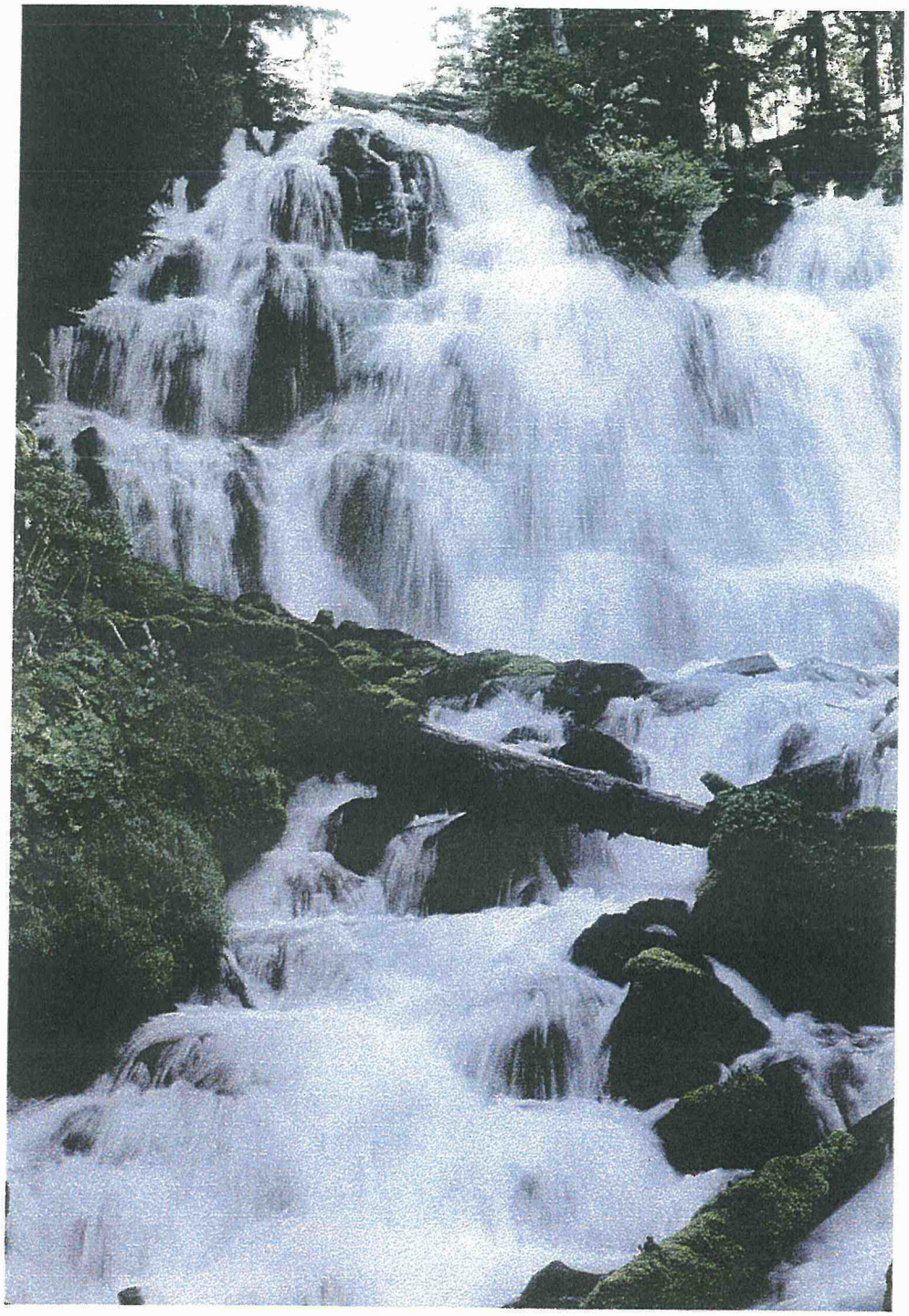
Horse Creek Watershed Analysis

Willamette National Forest **September 1997**



United States Department of Agriculture

Forest Service Pacific Northwest Region

HORSE CREEK
WATERSHED ANALYSIS

September 1997

McKenzie Ranger District
Willamette National Forest

For further information contact:

Administrative Contact:

John Allen, District Ranger

McKenzie Ranger District
McKenzie Bridge, OR 97413

Technical Contact:

Cheryl Friesen, Team Leader

McKenzie Ranger District
McKenzie Bridge, OR 97413

TEAM MEMBERS

Cheryl Friesen	**Team Leader, Wildlife Biologist**
Al Brown	**Forester**
Michelle McSwain	**Hydrologist**
John Phillips	**Soil Scientist**
Pat Ford	**Botanist**
Dawn Pozzani	**GIS Specialist**
Rich Pyzik	**Fisheries Biologist**
Phil Raab	**Recreation Specialist**
John Orbeton	**Fire Behavior Specialist**
Eric Bergland	**Archaeologist**

with important assistance by:

Shane Kamrath	**Wildlife Biologist**
Lisa Lyon	**Wildlife Biologist**
Gene Skrine	**Silviculturist**
Dave Bickford	**Fisheries Biologist**
Jane Kertis	**Ecologist**

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HORSE CREEK WATERSHED ANALYSIS

CHAPTER 1

INTRODUCTION

INTENT OF WATERSHED ANALYSIS

The intent of this Watershed Analysis is to develop and document a scientifically based understanding of the processes and interactions occurring within the Horse Creek watershed. This understanding, which is focused by the watershed's key issues, is essential for making sound management decisions. Gaining an understanding of the interactions between land-use activities and the physical and biological environments in this area will be invaluable to the success of managing this ecosystem for all its values.

Direction for conducting this report lies within the FEMAT Report (USDA/USDI 1993) and the FEIS ROD on Management for Late Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl (USDA USDI 1994, hereafter referred to as the ROD). A Federal Agency Guide for Watershed Analysis (versions 1.1 and 1.2)(USDA 1994) was followed to guide this analysis.

This watershed analysis will produce a "living" document. Appendices and other additions will continue to be produced over time as new data is obtained or new issues are recognized.

Products of the analysis will include:

- A description of the watershed, including its biotic and abiotic resources
- A description of the watershed key issues
- Past and current conditions and processes on this landscape
- Trends and potential effects of future land management actions
- Recommendations for future management actions
- Guidance to be considered in future site-specific analysis and project-level planning

The findings within this analysis represent a foundation on which to develop site specific project proposals and to base specific future decisions.

RELATED DOCUMENTS

Documents with direction or information related to this project at the forest level includes the Willamette National Forest Resource Plan (1990) as amended by the ROD (1994). At the subbasin scale, the McKenzie Watershed Council is compiling some analytical information through the Lane Council of Governments (LCOG). Information from these documents was incorporated into this analysis.

CHARACTERIZATION OF WATERSHED

LOCATION AND LAND USE

The Horse Creek is an approximately 101,000 acre Watershed that lies within the McKenzie sub-basin on the western flank of the Cascade Crest (Maps 1-1 and 1-2). Relief ranges from about 1200 feet at the confluence of Horse Creek and the mainstem of the McKenzie River at McKenzie Bridge, to 10,358 feet at the summit of South Sister.

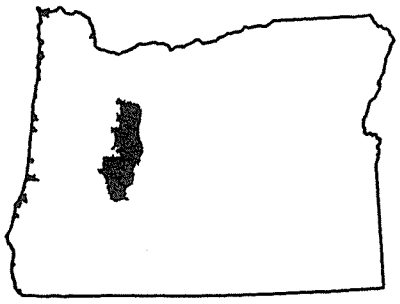
Table 1-1 and Maps 1-3 and 1-3a display the land allocations within this watershed. The bulk of the area is Late Successional Reserve and wilderness. There is a small amount of private land within the watershed, primarily residences along King Road.

Table 1-1: Land Allocations within the Horse Creek Watershed.

Willamette National Forest Land Management Plan (1990) Allocations:

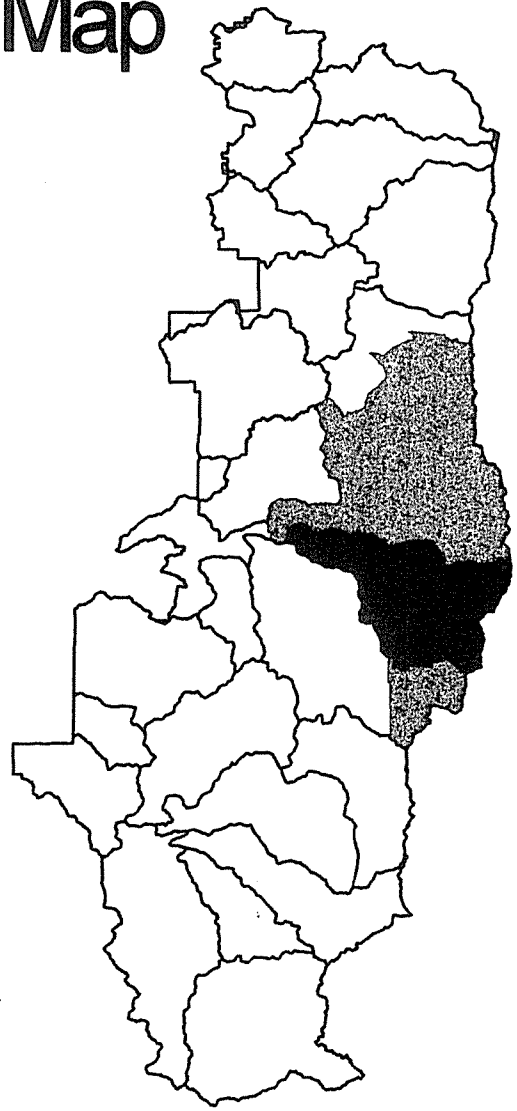
Land Allocation	Acres
Wilderness (Three Sisters)	76,031
Research Natural Area (Olallie)	533
Special Interest Area	417
Special Wildlife Habitat Area	60
Dispersed Recreation: Semi-primitive, Nonmotorized use	912
Scenic - Modification: Middleground	155
Scenic - Partial Retention Middleground	1,406
Scenic - Partial Retention Foreground	1,085
Scenic - Retention Middleground	3,080
Scenic - Retention Foreground	824
General Forest	15,200
Private	1,725
TOTAL	101,428

Map 1: Horse Creek Watershed Locator Map



Oregon

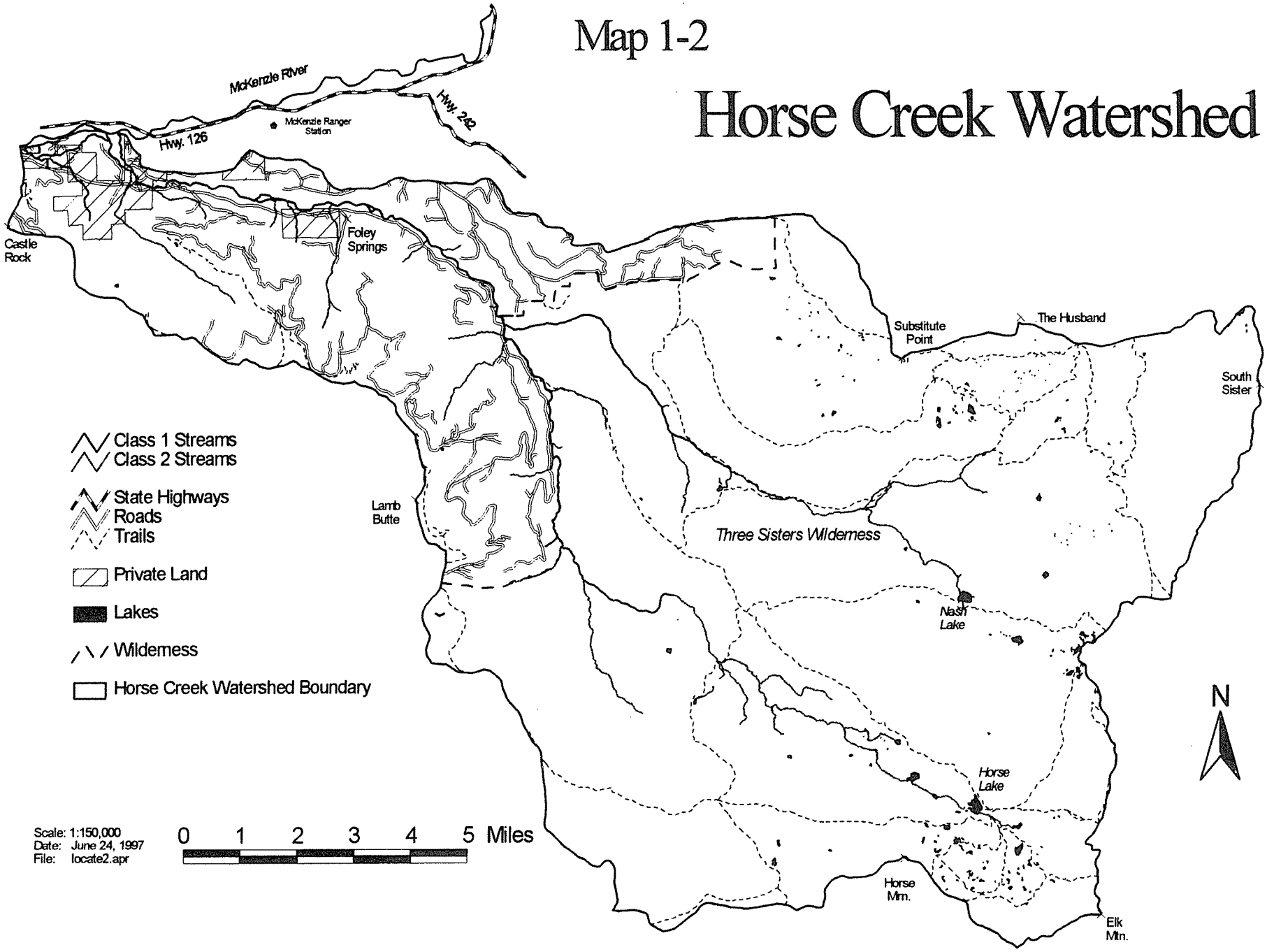
Willamette National Forest



Horse Creek Watershed
McKenzie Ranger District
Watersheds intersecting Willamette NF

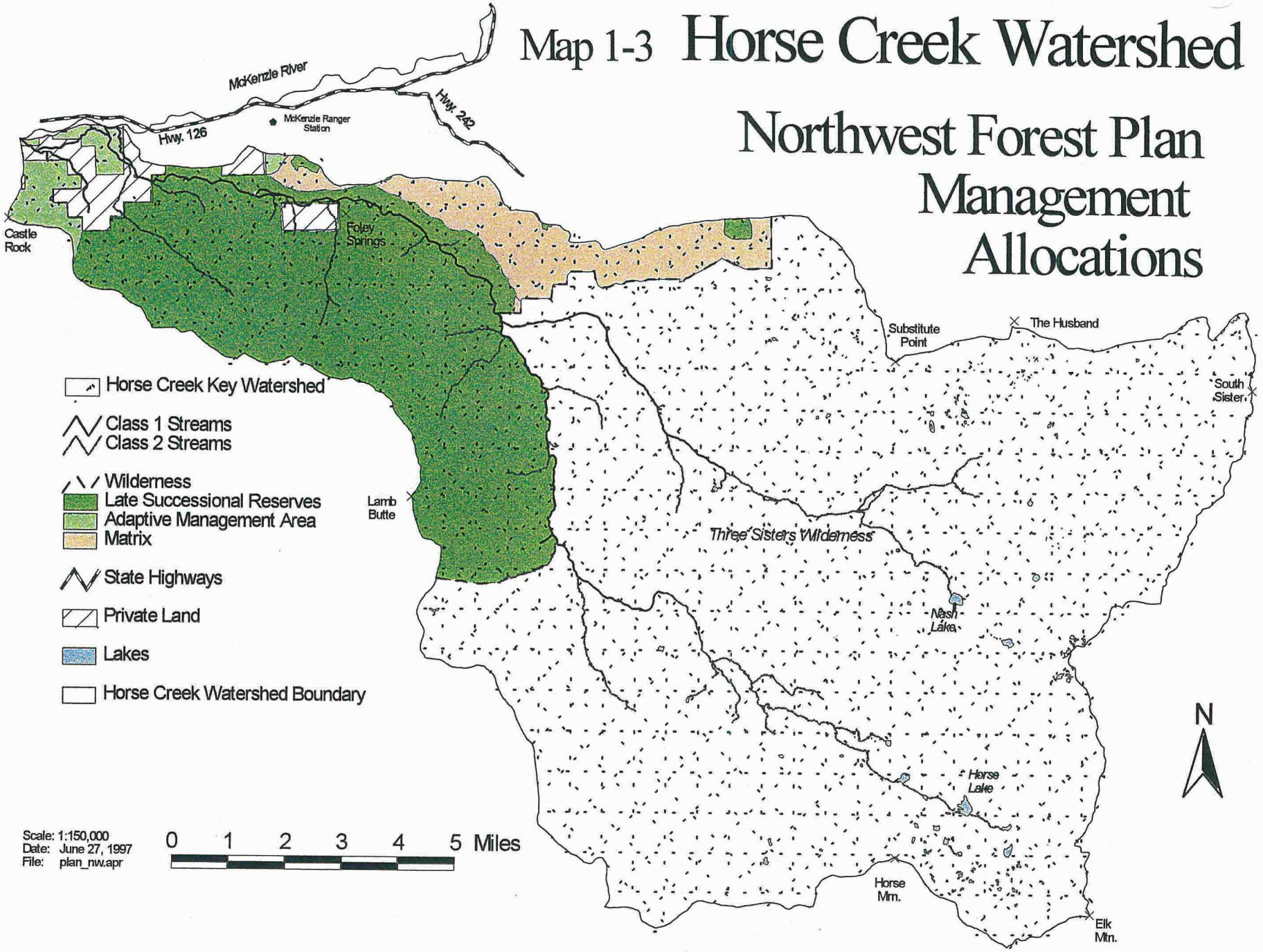
Map 1-2

Horse Creek Watershed

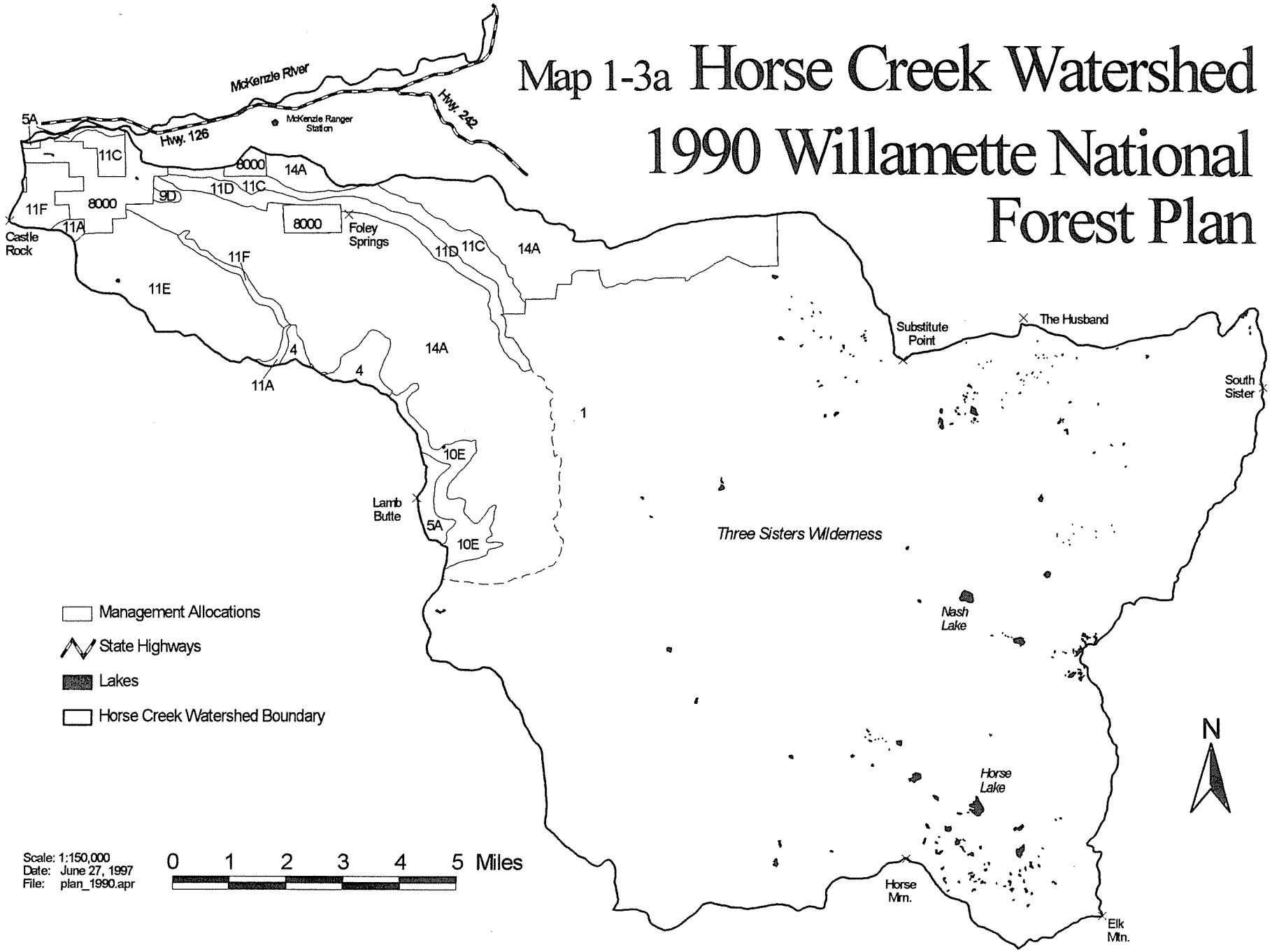


Map 1-3 Horse Creek Watershed

Northwest Forest Plan Management Allocations



Map 1-3a Horse Creek Watershed 1990 Willamette National Forest Plan



*Northwest Forest Plan Allocations**

Land Allocation	Acres
Late Successional Reserves	18,320
Late Successional Reserves (100ac)	168
Adaptive Management Area	1207
Riparian Reserve (outside of LSR, AMA, and Wilderness allocations, but overlaps with Matrix)	357
Matrix	3,620
Wilderness (Three Sisters)	76,031

**These allocations overlap with the Willamette National Forest Plan Allocations*

GEOLOGY

Horse Creek Watershed a volcanic terrain modified by glacial and fluvial processes. The watershed can be subdivided into two geographical areas: The Western Cascades and the High Cascades.

Western Cascades

The western 1/3 of the watershed lies in the Lower Horse Creek subwatershed between 1,000 and 4,000 feet elevation. This subwatershed is comprised of older Western Cascade basaltic lava flows that are interbedded with pyroclastic tuffs and breccias 10 to 17 million years old. Ridge-capping basalts of the Early High Cascades (9 - 4 million years old) overlie the Western Cascade rocks. These ridge-capping basalts, the peaks of Olallie Ridge, define the watershed boundary to the south and separate it from the tributaries of the South Fork of the McKenzie. The intracanyon basalt flows of Foley Ridge (2-4 million years old) dominate the northwestern portion of the watershed, and form the boundary with the McKenzie River mainstem. Lower Horse Creek subwatershed is very steep, with approximately 5200 acres on slopes greater than 70%. Steep slopes form the canyon walls along Separation Creek and lie south and west of Horse Creek. The valley bottoms contain glacial outwash and terrace deposits as well as two large ancient landslides.

High Cascades

The eastern 2/3 of the watershed is located in the Three Sisters Wilderness. The majority of this area lies on the High Cascade volcanic plateau (4,000 to 6,000 feet elevation) with relatively low relief except for the valley side slopes of Separation and upper Horse Creeks and the side slopes of small cinder cones. The source area for the Late High Cascade basalts (1 - 4 million years old) is the South Sister composite volcano and other smaller High Cascade volcanic cones. The most recent lava flows from South Sister are less than 2,600 years old (Taylor et al., 1987). Five alpine glaciers (Frazier, Eugene, Lost Creek, Skinner, and Clark) are still active on the west slope of South Sister.

EROSION PROCESSES

The areas with most active erosion are on the west flank of South Sister and other cinder cones, where snow melt on slopes greater than 100% produces high gradient streams in loose unconsolidated volcanic ash and cinders. Much of the material is then deposited in the high elevation meadows between 4,000 and 6,000 feet elevation. Thin glacial soils on the valley sideslopes of Separation Creek and upper Horse Creek (in the wilderness) are prone to mass wasting in the form of translational landslides, especially in zones of rain-on-snow potential and in areas where high intensity wildfire has occurred. Rockfall and debris avalanches are common in valley headwall areas.

The lower Horse Creek area is more prone to mass wasting due to the steeply incised valleys. Higher strength ridge-capping basalts and intracanyon flows that sit on top of older, less resistant Western Cascade rocks result in differential erosion. This is especially the case in the uplands of Olallie and Foley Ridges. The accumulation of surface deposits in the form of glacial outwash and terrace gravels on the lower slopes provide a large sediment source for debris slides that initiate higher up on the hillslope. High intensity storm and fire events may trigger these debris slides, which become debris flows as they gather wood, water, and sediment along the way downslope.

VEGETATION / DISTURBANCE

The vegetation of the Horse Creek Watershed is characteristic of plant communities west of the Cascade crest. Figure 1-1 and Map 1-4 display the condition of the forests in this area by series. Plant series classification is a convenient and often used way of defining and stratifying these plant communities. The forested plant series typically found in the Western Cascades include:

1) Douglas-fir series - (Pseudosuga menziesii),
2) Grand fir series - (Abies grandis),
3) Western hemlock - (Tsuga heterophylla),
4) Pacific silver fir series - (Abies amabilis),
5) Mountain hemlock series - (Tsuga mertensiana)
6) Subalpine Communities

Map 1-4 Horse Creek Watershed Forest Series

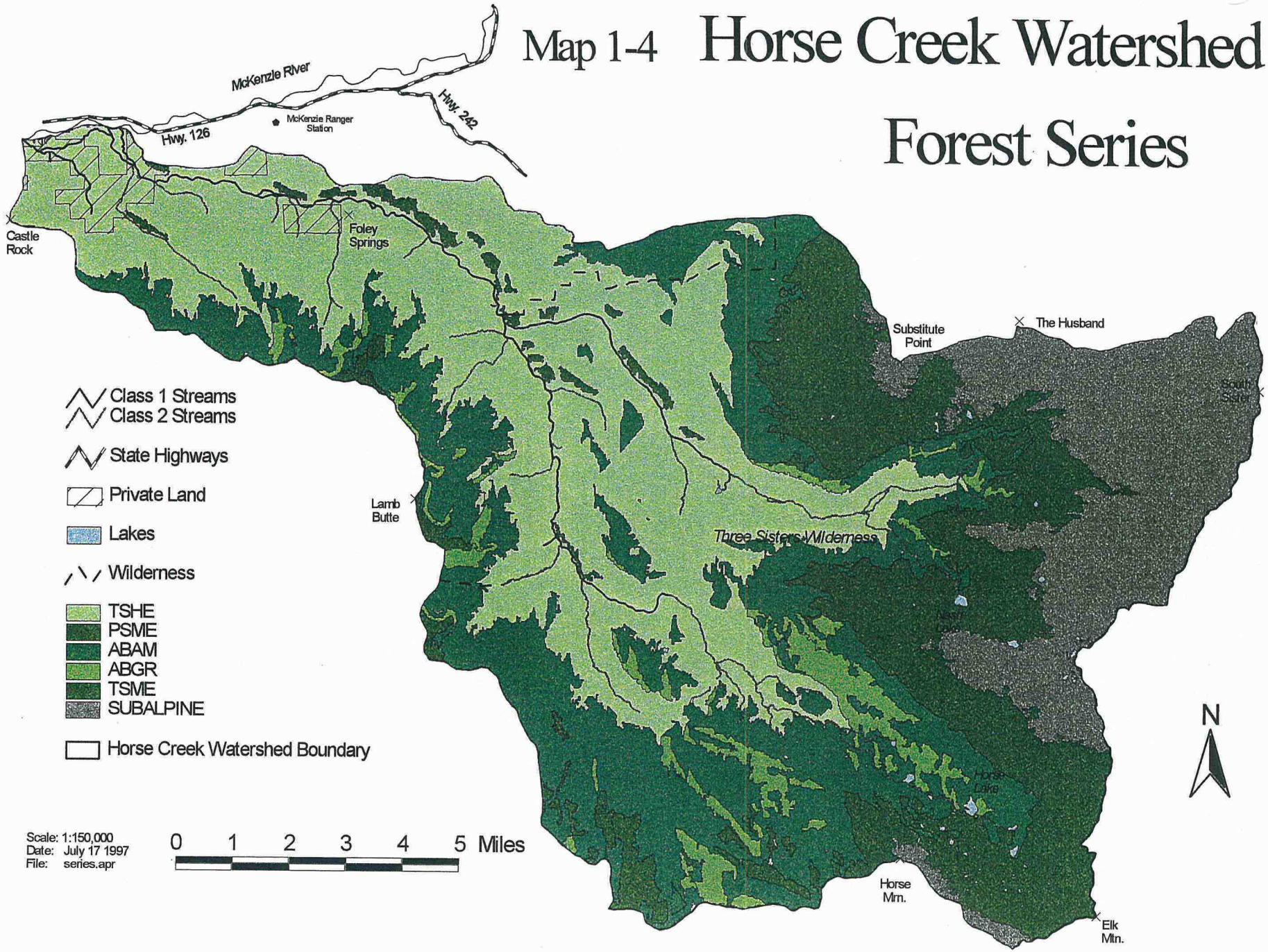
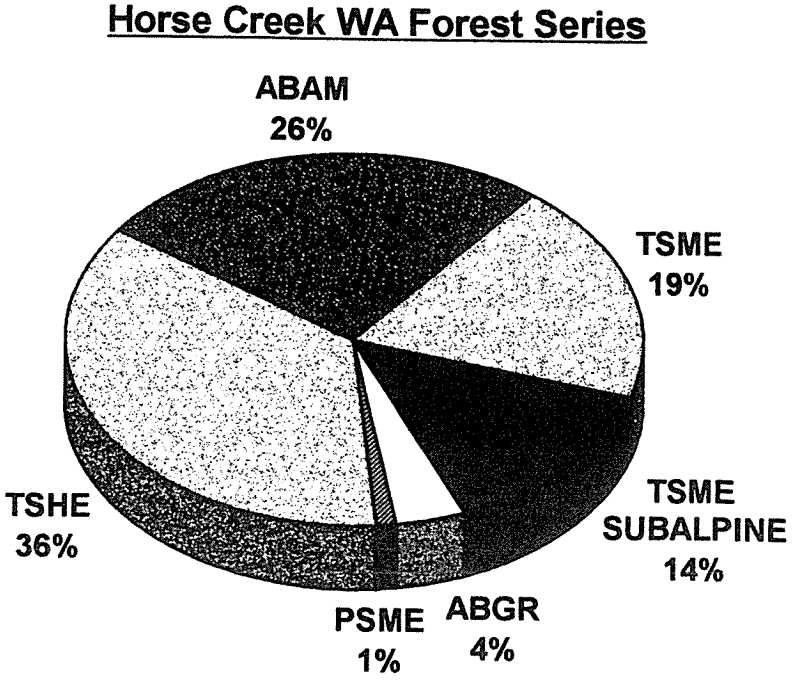


Figure 1-1: Percentage of each plant series in the Horse Creek watershed.



For a more complete description of the environmental conditions, classification system, listings of plant species, and plant association groups for each series, refer to the Willamette National Forest Plant Association and Management Guide (Hemstrom et. al 1987).

RIPARIAN AND AQUATIC RESOURCES

Precipitation within the Horse Creek Watershed is dominated by snow accumulation, with rain and rain-on-snow events occurring at lower elevations in approximately 1/4-1/3 of the watershed. The majority of the wilderness area is located within the permanent snow zone, thereby making it a low probability for a rain-on-snow event to take place. Beneficial uses within the Horse Creek watershed include aquatic life, domestic water supply (lower Horse Creek residents, City of Eugene), and recreation. Aquatic life uses include spawning and rearing habitat for spring chinook and rearing habitat for bull trout in the mainstem of Horse Creek. Separation Creek, a tributary to Horse Creek, provides suspected spawning habitat and rearing habitat for bull trout. Water quality parameters important to spawning and rearing success are low stream temperature, low sediment, and relatively constant flow.

Table 1-2 displays the miles of stream within the Horse Creek Watershed by management allocation and stream class. Map 1-5 shows the distribution of streams by class within the watershed.

Table 1-2: Miles of stream by stream class and acres of wet areas by Management Allocation.

Management Allocation	Class I (miles)	Class II (miles)	Class III (miles)	Class IV (miles)	Lakes and Ponds (acres)
Matrix	0	0	4	5	0
Wilderness	10	31	61	356	231
Late Successional Reserve	9	12	30	104	0
Adaptive Management Area	2	0	0	1	0
Private	4	2	1	1	0
Total	25	45	96	467	231

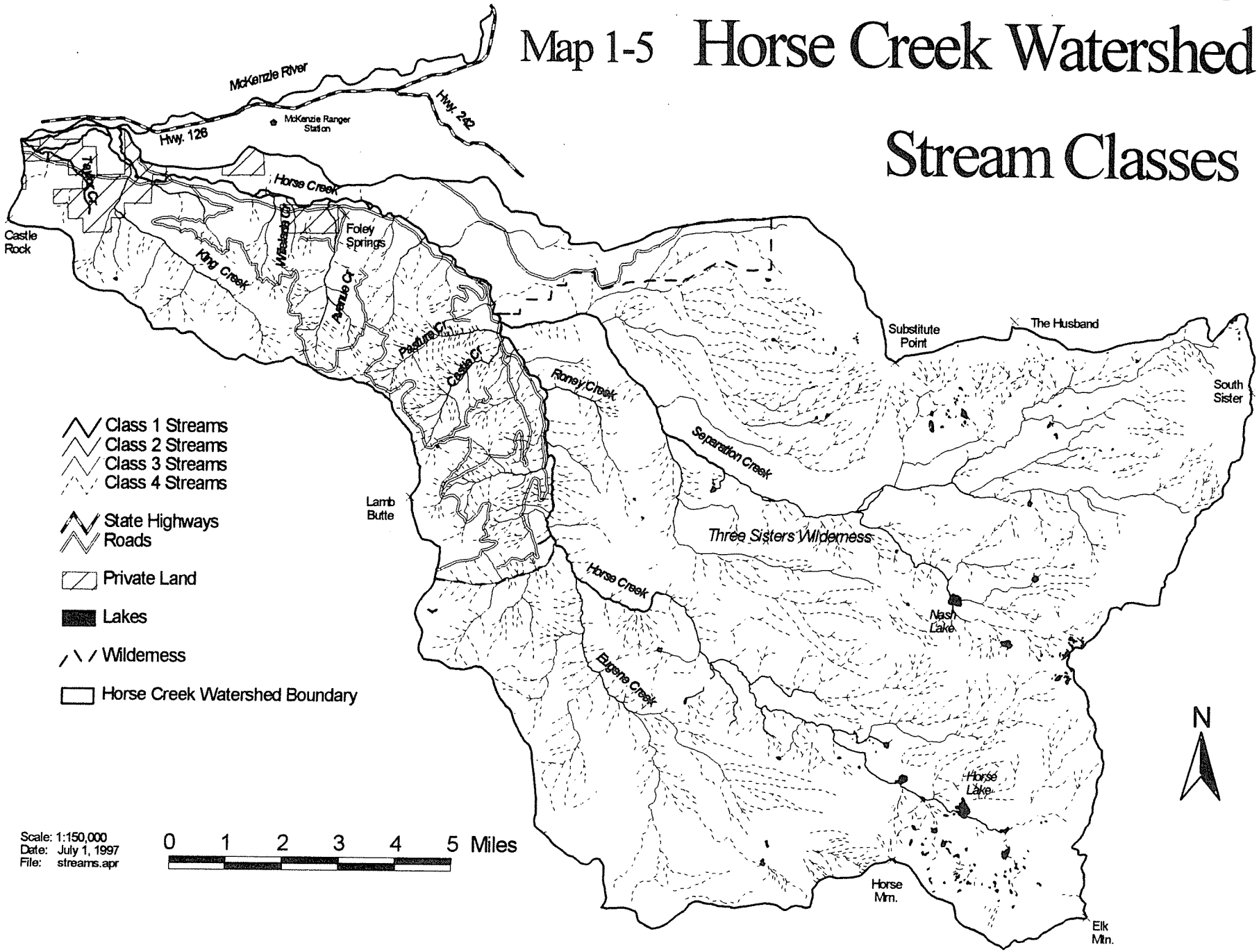
Horse Creek is a major tributary of the McKenzie River. It originates in Sunset and Horse Lake, and flows 28 miles through a glacially carved valley into the south side of the McKenzie River (near McKenzie Bridge). Downstream from Separation Creek, Horse Creek flows within a well-defined channel, dominated by swift riffle and white water stretches. Within the Lower Horse Creek Subwatershed, the channel is relatively unconstrained, allowing the main channel to shift location during large flow events. This is particularly true where Horse Creek flows within the McKenzie River Valley. Following large storm events, multiple channels that flow over a large alluvial fan change locations. Upstream of Separation Creek, Horse Creek flows through a number of broad, active flood plain deposits, often in multiple channels. Large, deep pools are not common in Horse Creek, but smaller pools formed by scour near wood, large rocks, and the stream bank are more common.

Examination of aerial photos from 1955 and 1967 show a decrease in the amount of large wood within the active channel following the 1964 flood. Prior to the 1964 flood, there were large accumulations of wood on point bars and at heads of islands, as well as within the channel which formed jams. Following the flood, salvage operations were extensive as depicted in interdepartmental memos recommending that rootwads and logs be removed to prevent further damage to roads and bridges. Salvage of logs was also recommended to facilitate fish passage as documented in the 1960's and 1970's. Recent events such as the flood in 1996 and stream restoration activities in the early 1990's have restored some of the lost large wood component to the mainstem Horse Creek.

With a few exceptions, the riparian area of Horse Creek is relatively undisturbed by human activities. Large conifers and 30-year old alder dominate the riparian area,

Map 1-5 Horse Creek Watershed

Stream Classes



providing a great potential source for future large wood input to the channel. Large cobble and small boulders dominate the substrate composition in the upper sections of the stream. Fine sediment is generally not a concern in Horse Creek due to the nature of the geology. Late High Cascade lava flows and glacial deposits are the dominant sediment source within the watershed. This geology type results in stream channels low in sediment, and dominated by gravels and cobbles lower in the watershed; excellent substrate for chinook spawning.

Fine sediments entering the Horse Creek system are the result of debris slides and debris flows located in the Lower Horse Creek subwatershed. Initiation of debris slides and debris flows in Lower Horse Creek may be caused by fire, large storm events, and from roads and harvest units. Fine sediment resulting from slides may be more of a localized problem in and near the mouths of tributaries, where timber harvest and road building has affected riparian vegetation, potential in-stream wood, and embeddedness in places. Fine sediment has deposited in side channels of Horse Creek.

Upper Horse Creek, Eugene Creek, Upper Mosquito Creek, Separation Creek, and Roney Creek flow through the Three Sisters Wilderness. Separation Creek is unique among the Horse Creek tributaries. It originates from glaciers on the South Sister and flows west through the wilderness into Horse Creek. The stream's relatively constant flow maintains bank stability, low embeddedness, and a large amount of in-stream wood.

Horse Creek originates from a series of lakes in Three Sisters Wilderness. The major lakes that form Horse Creek include Sunset, Upper Horse, Middle Horse, and Lower Horse Lakes. Of these lakes, Horse Lake is most substantial at 56 acres and 24 feet maximum depth. Although the other lakes are shallower and smaller, all of these lakes have or provide access to spawning gravels for resident and introduced trout species.

Aquatic Species

The fish populations in Horse Creek, its tributaries, and the lakes within the watershed are diverse. In Horse Creek itself, spring chinook salmon, summer steelhead, rainbow, cutthroat, brook and bull trout, mountain whitefish, and several sculpin species occur. In Horse Creek tributaries, cutthroat trout and sculpin are the dominant species. In some of the larger tributaries, rainbow trout occur with the cutthroat trout in low gradient downstream reaches. Bull trout adults and sub-adults and chinook salmon juveniles probably utilize the lower reaches of most of these creeks, particularly during the winter, for foraging and rearing respectively. Bull trout are suspected to spawn and rear in the relatively constant flow and cold water of lower Separation Creek. Introduced to Horse Creek in 1970 but no longer stocked, a remnant population of steelhead still returns to spawn.

The past introduction of non-native trout in the headwater lakes of Horse Creek has and may continue to impact native fish populations in the watershed. The population

of wild cutthroat trout which once inhabited Horse Lake has been displaced by introduced brook trout. Brook trout may also be affecting the populations of wild cutthroat trout which inhabit Middle and Lower Horse Lakes. There is a potential these introduced brook trout may be moving down Horse Creek and may impact bull trout populations. During a night snorkel in a side channel of lower Horse Creek in 1993, suspected bull trout/brook trout hybrid was observed. It is uncertain whether this fish was produced in Horse Creek or somewhere in the upper McKenzie River, but brook trout/bull trout hybrids are a concern in Horse Creek. These fish have developmental problems, their offspring have been shown to be sterile, and the reproductive union depletes genes from the already small bull trout gene pool.

The diversity of fish species that inhabit Horse Creek reflect the diversity of habitat available within the watershed. Although some creeks and lakes within the watershed have been impacted by management, on the whole, Horse Creek is in good condition. Holding and rearing pools, formed by scour associated with wood, rocks, and stream banks, are found throughout the length of Horse Creek. Side channels, important habitat for rearing chinook salmon and refuge from high winter flows, are common. Although tributaries to Horse Creek are generally steep, they also provide spawning and rearing habitat, particularly for cutthroat and rainbow trout and bull trout. Numerous lakes occur in the headwaters, some deep enough to sustain fish populations throughout the winter and some with available spawning habitat.

RECREATION RESOURCES

Recreation takes many forms within the wilderness area of the Horse Creek Watershed. Hiking, horse-back riding, climbing, camping and viewing scenery are the more common pursuits in the Three Sisters Wilderness area.

Horse Creek is a popular fishing destination, particularly from the confluence with Castle Creek, downstream and in its headwater lakes. As ease of access to the creek decreases further upstream, fish resource use also decreases. The anglers are diverse and range from locals to individuals from out of state, and from spinning reel users to expert fly-fishers. The creek is not stocked with hatchery fish.

This area is also popular for deer and elk hunting. Though no records are available for exact numbers of hunters that enter the area, during the fall months traffic is definitely on the rise from hunting parties moving to and from favorite spots. A large portion of the watershed is wilderness, providing the potential for high quality hunting opportunities.

BOTANICAL AND WILDLIFE RESOURCES

Horse Creek Watershed contains potential habitat for over 300 species of wildlife and over 1000 species of plants. Threatened species in the watershed include the northern spotted owl and bald eagle. Endangered species include the peregrine falcon. Sensitive species include the sandhill crane, red-legged frog, wolverine, Townsend's big-eared bat, harlequin duck, and the plant Adder's tongue.

This watershed has a rich diversity of habitats including forests, lakes, wetlands, lava flows, meadows, and alpine areas. The majority of the watershed has not been actively managed for timber resources. Habitats have generally not been degraded. All species that historically occurred in this area are thought to still be present.

HORSE CREEK

CHAPTER 2

ISSUES AND KEY QUESTIONS

The development of high priority issues is critical to focus the scope of a watershed analysis. Key questions that address the issues further refine the analytical task.

The following chapter lists current, high priority issues and key questions identified within the Horse Creek Watershed. The issues are organized by domains as recommended by the Watershed Analysis Handbook (1995).

AQUATIC AND RIPARIAN DOMAIN

1 Management practices such as road building and maintenance, timber harvest, and slash treatments may have changed the frequency and spatial distribution of mass wasting and surface erosion. This can result in increased turbidity and filling of large pools with sediment.

a. Question: What are the main sediment sources to Horse Creek? Where do they occur?
b. Question: Where are road fills that are unstable and what is the potential for fills to initiate debris torrents or debris avalanches?
c. Question: Have roads and harvest units increased the frequency and magnitude of slope failures over time? Do we see conditions typical of this type of failure here?
d. Question: Where are soils conducive to timber harvest and road construction?
e. Question: Where are soils of concern where timber harvest or road construction could potentially cause detrimental resource effects?
f. Question: How has fire influenced the erosion processes in this landscape historically, and how would future prescribed natural fire or management ignited fire implementation affect these processes?

2 Increases in peak flows resulting from timber harvest and extension of the drainage network by road systems may have reduced channel complexity through: scouring and downcutting of the channel; isolating side channels; and transporting large woody debris out of the system.

a. Question: Have management activities affected the magnitude and frequency of peak flows? Have increased peak flows reduced channel

complexity or modified aquatic habitat beyond the range of historic variability? How have flood events and management activities affected channel characteristics and channel patterns through time?

b. Question: To what extent and degree have riparian areas and floodplains been altered by management? Have alterations affected the aquatic ecosystem?

c. Question: What are the in-stream erosion processes and where do they occur? Where have management activities altered these processes?

d. Question: Which water quality parameters are critical to beneficial uses? What are the existing water quality conditions, do they meet state standards, how do they impact beneficial uses, and how do they compare with benchmarks currently in place?

e. Question: How has fire influenced the aquatic habitat in this landscape historically, and how would future prescribed natural fire or management ignited fire implementation affect their maintenance?

3 Private lands can be affected by changes in channel morphology that result from management practices (i.e. road building/maintenance, timber harvest, prescribed natural fire, and fish habitat manipulation). This is especially true if those activities change flow regimes or alter within-stream large wood.

a. Question: What is the historic pattern of channel changes along Horse Creek, particularly in the Horse Creek delta near private residences?

4 Private landowner practices such as construction (housing and roads), and stream bank protection measures may have altered historic channel patterns. The results may change channel morphology.

a. Question: Where and what actions on private lands might be affecting natural channel morphological processes?

b. Question: What private landowner activities are regulated by county, state, and federal regulations, and how are they impacting beneficial uses?

5 As a Key Watershed, Horse Creek provides important habitat to fish (streams and lakes) in this basin.

a. Question: What is the current and historic distribution of fish in Horse Creek Watershed?

b. Question: What are current in-stream habitat conditions, and how do they compare to historic conditions?

c. Question: Where are non-native fish present in the watershed? How have non-native fish influenced native fish?

d. Question: What role does Horse Creek play in providing refuge for aquatic organisms? Where are areas critical to spring chinook and bull trout in Horse Creek?

e. Question: What recreational impacts occur to native fisheries?

f. Question: What passage barriers exist and which ones are causing critical problems?

6 Existing riparian habitat must adequately maintain the quality/quantity of habitat to support viable populations of riparian-dependent species.

a. Question: What was the historic composition of the riparian vegetation? How does that compare to current conditions?
b. Question: What is the historic role of disturbance in the riparian areas? How do historic disturbances compare to the current processes?
c. Question: Will the riparian reserves adequately function to meet all objectives outlined in the Northwest Forest Plan?
d. Question: What criteria could lead to interim riparian reserve adjustments, and where are some of the areas that fit these criteria?

7 Since the completion of the 1990 Forest LMP and implementation of the watershed analysis process direction has been developed to make a preliminary analysis as to the possible eligibility of rivers and streams for inclusion under the Wild and Scenic Rivers Act. This analysis provides an opportunity to document current information about the streams within the watershed for use in a future Forest-wide process that determines additional eligible Wild and Scenic Rivers.

a. Question: Which major tributaries in the watershed were not analyzed in the eligibility assessment developed for the 1990 Willamette National Forest LRMP? What attributes (Outstandingly Remarkable Values) do they have that may warrant their further consideration under the Wild and Scenic Rivers Act?

TERRESTRIAL DOMAIN

1 Management activities within these forests, including timber harvest, road building, and fire exclusion, may have altered species' composition or created patterns and conditions that are outside of the historic range of variability. The biological diversity of the watershed may have been altered.

a. Question: What is the array and landscape pattern of forested plant communities in this watershed?
b. Question: How does the current condition of forested vegetation compare with the historic range of variability?
c. Question: What processes caused these patterns? (fire, wind, insects, diseases, volcanism, timber harvesting, erosion, rain on snow, etc.)
d. Question: How does the current conditions affect future land management objectives or ecosystem function?
e. Question: How will the implementation of Prescribed Natural Fire or management ignited fire affect the vegetation on this landscape?

