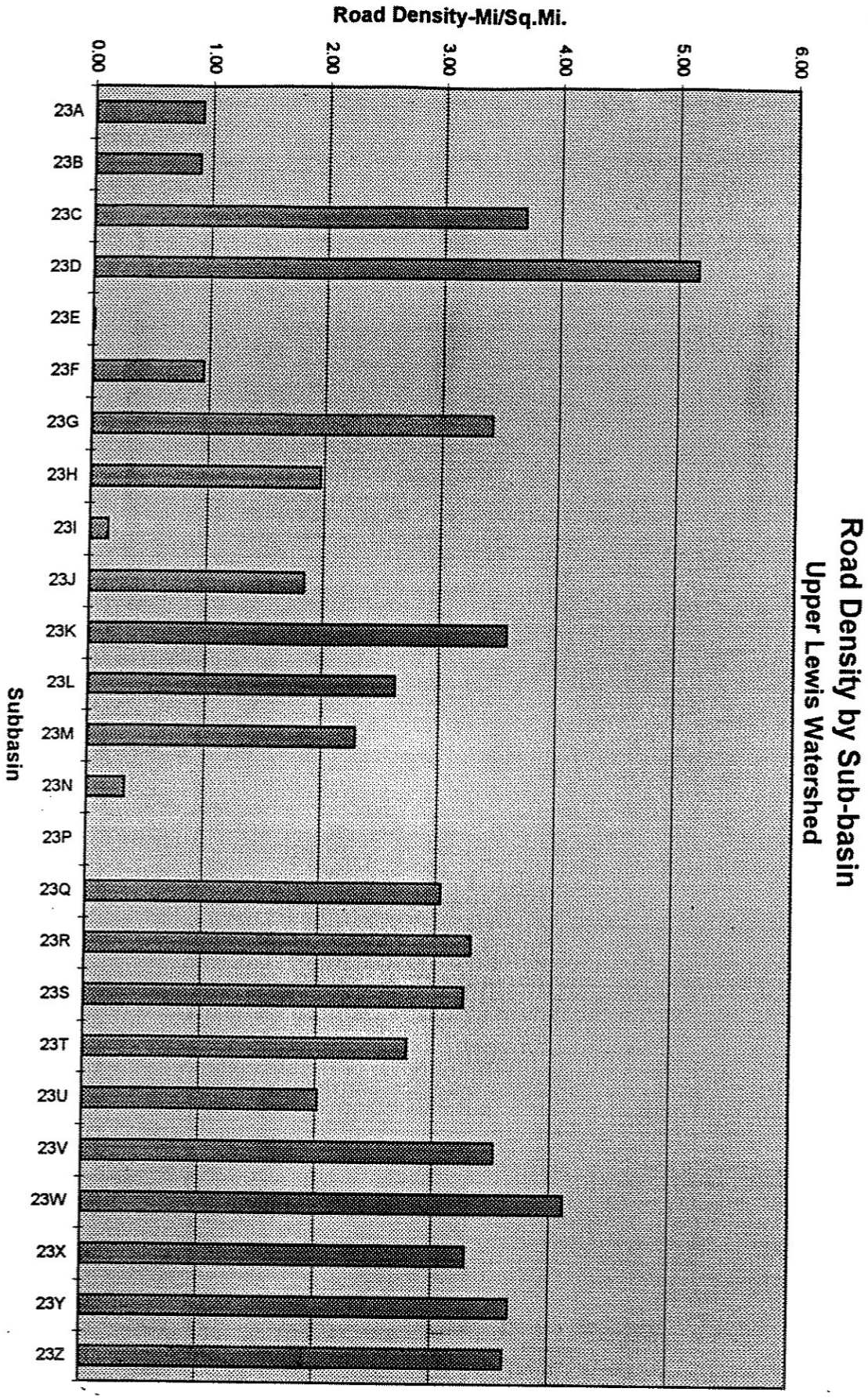

Road Density-Mi/Sq.Mi.
0.00
1.00
2.00
3.00
4.00
5.00
6.00
Subbasin
23A
23B
23C
23D
23E
23F
23G
23H
23I
23J
23K
23L
23M
23N
23P
23Q
23R
23S
23T
23U
23V
23W
23X
23Y
23Z
Road Density by Sub-basin
Upper Lewis Watershed

FIGURE 6

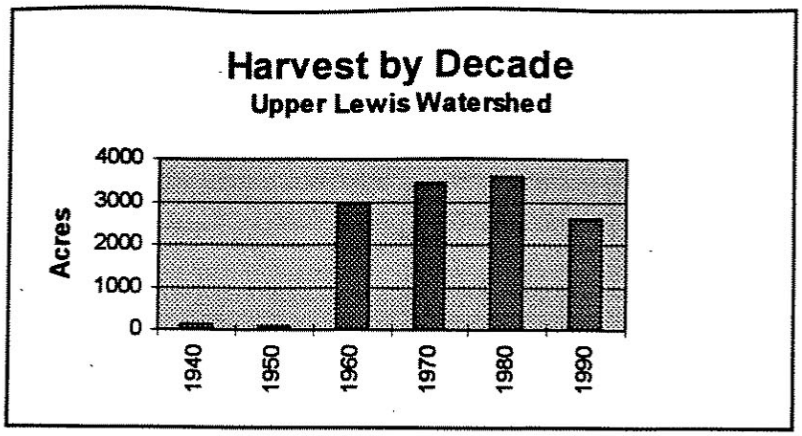


Figure 7 Harvest by Decade

Information on distribution and abundance of these resident species is poorly documented. Biologists are conducting presence/absence surveys to determine the exact distributions throughout the watershed. Stream surveys have documented barriers to migration and distributions for the salmonid species; however, this data has not been input into the GIS system. Distribution of salmonid populations is assumed to be within all Class 1, and 2 streams. Species abundance information has not been collected in this watershed. Forest Plan monitoring protocols are being developed and tested to determine relative abundance, however, at this time they have not been used in this area. Information on populations of aquatic organisms other than fish is entirely lacking and no analysis was conducted.

People On the Landscape

The current use of resources within the Upper Lewis Watershed is similar to that which occurred historically. Hunting, fishing, and berry picking still take place, and the area is more accessible by the roads that were created primarily for timber harvesting. See Figure 6, Road Densities by Sub-basin, which shows road densities in each sub-basin. Some mining claims in the Boulder Creek area are still valid, but no major activity has been noted and no operating plans have been submitted. Timber harvest in the 1990's has occurred on about 2600 acres as of 1994.

Most people visit the Upper Lewis Watershed to work or to recreate. Camping, hunting, fishing, backpacking, hiking, horseback riding, mountain bike riding, and motorcycle riding are the primary recreational pursuits. Road traffic counts along Road 90 indicate over 60 percent of the traffic volume is from private vehicles, 10 percent is from government type vehicles, and about 20 percent is logging or commercial type vehicles.

Hunting is a major recreational use in the Upper Lewis watershed. Elk hunting is traditionally strong in the area around Steamboat Mountain. Deer, bear, cougar, and grouse are also hunted. The watershed offers a good mixture of isolated and easy access hunting conditions. These range from isolated hunts in the Dark Divide Area in the northern portion

of the watershed, and in the Mt. Adams Wilderness, to the more easily accessed areas with numerous logging roads in the southern portion of the watershed. High road densities have reduced the quality of hunting to some degree in the Steamboat Mountain area. Primitive dispersed camping is typical.

Horseback riding is currently on the rise. Horseback riders have quick access to a difficult 10-12 mile stretch of Quartz Creek Trail. Horseback riders and hikers use Table Mountain Trail to access the Table Mountain area and loop back over to Council Lake.

There is moderate use by hikers and backpackers who may camp for several days along a trail network. The trails preferred by hikers access remote portions of the Quartz Creek drainage which is in the Dark Divide Area. Several trails also access the Mt. Adams Wilderness in the eastern part of the watershed. Road access to trailheads is via Road 90 for Quartz Creek; Road 23 for the Mt. Adams Wilderness; and Roads 2334 and 9091 for the Table Mountain area.

A number of herbaceous and woody plant species in the watershed are collected for special forest products. These include beargrass, mushrooms, salal, Pacific yew, and various tree and shrub transplants. While the number of permits for these special products is increasing, collection has not noticeably altered vegetation composition or structure beyond a few roadside locations.

CHAPTER IV - PAST CONDITIONS

Geologic Processes

The Upper Lewis Watershed has been shaped by:
volcanic,
glacial, and
seismic events.

Volcanic episodes from Mt. Adams, as well as numerous other vents in the area, have occurred over the past 300,000 years. The landscape has been modified over the last 40,000 years by landslides and glaciation. According to one theory, some landslides were caused by an earthquake that took place 400 to 600 years ago.

These past conditions could give an indication of possible future events; however, (as with Mount St. Helens prior to 1980) the effects on the landscape cannot be known nor can a time frame for these events be predicted.

Stream Channels

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 others taken in 1979 and 1989, a progression of conditions was interpreted. The following channel related items were noted.

- Recent river terraces appeared in all response segments (see definition on page 19) 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 amount of large woody debris (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. See Map 12, Lewis River Stream Segments.

- 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.

- Lewis River segments 1003, 0103, and 0102 experienced channel widening from the 1970's floods. 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.