2 Levels of large woody debris and snags in managed forests, including plantations, campgrounds, roadsides, etc., may be outside of the historic range of

natural variability for unmanaged forest systems. This could impact a variety of species that depend on these structural elements for habitat.

a. Question: What is the historic natural range of variability for large woody debris and snags on this landscape?
b. Question: Have management activities altered the landscape condition significantly outside the historic range for snags and large woody debris?
c. Question: Have management threshold levels been achieved? Where are conditions outside of "acceptable" ranges?

3 Future land management strategies focused on the maintenance or development of late-successional forest species may result in diminished availability of habitat for early seral species.

a. Question: What species are associated with early seral habitats?
b. Question: What is the historic and projected future availability of early, mid, and late seral habitat over time in this watershed?
c. Question: How will the availability and distribution of these habitat types affect species associated with them over time?

4 The majority of sensitive and rare plant species that are known or suspected to occur in the watershed occupy non-forested areas (special habitats). These areas, though protected by S&G's, are generally un-mapped and unsurveyed. It is unknown what their current contribution to biodiversity on the landscape is or what threats they may be receiving.

a. Question: Where and what kind of special habitats are present within the watershed? How have these habitats evolved?
b. Question: Are there special habitats within the watershed that have limited distribution across the watershed/Forest/or Region?
c. Question: What threatens the continued stability or functioning of these special habitats?
d. Question: What wildlife and botanical species of interest are associated with these areas?
e. Question: What are the threats to the Research Natural Areas?

5 Diversity (i.e. horizontal structure, species mix, stocking levels) in past harvest areas may be providing low quality habitat for species that rely on early seral stages.

a. Question: What is the current diversity level within managed plantations? How does this compare with early seral habitat that resulted from natural disturbances?

6 The Northwest Forest Plan requires surveys and management for numerous species of wildlife, fungi, lichens, bryophytes and vascular plants (Northwest Forest Plan ROD Table C-3). The location and potential distribution of many of these species within the watershed is unknown.

a. Question: What C-3 species potentially occur in the watershed based on their known range and habitat requirements?

b. Question: What Table C-3 wildlife and plant species are known to occur in the watershed?

c. Question: Do the Northwest Forest Plan standards and guidelines adequately protect existing habitat and provide long-term habitat for species of concern listed within the Plan?

7 The watershed must continue to contribute to the recovery of several threatened and endangered fish and wildlife species, and it also must maintain or increase the populations of rare or sensitive species.

a. Question: What TES species are known to occur or potentially occur within this watershed?

b. Question: What is the condition of the populations of these species and their habitat?

c. Question: What is the status of TE species recovery, and how is this watershed contributing to recovery goals?

8 The watershed contains a portion of a Late Successional Reserve. Its potential contribution to the recovery of the spotted owl and maintenance of late successional species can be influenced by human activities, such as timber harvest. * Answers to these questions should be fully addressed in the Forest-Level Late Successional Reserve Analysis currently underway. The condition of the LSR will be briefly summarized in this Watershed Analysis.

a. Question: What is the amount and distribution of late successional habitat (current and historic) in the LSR?

b. Question: What is the potential for success in maintaining late successional habitat over time? What are the major risks to maintaining this habitat?

c. Question: Are there management techniques that can promote late successional conditions in these stand types (i.e. prescribed fire, mechanical treatments, etc.)? Do stands exist that would be appropriate for this management? Where are they?

d. How stable and productive are the existing spotted owl sites?

e. What is the expected population level of this LSR's spotted owls in the future? How does this differ from the current level?

f. What other late successional species occur or could occur in this area? Are there significant concerns for their viability related to management of this area?

9 Important geological resources may be at risk from management activities.

a. Question: Are there areas of with unique geological value (fossils or formations) that are at risk from management activities?

10 Road management strategies for the watershed may increase or decrease the quality of wildlife habitat and hunting opportunities.

a. Question: What are the current road densities and network within the watershed? How do they currently impact wildlife habitat, hunting opportunities, and dispersed recreation?

SOCIAL AND ECONOMIC DOMAIN
(Note: this will be a qualitative treatment, not quantitative)

1 There may be conflicts between economic growth and resource conditions. Increased demands on campgrounds, wildlife hunting and viewing, and fishing may affect the resource and/or change visitor use.

a. Question: What actions in the future may change the tourism-generated economic benefits to the local economy?

2 Impacts to the scenic quality of natural features may be occurring from degradation caused by rock sources and harvest units.

a. Question: What management existing conditions are inconsistent with the Scenic allocations within the Forest Plan?
b. Question: Is this area approaching any thresholds? Are there restoration opportunities?

3 Prescribed natural fire (natural or management ignited) may occur within designated Class 1 airsheds. This type of management may be limited by air quality regulations. The public's desires for clean air and good visibility, and the ecological need for using Prescribed Natural Fire as an ecosystem management tool, may conflict.

a. Question: What was the historical air quality between 1850 and 1900?
b. Question: What is the current National Ambient air quality Standards and benchmark for our areas?

4 Access management strategies (roads and trails) within the watershed may be affecting sensitive areas, conflict with land use allocation objectives, or not address other issues in the watershed.

a. Question: Are there roads and trails leading forest users into sensitive areas (i.e. riparian, RNA, LSR)? If so, what and where are they? And, is current or future projected levels of use in conflict with their desired future condition?
b. Question: Are existing road management measures effective? If so, why not?

c. Question: What are current road use patterns and are they expected to change in the future?
d. Question: What is the current level of trail development within Wilderness and is that level appropriate to the WRS class?

5 Road standards may not be appropriate to current and anticipated uses, and funding of those standards may/may not be adequate.

a. Question: Are road standards appropriate to anticipated uses? And can we maintain that based upon funding outlooks?

6 Human uses (transportation system, recreation) may be in conflict with the ability to maintain elk habitat. Effectiveness of existing habitats may have been altered.

a. Question: What is the HEr within the watershed?
b. Question: What are the seasonal impacts of these uses during winter, early summer, summer, and fall?

7 Recreation uses within the watershed may have affected forest resources, visual quality, social encounters, and visitor's recreational experiences. Some recreational uses result in conflicts with other forest resources, and between recreationists who participate in various legitimate uses within the watershed.

a. Question: What types of recreation uses occur within the watershed? Where and when do they occur, and to what intensity?
b. Question: What impacts do current levels of recreational use have on natural resources? Where are unacceptable impacts occurring?
c. Question: How and where are current levels of recreation use impacting user experience including scenic quality, social encounters, and user conflicts?

8 Grazing of pack animals and human use in wilderness areas may be impacting Aquatic Conservation Strategy Objectives.

a. Question: Where and what kind of disturbance has occurred to riparian habitat from grazing and other human uses in the wilderness?
b. Question: Where are areas with the highest potential for degradation in from grazing the future?
c. Question: What are some of the restoration activities that could be recommended?

9 Congressionally designated Wilderness has traditionally been viewed as a "recreational" allocation. This view may have limited past management strategies in achieving integrated Wilderness management.

a. Question: What and where has non-recreational resource coordination and integration occurred? How have those efforts been incorporated in overall Wilderness management efforts?

10 Areas within this watershed may contain prehistoric and historic sites. Management activities within the watershed may have impacted these areas.

a. Question: What are the major human uses, including tribal uses and treaty rights?
b. Question: Where are these sites in the watershed, how were/are they used?
c. Question: Where site specific information is not known, where are the areas of "high probability" of Native American sites.
d. Question: Where and what levels of damage are occurring to these sites?
e. Question: What restoration/protective measures could be implemented?

11. Cities and un-incorporated communities along the McKenzie River have a close tie to federal lands for their economic base. The local economy is tied to the health of the ecosystem.

a. Question: What are the management opportunities within the watershed that will contribute to sustainable communities?
b. Question: What are the additional, marketable products that can help diversify the local economies that are not now being sold from the watershed? (i.e. special forest products)
c. Question: How can the watershed best provide diverse recreational opportunities that reflect current and future demands and contribute to the stability of local economies?
d. Question: What are the suitable and available acres for harvest in the watershed?

HORSE CREEK WATERSHED ANALYSIS

CHAPTER 3

HISTORIC, CURRENT, AND FUTURE TRENDS

OVERVIEW OF GEOLOGIC RESOURCES

Introduction

The Horse Creek Watershed is a complex and highly diverse assemblage of biotic and abiotic components (Map 3-1). These components influence the type and abundance of ecosystems present and how they respond temporally and spatially to disturbance events. Understanding these ecosystem resources requires an interpretation of the natural disturbance regimes that have resulted in the current topography and geomorphic landforms.

Valley Stress Relief

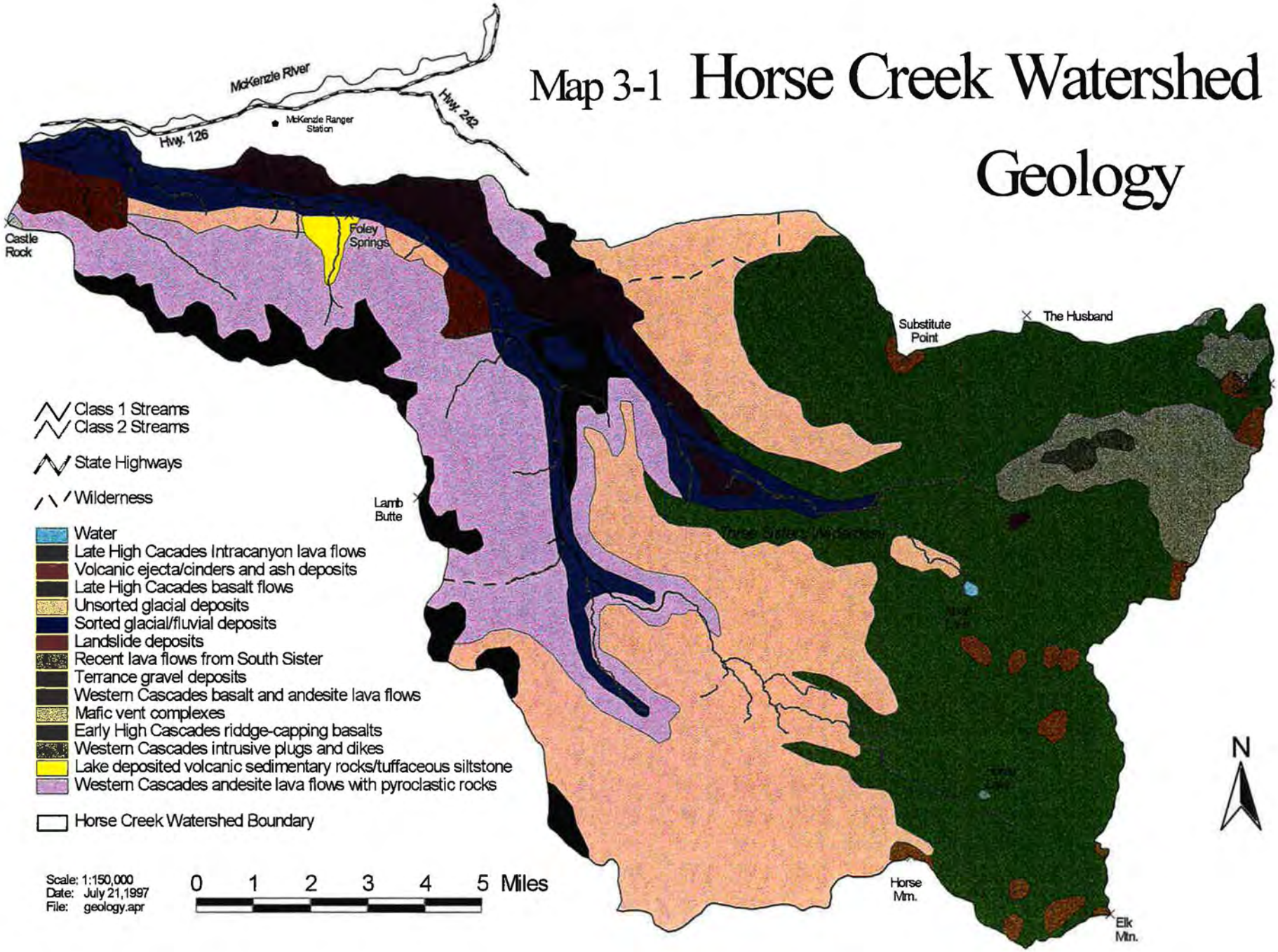
The collapse of valley sideslopes and the resulting talus and deep colluvial toe slopes is the result of valley stress relief and elastic rebound. These conditions, which are conducive to mass wasting, are prevalent in Separation Creek. Differential weathering occurs in rock masses that are layered with alternating rock of different strength, such as sandstone and shale sequences; basalt flows over glacial till; ridge-capping basalts overlying pyroclastic rocks (such as in Lower Horse Creek); or the inter-canyon lava flows of Foley Ridge. In these situations, the lower-strength, underlying material weathers at a faster rate than the overlying material, resulting in an overhang. The imbalance eventually results in failure of the overhang, which can cause mass failure of the slope.

Alpine Glacial Processes

During the Pleistocene (1.6 my bp to 12,000 yrs. bp) at least three major changes of climate (perhaps more than a dozen) produced a High Cascade ice field that completely covered all but the highest of the Cascade volcanoes (Birchfield et. al 1981). The ice sheet eventually moved down the valleys on both sides of the Cascades and into Separation and Horse Creek, causing scour and valley side slope stress. These advances were followed by retreats of the ice, which resulted in landslides from stress relief and outwash flooding.

During glacial retreat, deposition also occurs along valley sidewalls. This deposited material fell on top of the ice mass at the lateral margins then became stranded on the

Map 3-1 Horse Creek Watershed Geology



valley side slopes after the ice melted. It may remain in a marginal state of slope equilibrium, and may be susceptible to failure with very little geometric modification, such as road construction or stream scour. Geomorphic features produced by glacial scour and morainal blockage of streams in the higher elevations include most of the high elevation basins of this watershed. Other features produced include cirques (depressions left by ice), cols (saddles between ridges formed by coalescing glaciers), and tarns (peaked spires).

Fire Processes

Fires of low, moderate, and high intensities have historically occurred throughout this watershed. Low and moderately intense fires leave the majority of the surface litter and vegetation, and generally do not produce hydrophobic conditions or barren soil over large, continuous areas. In comparison, high intensity fires kill the majority of the live vegetation, combust much of the surface litter, seed stores, and fine roots, and can create hydrophobic conditions over relatively large, continuous areas. Swanson (1979) cites that "almost 70 percent of long-term sediment yield ...occurs in the first year after fire...." Amaranthus and Trappe (1993) found that 2 to 4 cm. (0.5 to 1.0 inches) of soil loss can occur during a single sustained rainfall event following stand replacement fires. Selective erosion removes trace nutrients, seed stores, and mineral clay particles which limits the establishment and survival of the conifer seedlings. Prior to fire suppression in this watershed, moderate and high intensity fires probably resulted in high sediment loads, due to the presence of soils sensitive to surface erosion.

Fire, especially of high intensities where tree mortality is greater than 70%, has four direct impacts on slope stability:

1) root strength is removed from the soil as root systems are burned underground and/or from root decay following mortality of the stand;
2) macropores are opened in stump holes leaving large cavities for water infiltration;
3) evapotranspiration becomes negligible;
4) tree surcharge, which adds a stability component to the slope, is removed.

OVERVIEW OF SOIL RESOURCES

Approximately 86% (87,588 acres) of the soils within this watershed are suitable for timber production (Map 3-2). This includes approximately 22,438 acres of Site Class II-III and 65,151 acres of Site Class IV-V soils. Cold, high elevation soils (SRI 73, 91, 910, and 920), those relatively low in productivity, and those which are potentially unstable, are also considered suitable for timber production. The Matrix allocation is almost entirely occupied by suitable soils. The LSR is dominated by suitable soils, but nearly

20% of the area in unsuitable SRI 3, 6, 21OU, and 61OU soil types. The wilderness is occupied by cold high elevation soils. Although unsuited soils support forest ecosystems, they pose unique challenges for managed forest regeneration and road construction.

There are 1318 acres of SRI units 310U and 610U in this watershed, which all fall within wilderness or late successional reserve allocations which prohibit or severely limit timber harvest. These soils are considered unsuitable for timber production due to difficulty of successful regeneration under a clear cut harvest regime. Several harvest units on these soils on south facing slopes have been successfully re-generated, however, not without multiple planting efforts.

There are approximately 5164 acres of slopes greater than 70%, which would be difficult to harvest without increasing the likelihood of slope failure. In the Lower Horse Creek area, steep slopes form the canyon walls along Separation Creek and southwest portions of Horse Creek (Map 3-3). These areas fall within the wilderness and late successional reserves where timber harvest is prohibited or very restricted. Silvicultural prescriptions (uneven-aged prescription, high green tree retention), road design (full bench/end haul) or road alignments (shallower slopes) can be crafted to limit or mitigate the potential of slope failures in these steep areas. Landform types and soils with greater than Slope Stability Class III on slopes steeper than 70% have the greatest potential of failure that could result in debris torrents (Map 3-3). In general, shallow mantled soils on slopes greater than 70% pose the greatest potential of failure. Fine textured soils (SRI 235 and 25) are uncommon and are associated with earthflow terrain. These soils are generally very productive, however, harvest can initiate slow moving rotational earthflows. These soils are also susceptible to compaction where slopes are shallow enough for ground based yarding systems. Map 3-4 displays the locations of previously documented landslides.

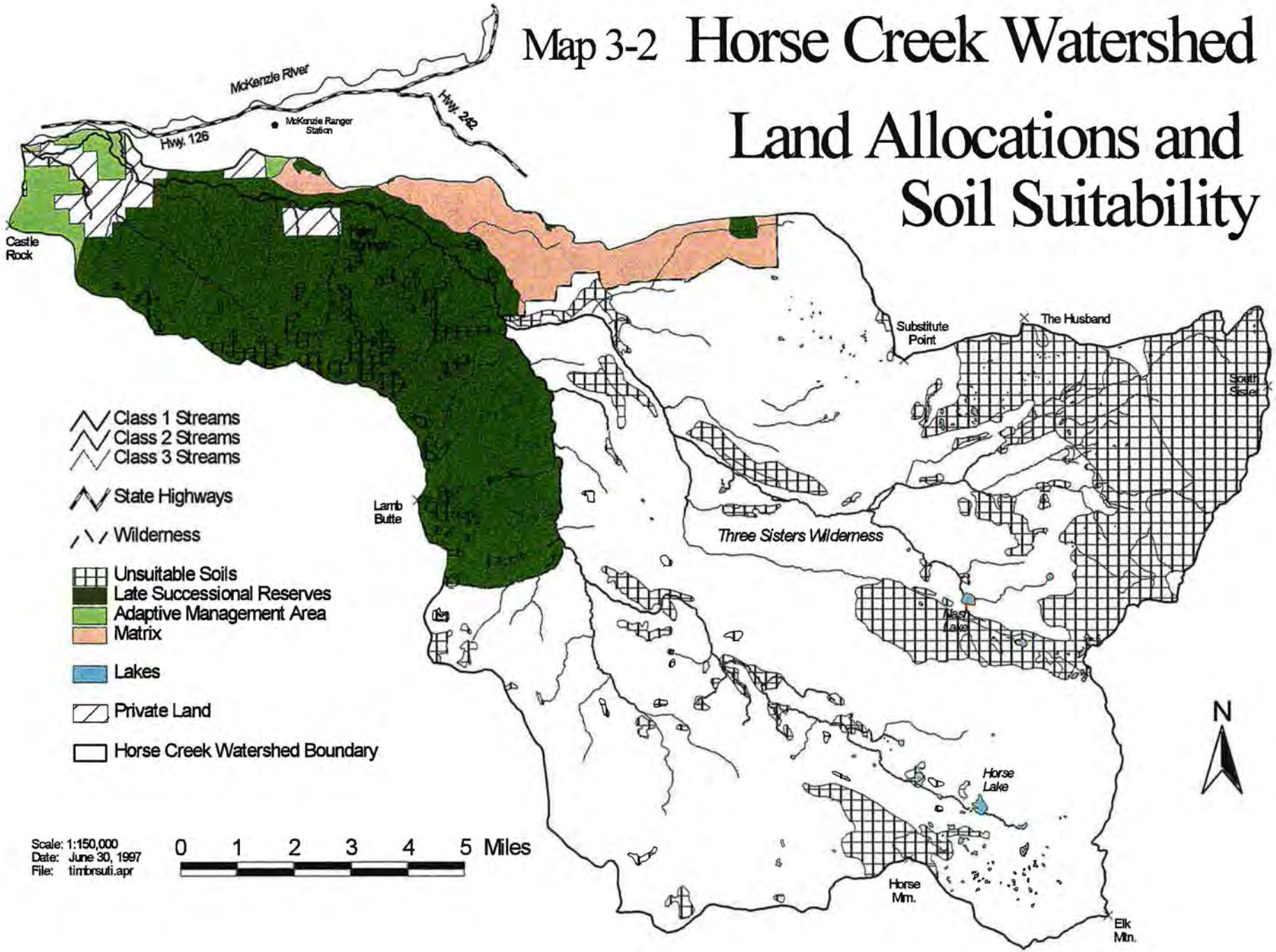
Although areas of steep slopes are often where unsuitable soils occur, they are not synonymous. Within the LSR, there is a relatively high correlation between 3, 6, and 61OU soils with steep slopes, where as in the wilderness, unsuitable soils are associated with wetlands, very cold, low productivity soils, and in recent volcanic ejecta.

Slope Stability and Historic Disturbance

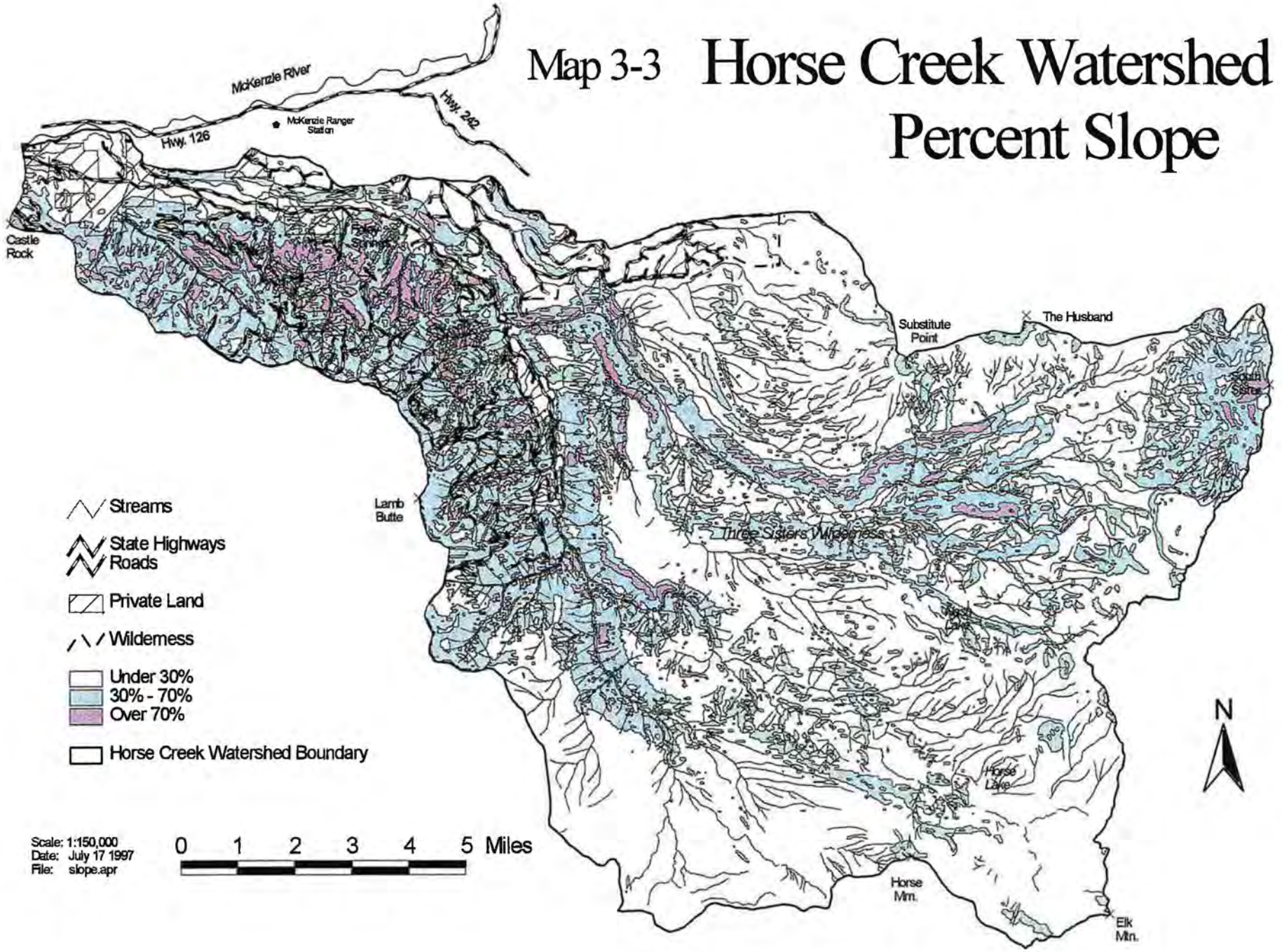
In general, the highest incidents of mass wasting have occurred in the lower Horse Creek drainage. This is because the landform is located in the glacially-scoured valleys of Western Cascade and Early High Cascade ridge-capping volcanics. These areas consist of hydrothermally altered basalts and pyroclastic rocks that are more susceptible to weathering and decomposition. Recent failures in the wilderness of this watershed have generally been due to high intensity storms or rain-on-snow events

Map 3-2 Horse Creek Watershed

Land Allocations and Soil Suitability



Map 3-3 Horse Creek Watershed Percent Slope



that initiated debris avalanche or debris flow. An anecdotal account of the 1933 failure of the Skinner glacier terminal moraine on South Sister was reported in the Eugene Register Guard (Tims 1958). An unusually warm summer accelerated the melting rate of the glacier, causing the melt water to overtop the debris dam at its front. The resulting failure sent "millions of cubic feet of water" down Separation and Horse Creeks to the McKenzie, scouring out the channel and substrate to bedrock.

S.R.I. Land Type and Stability Classification Conditions

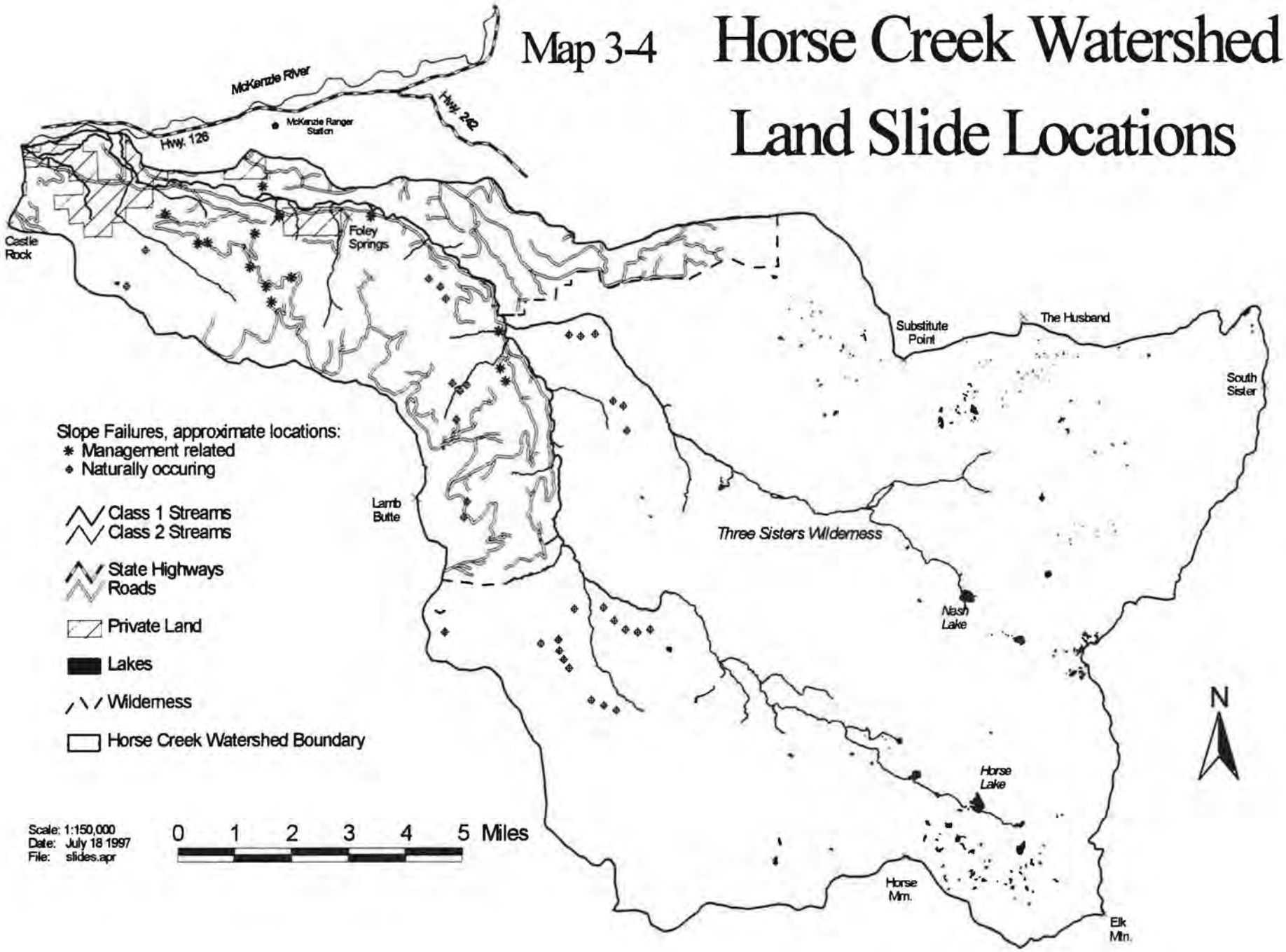
The following groupings of SRI soil complexes were used to delineate mass wasting potential.

I. **Unstable**: areas which are prone to mass failure under natural conditions (un-roaded, unharvested), and where human activities such as road construction and timber harvest are likely to increase landslide distribution in time and space to the point where this change is likely to modify natural geomorphic and hydrologic processes. Classified by the Forest S.R.I. as moderately unstable (several failures observed within a polygon) to very unstable (entire polygon shows evidence of recent and past failures).

SRI Type w/in Horse Creek Watershed	*Description*	*Acres*	*Location*
25	Cohesive residual and colluvial soil, sandy silt with some clay and rock fragments overlying pyroclastic rock on 20 to 40% slopes.	59	Lower Horse Creek

II. **Potentially Unstable**: Areas which contain conditions of steep geometry, high ground water potential, and soil with low shear strength characteristics that considers the probability of landslide-triggering storms within the period of minimum root strength and elevated ground water (as well as slope adjustment to piping changes), and the probability of channel adjustments that trigger streambank and toeslope failures. These conditions include areas following high intensity fire and clear-cut harvesting. Classified by the Forest S.R.I. as stable or moderately stable to locally unstable.

Map 3-4 Horse Creek Watershed Land Slide Locations



II. Potentially Unstable:

SRI Type w/in Horse Creek Watershed	*Description*	*Acres*	*Location*
3	Rock outcrops of basalt, andesite, and pyroclastic material which are prone to differential weathering and stress relief from glacial unloading which produce talus slopes and debris avalanches.	5400	Throughout the watershed
235	Granular glacial/fluvial deposits on mid-slope and toeslopes.	803	Western Portion of watershed

III. Potentially Unstable on slopes >70 %: Shallow soils in steep sideslope or valley headwall areas that have a potential for debris avalanche or shallow translational landslide failure. Classified by the Forest S.R.I. as stable.

SRI Type w/in Horse Creek Watershed	*Description*	*Acres*	*Location*
16	Toe slopes glacial/fluvial deposits	4300	Eastern portion
61, 64, 610, 610U, 614	Glacial till overlying basalt and andesite soil depth 3-6 feet	8300	Western portion
71	Ridges and cirque headwalls w/less than 3 feet of granular soil.	445	Eastern portion of watershed
21, 203, 210U, 310U	Sandy silt to clayey silt overlying tuffs and breccias with less than 3 feet of lightly plastic soil.	4149	Western portion of watershed

SOILS AND SLOPE STABILITY

Mass Wasting

This watershed has a diversity of landforms and geologic materials that are prone to instability. However, the watershed is not dominated by these features. Naturally unstable slopes are largely associated with slopes greater than 70%, earth flows, and intra-canyon lava flows or differentially weathered rock types. Although naturally

unstable landforms exist, slope failures are largely restricted to steep and volcanic ejecta within the Wilderness and along the steep canyon walls of lower Horse Creek and Separation Creek. Management related slope instability is restricted to a relatively small portion of the watershed within the LSR in the western third of the watershed.

Mass wasting and landslide processes in the Lower Horse Creek Watershed, and glacial scour and bank erosion along high gradient drainages on the South Sister, remain the largest sources of sediment and geologic materials entering this watershed's stream system. Slope failures generally occur episodically during higher than normal years of precipitation, during intense rain storms and/or rain on snow events, or following seismic activity. The storms during February, November and December of 1996, and the storm of 1964 introduced considerable amounts of sediment, geologic materials, and large woody debris into the drainage system via landslides and stream bank erosion.

Although a comprehensive assessment of the entire watershed has not been performed by aerial photograph interpretation or through extensive ground reconnaissance since the storms of 1996, it is likely that road alignments and even-aged timber management on slopes greater than 70% have increased the frequency of slope failures. It is known that slope failures did occur along present road alignments and from within some harvested stands (Map 3-4). No slides from the 1996 storms have been observed in fully forested areas within the watershed. Observing debris avalanches and torrents in fully forested areas is difficult due to the heavy canopy and the characteristically narrow paths of torrents. The sub-drainages of Separation Creek, Pasture Creek, Castle Creek, Eugene Creek, Wildcat Creek, and an un-named face drainage north of Pasture Creek show a history of debris torrents, scree slopes, and rock fall. However, identifying recent disturbance in an established active debris path may not appear significantly different in aerial photography following a flood producing storm event. These scree slopes are unstable and are subject to constant rock fall, which keeps the debris torrent path void of overstory vegetation and dominated by rock fall material.

Six known slope failures in the form of debris avalanches originated within harvested areas on SRI soil type 16, 168, 203 and 616 in the 1996 storms. Three resulted in debris torrents that directly affected surface water quality and channel morphology of the drainage it originated in, and indirectly impacted Horse Creek. Aerial photography and data on possible slope failures outside roaded areas and in the wilderness are lacking; therefore, there is insufficient data to evaluate the response of the watershed as a whole and how fully forested stands responded to the recent storm events. In many respects, the storms of 1996 provided a threshold event for managed and unmanaged normally unstable slopes. There are no indications of movement in deep seated earth flows that could have been initiated by the higher than normal precipitation of 1996.

Forest Road 1993 (Wapiti Road) and associated spurs are constructed on SRI land types that are largely stable and moderately stable. However, where alignments occur on slopes greater than 70% using side cast construction, the potential for road related slope failure increases. The Wapiti Road has a history of fill slope and cut bank instability. Road related slope failures are likely to initiate debris avalanches and debris torrents due to the topographic relief (steep slopes) and the high drainage density. During the storms of 1996, eight road-related slope failures on this road were identified. Most of the road-related failures occurred along FR1993. Three failures that occurred above FR 2639 did result in debris torrents that impacted the road. However, they did not reach Horse Creek. Failures off FR 1993 have not been fully investigated to determine the existence or extent of a torrent.

Pasture Creek experienced debris torrents during the floods of 1964 and 1996. These torrents were naturally occurring and were not initiated from roads or managed areas.

Soil Erosion Potential

The 1990 SRI, as mapped, indicates the majority of the soils within the Horse Creek Watershed have a moderate-severe to very severe erosion hazard rating. Based on knowledge of the slope and soil texture characteristics, and monitoring of past land management activities in the watershed; the SRI inaccurately portrays the abilities of these soil to produce sediment and their sensitivity to erosion. Moderately severe to severely erosive soils are limited to the very steep slopes along lower Horse Creek and Separation Creek, and on the cinder cones and tallus slopes of the Three Sisters in the Wilderness.

Erosion potentials are based on the rate of soil erosion that would occur if all the surface vegetation and litter were removed. These conditions are similar to what would be expected following a stand replacement fire. Severely erosive soils are those low in clays (sandy and loamy textures), low in surface and internal rock fragments, steep, and/or have long slope length. Although slope plays a role in the erosive energy of surface flows, it is the texture and lack of surface rock fragments along with slope that strongly influence erodability.

Surface Erosion

Surface erosion is rare throughout the watershed and is limited to the very steep poorly vegetated slopes in the Wilderness. Past regeneration harvest followed by hot prescribed fires in the Wapiti area has resulted in temporary increases in soil loss rates. These effects are limited to two or three years due to the rapid recovery of vegetation which provides effective ground cover. In the remainder of the watershed, outside the Wilderness surface erosion is rare due to the high infiltration and percolation rates of

the soils, the low intensity rainfall patterns, and high levels of effective ground cover. Surface erosion from harvested stands (except where noted above) remains rare and cumulatively well below the amount of sedimentation from road surfaces and slope failures.

Management-related surface erosion and sediment transport remain largely a function of roads within the watershed. The watershed is largely lacking in roads, with the majority occurring in the south west. The roads produce sediment on a relatively continuous basis, which is quickly and efficiently incorporated into the drainages of the watershed. A site-specific assessment of sediment production from roads and transport mechanisms into the drainage network has not been performed. Specific road alignments that indirectly contribute sediment into Horse Creek have not been determined.

Surface erosion in forested areas is absent or non-existent. The soils are largely very well drained with high infiltration rates which are rarely exceeded by normal precipitation or rain on snow events. Soils associated with wetlands and upland grassland communities are stable and show little evidence of surface erosion. Some upland grassland and wetland communities continue to experience erosion patterns established during historic grazing practices or by recent use by permitted outfitter-guides, hunters with pack livestock, and/or by human impact (foot traffic). These areas of accelerated erosion are limited to rather rare grassland and wetland communities in the wilderness which are heavily used by recreationists. The impacts are minimal with respect to spatial extent, threats to site productivity, and water quality.

Fire and Erosion

It is unlikely, given the limited affects of low and moderate intensity fires, that fire altered the soil erosion pattern or rate, or the frequency of mass wasting events. Planned ignitions of low and moderately intense fire would produce the same magnitude of effect.

High intensity fires would have caused high levels of mortality in the overstory, and consumption of surface litter, down woody debris, and soil organic matter. This could have resulted in a significant increase of surface erosion and mass wasting. Historically, high intensity wildfires did occur in parts of this watershed. Since this

watershed is dominated (60% or 60368 acres) by soils with a moderate-severe and severe-very sever erosion potential, it is highly likely that fire occurred on these soil types. The post-fire condition could have produced soil loss rates greater than 35 tons per acre per year, and possibly higher on very steep slopes. These conditions would exist for years, maybe decades, before effective ground cover would be provided by early seral plant species. High intensity fires on less erosive soils would have produced soil loss rates much greater than fully forest conditions, but the loss rates and could have affected site productivity.

Rural Residential

Riparian area soils and ecosystems in the lower Horse Creek that are in private land holdings have been impacted by urban development, road construction, and conversion to orchards and grazing pasture. Housing and paved road construction permanently removes the land from productive condition. These constructs are also impermeable to infiltration, which influences the routing of precipitation and may increase the transport of non-point sediment and other pollutants into surface waters. The use of household herbicides and pesticides, the use of chemicals in commercial orchards, and silvicultural operations near Horse Creek and its tributaries may introduce material into the drainage network. Livestock pastures often have reduced infiltration rates due to compaction of the soils which may increase surface erosion and the transport of sediment and other non-point pollutants.

Road and residential construction along with active filling or blocking of secondary and tertiary channels reduces the effective capacity of the river channel. The results are often felt during flood events, as in 1996, when the active channel is exceeded and the secondary channels are unavailable to accept the flood discharge. Housing, roads, and land developments can be threatened under flood conditions due to the positioning of many of these improvements within the active 100 year flood plain.

Riparian Reserves and Aquatic Conservation Strategy Objectives

Consideration in managing riparian areas in the Class I and II portions of this watershed's streams should incorporate the entire flood plain, terraced glacial terrace deposits (SRI 16), or toe slopes in many areas along Horse Creek to meet the intent of the ACSO's. Protecting the immediate area near the stream and not considering potentially unstable slopes/landforms adjacent to the riparian area or on the upslope is unlikely to adequately protect surface water quality and fish habitat. Understanding the inter-relationship between hill slope processes and channel dynamics, and incorporation those concepts into project planning and implementation on a site specific basis, is more likely to meet riparian and water quality objectives.

The inter-relationship between the present channel morphology/dynamics and SRI

15and 16 soils warrants consideration. The soils and landforms associated with SRI 16 are perched above the present flood plain (Map 3-5). The slope and soils of SRI 16 are relatively susceptible to slope failures. Slope failures did occur in 1996 within harvested SRI 16 soils immediately above the present flood plain. These slope failures impacted the riparian areas by the physical disturbance of the slide, and the deposition of large woody debris and geologic materials. These areas will remain as sources for sediment that is incorporated into the drainage system until vegetation provides effective ground cover and slope stability.

OVERVIEW OF HUMAN USE

Prehistoric Resources

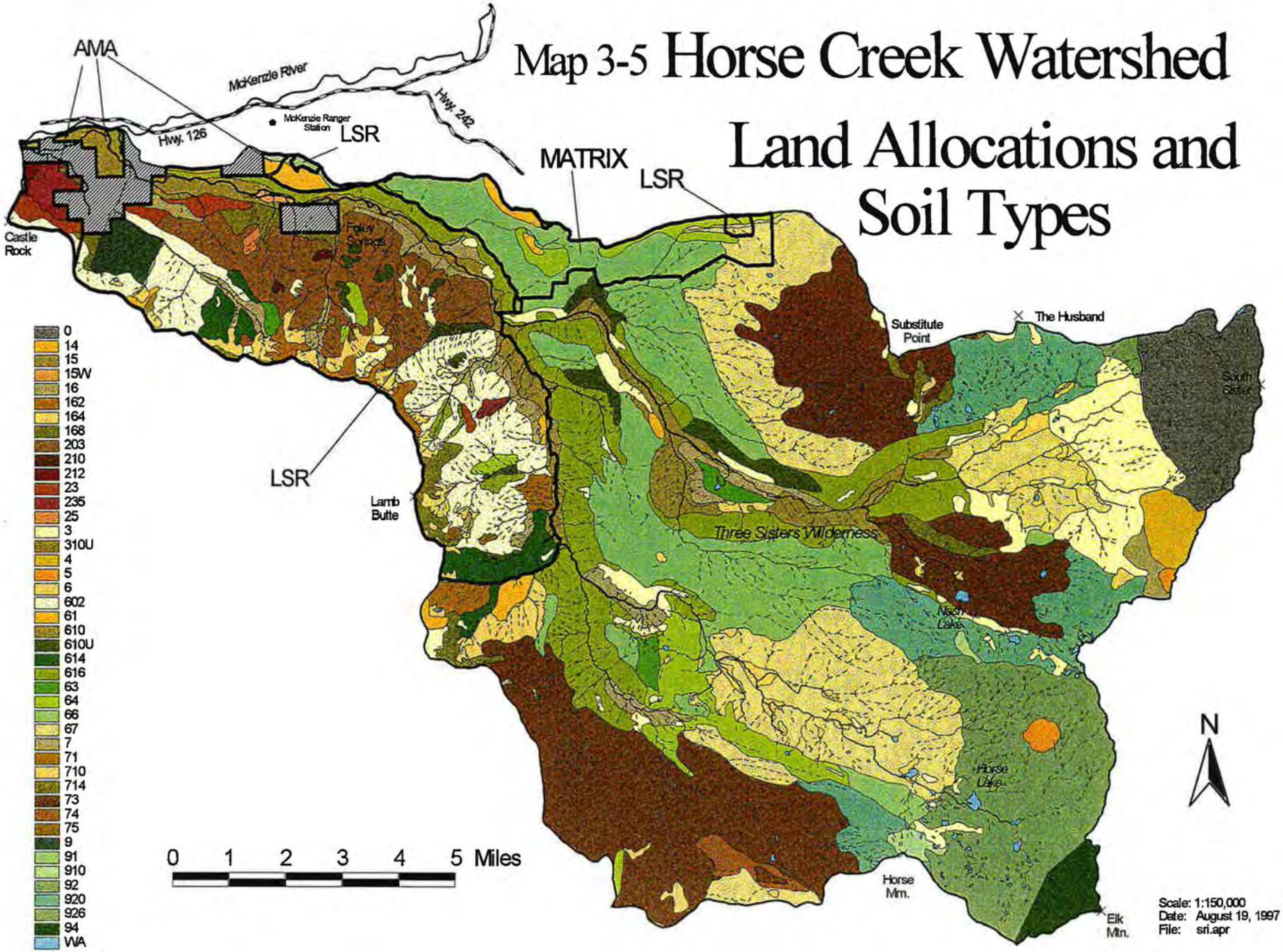
Prehistoric heritage resources in the Horse Creek watershed are not well-understood at this time in terms of the activities of native peoples which lead to the deposited artifacts. Most artifact patterning observed today leads to generalized interpretations. For example, we assume that hunting-related activities and plant resource processing must have taken place at many locations. Yet the obsidian spearpoints and scraping and cutting tools left at those sites have seldom been subjected to detailed study which could yield specific information about which plants or which animals were involved. Most documentation is in the form of USFS Region Six Site Forms. Earlier years of recording (1979-86) are rather sketchy, though improvements in data have occurred in recent years. In addition, several archeological evaluations have resulted in some increased understanding.

Clusters of prehistoric archeological sites have been recorded in the northwest and southeast portions of the watershed. The meaning of that clustering is unclear, since archeological survey has been project-specific rather than research design-based. Environmental data (topography and freshwater availability) suggest that those in the northwest portion may have been temporary camps along travel routes into the high country obsidian sources north of the watershed.

Prehistoric resources include chipped obsidian lithic scatters and obsidian lithic isolates, representing tool use, modification or manufacture related to "broad spectrum" hunting and gathering. Ongoing stone tool analysis, both by USFS archeologists and contractors, suggests that this portion of the Cascades was occupied primarily by people indigenous to the Cascades. Those people were probably ancestral to the Molalla and possibly Kalapuya people involved in early treaties of the 1850's, some of whose descendants are members of the Siletz and Grande Ronde confederated tribes. However, it is also highly likely that people living east of the Cascade crest (prehistoric ancestors of the Tenino and Paiute people currently enrolled at Warm Springs), also made seasonal (summertime) trips to the upper reaches of the Horse Creek watershed.

Map 3-5 Horse Creek Watershed

Land Allocations and Soil Types



There appears to be a long period, the Middle Archaic (about 8,000-2,000 years ago) where there was marked stability in adaptation, at least insofar as it relates to stone tool use. Many of the sites from that period probably represent warm season occupation of the high elevation reaches of an ethnic group's territory, or they may be in areas of probable travel routes (such as the Foley Ridge area). The large number and high density of prehistoric sites near high elevation lakes in the southeast portion of the watershed are likely to be temporally - overlapping summertime encampments.

Historic Resources - Native American

Two unique resources dating to the Native American historic period are found in the western half of Horse Creek watershed. They are peeled cedar tree sites, the living remnants of 19th and early 20th century Warm Springs container-making activities.

The mid-19th century was a time of sweeping cultural, geographic, and technological change for Indians in Oregon. The most significant land use or geographic change involved the resettlement of Native American tribes and bands onto reservations. Although Horse Creek watershed clearly had seen prehistoric land use, there were no Indian villages whose residents were displaced by white settlers, unlike so many locations in the Willamette Valley.

What the early explorers, settlers, and then merchants of the upper McKenzie area saw when they saw Indians were Warm Springs reservation people, who had been moved to their central Oregon reservation near Madras in the 1850's through the 1870's. Those Indians were primarily from Tenino, Wasco, and Warm Springs culture areas along the Columbia and lower reaches of the Deschutes Rivers. After the Paiute wars ended, Northern Paiutes from the desert Great Basin also were resettled at the Warm Springs Reservation.

A major technological change (only one or two generations old by the 1850's) was the use of the horse by the Indians. Horses had become major status markers for Indians, and the number of horses one owned that could be exchanged for a bride or given to one's relatives was a direct measure of social status. Horses certainly enabled long distance travel for trade and subsistence purposes, but they also required adequate forage and safeguarding. Thus, the rich huckleberry fields on burned over Cascade Mountain ridgetops became natural resource draws, because the horse made them accessible and enabled transport of large quantities of dried berries (Bergland 1992). There was abundant forage (although not without some competition from sheep herders), water and relative safety from Northern Paiute people, who apparently were raiding horses from the Warm Springs reservation until the 1870's.

Warm Springs Indians on summer/fall seasonal trips into and through the Horse Creekwatershed were observed by early USFS Rangers, sheep herders, and residents from the 1860's until as recently as the 1920's and 1930's. One particularly important archeological site from that period is found near Lamb Butte along the western edge of the watershed. There we have documented historic camp remains and peeled Alaska yellow cedar trees. The presence of other rare botanical species in the Lamb Butte area suggests the possibility that Native Americans also may have used the area for the gathering of special medicinal plants. Chinook jargon place names also suggest the importance of the area to Indians. For example, Olallie Ridge and Olallie Mountain both probably were named for the abundant huckleberries nearby. Horsepasture Mountain reportedly was the scene of summertime Indian horse racing (Williams 1988:109), and it is also near the western edge of the Horse Creek Watershed.

Historic Resources - Euroamerican (Early Settlement)

Historic period Euroamerican settlement is not yet manifested in documented archeological sites within the Horse Creek watershed. Williams recounts a number of instances and situations which may some day be verified, either through historic documents or historic archeology.

Horse Creek itself is perhaps named after an incident in the 1840's or 1850's, in which one or two immigrant wagons made it over the crest of the Cascades and down Horse Creek, where they lost their horses (Williams 1988:106). Various confirmations of this event have been postulated, including the purported discovery of wagon remains along Horse Creek, and the purported discovery of wagon parts on Olallie Ridge in the early 1900's, but neither discovery can be objectively confirmed at this time. Another somewhat better-documented immigrant tale is from 1853, when a party on horseback (who had separated from a wagon train in central Oregon) supposedly came through the Separation Creek and Horse Creek areas, were lost, and were subsequently rescued by a settler from the Springfield area (Williams 1988:150).

According to an elderly informant, Mrs. Elizabeth King homesteaded the area along King Road in the 1860's (Williams 1988:122). Williams goes on to note, however, that Mrs. King officially filed on a claim under the 1906 Forest Homestead Act in 1910. It may be that the 1860's date is wrong, or that Mrs. King had a "squatter claim," a not uncommon practice at the time. At any rate, if correct, the 1860's date would make it one of the earliest homestead dates in the area, on a par with the John T. Craig homestead near McKenzie Bridge, established ca. 1869.

Historic Resources - Euroamerican (Sheep herding)

Sheep herding was a significant early economic use of the Cascades. According to Williams, the area along both the east and west sides of the watershed bears place names which relate to sheep herders: McClennan Mt. (herded by Ewan McClennan from 1907-1918); O'Leary Mt. (herded by Johnny O'Leary at turn of the century); and

Hinton Creek (grazed 1912-1948 by Jim Hinton, and we have 1982 photographs from the Separation Meadow area of a carved tree marked with the name Hinton and a 1907 date). Mike Reider was another sheep herder who used the Olallie Mountain area with up to 3,000 sheep from 1872-1909. In 1872 he supposedly drove off a band of Warm Springs Indians who arrived on Olallie Meadows with about 250 horses, and who had come to fatten the horses and pick huckleberries. Sheep herding persisted on Olallie Mountain until the mid-1930's, and there may be archeological evidence there for sheep camps (Williams:177). Indeed, the historic materials found near Lamb Butte area may be from sheep herders or Native Americans, since both were using much of the same gear at the time.

Historic Resources - Euroamerican (Recreation)

The most significant historic recreational development within the Horse Creek watershed was Foley Hot Springs, a major public attraction from the 1870's through probably 1950. The development of Foley in many ways paralleled that of Belknap Hot Springs, and thus constitutes the first purely recreational commercial development in the area.

Other recreational developments which are discernible in their physical traces are the Forest Service hiking and pack trails dating from the turn of the century through the WWII era. Many such traces are to be found in the Three Sisters Wilderness portion of the Horse Creek watershed, and perhaps the most significant are those traces of the Oregon Skyline Trail.

Yet another remnant of historic recreation development may be found in the Eastern Brook trout - Williams notes that a local fishing and hunting guide, Harry Hayes (who also owned the McKenzie Bridge general store), stocked Separation Lake with brook trout, and essentially used the lake as a destination for his guided trips (Williams 1988:213)

Historic Resources - Euroamerican (Forest Service)

Forest Service-related heritage resources overlap with some of the above categories; historic trails, for example. There were two fire lookouts within the watershed, but those have been demolished (Castle Rock and Horsepasture Mountain), and only archeological traces remain. Likewise, the Horse Lake Ranger Station, first built in 1909, then rebuilt in 1934, was demolished in 1972, at which time the Horse Lake Shelter (built in the mid-1930's) was also torn down.

The reference trees carved by the Forest Reserve rangers are rare, early Forest Service heritage resources. Two such examples are known within the watershed, and there may be more. They were carved by Ranger Cy Bingham in 1907, and appear to have marked designated sheep herder camps (one of the early ranger duties was to administer grazing permits). See the above discussion of sheep herding.

OVERVIEW OF RECREATION

Recreational activities within the analysis area vary by setting where the recreation occurs, seasonal distribution of use, and levels of use. Use data within the watershed is not detailed.

SETTINGS

Private Ownership
Recreational activities occur on about 1725 acres of private lands within the watershed. Residences, resorts and individual cabin rentals dominate these lands. Considerable angling occurs along portions of the various forks of Horse Creek in the Delta area.

National Forest
Recreational settings on National Forest Lands are described by the Recreation Opportunity Spectrum (ROS). Some specific settings are prescribed by Land Management allocations contained in the Forest Land and Resource Management Plan.

Land Management allocations (MAs) within the watershed which specifically describe a range of appropriate recreational activities include Wilderness (MA-1A), recreation sites (MA-12a), and special use sites (MA-12b).

SEASON OF USE

The majority of recreation use within the watershed occurs between mid-April and late November. The traditional opening of fishing season marks the beginning of the "recreation season" and concludes with the closing of elk season. Between those times most activities follow a seasonal pattern. That pattern generally progresses from fishing, wildflower viewing, berry picking, through the various big game hunting seasons, and fall foliage viewing.

Other activities occur more-or-less uniformly throughout this period. Camping, picnicking, viewing scenery, driving for pleasure, mountain biking, and hiking are typical of those pursuits.

Winter recreation use is low. Contributing to low use levels is the pattern of access and snowfall patterns. Winter access is generally along Forest Road 2638. The road is frequently covered with snow of poor quality. This generally makes the higher elevation, and higher quality snows inaccessible. During periods of high quality snow

at lower elevations snowmobiling and nordic skiing occur on a sporadic basis. Very low levels of winter "adventure recreation" occur at the highest elevations with the Wilderness.

There also exists an elevational component to seasonal use patterns that is dictated by the rate and pattern of snowmelt. Consequently, much of the recreational use within the Wilderness is concentrated during the relatively brief period of early July to late October. Heavy concentrations of insects (mosquitoes and flies) early in the season further concentrates use at higher elevations.

Probably the most consistent year-round recreational activity is the use of the recreation residences within the Delta A and Delta B recreation residence tracts. These recreation residences are operated under the Forest Service Special Uses Program.

LEVELS OF USE

The 1996 Recreation Resource Inventory System (RRIS) tracks different recreational activities on the McKenzie Ranger District. Over 1,542,468 separate activity-days (occasions) were tabulated. This equals 405,430 Recreation Visitor Days or RVDs. An RVD is equivalent to one person recreating for 12 hours. This may be one person counted several times as they hiked, rode, or camped overnight during their stay within the watershed. The Horse Creek watershed accounted for approximately 15% of total occasions on the District.

While recreation use across the watershed can generally be characterized as low to moderate, there are sites of concentrated use or popularity.

Non-Wilderness

- Forest Road 1993 (Wapiti Road): This road links the Horse Creek drainage with Forest Road 19 at Cougar Dam. Within the watershed, the route is generally steep with extremely steep sideslopes. Because of the landforms it traverses and its position on the highest prominent ridge to the west of the Three sisters Wilderness, the panoramic views of the Three Sisters make it extremely popular for viewing scenery and photography. For those not deterred by driving challenges, it is perhaps the premier scenic route on the McKenzie Ranger District. Views from along this route are to be found in 'Coffee Table' books, posters, and postcards.

- Horse Pasture Mountain: Located along the western watershed boundary, this spot is frequently visited by those seeking a scenic vista, a photographic opportunity, and in the early summer viewing wildflowers.

- Recreation residences in Delta A and Delta B tracts along the McKenzie River and the west fork of Horse Creek: These areas are extremely popular recreational retreats for Special Use Permit Holders.

- Horse Creek group site campground: While occupancy rates at this facility are not heavy (35% of capacity), it serves as the only group reservation site on the McKenzie Ranger District. Operated on a reservation system, it serves as base for many other recreational activities in the McKenzie Bridge area.

- Mosquito Falls viewpoint: This undeveloped viewpoint, accessed by a short cross country hike from Forest Road 2638, receives moderate levels of use. It is a popular site for "rural" weddings.

Three Sisters Wilderness

Records show that 50,886 people visited the entire Three sisters Wilderness in 1996. Of those about 24% stayed overnight, with an average length of stay of 2.5 days, and as part of a group of 2.8 people. Ninety percent traveled by foot, and 10% traveled with stock. Use within the analysis area accounted for approximately 6.5% of the total Wilderness use. (See Map 3-6 for high use areas and the trail system in the Horse Creek watershed).

- James Creek, Hinton Creek, Mesa Creek and Separation Creek: Use in the meadow areas, at these sites is generally moderate with about 1,500 visitors annually. Major travel routes into the area include the Foley Ridge, Louise Creek and Pacific Crest National Scenic Trail (PCNST). Stock use is more common during hunting season, (September - November) around meadows due to the presence of good feed, water, and camp locations. A small three sided, Adirondack style shelter constructed by the CCC's is located near James Creek.

- Honey Lakes complex: The Honey Lakes area is comprised of several medium sized lakes including Honey, Kidney, and Square Lakes, along with Buck Meadows. Use is low to moderate with about 1,000 visits annually. The lake areas draw the most use and have the highest concentration of camp sites within the complex. The Buck Meadows shelter, also a small three sided Adirondack style built by the CCC's, draws numerous campers. The primary recreational pursuit within the complex is fishing.

- Sister Mirror Lake complex.: The Sisters Mirror complex is comprised of numerous small lakes located between Burnt Top peak to the west, Koosah Mountain to the south, and House Rock to the north.

- Horse Lake: Once the site of Horse Lake Guard Station Administrative Site, this lake remains popular with anglers. Sites are accessible by early summer in all but the most severe snow years. A number of the most severely impacted campsites within the Three Sisters Wilderness are found along the northern and eastern shores of the lake.

There are a total of 282 inventoried campsites located within the Wilderness portion of the analysis area. The majority of those located in the areas of concentrated use described above. A review of inventory data collected since 1985 reveals the presence of water is the geographical feature which overwhelmingly attracts people to a particular camping location. Data indicates that 257 of the 282 inventoried sites lie within the riparian zone as defined in the rest of this document. The influence of this preference raises important issues related to water quality and riparian function.

Neither of these parameters have been extensively measured and represent future data needs within the watershed. Some hydrologic and fisheries inventory work has been accomplished but are insufficient to draw any conclusions as to the impact of this pattern of recreation use.

However a comparative look at total riparian acres and acres of direct campsite disturbance within the riparian zone gives one a sense of the magnitude of the possible impacts. The area of disturbance associated with these campsites was derived from "Campsite Monitoring Impacts Worksheet" data forms collected by Wilderness management personnel. The sites were inventoried between 1985 and 1988. Approximately 60% of all sites have been re-inventoried at least once since initial measurement. Some 26 parameters are measured; of those three were used to construct the tables that follow. Those parameters were "distance to water," "camp area," and "barren core area."

"Distance to water" is a direct measurement of the distance the "camp area" is from the nearest water. "Camp area" is the size of area used for camping. This is determined by changes in ground cover ratios between the campsite and of adjacent undisturbed areas. It is recorded in square feet. The "Barren core area" is that area of nearly every campsite that is devoid of ground cover and forest litter. Most commonly it is associated with the area of the site that serves the "kitchen area" function and the immediate area around the campfire (if present); it also is recorded in square feet. The results are summarized in the tables below.

Table 3-1a: Wilderness campsites within the Horse Creek Watershed.

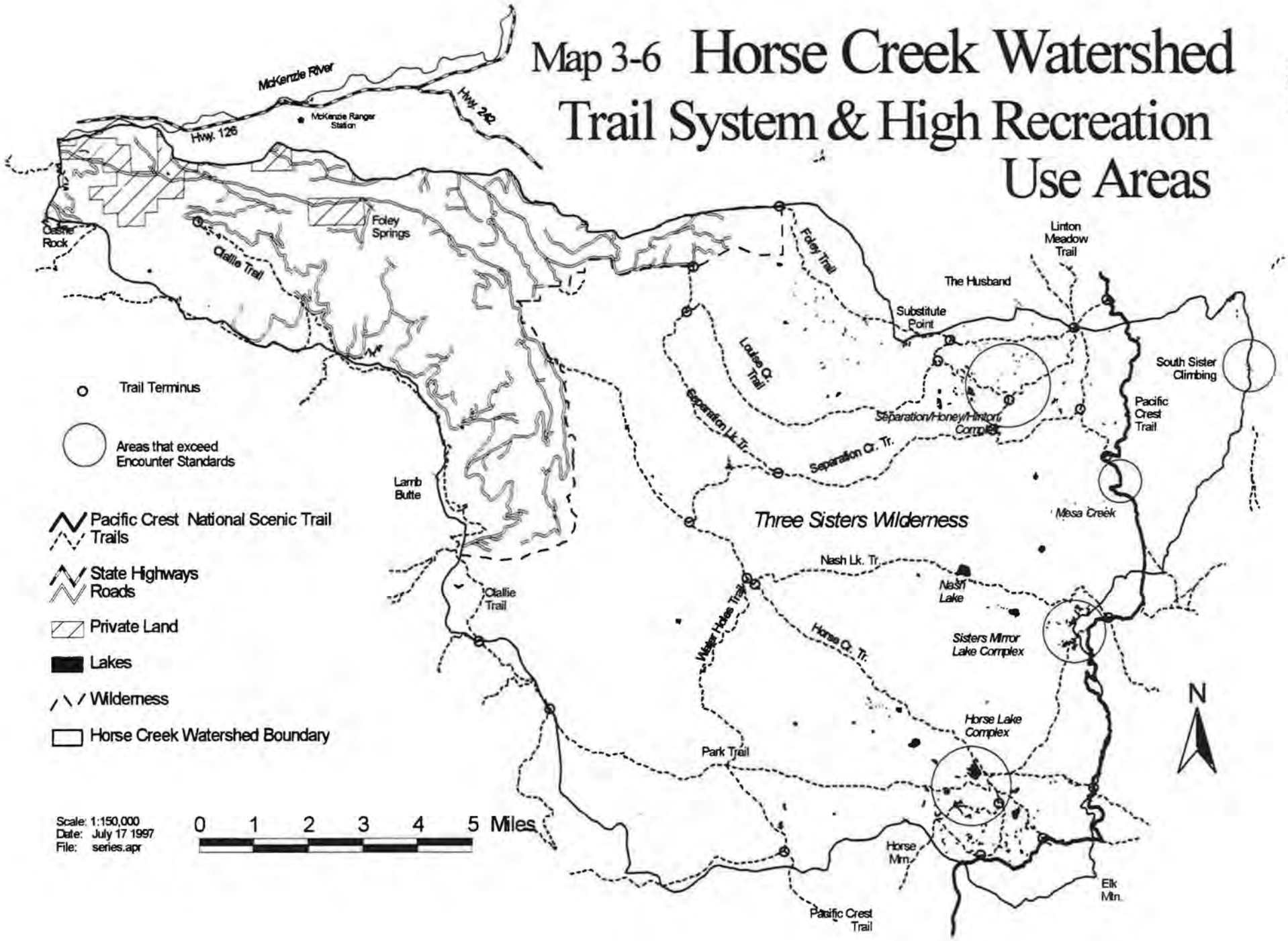
			CAMPSITE AREA WITHIN RIPARIAN [1]				
				STREAMS [2]			
Travel Zone	Total Sites	Sites w/in Riparian	Lakes [2]	Class I	Class II	Class III	Class IV
030	5	5	1846 (210)	-	-	-	-
032	25	23	24400 (7410)	-	-	15600 (4500)	-
033	94	85	9575 (3600)	-	-	141904 (41607)	5995 (1104)
034	0	0	-	-	-	-	-
035	17	13	12650 (4900)	-	5800 (1514)	-	-
040	5	1	2762 (2762)	-	-	-	-
041	19	16	36975 (8400)	-	-	-	-
042	37	37	30350 (10825)	-	-	7170 (3150)	-
043	61	60	75325 (29630)	-	-	-	-
050	19	17	26125 (135630)	-	-	-	-
TOTAL	282	257	220008 (81300)	-	5800 (1514)	164679 (49257)	5995 (1104)
			ACRE CONVERSION				
			5.05 (1.87)	-	0.13 (0.03)	3.78 (1.13)	0.14 (0.03)

[1] Two figures given. The parenthetical number is the "barren core" area of the campsite. The 'barren core" is the area of exposed mineral soil within a campsite. The non-parenthetical number is the total area of a campsite. This is defined by changes in vegetative cover (includes the 'barren area').
[2] Area given in square feet.

Table 3-1b: Summary of wilderness campsites within riparian areas.

RIPARIAN TYPE		RIPARIAN AREA (ACRES)	CAMPSITE AREA (ACRES)	% TOTAL RIPARIAN
Lake		5350	5.05	0.094
Streams				
	Class I	935	0	0.0
	Class II	2262	0.13	0.01
	Class III	2213	3.78	0.17
	Class IV	10774	0.14	0.001
TOTAL		21534	9.10	0.04

Map 3-6 Horse Creek Watershed Trail System & High Recreation Use Areas



While the total area of riparian occupied by campsites is quite small it is impossible, with available data, to determine to what level riparian functions may be being affected.

It is interesting to note that in all the sites inventoried no "barren core areas" are located immediately on water, i.e. "distance to water" equals zero. And that the majority of campsites are more than 45 feet from the water's edge.

When looking at re-inventory data there is no clear trend whether sites are growing or diminishing in size. Where there have been active management efforts sites seem to be remaining the same or diminishing slightly. A few sites where no management activities other than litter clean-up and fire ring reduction show evidence of growth. In the light of a growing use trend in the Three Sisters (about 5% per-annum) impacts from campsites seems to be relatively stable.

TRAIL USE

There are a total 117.6 miles of system trails within the analysis area.: 12.8 in non-wilderness areas and 104.8 miles in wilderness. Trails are rated according to type of travel, difficulty level, and maintenance level. Tables 3-1c and 3-1d describe the extent of the trail system and recent use.

Table 3-1c: Trail system within the Horse Creek Watershed.

Trail Name	Trail No.	Total Miles	WA Miles	Trail Class	Primary Use	Wilderness
King Castle	4326	3.6	1.7	M	Hiker/Bike	No
Olallie	3529	11.1	11.1	M	Hiker/Bike	No
Olallie	3529	3.0	2.2	M	Horse/Hiker	Yes
Horsepasture	3529.5	1.3	1.3	M	Hiker/Bike	No
Park	3530	11.3	11.3	M	Horse/Hiker	Yes
Horse Creek	3514	14.9	14.9	M	Horse/Hiker	Yes
Separation Lk	3536	8.1	8.1	M	Horse/Hiker	Yes
Separation CK	3524	7.2	7.2	S	Hiker	Yes
Louise Creek	3520	9.2	9.2	M	Horse/Hiker	Yes
Foley	3511	8.7	7.7	M	Horse/Hiker	Yes
Indian Holes	3524	2.5	2.5	S	Hiker	Yes
Separation Mdw	4331	2.0	2.0	S	Hiker	Yes

Trail Name	Trail No.	Total Miles	WA Miles	Trail Class	Primary Use	Wilderness
Linton Mdw	3547	5.6	3.1	M	Horse/Hiker	Yes
Nash Lake	3527	8.5	8.0	M	Horse/Hiker	Yes
Water Holes	3538	10.8	7.8	S	Horse	Yes
Pacific Crest	2000	38.6	18.0	M	Horse/Hiker	Yes
McBee	3523	0.0	1.5	M	Horse/Hiker	Yes
Island	3515	1.5	1.5	S	Horse/Hiker	Yes
Rainbow Falls	3543	0.7	0.7	S	Hiker	Yes

M= Mainline trail
S= Secondary trail

Table 3-1d: Trailhead use in the Horse Creek Watershed, 1991-1994.

Trailhead Name	No.	Use (Total Visits)			
		1994	1993	1992	1991
Foley Ridge	26	567	537	580	488
Separation Lake	25	258	306	181	238
Horse Creek	24	195	147	128	55
Pat Saddle	23	369	328	384	376
Olallie	(No data available)				

Data from Wilderness Permit information

Trail use has not increased in this watershed to the extent it has in other areas of the Three Sisters. Use level generated trail problems are generally minimal within the watershed. Trails with heavy stock use, particularly those used early and late in the season when wet conditions predominate, show the greatest levels of impact. Other than very localized situations these impacts do not seem to be affecting other resources.

The largest cause of trail related impacts is due to a large backlog of heavy maintenance items. The cause is directly related to declining levels of trails funding over the last decade. Those items include trail drainage problems, relocation needs, trail alignment problems, and deteriorating trail structures (water crossings, turnpikes, and puncheon).

POTENTIAL WILD AND SCENIC RIVER ELIGIBILITY

Background

The Willamette National Forest has identified the Watershed Analysis process as the vehicle to identify rivers and streams that may meet eligibility criteria for Wild and Scenic River status. The criteria are the river/stream be: 1) free-flowing and 2) have at least one "outstandingly remarkable value" (ORV). This screening process will result in a preliminary list of rivers/streams which appear to meet eligibility criteria that would be validated in the public scoping part of a Forest suitability study EIS. Eligible rivers will be protected according to Forest Plan direction until a suitability study is completed and Congress determines which - if any - rivers/streams are to be designated.

To qualify as an "Outstandingly Remarkable Value," a river-related value must be a unique, rare, or exemplary feature significant at a regional or national level. For regional comparison, the geographic regions defined in the 1989 Statewide Comprehensive Outdoor Recreation Plan (SCORP) for Oregon are used. SCORP Region 8 is used for rivers/streams on the Willamette National Forest.

Rivers/streams are evaluated using nine criteria. Each of these are made up of various components. The ten values examined during the resource assessment are: scenic values, recreation, geology, water quality/hydrology, vegetation/ecology, prehistoric, historic, fish - anadromous and resident, and wildlife. Evaluation criteria details can be found in the Recreation Appendix.

Two streams, Horse and Separation Creeks, were examined for their eligibility potential. Based upon physical attributes Horse Creek was analyzed in three segments; Separation Creek as a single segment.

Horse Creek was segmented as follows:

- Segment 1 (Delta): Confluence of Horse Creek with the McKenzie River (RM 0.0) to Horse Creek bridge on Forest Rd 2638 (T.16S., R.6E., Sec 24)(RM 3.0).
- Segment 2 (Middle Horse): Horse Creek bridge (RM 3.0) to the confluence of Mosquito Creek (T.17S., R.6 1/2E., NE 1/2Sec.28)(RM 15.5).
- Segment 3 (Upper Horse): Confluence of Mosquito Creek (RM 15.5) to Sunset Lake (T.18S., R.7E., NE1/2Sec.26)(RM 28.0).
-

The termini used for Separation Creek were from the confluence with Horse Creek (RM 0.0) (Horse Creek RM 10.8) to the west end of Separation Meadows (T.17S., R7E., NW1/4Sec.13) (RM 13.0).

Findings

The resource assessment found Outstandingly Remarkable Values for Separation Creek and all segments of Horse Creek. Findings are summarized in the following table. Detailed analysis results are found in Recreation Appendix, however, Table 3-1e displays a summary of the Outstanding Remarkable Values.

Both streams are wholly or partially within the Three Sisters Wilderness. Separation Creek lies entirely within the Three Sisters. The Wilderness boundary description establishes the boundary as the "thread" of Horse Creek. The easterly half of Horse Creek stream channel from Horse Creek's confluence with Separation Creek to the Mosquito Creek confluence lies within the wilderness. Upstream of Mosquito Creek Horse Creek lies entirely within the Wilderness.

Table 3-1e: Summary of Outstanding Remarkable Values for Horse Creek and Separation Creek.

	Outstanding Remarkable Values[1] (ORV)								
	1	2	3	4	5	6	7	8	9
Horse Creek									
Segment 1	N[2]	N	N	N	N	N	N	Y	N
Segment 2	N	N	N	N	N	N	N	Y	Y
Segment 3	N	N	N	N	N	N	N	Y	N
Separation Creek	N	N	N	N	N	N	N	Y	Y

[1] 1 = Scenic, 2 = Recreation, 3 = Geology, 4 = Water Quality/Hydrology, 5 = Vegetation/Ecology, 6 = Prehistoric, 7 = Historic, 8 = Fish(anadromous and resident), 9 = Wildlife

[2] N= Not found to be an ORV
Y= ORV

OVERVIEW OF UPLAND VEGETATION

The forested vegetation of the Horse Creek Watershed is characteristic of vegetation west of the Cascade crest. Plant series classification is a convenient and often used way of defining and stratifying these plant communities. The forested plant series typically found in the Western Cascades include Douglas-fir (PSME), Grand fir (ABGR), Western hemlock (TSHE), Pacific silver fir (ABAM), and Mountain Hemlock (TSME = lower subzone; TSME SUBALPINE = upper subzone).

Disturbances are events that may result in change to vegetative or topographical characteristics within the landscape. They can be described in terms of their type, intensity, frequency, duration, and effect. The prominent disturbance phenomena influencing the current natural landscape patterns in the Western Cascades include fire (human caused and lightning starts), wind, insects and pathogens, and landslides (Diaz and Apostol 1992). These disturbance phenomena can be thought of as a complex which may increase or decrease the biotic diversity on the landscape. Their interactions are dynamic, and unique combinations may exist at a forest, community, or micro-site level. Because these factors are interdependent, removing or altering one disturbance factor may influence the role of the others. Glaciation and volcanism are also disturbance factors on this landscape. They created the topographical features and heavily influenced the subsequent development of vegetation. More detail on these disturbances follows.

Insects and Disease

With the increase in fire suppression since the turn of the century, the role of insects and disease as a disturbance factor has increased within the Horse Creek watershed. The following species are known to influence the structure and pattern of vegetation:

1. Western spruce budworm (Choristoneura occidentalis)

2. Douglas-fir beetle (Dendroctonus pseudotsugae)

3. Armillaria root rot (Armillaria ostoyae) and laminated root rot (Phellinus weirii)

4. White pine blister rust (Cronartium ribicola

There is evidence to suspect that the cycle of western spruce budworm (*Choristoneura occidentalis*) outbreaks that occur within the watershed is becoming shorter than the historical average. The two most recently recorded budworm outbreaks are 1949-1953 and 1986-1993. There is also evidence to suspect that the fire suppression of the last 80+ years within the watershed has resulted in larger scale outbreaks than previously recorded. In the absence of fire, the western spruce budworm can play a similar role in the forest, killing tree species and age classes that would have burned if wildfire ignitions had not been successfully suppressed. Because larger outbreaks increase the number of dead and weakened trees, they also influence the magnitude of subsequent fire events.

The development of damaging budworm outbreaks depends ultimately on the availability of suitable forest habitat and favorable climate. The availability of suitable budworm habitat is directly related to fire exclusion and the development of multi-storied stands of fire susceptible true fir.

Douglas-fir beetle (*Dendroctonus pseudotsugae*) is the primary insect attacking Douglas-fir trees within the watershed. Douglas-fir beetle population increases are strongly associated with areas of fresh blowdown or dead standing timber. Once Douglas-fir beetle populations become elevated, they infest and are highly destructive to live green Douglas-fir trees. They often infest live trees that are weakened by drought, disease, or competition stress. Douglas-fir beetles can fly many miles over the landscape to find patches of weakened or stressed trees.

Root disease is a factor that affects the vegetative composition and health of the forests in the watershed. The two root diseases that have the most impact are Armillaria root rot (*Armillaria ostoyae*) and laminated root rot (*Phellinus weirii*). Both of these diseases are widespread within the watershed and are capable of causing considerable tree mortality.

White pine blister rust (*Cronartium ribicola*) has significantly reduced the population of Western white pine within the watershed over the last thirty years. White pine blister rust is a fungus that attacks and kills all five-needle pines. It was inadvertently imported from France in the early 1900's, and it continues to kill and injure many trees. Affected trees in the watershed include western white pine (*Pinus monticola*), whitebark pine (*Pinus albicaulis*), and sugar pine (*Pinus lambertiana*). Rust-resistant strains do occur in nature, and rust-resistant Western white pine planting stock is available for reforestation.

Management Activities

Commercial sheep grazing in the early 1900's was mainly in the upper reaches of the watershed. Grazing in the lower reaches was mostly for personal use by homesteaders. Sheepmen of the late 1800's wintered their flocks in eastern Oregon and drove them into the Cascades in May and June to reach the alpine meadows by August. The area in and around the Three Sisters was a popular grazing spot for local residents, and it continued into the 1900's. In the 1930's, sheep grazing increasingly conflicted with the demand for recreation in the Forests (Miller 1995). After World War II, sheep grazing became unprofitable in the Cascades because wool produced from Australia and New Zealand became cheaper (Rakestraw and Rakestraw 1991). Sheep grazing was last recorded in the Willamette National Forest in 1947 (Johnson 1985, Rakestraw and Rakestraw 1991).

Federal management began in September of 1893, when President Grover Cleveland created the Cascade Range Forest Reserve under the jurisdiction of the General Land Office. Grazing was excluded after creation of the forest reserve. However, there were instances of trespass. In 1898, the reserve was reopened to legal grazing using a permit system to regulate the size and range of the sheep herds. The grazing agreement required the sheep owners to suppress human-caused fires.

From 1898 to 1905, the management in the forest reserve became more active. Activities included small timber sales, grazing, special product collection, settlement, trail building, and fire suppression. After initial fire suppression efforts in 1898, fire management increased in efficiency as other management activities increased.

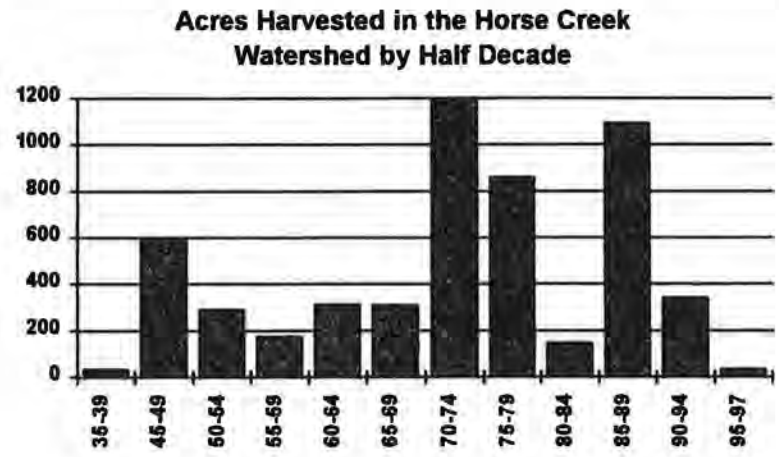
In February of 1905, control and management of the forest reserves was transferred to the Secretary of Agriculture. In 1908, the area was part of the Cascade National Forest.

Grazing reached its legal peak in this area in 1909 and 1910; the grazing tapered-off as old burns and cutover areas were reforested, thereby reducing available forage. In addition, this was a time of general decline of the grazing industry. Partly in response to grazing competition from sheep, a Federal game refuge was created in the 1920's around the Three Sister big game summer range where grazing and hunting were forbidden.

In 1933, the Willamette National Forest was created from the Cascade and Santiam National Forests. It wasn't until after World War II that timber management became active within the Horse Creek watershed.

The majority of the past timber harvest units outside of the wilderness area have been clearcut. However, differing forest practices have left a varied legacy. Harvests in the early 1960's and before did not remove material that was considered unmerchantable. The resulting "cull" logs left behind now provide a significant source of large down woody debris. Timber harvest in the late-60's, 70's, and early 80's were "clean" logging; timber purchasers were required to yard most of the down material. Units from the late 1980's to the present have had requirements to leave large woody debris and snags. Figure 3-1 displays the acres harvested within the past 60 years.

Figure 3-1: Acres harvested in the Horse Creek Watershed 1935-1997.



Fire

Fire is a significant environmental process. Fire affects the environment because it:

- Influences vegetative succession,
- Influences age structure and species composition of vegetation,
- Produces the vegetation mosaic on the landscape,
- Affects impacts of insects and plant diseases,
- Influences nutrient cycles and energy flows,
- Influences productivity, diversity, and stability of ecosystem,
- Determines availability of habitats for wildlife over space and time (Heinselman 1981).

Periodic fire has been a ecological, reoccurring component of the Horse Creek watershed since the retreat of the last glacier, playing an important, often dominant role in shaping and maintaining the vegetative communities. These forests have periodically experienced both large and small disturbances that altered vegetation on areas encompassing less than an acre to thousands of acres at a time. Fire is essential to the functioning of the ecosystem.

The relationship between fire and this landscape has been heavily influenced by the presence of humans. Fire suppression efforts that began in the early 1900's altered the historical fire regimes. There is little evidence that Native Americans used fire to manage the environment in the Horse Creek watershed prior to European settlement.

Topography plays a major role in the fire disturbance process due to its influence on wind patterns. Fires occurring on steep slopes or exposed areas during east wind episodes would often result in stand replacing events.

Strong east winds frequently blow across the surface of this watershed, and they are intensified as they are funneled between Middle Sister and South Sister. Maps 3-7 and 3-8 display the wind patterns for this watershed.

Separation and Horse Creek drainages are deep, east-west trending valleys with steep side slopes. The bottoms of these valleys are less frequently affected by east winds than the up-slope portions, where full effects of east winds may be felt, beginning around 500 feet above the valley bottom. Weather fronts from the west blow across the surface throughout the area, including the drainage bottoms. Eastern slopes of Wapiti Ridge are generally the only areas in the watershed sheltered from westerly winds.

The fire regimes of the watershed can be best characterized by looking at the plant associations that have developed within this area. A detailed analysis of the fire regimes by plant series in the area are discussed later in this chapter.

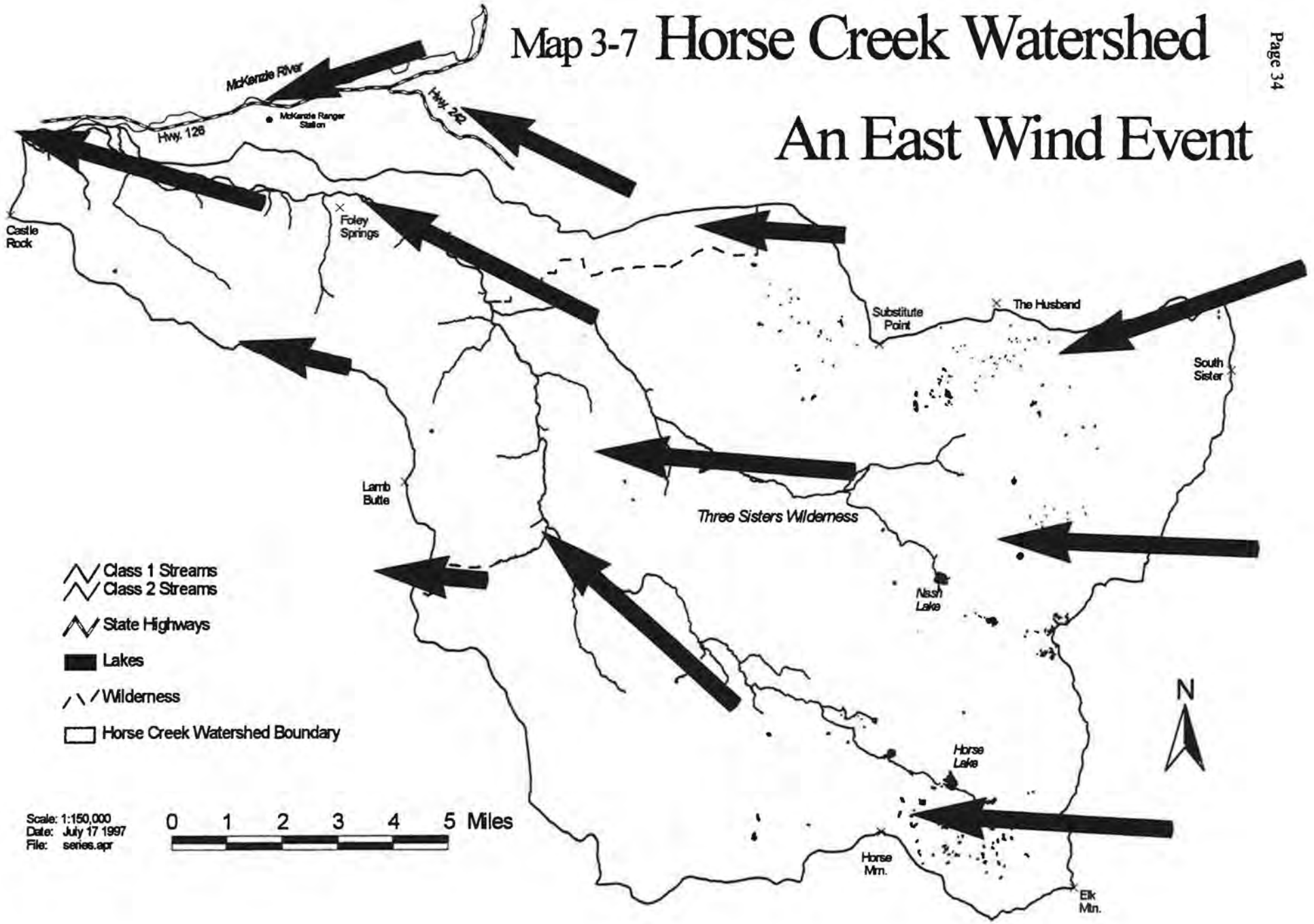
Lightning

Lightning is the primary source of fire ignition within the watershed, typically occurring in the summer months. There is a wide variance in the number and severity of lightning caused ignitions. District fire records have documented 93 lightning-caused fires between years 1970 to 1994. Almost all lightning fires from that period occurred between June and September, with two-thirds of the starts in August. Many fires go unnoticed because of their very small size. The average frequency of lightning storms per year is influenced by climate. Climatic variations affect the potential for thunder storms and the fuel flammability. The variation in the annual number of lightning-caused fires is great with a few lightning storms dominating the record. Records show that 1967 produced numerous lightning fires with the majority of them occurring between August 10 and August 28.

There is a strong correlation between summer drought (monthly precipitation) and fire frequency in this area. When average monthly precipitation is compared to monthly lightning fire frequency, the highest occurrence of lightning fires coincides with the lowest average monthly precipitation. This is typical during the months of July and August. Under these conditions, small lightning-caused fires have the potential of becoming large stand-replacement fires.

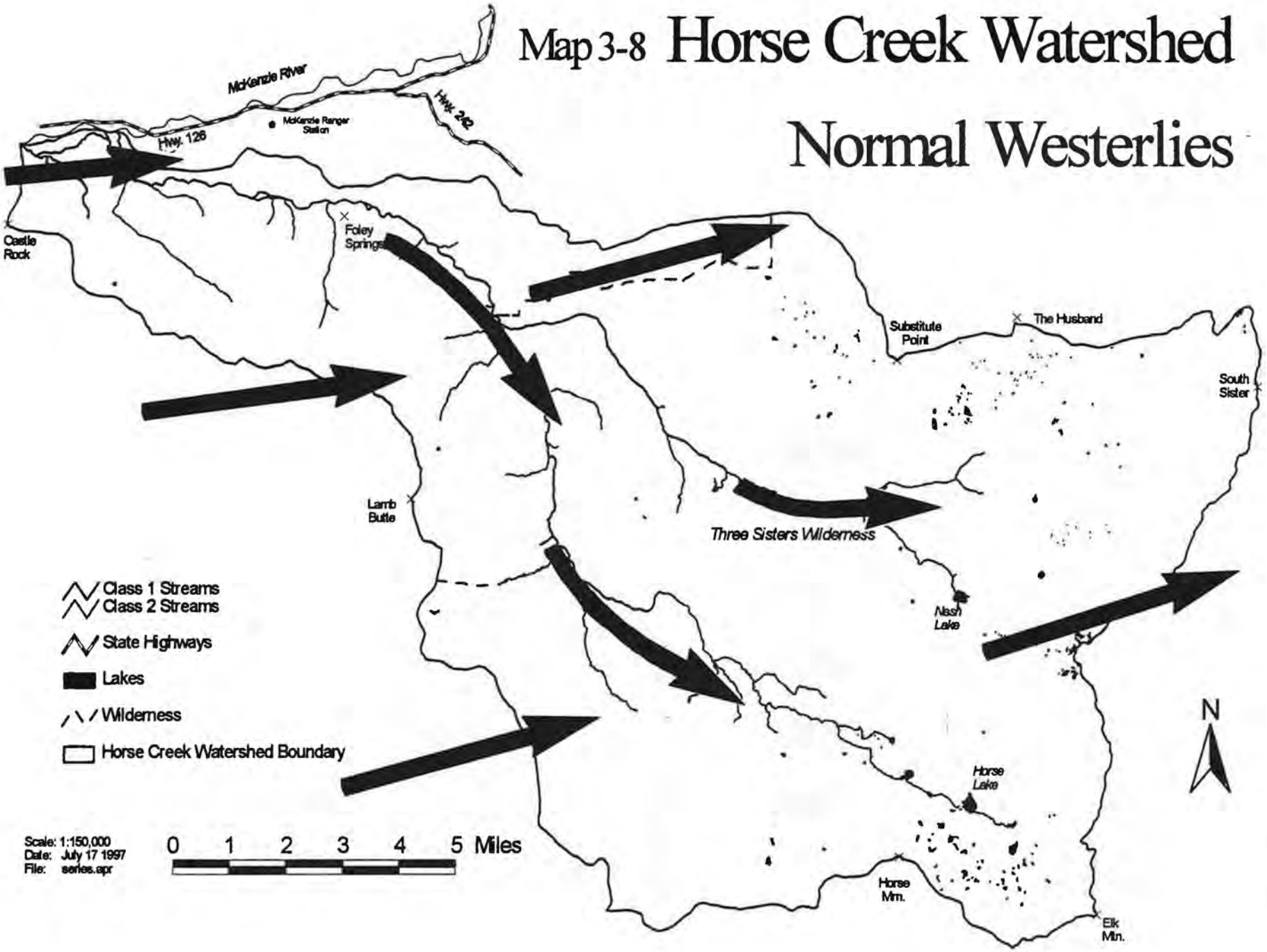
Map 3-7 Horse Creek Watershed

An East Wind Event



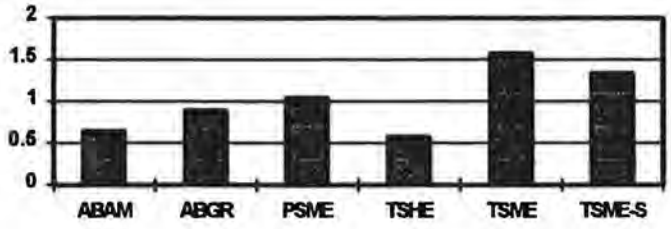
Map 3-8 Horse Creek Watershed

Normal Westerlies



Fire records documenting lightning fires are based on reported fires. Prior to 1949 (the start of aerial detection) it is very unlikely that all lightning fires were reported. Lightning storms with many ground strikes probably ignited many small unrecorded small fires. Fire detection and suppression improved over time because of improved access to the watershed, suppression methods, and staffing. Figure 3-2 displays lightning-caused fires per 1000 acres by plant series. Series TSME-S is the subalpine portion of the mountain hemlock forests. This series has the a high rate of lightning fires because the crest of the Cascades receives significantly more lightning strikes than the lower portions of the watershed.

Figure 3-2: Rate of Lightning Fires Per 1000 Acres By Plant Series.



Fire Regimes in Horse Creek Watershed

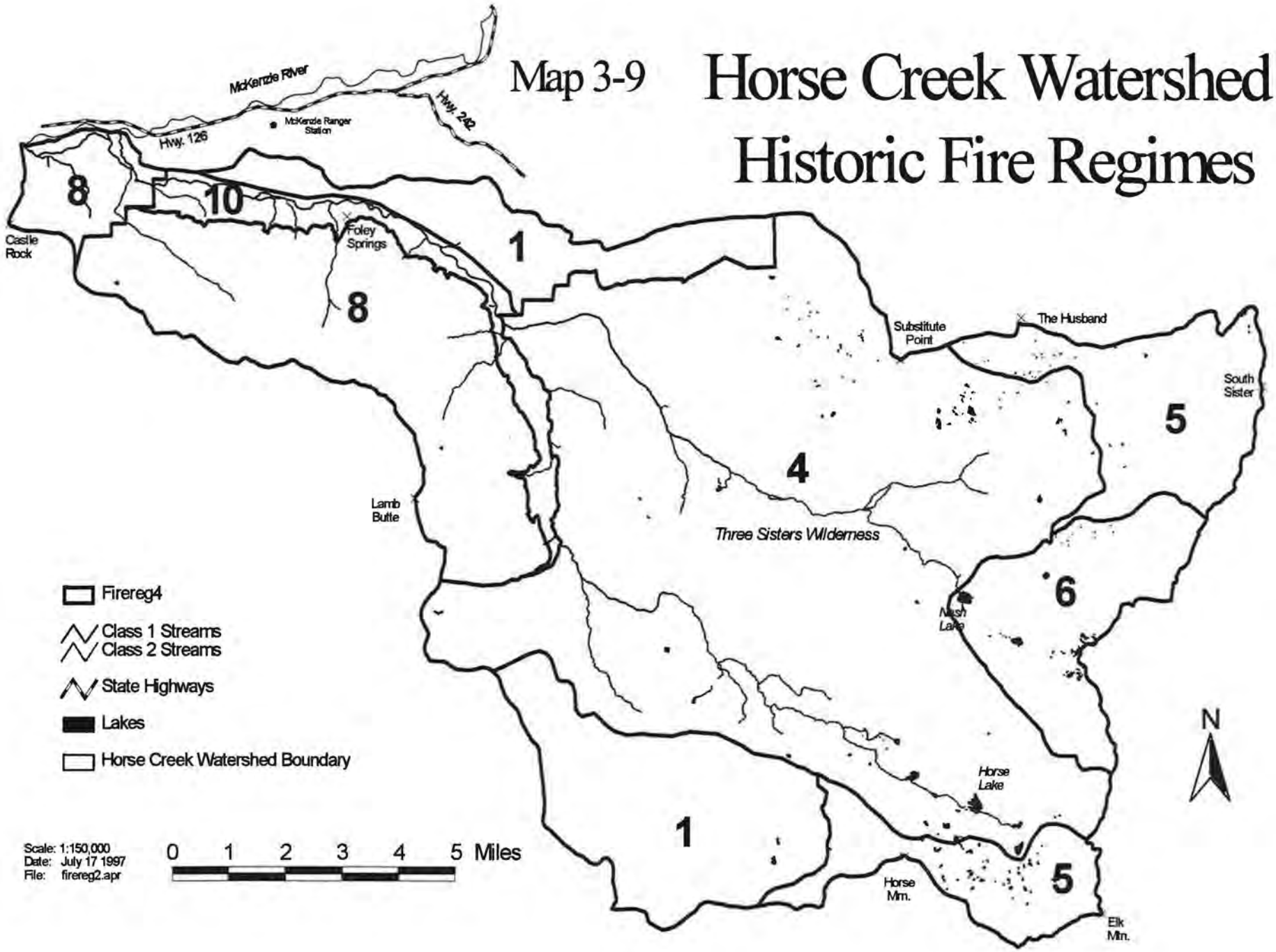
The following information was developed through extensive sampling in the Three Sister's Wilderness for the Crest Study (Kertis et al., unpublished). The data was collected to provide supporting information during development of the Prescribed Natural Fire Plan for the Crest Wildernesses (U.S.D.A. 1996). Fire regimes 8 and 10 lie outside of the wilderness area, and their regimes were developed by extrapolating the wilderness data. Map 3-9 displays the fire regimes for this watershed. Trends in the forested condition of each fire regime block are displayed by comparing the condition of the landscape in 1900 to current. Maps 3-10 and 3-11 display the distribution and abundance of early, mid and late seral habitat in the years 1900 and 1997. Statistics comparing those maps follow.