Water Quantity

Large flood events have occurred periodically in the Lewis River basin. Stream gage records for the Lewis River indicate major flood events in 1934, 1974, 1973, and 1972. The 1934 event washed out the stream gauge, and it was not reinstalled until 1955. New river terraces noted in the 1959 air photos indicate another significant flood probably occurred sometime between 1935 and 1955 but was not recorded due to the loss of the stream gage. As is typical in the western Cascade mountains, these floods were associated with rain on snow events.

Fire History

Wildfires have historically been a major natural disturbance in the forest landscape of the Lewis River Watershed. Fire has been an integral part of the ecosystem, affecting wildlife habitat, vegetation dynamics, soil properties and watershed hydrology. Large, high-intensity stand replacement fires appear to have been common prior to European settlement throughout the Western Cascades. Native American use of fire is known to have occurred in maintaining huckleberry fields northwest of Mount Adams. Historically, Native American ignition of the forest through intentional or accidental means is probable but poorly documented. Lightning by itself could have accounted for the observed fire record for the watershed.

Since 1900, very little of the watershed has burned from wildfire.
Two distinct fire regimes are found within the 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 the mid to higher elevation areas and in valleys protected from the east wind.

Most recent fires, caused by lightning and forest visitors, have been relatively small. Approximately 45 percent of fire starts between 1970 and 1994 were caused by lightning while 37 percent were from abandoned campfires. Although most of these fires consumed less than one acre, four fires in the past ten years have burned 10-100 acres each. While the number of catastrophic fires may be minimized with today's fire prevention and suppression strategies, large severe fires in the future are inevitable.

While fire and timber harvest have been the primary disturbance forces, wind, insects, and disease have had small-scale, localized effects. These agents cause mortality of single trees or small groups, thus benefiting vegetative growth near the forest floor.

Terrestrial Vegetation

The Upper Lewis River watershed has historically contained broad, continuous conifer stands in varying age classes. These stands, characterized by diverse species compositions and structures, included a variety of remnants from previous stands such as green trees, standing dead trees, and down logs.

Through time, the proportion of the vegetation in various forest age or development classes has varied widely. The Regional Ecological Assessment Report (REAP 1993) shows that (for the overall Lewis River basin) approximately 45-70% of the area has historically been in late successional stages; by comparison 40 percent of the upper Lewis River watershed is now occupied by late successional stands. The proportion of the basin in early successional stages is estimated at 10-50% for the Western Hemlock Zone and 15-30% for the Pacific Silver Fir Zone.

Since the 1960's, an array of "staggered setting" young, managed stands have been created throughout the watershed, fragmenting the continuity of the older natural stands. Approximately 17% of the watershed (12,500 acres) is now in managed stands (see Map 6, Roads and Managed Stands). Managed stands in the watershed generally contain a low amount of large-size green trees, standing dead trees, and down logs.

Riparian Vegetation

Influenced by disturbances, the composition and structure of vegetation in riparian areas has varied greatly. Prior to the advent of timber management in the early 1960's, riparian reserve vegetation was shaped by floods, mass land movement, fire, windfall, and other factors. Hardwood trees and shrubs and other pioneer plant species quickly occupied the disturbed areas and were progressively replaced by later successional species including conifer trees.

Since the 1960's, timber harvest, road construction, recreation development, and other human disturbances have increased the proportion of riparian areas in early successional vegetation stages. While we were not able to determine historical proportions in various age or development classes, we know that approximately 16% of riparian areas today are in the 0-40 year age class. A large proportion of the 16 percent was caused by human activity. The amount of large woody debris present and available for recruitment is low in riparian areas with these young age classes.

An estimated 35 percent of the watershed's riparian vegetation is currently 161+ years of age. While historical proportions are not known, the current percent of riparian areas in late age classes has dropped since the 1960's. Vegetation in many riparian areas- especially upland Class III and IV drainages- was disturbed during harvest of adjacent clearcut units.

Wildlife

Little information is available about past habitats or species richness and abundance in the Upper Lewis Watershed. The past disturbance patterns noted above were used as a basis for assumed historic habitat for terrestrial animals. Late seral forest prior to European settlement covered about 45-70% of the Lewis River Basin. It is assumed that the upper Lewis watershed was comparable to the rest of the basin. The past habitat spatial distribution was probably very different than what it is today. Historic fire patterns indicate that late seral forests in the watershed were more contiguous. Similarly, the mid-late and early seral forest were arranged in large clumps; instead of small scattered patches that exist today.

Species abundance and richness were probably also greater in the past. Populations of late seral terrestrial species such as the spotted owl and northern goshawk were probably limited by territory size through intra-species competition, instead of habitat availability. Two species (gray wolf and grizzly bear) now extirpated from the watershed were believed to use various portions in the past.

Aquatic Ecosystems

Habitats/Populations:

Historical aquatic habitat and population information in this watershed is poorly documented. We know, however, that rainbow and cutthroat trout were quite abundant in the Lewis river and it's tributaries and ranged in size to 18" with a 12" average (WDG, 1957). Aerial photo analysis completed for channel conditions using 1959, 1979, and 1989 photos indicate variations in channel conditions across this time period.

Water Quality

Due to lack of historic data, very little is known about past temperature and turbidity conditions. The Regional Ecosystem Assessment Project (REAP) defined the historic range for maximum stream temperature for the entire Lewis River basin as between 14 and 19 degrees C. A 1957 State of Washington Department of Game report found that "low water, late summer" stream temperatures in the upper Lewis River watershed ranged from 45-55 degrees F (7-13 degrees C).

No reference for historic turbidity levels in the upper Lewis River watershed was found.

People On The Landscape

Recent archeological investigations provide information on the types and patterns of human use within the Upper Lewis Watershed. Sites located along meadows, lakes, and the Lewis River suggest (for the past 7,000 years and continuing into the historic period) a pattern of repeated seasonal occupation by small groups. The pattern was disrupted by volcanic deposition of a thick layer of tephra. The devastation of local resources led to abandonment of the area between approximately 3500 and 2000 years before present.

Prehistoric use was seasonal. Small hunting and gathering groups moved from low elevation winter areas to higher elevations in the spring, summer and fall following available resources. Warm season resources include huckleberries, strawberries, elderberries, raspberries, service berries, blackberries, gooseberries, currants, salmon berries, trout, salmon, deer, elk, bear, and grouse. Huckleberries are notable in that they were available in quantities suitable for collection as a stored food. Both the Yakama and Klickitat tribes gathered large quantities of huckleberries on the slopes of Mt. Adams.

Historic land use includes sheep grazing (dating back to the 1880's), trapping, and mining. The Quartz Creek and Platinum Creek areas in particular were mined during the 1930's. Timber harvest began in the 1940's but only involved 136 acres during that period and 106 acres in the 50's. Limited timber harvest was a result of limited road access during these times. With better road access in the 1960's came an increase in timber harvest to nearly 3000 acres (120 million board feet) within the Upper Lewis Watershed with a maximum harvest occurring in the 1980's of over 3500 acres (see Figure 7, Harvest by Decade).

CHAPTER V - FUTURE TRENDS

Future trends are based on the assumption that the President's Forest Plan will be fully implemented including an intensive and timely watershed restoration program. If any of these assumptions are not met, the future trends discussed below will need to be reevaluated.

Geologic Processes

Mass instability in the watershed occurs naturally. Some areas that were dormant or slow moving have become more active with management activities. There is potential for stopping and/or slowing some of the active areas in the slide mass located in the Poison and Pass Creek drainages. Adverse effects can be mitigated through application of appropriate timber harvest and road construction practices. Any effort to stop or slow movement would require a geotechnical and geologic investigation.

Aquatic Ecosystem

Water quality/quantity/habitats and populations

As displayed in Figure 9, Desired Conditions, and Figure 10, Existing Condition Compared to Desired Condition and Trends, pages 57-58 and 59-62 respectively, trends for the conditions discussed in Chapter IV are recovering. Due to establishment of the elements in the Aquatic Conservation Strategy, the conditions are projected to be in a recovery trend.

Terrestrial Vegetation

With continued fire prevention and suppression of wildfires in the watershed, the primary agent for disturbance and succession will continue to be timber harvest. Nearly all of the future stand replacement timber harvest will be in the Matrix allocation which occurs on 40 percent of the watershed.

Through harvest and young stand treatments, vegetation in the Matrix will progress toward a desired condition of approximately 85 percent in managed stands.

- Approximately 15 percent of the Matrix will be retained in upland late successional stands. In areas of high visual sensitivity and other special management emphasis areas in the Matrix standing green trees may be retained in greater amounts than the 15 percent generally prescribed.

- Approximately 15 percent of new (post 1994) managed stands will contain small inclusions of late successional stands (averaging about 2.5 acres each).

- Managed stands will contain standing dead and down logs in sufficient numbers for habitat and long term productivity.

- As locations of the survey-and-manage species identified in the C-3 list in the President's Forest Plan become known, inclusions of late successional stands will be adjusted to ensure attainment of standards and guidelines and site specific prescriptions.

Vegetation changes in Late Successional Reserves and Wilderness will be primarily determined by fire (natural and human-caused), windfall, and other natural disturbances. There may be some thinning or other light manipulation of managed stands (up to 80 years) in late successional reserves in order to enhance development of late successional habitat. Some salvage of mortality may occur in late successional reserves if it is beneficial to habitat development.

Riparian Vegetation

Vegetation in all riparian reserves will continue to be shaped by floods, mass movement, wind, fire, and other disturbances. While all reserves are excluded from harvest, harvest of adjacent lands may indirectly contribute to windfall in some riparian reserves. For most riparian areas in the Upper Lewis, vegetation condition will primarily depend on natural disturbances and succession.