Fire regimes are generally described by four attributes:

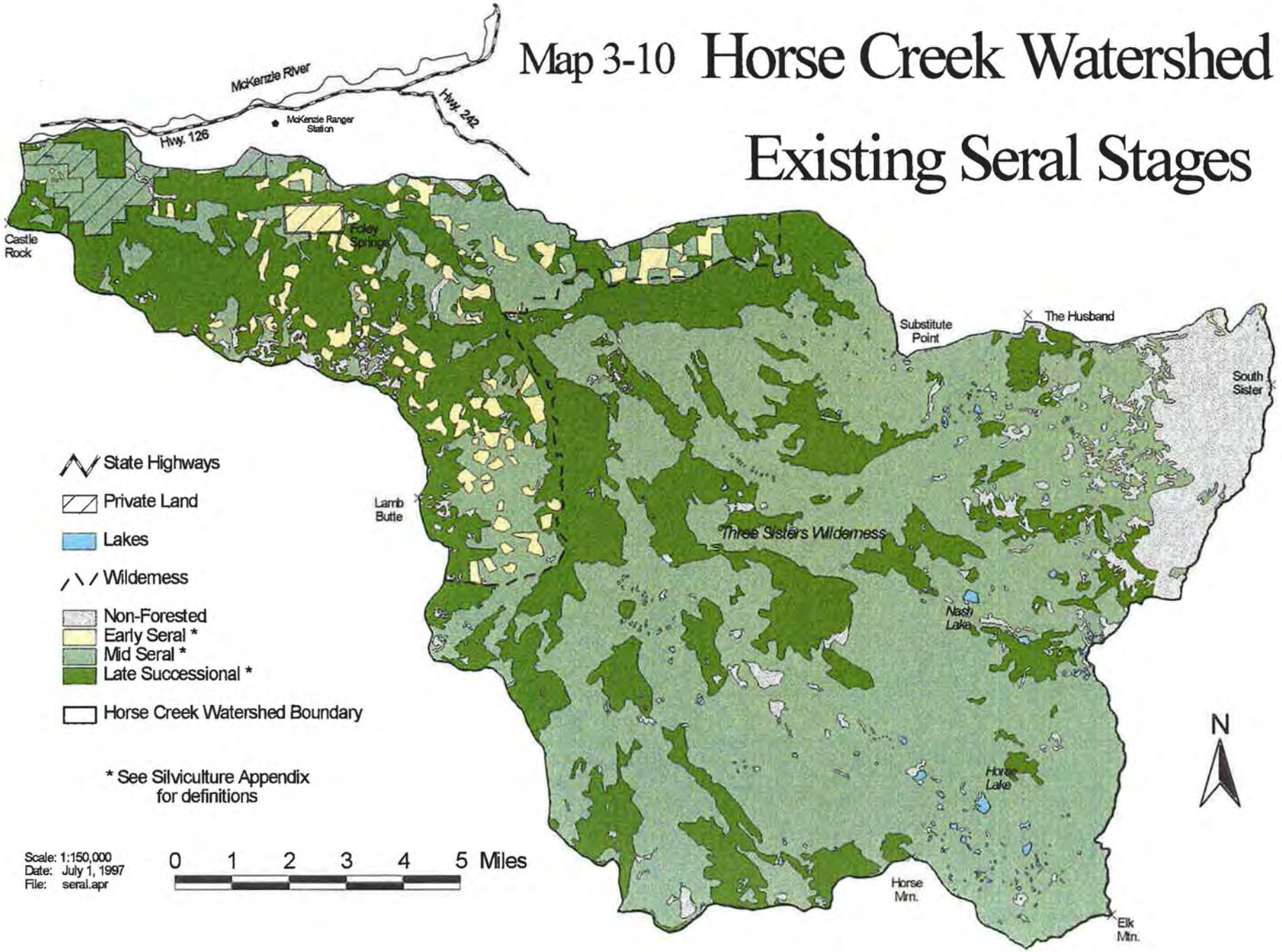
1) Scale Acres
2) Interval Period of years between ignitions

Short (S)	< 125 years
Medium (M)	150 to 275 years
Long (L)	> or = 300 years

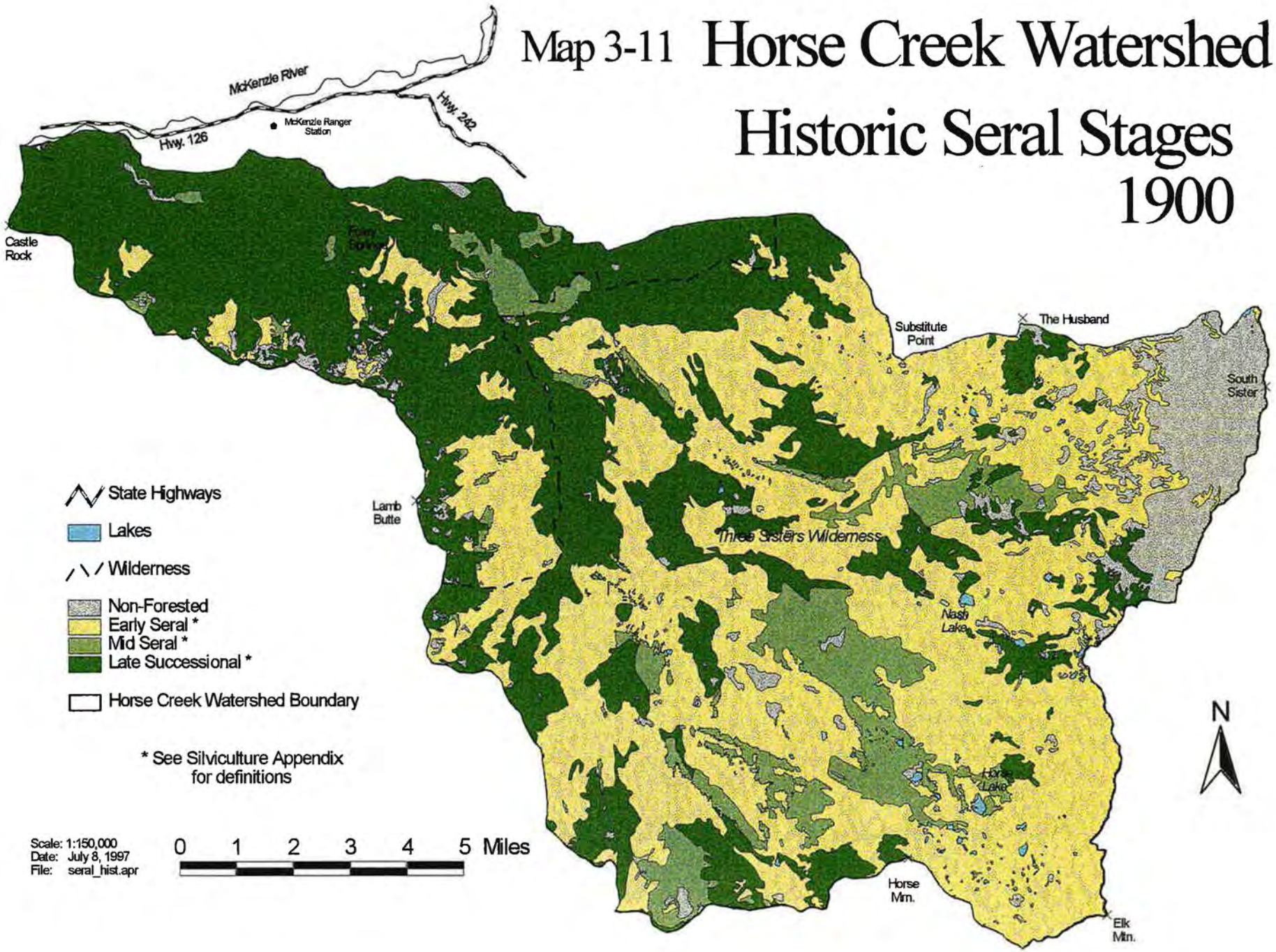
Map 3-9 Horse Creek Watershed Historic Fire Regimes



Map 3-10 Horse Creek Watershed Existing Seral Stages



Map 3-11 Horse Creek Watershed Historic Seral Stages 1900



3) Severity Levels of mortality of vegetation

Low (L)	< 30%
Moderate (M)	30% to 70%
High (H)	> 70%

4) Plant Series Dominant Forest Vegetation

Series *	**Dominant Early Seral Species**	**Dominant Late Seral Species**
Western Hemlock	Douglas-fir	Western Hemlock Western Red cedar Douglas-fir
Pacific Silver Fir	Douglas-fir Lodgepole Pine Engelmann Spruce Subalpine Fir Grand Fir Ponderosa Pine (eastside)	Pacific Silver Fir Grand Fir Subalpine Fir Douglas-Fir
Grand Fir	Lodgepole Pine Douglas-fir Ponderosa Pine (eastside) Grand Fir	Grand Fir Douglas-Fir
Mountain Hemlock (lower subzone)	Lodgepole Pine Subalpine Fir Mountain Hemlock Ponderosa Pine (eastside)	Mountain Hemlock Pacific Silver Fir Subalpine Fir
Subalpine Parkland (mountain hemlock upper subzone)	Lodgepole Pine Whitebark Pine Mountain Hemlock Subalpine Fir	Subalpine Fir Mountain Hemlock
**from Hemstrom et al. 1987 and Simon 1991		

Fire Regime 1: Short Interval and Variable Severity:

- Fire Characteristics: Drier climatic conditions result in varied severity events. Climatic conditions and topography contribute to partial stand replacing or full stand replacing events. Fires occur frequently (<125 years mean interval) and fire effects are variable. Partial stand replacing events (intermediate events) may occur between stand replacement events.

- Location: This regime is located in the west central portion of the Three Sisters Wildernesses. This regime is in areas of high lightning occurrence. Topography is for the most part, of moderate steepness and is open to east wind events.

- Plant Series: This fire regime is most common in the grand fir and mountain hemlock series. It has limited occurrence in the western hemlock, Douglas-fir and Pacific Silver fir series located in the Three Sisters Wilderness.

  Successional pathways/structural development: Short interval stand replacing events favor lodgepole pine as a dominant seral species. Partial stand replacing events usually result in a mix of early and late seral species in both grand fir and mountain hemlock series. This fire regime usually results in even aged or two aged single storied stands, with older age classes clumped in remnant patches within stands

- Fire Behavior Characteristics: Fuel loading are low to moderate, resulting in surface fires with low spread factors. Stand replacement fires are dependent on wind events moving fire from the surface into the crowns and keeping it there. Most stand disturbances are one burning period (24 hours), dependent on length and intensity of the wind event.

Of all the fire regimes, this is and will be the most affected by fire suppression. Continued fire suppression results in increased insect and disease episodes. A shift from early to late seral species will occur. Multi-layered stands will become more common. These conditions will favor very large stand replacement events.

- Trends in this Fire Regime Block:
  Early Seral: Five-fold decrease in habitat type; patches significantly smaller with less edge.
  Mid Seral: Four-fold increase in habitat type; patches size doubled with increased edge.
  Late Seral: Small decrease in acres; patch size significantly smaller with increased number.

This regime occurs in two vastly different management areas: Foley Ridge and the southwest portion of the Three Sister's Wilderness. Foley Ridge has received moderate to high levels of harvesting in the past 20 years, resulting in abundant early seral habitat and less old growth. Fire suppression in the Wilderness area has resulted in less early seral habitat and maintenance of existing old growth. Under current management conditions, Foley Ridge could continue to see a

reduction in late seral habitat through matrix lands management guidelines. The Wilderness, if fire suppression continues, could continue to trend outside of its range of variability for early seral habitat. Prescribed or management ignited fire should be considered for this area. Future-reanalysis of this data should separate these 2 distinct areas.

EARLY SERAL HABITAT

CONDITION IN 1900				CONDITION IN 1997			
Acres	*# of Patches*	*Mean Patch Size*	*Edge Density**	*Acres*	*# of Patches*	*Mean Patch Size*	*Edge Density*
4755	28	170 acres	21	818	25	33 acres	8

*From Fragstats; an index of fragmentation. The greater this number is, the more fragmented the landscape.

MID SERAL HABITAT

CONDITION IN 1900				CONDITION IN 1997			
Acres	*# Of Patches*	*Mean Patch Size*	*Edge Density*	*Acres*	*# of Patches*	*Mean Patch Size*	*Edge Density*
2584	21	123 acres	15	8981	33	272 acres	30

LATE SERAL HABITAT

CONDITION IN 1900				CONDITION IN 1997			
Acres	*# Of Patches*	*Mean Patch Size*	*Edge Density*	*Acres*	*# of Patches*	*Mean Patch Size*	*Edge Density*
6807	21	324 acres	23	4345	35	124 acres	25

Fire Regime 3 (part of regime #8 and #10): Medium Interval and Low-Moderate Severity

- Fire Characteristics: Fires occur at a mean interval between 150 and 275 years, with variable effects. Intermediate, *n*on-stand replacing events occur between full stand replacement events. The overall effect is a relatively homogenous landscape pattern.

- Location: See # 8 and #10

- Plant Series: This fire regime is most common in the Pacific silver fir and mountain hemlock series.

- Successional pathways/structural development: Low to moderate fire severity conditions usually results in the creation and maintenance of multi-layered stands, dominated by late seral species.

- Fire Behavior: Fuel loadings are low to moderate, resulting in surface fires with low spread factors. Over time fuel loading does increase, but non-standing replacement events help to reduce fuels. Generally, fires are surface spread with occasional pockets of crowning. Due to the east wind sheltering effect the probability of sustained crown fire movement is low. Only under extreme climatic conditions would crown fire and stand replacement events occur.

Fire suppression over the last 50 years or so hasn't severely affected this regime. Continued, long-term fire suppression will shift this fire regime into a high severity one similar to fire regime 4. Fires, when they occur, may be larger then under normal conditions, and loss of multi-layered stands conditions would occur.

Fire Regime 4: Medium Interval and High Severity:

- Fire Characteristics: Mean fires cycles between 150 to 275 years occur as stand replacing events. This results in a homogenous landscape pattern of similar structural characteristics.

- Location: This has the widest range of any of the regimes. For the most part, this is a western slope regime and is common in the Three Sisters Wildernesses. This regime is middle elevation (3,000 to 5,000 feet) and is partially protected from east wind events

- Plant Series: This fire regime is found in the western hemlock, Pacific silver fir, and mountain hemlock series.

- Successional pathways/structural development: This fire regime usually results in single layered stands of early seral species developing into multi-canopy stands dominated by late seral species.

- Fire Behavior: Fuel loadings are varied but generally are considered average level for the wilderness. Over time fuel loading and fuel ladders increase leading to a higher probability of stand replacement events. Fire conditions range from surface spread to crowning. Topographic features (drainage's, aspects, slopes) will drive crown fire distribution and spread.

Fire suppression hasn't significantly affected stands. Many stands are now approaching multi-layer conditions leading to a higher possibility of stand replacement events if climatic conditions are favorable. Continued long-term fire suppression will eventually increase insect and disease outbreak resulting in larger stand replacement incidents.

- Trends in this Fire Regime Block:
  - Early Seral: Extreme decrease in habitat type to condition of severe limitations of availability.
  - Mid Seral: Five-fold increase in habitat type; ten-fold increase in patch size with increased edge.
  - Late Seral: Has remained stable in abundance and patch size.

This regime includes the central majority of this watershed, which is entirely wilderness. Fire suppression over the past 80 years may have resulted in a shift of early seral habitat created during the fire events of the late 1800's, into mid seral habitat. The extreme loss of early seral habitat in this area indicates a high priority for Prescribed Natural Fire or Management Ignited fire for restoration.

EARLY SERAL HABITAT

CONDITION IN 1900				CONDITION IN 1997			
Acres	*# Of Patches*	*Mean Patch Size*	*Edge Density*	*Acres*	*# of Patches*	*Mean Patch Size*	*Edge Density*
28459	26	1094 acres	26	22	2	11 acres	0.1

MID SERAL HABITAT

CONDITION IN 1900				CONDITION IN 1997			
Acres	*# Of Patches*	*Mean Patch Size*	*Edge Density*	*Acres*	*# of Patches*	*Mean Patch Size*	*Edge Density*
6103	30	202 acres	9	33466	17	1969 acres	23

LATE SERAL HABITAT

CONDITION IN 1900				CONDITION IN 1997			
Acres	*# Of Patches*	*Mean Patch Size*	*Edge Density*	*Acres*	*# of Patches*	*Mean Patch Size*	*Edge Density*
13271	37	358 acres	17	14345	34	422 acres	17

Fire Regime 5: Long Interval and High Severity:

- Very infrequent stand replacing events occur on average every 300 years or greater. This regime results in a homogenous pattern of similar age and structural characteristics.

- Location: Areas above 5,500 feet and drainage's surrounding the Three Sisters are located in this regime. Moderate to high elevations in high lake density areas such as the Mink Lake

Basin and extending down into the Waldo Lake basis area are also included here. In general, these are areas of high elevation and heavy snow pack existing late into the season. In lake areas such as the Mink Lake Basin, the network of lakes tend to have a moderating influence on fire spread. In addition these areas are for the most part protected from east winds.

- Plant Series: This fire regime is most common in the mountain hemlock and parkland type series. The western hemlock series, located in the drainage's of the western Three Sisters Wilderness areas are also influenced by this regime.

- Successional pathways/structural development: Stand replacing events initially result in single storied stands dominated by early seral species. Over time, stands develop multi-layered canopies with old growth characteristics

Fire Behavior: Fuel loadings vary from moderate to high. Over time fuel loading and fuel ladders increase leading to a higher probability of stand replacement events. Fire conditions range from surface spread to crowning. Topographic features (drainage's, aspect, slope) will drive crown fire distribution and spread.

This fire regime has been the least affected by fire suppression. Many stands are now multi-layered leading to a higher possibility of stand replacement events if extreme climatic conditions prevail. Many stands are now 300 to 600 years old.

- Trends in this Fire Regime Block:
  Early Seral: Extreme decrease in habitat type to condition of severe limitations of availability.
  Mid Seral: Extreme increase in habitat type with increased edge.
  Late Seral: Has remained stable in abundance and patch size.

This regime includes the alpine and subalpine areas on the flanks of South Sister, Elk Mountain, and Horse Mountain. This fire regime, with its long return intervals, can result in large blocks of older forest developing and being sustained over time (as indicated by this trend data). The current age of the stands (>300 years) and the indicates an increased potential for stand-replacement fires in the near future.

EARLY SERAL HABITAT

CONDITION IN 1900				CONDITION IN 1997			
Acres	*# Of Patches*	*Mean Patch Size*	*Edge Density*	*Acres*	*# of Patches*	*Mean Patch Size*	*Edge Density*
5837	27	217 acres	51	25	3	8 acres	1.2

MID SERAL HABITAT

CONDITION IN 1900				CONDITION IN 1997			
Acres	*# Of Patches*	*Mean Patch Size*	*Edge Density*	*Acres*	*# of Patches*	*Mean Patch Size*	*Edge Density*
17	3	6 acres	0.7	5842	24	243 acres	50

LATE SERAL HABITAT

CONDITION IN 1900				CONDITION IN 1997			
Acres	*# Of Patches*	*Mean Patch Size*	*Edge Density*	*Acres*	*# of Patches*	*Mean Patch Size*	*Edge Density*
1015	12	84 acres	13	1003	11	91 acres	13

Fire Regime 6: Complex

- Fire Characteristics: Very difficult to characterize due to geographical or climatic conditions which vary over the landscape. This results in the full range of intervals and severalties over a small area. Characteristics of all fire regimes are present. Fires occur anywhere between 100 to 300 years with mixed severity. Because of the high variances found in this area, it is not possible to predict a single fire return interval.

- Location: This regime is located in the east-west transition zone of the southern part of the Three Sisters Wilderness. This is in an area of highly variable topography, with east wind playing a key role along with lightning occurrence.

- Plant Series: This fire regime is found in the mountain hemlock series.

- Successional pathways/structural development: This fire regime usually results in a mosaic of single story and multi-canopy stands, with a diverse mix of early and late seral species.

- Fire Behavior: Fuels through the area are highly variable. Fires range from general surface fires to crown fires and depend on climatic factors. Long term fire predictions will be more difficult in this area if based just on fire regime conditions. High rates of spread are possible. Most stand disturbances are one burning period (24 hours), dependent on length and intensity of the wind event.

Fire suppression effects are difficult to discern in this regime. Fire suppression may reduce the diversity of stand conditions present in the area, and increase the probability of stand replacing events. Insects and disease play a major role along with fire in the dynamics of the stands.

- Trends in this Fire Regime Block:
  Early and Mid Seral: Our analysis indicates all of the early seral existing in 1900 shifted to mid seral over the past 97 years.
  Late Seral: Has remained stable in abundance and patch size.

The variability of this fire regime and the difficulties in discerning fire impacts complicate the interpretation of this data. Trends toward development of older stands are occurring, and fire suppression may have played a role in that succession. The total loss of early seral habitat over the past 97 years may indicate a trend outside of the historic range of variability.

EARLY SERAL HABITAT

CONDITION IN 1900				CONDITION IN 1997			
Acres	*# Of Patches*	*Mean Patch Size*	*Edge Density*	*Acres*	*# of Patches*	*Mean Patch Size*	*Edge Density*
3863	10	385 acres	43	0	0	0 acres	0

MID SERAL HABITAT

CONDITION IN 1900				CONDITION IN 1997			
Acres	*# Of Patches*	*Mean Patch Size*	*Edge Density*	*Acres*	*# of Patches*	*Mean Patch Size*	*Edge Density*
0	0	0 acres	0	3927	10	393 acres	43

LATE SERAL HABITAT

CONDITION IN 1900				CONDITION IN 1997			
Acres	*# Of Patches*	*Mean Patch Size*	*Edge Density*	*Acres*	*# of Patches*	*Mean Patch Size*	*Edge Density*
1146	11	104 acres	27	1082	9	121 acres	26

Fire Regime 8: Medium Interval with High Severity and Medium Interval with Low-Moderate Severity:

See #3 and #4

- Location: This regime is located in the Horse Creek Late Successional Reserve from the ridgetop down to the Horse Creek drainage. This is an area of very steep topography with a northeast aspect.

- Trends in this Fire Regime Block:
  Early Seral: Abundance reduced by half; increased number of smaller patches.
  Mid Seral: Increased abundance with significant increase in patch size and number.
  Late Seral: Slight decrease in abundance with increase in number of smaller patches.

Though this area now falls in a Late Successional Reserve, and future harvest will be limited, some early seral habitat has been created over the past 15 years through clearcutting. The reductions in late seral in this analysis are reflective of that harvesting. Fires in the late 1800's created fairly extensive areas of early seral, which are now shifting to mid seral habitat. The mixture of fire regimes in this area historically created a diverse mosaic of seral stages, and old growth refugia probably did not commonly occur. The current age of un-managed stands (>150 years) indicates a potential for stand-replacement and partial stand-replacement fires in the near future. The potential for this natural disturbance may impede our ability to protect and maintain this area as a late successional reserve.

EARLY SERAL HABITAT

CONDITION IN 1900				CONDITION IN 1997			
Acres	*# Of Patches*	*Mean Patch Size*	*Edge Density*	*Acres*	*# of Patches*	*Mean Patch Size*	*Edge Density*
3656	34	109 acres	17	1692	63	27 acres	17

MID SERAL HABITAT

CONDITION IN 1900				CONDITION IN 1997			
Acres	*# Of Patches*	*Mean Patch Size*	*Edge Density*	*Acres*	*# of Patches*	*Mean Patch Size*	*Edge Density*
304	15	20 acres	4	5138	41	126 acres	27

LATE SERAL HABITAT

CONDITION IN 1900				CONDITION IN 1997			
Acres	*# Of Patches*	*Mean Patch Size*	*Edge Density*	*Acres*	*# of Patches*	*Mean Patch Size*	*Edge Density*
12286	9	1366 acres	27	9396	17	553 acres	36

Fire Regime 10: Long Interval with High Severity and Medium Interval with Low-Moderate Severity.

See #3 and #5

- Location: This regime is located in the valley bottom of the Horse Creek drainage and includes just the "flats" between the steep slopes of Foley Ridge and Wapiti.

- Trends in this Fire Regime Block:
  Early Seral: Small increase in abundance, number of patches and patch size.
  Mid Seral: Four-fold increase in abundance and number of patches. No significant change in patch size.
  Late Seral: Reduction in abundance by one-third. Much smaller patch size and increase number of patches.

This fire regime, with its long return intervals, can result in large blocks of older forest developing and being sustained over time. Harvest activity within the area has reduced the abundance of late seral in the past 97 years, while increasing small patches of early seral habitat. There is potential for stand-replacement or partial-stand-replacement in the near future. Extreme weather conditions would drive this type of event, since this wet, protected river bottom would generally not carry fire well.

EARLY SERAL HABITAT

CONDITION IN 1900				CONDITION IN 1997			
Acres	*# Of Patches*	*Mean Patch Size*	*Edge Density*	*Acres*	*# of Patches*	*Mean Patch Size*	*Edge Density*
264	15	17 acres	14	571	21	27 acres	21

MID SERAL HABITAT

CONDITION IN 1900				CONDITION IN 1997			
Acres	*# Of Patches*	*Mean Patch Size*	*Edge Density*	*Acres*	*# of Patches*	*Mean Patch Size*	*Edge Density*
225	5	45 acres	7	842	24	35 acres	32

LATE SERAL HABITAT

CONDITION IN 1900				CONDITION IN 1997			
Acres	*# Of Patches*	*Mean Patch Size*	*Edge Density*	*Acres*	*# of Patches*	*Mean Patch Size*	*Edge Density*
2890	2	1445 acres	45	1966	11	178 acres	54

Stand Dynamics and Succession

Because of the close relationship between disturbance, particularly fire, and the development of vegetation within the Horse Creek watershed, an "initial floristics" model of stand development is most appropriate for this area (with the exception of high elevation mountain hemlock). General stages of this model are as follows: early

seral, stand initiation, stem exclusion, understory reinitiation, and late-successional old growth. Full descriptions of these stages can be found in the Upper McKenzie Watershed Analysis (1995).

In the Horse Creek Watershed Analysis area, the plant associations present have evolved over time with fire as a natural disturbance affecting successional changes. The effect of fire (in terms of intensity and frequency) has created plant communities with a great complexity of species and structural diversity. Many of the plant communities follow a single regeneration pattern under "normal" fire periodicity. However, succession patterns change following a disturbance of very short or long fire intervals. The macro- and micro-environment, and the role fire has had in the watershed has created a landscape of multiple successional pathways. One example of a common succession pattern is the post-fire seral invader species, lodgepole pine. Lodgepole pine is able to invade and dominate following a fire disturbance if it was present in the pre-fire plant community or a seed source.

CHARACTERISTIC DISTURBANCE REGIME BY PLANT SERIES

What follows is a general description of the flora and fauna associated with each vegetation series and a characterization of the processes and interactions that have and are occurring within each series in the watershed. The watershed contains a wide variety of site conditions. Nearly every plant association found on the Willamette Forest is represented within this watershed. Map 1-4 displays the distribution of forested series in this watershed.

For shorthand notation, plant species are given a four letter code. The first two letters are the first letters in the genus name and the second two are the first letters in the species name (e.g., PSME= *Pseudotsuga menziesii* = Douglas-fir). For a complete list of the code names see the Willamette Forest Plant Association and Management Guide.

DOUGLAS-FIR (PSME) SERIES

The plant associations included in this group are: PSME/HODI-BENE, PSME/HODI/GRASS, PSME/HODI-WHMO, PSME/SYMO-WILL, PSME-TSHE/BENE, PSME-TSHE/RHMA, PSME-TSHE/GASH. These sites typically occur on relatively hot, dry sites at lower elevations and on relatively steep south and southwest facing slopes. The Douglas-fir series occupies the driest environments capable of supporting closed forest on the Willamette National Forest. Predawn plant moisture stress often exceeds 15 bars during August and early September (Means 1980).

Fire Disturbance - Douglas-fir

The growth and development of the Douglas-fir forests within the watershed have been

dictated to a large degree by fire. The fire regime for Douglas-fir forests is characterized by medium to high fire intensity, which generally results in partial or total stand replacement fires. Lightning is common in these forests and the fire return interval is relatively low. Agee et. al 1990 found a 52 - 76 year mean fire return interval for these forests.

The effect of fire on Douglas-fir forests depends on the species composition and the structure of the vegetation at the time of the fire (Agee 1993). Douglas-fir is moderately resistant to fire, especially at mid to late age. Douglas-fir has thick bark that insulates the cambium against damage. In mature stands its height helps it to avoid crown scorch (Agee 1993). Low intensity fires generally only kill the thinner barked, less fire resistant trees and shrubs.

Woody Debris/Fuel Loading - Douglas-fir

Because of the frequent fire return intervals, levels of woody debris and fuel loadings do not get very high. Most of the woody debris is large Douglas-fir logs that are capable of surviving low intensity fires. Although the logs are large, the average tonnage per acre is not great. Fuel loadings less than 20 tons per acre are common.

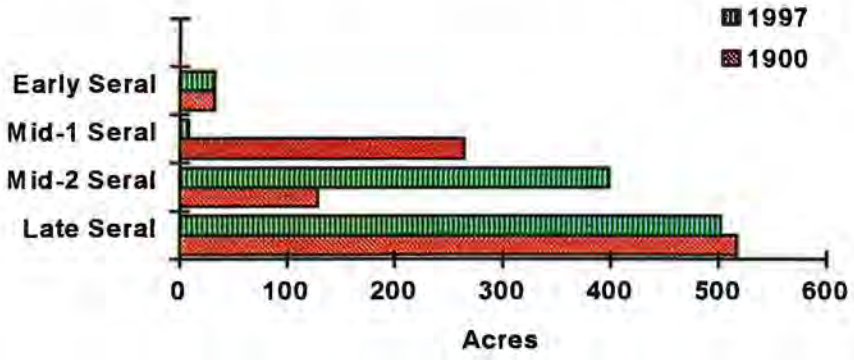
Comparison of Historic Versus Existing Landscape Vegetation - Douglas-fir

Using old timber inventory maps and past fire history information, an approximation of the vegetation within the watershed area was developed for the year 1900.

Historic information on the composition and distribution of vegetation was not compiled specifically for Douglas-fir forests during the Regional Ecosystem Assessment Project (REAP). forests. Early seral stages include grass/forb, open sapling/pole, shelterwood, and shrub conditions. Mid-1 includes closed sapling/pole, Mid-2 includes open small saw and closed small saw conditions. Late includes large saw and old growth.

Figure 3-3 graphically displays a shift of the overall vegetation from a predominance within the early to mid-1 seral stages in 1900, to a mid-2 and late seral condition in 1997. This shift in dominance to mid-2 to late seral corresponds to our era of fire suppression, approximately 1910 to the present.

Figure 3-3: Acres of current and historic Douglas-fir seral stages.



GRAND FIR (ABGR) SERIES

Plant associations included in this group are comprised of: ABGR/BENE, ABGR/CHUM, and ABGR/ARUV. These sites typically have more moisture than Douglas-fir plant associations, less moisture than Pacific silver fir sites, and they are warmer than mountain hemlock sites. Grand fir forests on the west side of the Cascades are relatively uncommon, but do exist in several other areas of the Willamette National Forest, particularly areas of the Rigdon Ranger District. Grand fir forests are typically associated with the drier, colder environment on the east side of the Cascade Crest. West-side grand fir sites occupy relatively cool, dry, well-drained, rocky, or ashy soils in Eastside to Westside transition areas. The topography of the grand fir forests in the watershed is relatively flat to gently sloping, with an elevation ranging from 3200 to 4400 feet. These grand fir forests are fairly contiguous and uniform in age and structure.

Fire Disturbance - Grand Fir

The growth and development of the grand fir forests within the watershed have been largely influenced by natural fire. The fire regime for grand fir forests is characterized by low to moderate fire intensity, which generally results in ground fires or partial stand-replacement fires. The fire regime can be characterized as relatively frequent low intensity burns (18-75 years) and less frequent moderate to high intensity stand replacement events (100-200 years).

The effect of fire on grand fir forests depends on the species composition and the structure of the vegetation at the time of the fire (Agee 1993). Grand fir is moderately susceptible to fire. Its low branching habit, flammable foliage, heavy lichen growth, relatively shallow roots, and high stocking density, all tend to increase its susceptibility to fire damage. High intensity fires kill grand fir and favor the regeneration of shrubs and lodgepole pine by creating a hot, dry, mineral-soil seed bed. Fires of moderate intensity often kill grand fir and increase the dominance of Douglas-fir relative to lodgepole pine or grand fir. Douglas-fir has thick bark that insulates the cambium

against damage. In mature stands its height helps it to avoid crown scorch (Agee 1993). Low intensity fires generally only kill the thinner barked, less fire resistant grand fir (especially young grand fir seedling and saplings).

Historically, low intensity burns that remove the stands' understory layer, have been common in these grand fir forests. Several years following low intensity burns, a new cohort of regeneration will develop. Depending on the intensity of the fire, this new cohort generally develops as shade-tolerant grand fir (Larson 1982) beneath an overstory of older, residual Douglas-fir that had survived the fire.

Substantial understory development, whether it occurs because of low severity fire or after the breakup of early seral lodgepole pine in the canopy, will encourage an"understory reinitiation" stage in stand development (Oliver 1981). Because of the "fire ladder" nature of this understory structure, it is closely associated with increased crown fire potential (Agee 1993). A long interval between underburns promotes the development of a tall understory, which has a higher probability of crowning (Davis et al. 1980), especially under severe burning conditions. Severe conditions often occur in late summer or early fall, and are associated with east winds.

The majority of the grand fir sites within the watershed are in this "understory re-initiation" phase of stand development. Eighty years of fire suppression has allowed a moderately high level of fuel and understory to develop in the grand fir stands in the watershed. This condition was historically transitory as a precursor to large, stand replacement fire events.

Woody Debris / Fuel Loading - Grand Fir

Site specific, quantitative descriptions of woody debris levels on grand fir sites are scarce. Downed, woody fuel on similar habitat types inventoried by Fischer (1981) in Western Montana ranged between about 13 and 38 tons per acre. The heavier levels tended to occur in very moist stream-side locations. Drier upland sites varied between 13 and 20 tons per acre. Much of this fuel is lodgepole pine mortality that occurs naturally during the "understory reinitiation" phase of stand development.

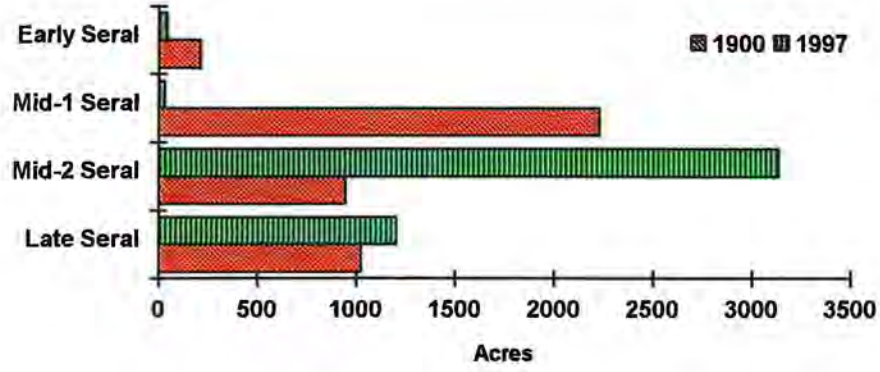
Comparison of Historic Versus Existing Landscape Vegetation - Grand Fir

Using old timber inventory maps and past fire history information, we were able to develop an approximation of the vegetation within the Horse Creek Watershed in the year 1900.

Figure 3-4 graphically displays the changes in vegetation from the years 1900 to 1997 within the grand fir forests. The overall vegetation shifts from a predominance of early to mid-1 seral stage in 1900, to more abundance in the mid-2 and late seral condition in 1997. This shift in seral stage corresponds to the era of fire suppression, from the period 1910 to the present. Information on the historical ranges of composition and

distribution of vegetation was not compiled specifically for grand fir forests during the Regional Ecosystem Assessment Project (REAP), and does not appear in the following table.

Figure 3-5: Acres of current and historic grand fir seral stages.



Early Seral

Historically, large patches of early seral habitat were periodically created by stand-replacement fires. Patches created from incidental mortality associated with ground fires were more common, but were often small and transient. Post-fire conditions included abundant dead material in the form of snags and down, large woody material. Grand fir are moderately susceptible to fire, and most do not survive stand replacing events. Large diameter Douglas-fir, often present in these stands, survive fires to provide residual green tree structure in the developing stand. The fire disturbances resulted in a mosaic of age classes and structures.

Large patches were a major landscape component around the turn of the century because of settler activity. Reburns were probably common, resulting in a diminished density of snag and down woody debris components. With the advent of fire suppression activity in the early 1900's, the availability of large or small patches of early seral habitat was dramatically reduced.

In the last 30 years, very little early seral habitat has been created in this forest type through clearcutting. These stands are often on unsuited soils. The clearcut patches that do exist are small and lacking in important structural components typically found after a fire event. Snags, down woody material, and residual green trees were not retained in these units.

Mid and Late Seral

The availability of this habitat type has not fluctuated greatly over time. Mid and late seral habitat has dominated this landscape for over 100 years. The abundance has

increased over this century with increased fire protection efforts. Protection efforts have also changed the structure of these stands, increasing the vertical diversity. Fire suppression efforts have resulted and will continue to result in a trend of increased availability of mid and late-seral grand fir habitat. This is beneficial to species that are associated with this habitat type.

MOUNTAIN HEMLOCK (TSME) SERIES

The plant associations included in this group are: TSME/VAME/XETE, TSME/VASC, TSME/RHMA, and TSME/LUZULA. The climate of mountain hemlock forests is characterized by relatively cold winter temperatures, substantial winter snowpack, and short growing seasons. Mountain hemlock sites are colder and less productive than lower elevation grand fir sites. Despite substantial rainfall, mountain hemlock sites tend to retain less moisture than Pacific silver fir sites in this area. The elevation of these forests ranges from 4400 to 5600 feet.

Franklin and Dryness (1973) divide the mountain hemlock forest into two major subzones, a lower subzone of closed forest and an upper parkland subzone. In the lower subzone, there is essentially continuous forest cover of mountain hemlock and it main associates, lodgepole pine and subalpine fir. The upper subzone (high elevation area surrounding Mt. Washington, Three Finger Jack, Belknap Crater, and the Three Sisters) is a mosaic of forest patches and tree groups interspersed with shrubby or herbaceous subalpine communities.

Fire Disturbance - Mountain Hemlock

The growth and development of the mountain hemlock forests within the watershed have been dictated to a large degree by natural fire. Mountain hemlocks are not well adapted to survive fire--they are fire avoiders (Agee 1993). Most fires within the mountain hemlock zone are stand replacement fires. Because of the lack of fire resistance of the species, within-stand individual tree and small group disturbance is more likely to be related to insect and disease mortality.

Mountain hemlock forests display very complicated fire behavior. The fires within the mountain hemlock forests are often weather-driven, resulting in erratic behavior. Fire behavior estimates based on natural fuel loads generally underestimate the fire potential of these mountain hemlock forests (Agee 1993). The fuel loadings do not indicate a significant fire hazard, but mountain hemlock has low-hanging branches, highly flammable foliage, and a tendency to grow in dense groups that make it very susceptible to fire injury. Mountain hemlock is easily killed by fire from root charring and crown scorching.

According to the scientific literature, the fire return interval of mountain hemlock forests is highly variable. Because dense subalpine forests transition into parkland and

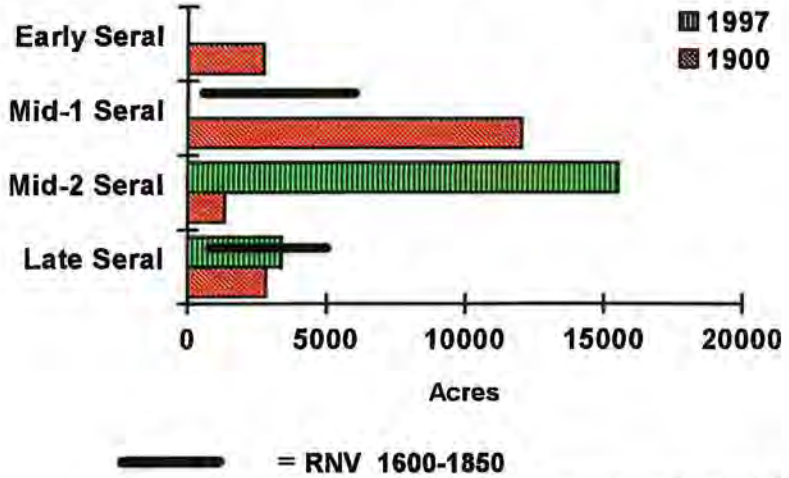
alpine areas, a clear delineation of zones is difficult, and estimates of fire-return intervals are often not possible (Agee 1993). The results of a fire study on the Mt. Jefferson Wilderness indicate the fire regime of mountain hemlock forests tends to include moderate to high intensity stand replacement fires on a moderate to long fire return interval. The fire return interval for stand replacement fires from nearby east-side sites on the Mt. Jefferson Wilderness range from 87 to 248 years (Simon 1991).

Lodgepole pine is the major pioneer species in the high cascades portion of the mountain hemlock zone. Mountain hemlock does not regenerate quickly or easily following intense fire, often taking decades to reestablish. Post-stand replacement fire communities are usually dominated by shrubs, such as *Ceanothus* or *Vaccinium*, and lodgepole pine. Mountain hemlock and subalpine fir often regenerate in the partial shade of the lodgepole pine overstory. As the lodgepole pine stands grow older and lose their dominance (approximately 80 years), gaps are created, and the mountain hemlock understory responds to the additional sunlight and available resources. Mountain hemlock will then retain dominance at the site until a stand replacement fire resets this cycle. Subalpine fir, Engelmann spruce, and western white pine will form an uneven understory with a forest floor composed of shrubs and herbaceous species.

Comparison of Historic Versus Existing Landscape Vegetation - Mountain Hemlock

The following information is patterned after the Regional Ecological Assessment Project, which used a course filter approach to investigate the range of natural historical conditions by plant series and seral stage in the region. The REAP process stratified the landscape into 3 age groups: early (1-20 years), mid (20-50 years), and late (200+ years). The age class between 50 and 199 was not analyzed during the REAP process. Figure 3-5 displays the acres of the mountain hemlock forest in each seral stage at 2 points in time. The dark solid line represents a historical range of variability from 1600 to 1850. That information is displayed for the years 1900 and 1997 as "Mid-2" to compare the change in the landscape within this century. The overall vegetation shifted from a predominance of early to mid-1 seral stages in 1900, to a dominance of mid-2 and late seral condition in1997. This shift in dominance corresponds to the era of fire suppression from approximately 1910 to the present.

Figure 3-5: Acres of current and historic Mountain Hemlock seral stages.



Note: 0 acres early seral and mid 1 for 1997

Early Seral - Mountain Hemlock

Early seral habitat historically resulted from catastrophic fire events in mountain hemlock forests. Post-fire conditions included abundant standing and down woody material. Mountain hemlocks are very susceptible to fire, resulting in few residual green trees on the landscape following stand-replacing fire events. Partial stand-replacement events occasionally create a mosaic of live patches of varying sizes. Areas protected by topography also provided patches of green tree remnants.

Historically, early-seral habitat was a major component of this landscape. Patches were generally large with irregular edges. As white settlers began to use this landscape, the increased frequency of fires in the late 1800's resulted in an extensive availability of early seral habitat. Reburns were common, resulting in a diminished density of snag and down woody debris components. Fire suppression activity from 1900 on may have resulted in a decreased availability of early seral habitat in these forests.

Mid and Late Seral - Mountain hemlock

Little mid and late seral habitat was available in the late 1800's and 1900's because of human caused fires and the lack of fire suppression of natural fires. Over the past 70 years, however, fire suppression has allowed stands to succeed, and the abundance and distribution of mid and late seral habitat has changed. Larger, contiguous blocks of mid-2 seral stands now exist throughout the eastern half of the watershed. Average patch size of late seral stands has not significantly changed, though there are more of them.

The abundance of late seral habitat is currently within the range of natural conditions. Fire suppression efforts will result in a trend of increased availability of mid and late seral mountain hemlock habitat. This is beneficial to species that are associated with

these high elevation forests, such as pine marten, black-backed and three-toed woodpeckers. This habitat is currently well distributed, and patches are large enough to provide high quality habitat. Mid seral stands created from historic fires general have important structural components. Those that succeeded from previous clearcuts are not as high a quality.

In the absence of fire, insects and diseases will have the greatest effect on this habitat. At a stand level, insects and disease can simplify stand structures, resulting in reduced vertical diversity and loss of niches for wildlife. However, they also result in an abundance of snags and large woody material, which are important breeding habitat for more than 51 species in this area. At the landscape level, these diseases increase horizontal diversity as they create pockets of mortality. Mistletoe is used by several species for food, nesting structures, and cover. It can also create spike tops, which provide mini-snag habitat used by wildlife. Mistletoe infections rarely reduce habitat quality for wildlife species. In general, these diseases are not expected to reduce the overall quality of Mountain hemlock habitat on this landscape.

PACIFIC SILVER FIR (ABAM) SERIES

The plant associations included in this group are: ABAM/TITR, ABAM/VAAL/COCA, ABAM/OPHO, ABAM/RHMA/XETE, ABAM/RHMA-BENE, ABAM/VAME/CLUN, ABAM/ACCI/TITR, ABAM-ABGR/SMST, ABAM/BENE, ABAM/VAME/XETE. The cool, temperate climate of Pacific silver fir forests is characterized by moderate winter temperatures, substantial winter snowpack, and relatively limited summer drought (Packee et al. 1981). Pacific silver fir forests are wetter and cooler than the adjacent, lower elevation western hemlock forests (Franklin and Dyrness 1973) and the adjacent grand fir forests, and they are warmer and more productive than mountain hemlock sites. The elevation of these forests ranges from 3200 to 5000 feet.

Fire Disturbance - Pacific Silver fir

The growth and development of the Pacific silver fir forest in the watershed have been strongly influenced but not dominated by fire. Of all the plant series in the watershed, the Pacific silver fir series has historically had the least distinguishable fire activity. Pacific silver fir seldom survives fire because of its thin bark and shallow roots.

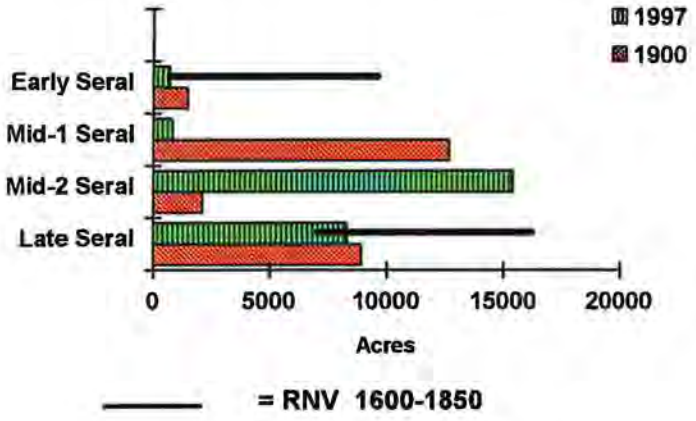
Comparison of Historic Versus Existing Landscape Vegetation - Pacific Silver Fir

The following information is patterned after the Regional Ecological Assessment Project. With this data, a comparison can be made between a range of "historical landscape conditions" pre-settlement conditions and a current state.

The REAP process stratified the landscape into 3 age groups: early (1-15), mid (16-50), and late (200+). The dark solid line represents a historical range of variability from 1600

to 1850 for the early and late seral stages. The age class between 50 and 199 was not analyzed during the REAP process. That information is displayed for the years 1900 and 1997 as "Mid-2" to compare the change in the landscape within this century. The overall vegetation shifted from a predominance of early to mid-1 seral stages in 1900, to a dominance of mid-2 and late seral condition in 1997. This shift in dominance corresponds to the era of fire suppression from approximately 1910 to the present. Figure 3-6 displays this trend.

Figure 3-6: Acres of current and historic Pacific silver fir seral stages.



Pacific silver fir is a fire avoiding species throughout all stages of its life (Agee 1991). It is extremely fire sensitive and its foliage is highly flammable. Underburning tends to cause complete mortality, except in stands with a high component of large size Douglas-fir.

Fuel Loading - Pacific Silver Fir

Eighty years of fire suppression has allowed a relatively high level of fuel to develop in the Pacific silver fir stands in the Horse Creek Watershed. The stand-replacing nature of most forest fires in the Pacific silver forests results in course woody debris patterns resembling a U-shaped curve over time (Agee 1993). Post-fire created snags slowly decay as the stand ages to a point where the firs start to die, then course woody debris loadings slowly increase again. This is basically the present condition that we see up in the Watershed.

WESTERN HEMLOCK (TSHE) SERIES

The plant associations included in this group are: TSHE/VAAL/COCA, TSHE/BENE, TSHE/ACTR, TSHE/BENE/OXOR, TSHE/BENE/GASH, TSHE/BENE/ACTR, TSHE/RHMA-VAAL/COCA, TSHE/RHMA/XETE, TSHE/RHMA/BENE, TSHE/RHMA/GASH - WILL, TSHE/RHMA/LIBO2, TSHE/GASH, TSHE/ACTR, and TSHE/LIBO2.

Western hemlock forests are the most common forest type on the Willamette National Forest. They occur at the lower elevations throughout the watershed. Climatic conditions in western hemlock forests are considered relatively mild. Temperatures range from slightly below freezing in winter to 90 to 100 degrees F in summer. Precipitation amounts vary from about 60 to over 100 inches per year, mostly falling as rain or snow in the winter. Winter snowpack are not usually deep nor long lasting. Plant moisture stress seldom exceeds 15 bars during the growing season (Means 1980, Zobel et al. 1976). Western hemlock forests occur within the watershed below 3400 feet in elevation.

Fire Disturbance - Western Hemlock

Western hemlock is not well adapted to survive fire; it is a fire avoider. The dominance of Douglas-fir within western hemlock forests in the watershed is directly tied to fire.

The effects of fire on western hemlock forests are variable, depending on the age of stand, fire frequency, intensity and extent. Fire creates a wide variety of post fire effects and patterns in mesic to dry western hemlock forests.

Recent work suggests a higher fire frequency in the drier western hemlock forests of the Oregon Cascades. A high elevation site transitional to the Pacific silver fir zone near the H.J. Andrews Experimental Forest has experienced four fires since 1530. Some of these were in the settlement period and probably reflect setter caused fire over that period, which were used to create and maintain clearings (Stewart 1986).

At another site near the H.J. Andrews, Morrison and Swanson (1990) suggest a natural fire rotation of 95-145 years over the last 5 centuries, well below that generally quoted for western hemlock forests. Another fire frequency analysis was completed by Teensma (1987) near this same area studied by Morrison and Swanson. Using conservative methods that recognized only fires that resulted in substantial regeneration or fire scaring, Teensma estimated a natural fire rotation of 100 years over the last 5 centuries.

Working in the same area, Teensma (1987) calculated a mean fire return interval for stand replacement fires of 130-150 years, about 50 percent longer that the fire return interval that included moderate severity fires (both estimates excluded low intensity fires).

These studies in and near the watershed strongly indicate that the mesic to dry western hemlock forests of the Oregon Cascades have a variable fire regime with much higher fire frequency than that typical associated with moist western hemlock forests.

This moderate severity fire regime is characteristic of the southern portion of the western hemlock zone (Agee 1991). The landscape pattern associated with this fire regime is a complex mosaic of stands with variable date and severity of last burn. In the fire history study at Deer Creek, Morrison and Swanson found that fire created patches originating in 1800-1900 were mostly less than 10 hectares.

It is not unusual to have a long early seral tree recruitment period (40-100 years) within TSHE forests following a high intensity stand replacement fire (Franklin and Hemstrom 1981, Huff 1984, Yamaguchi 1986). Lack of seed source, brush competition, and/or reburns have been identified as factors delaying regeneration after stand replacement fires (Franklin and Hemstrom 1981). Redstem ceanothus (*Ceanothus sanguineus*) and snowbrush (*Ceanothus velutinus*) are two tall shrubs that tend to dominate early seral stands within the watershed. Douglas-fir regeneration is favored over western hemlock with high intensity fires.

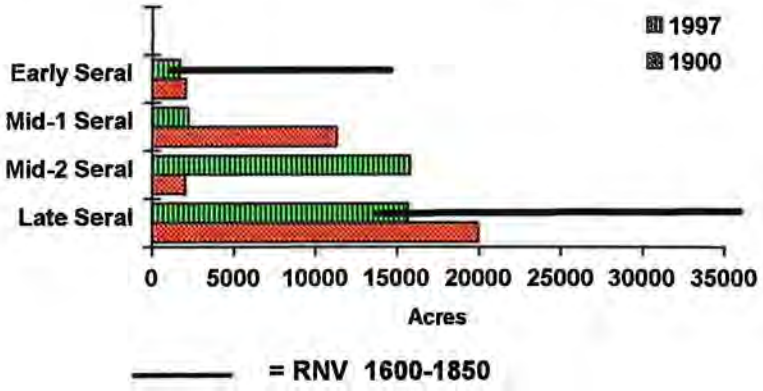
A moderate or partial stand replacement event reduces the tree recruitment period. Beargrass, fireweed, Ceanothus, big leaf huckleberry, and bracken fern are typically reestablished in the early seral stage. Douglas-fir and western hemlock reestablish in the stand initiation stage following the herbs and shrubs. Conifers, shrubs, and herbaceous species continue to grow until the forest canopy closes and prevents further regeneration. This closed sapling stage is composed of a mixture of western hemlock and Douglas-fir. Competition for site resources reduces the number of saplings and poles. Douglas-fir tends to outcompete western hemlock and dominates the site. Shrubs, herbaceous species, and cryptograms are established during understory-reinitiation, because the dense canopy of the conifers begins to open and create gaps. As the conifers mature and die, the understory develops as an uneven-aged structure with an irregular canopy. Western hemlock is the major climax species, with twinflower, vanilla leaf, dwarf Oregon grape, and big leaf huckleberry in the herb and shrub layer. If the fire is less than a stand replacement event, sufficient overstory may remain to encourage regeneration of western hemlock and western red cedar, but not Douglas-fir.

Because of their thick bark, large Douglas-fir tend to be resistant to fire and may survive ground fires that eliminate thin barked species like hemlock and red cedar, and understory shrubs and young trees. Many of the stands within the lower elevations of the watershed contain scattered residual Douglas-firs that have survived numerous ground and partial stand replacement fires. All the old-growth stands within the watershed have evolved through understory and partial stand replacement fire disturbances.

Comparison of Historic Versus Existing Landscape Vegetation - Western Hemlock

The following information is patterned after the Regional Ecological Assessment Project. The REAP process stratified the landscape into three age groups: early (1-10 years old), mid (11-50 years), and late (200+ years). The age class between 50 and 199 was not analyzed during the REAP process. That information is displayed for the years 1900 and 1997 as Mid-2 to compare the change in the landscape within this century (Figure 3-7).

Figure 3-7: Acres of current and historic Western Hemlock seral stages.



The distribution of the vegetation shows an increase level of late-successional forest. The current level of late-successional forest is within the historical range of variability. The solid dark line represents the range of historical variability from 1600 to 1850.

Stand Dynamics and Succession

Because of the close relationship between disturbance, particularly fire, and the development of vegetation within the watershed, an "initial floristics" model of stand development is most appropriate for this area (with the probable exception of high elevation mountain hemlock). General stages of this model are as follows: early seral, stand initiation, stem exclusion, understory reinitiation, and late-successional old growth.

The early seral stage begins after a disturbance to the preexisting plant community. During this period, seeds present in the seed bank, pioneer invader species, and regrowth from vegetative sprouts dominant the area. In the second stage, stand initiation, conifers regenerate, and shrubs and herbaceous species that were present in the preexisting plant community are usually reestablished in abundance. The next stage is stem exclusion. As saplings grow, a dense canopy develops, limiting the sunlight available to shade-intolerant species and preventing further regeneration. During this period, the natural thinning of the conifers can create openings in the canopy. Shade-tolerant trees, shrubs, herbaceous plants, and cryptogams are

established in the understory. Eventually, large trees in the overstory die, creating gaps; younger trees in the lower canopy layers are released; and the stand develops into an old-growth stage with an irregular canopy (Oliver and Larson 1990).

Forest development does not typically proceed in chronological uniformity. It will vary depending on the type of disturbance and intensity, soil composition, macro and micro-environmental conditions and the preexisting plant communities. A seral stage can occupy or overlap in various sequences for an indefinite period of time until site conditions initiate change.

In the watershed, the plant associations present have evolved over time with fire as a frequent natural disturbance influencing successional changes. The effect of fire (intensity and frequency) has created plant communities with great complexity of species and structural diversity. Many of the plant communities follow a single regeneration pattern under "normal" fire periods. However, succession patterns can change following a disturbance of very short or long fire intervals. The macro- and micro-environment of the watershed, and the dominant role fire has had in the area, have created a landscape of multiple successional pathways. One example of a common succession pattern is the post-fire seral invader species, lodgepole pine. Lodgepole pine is able to invade and dominate following a fire disturbance if it was present in the pre-fire plant community or if a seed source exists for regeneration.

Crest Wildernesses Prescribed Natural Fire Program within the Horse Creek Watershed.

Vegetative communities and their associated flora and fauna are adapted to the effects of reoccurring fire. As fire is excluded, the condition and distribution of vegetative communities will continue trending outside of their historical range of variability. The exclusion of fire often results in ecosystem instability. As disturbance inevitably returns, losses of key ecosystem components associated with late-successional stands may occur in both the short and long-term.

The Crest Wildernesses Prescribed Natural Fire Program (PNF Plan, USDA Forest Service, Deschutes and Willamette National Forests, 1996) currently enables fire managers to allow certain lightning caused wildfires to play their role in this ecosystem. Though containment risks are inherently associated with this program, the benefits from restoring key ecosystem components provides the incentive for establishing such a program.

Prescribed fire, both natural and management ignited, allows for the reintroduction of disturbance under managed circumstances. Using this tool, disturbance would be allowed to play a role in this system in a way that can minimize short-term effects while providing for long-term sustainability.

The frequency, timing and locations of natural ignitions are random. These ignitions, coupled with analysis of current and past weather phenomena, have the potential to be accepted as a prescribed natural fire (PNF). The result may range from a small, low intensity fire to a large high intensity stand replacing event. Both of these outcomes have occurred at varying frequency in the within the watershed (see Fire Regime descriptions).

The risk and potential impact of a natural ignition may eliminate it from acceptance as a prescribed natural fire (See PNF Plan). This may occur because, due to past fire suppression, there are few natural barriers limiting the size of a burn and the amount of forest fuels are increasing. Therefore, it is possible that PNF's in the near future will be small and minimize program accomplishment, or large stand replacement events with higher risk and resource impact. The desired result would produce mostly moderately sized burns of varying intensity.

A complete program for returning fire to the ecosystem would also include management ignited fire (MIF). This tool could be used to create fuel breaks to limit future fire size under PNF. It could also control fire intensity in sensitive areas and increase the pace at which fire returns to the ecosystem. Management ignited fire would help reduce the risks and potential impacts of PNF, and maximize the factors affecting fire behavior which can be controlled while minimizing factors that can not be controlled.

OVERVIEW OF BOTANICAL RESOURCES

Non-Forested Habitats

Many researchers have sought to answer questions about the non-forested habitats in the Western and Northern Cascades and Olympic Mountain Ranges. Researchers Charles Halpern, B. G. Smith, and Jerry Franklin (Halpern et al 1984), attempted to answer the following questions about the habitat types found in the Three Sisters Wilderness Area:

- What are the origins of the variety of non-forested lands?
- What environmental and/or biotic features maintain them as such?
- What changes are occurring within these meadows and across their ecotones?
- Why and when did change occur?

The researchers' work focused on establishing a series of permanent transects through various habitat types in the Three Sisters Wilderness Area. This information in conjunction with research done in the Western Cascades was used for this analysis.

Natural disturbances such as volcanic eruptions, fires, and floods created the habitats on the Horse Creek landscape. There are strong correlations between plant community composition, soil moisture, landform type, and elevation. The types of non-forested plant communities and their distribution on the landscape historically probably was more extensive than today. Non-forested plant communities most likely occurred over larger areas and for longer periods of time. Disturbance by fire or other factors in subalpine forests probably resulted in openings that remained a century or more, as forest succession may be much slower in subalpine than in montane forests (Peet 1978, 1981). Reoccurring fires historically created and maintained meadow and shrub dominated communities. Fire is the principal agent through which meadows expand (Miller 1995). Native Americans are reported to have burned meadows (William 1994) for removal of undergrowth vegetation, travel accessibility, maintenance of huckleberry fields, grass growth, and hunting (Coville 1898, Burke 1979, Williams 1994). Many researchers cite environmental and climatic factors over the last century that have influenced montane and subalpine plant communities (Douglas & Bliss 1977, Franklin & Dyrness 1988, Hickman 1976, Miller 1995, Miller & Halpern 1997). The effects of sheep grazing in the watershed from the late 1800's until cessation in 1938 have influenced meadow plant communities. Fire suppression since 1910 has also played a critical factor in meadow and shrub habitat types in the watershed.

A high diversity of non-forested habitats and associated species richness is present in the watershed. The diversity in species composition and growth forms reflects the broad range of environmental conditions that can found in the watershed. The following table (Table 3-2) lists the dominant habitat types and approximate acres in the Horse Creek Watershed.

Table 3-2: Dominant special habitat types in the Horse Creek Watershed.

Habitat type	**Acres**	**% of Watershed**
Rock, talus, pumice and lava fields	5,580	6%
Shrub/forb/grass communities	1,540	2%
Wetlands	725	1%

The soils and geology of the watershed are of two distinct physiographic provinces. The mountains on the western boundary are O'Leary, Horsepasture, Lamb Butte, and English. This area of the watershed lies within a geologically older (Oligocene to Miocene) part of the Cascade Range. The Western Cascades are more dissected, with deep soils. Habitat types include lush forb meadows, shrub thickets, and ridgetop rock outcrops and gardens. In the Central and Western Cascades the rugged topography and heavier snowfall result in variable snow depths and release dates, leading to steep

environmental gradients, constricted communities, and abrupt changes in community type (Douglas and Bliss 1977).

To the east are the High Cascades, where soils are young and well-drained, and composed of pumice, ash, and cinders. The alpine zone occurs on only recently dormant Pleistocene volcanoes of the Cascade Range (Franklin & Dyrness 1973). High elevation subalpine to alpine habitats are present in the form of grass and forb meadows, dwarf shrub communities, pumice, and talus slopes. Lakes, ponds, and seasonally wet areas and associated vegetation are abundant. Map 3-11a displays the location of known special habitats in this watershed.

Western Cascades Plant Communities

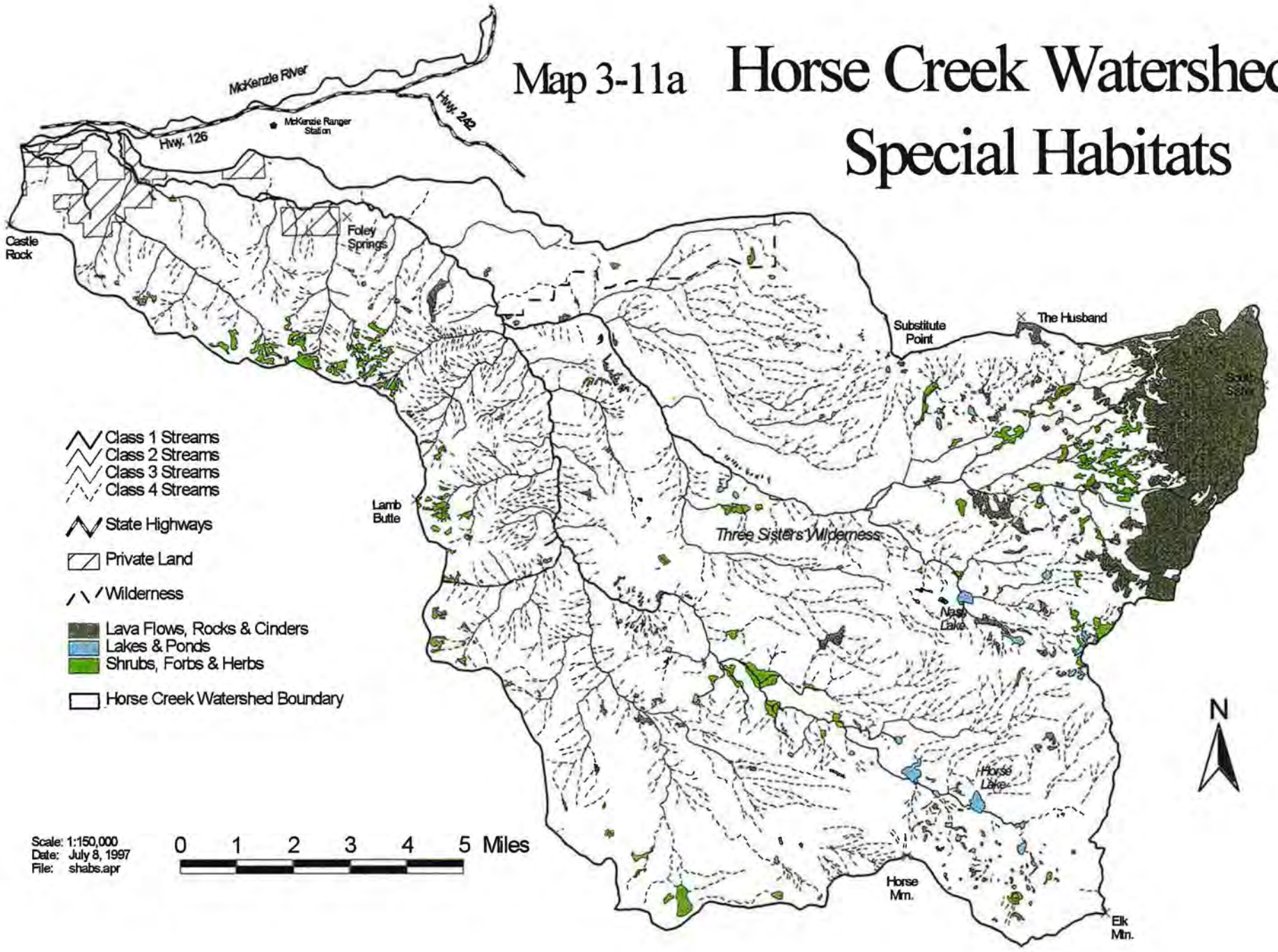
Two dominant herbaceous mesic montane meadows that occur in this area are *Veratrum / Valeriana / Senecio* and *Rubus / Pteridium*. Two common ridgetop rock gardens are *Gilia / Polygoum / Eriogonum* and *Eriophyllum / Castilleja / Sedum*. These rocky habitats have thin soils from the continuous erosion that occurs. Sitka alder (*Alnus sinuata)* communities are common on the north slopes near water or where ground water is close to the surface. Vine maple (*Acer circinatum*) and rocky soil associations occur on drier sites. An emergent wetland identified as "The Potholes" is located in the Lamb Butte Special Interest Area. The only other moist habitat in this area of the watershed is a small spring east of The Potholes. Research in 1968 identified Horsepasture Mountain as one of the most floristically diverse area in the entire Western Cascades (Hickman 1968).

High Cascades Plant Communities

Subalpine grass, sedge, and shrub communities; pumice flats, aquatic and seasonally wet areas with associated vegetation are abundant in the eastern portion of the watershed. Shrub communities located on cool, north-facing slopes are dominated by pink heather (*Phyllodoce empetriformis*) and white heather (*Cassiope mertensiana).* Dry south slopes are dominated by broadleaf lupine (*Lupinus latifolius)* and mountain bunchgrass (*Festuca viridula*). Mountain bunchgrass (*Festuca viridula*) communities were heavily grazed by sheep from the late 1800's until cessation in the 1938. Black sedge (*Carex nigricans)* community typically occurs in basins and depressions with poor drainage and persistent snow. Mixed grass and forb communities of tufted hairgrass (*Deschampsia cespitosa)* and long-stalked clover (*Trifolium longipes*) are found where there is seasonal water. The dry subalpine pumice flats are dominated by Newberry's fleeceflower (*Polygonum newberryi*) communities. These high elevation subalpine communities have short growing seasons due to late persisting snowbanks and cold, wet soils. By late summer, low moisture stress limits plant growth in many of these communities.

All of the habitat types identified in the Horse Creek watershed have wide distribution throughout the Central, Western, and Northern Cascades to British Columbia, and the Olympia Mountains.

Map 3-11a Horse Creek Watershed Special Habitats



Community Locations

- *Veratrum/Valeriana/Senecio* meadows typically occur on east to northwest-facing slopes, with a constant source of moisture.
- *Rubus/Pteridium* community is an extremely widespread type in the Pacific Northwest (Hickman 1976).
- *Gilia/Polygoum/Eriogonum* community type is the driest of the meadow associations in the Western Cascades and includes many distinct species (Hickman 1976).
- *Eriophyllum/Castilleja/Sedum* community type occurs on steep south or west -facing slopes.
- Heather communities dominated by *Phyllodoce empetriformis* and *Cassiope mertensiana.* are common in the Central and Northern Cascades and Coastal mountains, extending into British Columbia.
- *Festuca virdula* and *Lupinus latifolius* communities were once widespread across the upper montane to subalpine zones of Oregon and Washington, but have probably decreased due to past grazing of livestock. This community has been reported on Mount Rainier, WA. (Meredith 1972), Mt. Jefferson (Swedberg 1961), and Three Sisters Wilderness Area (Van Vechten 1960).
- *Carex nigricans* communities occur in the Central to Northern Cascades and Olympic Mountains where there is heavy snowpack. This community type occurs from the Siskiyou mountains of California, north to Alaska, and east to the Rocky Mountains of Colorado and Alberta (Munz 1959). This widespread distribution is the result of the southern migration during the Pleistocene glaciation and its persistence on mountain tops since the retreat of the glaciers (Jones 1947).
- Large, pumice flats, mostly barren of vegetation are conspicuous features of the subalpine parkland (Van Vechten 1960, Swedberg 1961, Horn 1968).

Threats to Non-Forest Communities

Conifer encroachment in montane and subalpine meadow communities is a major threat to the viability of these plant communities. Reduction through the loss of habitat by conifer encroachment has been widely studied in the western United States during the last forty years. The origin and persistence of meadows in areas that can support coniferous forests have been studied by various researchers (Kuramoto & Bliss 1970, Franklin et al. 1971, Vale 1981, Magee & Antos 1992, Rochefort & Peterson, Miller 1995, Miller & Halpern 1997). Most of the scientific literature on montane and subalpine meadow communities have cited climatic changes, fire suppression, and past livestock grazing as influencing conifer encroachment and meadow succession in this century.

For many meadow communities, it is the interactions of two factors that determine meadow successional dynamics: abiotic (snowpack duration, variation in temperature, and precipitation) and biotic (livestock grazing, seed source). Tree invasion patterns in

several Oregon montane meadows over the last 100 years seems to be controlled by the interactions among grazing, fire use and the subsequent suppression, and climatic variability (Vale 1981, Magee & Antos 1992, Miller 1995, Miller & Halpern 1997).

Depending on the location and type of meadow community, weather conditions can increase or decrease conifer invasion and establishment. Franklin et al (1971) suggested that the warmer, drier climate experienced between the late 1800's to the mid 1940's is responsible for conifer invasion into montane and subalpine meadows. Longer snow-free periods associated with a regional drought in 1920 to 1940 were accompanied by massive conifer invasion. Conifer invasion was accelerated from 1945 to 1985 with the absence of frequent fires, cessation of grazing by sheep, and a period of cool, wet weather. (Agee & Smith 1984, Franklin & Dyrness 1973). In the Three Sisters Wilderness James Creek, Separation Creek, and Wickiup Plains and on the west side of the watershed Olallie Ridge were intensively used for sheep grazing from 1875-1938 (Johnson 1985). Meadow composition has most likely been strongly influenced by the presence of over 50 years of sheep grazing.

In 1993 Eric Miller re-sampled Halpern, Smith, and Franklin's transects (established in 1984) in the Three Sisters Wilderness Area and identified various factors in the establishment of conifers in some of the meadows (Miller 1995). Miller's research focused on the changes in establishment, survivorship, and growth rates of conifer populations and associated changes in the distribution and abundance of meadow communities. Study sites were James Creek, Separation Creek, and Wickiup Plains. He concluded that trees established in north-sloping, subalpine heath shrub mesic meadows occurred during periods of moderately earlier snowmelt and high summer precipitation (1920-1945). South-facing, subalpine mesoxeric meadows such as James Creek, were invaded during cool, wetter climatic conditions (1945-1985). Miller's work in the Three Sisters Wilderness determined that climate was the best explanation of conifer invasion into higher elevation meadows. Fire suppression and the cessation of sheep grazing were contributing factors for conifer invasion into meadow habitats.

Road construction of Forest Road 1993 cut through many of the mesic montane meadows from O'Leary to Horsepasture Mountain. Road construction adjacent to or through these habitats reduced habitat size and influenced plant species composition. Harvest of conifer stands adjacent to meadow and rock habitats effects the microclimate, hydrology, and plant species composition.

Many dry habitats such as rock gardens and pumice flats have hiking trails through the habitat. The presence of hiking trails can increase erosion in these sensitive areas and favor the introduction of noxious and other nonnative plant species. Human traffic has probably most affected the relatively flat, subalpine meadows near major trailheads such as Wickiup Plains (Shelby and Hall 1992), though the total acreage is very small (<1/4 acre). Packstock may be impacting sensitive hydric and mesic meadows. The

highest use areas in the wilderness are Separation-Mesa Complex, Nash Lake, and the Horse Lake Complex. These areas need field verification to assess impacts to the resources.

Fire Effects on Non-Forested Habitats

Fire effects on non-forested plant communities varies with habitat type and plant community. Environmental conditions such as climate and drought can affect vegetative conditions and fire intensity. Lakes and wet meadows can impede fire. Sitka alder communities with high soil moisture may also impede the spread of fire. Areas of talus, rock outcrops, and pumice fields can act as barriers that may impede the spread of some fires. Dry meadows on south-facing slopes may burn and enlarge the size of the meadows. Subalpine meadows typically have less fuels and fire will skip over these areas. Fire disturbances may result in forest openings that remain a century or more, as forest succession may be much slower in subalpine than in montane forest (Peet 1978, 1981). Forests that burn at this elevation can be set back to early seral huckleberry meadows for many years before conifers reestablish. Plant species success to compete in a post-fire community are dependent on species regeneration, reproductive abilities, and favorable environmental conditions. Table 3-3 lists potential fire response of some of the more common plant communities found in the watershed.

Noxious weeds and other invasive non-native plant species threaten the biological diversity and species composition in special habitat areas. Conifers invasion in meadow communities provide a micro-environment and seed source for further expansion. Re-introduction of fire to reduce conifer encroachment is needed in many of the subalpine meadow communities. Tree establishment has been more dense in subalpine meadow habitats than in montane meadows (Miller & Halpern 1997).

Table 3-3: Common plant communities found in Horse Creek Watershed and their potential response to fire.

Community Type	Fire Type	Role of Fire in Community Maintenance	Vegetation Response
Dry-Subalpine			
Carex nigricans	surface fire	low	set back conifer encroachment, stimulate vegetation growth
Festuca viridula	surface fire	high	set back conifer encroachment, stimulate vegetation growth
Lupinus latifolius	surface fire	moderate	set back conifer encroachment, stimulate vegetation growth
Polygonum newberryi	surface fire	low	stimulate vegetation growth
Mesic-Subalpine			
Phyllodoce empetriformis / Cassiope mertensiana	surface fire	low	set back to early seral huckleberry
Wet/Mesic-Mid-High Elevation			
Alnus sinuata	surface fire	infrequent	stimulate vegetation growth
Deschampsia caespitosas	surface fire	very low	stimulate vegetation growth
Luzula laxiflora	surface fire	low	stimulate vegetation growth
Pteridium aquilinum/ Carex pennsylvanica	surface fire	very low	stimulate vegetation growth
Salix-Spiraea douglasii	surface fire	infrequent	stimulate vegetation growth

Botanical Areas of Interest in the Horse Creek Watershed

Olallie Ridge Natural Research Area

Olallie Ridge Research Natural Area (RNA) was established in 1963 to provide an example of subalpine mountain meadows and true fir - mountain hemlock communities found on high ridges in the western Cascades of Oregon. The Olallie Ridge RNA is 720 acres located on the summit of O'Leary Mountain in the west and Horsepasture Mountain in the east. The most outstanding features of the RNA are the non-forested communities which occupy a variety of habitats and support a rich flora (Franklin 1972). Extensive observations of the flora and plant community types (Hickman 1968) have found Horsepasture Mountain to be one of the most floristically diverse areas in the entire western Cascades. Dr. Hickman identified thirty disjunct species of phytogeographic significance on Horsepasture and O'Leary Mountains.

The Olallie Ridge area was intensively used as a sheep range until 1938. There is still evidence of sheep camps around some grassy openings. Meadow composition has undoubtedly been strongly influenced by overgrazing of sheep (Franklin 1992).

Noxious weeds and other invasive nonnative plant species will continue to be monitored within the Olallie Ridge RNA. Encroachment of conifers into the montane meadows should also continue to be monitored.

Lamb Butte Special Interest Area

Lamb Butte is a Special Interest Area (SIA) of approximately 390 acres. It is located on the crest of a north-south ridgeline consisting of three peaks: Taylor Castle, Lamb Butte, and English Mountain. Dry, rocky outcrops are present on or near the top of all three peaks. A wet meadow and small spring known as "The Potholes" is located in the southeast section of the SIA. A population of the uncommon plant species cow-bane (*Oxypolis occidentalis)* is located in the wet meadow. The SIA was designated because it contains exceptional scenic qualities and biological features. This area was used by Native Americans for medicinal plant gathering (See Human Use section of this Chapter).

The Lamb Butte Special Interest Area has been identified as a "hot spot" for fungal diversity because of its concentration of rare and endemic species of fungus (Appendix J2, FSEIS USDA and USDI 1994). Habitat conditions for these species of fungi are upper mid elevation (5000 ft.) stands of mature to old growth grand fir, silver fir, Douglas-fir, western hemlock, and mountain hemlock. The FSEIS (USDA and USDI 1994) recommended protection of Lamb Butte Area by the following measures:

- Designate the area as Mycological Special Interest Area
- Merge the Lamb Butte Special Interest Area with the Olallie Ridge Research Natural Area.

Sensitive Species Surveys and Potential Habitat

Sensitive plant surveys have occurred in the watershed for proposed timber harvest and for other management activities involving ground disturbance. No formal surveys for rare and uncommon plants have been completed on private lands in the watershed. The diversity of habitat types found within the watershed provide potential habitat for twenty-nine species listed on the Regional Forester's Sensitive Plant List for the Willamette National Forest.

Known Sensitive Populations

A population of the sensitive plant species *Ophioglossum pusillum* (Adder's-tongue) is located in the watershed. Adder's-tongue is a very low growing fern that inhabits pond margins and wet meadows. The population in the watershed occurs in a seasonal wet meadow near Owl Creek. Two additional uncommon species *Sidalcea cusickii* (Cusick's mallow) and *Botrychium virginianum* (Virginia grape-fern) are found in the

meadow. Adder's-tongue is dependent on its mycorrihizal association with fungus, which transfers energy and nutrients from the soil to the plants. Although the plant is perennial, individual plants may not emerge every year. This population is one of only six known populations in the state of Oregon. All six sightings are located on USDA Forest Service lands. A Conservation Strategy and Monitoring Plan for Adder's-tongue was completed in 1996 between the Willamette, Umpqua, Siuslaw and the Mt. Hood Forests (USDA 1996). The primary objective of the Plan is to maintain long-term population viability of Adder's-tongue on these four forests.

The occurrence of Adder's-tongue is related to available soil moisture. It is suspected that changes in available soil moisture can affect the viability of the species. Current moisture levels in the meadow have increased as result of the removal of a mature conifer stand on the adjoining hillslope approximately 15 years ago. Today, a young stand of conifers occupies the site. High levels of surface water will gradually decrease over time, until the hillslope stand reaches 120 years old (McSwain, pers. comm.). Population census on Adder's-tongue was not taken prior to stand harvest. The Conservation Strategy for this species requires population census to occur biennially. In 1996 the first census of the population was taken. Changes in the Adder's-tongue population, species composition of the meadow, and hydrologic conditions will be tracked. There is also a concern for the loss of habitat due to natural succession in the meadow. Currently the meadow is being encroached by competing vegetation.

Oxypolis occidentalis (cow-bane) is also documented in the watershed. This species is currently listed on the Willamette National Forest Sensitive Species List. However, when the sensitive list is revised, cow-bane will be removed from the sensitive list and placed on the Forest Watch List because numerous populations of this species have been found throughout its range.

Other Plant Species of Concern

Six uncommon plant species have been documented in the watershed. Uncommon plant species are listed on the Forest Watch and Concern Lists. Unlike the Sensitive list, the Watch and Concern Lists do not have management guildelines. However, many species are associated with non-forested habitats (special habitats) which are protected by standard and guideline FW-211. Listed plant species are monitored to track species occurrence and abundance on the Forest. An example of an uncommon species is *Draba aureola* (golden alpine draba), which grows at 9,500 feet in the pumice soils on South Sister Mountain. Table 3-4 lists the uncommon and rare plant species in this watershed.

Table 3-4: Rare and uncommon plant species in the Horse Creek Watershed.

Species	Common Name	Site Name	*Status
Ophioglossum pusillum	Adder's-tongue	Owl Creek Meadow	S
Draba aureola	Golden alpine draba	South Sister	W
Oxypolis occidentalis	Cow-bane	The Potholes	W
Sidalcea cusickii	Cusick's mallow	Owl Creek Meadow	W
Botrychium virginianum	Virginia grape-fern	Owl Creek Meadow	C
Botrychium virginianum	Virginia grape-fern	Horsepasture Mtn. Trail	C
Corallorhiza trifida	Yellow coral-root	Three Sisters Wilderness	C
Pleurocospora fimbriolata	Fringed pinesap	Three Sisters Wilderness	C
Polystichum andersonii	Anderson's swordfern	Horsepasture Mtn.	C

*Willamette National Forest Sensitive, Watch, and Concern Lists.

Survey and Manage Species: Fungi, Lichens, Bryophytes and Vascular Plants

The Northwest Forest Plan contains a list of species generally associated with late-successional forests and riparian habitat. The standard and guidelines for the survey and management of these species contain four components:

1. Manage known species sites, and include provisions for their protection.
2. Survey prior to ground disturbing activities implemented in 1999 and manage known species sites.
3. Develop survey protocols and species management guidelines. Conduct extensive regional surveys to find high priority sites for species management.
4. Conduct general regional surveys.

Species of fungi, lichens, bryophytes and vascular plants are valued as indicators of biodiversity and forest stability. Species diversity for the majority of these species appears highest in late-successional forests due to the diversity of habitat structures, host species, and large amounts of duff and down material. Many of these species have poor dispersal capabilities and are unable to move across fragmented habitats. Fragmented habitat may restrict gene flow between populations in the landscape. No Forest-wide inventories for survey and manage fungi, lichen, bryophyte and vascular plant species have occurred in the watershed. Two vascular plants, *Botrychium minganense* and *Botrychium montanum,* are on the survey and manage list of species and

are also on the Willamette National Forest Sensitive Plant List. A list of potential survey and manage species and their associated habitats is located in the Botany Appendix.

Locations of fungi, lichen, bryophyte, and vascular plant species that are documented in the watershed (Table 3-5) are from research collections and incidental sightings. Field surveys done by Dr. J. Trappe in the Lamb Butte Special Interest Area documented thirteen previously unknown species of ectomycorrhizal fungi. These species are locally endemic "type species" and are listed under survey strategy component 1. "Type species" are specimens designated to serve as a reference point for a scientific name. Because of the concentration of rare and endemic fungal species in the Lamb Butte Area, researchers have recommended that the area be protected by the following mitigation measures (from Appendix J 2 FSEIS USDA and USDI 1994):

1. Designate the area as Mycological Special Interest Area.
2. Merge the Lamb Butte Special Interest Area with the Olallie Ridge Research Natural Area.

Table 3-5: Survey and manage species documented in the Horse Creek Watershed.

Species	Classification	Survey Strategy	Geographic Area
Chroogomphus loculatus	rare gilled mushroom/ mycorrhizal fungi	1, 3	The Potholes, Lamb Butte Scenic Area,
Gastroboletus imbelellus	rare bolete mushroom / mycorrhizal fungi	1, 3	The Potholes, Lamb Butte Scenic Area
Gastroboletus ruber	rare bolete mushroom / mycorrhizal fungi	1, 3	Lamb Butte Scenic Area
Glomus radiatum	rare zygomycete/ mycorrhizal fungi	1, 3	The Potholes, Lambs Butte Scenic Area,
Gymnomyces sp. nov. # Trappe 1690,	rare truffle or false truffle/ mycorrhizal fungi	1, 3	Olallie Trail, Lamb Butte Scenic Area
Gymnomyces sp. nov. # Trappe 1706,	rare truffle or false truffle/ mycorrhizal fungi	1, 3	Olallie Trail, Lamb Butte Scenic Area
Gymnomyces sp. nov. # Trappe 1710	rare truffle or false truffle/ mycorrhizal fungi	1, 3	Olallie Trail, Lamb Butte Scenic Area
Hypogymnia oceanica	rare lichen	1, 3	Fisher Lake area, Three Sisters Wilderness Area

Table continued

Species	Classification	Survey Strategy	Geographic Area
Martellia idahoensis	rare false truffle/ mycorrhizal fungi	1, 3	Lamb Butte Scenic Area
Martellia sp. Nov. # Trappe 1700	rare truffle/ mycorrhizal fungi	1, 3	The Potholes, Lamb Butte Scenic Area
Octavianina sp. nov. # Trappe 7502	rare truffle or false truffle/ mycorrhizal fungi	1, 3	The Potholes, Lamb Butte Scenic Area
Rhizopogon evadens var. subalpinus	rare false truffle/ mycorrhizal fungi	1, 3	The Potholes, Lamb Butte Scenic Area
Rhizopogon sp. nov. # Trappe 1692	rare truffle or false truffle/ mycorrhizal fungi	1, 3	The Potholes, Lamb Butte Scenic Area
Rhizopogon sp. nov. # Trappe 1698	rare truffle or false truffle/ mycorrhizal fungi	1, 3	The Potholes, Lamb Butte Scenic Area
Cantharellus cibarius	Chanterelle/ mycorrhizal fungi	3, 4	mature and 2nd growth stands
Lobaria oregana	nitrogen-fixing lichen	4	mature and old-growth conifer forests
Lobaria pulmonaria	nitrogen-fixing lichen	4	mature and old-growth conifer forests

Noxious Weeds

Noxious weeds and other invasive non-native plants threaten biodiversity, habitat quality, and ecosystem function. These species originate from other countries and are able to displace and out-compete native species because they arrive without the host of predators, disease, and other ecosystem components that limit their abundance in their native homeland. Noxious weeds reduce the quality and quantify of native forage available for animals because many of these weeds are toxic or unpalatable.

A number of noxious weeds and other invasive non-native species are found in the Horse Creek Watershed. Weeds known to be present are listed below.

Table 3-6: Noxious weeds known to occur in the Horse Creek Watershed.

Noxious Weeds	Invasive non-native weed species
Bull thistle - *Cirsium vulgare* Canada thistle - *Cirsium arvense* Scotch broom - *Cytisus scoparius* St. John's-wort - *Hypericum perforatum* Tansy ragweed - *Seneica jacobea*	Dandelion - *Taraxacum officinale* Kentucky bluegrass -*Poa prastensis* Mullen - *Verbascum thapsus* Ox-eye daisy - *Chrysanthemum leucanthemum* Red sorrrel - *Rumex acetosella.* Selfheal - *Prunella vulgaris var. vulgaris* Sweet pea - *Lathyrus tingitannus* Wall lettuce - *Lactuca muralis* *Cat's ear - Hypochaeris radicata*

Forest Service and county roads host the majority of the weed infestations. Noxious weeds and invasive non-native species are located adjacent to most Forest Service roads and roads with trailheads into the Three Sisters Wilderness Area. Non-native weedy species have been found in the Three Sisters Wilderness Area and the Olallie Research Natural Area. Existing populations of noxious weeds serve as a propagule source for further weed distribution and establishment. Road construction and maintenance have been the most important factors contributing to the spread of noxious weeds and other nonnative plants.

District roads were surveyed for the presence of noxious weeds in 1995 and 1997. No surveys have been completed in the wilderness, However, the wilderness rangers are observant of the presence of noxious weeds. Noxious weeds identified are usually pulled out by the rangers, and the locations are recorded. The use of pack animals in the wilderness increases the threat of introducing weedy plants. Invasive weed species in the wilderness and other botanically rich areas are a threat to the biological diversity and species composition of these areas.

OVERVIEW OF RIPARIAN AND AQUATIC RESOURCES

Stream Channel Conditions and Flood Effects

Horse Creek and its major tributaries (Separation Creek and Roney Creek) flow within glacially carved valleys. The upper section of Horse Creek downstream to about Roney Creek has a relatively high gradient and is considered to be Valley Segment Type U-3 (Incised U-Shaped Valley, High Gradient). The channel is downcut through deep valley bottom glacial till and glacio-fluvial deposits, and it is vertically incised into the valley fill deposits with a 6-%11 gradient. Moving downstream, the Valley

Segment Type changes to U-2 (Incised U-Shaped Valley, Moderate Gradient) around the confluence with Roney Creek, which is similar to U-3 but with a more moderate channel gradient of 2-5%. The valley width and gradients within the U-2 valley segment type are conducive to the formation of mid-channel bars and side channels. The U-2 Valley Segment Type changes to U-Shaped Trough just upstream of the confluence with Avenue Creek. This is where the valley width increases dramatically and stream gradients decline.

Around the confluence with King Creek, Horse Creek enters the McKenzie River valley, and flows over a broad alluvial fan. The main channel is prone to shifting its location during rare storm events within the broad, glacial valley of the U-Shaped Trough and the Alluvial Fan valley segment types. The channel within the Alluvial Fan valley segment type has changed location many times, often with more than one active channel joining the McKenzie River at various locations. Maps 3-12, 3-13, and 3-14 display the Horse Creek channel for four time periods (1955, 1967, 1990 and 1996) from Horse Creek Campground downstream to its confluence with the McKenzie River.

The 1964 flood, an event with a recurrence interval of 100-120 years, caused Horse Creek to abandon several channels and form new ones, as indicated by comparing the 1955 channels to 1967. During the 1964 event, West Fork Horse Creek aggraded and abandoned its original channel that flowed adjacent to homes. New channels were created both to the north and to the east of the original West Fork Horse Creek channel.

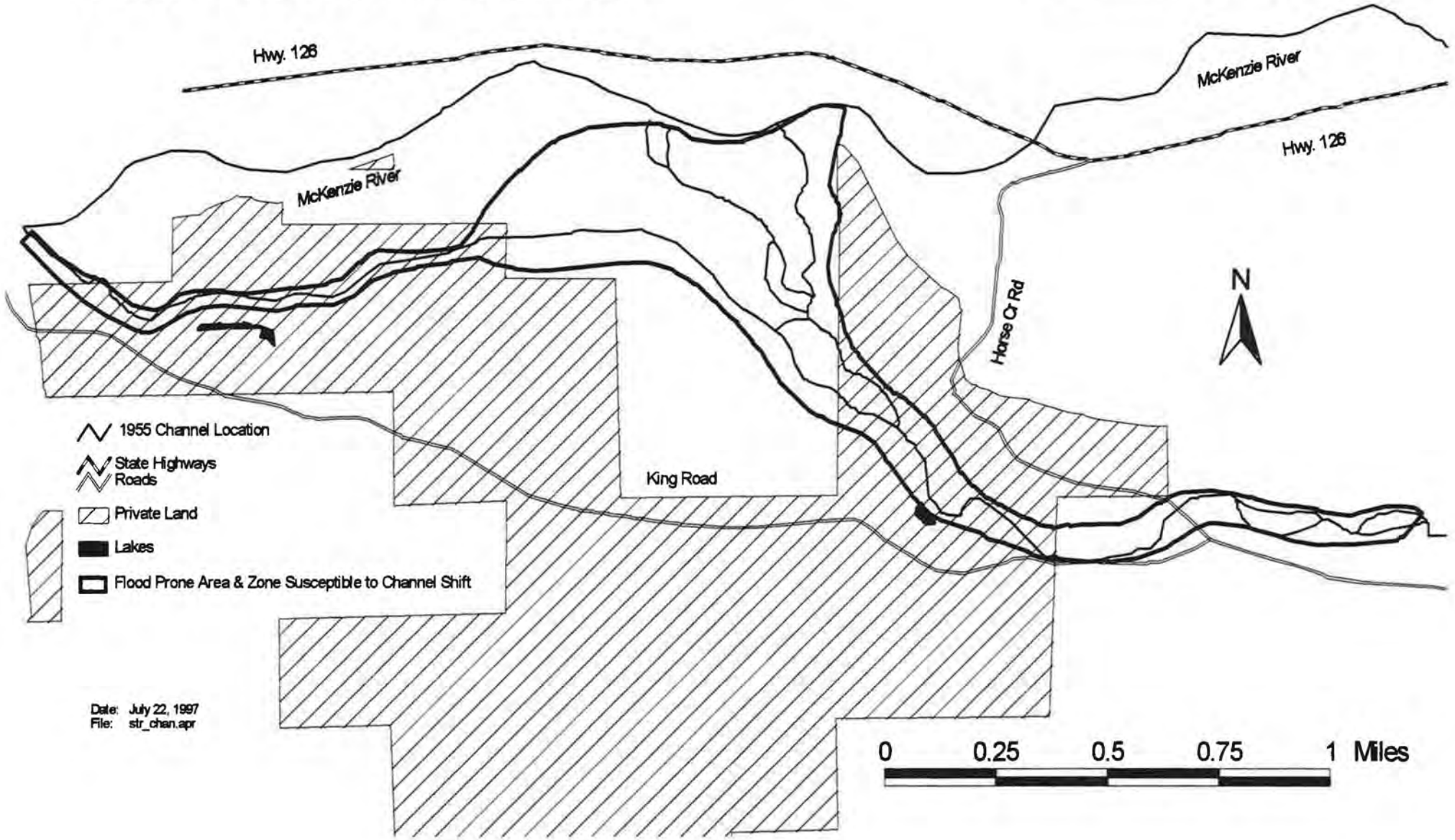
Today, West Fork Horse Creek is virtually dry during summer months, flowing only during the winter and spring. The main channel carrying most of the flow travels directly north into the McKenzie River. In the past, attempts have been made by private citizens to increase flow into West Fork Horse Creek through the use of structures made of gabions, rock, and logs. Installation of these structures have actually accomplished the opposite of the intended effect, causing channel downcutting in East Fork Horse Creek and increasing streamflow in the channel that flows directly north into the McKenzie River.

Prior to the 1964 flood, and today, much of Horse Creek streamside vegetation was dominated by mature conifers and was well vegetated along most of the stream length. Hardwoods in localized areas was the dominant vegetation on point bars within the U2 valley segment type (Incised U-Shaped Valley, Moderate Gradient). The exception is the alluvial fan of lower Horse Creek which had already been heavily harvested by 1955, with much of East Fork Horse Creek and eastward harvested. Most of the major tributaries appeared stable. However, Avenue Creek appeared to have sluiced many years prior to the 1964 flood; Pasture Creek showed evidence of ravelly banks and sideslope failures high in the subwatershed; and Castle Creek had streamside slides and abundant sediments stored within the channel.