Managed stands currently within riparian reserves will continue to develop. As trees become larger they will provide increased shade, root strength, and habitat attributes. Managed stands in riparian reserves may be periodically thinned to meet restoration objectives. Thinning prescriptions would be designed to accelerate stand growth and structural development to meet water and habitat objectives.

Wildlife

With an emphasis to manage forest ecosystems on a landscape scale, changes will occur in the current habitat condition, species abundance and species richness. The table below summarizes the expected trends in the five habitat types and their associated wildlife species within the Upper Lewis Watershed. Figure 10, pages 59 through 62, specifically describes trends and summarizes condition concerns.

Summary of Expected Trends in Habitat Types

Habitat Type	Current Acres	Expected Future Trend
Early Seral Forest	12,472	Increase
Mid-Seral Forest	30,515	Not Known
Late Seral Forest	27,713	Decrease
Riparian Habitat	14,000	Stable
Special Habitat	6,128	Stable

People on the Landscape

Timber harvest in the 1990's has occurred on about 2600 acres. Harvest rates have slowed dramatically in the past two years following Judge William Dwyer's injunction, implemented while the President's Forest Plan was being prepared. The harvest rate is expected to increase over present rates now that the President's Forest Plan is being implemented. It is currently not clear how the available timbered acres in this watershed could be scheduled out over time to provide a sustainable even-flow output of wood fiber.
With a rapidly growing population, human use in the watershed will increase proportionally, and controversy between special interest groups will undoubtedly grow as well.

It is anticipated that increased human use of the following types will occur over time:

1. Use of special forest products such as beargrass, mushrooms, and huckleberries
2. Use by horseback riders, llama users, and bike riders
3. Use by motorists in the increasing north/south traffic
4. Use of dispersed camp sites

CHAPTER VI - ECOLOGICAL CONDITION CONCERNS

The interdisciplinary team reviewed available data and knowledge about the Upper Lewis River Watershed and listed areas of concern about the health of the ecosystem. The ID team identified integrated areas of ecological concern across the watershed and denoted them in each sub-basin where they occur. Sub-basins having four or more concerns are highlighted in Figure 8, Synthesis Table. As shown in Chapter VII, the team then identified desired ecological conditions. This set the stage for listing the types of projects (restoration and producing commodities and services) that would take the ecosystem from present conditions toward the desired condition.

The ecological condition concerns are

1. **Unstable Areas/Mass Wasting**

   More than 10 percent of this watershed is mapped as unstable or potentially unstable. Sediment input from these areas could have adverse effects on the aquatic systems here and further downstream. Sub-basins that have large unstable areas are shown in the Synthesis Table.

2. **Surface Erosion**

   Surface erosion from slopes where bare mineral soil is exposed (along roads and other areas) is a potential source of sediment for streams. Sub-basins that have large areas of high surface erosion potential are shown in the Synthesis Table.

3. **Unstable Channels**

   Chronic sediment input and/or increased peak flow into some streams may cause prolonged adverse effects. Damage in the form of excess sediment could degrade the ecosystem along the edge of the streams through channel widening and could damage habitat for fish and other aquatic life that need deep stream beds. Sub-basins with channel segments that are unstable (indicated by stream survey data) or are recovering slowly from past channel widening are shown in the Synthesis Table.

4. **Peak Stream Flows**

   Increased peak flows due to loss of vegetation could degrade some stream channels by increasing bank erosion and channel bed scour. This, in turn, could degrade habitat for aquatic organisms. Sub-basins that have a high sensitivity and a high level of concern for increased peak flow are shown in the Synthesis Table.

Synthesis Table

Ecological Condition Concerns by Sub-basin

	Unstable Areas	Surface Erosion	Unstable Channels	Channel Widening	Peakflow	Interior Habitat	T,E,and S Plants	Owl Site Centers	Salamanders	Primary Pools	Large Woody Debris	Water Temperature	Turbidity	Aquatic Habitat Frag.	Road Density > 3	Dark Divide Habitat	Total
23 A - Upper Lewis River																	0
23 B - Twin Falls Creek																	0
23 C - Pass Creek						X						X		X			3
23 D - Steamboat Creek					X	X					X	X	X	X			6
23 E - Upper Quartz Creek								X									1
23 F - Pin Creek																	0
23 G - Upper Sidewall Tribs											X		X	X	X		4
23 H - Lower Sidewall Tribs				X			X										2
23 I - French Creek							X		X								2
23 J - Straight Creek	X	X				X	X		X	X							6
23 K - Lower Tillicum Creek						X						X		X			3
23 L - Boulder Creek						X	X				X	X			X		5
23 M - Snagtooth Creek					X	X		X	X	X				X			6
23 N - Middle Quartz Creek	X	X							X	X							4
23 P - Deer Creek																	0
23 Q - Middle Tillicum Creek					X	X					X		X	X			5
23 R - Surprise Meadow						X							X	X			3
23 S - Up. Tillicum/Strawberry														X			1
23 T - Poison Creek	X		X	X		X						X					5
23 U - Swampy Creek						X	X	X			X		X	X			6
23 V - NF Pass Creek	X					X							X	X			4
23 W - NF Swampy Creek												X	X				2
23 X - Platinum Creek					X	X				X	X	X		X	X		7
23 Y - Upper Frontwall Tribs.						–								X			1
23 Z - Lower Frontwall Tribs.						X								X			2

- Denotes sub-basins with five or more concerns

FIGURE 8

5. Interior Habitat Fragmentation

Openings created through past clearcut and regeneration have resulted in fragmentation of natural stands and loss of interior habitat. Managed stands (0-40 years) are much smaller in size and are more dispersed than young forests which originated from wildfire prior to settlement. Extensive road construction for harvest and other management has also reduced interior habitat. This rapid change in vegetation patch size, distribution, and continuity may reduce the quality of habitat for certain wildlife and plant species.

Fragmentation and loss of interior habitat is of highest concern in the Late Successional Reserve. Fragmentation is also a concern in portions of Matrix lands and riparian reserves that have high proportions of small, dispersed young managed stands. Matrix lands and riparian reserves are to serve as connectivity between late successional reserves and provide habitat for a variety of organisms associated with both late successional and younger forests.

The Synthesis Table shows the sub-basins where fragmentation of interior habitat is a concern. Sub-basins of concern were identified by evaluating proportion and size of interior habitat blocks with respect to individual sub-basins and aggregates of sub-basins. A specific level of threshold was not used, but a visual evaluation was made of block size and connectivity at a variety of scales.

6. Threatened, Endangered and Sensitive Plants

Past surveys for Threatened, Endangered and Sensitive Plants did not include surveys for the recently identified C-3 species in the President's Forest Plan. Past management actions have changed the historic vegetation distribution. Habitat conditions needed by the known populations of sensitive plants, and other populations as yet undiscovered, may be adversely affected by future management actions. This could reduce the viability and abundance of species requiring protection.

7. Northern Spotted Owl Site Centers

Two northern spotted owl home ranges within the Upper Lewis Watershed are presently below "take" thresholds set by the USDI Fish and Wildlife Service. These owl sites are recognized as not having enough high quality habitat within their home range to sustain viability or to provide adequate habitat for successful reproduction. One site is located in the Matrix and the other in Late Successional Reserve. Sub-basins where spotted owl home ranges are below minimal thresholds are identified in the Synthesis Table.

8. Salamanders

Populations of Larch Mountain and Van Dykes salamanders were found in the Upper Lewis River watershed. Both species are highly specialized and very sensitive to changes in their habitat. Little information is available on their abundance and

distribution. Because of this lack of data, it is virtually impossible to understand how known sites function at a watershed level (Upper Lewis River), as well as a sub-basin level (Lewis River sub-basins). Sub-basins where either species was located are displayed in the Synthesis Table.

9. Aquatic Habitat Attributes

Primary pools/mile and pieces of large woody debris/mile are below regional standards. These key habitat attributes are critical for resident fish survival. Sub-basins that rated 100 percent "poor" for pools and over 90 percent poor for large woody debris are displayed in the Synthesis Table.

10. Water Temperature

Water temperature exceeds State of Washington standards in Quartz Creek and the Lewis River. Sub-basins that have more than 25 percent of the Riparian Reserve along streams that has been harvested are displayed in the Synthesis Table.

11. Turbidity

The amount of suspended sediment in water is a concern in six of the 25 sub-basins. Sub-basins that were noted as having turbid water during a field visit are shown in the Synthesis Table.

12. Aquatic Habitat Fragmentation

There are three major dams along the Lewis River. These dams block the migration of anadromous salmon to the upper reaches of the river where they once spawned. In addition to the dams, road building without adequate facilities for passage of fish has increased aquatic habitat fragmentation. Sub-basins with over 1.0 road crossings per fish-bearing stream mile are shown in the Synthesis Table.

13. Road Densities

Road densities in some areas exceed 3.0 miles per square mile. This may be an indication of potential road related sediment problems in stream systems. Roads can contribute fine (turbidity) and coarse sediment through road cut and fill failures and surface erosion. This sediment could degrade aquatic habitat and pose risks to facilities such as bridges and campgrounds. Sub-basins with three or more miles of road per square mile are shown in the Synthesis Table.

14. Dark Divide Area Remote Experience

The Dark Divide Area offers one of the few remaining isolated areas of interior forest habitat in the Upper Lewis Watershed as well as in the entire Lewis River drainage. As a result, this area may provide refuge for wildlife species highly sensitive to human disturbance. For instance, a highly reliable wolf sighting occurred there in 1992. Sub-basins containing remote qualities are identified in the Synthesis Table.