Map 3-12

Horse Creek Watershed

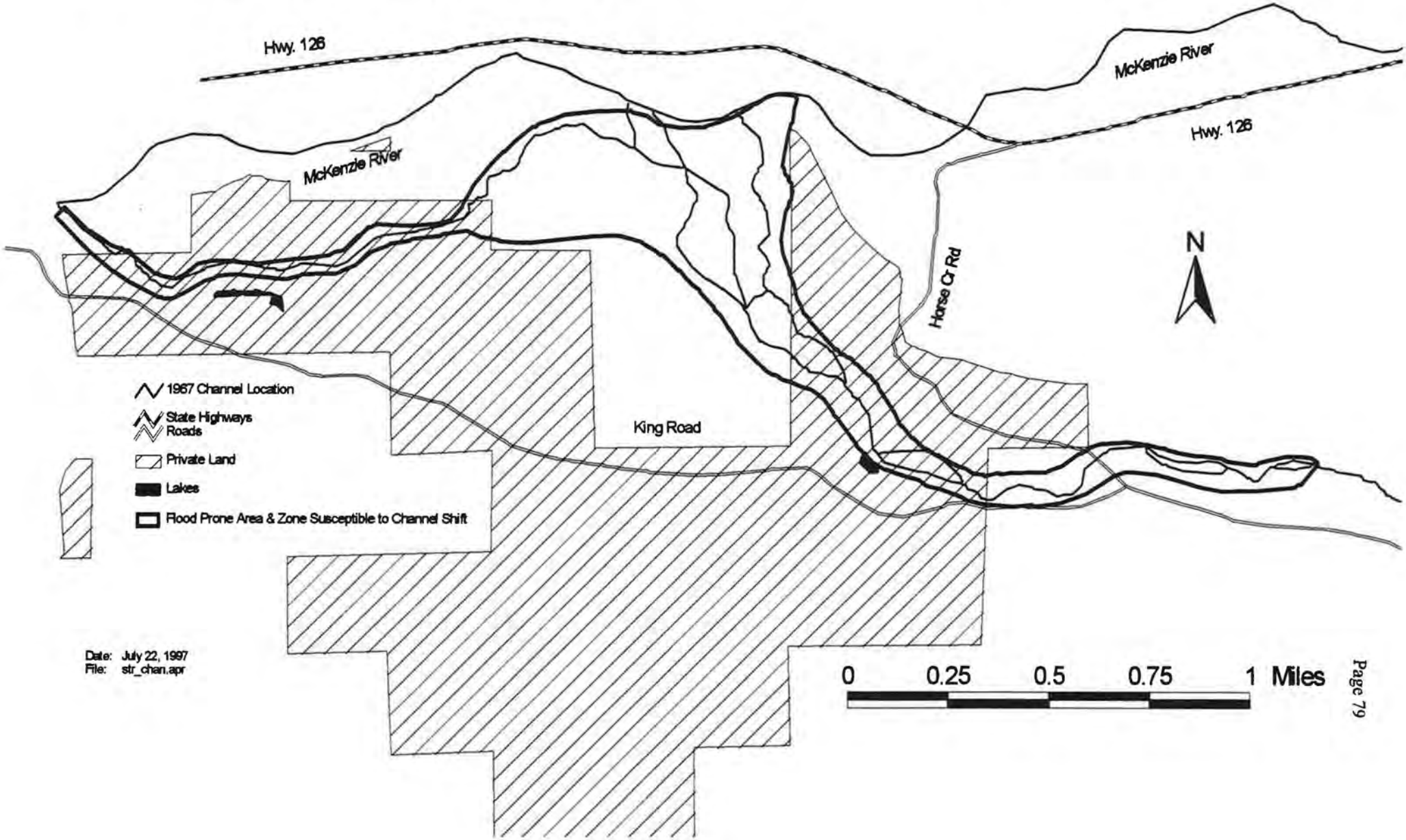
1955 Lower Horse Creek Stream Channel Locations



Map 3-13

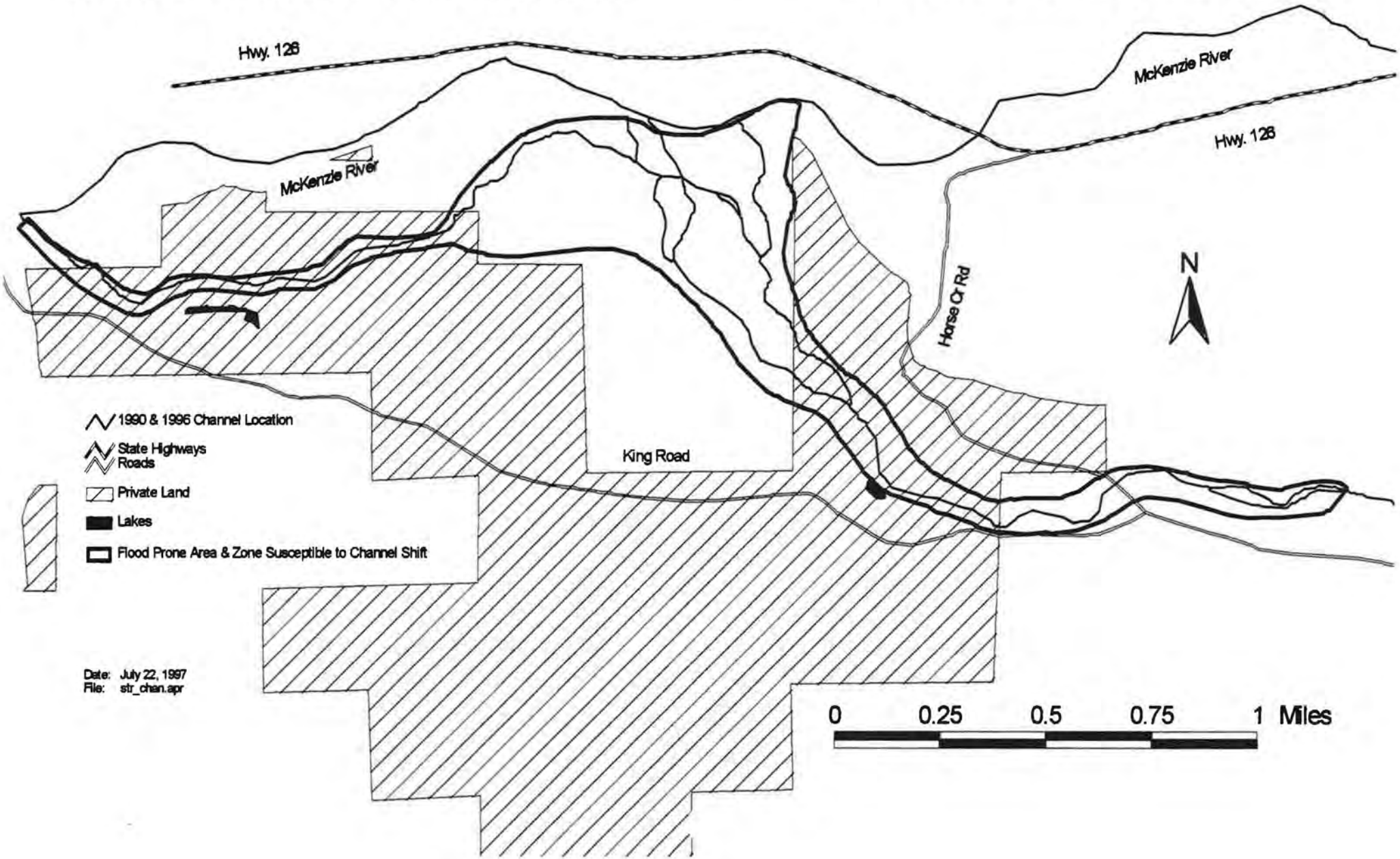
Horse Creek Watershed

1967 Lower Horse Creek Stream Channel Locations



Map 3-14
Horse Creek Watershed

1990 & 1996 Lower Horse Creek Stream Channel Locations



The effects of the 1964 flood on Horse Creek and its tributaries is quite complex. Several tributaries experienced debris torrents, sending massive quantities of sediment down Horse Creek, including Castle Creek, whose stored sediments careened down the channel and into Horse Creek. At least two other tributaries had debris torrents, including an un-named tributary upstream of Roney Creek and Mosquito Creek. All of the stream failures detected on aerial photos occurred in unmanaged stands and were not the result of harvest or road building. Mass-wasting of tributaries as high in the system as Mosquito Creek resulted in many miles of stream length in main Horse Creek being seriously affected by the flood. Riparian vegetation within the U2 segment was wiped out, and sediment was deposited on point bars. However, the U2 segment is more of a "transport" section, sending most of the sediment further downstream to the U-Shaped Glacial Trough and Alluvial Fan "response" sections where large quantities of sediment, particularly cobbles and gravel, were deposited on point bars. Within the U-Shaped Glacial Trough, the channel widened and a high proportion of vegetation on bars and islands was wiped out.

Extensive opening of the channel likely resulted in increased stream temperatures within Horse Creek. Revegetation of accumulated sediments with alder are contributing shade to the channel, helping to reduce stream temperatures. However, temperatures probably remain higher during summer months than prior to the 1964 flood due to lack of shade from tall conifers on islands, mid-channel bars, and point bars.

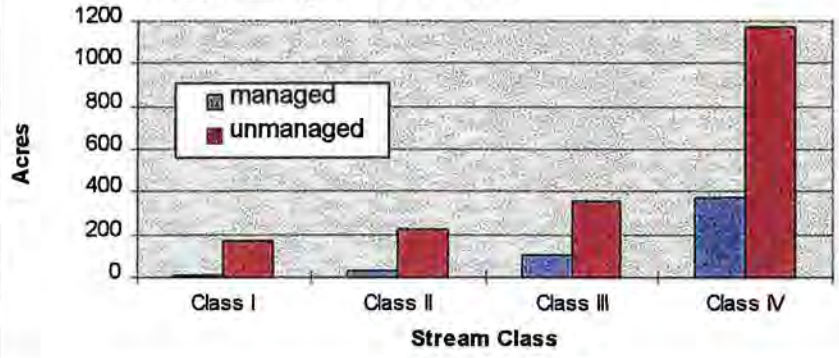
In contrast to the 1964 flood, examination of aerial photos from 1990 and 1996 verify that large-scale channel changes did not occur in the alluvial fan of lower Horse Creek or the U2 segment of Horse Creek during the flood of 1996, a storm with a recurrence interval of approximately 50 years in the upper McKenzie River watershed. Minor changes did occur, however, such as accumulations of large wood into log jams, acceleration and migration of point-bar growth, localized streambank cutting, and shifting of secondary channels to primary channels. Point bars heavily vegetated with alder remained intact for the most part. Wilelada Creek experienced a debris torrent, sending some sediment and wood into Horse Creek. There were several other slides and failures that occurred in association with roads or timber harvest, but most of the sediment from these failures never reached Horse Creek.

Map 3-14 illustrates the area potentially subject to flooding or changes in channel location due to large storm events from Horse Creek Campground down to the confluence with the McKenzie River. This includes the lower Horse Creek floodplain and adjacent zones susceptible to channel shift. This depicts areas prone to flooding or channel location shifts resulting from storm events with a return interval >50-75 years. Note that several residences on the east side of Horse Creek are located within the area potentially subject to flooding.

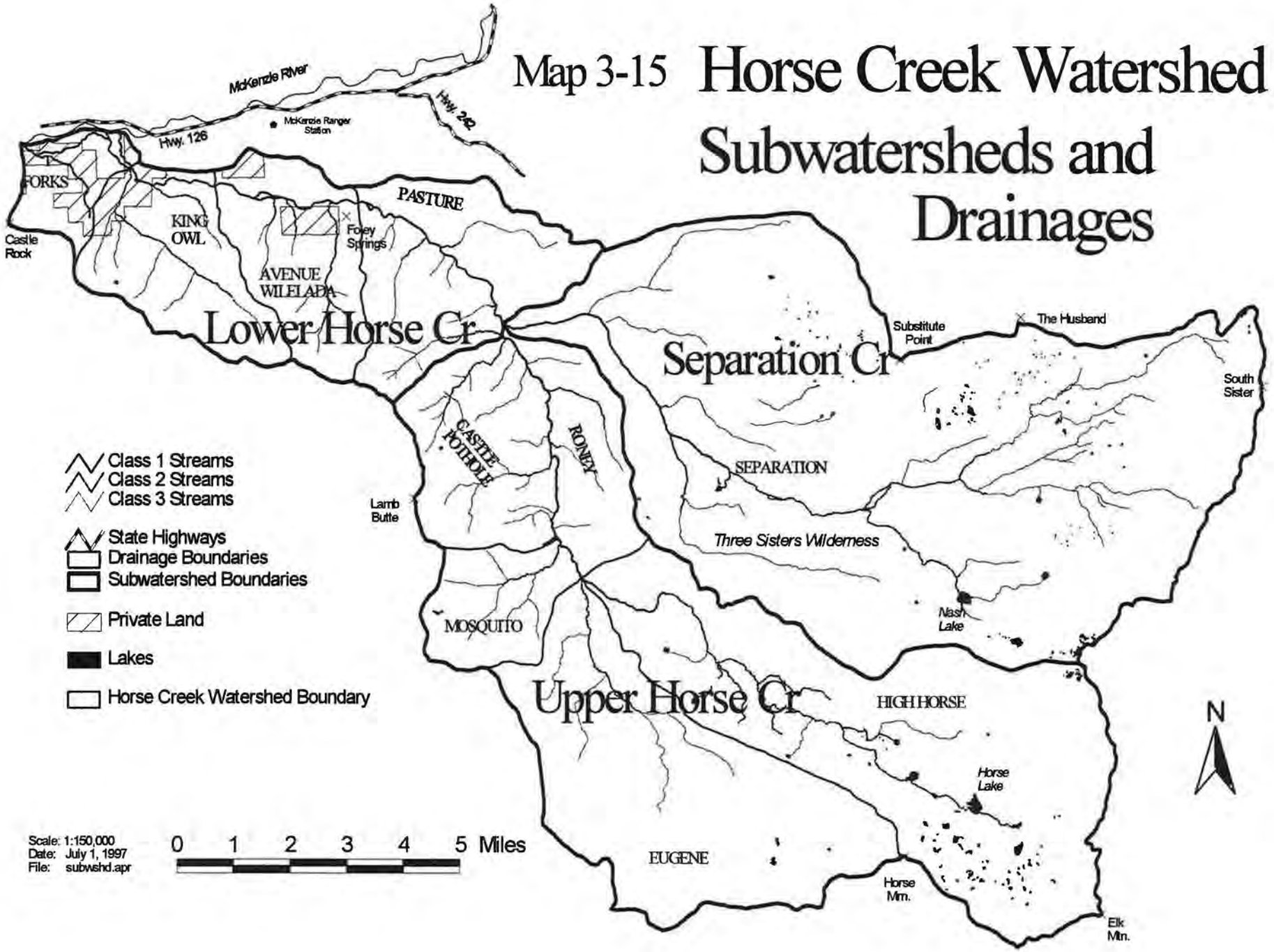
Riparian Area Management

For purposes of display and analysis, the watershed is broken into subwatershed and drainage areas. Map 3-15 shows subwatersheds and drainage boundaries. Managed areas (those that have been harvested and roaded) within this watershed is displayed by subwatershed in the following figures (these do not include private roads). Management within riparian areas and floodplains of Separation and Upper Horse Subwatersheds is relatively low due to the high proportion of their area in wilderness. All of the drainages with greater than 5% of their riparian areas in a managed condition are located in Lower Horse Subwatershed and the Castle/Pothole Drainage (in Upper Horse Subwatershed)(Figure 3-8). Managed acres of riparian areas for drainages within Lower Horse Subwatershed range from 15% in Pasture Drainage to 53% in Forks. Approximately ¼ of the riparian areas in the Castle/Pothole Drainage is in a managed condition.

Figure 3-8: Castle/Pothole Drainage Managed Acres (Roads and Harvest) in Riparian Reserves by Stream Class



Map 3-15 Horse Creek Watershed Subwatersheds and Drainages



Virtually all (90%) of the previously managed riparian area acres in the Forks Drainage are near Class I streams (Figure 3-9). Ninety-nine percent of these managed acres are privately owned. Similar situations occur both in Avenue/Wilelada and King/Owl Drainages, where 38% and 29%, respectively, of Class II riparian areas are in a managed condition and have >3/4 of the riparian areas privately owned (Figures 3-10 and 3-11). The high proportion of managed Class IV riparian areas in the Avenue/Wilelada Drainage (32%) and Castle/Pothole Drainage (24%) reflects the intensity of management within the headwaters of these drainages on Forest Service lands. Within Class III riparian areas of the Pasture Drainage, most of the 29% in a managed condition is within a Class III tributary to Horse Creek located immediately north of Pasture Creek and not within Pasture Creek itself (Figure 3-12).

Figure 3-9: Forks Drainage Managed Acres (Roads & Harvest) in Riparian Reserves by Stream Class

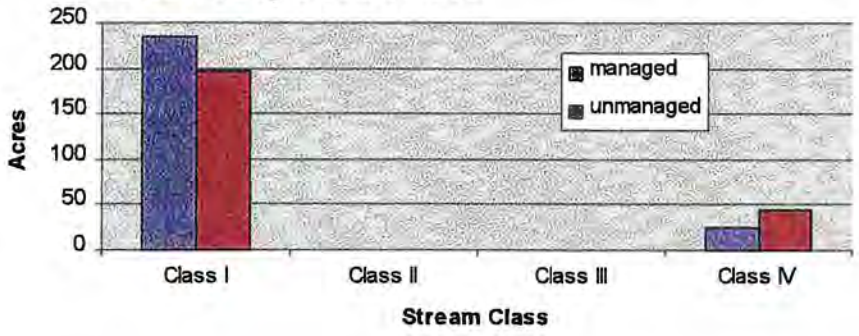


Figure 3-10: Avenue/Wilelada Drainage Managed Acres (Roads and Harvest) in Riparian Reserves by Stream Class

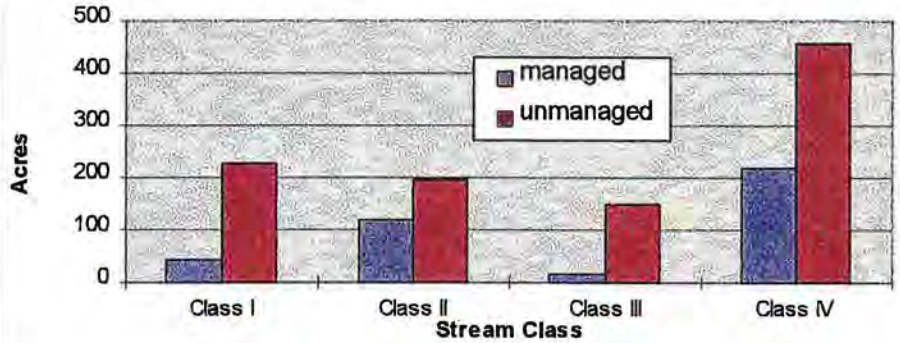


Figure 3-11: King/Owl Drainage Managed Acres (Roads and Harvest) in Riparian Reserves by Stream Class

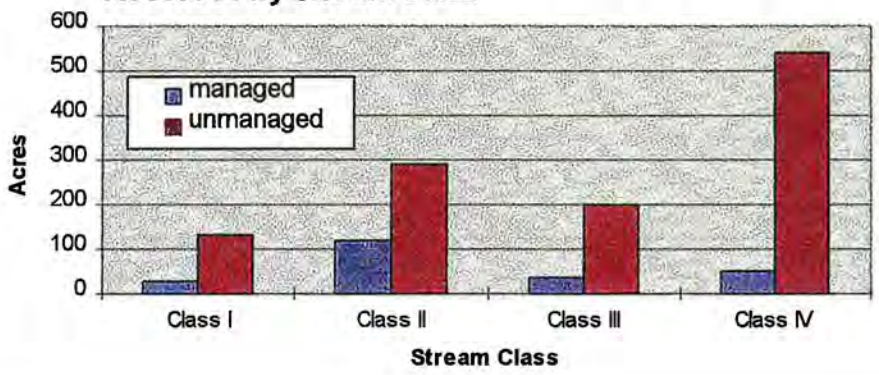
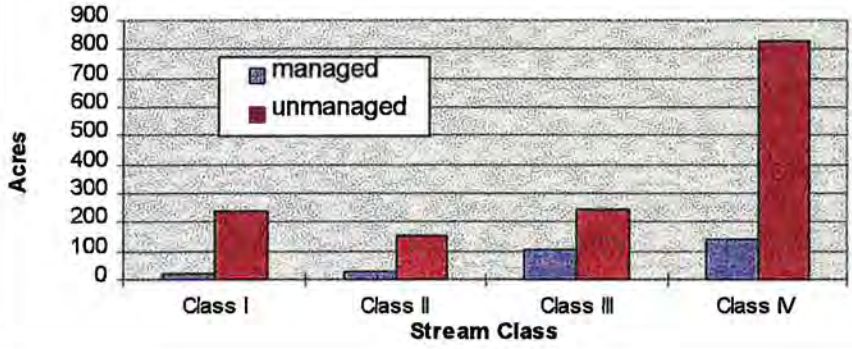
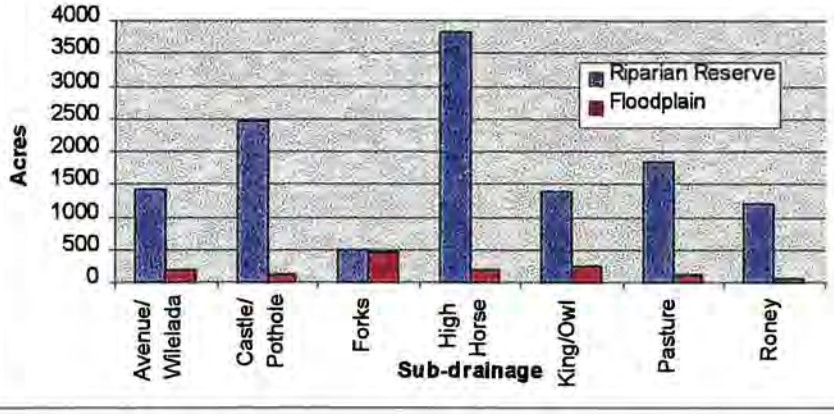


Figure 3-12: Pasture Drainage Managed Acres (Roads and Harvest) in Riparian Reserves by Stream Class



The floodplain of Horse Creek was defined by SRI type 15 and 15W. Management along Class I streams of the drainages in Figure 3-13, and Class II streams of King / Owl, Avenue / Wilelada, and Castle / Pothole drainages should be particularly sensitive to floodplain location.

Figure 3-13: Riparian Reserves vs. Floodplains by Drainage in the Horse Creek Watershed



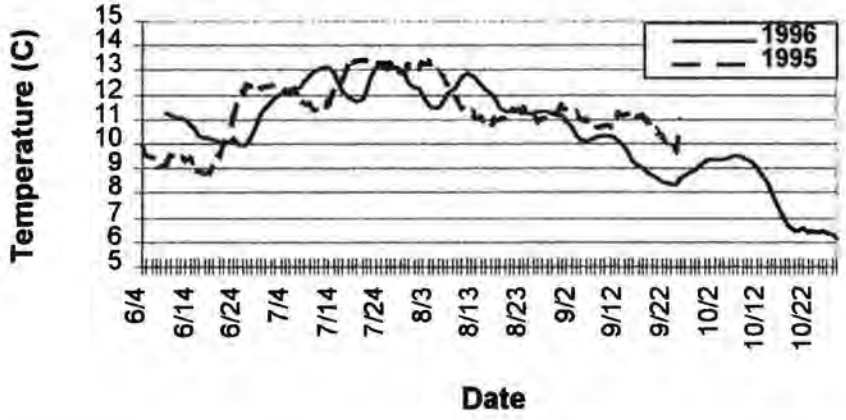
Water Quality - Stream Temperature and Sediment

Stream temperatures within Separation Creek are very cold due to the geology of the area. Springs located at the interface between recent lava flows at the base of South Sister and late high cascade volcanics provide cold, clear water to Separation Creek, making it suitable for bull trout spawning and early rearing in the lower two miles and potentially between river miles 6.0 and 8.0. Stand replacement fires within Separation Creek could increase stream temperatures, although the steeply incised stream channel would topographically provide some shade to the channel.

Horse Creek was listed as water quality impaired for stream temperature on the Oregon Department of Environmental Quality's Draft list of water quality limited streams per Section 303(d) of the Clean Water Act (DEQ 1996). The criteria used for Horse Creek is for bull trout habitat, which requires that the 7-day moving average of the daily maximum stream temperature not exceed 10 deg. C. (50 deg. F). A USFS response to the draft listing (October 1996) requested that the criteria be better defined to require only spawning and rearing habitat to not exceed the 10 deg. C. limit, and that foraging habitat meet other standards for the basin. Bull trout are not known or suspected to spawn in Horse Creek, currently or historically, and we felt that the standard was inappropriate for the use by this species.

Another standard for the basin that is applicable to Horse Creek requires that streams which support salmon spawning, egg incubation and fry emergence, should have the 7-day moving average of the daily maximum temperature not exceed 12.8 deg C. (55 deg F) during times that these activities occur. In Horse Creek, salmon spawning occurs in the fall, beginning in September. Figure 3-14 displays the 7-day moving average of daily maximum stream temperatures for 1995 and 1996. This data indicates that Horse Creek is in compliance with salmonid spawning temperature standards.

Figure 3-14: Horse Cr. Stream Temperatures
7-Day Moving Average of Daily Maximums
1995 & 1996



Separation Creek meets the 10 deg. C. water quality criteria for bull trout habitat established by the DEQ. Currently, there is no continuous temperature data for Separation Creek However, during stream survey work over the course of the summer in 1995, single point temperature measurements in Separation Creek ranged from 6-10 deg C. Historically, intense fire within the valley bottom of Separation Creek removed a substantial amount of the forested stands, reflected in the lack of old growth structure that remains today. These historical disturbances could have resulted in increased stream temperatures.

Glacial terraces and glacio-fluvial deposits located on the steep side slopes of Separation Creek and upper Horse Creek provide much of the sediment to lower Horse Creek. These sediments are generally gravel and cobble size, providing important spawning material. Also, unconsolidated sediment from the west flank of South Sister contributes ash and cinders to the stream channel. Where the potential for high intensity fires exist within upper Horse Creek and Separation Creek, the result could be increased sediment from streamside slides.

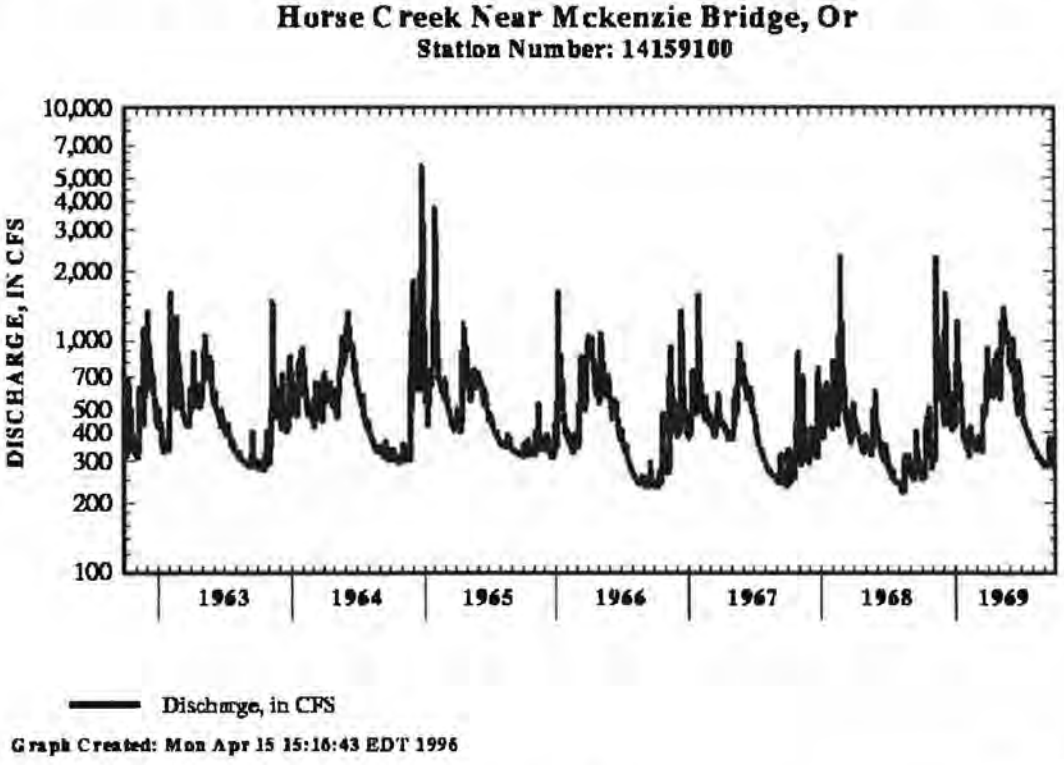
Shallow soils derived from red breccias and tuffs introduce clay-sized sediment into lower Horse Creek when debris slides are initiated in the upper headwaters of Owl, Wilelada, Avenue, Cedar Swamp, and Pasture Creeks. Other tributaries that introduce both fine and coarse sediment include Pasture, Pothole, and Castle Creeks. Some of the fine sediment may deposit into the channel substrate and along the channel margins of Horse Creek, particularly if stream flows are not sufficient to transport the fines out of the Horse Creek watershed. Deposition of most fines is likely to occur within the lower

alluvial fan of Horse Creek, where the stream enters the McKenzie River Valley, and within side channels and secondary channels. Debris slides that initiate within the tributary headwaters are the result of large storm events, fire, roads, and harvest units.

Hydrology and Peak Flows

Discharge measurements are available from 1963-1969 on Horse Creek. Data is available through the USGS and the daily average discharge is displayed below (Figure 3-15).

Figure 3-15: Daily average discharge from Horse Creek from 1963-1969.



Daily average flows for summer during the period of record (1963-1969) ranged from approximately 250 to 300 cfs, while peak flows ranged from 1,600 to 2,500 cfs. Daily average flows during the 1964 flood reached 6,000 cfs, while the average daily maximum flow was 14,000 cfs.

Precipitation within the Horse Creek Watershed is dominated by snow, with rain and rain-on-snow events occurring at lower elevations in approximately 1/4-1/3 of the total watershed area. Map 3-16 displays the potential contributing areas to rain-on-snow within this watershed. The steep, south-facing slopes of Foley Ridge are the most vulnerable to rain-on-snow events due to the location within the transient snow zone, and the aspect. North-northeast aspects of Olallie Ridge protect the slopes from the

south-southwest driven warm rains. However, steep slopes coupled with shallow soils make these slopes prone to debris slides and debris flows. The majority of the wilderness area is located within the permanent snow zone, resulting in a low probability for rain-on-snow events.

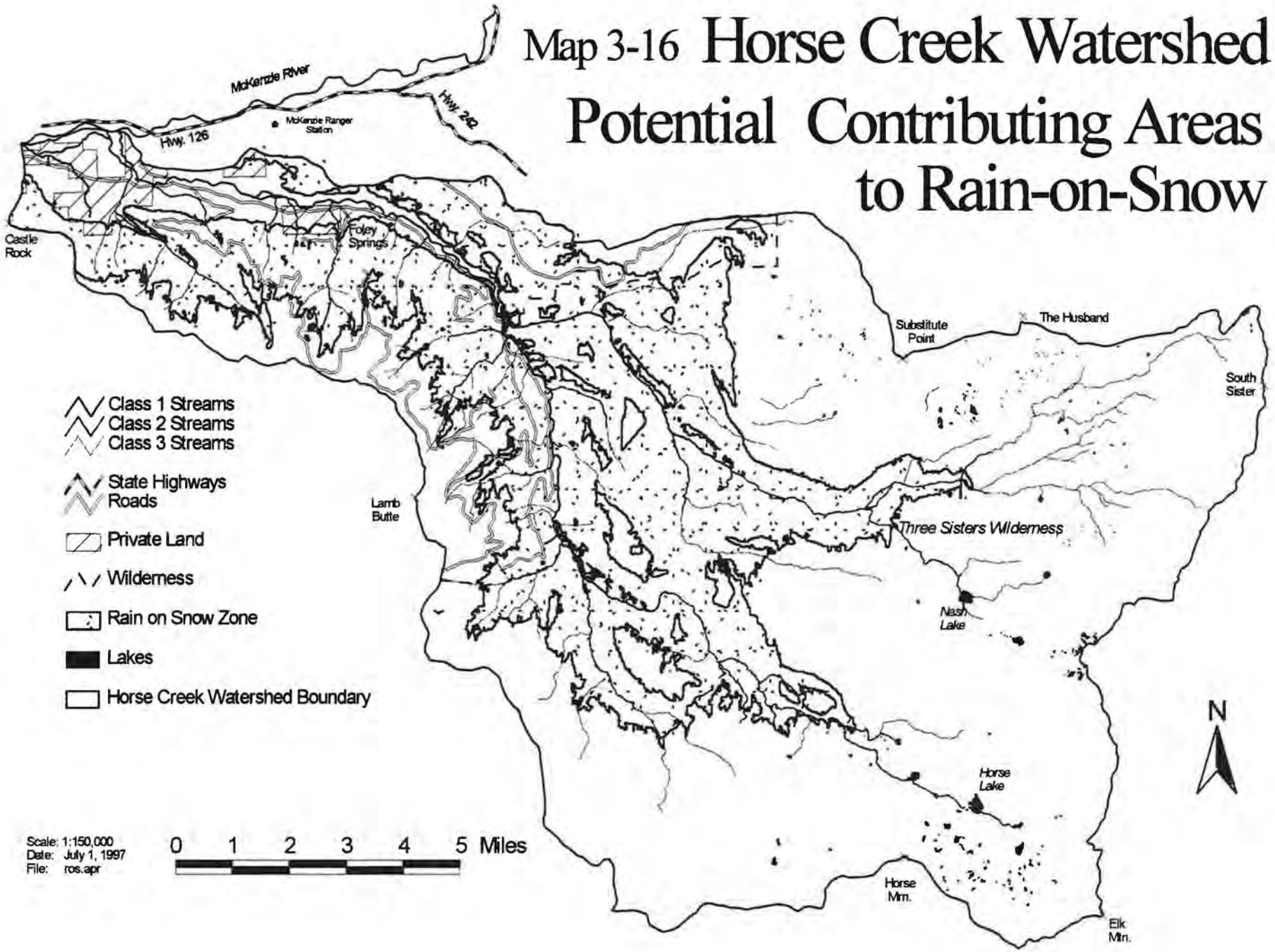
Peak streamflows may occur as a result of rain events or rain-on-snow events. They cause transport of large channel substrate, channel widening, bank erosion, and deposition of substrate that provides a medium for early seral riparian vegetation. Forest management may cause increases in peak flows. In a large basin study on peak flow responses to clearcutting on the Willamette National Forest (Wemple et al. 1996) found that watersheds ranging in size from 15,000 to 150,000 acres had increased peak discharges as the cumulative area of harvest and road construction increased. However, the increase in peaks was for storm events that produced discharges with <2 year return intervals. While it is apparent that small peak discharges are increased with management, there is no evidence that large peak discharges are increased. It is unclear what the effects of increased peak flows of <2 year return interval are on stream channel conditions and aquatic habitat. Possible effects are increased bank erosion and transport of larger bedload than is typical during bankfull flows.

Hydrologic recovery of a watershed determines the extent to which peak discharges may be increased. A relative measure of the hydrologic recovery used by the Willamette National Forest is the Aggregate Recovery Percentage (ARP). This is the percent of the watershed considered to have large enough trees to intercept and hold snow within their canopies. Table 3-7 displays the ARP value by subwatershed and drainage. In addition, the table displays the mid-point ARP value taken from the WNF LMP. The midpoint ARP value was determined at the subwatershed level, and is based on landtype sensitivity and beneficial uses. Midpoint ARP values may increase or decrease depending on channel conditions.

Table 3-7: ARP Values for Horse Creek Watershed by subwatershed and drainage.

SUBWATERSHED NUMBER	SUBWATERSHED NAME	DRAINAGE NAME	CURRENT ARP VALUE	MIDPOINT ARP VALUE
14-1	Lower Horse Cr.		91	70-75 (75-80*)
		Avenue/ Wilelada	86	
		Forks	96	
		King/Owl	97	
		Pasture	89	
14-2	Upper Horse Cr.		97	70-80
		Castle/ Pothole	86	

Map 3-16 Horse Creek Watershed Potential Contributing Areas to Rain-on-Snow



SUBWATERSHED NUMBER	SUBWATERSHED NAME	DRAINAGE NAME	CURRENT ARP VALUE	MIDPOINT ARP VALUE
		Eugene	100	
		High Horse	100	
		Mosquito	97	
		Roney	100	
14-3	Separation Cr.		99	65 (70-75*)
		Separation	99	

*See Text below: recommended new ranges.

The table demonstrates that ARP values for Horse Creek Watershed are well above the Midpoint ARP values. However, two of the Midpoint ARP values should be updated due to additional information gained since the LMP was finalized in 1990. The Midpoint ARP value for Lower Horse subwatershed was based on a landtype sensitivity of moderate value. The landtype sensitivity is based on the amount of area in the rain-on-snow zone and steepness of slope. Map 3-16, which displays rain on snow areas, indicates that Lower Horse subwatershed is a high contributing area to rain-on-snow. In addition, many slopes in the subwatershed are >70%. Therefore, the Midpoint ARP value for Lower Horse subwatershed should be 75-80 due to a high landtype sensitivity and high beneficial use of anadromous fish. The second Midpoint ARP that should be changed is Separation Creek. We have since learned that Separation Creek is bull trout habitat, and therefore should have a high beneficial use. Currently, the beneficial use is moderate. The new rating to high would result in a Midpoint ARP at a value of 70-75.

Increases in small peak streamflows within the watershed may have occurred in the past when hydrologic recovery of the drainages was lower. However, effects of the increases are likely masked by the effects of mass failures in the form of debris torrents, streamside slides, and road failures that occur with large storm events such as the 1964 and 1996 floods. Although a complete reconnaissance of the watershed has not been completed since the flood of 1996, initial data suggests most slides originated at roads or within harvest units.

Roads have been documented to increase small peak flows by increasing their efficiency and extending the drainage network of a watershed (Jones and Grant 1996). Table 3-8 displays the road density of the watershed by subwatershed and drainage. Though none exceed 3.0 miles/mile^2, two drainages, Avenue/Wilelada and Castle/Pothole, may experience increased peak flows due to road densities, steep slopes, and shallow soils. Three drainages, Eugene, High Horse, and Roney, do not have any roads within their drainages and are not displayed in the table.

Table 3-8: Road densities in Horse Creek Watershed by subwatershed and drainage.

SUBWATERSHED NAME	DRAINAGE NAME	ROAD DENSITY (miles/mile²)
Lower Horse Cr.		2.3
	Avenue/Wilelada	2.6
	Forks	2.0
	King/Owl	1.5
	Pasture	2.6
Upper Horse Cr.		0.4
	Castle/Pothole	2.3
	Mosquito	0.7
Separation Cr.		0.1
	Separation	0.1

OVERVIEW OF FISHERIES

Habitat Conditions - Streams

In 1937, U.S. Bureau of Fisheries biologists Baltzo, Kolloen, and Parkhurst surveyed the lower 11.1 miles of Horse Creek and the first 2.4 miles of Separation Creek to document the quantity and quality of anadromous fish habitat (McIntosh et al. 1995). This was part of a larger effort to document anadromous fish habitat in the Columbia River Basin. They described the stream as flowing through a flat bottom valley 2-3 miles wide near its mouth, but varying from only ¼ to ½ mile in width above the lower 2.5 miles. The valley was bordered by moderately steep hills at its downstream end, but the topography becomes mountainous and the valley walls increasingly steep upstream.

They described the watershed as being heavily wooded with large conifers. The undergrowth was moderate on the hill slopes, but the flat valley floor was described as filled with a damp jungle and huge cedars. They did not observe any erosion of the surrounding hillsides into the stream. The bank of the stream was covered with a dense jungle of vine maple, alder, cedar and brush which hung over the water, providing cover and food for fish. Throughout the lowest 5 miles of Horse Creek, the stream flowed through an intricate network of cross-connecting channels which constantly shifted with each high water. The low, flat banks permitted much of the valley to be flooded at high water stages, and the resultant erosion made the water turbid after heavy rains. They described the country above the confluence with

Separation Creek as being rough and mountainous. In Horse Creek, the Bureau of Fisheries surveyors observed few large pools (>20m^2 and > 1 m deep), but saw numerous small ones. Twelve large pools per mile were documented. The surveyors considered Horse Creek capable of supporting a very large run of salmon.

The first 2.4 miles of Separation Creek was also surveyed by the Bureau of Fisheries (McIntosh et. al 1995) in the same time period. The dominant stream bed substrate here was large cobble. The banks were described as being very steep and vegetated by conifers with occasional willows and ferns. The stream was also described as steep, with few resting pools. Glacial silt was documented suspended in the water.

Oregon Fish and Game Commission and U.S. Forest Service survey reports since 1965 have documented removal of large wood, logging and road-related slides, and harvesting of riparian areas along tributary streams. An Oregon Fish and Game Commission Annual Report (1965) documents cleanup after the 1964 flood which consisted of stream channelization and rip-rapping, and removal of in-stream wood. The flood damage to the road in the Horse Creek flood plain which paralleled the creek necessitated the building of a new road, further up slope and out of the flood plain. Meeting notes from a U.S. Forest Service/Oregon Fish and Game Commission field trip (1972) recommend the removal of a large log jam approximately 1 mile upstream of the Separation Creek confluence. A similar log jam was described in this location in the 1937-8 survey (McIntosh 1995). Also, it was agreed to pull large wood out of the stream just above Horse Creek Bridge. Although these efforts sent fiber to the mills, the work was also thought at the time to be necessary to facilitate passage of upstream migrating fish.

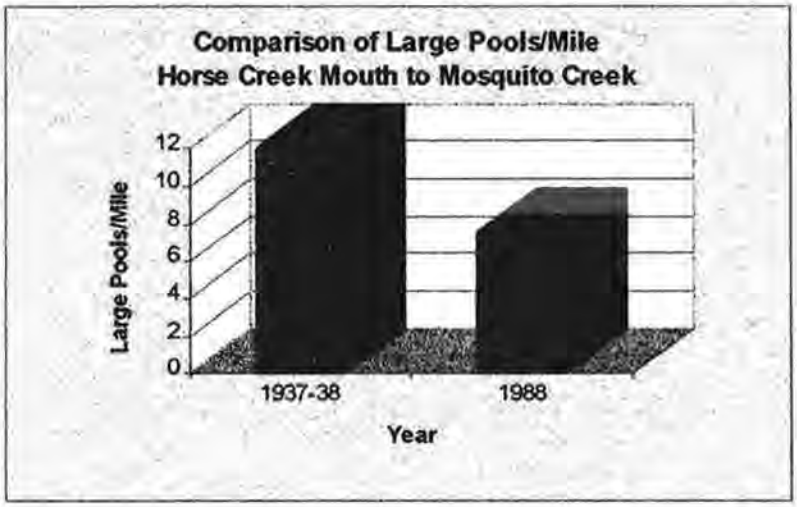
U.S. Forest Service stream biologists Heller and Baker surveyed Horse Creek in 1974 (Willamette National Forest 1974) and described a gently-graded stream which drains a broad, open valley. Below Separation Creek, the stream channel is broad and well defined, and is dominated by swift riffle and white water reaches. The stream bottom is composed of large cobbles and boulders. They reported the deposition of sand and gravel predominantly in active flood plain areas, in secondary channels or intermittent stream channels, and behind large log jams. A number of past mass movements of side-cast waste have added to the stream's sediment load. The riparian area of Horse Creek consists of alder, big-leaf maple, vine maple, cottonwood, and old-growth conifers except for the area along the old road, short sections of the new road, and some dispersed camping sites along the creek.

Oregon State University surveyed Horse Creek in 1988 and observed 7 large pools per mile (>20m^2 and > 1 m deep). This is a 38% decrease in the amount of large pools from its mouth to its confluence with Mosquito Creek since the 1937-8 survey (Sedell et al. 1992). This is not likely due to silting in of pools as much as the simplification of the stream channel during the 1964 flood. The removal of large wood from the channel following the flood may have also been a factor in the decline in large pools in Horse

Creek over this time period. Other factors which may have contributed to the loss of large pools include loss of side channel development and increased bedload movement particularly boulder material which helps in pool formation.

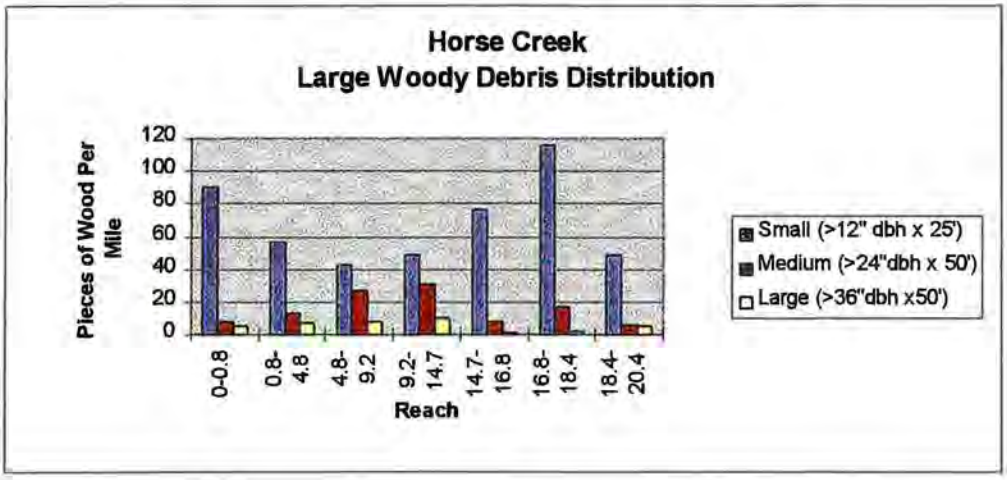
Horse Creek was surveyed by the U.S. Forest Service in 1996. It is a Class I stream up to River Mile 16.8, which is approximately 0.8 miles above the Horse Creek-Eugene Creek confluence, and is a Class II stream above that point. Horse Creek is considered a low to moderate gradient stream (1-7%) with little sinuosity and a riffle/pool ratio of 73:12. A comparison of large pools per mile in Horse Creek is provided in Figure 3-16, covering the years 1937-38 and 1988.

Figure 3-16: Comparison of large pools per mile in Horse Creek.



A delta area, alluvial fan, located in the first 0.5 miles of Horse Creek has significant side channel development which provides excellent spawning and rearing areas for spring chinook salmon. Side channels constituted 14% of the habitat in Horse Creek as recorded by surveyors in 1996. These side channels have been documented as providing rearing, high flow refugia, and in some cases spawning habitat for the fisheries resources of Horse Creek. Substrate is dominated by cobbles while small boulders are the subdominant substrate type. Cobble embeddedness ranged from 0 to 40% in the 1996 survey. Stream canopy shading ranged from 2 to 93% and averaged 49%. The average diameter of tree at breast height (DBH) for conifers in the riparian area was 8 to greater than 32 inches. Instream large woody debris was mainly in the small size class with low amounts in the medium and large classes (Figure 3-17).

Figure 3-17: 1996 Large woody debris distribution in Horse Creek.



Large woody debris (LWD) distribution between non-wilderness (RM 0.0-15) and wilderness (RM 15-21) areas has some differences. In the non-wilderness area of Horse Creek, LWD in the medium and large size classes occur at a higher frequency than in the wilderness area. Conversely, LWD in the small size class occurs at a higher frequency in the wilderness area as compared to the non-wilderness area. The variance in elevation, topography, geology, fire history, and forest management between the two areas is a possible explanation for the types of LWD distribution.

In the 1990's, the U.S. Forest Service surveyed many tributaries of Horse Creek. Of those surveyed, Mosquito, Separation, and Roney Creeks occur partially or completely in wilderness.

Horse Creek Tributaries

The following narratives on tributary streams (moving upstream from Horse Creek's confluence with the McKenzie River) are presented with the most recent Willamette National Forest stream survey data. The 1975 Information presented is cursory, generally of short stream lengths, and reported numbers are from visual estimations.

King Creek was surveyed by the U.S. Forest Service in 1992. It is a Class II stream with the lower 0.5 miles on private land and the upper 2.4 miles on National Forest land. King Creek enters Horse Creek at River Mile 2.5, is considered a moderate to high gradient stream (3-15%) with little sinuosity and a riffle/pool ratio of 64:22. Cobble is the dominant substrate with small boulder and gravel the subdominant types. Gravel was noted in all habitat units, primarily riffles and pool tailouts. Cobble embeddedness ranged from 10 to 75%. Stream canopy shading ranged from 20 to 90%.

Conifers in the riparian area had a DBH of 8 to 32 inches. Instream large woody debris consisted largely of small size class (diameter >12 inches at 25 feet from large end) with low to moderate amounts in the medium size class (diameter >24 inches at 50 feet from large end) and very few in the large size class (diameter >36 inches at 50 feet from large end) (Figure 3-18). Fish species observed during a biological survey included cutthroat trout adults and juveniles. No other species were observed.

A prior survey by U.S. Forest Service biologist Armantrout and Shula in 1975 of 0.7 miles of King Creek recorded a flat bottomed valley with steep side slopes and a riffle/pool ratio of 50:40. The substrate was dominated by boulders and cobbles with fair amounts of spawning or gravel-size substrate subdominant. Stream side cover was considered good. They documented a good population of cutthroat trout with fish up to nine inches.

Wilelada Creek was surveyed by the U.S. Forest Service in 1991. It is a Class II stream entirely on National Forest land and enters Horse Creek at River Mile 5.5. It is a high gradient stream (13-29%) with little sinuosity and a riffle/pool ratio of 64:14. Cobble and small boulders are the dominant substrate with gravel being the subdominant type. Cobble embeddedness ranged from 0 to 35%. Stream canopy shading ranged from 0 to 50%. Conifers in the riparian zone had a DBH range of 8 to 21 inches. Instream large woody debris in all sizes classes was low (Figure 3-19). This stream was found to go subsurface in an alluvium deposit near the mouth. Cutthroat trout were the only fish species documented during a biological survey of Wilelada Creek.

A survey by U.S. Forest Service biologist Armantrout and Shula in 1975 of 0.1 mile of Wilelada Creek near the confluence of Horse Creek documented a heavily silted stream with its west bank logged (USFS land) to the streambank. Frequent bank failure was observed and logging debris was common in the channel. The stream was found to fork near the confluence with Horse Creek, having lost its flow in the alluvium at the mouth. Wilelada Creek had an estimated riffle/pool ratio of 50:40, with cobble the dominant substrate and gravel subdominant. The 1991 survey also recorded a 200 foot dry channel at the confluence.

Avenue Creek was surveyed by the U.S. Forest Service in 1990. It enters Horse Creek at River Mile 6.0 and is considered a Class II stream for its first 2.4 miles while the upper 1.0 mile is Class III. The lower mile is on private land and the remaining 2.4 miles are on National Forest land. Avenue Creek is a high gradient stream (6-39%) with little sinuosity and a riffle/pool ratio of 93:2. Cobble and small boulder are the dominant substrate types with gravel being the subdominant type. Cobble embeddedness ranged from 0 to 5%. Stream canopy shading ranged from 5 to 70%. Conifers in the riparian area had a DBH of 8 to 32 inches. Instream woody debris consisted largely of the small size class with low amounts in the medium and large

size classes (Figure 3-20). Cutthroat trout were the only fish species documented during a biological survey on Avenue Creek.

A prior survey by U.S. Forest Service biologist Armantrout and Shula in 1975 of 0.6 miles of Avenue Creek recorded an unstable, flat bottomed canyon consisting of rock and alluvium. The stream channel has cut through this material to expose large cobble and boulders with many cascades and falls to 4 feet. The stream had an estimated riffle/pool ratio of 45:40, with boulder the dominant substrate and cobble subdominant. Erosion was common along roads and logging areas. Cutthroat trout were observed throughout the 0.6 miles.

Pasture Creek was surveyed by the U.S. Forest Service in 1995. It is a Class II stream which lies entirely on National Forest land and enters Horse Creek at River Mile 10.9. Pasture Creek is a high gradient stream (14-23%) with little to no sinuosity and a riffle/pool ratio of 72:9. Cobble and small boulders are the dominant substrate type with significant areas of bedrock. Cobble and gravel are the primary subdominant substrates. Cobble embeddedness ranged from 10 to 60%. Stream canopy shading averaged 50%. The average DBH of the conifers in the riparian area was 32 inches. Instream large woody debris consists mostly of the small size class with low frequencies of wood in the medium and large size classes (Figure 3-21). This is likely the result of the high gradient stream channel and occurrences of debris torrents in the drainage. Cutthroat and rainbow trout were noted during a biological survey of Pasture Creek. Spring chinook juveniles area suspected to forage and rear in the lower reaches of the creek.

Pasture Creek passed through a seven foot diameter culvert under Road 2638 (Horse Creek Road) near its confluence with Horse Creek. This culvert was considered a passage barrier to native rainbow and cutthroat trout as well as rearing spring chinook juveniles because of high velocities in the culvert and the lack of a sufficient jump height to enter the culvert. In 1996 the existing culvert was removed and replaced with a 15 foot by 8 foot open bottomed arch culvert. This type of culvert uses the existing stream channel to allow for upstream fish passage. The new culvert now provides access to nearly 2.0 miles of historic spawning, rearing and foraging habitat.

A survey by U.S. Forest Service biologists Aramantrout and Shula in 1975 of 0.6 miles of Pasture Creek documented a fairly narrow canyon with steep rocky slopes. Cobble and boulders dominated the stream channel with cascades and falls to 4 feet and numerous pools up to 5 feet deep. The estimated riffle/pool ratio was 60:30. Cutthroat trout up to 8 inches were observed.

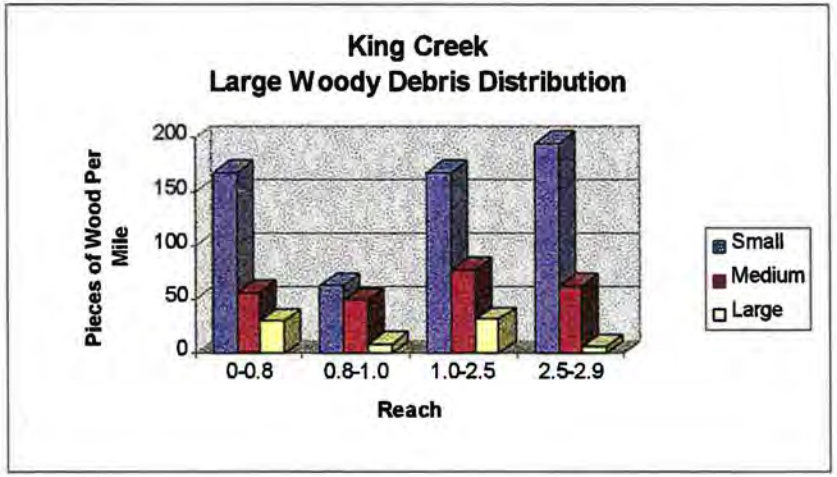
Separation Creek was surveyed by U.S. Forest Service in 1995. It enters Horse Creek at river mile 10.8. It is considered a Class I stream for its first 6 miles, and an extensive network of Class II, III and IV channels are located upstream of that reach. Stream

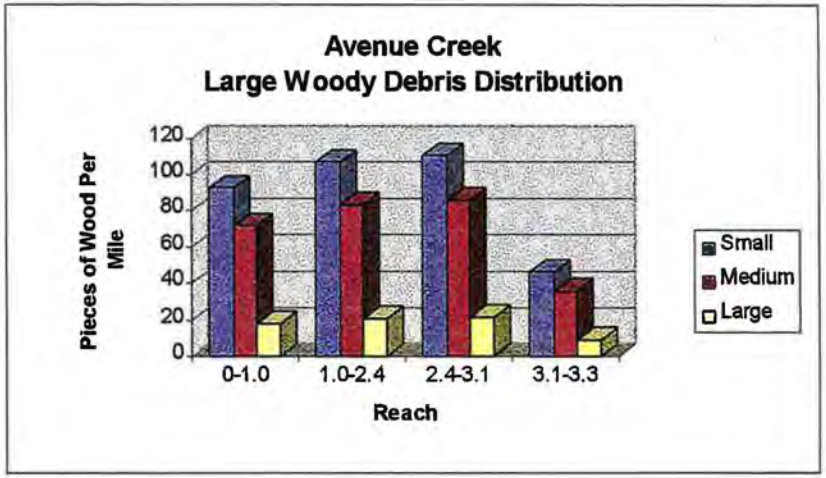
substrate consists mainly of small boulder and cobble, with gravels settling out in tail-outs of pocket pools and in side channels. No cobble embeddedness was observed. Bank cutting is infrequent due to large substrates, high plant density, good root mass, and relatively constant flows. Conifers dominate the riparian area, with hardwoods closer to the stream banks. Stream shade canopy ranged from 75-85%. The surrounding forest supplies a good amount of wood to the creek, mainly in small sizes (with a diameter >12 inches and a length >25 feet). The medium (with a diameter >24 inches and length >50 feet) and large (diameter >36 inches and length > 50 feet) size wood are infrequent (Figure 3-22). A large proportion of the conifers surrounding the stream are reaching the medium diameter size and, barring a wildfire, will likely substantially add to this in-stream wood size class in the short term. A biological survey of Separation Creek documented cutthroat and rainbow trout, mountain whitefish, and sculpins.

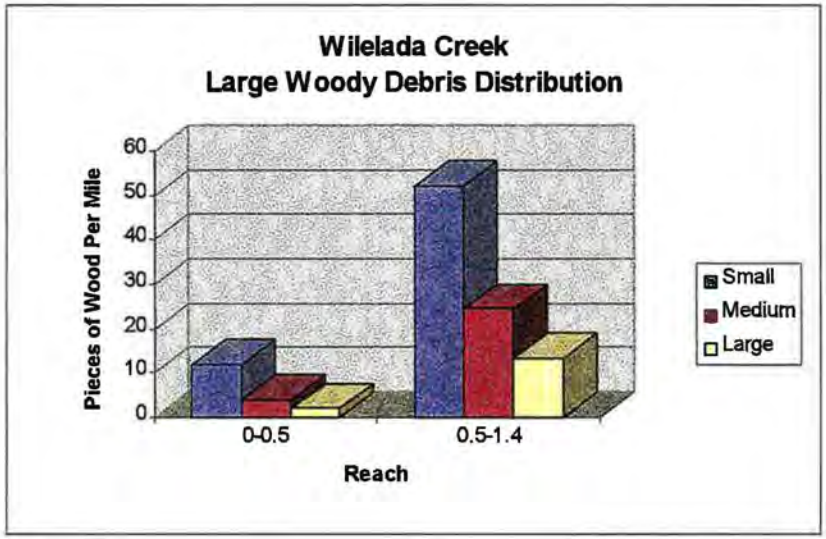
Chinook salmon, bull trout, rainbow trout, cutthroat trout, brook trout, mountain whitefish, and sculpin are the fish species that inhabit Separation Creek. Tailed frogs and Pacific giant salamanders were also observed during biological surveys (Willamette National Forest 1995b). An upstream migration barrier was identified 6 miles from its mouth. Above this point, brook trout (introduced into Nash Lake and now naturally reproducing) and cutthroat trout have been observed. Since this stream originates from Eugene, Lost Creek, and Skinner glaciers on the South Sister, it is extremely cold. It maintains relatively constant flows throughout the year due to significant amount of spring-fed flow originating from tributaries in upper Separation Creek. These tributaries are Mesa, James, and Hinton Creeks. Spawning gravels are not embedded. These qualities make Separation Creek suitable bull trout spawning and early rearing habitat. Currently there are 2.0 miles of known suitable spawning habitat in Lower Separation Creek.

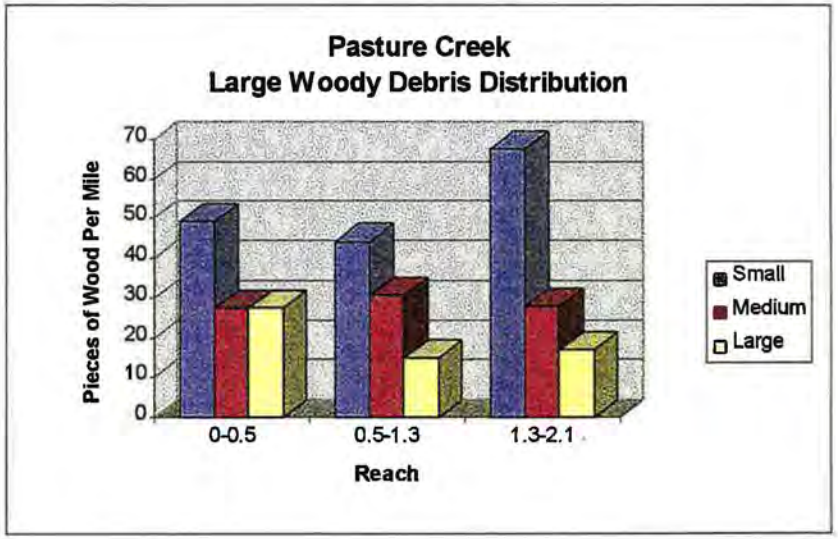
It is suspected that an additional 2.0 miles of spawning and rearing habitat occurs between river miles 6.0 and 8.0. Whitefish and sculpin are probably the main forage for the bull trout as they mature. They may also feed on the salmon fry produced from the few salmon redds excavated in Separation Creek each year. Pools in Separation Creek are deep, providing good rearing and holding habitat. In-stream wood provides good cover.

Figures 3-18 through 3-21: Large woody debris distributions for Horse Creek tributaries.



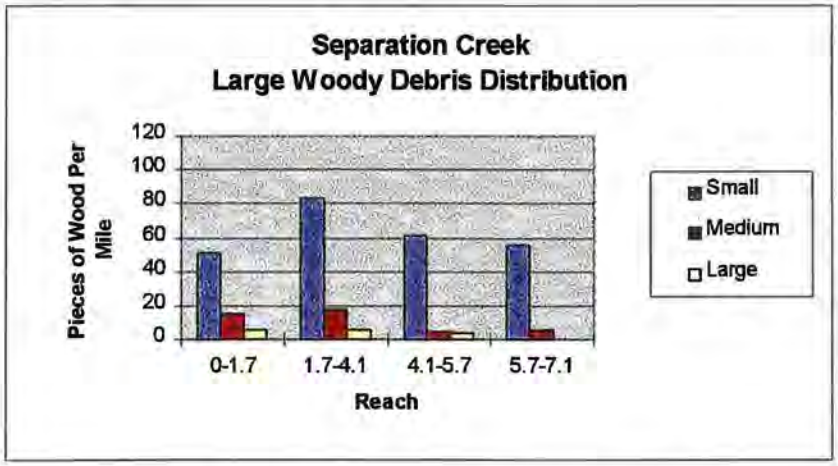






Biological probes of lower Separation Creek and Harvey Creek, a tributary stream, were conducted by biologists from the U.S. Forest Service and Oregon Department of Fish and Wildlife. These probes were conducted to determine bull trout use of these creeks. Results from the probes did not document bull trout presence but did identify areas of suitable spawning and rearing habitat. Fish species observed during the probes include rainbow and cutthroat trout and sculpin.

Figure 3-22: 1995 Large woody debris distribution in Separation Creek.



Castle Creek was surveyed by the U.S. Forest Service in 1991. It is a Class II stream for the first 1.6 miles and then is classified as a Class III stream for the remaining 1.1 miles. Castle Creek enters Horse Creek at River Mile 11.1 and is considered a high gradient stream (7-28%) with little sinuosity and a riffle/pool ratio of 66:11. Small boulders and cobble are the dominant substrate types with gravel being the subdominant substrate. Cobble embeddedness averaged 35%. Stream canopy shading ranged between 61 and 100%. The average DBH of the conifers in the riparian area was 8 to 21 inches. Instream large woody debris was fairly evenly distributed among the size classes (small, medium, and large). All size classes increased in frequency as surveyors progressed upstream (Figure 3-23). Cutthroat trout were the only fish species observed during a biological survey of Castle Creek.

Castle Creek passed through a seven foot diameter culvert under Road 2638 approximately 0.1 miles upstream from its confluence with Horse Creek. This culvert was considered a passage barrier to native rainbow and cutthroat trout as well as rearing juvenile spring chinook. Velocities in the culvert were measured in excess of 15 feet per second. In 1994 a 10 foot diameter culvert, pre-fit with weirs, was installed to the north of the existing culvert. The new culvert was positioned to accept the majority of Castle Creeks flow during most of the year. The existing seven foot diameter culvert was left in place to accept flow during extreme high flow events. The new culvert was

designed to provide upstream passage for rainbow and cutthroat trout and juvenile spring chinook. The new culvert now provides access to approximately 3.0 miles of historic spawning, rearing, and foraging habitat.

A prior survey by U.S. Forest Service biologists Armantrout and Shula in 1975 of 0.8 miles of Castle Creek described a stream with old growth Douglas fir and hemlock above the active stream margins. Castle Creek had an observed riffle/pool ratio of 65:35 with cobble being the dominant substrate and gravel the subdominant. The stream had unstable banks with significant areas of erosion. Mass failures and a very high potential for mass failures were observed. Cutthroat trout to 8 inches were observed during the survey.

Roney Creek was surveyed by the U.S. Forest Service in 1996. It is a Class II stream which is entirely within the Three Sisters Wilderness Area and enters Horse Creek at River Mile 12.3. It is a high gradient stream with very little sinuosity and a riffle/pool ratio of 76:8. Small boulder is the dominant substrate while cobble is the subdominant type. Gravel was noted in all habitat units and ranged from 10 to 70% of the total substrate composition. Cobble embeddedness ranged from 0 to 50%. Stream canopy shading ranged from 55% to 86%, average 73%. Conifers in the riparian area had a DBH of 8 to 32 inches. Instream large woody debris consisted primarily of the small size class with little to no material in the medium and large size classes (Figure 3-24). Cutthroat trout to six inches were the only fish species observed during a biological survey of Roney Creek. No other surveys of this stream have been conducted.

Pothole Creek was surveyed by the U.S. Forest Service in 1995. It is a Class II stream occurring entirely on National Forest land. Pothole Creek enters Horse Creek at River Mile 13.5 and is considered to be a high gradient stream (6-25%) with little sinuosity and a riffle/pool ratio of 72:8. Cobble and gravel are the dominant substrate types with cobble also occurring as the subdominant substrate. Cobble embeddedness was absent in the creek. The average DBH of conifers in the riparian area was 8 to 32 inches. Instream large woody debris was primarily in the small size class with little to no wood in the medium and large classes (Figure 3-25). The only fish species observed during a biological survey of Pothole Creek was cutthroat trout. A man-made barrier exists on Pothole Creek in the form of a culvert under Horse Creek Road. Plans to improve fish passage through the culvert are scheduled for 1998 or 1999.

A prior survey by U.S. Forest Service biologists Armantrout and Shula in 1975 of 0.8 miles of Pothole Creek documented a well shaded stream in a flat bottomed, steep walled canyon. Stream channel consisted of cobble (dominant) and boulders (subdominant) with log jam/alluvial piles and pools to 5 feet deep and falls to 20 feet. Pothole Creek had an estimated riffle/pool ratio of 60:40. Cutthroat trout to 8 inches were observed.

Mosquito Creek is a Class II stream which originates in wilderness and straddles the wilderness boundary for over a mile of its final length before emptying into Horse Creek. Mosquito Creek was surveyed by the U.S. Forest Service in 1995. It's a high gradient stream with little sinuosity. Small boulder is the dominant substrate. Some gravel was noted in virtually every habitat unit and generally ranged from 10-30% of the total substrate. Cobble embeddedness ranged from 30 to 50%. Stream canopy shading averaged 69%. The average DBH of the conifers in the riparian area ranged from 8 to 32. Fire event frequency and intensity may be more substantial here. This, and slash from a stream-side timber harvest unit, may account for the significant amount of small size class woody debris observed in the stream (Figure 3-26). Slope instability in the form of mass wasting was noted particularly upstream of a mile from the mouth. Cutthroat trout were the only fish species observed during a biological survey of Mosquito Creek. Other fish species, including chinook salmon juveniles, bull trout adults and sub-adults, and rainbow trout may utilize lower Mosquito Creek as rearing and foraging habitat. This stream provides good habitat for cutthroat trout. Although upstream migration barriers were noted (the furthest downstream being at 0.6 mile from the mouth), cutthroat trout were observed throughout the survey. In-stream wood worked well to retain gravels, create scour, and provide cover. A good source of future in-stream large wood exists along the entire stream. Spawning habitat was associated with most pools.

A survey by U.S. Forest Service biologists Armantrout and Shula in 1975 of 1.1 miles of Mosquito Creek described a stream channel dominated by cobble and boulders in a steep walled, flat bottomed canyon with gravel the subdominant substrate. Stream side shading was considered to be good. Fair amounts of spawning gravel with pools 3 to 5 feet in depth. The estimated riffle/pool ratio for this creek was 60:40. A 250 foot waterfall occurs about 0.6 miles upstream of the mouth. Cutthroat trout to 9 inches were observed.

Species Composition - Streams

In 1937-8, U.S. Bureau of Fisheries biologists surveyed Horse Creek and documented the existence of spring chinook salmon, rainbow and cutthroat trout (McIntosh et al 1995). They believed Horse Creek once supported a large population of spring chinook, but observed only 7 adult salmon in 1937 because the fish racks in the lower McKenzie River were already in operation, intercepting most of the spring chinook salmon migrating upstream. In 1938, 100 spring chinook salmon were observed in Horse Creek, likely due to the washing out of the lower McKenzie fish racks during a spring freshet allowing some salmon to pass upstream. In 1959, the U.S. Bureau of Fisheries counted 622 chinook salmon redds in Horse Creek form its mouth to Separation Creek (Oregon Fish Commission 1960). Apparently, the debate regarding the existence of wild steelhead in the McKenzie sub-basin was raging at the time of this survey. The surveyors document a disagreement between individuals on whether the

species occur in Horse Creek. Any "steelhead" observed in Horse Creek and its tributaries up to 1970 were actually wild redside rainbow trout (Willamette National Forest 1974).

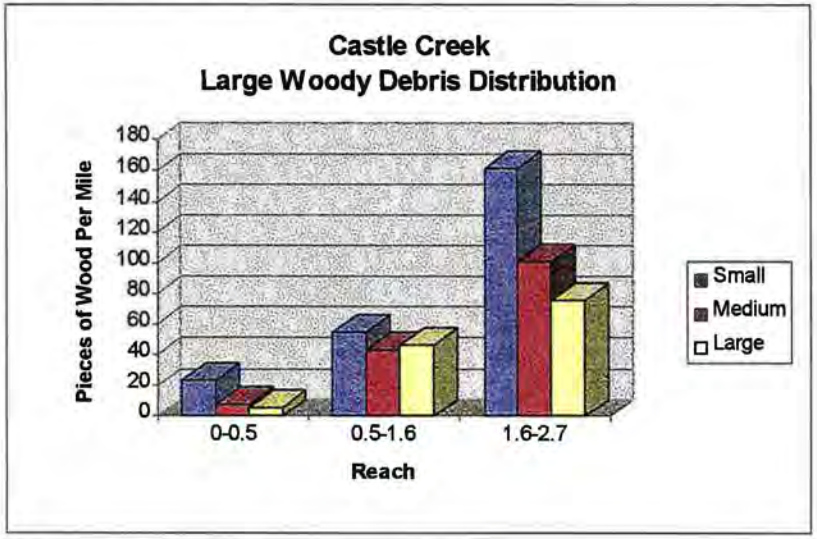
Currently, Horse Creek supports fish populations of bull, rainbow, cutthroat, and brook trout, spring chinook salmon, summer steelhead, mountain whitefish, and several species of sculpin (Table 3-9). It is likely there is significant interchange between the Horse Creek and McKenzie River bull, rainbow, and cutthroat trout populations. While some individuals from each of these species may spend their entire lives in Horse Creek, others may migrate to and from the McKenzie River. Brook trout have been introduced into the headwater lakes of Horse Creek and may be slowly expanding their range down Horse Creek. Spring chinook salmon return to Horse Creek to spawn. Salmon juveniles rear in Horse Creek for up to a year before migrating to the ocean. Steelhead were introduced to Horse Creek in 1970. Although steelhead are no longer stocked in Horse Creek, a naturalized population returns to the upper McKenzie River to spawn, and likely utilize Horse Creek.

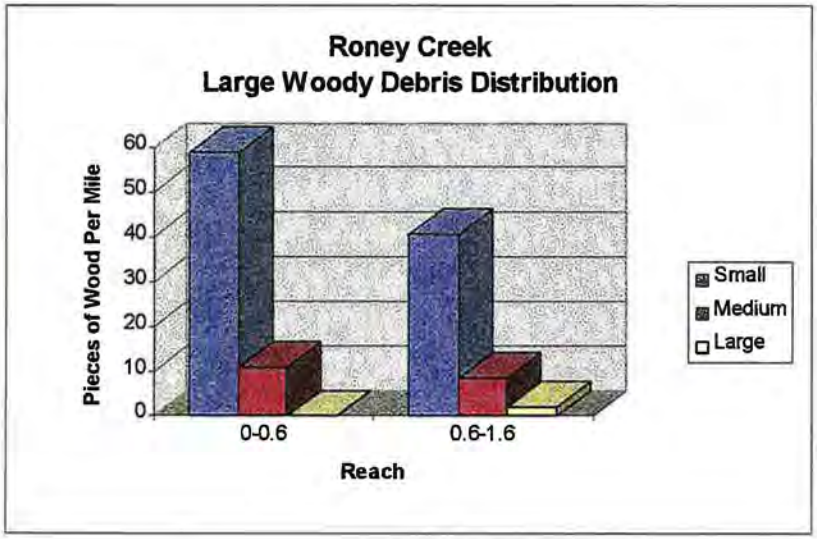
Table 3-9: Fish species known or suspected to occur in the Horse Creek Watershed.

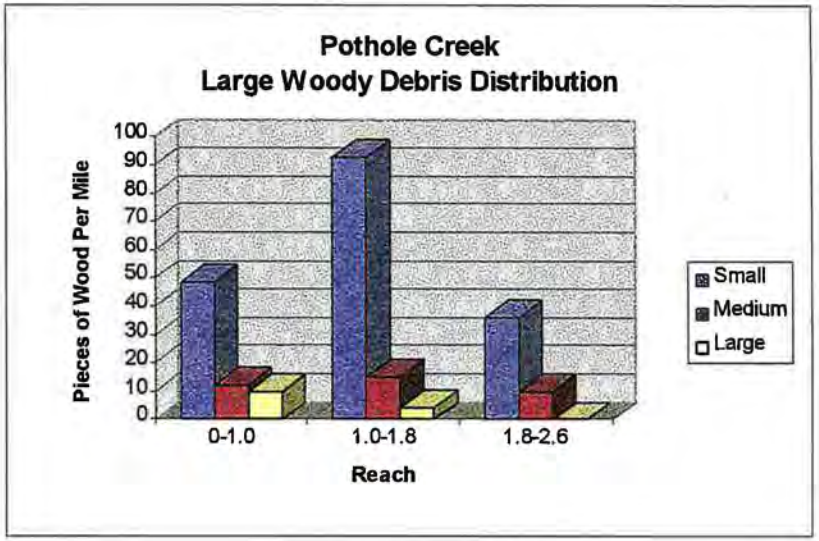
COMMON NAME	SCIENTIFIC NAME
Spring Chinook	***Oncorhynchus tshawytscha***
Bull Trout	***Salvelinus confluentus***
Rainbow Trout	***Oncorhynchus mykiss***
Cutthroat Trout	***Oncorhynchus clarki***
Brook Trout*	***Salvelinus fontinalis***
Summer Steelhead*	***Oncorhynchus mykiss***
Mountain Whitefish	***Prosopium williamsoni***
Largescale Sucker	*Catostomus macrocheilus*
Torrent Sculpin	***Cottus rhotheus***
Reticulate Sculpin	*Cottus perplexus*
Shorthead Sculpin	***Cottus confusus***
Paiute Sculpin	*Cottus beldingi*
Mottled Sculpin	*Cottus bairdi*

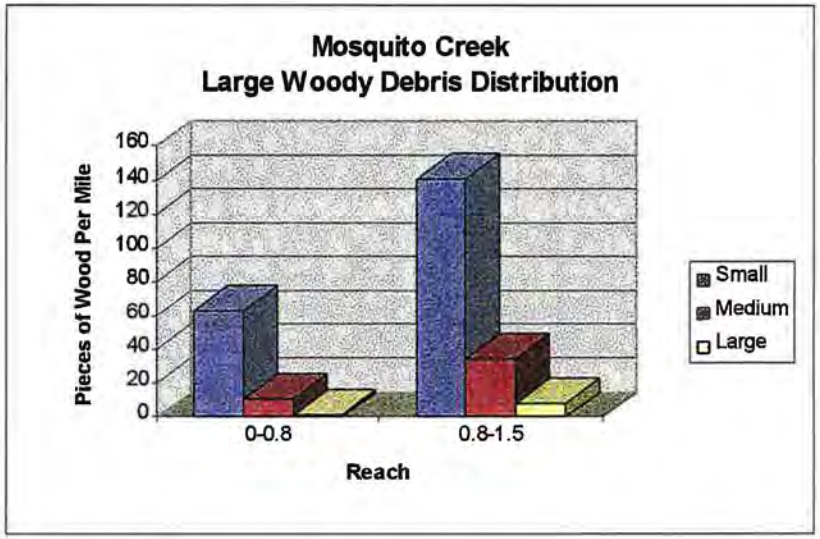
*Introduced into the watershed; **Bold** = Known to occur

Figures 3-23 through 3-26: Large woody debris distribution for Horse Creek Tributaries Castle, Roney, Pothole, and Mosquito.









While some populations of fish in Horse Creek appear to be increasing in number (or at least holding their own), others are declining. There are indications that bull trout in the upper McKenzie River are increasing in number. The status of the Separation Creek spawning population is unknown. Recent monitoring of Separation Creek has not found spawning bull trout, but bull trout juveniles have been found in lower Separation Creek. Continued monitoring is necessary to detect bull trout spawning and rearing habitat in Separation and Horse Creeks.

Redside rainbow trout utilize Horse Creek. Rather large adults have been documented. The population of rainbow trout that utilize Horse Creek are probably in better condition than rainbow elsewhere in the McKenzie River because they do not have to compete with introduced hatchery rainbow trout. However, their exact status is unknown. Mountain whitefish appear to be stable in the upper McKenzie River, but little information exists regarding the population's health in Horse Creek.

Willamette Spring Chinook
Status: Regional Forest Sensitive Species List

The McKenzie River is considered the best source of natural production for spring chinook within the Willamette Basin (Smith and Zakel 1981). The McKenzie run of Willamette spring chinook is the only native anadromous salmonid in the McKenzie Subbasin.

Horse Creek is a major spawning and rearing tributary for spring chinook and is considered to have some of the highest production in the McKenzie Subbasin. Spring chinook returns to the Horse Creek drainage have been monitored by annual spawning surveys. Results from these surveys have shown a steady decline in returning adults beginning in the 1940's. Chinook salmon appear to be decreasing in quantity compared to earlier records. In 1959, 662 salmon redds were counted in Horse Creek and in 1995, 45 were counted. It is uncertain how many of these fish are of wild or hatchery origin. **However, recent monitoring of spring chinook migration through Leaburg Diversion Fish Passage find 48% of upper river migration consists of hatchery origin salmon (S.P. Cramer & Assoc. 1996).**

Location of Important Habitat for Spring Chinook
Habitats essential to spring chinook are the mainstem of Horse Creek up to above its confluence with Eugene Creek and Separation Creek up to River Mile 6.1 (Map 3-17). Adult holding areas consist of deep pools and glide areas. Spawning habitat utilized by spring chinook include areas of low gradient riffles and pool tailouts which have abundant supplies of cobble and gravel. Rearing habitat and winter refugia consists of

low velocity river margins, lower reaches of tributary streams, and side channels.

Role of the Horse Creek Watershed in the Recovery of Willamette Spring Chinook

To maintain or enhance the wild population of Willamette spring chinook, the Horse Creek watershed habitats have become increasingly important. This is due to the comparatively high water quality and habitat condition of Horse Creek and lower quality conditions of the lower basin habitats.

Horse Creek, within the analysis area, provides habitats on a reach level for Willamette spring chinook, as lower reaches in the McKenzie and Willamette Rivers have been extensively altered by human development. Small increases in spring chinook production could be expected by maintaining and restoring channel complexity in the analysis area. It should be expected that greater increases in spring chinook production would likely come from restoration of McKenzie and Willamette River channels due to the life history requirements of spring chinook. Typically, resource management agencies use a top-down approach to habitat restoration by beginning with healthier upper basin reaches. It may be necessary to restore lower basin habitats (McKenzie & Willamette) simultaneously to maximize spring chinook production. This is the approach (bottom up) taken by the McKenzie Watershed Council to restore stream channel complexity, aquatic habitat, and water quality in the mainstem McKenzie and its tributary streams. The genetic fitness of the wild spring chinook population in Horse Creek may be at risk from the high proportion of hatchery produced spring chinook in the McKenzie basin. State monitoring efforts (S.P. Cramer & Assoc. 1995) to determine the extent of hatchery influence will shape wild fish management policy as well as maintenance and restoration of the McKenzie River wild spring chinook stock, to which Horse Creek provides a significant area of spring chinook habitat.

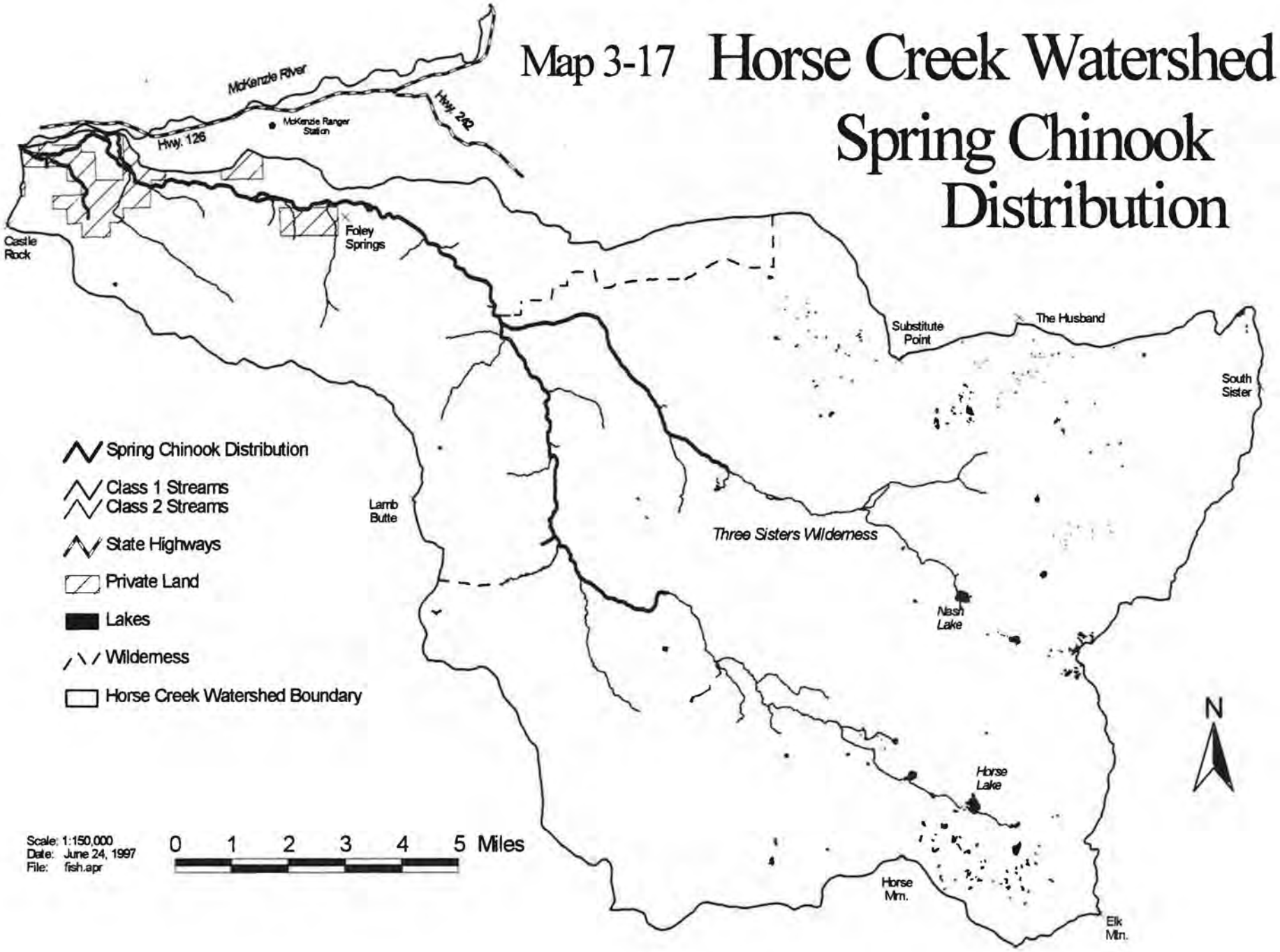
Bull Trout

Status: Proposed Species for Threatened and Endangered Listing, R6 Sensitive List

A river dwelling, migratory (fluvial) population of bull trout use the mainstem Horse Creek and tributaries as foraging and rearing habitat. Spawning and rearing habitat is found in spring or glacial fed tributaries such as Separation Creek although documented spawning has not been confirmed. Spawning and rearing habitat in Upper Horse Creek (in the vicinity of Eugene Creek) is potentially present, but use has not been confirmed. Streams fed by springs on the New High Cascades provide clear, cold, constant water temperatures necessary for bull trout spawning, egg incubation, and rearing.

Little information is available regarding bull trout numbers in the watershed. It is assumed that this aquatic predator was more abundant, based upon the former abundance of native prey species, such as spring chinook. No estimate is available for

Map 3-17 Horse Creek Watershed Spring Chinook Distribution



healthy population density of fluvial bull trout, which is difficult to attain for migratory species. Adult bull trout are opportunistic predators, feeding on the most plentiful and available food source - primarily fish. Rearing and adult bull trout can be found were prey species are concentrated such as spring chinook fry and smolts. For this reason, the health of fish populations which bull trout evolved and coexist with plays a significant role in bull trout recovery.

Location of Important Habitat for Bull Trout

Habitats essential to bull trout are the mainstem of Horse Creek up to its confluence with Eugene Creek and Separation Creek up to River Mile 2.1 (Map 3-18). Adult holding areas consist of deep pools and glide areas. Spawning habitat utilized by bull trout include areas of low gradient riffles, margins, and pool tailouts, typically in spring-fed streams, which have abundant supplies of gravel. This habitat occurs in the lower 2.0 miles of Separation Creek and potentially exists on Separation Creek between river miles 6.0 and 8.0, upstream of Separation Lake outlet. Spawning use of Horse Creek by bull trout is difficult to determine, due to the similarity in habitat preference and egg nest size to spring chinook. Because of these similarities, bull trout redd surveys must find adults on the egg nests to confirm bull trout reproduction or must find the presence of bull trout fry, Age 1+, or Age 2+ juveniles. Spawning use of Separation Creek by bull trout is also difficult to assess due to its remoteness and steep channel gradient. Elsewhere, where bull trout use steep channels (such as Roaring River, Blue River Ranger District), bull trout redds are difficult to distinguish due to normally brightly scoured tailouts and heavy turbulence. Future efforts by state and federal agencies will continue to examine suspected bull trout spawning habitat in Horse and Separation Creeks as well as improving methods of detection.

Spawning in Horse Creek by bull trout would most likely occur where water temperatures are conducive to this stage in their life cycle. Adult bull trout require water temperatures between 4^0 and 10^0C for spawning and rearing and 1^0 to 6^0C for egg incubation. Water temperatures in this range in Horse Creek can be found at or near the confluence of cold, spring-fed tributary streams such as Separation and Eugene Creeks. Horse Creek downstream of Separation Creek would not be expected to have a high degree of use by spawning adults as measured water temperatures during spawning season (mid-August to late October) are above 10^0C. It is felt that the current water temperature regime is similar to the historic regime based on the amount of land management activities in the watershed and thus historic use of Horse Creek below Separation Creek as spawning habitat by bull trout is considered minimal.

The use of Separation Creek (River Mile 0.0 to 2.0) by spawning bull trout is suspected based on the presence of suitable stream habitat conditions, water temperatures, and the sightings of juvenile bull trout in Separation Creek. No confirmed bull trout redds have been documented in Separation Creek which does provide water temperatures

suitable for bull trout spawning, egg incubation, and juvenile rearing. An additional area which may contain suitable bull trout spawning and rearing habitat occurs between River Miles 6.0 and 8.0 on Separation Creek, upstream of the Separation Lake outlet confluence.

Separation Creek between river mile 6.0 and 8.0 was probed by USFS biologists on August 17 and 18, 1997. No bull trout were observed. Results of the probe identified suitable spawning and rearing habitat for bull trout. Prey species included numerous aquatic macro-invertebrates, a healthy cutthroat trout population, and sculpin. A series of falls between river mile 5.5 and 6.0 is considered to be an upstream migration barrier to bull trout and would prohibit access to this habitat. An interesting note is the presence of sculpin above this barrier. Bull trout spawning/rearing streams on the Upper McKenzie River contain sculpins and cutthroat trout. The presence of these two species above the falls suggest they are long-term isolates and that fluvial bull trout may have had access to upper Separation Creek at one time. It is suggested that further probes in Separation Creek be concentrated between river miles 0.0 and 4. As this is the only reach accessible to bull trout.

Rearing habitat consists of low velocity stream margins with significant amounts of detritus, side channels, and large woody debris accumulations in all size classes. Forage areas for adult bull trout consist of the mainstem Horse Creek, lower reaches of tributary streams, and side channels.

Role of the Horse Creek Watershed in the Recovery of Bull Trout

Horse Creek and Separation Creeks have been documented as rearing and foraging habitat for sub-adult and adult bull trout. Continuing efforts will likely discover bull trout spawning and early rearing habitat. Horse Creek, as a source of high quality habitat for bull trout, plays a crucial role in the McKenzie subbasin. Currently, only about 3 miles of spawning habitat are known to be available to the mainstem McKenzie River population (below Trail Bridge Dam), which is present in a small geographic area subject to a moderate fire recurrence interval (80 to 120 years). Horse Creek is important as a refuge source of bull trout spawning and rearing habitat in the event of a catastrophic fire in the Anderson-Olallie sub-drainage in the Upper McKenzie Watershed.

As the McKenzie River adult bull trout population increases in number, the likelihood of bull trout reoccupying former habitat in the McKenzie subbasin strengthens. Competition among predators is known to displace individuals to the fringe of current distribution. Displaced individuals are less likely to survive, but reoccupation of former habitat by a few successful individuals may be expected to occur. This may be the case with Horse and Separation Creeks (and Lost Creek) where present day bull trout spawning has not been documented, but where juveniles have been confirmed.

Due to high water quality in the Horse Creek subbasin, low turbidity and cool water temperature, water clarity in Horse Creek has been characterized through anecdotal accounts as similar to the McKenzie River. Periodic flushes of sediment occur with some storms, but turbidity in general is described as very low.

Low water temperatures recorded in lower Horse Creek (meeting Oregon Department of Environmental Quality standards for an anadromous reproductive stream) may be used to estimate upper subbasin temperatures in areas likely important to bull trout reproduction. In Horse Creek at River Mile 16.0 (near Eugene Creek), water temperatures may be expected to be in the 6° to 9° C range in September (USFS 1993). Similarly, Separation Creek possess a high proportion of spring feed with low water temperatures (USFS 1994) and at temperatures suitable for bull trout reproduction (ODEQ 1995).

Cutthroat Trout

Cutthroat trout appear to be doing well throughout the upper McKenzie drainage. Two life history patterns appear to exist. A resident pattern cutthroat trout may live its entire life in the tributary in which it was spawned while fluvial cutthroat may spend most of their sub-adult and adult life in the mainstem of Horse Creek or the McKenzie River. Recent stream surveys were completed by U.S. Forest Service on streams within the Horse Creek watershed documented cutthroat trout as the dominant species in these streams. Some cutthroat trout observed in these streams appeared to have a rather unique coloration, with a white ventral surface and sometimes a white streak between the dorsal surface and the lateral line.

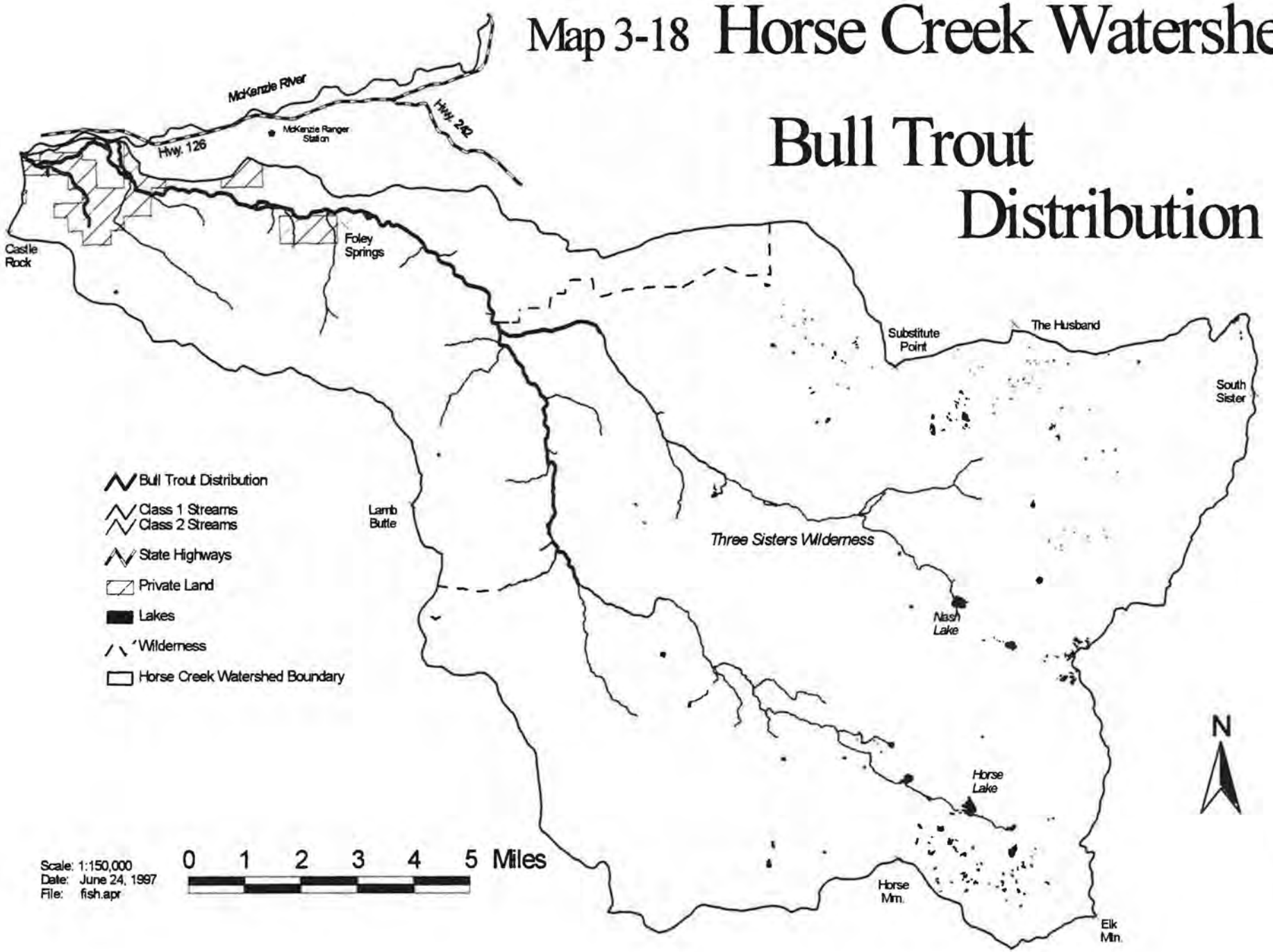
Considerable genetic variability between populations, particularly between isolated populations, is possible. Potential for genetically unique isolated populations exists in numerous upper tributaries and portions of the subbasin isolated by volcanic events. Cutthroat population trends have not been made as occasional trout inventories have been scattered throughout the subbasin. The extent and influence of hatchery stocking of non-native cutthroat is unknown, most of the activity having occurred in the early 1900's. Existing records describe planting of non-native hatchery stocks in lakes. Where brook trout overlap native cutthroat trout, brook trout have displaced the native population. This has occurred in Horse Lake Complex, Horse Creek above Eugene Creek, and in Nash Lake.