Protecting the remoteness of this area is seen as a problem. Roads extending to the edge of the Dark Divide Area are causing the perimeter areas to be overly used. If more roads are built then the perimeter will become even more accessible and gradually the "remote area" will shrink as people begin to penetrate the edges.

CHAPTER VII OPPORTUNITIES FOR MANAGEMENT

Desired Future Conditions

Desired conditions were developed from review of past and current watershed conditions and from management direction elaborated in the President's Forest Plan and the 1990 GPNF Forest Plan. Figure 9, Desired Conditions, summarizes the desired conditions for the Upper Lewis Watershed based on ecological processes and functions.

Figure 10, Existing Condition Compared to Desired Condition and Trends, shows how the Upper Lewis Watershed existing conditions relate to trends and desired conditions.

Management Opportunities

After reviewing desired conditions and expected trends for the overall watershed and individual sub-basins, management objectives were developed. These objectives were used to identify the kinds of management activities which appear to be appropriate for particular sub-basins. The next step after watershed analysis is to develop site specific project proposals which will be analyzed for environmental effects (NEPA process) before making decisions about which projects to implement (see Figure 11, Restoration and Monitoring Opportunities and Figure 12, Management Activities)

Evaluation of Riparian Reserves

The ID Team recommends maintaining interim ROD widths for intermittent streams, unstable and potentially unstable areas, permanently flowing streams, ponds, and wet areas or wetlands. There are two large unstable areas (Poison Creek and North Fork Pass Creek) that may be adjusted through site specific analysis conducted at the project level. These two areas are currently mapped as general areas which have incursions of stable ground within the larger boundaries.

Further evaluation is needed to adjust specifically identified processes and activities that may influence recommendations to the ROD interim widths. The following is a list of information needs identified by the ID Team in order to make adjustments from the interim Riparian Reserves widths listed in the ROD:

- What role do the Riparian Reserves have in connecting other reserve areas/special habitats to one another across the landscape?

- Are the conditions, such as channel configuration, stream temperature, connectivity, and unstable areas in this watershed different from the ROD standards and guidelines?

- What is the geomorphology of stream channels in the watershed?

Desired Conditions

Ecological Condition Concerns	Desired Condition
Peakflow	The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected[1] The distribution of land use activities, such as timber harvest or roads, must minimize increases in peak flows[2]
Interior Habitat	In LSR, protect and enhance conditions of late successional and old growth forest ecosystems[3] In matrix, provide adequate level of dispersal habitat for late successional and old growth forest species[4] Reflect a historic perspective of large continuous blocks of succession/disturbance rather than many small, scattered openings
T,E,&S Species (plants)	Provide and maintain habitat/viability of known T,E,&S plant species. Ensure high likelihood of locating and protection of C-3 species within LSR and Matrix lands of the watershed[5]
Owl Site Centers	Spotted owl home range containing less than 40% high quality habitat, is an indication of non-viability threshold[6]
Salamanders	Maintain suitable habitat conditions of all occupied sites[7]
Primary Pools	Number of large pools per mile are established by the PIG and related to the average wetted width[8]
LWD in Streams	≥80 pieces/mile that are ≥50' long and 36" dbh[9]
Water Temperature	Temperatures shall not exceed 16.0°C due to human activities[10] Historic range of maximum stream temperature in the Lewis River Basin was 14-19°C[11]

[1] ROD Aquatic Conservation Strategy Objectives-B11

[2] ROD Aquatic Conservation Strategy Objectives-B9

[3] ROD Late Successional Reserve Objectives-A4

[4] ROD Matrix Objectives-C44

[5] ROD S&G-C4,C19

[6] USDI Fish and Wildlife Service Take Guides

[7] ROD Survey and Manage-C4

[8] Columbia River Basin Policy Implementation Guide

[9] Columbia River Basin Policy Implementation Guide

[10] Water Quality Standards for Waters of the State of Washington

[11] Regional Ecological Assessment Project

FIGURE 9

Ecological Condition Concerns	Desired Condition
Turbidity	Turbidity shall not exceed 5 NTU over background turbidity when the background turbidity is 50 NTU or less[1]
Aquatic Habitat Fragmentation	Provide and maintain fish passage at all road crossings of existing and potential fish-bearing streams[2] New stream crossings on fish-bearing streams should be designed to allow fish passage[3]

[1] Water Quality Standards for Waters of the State of Washington

[2] ROD S&G's-C33

[3] Gifford Pinchot National Forest LRMP

FIGURE 9-Cont.

Existing Condition Compared to Desired Conditions and Trends

Ecological Condition Concerns	Existing Condition Compared to Desired Condition	Effects to Beneficial Uses	Trends
Unstable Channels/Sed-imentation	Not able to determine One segment on the Lewis River and sub-basin 23t have unstable channels and/or are experiencing slow recovery to past channel widening from sediment input	Increased bank erosion, channel widening, channel migration, pool filling, sedimentation Degradation of aquatic habitat. Loss or damage of facilities (campgrounds, bridges)	Recovering - riparian reserves, designation of Tier 1 key watershed, proposed restoration projects of road decommissioning and planting
Peakflow	Outside Desired Condition Sub-basins 23x, 23m, 23q, 23d have high sensitivity and high level of concern. Sub-basins 23y and 23k have a high sensitivity and a moderate level of concern with potential changes in peakflow Sub-basin 23v had a 15-37% increase, sub-basin 23w had a 13-32% increase, and sub-basins 23c and 23d had a 12-30% increase in the drainage network due to roads.	Increased bedscour, bank erosion, channel widening or downcutting, channel migration, sedimentation Degradation of aquatic habitat. Loss or damage of facilities (campgrounds, bridges) See above	Recovering - designation of LSR in a portion of the basin, retention within new harvest units, riparian reserves, designation of Tier 1 key watershed, proposed restoration projects of road decommissioning and planting Recovering - proposed restoration projects including road decommissioning

FIGURE 10

Ecological Condition Concerns	Existing Condition Compared to Desired Condition	Effects to Beneficial Uses	Trends
Interior Habitat	The percentage of late seral forest is within range of natural variability, however the spatial arrangements are outside	Loss of interior habitat (wildlife and plant) in matrix limits dispersal between reserves	In LSR- Recovering, as fragmented areas gain LSOG characteristics In matrix- Increased forest fragmentation of interior habitat; forest ecotones; and stand distributions. It is important to identify key interior habitat patches that provide essential links between reserves
T,E,and S Species (plants)	Not able to determine The seven known sensitive species within the watershed will continue to be protected. Historic occurrance/distribution of known and potential T,E,&S species unknown. Habitat exists in the watershed that will support many of the C-3 and T,E,&S species	Loss of interior habitat for plant species dependant on that habitat	Old growth forest remaining in the Late Successional Reserves will continue to support habitat conducive to many C-3 species and T,E,&S plant species. Fragmentation of habitat will continue to occur within the matrix land.
Owl Site Centers	Outside Desired Condition Habitat within home range of several pairs of spotted owls occupying the LSR is highly fragmented. It involves the following sub-basins: 23j, 23m	Reduced viability of later seral and old growth forest species	In LSR- Recovering, as fragmented areas gain LSOG characteristics

FIGURE 10.Cont.

Ecological Condition Concerns	Existing Condition Compared to Desired Condition	Effects to Beneficial Uses	Trends
Salamanders	Not able to determine Populations of Larch Mountain and Van Dyke's salamanders have been found in sub-basins 23d, 23e, 23j, 23m, 23n	Reduced viability of species with specialized habitat needs	Constant- Due to ROD S&G's that will buffer all known sites from activities that may disrupt habitat
Primary Pools	Outside Desired Condition Stream surveys indicate only 3% of surveyed segments meet standards	Reduced rearing habitat and over-winter survival for fish. Reduced habitat complexity and increased stream velocities	Recovering - riparian reserves, LSR, designation of Tier 1 key watershed, proposed restoration projects of road decommissioning and riparian planting
LWD	Outside Desired Condition Stream surveys indicate all streams except Tillicum Creek are below LWD standards	Degradation of aquatic habitat through habitat simplification, loss of channel roughness and increased channel bed scour, altered nutrient cycling	Recovering - riparian reserves, LSR, designation of Tier 1 key watershed, proposed restoration projects of road decommissioning and riparian planting

FIGURE 10 Cont.

Ecological Condition Concerns	Existing Condition Compared to Desired Condition	Effects to Beneficial Uses	Trends
Water Temperature	Possibly outside Desired Condition Water temps >16°C in Quartz Creek (in analysis area) and Lewis River (below analysis area) in 1988. Sub-basin 23d, 23g, 23l, 23q, 23x had > 25% of the riparian reserve along streams harvested	High stream temperatures stress aquatic organisms	Recovering- riparian reserves, designation of Tier 1 key watershed, proposed restoration projects of road decommissioning and riparian planting
Turbidity	Not able to determine Insufficient data to determine "background" level for turbidity on the Lewis River and Quartz Creek	Increased pool filling, bank erosion, channel widening, channel migration, sedimentation Degradation of aquatic habitat. Loss or damage of facilities (campgrounds, bridges)	Recovering- designation of Tier 1 key watershed, proposed restoration projects of road decommissioning and erosion control along existing roads
Aquatic Habitat Fragmentation	Outside Desired Condition High road densities and road crossings over fish-bearing streams in sub-basins 23d, 23g, 23r, 23u, 23v, 23w, 23x	Limited distribution of resident salmonids and other migratory aquatic organisms	Recovering to occupy historic ranges - riparian reserves, designation of Tier 1 key watershed, and proposed restoration projects of road decommissioning and road crossing repair

FIGURE 10 Cont.

Restoration and Monitoring Opportunities

Ecological Condition Concern	Objective	Activities	Activity Priority	Locations
Unstable Areas	Reduce frequency and volumes of landslides to more reflect historic conditions in the watershed.	1) Road decommissioning in areas with unstable features	High	**23d**,23j,23n,23t,23v
		2) Road reconstruction to correct drainage problems and stabilize sections that are prone to failure	High	**23d**,23j,23n,23t,23v
		3) Trail rehabilitation to bypass unstable areas or correct existing drainage problems	Medium	**23j,23m,23n,23i,23e**
		4) Phase II ATM surveys to identify problem areas in existing roads	High	**23d,23j,23n,23t,23v** All other sub-basins
		5) Slide rehabilitation to stabilize slides	Medium	**23d,23j,23n,23t,23v**
		6) Detailed mapping of the 2 large unstable areas to further define stable inclusions within	High	**23t,23v,23d,23y,23u**
Surface Erosion	Reduce frequency and volumes of surface erosion to more reflect historic conditions in the watershed.	1) Road decommissioning in areas with high surface erosion potential	High	**23j,23n**
		2) Road reconstruction to correct drainage problems and stabilize sections that are prone to high surface erosion	High	**23j,23n**
		3) Phase II ATM surveys to identify problem areas in existing roads	High	**23j,23n** All other sub-basins
		4) Erosion control projects to stabilize areas of high surface erosion	Medium	**23j,23n**

*Locations shown in **bold** are considered high priority areas to conduct described activities

FIGURE 11

Ecological Condition Concern	Objective	Activities	Activity Priority	Locations
Unstable Channels	Reduce sediment input to stream channel segments that are unstable or recovering slowly from past channel widening caused by human activity. This will help stabilize these channel segments by restoring sediment regimes to more reflect historic conditions in the watershed.	1) Road decommissioning in areas with unstable channels	High	**23d,23k,23u,23x, 23c,23q**,23g,23m, 23r,23v,23y,23z
		2) Road closures in areas with unstable channels	Medium	**23d,23k,23u,23x, 23c,23q**,23g,23m, 23r,23v,23y,23z
		3) Road reconstruction to correct drainage problems and stabilize sections that are prone to failure	High	**23d,23k,23u,23x, 23c,23q**,23g,23m, 23r,23v,23y,23z
		4) Trail rehabilitation to bypass unstable areas or correct existing drainage problems	Medium	**23j,23m,23n,23i, 23e**
		5) Phase II ATM surveys to identify problem areas in existing roads	High	**23d,23k,23u,23x, 23c,23q** All other sub-basins
		6) Slide rehabilitation to stabilize slides	Low	**23d,23j,23t,23v**
		7) Detailed mapping of the 2 large unstable areas to further define stable inclusions within	Medium	**23t,23v,23d,23y, 23u**
		8) Stream surveys to determine sediment sources and unstable channel locations	High	All sub-basins
		9) Dispersed campsite rehabilitation to stabilize near channel sediment sources	Low	23j and other locations as they are found

*Locations shown in **bold** are considered high priority areas to conduct described activities

FIGURE 11 Cont.

Ecological Condition Concern	Objective	Activities	Activity Priority	Locations
Peakflow	Accelerate development of hydrologically mature coniferous vegetation, reduce basin compaction, and decrease the extension of the stream channel network due to roads. This will restore the amount and timing of runoff to reflect historic conditions in the watershed.	1) Road decommissioning in areas with peakflow concerns	High	**23d,23m,23q,23x**
		2) Road reconstruction to decrease distances between relief culverts	Low	**23d,23m,23q,23x**
		3) Precommercial thinning in plantations to encourage growth of conifers	High	**23d,23m,23q,23x**
		4) Conduct stream surveys to detect channel damage from increased peakflow	Medium	All other sub-basins
Interior Habitat	In the LSR-Accelerate development of late successional forest characteristics in managed stands and improve structural diversity in young stands. In the matrix-Accelerate mid to late successional stand conditions and improve/maintain conductivity between reserves.	1)Precommercial thinning to accelerate development of large trees and stand composition/structural diversity	High	**23c,23d,23j,23k, 23l,23m,23q,23r, 23t,23u,23v,23x, 23z**
		2) Interplanting and planting to establish tree cover and accelerate development of large trees and stand compositional/structural diversity	Medium /High	**23c,23d,23j,23k, 23l,23m,23q,23r, 23t,23u,23v,23x, 23z**
		3) Fertilization to accelerate development of large trees and structural diversity	Medium	All sub-basins
		4) Monitoring results of silviculture activities and habitat recovery	High	**23c,23d,23j,23k, 23l,23m,23q,23r, 23t,23u,23v,23x, 23z**
		5) Noxious weed eradication to control or contain spread of weeds having limited distribution deemed noxious	Medium	**23c,23d,23j,23k, 23l,23m,23q,23r, 23t,23u,23v,23x, 23z**

*Locations shown in **bold** are considered high priority areas to conduct described activities

FIGURE 11 Cont.

Ecological Condition Concern	Objective	Activities	Activity Priority	Locations
T,E,&S Plants	Provide and maintain habitat viability of known T,E,&S plants. Ensure likelihood of locating and protecting other T,E,&S species and C-3 species.	1) Survey, map and monitor known and potential sites for T,E,&S plants	Medium	All Subbasins
		2) Fertilization to accelerate development of large trees and structural diversity	Low	**23h,23i,23j,23l, 23w**
		3) Precommercial thinning to accelerate development of large trees and stand compositional/structural diversity	Low	**23h,23i,23j,23l, 23w**
		4) Noxious weed eradication to control or contain spread of weeds having limited distribution deemed noxious	Medium	**23h,23i,23j,23l, 23u**
Owl Site Centers	Owl home ranges lacking adequate levels of high quality habitat can not sustain viability or successful reproduction. Accelerate development of late seral forest characteristics within the home range of spotted owl sites 110 and 3009.	1) Precommercial thinning to accelerate development of large trees and stand compositional/structural diversity	High	**23m**,23h
		2) Interplanting and planting to establish tree cover and accelerate development of large trees and stand compositional/structural diversity	Medium	**23m**,23h
		3) Large woody debris placement in units lacking an adequate level	Medium	**23m**,23h
Salamanders	Larch Mountain and Van Dyke's salamanders are highly sensitive to changes in their habitat. Little information is available on the abundance and distribution throughout the watershed. It is an objective to maintain current population levels of these salamanders in this watershed.	1) Continue salamander surveys to determine abundance and distribution	High	**23e,23i,23j,23l, 23u**

*Locations shown in **bold** are considered high priority areas to conduct described activities

FIGURE 11 Cont.

Ecological Condition Concern	Objective	Activities	Activity Priority	Locations
Primary Pools	Validate current Regional standards for primary pools in this watershed and where appropriate, increase the number of primary pools in streams	1) Installing LWD and/or boulders in streams to create primary pools	Medium	**23j,23m,23n,23x,** 23u,23w
		2) Conduct stream surveys to determine desired conditions for primary pools, validate standards and identify other areas lacking primary pools	High	All sub-basins
		3) Precommercial thinning to accelerate development of large trees in the riparian area to provide future LWD for pool formation	Low	**23g,23x,**23d,23l, 23q,23j,23v
Large Woody Debris	Validate current Regional standards for LWD in this watershed. Where appropriate, increase development of large coniferous trees in riparian reserves (along streams) to provide for future in-channel LWD needs.	1) Precommercial thinning to accelerate development of large trees in the riparian area to provide future LWD	Medium	**23g,23x,**23d,23l, 23q,23j,23v
		2) Interplanting and planting diverse coniferous species in hardwood dominated Riparian Reserves along streams	Medium	On-ground surveys needed to locate site
		3) Conduct stream surveys to determine desired conditions for LWD, validate standards, and identify other areas lacking LWD	High	All sub-basins
Water Temperature	Provide stream shading along perennial streams that are lacking shade, to moderate water temperatures. Also, further define influences on water temperature in the watershed.	1) Monitor water temperature to determine current condition of streams	High	**23d,23g,23l,23q, 23x,23j**
		2) Planting coniferous and hardwood trees along perennial streams that lack vegetation	High	**23d,23g,23l,23q, 23x**

*Locations shown in **bold** are considered high priority areas to conduct described activities

FIGURE 11 Cont.

Ecological Condition Concern	Objective	Activities	Activity Priority	Locations
Turbidity	Reduce turbidity levels in streams to restore sediment regimes that more reflect historic conditions in the watershed.	1) Road decommissioning in areas with high turbidity and high road density	High	**23d,23k,23c,**23t, 23w,23g,23m,23q 23r,23s,23v,23x
		2) Road closures in areas with high turbidity and high road density	High	**23d,23k,23c,**23t, 23w,23g,23m,23q 23r,23s,23v,23x
		3) Road reconstruction to correct drainage problems and stabilize sections that have surface erosion problems	High	**23d,23k,23c,**23t, 23w,23g,23m,23q 23r,23s,23v,23x
		4) Phase II ATM surveys to identify problem areas in existing roads	High	**23d,23k,23c** Other remaining sub-basins
		5) Slide rehabilitation to stabilize slides	Low	**23d,23k,23c**
		6) Stream surveys to determine sediment sources	Medium	All subbasins
		7) Monitor turbidity to determine "background" conditions	High	**Lewis River**
Aquatic Habitat Fragmen-tation	Restore aquatic habitat connectivity along streams by decreasing the number of road crossings without adequate passage for fish	1) Replace or remove culverts in fish-bearing streams, that are impassible to fish	High	**23d,23s,23t**,23g, 23q,23r,23u,23v, 23w,23x
		2) Use Phase 2 ATM to identify culverts without adequate fish passage	High	**23d,23s,23t**,23g, 23q,23r,23u,23v, 23w,23x

*Locations shown in **bold** are considered high priority areas to conduct described activities

FIGURE 11 Cont.

Ecological Condition Concern	Objective	Activities	Activity Priority	Locations
Road Density >3 miles per square mile	Reduce sediment input to stream channels by decreasing miles of open road. This will help restore sediment regimes that more reflect historic conditions in the watershed.	1) Road decommissioning in areas with high road density	High	**23c,23d,23g,23k, 23m,23q,23r,23s, 23v,23x,23y,23z**
		2) Road closures in areas with high road density	Medium	**23c,23d,23g,23k, 23m,23q,23r,23s, 23v,23x,23y,23z**
		3) Phase II ATM surveys to identify problem areas in existing roads	High	**23c,23d,23g,23k, 23m,23q,23r,23s, 23v,23x,23y,23z**
Dark Divide Habitat	Increased human use in the Dark Divide area may reduce its habitat effectiveness for species highly sensitive to human presence. It is important to maintain the remote qualities possessed by the Dark Divide area.	1) Monitor human use levels	High	**23g,23l**,23m
		2) Survey and monitor for species sensitive to human disturbance	Medium	**23g,23l**,23m
		3) Close perimeter roads to reduce disturbance	High	**23g,23l**,23m

*Locations shown in **bold** are considered high priority areas to conduct described activities

FIGURE 11 Cont.

Management Activities

Need	Objective	Activities	Locations
Sustained Timber Supply from Matrix	Maximize volume production and product quality of Matrix managed stands	1) Harvest and regeneration of stands at culmination of mean annual increment	23a,23b,23c,23d,23f, 23g,23r,23s,23u,23v, 23w,23y,23z
		2) Precommercial thinning to maintain tree/stand growth	23d,23r,23z,23k,23q
		3) Commercial thinning to maintain tree/stand growth and utilize imminent mortality	23c,23d,23g,23q,23r, 23s
		4) Fertilization to maintain tree/stand growth	Evaluate managed stands in Matrix with precommercial thinning and commercial thinning complete
		5) Pruning for high wood quality	Evaluate managed stands in Matrix ages 10-25 yrs with precommercial thinning complete
		6) Planting to regenerate harvested areas	23l,23g,23f,23j,23c,23t
	Review (validate/modify) Probable Sale Quantity (PSQ) and timber opportunities in the watershed	1) PSQ and Timber Opportunity/Priorities analysis	All Matrix sub-basins
Accommodate diverse recreational uses with minimum user and resource conflict	Develop strategies and develop/maintain facilities in areas with user conflict and resource concerns	1) Develop Dispersed Recreation Plan	23x,23j,23m,23n,23e, 23i,23h
		2) Develop, improve, maintain trails	23x,23j,23m,23n,23e, 23i,23h
		3) Develop, improve, maintain campgrounds	23x,23j,23m,23n,23e, 23i,23h

FIGURE 12

Need	Objective	Activities	Locations
Managing increasing demand for miscellaneous special forest products such as mushrooms, beargrass, transplants, huckleberries	Provide opportunities for harvest of special forest products which minimize other resource effects and conflicts	1) Develop Special Forest Products Management Plan	All sub-basins
		2) Harvest of special products	All sub-basins
		3) Monitoring for use and conflicts	All sub-basins
Enhance the recreational experience by improving the unnatural appearance of managed stand edges seen from major travel routes.	Modify visual contrast of managed stand edges (straight line,sharp edges) on views from Roads 90,23,and the Lewis River.	1) Moderate to high retention timber harvest along sharp managed stand edges	23a,23b,23g,23u,23b, 23w,23y,23z
		2)Precommercial and commercial thinning of managed stands to accelerate tree and stand growth and structural development	23a,23b,23g,23u,23b, 23w,23y,23z

FIGURE 12 Cont.

Timber Opportunities

The Upper Lewis Watershed Team reviewed current and desired conditions and identified sub-basins appearing to have the best timber harvest opportunities in the next five years. The Team used the following two-step approach:

1. First, sub-basins with areas available for timber harvest were identified.

These sub-basins are located:

a) within the Matrix allocation (President's Forest Plan),

b) outside of more restrictive Forest Plan allocations which do not include programmed harvest, and

c) outside of broad geologic unstable riparian reserve areas.
(Riparian reserves along streams, lakes and meadows were considered inclusions and not eliminated at this stage).

Sub-basins with areas available for timber harvest include:

Upper Lewis (23A) Upper Sidewall Tribs. (23G) Swampy Cr. (23U)
Twin Falls Cr. (23B) Boulder Creek (23L) NF Pass Cr. (23V)
Pass Cr. (23C) Middle Tillicum Cr. (23Q) NF Swampy CR. (23W)
Steamboat Cr. (23D) Surprise Meadow (23R) Up. Frontwall Tribs. (23Y)
Pin Cr. (23F) Up. Tillicum/Strw Cr. (23S) Low. Frontwall Tribs. (23Z)

See Map 21, Programmed Timber Harvest Areas, for locations of available programmed harvest.

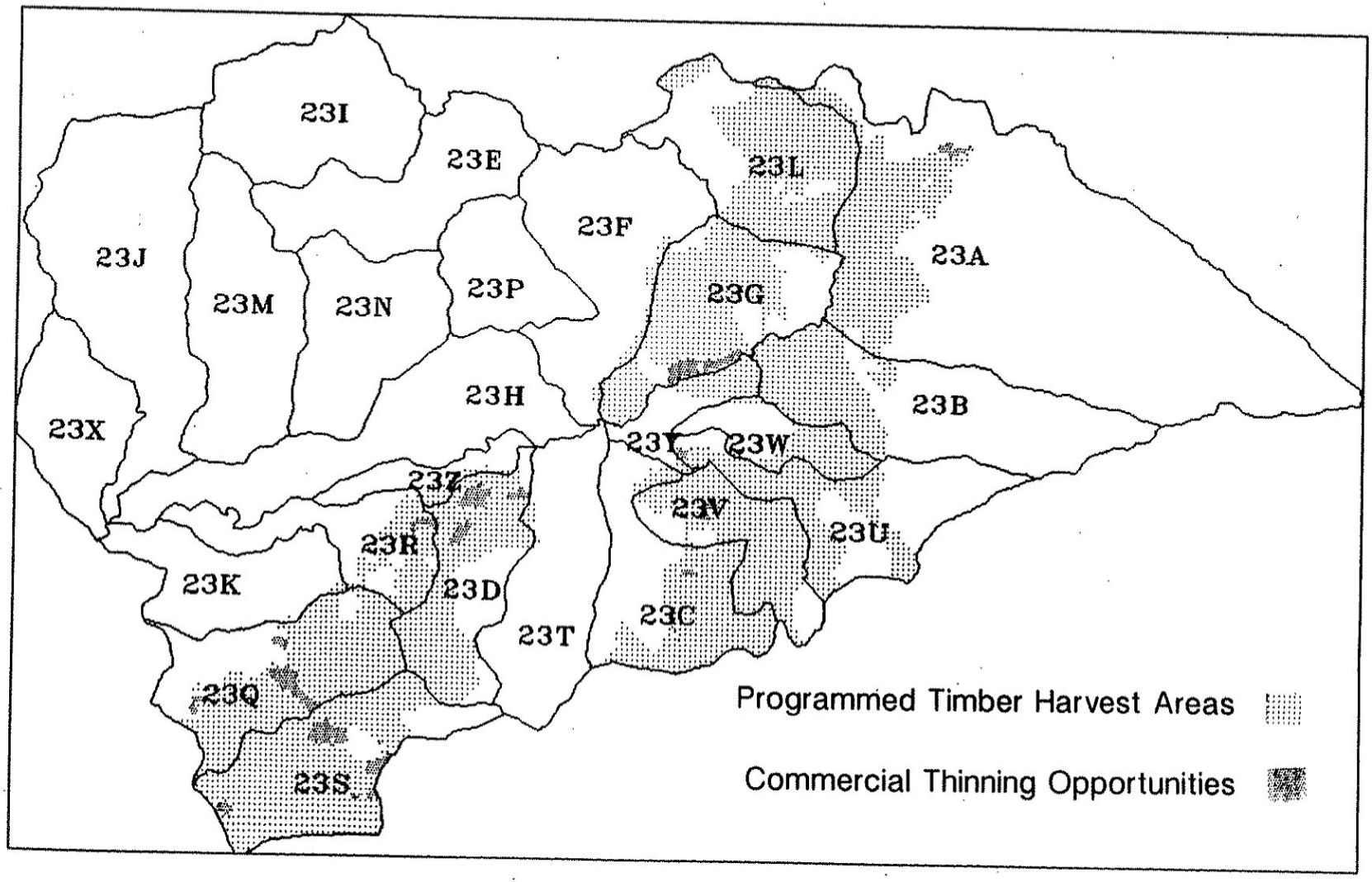
2. Next, the conditions of the above sub-basins were evaluated to determine relative harvest priorities. Peakflow, turbidity, amount of recent harvest, and stand conditions were key factors used to determine priority.

a) From this initial watershed analysis screening, sub-basins considered to have the highest priority regeneration harvest areas in the next five years are:

Upper Lewis (23A) Upper Sidewall Tribs. (23G) Low. Frontwall Tribs. (23Z)
Twin Falls Cr. (23B) NF Pass Cr. (23V) Up. Frontwall Tribs. (23Y)
Pass Cr. (23C) Surprise Meadow (23R) NF Swampy CR. (23W)
Pin Cr. (23F) Up. Tillicum/Strw Cr. (23S)

These sub-basins have stands with high priority regeneration needs and relatively low amount of condition concerns which favor delay of harvest for additional recovery based on this initial screening in the watershed analysis.

Programmed Timber Harvest Areas



MAP 21

b) Sub-basins considered to have the highest priority for more detailed investigation of commercial thinning opportunities in the next five years are:

Pass Cr. (23C) Mid. Tillicum Cr. (23Q)
Steamboat Cr. (23D) Up. Tillicum/Strw (23S)
Up. Sidewall Tribs (23G) Surprise Meadow (23R)

These sub-basins contain stands of 35 to 80 years old which are in the matrix and have not been previously thinned.

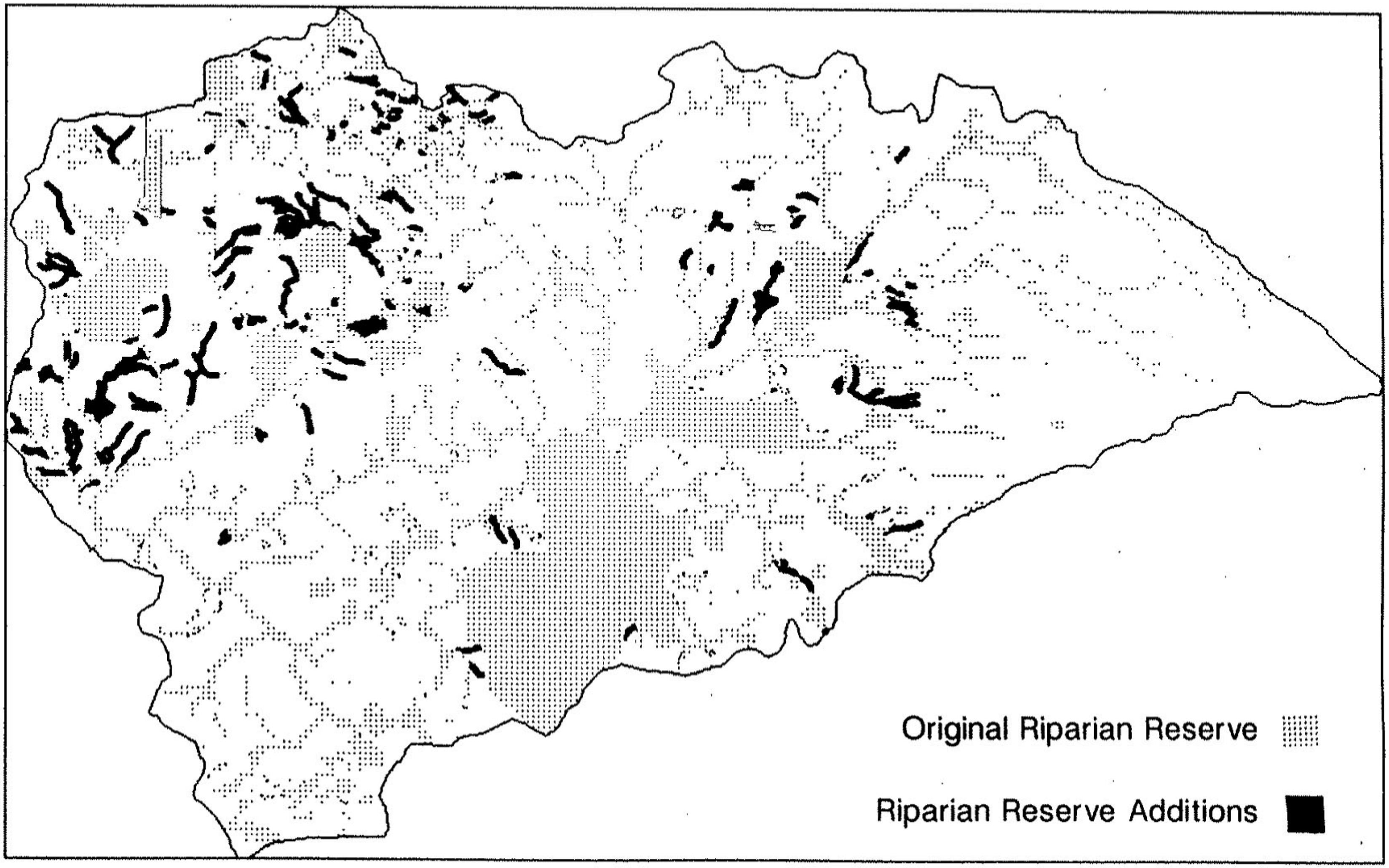
Map 21 also shows areas considered to be highest priority for more detailed investigation of regeneration harvest and commercial thinning in the next five years.

Information for PSQ Evaluation

This watershed analysis process has resulted in identification of 2,700 acres of stream riparian reserves that were not mapped prior to the analysis. The analysis team conducted a detailed photo and map search for additional Class IV streams on about one-third of the watershed. On the sub-basins reviewed in detail for additional Class IV streams, riparian reserves only for streams represented 19 percent of the total area. This compares with a pre-analysis figure of 15 percent in stream riparian reserves for the same area (Map 22, Riparian Reserve Additions).

A critical data need to estimate the PSQ is completion of a detailed review of Class IV streams in the watershed.

Riparian Reserve Additions



MAP 22

CHAPTER VIII DATA GAPS

The following are data gaps for this analysis.

- Valley segment types were not mapped for portions of the analysis area. Segments that were stream surveyed with the addition of the Lewis River were segment typed, leaving a number of streams in the upper watershed without valley segment types assigned to them.

- Stream temperature data was not available for a majority of the steams in the analysis area. Where it was available, it was incomplete and ended in 1988 (some scattered data available after 1988).

- Minimal data that was pertinent to hydrologic interpretations such as width/depth ratios, pebble counts, cross sections, v* was collected during stream surveys

- The GIS vegetation layer for Mount Adams had a number of missing pieces of information including stand year origin.

- There is a need to complete road surveys so possible restoration opportunities as well as potential sediment production figures can be identified.

- There is a need for historic information on stream temperatures, turbidity, and other physical stream channel parameters such as pools per mile and amounts of LWD for this area.

- There is a need for abundance data for aquatic organisms (fish and others) in the analysis area.

- Standards identified regionally for pools/LWD may not be appropriate for this sub-basin. An analysis determining more specific standards for pools and LWD needs to be developed at the Forest and basin level.

- There is a need for abundance data and objectives for bull trout populations in the Lewis River basin.

- Stream surveys only cover approximately 1/3 of the analysis area. Nine sub-basins have no stream survey data and 16 sub-basins have incomplete stream surveys.

- There is a need for stream survey information in pristine sub-basins, to develop relationships between current channel conditions in managed sub-basins with those in unmanaged sub-basins.

- There is a need to know where and how much special forest products are being gathered.

There is a need for specific riparian vegetation data to quantify shade, species composition and existing condition of the Riaprian Reserves.

- There is a need to know where and the amounts of special forest products being gathered.

- We lack the capability to run the spatial relationship model. This would allow for the habitat assessment of various life history guilds.

- There is a lack of data on current levels of terrestrial coarse woody debris (dead and down as well as standing dead).

- Need an assessment to determine if reserves (American marten and pileated woodpecker) in forest Matrix are needed to maintain viability of these species.

- Small stream temperature data is needed for assessing salamander habitat potential.

- Historic and current plant surveys for Threatened, Endangered, and Sensitive species were limited to site-specific areas and have been accomplished on less than five percent of the watershed. Abundance data of specific plant species (noxious weeds and TE & S species) is not known.

- The President's Forest Plan calls for surveys and management of numerous species of vascular plants and non-vascular plants including fungi, lichens, and bryophytes. Information on many of these species is lacking within the Upper Lewis River watershed.

- There is a need for information on habitat use and population abundance for aquatic organisms other than fish (e.g. molluscs, macroinvertebrates, amphibians, etc.)

- There is a need to assess effectiveness of road closures in the watershed.

Appendix A

APPENDIX A KEY QUESTIONS

REVISED KEY QUESTIONS UPPER LEWIS RIVER WATERSHED ANALYSIS

I VEGETATION

A. What is the current /potential vegetation within the watershed?

1. Riparian

   What is the Current Condition and how does it compare to the Range of Natural Variability of the relative proportions of early, middle and late seral vegetation in the riparian zone?

2. Terrestrial Vegetation:

   What is the current vegetative condition (seral stages)in acres and distribution across the watershed, and how does it compare to the range of natural variability for seral stages across the watershed? What is the potential vegetative condition of the watershed (Climax Forest Potential) and what are the projected vegetative conditions within the watershed, assuming no management activities were to occur in the next 100 years?

B. Where and what kind of special haitats are present within the watershed?

1. Aquatic/Riparian Habitat:

   Where are the areas of existing or potential special habitat use by aquatic species?

2. Terrestrial Vegetation:
   Plant Species of Concern:

   Where are the extant, historic and potential sites for these taxa?

   What is determining the distribution of these taxa? Is suitable habitat diminishing, increasing, remaining the same and if so why? What areas, if any, have been inventoried and where are priority areas for future inventory?

C. What plant species of concern or noxious weeds are found within the watershed?

1. Aquatic Biology: (Relative to aquatic plants, non-salmonide fish, etc.)

   No module currently available but recognized as a crucial element in the ecosystem and identified as a Key Question for tracking.

2. Terrestrial Vegetation
   Plant Species of Concern:

   What are the taxa of concern that may occur within the watershed?

   Where are the extant, historic and potential sites for sensitive plants (i.e. where is the best habitat?) What is determining the distribution of these taxa? (i.e. is suitable habitat diminishing, increasing, remaining the same and if so why?) What areas, if any have been inventoried and where are priority areas for future inventory? How does the currentmosaic of landscape features (meadows, wetlands seral communities) compare to historic and potential mosaics?

II WILDLIFE

A. What wildlife species groups inhabit the watershed and what processes affect their welfare?

1. Aquatic Biology: (Relative to invertebrates, non-salmonid fish, etc.)

   No module currently available but recognized as a crucial element in the ecosystem and identified as a key question for tracking.

2. Wildlife Habitat:

   Where are the potential habitat locations for species and guilds of species?

   What are the rankings of habitat conditions for wildlife species/guilds of species?

   Based on landscape habitat assessment, what are the gaps and concerns for wildlife habitat?

   What species or guilds of species are known to occur or suspected to occur based on habitat suitability within the watershed?

Are there any unique habitats present that sustain TES species or provide other ecological niches?

What is the current condition of the deer/elk summer and winter range?

What is the current spotted owl habitat condition within the watershed and how is it linked to late successional reserves outside the watershed?

B. What are the processes effecting wildlife biological diversity?

1. Water Quality:

   Are temperatures in small streams acceptable for wildlife (Copes Giant salamanders 8-14 degrees C., Cascade Torrent salamanders 8-12 degrees C., tailed-frogs 11-12 degrees C? If not, describe problem areas.

2. Landscape Patterns:

   Fragmentation:

   How does the existing landscape compare to the historic range of conditions with regard to spatial patterns, spatial features (patch types, matrix, connectivity, fragmentation) and disturbance (frequency, intensity, distribution, size)

C. What wildlife species recognized as in peril are associated with the watershed?

1. Fish Habitat:

   What is the distribution and relative abundance of salmonid fish species in the watershed analysis unit?

2. Wildlife Habitat:

   Are there any unique habitats present that sustain TES species or provide other ecological niches?

   What is the current spotted owl habitat condition within the watershed and how is it linked to late-successional reserves outside the watershed?

III HILLSLOPE PROCESSES

A. What processes deliver sediment to aquatic systems and where do they occur within the watershed?

1. Sediment Routing

   Is this potential impact (sediment or peak flow) transported or routed to the indicator segment of concern?

2. Water Quantity:

   What is the history of floods and disturbances?

3. Hillslope Erosion:

   What is the hillslope erosion potential?
   Are contributing activities present?
   Is sediment delivered to streams?
   What areas are sensitive to forest practices?

4. Road Erosion:

   What are the roads erosion potential?
   Are contributing activities present?
   Is sediment delivered to streams?

5. Volcanic Eruption:

   Are volcanic eruptions part of the disturbance regime within this watershed? If so characterize the potential types of disturbance (lava flow, mudflow, pyroclastic flow, ash deposits).

   To the extent possible, characterize the impacts of these disturbances on various aquatic, riparian and terrestrial resources within the watershed.

B. What effect has timber harvest and road construction had on hillslope processes that deliver sediment to aquatic systems?

1. Hillslope Erosion:

   Are contributing activities present?

   What areas are sensitive to forest practices?

2. Road Erosion:

What are the roads erosion potential?

Are contributing activities present?

3. Mass Wasting:

Is there evidence of, or potential for, mass wasting in the watershed?

What Mass Wasting processes are active?

Do landslides deliver sediment to stream channels or other waters?

What percent, by type and amount of sediment, reachs streams?

IV STREAMFLOW

A. What management related processes have the potential to change the natural magnitude and frequency of streamflow?

1. Mass Wasting:

Do forest management activities create or contribute to instability?

Do these management caused mass failures produce similar quantities as natural events?

2. Hillslope Erosion:

What are the areas sensitive to forest practices?

3. Road Erosion:

Are contributing activities present?

What roads are sensitive to forest practices?

B. Is there evidence of changes in the magintude, timing or frequency of peak flows or low flows for Upper Lewis Watershed or its tributaries?

V WATER QUALITY/RIPARIAN CANOPY

A. Is there evidence of increased sediment loading and or reduced water clarity in the Upper Lewis Watershed or any of its tributaries?

1. Riparian Conncetivity:

   Do water quality parameters meet the state standards for turbidity?

2. Sediment Yield:

   What is the baseline sediment level?

B. What have the effects of land management been on stream temperatures?

1. Riparian Function Module:

   What is the current degree of canopy closure provided by riparian vegetation relative to what is needed to maintain desirable stream temperatures?

   Where, if anywhere, is canopy closure provided by riparian vegetation insufficient to maintain desirable stream temperatures?

   Are riparian shade values and water temperatures outside of the expected range of natural variation?

2. Water Quality:

   Are there stream segments identified as "water quality limited" in the State of Washington 505 (b) report because of water temperature?

   Are 7 day average high temperatures acceptable for fish (see Federal Guide)? If not, describe.

C. What other types of potential water quality impacts may be associated with human activities in the watershed?

VI LARGE WOOD SUPPLY

A. What are the processes that deliver large wood and where do they occur?

1. What are the sources of large woody debris?

2. Riparian Function Module:

   What is the condition of the riparian zone relative to its availability to supply large woody debris to the stream in the near term and long term?

3. Wildlife Habitat:

   What is the current range of snags and down log amounts and distribution as compared to prior management?

B. What changes have occurred in the amount and distribution of large woody debris?

VII CHANNEL MORPHOLOGY AND CONDITION

A. Is there evidence of accelerated or detrimental changes in stream channel morphology or channel conditon?

1. Water Quantity:

   What is the history of floods and disturbances?

2. Stream Channel Assessment:

   Is sediment deposition changing the morphology of the stream such as widening, braiding, eroding banks and causing treefall? Are these things contributing to/degrading habitat complexity?

VIII AQUATIC SPECIES, HABITAT AND POPULATIONS

A. What is the historic and current life history, population and distribution, and habitat conditions of fishand other aquatic organisms?

1. Fish Habitat:

   What is the distribution and relative abundance of salmonid fish species in the watershed analysis unit?

   Where are the areas of high existing or potential habitat use (by species and life history stage)?

   What is the current conditon and how does it compare to the range of natural variability for fish habitat as represented by pool-per-mile?

2. Aquatic Biology:

   No module currently available but recognized as a crucial element in the ecosystem and identified as a key question for tracking.

B. What aquatic sepcies are recognized as at risk (e.g. threatened, endangered or sensitive) in the Upper Lewis Watershed?)

1. Fish Habitat:

   What is the distribution and relative abundance of at risk salmonid fish species in the watershed analysis unit?

   What role does or should the watershed play in providing for conservation or recovery of these species?

   How have altered physical processes impacted aquatic organizms? What are the altered physical processes? Are there risks associated with these changes?

IX NATURAL DISTURBANCES

A. What are the various agents of disturbance in the watershed, both past and present? Which are important in terms of having a significant affect on the watershed's ecological functions? Are we currently outside the range of natural variability for agents of disturbance, especially fire?

1. Blowdown:

   Is there a connection between size/width of the buffer/leave strips and the amount and severity of blowdown? Is there a connection between a stands' species composition and structure and the amount and severity of the blowdown?

2. Volcanic Eruption:

   To the extent possible characterize the impacts of these disturbances on various aquatic, riparian and terrestrial resources within the watershed.

3. Seismic Disturbance:

   To the extent possible, characterize the impacts of these disturbances on various aquatic, riparian and terrestrial resources within the watershed.

4. Fire History:

   What role has fire played in shaping the composition and distribution of vegetation in the watershed? What effects has fire had on the functions of this watersheds' ecological processes (you could list a whole variety of things here such as functioning of streams, meadows, wetlands, etc.) What role has fire suppression played in the function of this watersheds' ecological processes?

X INTEGRATION

A. What Upper Lewis Watershed processes effect the level of imperilment?

B. What role does the watershed play in providing for conservation or recovery of these species?

C. What landscape pattern would best meet ecological objectives and social expectations for watershed over time?

XI COMMODITIES

A. What resources used by humans have been extracted from the ecosystem in the past and at what magnitude?

B. What are the opportunities for commodity extraction?

XII AIR QUALITY

A. What areas are sensitive to air quality related values?

B. What areas outside this watershed are sensitive to activtiies such as burning slash and wildfires?

XIII PUBLIC USE

A. What have been the historic human uses and activities in the watershed?

B. What types and intensity of recreational use occur in the watershed at present?

C. What type of access and transportation system (roads, trails, etc) have been and should be provided for activities such as timber harest, watershed management, recreation and fire fighting, etc.?