Rainbow Trout

Native rainbow trout, also known as "McKenzie Redsides" occur in the lower 12.0 miles of mainstem Horse Creek and some lower reaches of larger tributaries. No stocking of hatchery rainbow trout occurs in flowing waters of the subbasin. A fluvial

Map 3-18 Horse Creek Watershed

Bull Trout Distribution



life history pattern is present in the main stem and larger tributaries. Spawning and rearing also occurs in the mainstem and larger tributaries. Little information is available on rainbow population trends or abundance.

Various lakes in the upper watershed have been stocked with rainbow trout. Potential for natural reproduction exists, although no known establishment of introduced rainbow stocks have occurred. The influence of hatchery origin rainbow trout and introduced summer steelhead upon native rainbow trout is not known. Monitoring of native populations will be necessary to avert potential detrimental effects of McKenzie River stocked rainbow and summer steelhead on the native population. These effects include hybridization, disease transfer, and displacement .

Summer Steelhead (Introduced)

Summer steelhead were introduced into the McKenzie subbasin in 1968 and into Horse Creek in 1970. Releases of summer steelhead into Horse Creek was stopped in 1983. A Skamania River (Washington State) stock is currently utilized in the McKenzie River as the original hatchery stock used (Siletz) was found to be susceptible to a naturally occurring disease organism, *Ceratomyxa shasta* (Howell et. al 1988). Spawning surveys have found adults are naturally reproducing in suitable larger tributaries to the McKenzie River such as Deer Creek, Quartz Creek, S. FK. McKenzie River, Lost Creek and Horse Creek in late winter and early spring. Similar habitat utilization by spawning summer steelhead adults as native rainbow and rearing habitat use by juvenile steelhead and native rainbow/chinook salmon likely poses production limitations on native species.

Brook Trout (Introduced)

This popular sportfish and successful exotic was first introduced into the watershed in the early 1900's. Utilization of brook trout as a sport fish has ceased in all waters where potential impacts to native species is possible. Naturally barren high mountain lakes lacking opportunity for downstream migration are the only locations currently used for brook trout stocking. Brook trout have established naturally reproducing populations in the upper watershed and have moved into moving waters of Horse Creek and lake outlet streams (Map 3-19). Competition between brook trout and native cutthroat threaten isolated populations of cutthroat trout in Horse Creek above Mosquito Creek, in the Horse Lake complex, and in Nash Lake. The potential for hybridization between native char, bull trout, and brook trout exists in the watershed.

Brook trout are likely increasing their population size and range. The brook trout introduced into the lakes within the Separation drainage are a concern. These fish have the potential to interbreed with bull trout, depleting genes from the bull trout gene pool.

Mountain Whitefish

A fluvial population of whitefish is found in the main stem Horse Creek and larger tributaries such as Separation Creek. Little is known of their abundance, population trends, or distribution in the watershed. Mountain whitefish are described as plentiful in the McKenzie River and are possibly the most prevalent sportfish in the McKenzie River.

Sculpins

There has also been limited studies on sculpin in Horse Creek. Two species of sculpin are known to occur while three species are suspected to exist in the Horse Creek subbasin based on available habitat and a wide range of elevations and the ability of the species to cohabitate (Pers. comm., Mike Sheehan, Fisheries Biologist, Willamette National Forest, June 6, 1997). In general the sculpin population in Horse Creek is considered to be stable. Potential increases in sediment in Horse Creek may result in decreased populations of some sculpin species because of their benthic orientation. Sculpin rely on substrate interstitial spaces which are at risk to filling with sediment.

LAKES - Habitat Conditions and Species Composition

The lakes in the headwaters have been surveyed since the 1930's by Oregon Fish and Game Commission and U.S. Forest Service (Smith 1933, Willamette National Forest 1938, Ziesenhenne 1937, Ziesenhenne 1938) . Although the surveys were somewhat cursory, they provide insights to lake habitat conditions. Horse Lake was described by Oregon Fish and Game Commission as having all the physical needs for a good fisheries lake, including food supply, depth, spawning habitat, and cover. Middle and Lower Horse Lakes were more shallow than Horse Lake, but also had good spawning habitat. The swampy nature of Lower Horse Lake may have enhanced its productivity.

In the 1990's, intensive surveys of the Mt. Washington and Three Sisters Wilderness Areas lakes began. These can be considered baseline, due to the cursory nature of the historical surveys. Information on lakes in the Horse Creek watershed have been summarized and provided in Table 3-10.

Species Composition

The majority of the lakes in the Horse Creek watershed historically did not contain any fish. The only lakes with native reproducing fish populations (cutthroat trout) are Horse Lake, Middle and Lower Horse Lake, and Nash Lake. All other fish species found in lakes within the Horse Creek watershed have been introduced.

The primary fish species in lakes within the watershed are rainbow, cutthroat, and brook trout. Brook trout are the fish species of greatest concern due to their propensity for displacing native populations. In the upper Horse Creek watershed that species is cutthroat trout. Brook trout in the Horse Creek drainage have moved out of lakes via perennial or intermittent outlet streams to reside in the mainstem Horse Creek and are slowly working their way downstream. Another concern regarding brook trout is their potential impact on native char in the watershed. Brook trout have been known to spawn with bull trout which produces has the effect of depleting the bull trout gene pool.

It is recommended that all lakes with native reproducing populations of trout not be stocked in order to protect the uniqueness and genetic integrity of these species. Additionally, current ODFW stocking policy does not stock brook trout where there is potential to influence bull trout or existing native fish populations. It is also recommended that an eradication plan be developed for brook trout in the Horse Creek watershed in cooperation with the ODFW. Potential benefits of an eradication program for brook trout would include a reduced risk to bull trout in Horse and Separation Creeks and a potential recovery of native cutthroat trout in the high lakes and upper Horse Creek. A recommendation for subbasin lake management is for the ODFW to coordinate stocking efforts with USFS Wilderness managers to help achieve wilderness objectives.

Map 3-19 Horse Creek Watershed

Brook Trout Distribution

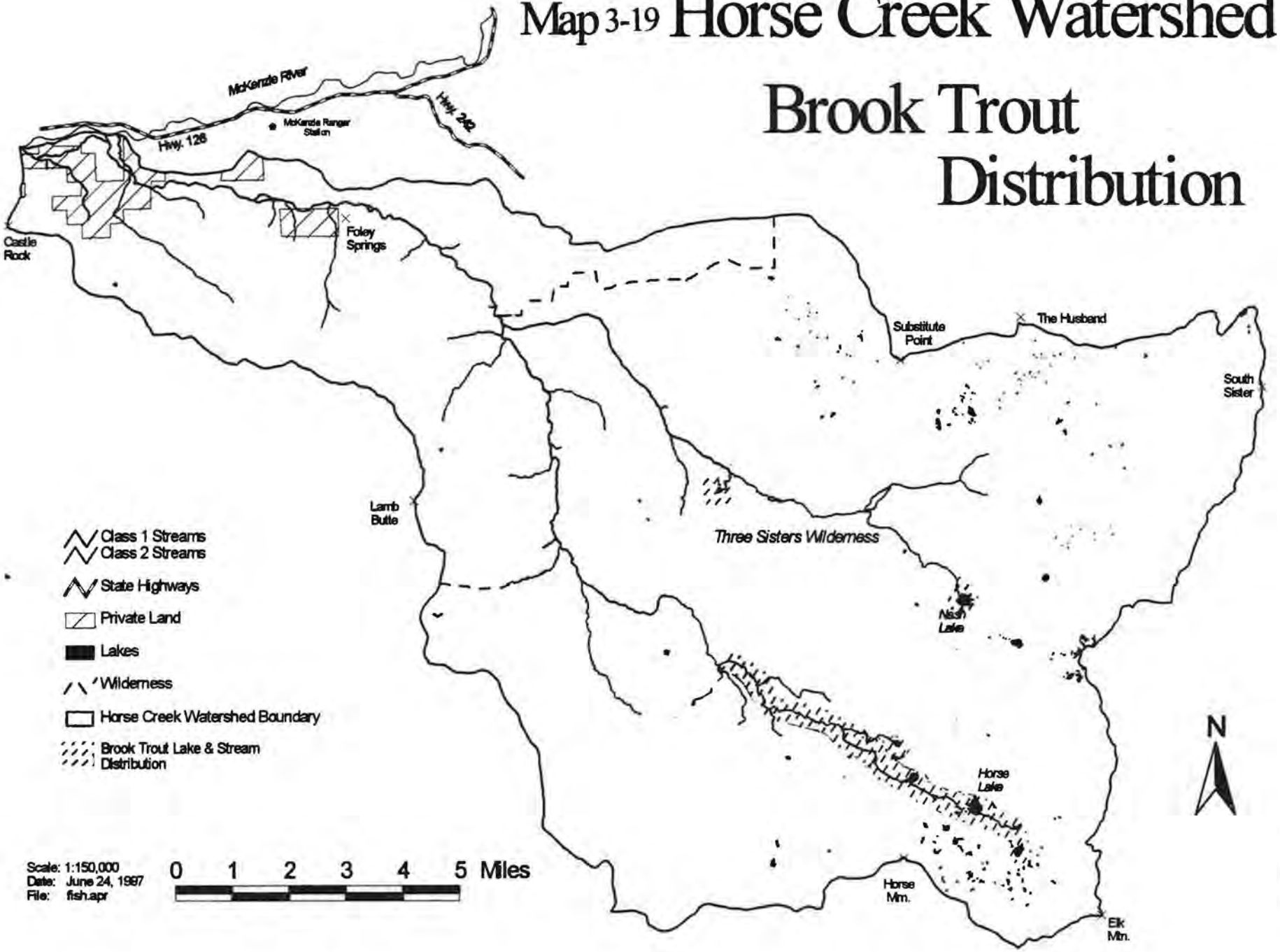


Table 3-10: Summary of lakes in the Horse Creek and Separation Creek drainages.

Lake Name	Survey Year	Native Population	Species Stocked	Stocking Frequency	Natural Reproduction	Exotic Established	Lake Size (acres)	Depth (feet)	Elevation (feet)	Recreational Use	Shoreline Impact	Trophic Status
HORSE CREEK												
Aerial Lake*		Barren	RB,BT	Biennial	No	No	2.6	38.0	5,400	Light	Light	?
Colt Lake*		Barren	BT	None	No	No	4.0	4.0	5,100	Light	Light	?
Dillon Lake*		Barren	CT	None	No	No	4.0	5.0	4,025	Light	Light	?
East Fisher Lake*		Barren	RB,CT,BT	Biennial	No	No	1.1	18.0	5,620	Mod./Heavy	Moderate	?
West Fisher Lake*		Barren	RB,BT	Biennial	No	No	1.3	13.0	5,620	Mod./Heavy	Moderate	?
Herb Lake*		Barren	RB,BT	Biennial	Yes	BT	1.5	9.0	5,400	Mod./Heavy	Moderate	?
Horse Lake*	1992	CT	RB,BT	None	Yes	BT	54.0	24.0	4,930	Mod./Heavy	Moderate	Ultraoligotrophic
Lower Horse Lake*	1997	CT	BT	None	Yes	BT	13.7	8.0	4,550	Moderate	Light	?
Middle Horse Lake*	1997	CT	RB,BT	None	Yes	BT	2.9	14.0	4,570	Moderate	Light	?
Marten Lake*		Barren	BT	None	No	No	8	12	5,590	Moderate	Light/Mod.	?
Mile Lake*		Barren	RB,CT,BT	Biennial	Yes	BT	4.3	19.0	5,100	Moderate	Moderate	?
Moonlight Lake*	1997	Barren	RB,BT	Biennial	No	No	8.0	14.0	4,550	Light/Mod.	Light	?
Park Lake*		Barren	BT	None	No	No	4.0	5.0	5,050	Light	Light	?
Platt Lake*		Barren	RB,BT,CT	Biennial	No	No	3.4	19.0	5,395	Mod./Heavy	Moderate	?
Sunset Lake*		Barren	RB,BT,CT	None	No	No	14.5	11.0	5,160	Moderate	Moderate	?

Table 3-10 continued.

Lake Name	Survey Year	Native Population	Species Stocked	Stocking Frequency	Natural Reproduction	Exotic Established	Lake Size (acres)	Depth (feet)	Elevation (feet)	Recreational Use	Shoreline Impact	Trophic Status
Separation Creek												
Bounty Lake*		Barren	RB,CT,BT	Biennial	No	No	1.6	15.0	6,000	Moderate	Moderate	?
Burnt Top Lake*	1993	Barren	RB,CT,BT	Biennial	No	No	20.0	28.0	5,650	Light	Light	Oligotrophic
Camelot Lake*		Barren	BT	None	No	No	3.0	4.0	6,100	Moderate	Moderate	?
Denude Lake*	1993	Barren	BT,RB,CT	Biennial	No	No	3.9	16.0	6,000	Heavy	Moderate	Oligotrophic
Dew Lake*		Barren	BT	Biennial	No	No	4.0	5.0	5,040	Light	Light	?
Honey Lake*	1995	Barren	RB,BT,CT	Biennial	Yes	BT	12.0	37.0	5,550	Moderate	Light/Mod.	Ultraoligotrophic
Kidney Lake*	1995	Barren	RB,BT	Biennial	No	No	10.0	15.0	5,465	Moderate	Light/Mod.	Oligotrophic
Lancelot Lake*	1993	Barren	RB,BT,CT	Biennial	No	No	2.4	13.0	6,010	Heavy	Moderate	Oligotrophic
Nash Lake*	1993	CT	RB,BT,CT	None	Yes	BT	33.0	34.0	4,900	Moderate	Moderate	Oligotrophic
Separation Lake*		Barren	RB,BT	None	Yes	BT	4.5	19.0	3,250	Moderate	Moderate	?
Sister Mirror Lake*		Barren	RB,BT,CT	Biennial	No	No	5.2	10.0	6,000	Heavy	Moderate	?
Square Lake*	1995	Barren	RB,BT,CT	Biennial	No	No	3.5	16.0	5,470	Moderate	Moderate	Oligotrophic
Tokatee Lake*		Barren	BT	Every 6 yrs.	No	No	3.0	6.0	5,120	Light	Light	?

*=Located in Three Sisters Wilderness BT=Brook Trout; CT=Cutthroat Trout; RB=Rainbow Trout

OVERVIEW OF WILDLIFE RESOURCES

Viability for the majority of the late successional and riparian associated species that occur within the Horse Creek Watershed were analyzed by FEMAT (1993). These species were all shown to exhibit moderate to high levels of viability under the management strategy of the Northwest Forest Plan (1994). There are a few species, however, that require additional analysis at finer scales to ensure viability. These species include:

- Table C-3 and other species listed in the Northwest Forest Plan (1994);
- Threatened, endangered, and sensitive species;
- Other species of concern
- Species that were outside of the scope of the Northwest Forest Plan and at risk

The following is an overview of species that require additional analysis (Table 3-11). Species of interest for reasons such as economic and hunting experience are also discussed below.

Table 3-11: Species within the Horse Creek Watershed that require finer scale analysis during watershed analysis.

Threatened or Endangered	**Sensitive**	**Table C-3 and S&M Species**
Northern Spotted Owl	White footed vole	Great gray owl
Northern Bald Eagle	California Wolverine	Red tree vole
Peregrine Falcon	Harlequin Duck	Black-backed woodpecker
Spotted Frog (candidate)	Sandhill Crane	Flammulated owl
	T. Big-eared Bat	*Prophysaon coeruleum*
		P.dubium
		Three-toed woodpecker

Recreation Concern	**Other**
Roosevelt Elk	Northern Goshawk

NORTHERN SPOTTED OWL (*Strix occidentalis*)

Surveys: Spotted owl surveys have been conducted for all of the matrix lands in this watershed. Portions of the LSR and Wilderness have been surveyed to protocol, but not consistently or extensively. Oregon State University has been monitoring

approximately 75 miles of trail in the wilderness every 3 years to determine occupancy and band juveniles. There are 20 owl sites in the wilderness portion of this watershed. This is the only wilderness area on the west side of the cascades that has been monitored for spotted owls, and valuable research data is being collected from that population.

Sites: There are 29 known owl sites within the watershed. There are an additional 16 sites with activity centers that fall outside of the watershed, but portions of their home ranges extend into the watershed. Three of the sites are currently in a "take" situation for available acres within 1.2 miles of the activity center, and 6 sites are in "take" at the 0.7 mile radius. Only one of the owl sites in "take" are within the matrix portion of the watershed. The rest fall in wilderness or late successional reserve allocations. Detailed information for future incidental take calculations is included in the Wildlife Appendix. The USFWS has recommended that take be avoided if possible in the matrix while the LSR's recover habitat and begin to fully function. However, incidental take will be granted by the USFWS in the matrix.

Quarter townships: There are 33 quarter-townships in the watershed. All meet the 50-11-40 guide for dispersal. Three are approaching the 50% threshold (16054, 17084, 18071). There are currently no concerns for dispersal throughout the watershed. There are no designated "areas of concern" in this watershed. The majority of the watershed is in a wilderness or LSR allocation, and dispersal habitat is well distributed and abundant. Detailed information of 50-11-40 analysis is included in the Wildlife Appendix.

Late Successional Reserve: There is one Late Successional Reserve that falls partly in this watershed (#218). This LSR is 26,960 acres in size, and it borders the Three Sister's Wilderness. Approximately 18,300 acres of the LSR falls within this watershed: the remainder lies in the South Fork McKenzie Watershed. There are 12 owl sites in this LSR, 9 of which are in this watershed. The condition of the Late Successional Reserves and the landscape between LSR's is being analyzed in a Forest Late Successional Reserve Assessment.

Critical Habitat Units: Critical Habitat Unit 17 lies in this watershed. Its current condition is provided in Table 3-12. Approximately one half of the CHU falls within this watershed. Approximately 66% of the CHU is either nesting or foraging habitat. The majority of this CHU (61%) is coincident with the Late Successional Reserve. There are 17 owl sites in the CHU, 9 in this watershed, and 8 on the Blue River Ranger District to the west.

According to a Draft USFWS Document (USFWS 1994), this CHU was designated to "maintain and provide essential nesting, roosting and foraging habitat. The unit contains some of the area's largest contiguous blocks of suitable nesting habitat...it is

not only important for providing secure nesting habitat in the core of the Western Cascades province, but given its link to the Three Sister's Wilderness, which rides the crest of the Cascade mountains, this unit helps secure an inter-provincial link to the Eastern Cascades province. The wilderness contains some large blocks of suitable habitat, but also encompasses large expanses of unsuitable, high elevation mountain peaks. Land within the Three Sister's was not proposed as critical habitat since it is not in need of special management nor additional protection." Because of its current condition and future management of adjacent land allocations, there are no concerns for the management of this CHU.

Table 3-12: Condition of the Critical Habitat Unit in the Horse Creek and South Fork McKenzie Watersheds.

CHU 17	NESTING	FORAGING	NON*	TOTAL ACRES
HABITAT ACRES	7189	19511	13595	40295
PERCENT OF TOTAL	18	48	33	

*includes dispersal habitat

Potential Risks

Adherence to Northwest Forest Plan Standards and Guidelines and seasonal restrictions to protect nest sites should ensure the continued viability of this species on the landscape.

NORTHERN BALD EAGLE (***Haliaeetus leucocephalus***)

Surveys: There have been no systematic surveys of lakes or rivers in this watershed. All observations have been non-protocol.

Potential Habitat/Occupancy: Potential nesting, foraging, and roosting habitat is recognized within the vicinity of Horse Creek, Nash Lake, and Horse Lake. Sightings have been recorded in all of these areas, however no nests have been documented. Additional habitat may be available in the smaller lakes within the wilderness, however we do not have recorded sightings or inventories of those areas.

The majority of these lakes, are providing moderate quality bald eagle habitat. Heavy snows, long ice packs, and low density of prey probably preclude the use of these areas for nesting. It is recommended that additional surveys be conducted within the wilderness to document the extent of use.

Potential Risks: There are no known risks to these sites. The class I portion of Horse Creek, which would most likely be used by bald eagles, falls within the AMA, wilderness, and LSR. Because timber harvest is either not allowed or not an emphasis in these areas, these allocations should maintain habitat quality. Increased recreational use in the wilderness may impact those areas in the future, and monitoring would be an important tool to document impacts to discovered nest sites. The Willamette National Forest Plan and the Bald Eagle Recovery Plan mandate protective measures to ensure the continued viability of this species.

AMERICAN PEREGRINE FALCON (*Falco peregrinus*)

Surveys: In 1981, 1990, 1991, and 1992 the Oregon Department of Fish and Wildlife conducted aerial reconnaissance of cliffs on the McKenzie Ranger District with potential nest ledges. The highest quality potential habitat has been surveyed on the ground.

Potential Habitat/Occupancy: There is one known eyrie in the watershed, which was first documented in 1990. In two years of successful reproduction, 4 young have been produced. A management plan has been completed (McKenzie RD 1994) that delineates protective management zones. There are no identified threats to the site.

There is an additional known eyrie just outside the watershed, and its draft tertiary management zone extends into the watershed. A draft management plan has been completed. This site has been known for 3 years, and has been successful the last 2 years (4 young produced).

In addition to these known eyries, there is also potential habitat known at two sites in the wilderness and two sites outside the wilderness. Two of these areas have had historical sightings. Ground surveys to these sites were completed for the first time in 1997, and no birds were observed. In 1990, the non-wilderness sites were aerially surveyed with no documented use.

There are also an additional six areas with potential to provide nesting habitat, but the probability of quality ledges is low. These areas have not been surveyed.

Potential Risks: The eyrie and the high potential sites lie within late successional reserves or wilderness. There are no known threats from human activity. These areas offer limited access for recreation.

Surveys to the potential sites should be a priority to determine if they are occupied. WNF LMP and the Peregrine Recovery Plan mandate protective measures to ensure the continued viability of this species.

GREATER SANDHILL CRANE (*Grus canadensis*)

Surveys: Surveys have been conducted at high potential habitat in the Wildcat Swamp Area. Other observations have been collected by informal surveys by wilderness rangers.

Potential Habitat/Occupancy: Sandhill cranes have been observed nesting at Wildcat Swamp since 1992 and Bear Flats since 1994. These birds are part of the Central Valley Population (CVP). This population is one of four in North America., and it is the westernmost and second most numerous (Schlorff et al. 1983). The CVP is fairly stable at this time (Littlefield, pers. comm., Marshall et al. 1992), and it is expanding its range into new areas, such as this one in the Cascade Range.

Wildcat Swamp has not been intensively surveyed, so we do not know the size the population. The nesting area is within view of a lightly used wilderness hiking trail, and the birds are often observed from the trail. The trail is becoming brushed in from lack of use, and there is only one campsite in the area that receives little use. Because this is a fairly high elevation site (4600'), snow reduces access to humans until late June, after the young have left the nest.

Potential Risks: Risks to this population include human disturbance associated with hikers and pets on the trail. There are no known risks to the wetland habitat. It appears to be fairly stable, and probably not heavily affected by fire exclusion.

Potential management options including relocation of the trail, relocation of the campsite, and/or trail-user education should be considered.

CALIFORNIA WOLVERINE (*Gulo gulo luteus*)

Surveys: There have been no surveys for wolverine in this watershed.

Potential Habitat/Occupancy: Potential habitat for wolverines does occur in the Horse Creek watershed. High elevation areas in the Three Sister's Wildernesses probably serve as their primary habitat for the majority of the year.

Potential Risks: Risks to their continued viability lie primarily in the loss of solitude at high elevations throughout their range, not just in the Horse Creek watershed. Increased recreational activity in wilderness areas needs to be assessed at the regional level in the future.

TOWNSEND'S BIG-EARED BAT (*Plecotus townsendii townsendii*)
Surveys: There have been no surveys conducted in this watershed.

Potential Habitat/Occupancy: Isolated populations of this bat have been found on the Willamette National Forest, but there have been no sightings in this watershed. Potential habitat has been not been inventoried or mapped in this watershed. There is one known cave in the King Creek area with potential for hibernaculum use. There is a bridge over Avenue Creek that may provide roosting habitat once it is replaced by the State Department of Transportation. We have been in consultation with that agency to construct a "bat friendly" structure.

Potential Risks: Because of the lack of information concerning habitat availability for this species in this watershed, there are no identified risks at this time. Completion of survey of the known cave, continued monitoring on the new Avenue Creek Bridge, and continued searches for currently undocumented habitat will be important activities for monitoring of this species.

RED-LEGGED FROG (*Rana aurora)*
Surveys: There have been no systematic surveys for this species in this watershed.

Potential Habitat/Occupancy: Red-legged frogs have been documented in this watershed in 8 locations, including King Creek, Olallie ponds, Pothole Creek, Roney Creek, Harvey Creek, Mesa Creek, and Horse Creek (near Cedar Swamp). They appear to be relatively common in appropriate riparian habitat on this District.

Potential Risks: Northwest Forest Plan Standards and Guidelines for Riparian Reserves should maintain the viability of this species. Interconnectedness of the population is probably not a concern in this area. The landscape will be well connected through the riparian network, and this species can also migrate through mid and late seral habitats to reach breeding sites.

HARLEQUIN DUCK (*Histrionicus histrionicus*)
Surveys: Surveys have been conducted for Harlequin ducks on Horse Creek. In 1996, Howard Brunner from Oregon State University conducted a test of the protocol on the lower 8 miles of Horse Creek. The Fisheries Department at the Ranger District surveyed the entire length of Horse Creek in 1996, and they documented wildlife species during their work. Because of the width and velocity of this creek, surveying for this species is extremely difficult.

Potential Habitat/Occupancy: The majority of the potential habitat occurs in Horse Creek and its lower tributaries. Three potential sites exist in the watershed based on known observations. There is high probability of more that have been undetected.

Potential Risks: Potential impacts to the population include human disturbance, loss of water quality, and loss of loafing sites. Horse Creek receives very little recreational activity, and we do not believe there is significant human impacts to ducks in this area. Harlequins nest on the ground under the shelter of vegetation, rocks, or large woody debris. Of the nests found, several were near areas of human activity. This species may be less sensitive to human disturbance than previously thought. Midstream loafing sites are very important, and Horse Creek has abundant boulders and islands to provide this type of habitat. Removal of large woody debris from the banks or within the stream channel could impact this species if adequate habitat is not available. Northwest Forest Plan Riparian Reserves will aid in maintaining the viability of this species.

WHITE-FOOTED VOLE (*Arborimus albipes*)

Surveys: No surveys for this species have been conducted in the watershed.

Potential Habitat/Occupancy: There were 3 individuals trapped on the nearby H.J. Andrews Experimental Forest, so we expect them to occur in similar habitat in this watershed. White-footed voles are extremely rare. Data from trapping indicates they are associated with mature riparian stands (D. Gomez, 1990) and red alder riparian habitats. They are often found in heavy cover consisting of downed logs and/or brush.

Potential Threats: Threats to their habitat include impacts to riparian vegetation, either through logging or human disturbance, and connectivity of the population within the watershed. Northwest Forest Plan Interim riparian reserves will aid in maintaining the viability of this species. Mature riparian habitat within the watershed will be well-connected with the prescribed riparian reserve network and other no-harvest allocations.

BLACK-BACKED AND THREE TOED WOODPECKER AND FLAMMULATED OWL

Surveys: There have been no surveys for these species in this watershed.

Potential Habitat/Occupancy: The Black-backed woodpecker is suspected to occur in this watershed. There are no documented sightings, but appropriate habitat does exist.

There is only one sighting of a three-toed woodpecker in the Foley Ridge area (Pacific silver fir series). We suspect that both of these species are scattered but rare occupants of the higher elevations of this watershed.

There has only been one flammulated owl sighting (in the Substitute Point area in the wilderness). We suspect this species to be an extremely rare occupant of the watershed. The ponderosa pine habitat this species prefers is not prevalent in this area. The

sighting was in a transition zone between Douglas-fir/Western Hemlock series and Mt. Hemlock series. There have been other sightings of this species in the higher elevation forested series on the district.

Potential Risks: Loss of snag habitat is the primary concern for these species. Impacts to their prey base is also a concern. The woodpeckers feed on wood-boring insects; flammulated owls feed on flying insects, including lepidoptera species.

Northwest Forest Plan Standards and Guidelines for matrix areas should aid in maintaining the viability of these species. Guidelines include maintenance of adequate numbers of large snags and green-tree replacements for future snags. Where feasible, green-tree replacements for future snags can be left in groups to reduce blowdown. No snags over 20" dbh should be marked for cutting. Full (100%) population potential for each species must be maintained. The 100% level for black-backed woodpeckers equates to 0.12 conifer snags per acre. These snags must be at least 17" dbh or largest available and in hard decay stages. This requirement must be added to provisions for other cavity nesting species already required by the Willamette Forest Plan (1990), which requires 40% levels for the guild. This equates to 4.94 snags per acre at high elevation sites. The Wildlife Appendix describes snag requirements for primary cavity excavators in the watershed. Black-backed woodpeckers also require beetle infested trees for foraging. Populations of this species are expected to be the highest in the wilderness portions of this watershed. Riparian reserves will aid in the maintenance of the flammulated owl population. Lepidoptera communities achieve their highest diversity in riparian areas.

The higher elevations of this watershed, where these species are most likely to occur, fall within late successional reserve and wilderness allocations. The potential for either of these threats to be detrimental to populations of this species is low.

GREAT GRAY OWL (*Strix nebulosa*)

Surveys: The matrix portion of the watershed was surveyed six times in 1997, with no response. The wilderness and LSR areas have not been surveyed. Non-protocol surveys have occurred in several locations of the watershed.

Potential Habitat/Occupancy: The great gray is a known but rare inhabitant of the Horse Creek watershed. There are 4 known sites, but no known nests. The most recent was heard in the McDuff Peak area. The sites are adjacent to or within the late successional reserve.

This species is most commonly found near meadow complexes on the east side of the Cascade Crest. It is a rare occupant of the west side. Only 19 activity centers are known on the entire Willamette National Forest, with the majority being in the Upper McKenzie Watershed to the north of this area. We hypothesize that the Santiam Pass

is a dispersal corridor for this species. Great grays on the west side forage in clearcut areas. The potential for this species to use the higher elevation meadows in the wilderness is unknown. Though the structure of the forest/meadow complexes would be favorable to this species, the short snow-free periods and heavy snow packs may preclude their presence.

Potential Risks: Northwest Forest Plan Standards and Guidelines specifically protect this species. Meadows within potential habitat must be buffered with 300' no harvest areas, and 1/4 mile protection zones must be established around nest sites. This requirement appears to be based on ecosystems where great grays forage in meadow complexes and nest near the meadows. The greatest risk to this species is our inability to adequately document their presence. The current protocols do not appear to be very successful at locating activity areas. Current guidelines for protection, once sites are found, are supported by great gray owl researchers in the United States and Canada. Continued data collection may result in changes in the future as more is known about this species' needs.

NORTHERN GOSHAWK

Surveys: There have not been extensive surveys within the watershed. Intermittent surveys to known sites have occurred over the past 6 years.

Potential Habitat/Occupancy: There is extensive potential habitat for this species in the mid and late seral forested stands in this watershed, particularly in the lower elevations. There are 2 non-wilderness sightings within the late successional reserve. Neither sighting documented a nest. There are also 2 wilderness sites, including one known nest (off Foley Ridge). The sighting is where Eugene Creek meets Horse Creek. The nest was discovered in 1990, and has been surveyed continuously for the last 3 years.

Potential Risks: There are no known threats to this species or these sites. The Northwest Forest Plan analyzed this species and determined that the allocations and standards and guidelines within the Plan would provide high levels of viability for this species.

AMPHIBIANS

None of the amphibians of concern listed in Table C-3 of the Northwest Forest Plan have geographical ranges that extend into this watershed. Requirements of the Plan, including riparian reserves, large woody debris retention requirements, special habitat reserves, and limitations on the removal of duff layers during burning should adequately protect the 17 amphibian species that are suspected to occur in the watershed.

However, there is one threat that is not covered by these plans. Introduction of fish species to high mountain lakes that were historically fishless could be impacting historic populations. Data has shown that long-toed salamanders are heavily impacted by introduced fish in high mountain lakes (Liss 1994). Undocumented impacts to other species may also be occurring. Management strategies for maintaining the native biota of the wilderness lakes should be explored.

SPOTTED FROG

There are several locations of spotted frogs in and adjacent to this watershed. Within the watershed, this species has been verified at Goose Lake and Penn Lake. Recent surveys documented this species still occurring at Penn Lake (which is actually just south of this watershed). Unverified reports have also been documented in Dillon Lake, Mesa Springs, and Wildcat Swamp. This is a USFWS Candidate species, and efforts are underway to develop a conservation agreement for Penn Lake that will facilitate future management and open opportunities for federal funding for monitoring, conservation, and study. Introduction of non-native fish species was identified as a concern for this species management at Penn lake.

OREGON RED TREE VOLE (*Arborimus longicaudas longicaudas*)

This species has been documented in this watershed through a limited trapping study done in 1984 by the USFWS (USFWS 1984). Extensive surveys have not been conducted. Their remains have been found in spotted owl pellets collected by researchers with the Oregon Cooperative Wildlife Research Unit (Swindle 1995) on Blue River RD, adjacent to the watershed to the west, and to the north in the Upper McKenzie Watershed (by Al Dohmen, 1990 pellet study at the Great Springs owl site). This species is highly associated with late successional forest patches, though recent survey efforts have also been finding nest sites in younger stands in the coast range (Biswell, personal comm.). Huff et al (1992) rated this species as the most vulnerable of the arboreal rodents to local extirpations resulting from the loss or fragmentation of old-growth forests.

There is a likelihood they do not occupy the higher elevation vegetation series in this watershed. The presence of Douglas-fir trees is a very important component of the overstory. Huff et al. (1992) described their range up to 3000' in the Central and Northern Cascade Range. However, owl pellets with voles have been found up to 4400' in an adjacent watershed. The Great Springs site is in a grand fir series, and a site on Blue River RD is in a transition area between Douglas-fir/Western hemlock and Pacific silver fir forests.

A USFS Interagency Memo (USFS 1996) described methods for analyzing landscapes for red tree vole habitat. If the 5th field watershed has greater than 40% of its area in a forested condition with at least 60% crown closure and 10" DBH trees, then no surveys

for this species are required. A Forest-level analysis for this species indicated that 88% of this watershed capable of producing red tree vole habitat is currently in an "10-40" condition. This is well above the threshold value for requiring surveys.

MOLLUSKS

Of the 43 mollusks listed in the Northwest Forest Plan Table C-3 and 97 analyzed for Appendix J2, only two have a "reasonable chance" of occurring on the Willamette National Forest (per Dr. Furnish, a researcher who reviewed the list for the S. Fork Pilot Watershed Analysis process on Blue River Ranger District). *Prophysaon coeruleum* is a slug that occurs in relatively moist coniferous forests from low to middle elevations from south Puget Sound down into the Willamette Valley. Historic sites are now within urban areas. There are no currently known locations in this watershed. *Prophysaon dubium* is another slug that is moderately associated with riparian areas. It is also found in rockslide areas. Road building and road maintenance are potential disturbances to this species in rockslide areas. The Northwest Forest Plan protects these species through managing known sites and conducting surveys. These surveys must be completed prior to ground disturbing activities implemented (i.e. contract sold) 1999 or later. Riparian reserves will provide some level of protection for these species, but rockslide areas outside of riparian zones should be identified and protected for *P. dubium*. Willamette National Forest Plan FW211 should protect rock slides with potential habitat. Appendix J2 hypothesizes that local extirpation (i.e. disappearance of the species locally, but it does not become extinct from its range) of these species will probably occur even with the above protective measures.

ARTHROPODS

There are four general groups of arthropods listed in the Northwest Forest Plan Table C-3. These species occur in the southern portion of the Spotted Owl's range in southern Oregon and Northern California. They do not occur in this watershed.

ROOSEVELT ELK

There are 10 elk management areas in this watershed, including 5 High and 5 Moderate. There are no Low Emphasis areas (Map 3-20). Elk habitat is displayed in Map 3-21. Each emphasis area has different management objectives within the Willamette Forest Plan. Complete model outputs for each analysis area are listed in the Wildlife Appendix. Table 3-13 displays all of the emphasis areas and indicates which are currently not meeting Forest Plan objectives. The location of these areas is shown in Map 3-20.

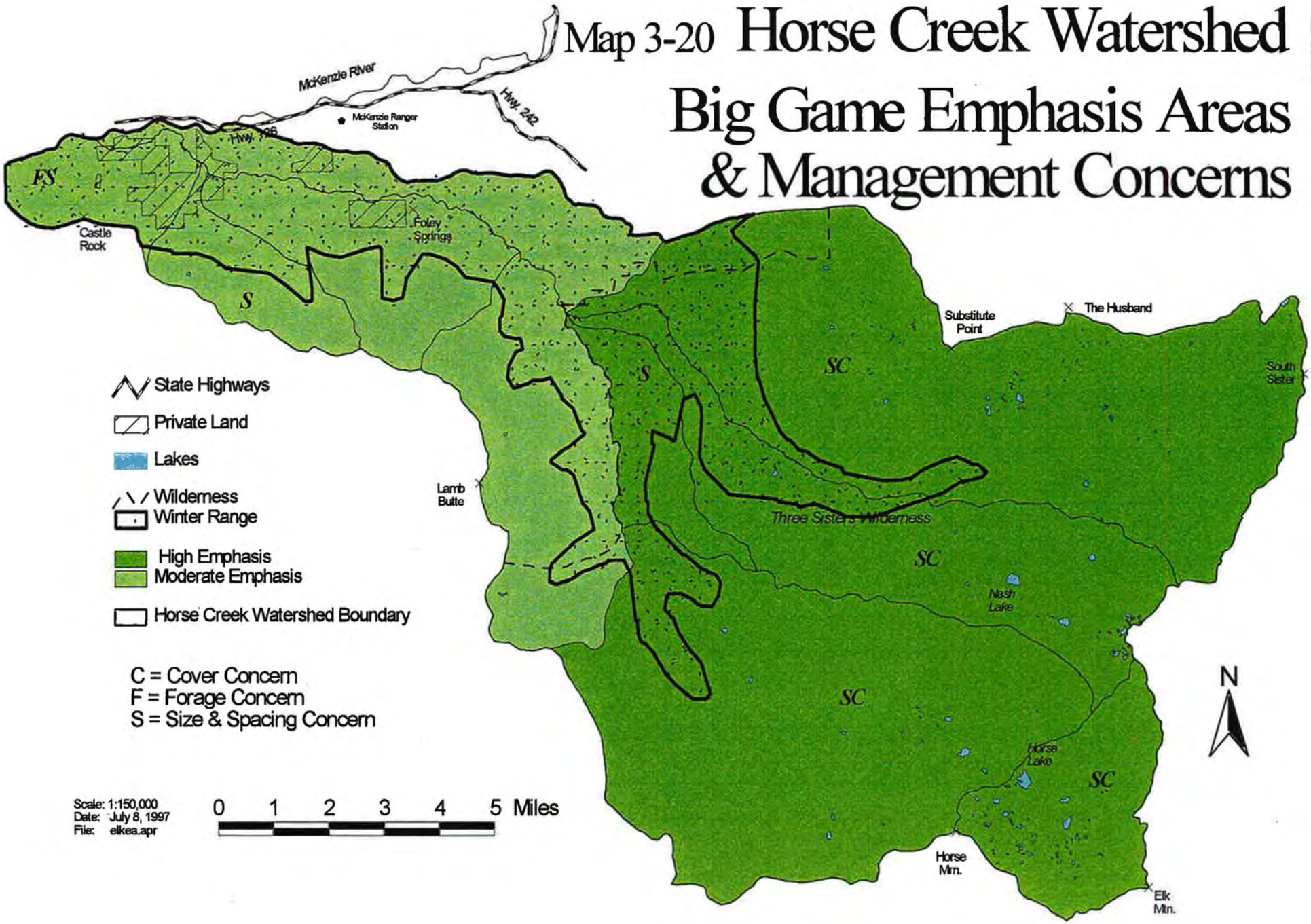
Table 3-13: Elk Emphasis areas that are not currently meeting Forest Plan objectives. (x indicates model value below Plan objectives)

EMPHASIS AREA	Emphasis	HEs	HEc	HEc winter	HEf	HEr	HEi
Separation/Honey	HIGH	X	X				
Eugene	HIGH	X	X				
Harvey/Sphynx	HIGH	X	X				
Roney	HIGH	X					
Horse Lake	HIGH	X	X				
N. Side Horse	MOD						
Castle/Mosquito/etc.	MOD						
King	MOD	X					
Avenue/Cedar Swamp/etc.	MOD						
Swamp/Castle-Taylor	MOD	X			X		

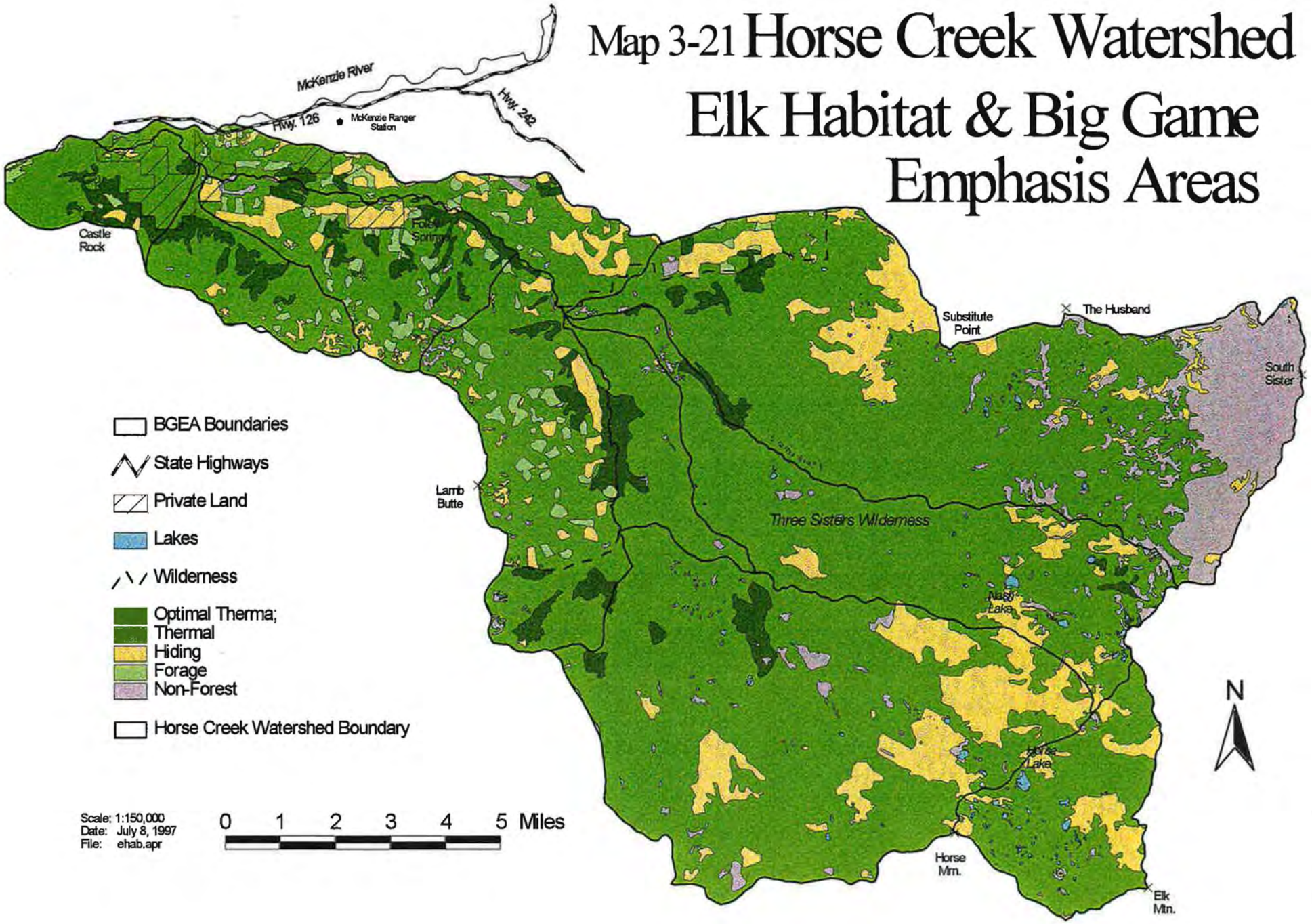
Summary: HEi is being met for all emphasis areas. Generally, HEc is difficult to reach because of the lack of optimal thermal (as currently defined by the McKenzie Ranger District in conjunction with ODFW biologists) in the higher elevation wilderness areas, though it is usually below the threshold in winter range portions. HEs is low because of the un-fragmented nature of the wilderness. The biggest issues in managing this area revolve around hunter ethics in the wilderness. The area receives heavy use by hunters packing in camps, and the impact to the wilderness and wildlife habitat from this use is increasing. Developing hunter-ethic education programs should be a priority for the district.

Separation/Honey: This High Emphasis area provides critical over-wintering habitat in the NW corner (matrix lands), and it also provides excellent summer range because of its seclusion and availability of meadow habitat in the wilderness. HEs is low because of the un-fragmented nature of wilderness, and HEc is low because of the rarity of optimal thermal cover in the higher elevations. However, HEc in the winter range portion is within the threshold. HEf is relatively high because of the abundance of meadows. These habitats are generally in good shape and not being encroached or impacted by recreationists. There are high levels of escapement habitat in this area. Though there is heavy human use on the t rails, there is limited off-trail use of the area. This area receives the heaviest hunting pressure in the Three

Map 3-20 Horse Creek Watershed Big Game Emphasis Areas & Management Concerns



Map 3-21 Horse Creek Watershed Elk Habitat & Big Game Emphasis Areas



Sister's Wilderness portion of this watershed. There is an interest in obliterating road 2643-485, which currently accesses an old trailhead. Removal of this road would increase HEr to 0.92. *Eugene Creek*: This High Emphasis area is all wilderness, and it receives moderate to high elk use. There is limited winter range in the northwest corner. The area provides excellent summer range habitat because of the abundance of meadows. Because the meadows are higher elevation and predominately wet, they are not being encroached dramatically by conifers. The area receives moderate human use, but the hikers are generally passing through to a destination at higher elevations. Trail locations and topography generally keep people out of elk habitat. HEs is low because of the un-fragmented nature of the wilderness. HEc is low because of the lack of optimal thermal cover in the higher elevations. However, HEc in the winter range portion is within the threshold.

Harvey/Sphynx: This High Emphasis area is all wilderness, and it receives moderate elk use. Well-distributed meadow habitat increases its value as summer range. Though there are trails into the area, they receive little use. This area receives the second heaviest hunting pressure I the Three Sister's Wilderness portion of this watershed. HEs is low because of the un-fragmented nature of the wilderness. HEc is low because of the lack of optimal thermal cover in the higher elevations, however, HEc in the winter range portion is within the threshold.

Roney Creek: This High Emphasis area is all wilderness, and the majority is winter range. It receives low to moderate elk use. It contains limited forage, and steep topography dominated by thick vegetation precludes heavy use. Elk in this area generally utilize the optimal thermal cover in the Horse Creek riparian zone. The animals use forage in an adjacent emphasis area. Hes is low because of the un-fragmented nature of the wilderness. This area receives low human use: people generally pass through to other destinations.

Horse Lake: This High Emphasis area is located in the wilderness, and it is entirely summer range. Because of its high elevation, access is limited by snow pack. It receives moderate elk use, generally for a short period of time in the summer. Forage is extremely limiting. HEs is low because of the un-fragmented nature of the wilderness. Human use is moderate to high, but hunting pressure is low.

North Side Horse: This Moderate Emphasis area is located on Foley Ridge. It provides critical winter range. There is high elk use year-round, and it receives the heaviest local road hunting. The topography of the ridge provides excellent escapement habitat (i.e. the animals escape down the steep sides when disturbed). Clearcut areas are still providing high quality forage, but they will shift to hiding cover within 10 years. The area is heavily roaded, but some spurs are closed. The linear ridge road heavily influences the quality of the habitat. All HE values are above thresholds, however some improvement could be made with roads by closing the 2643-469 road (2 miles)

and the 2643-480 road that heads into the Rainbow Falls viewpoint. The Viewpoint road is currently bermed, but it is not functioning. Closing these roads would increase Her to 0.42.

Castle/Mosquito/Pasture/Pothole: This Moderate emphasis area receives low to moderate elk use in the eastern half (lower elevations) where abundant meadows are located. Because of its steep topography, the majority of the area receives little use. Timber harvesting activity has created some forage, but the units will transition into cover within the next 10 years. The meadows will still be providing the best forage at that time.

King Creek: This Moderate Emphasis area receives very limited use. Elevations range from winter to summer range, however the topography is very steep. HEs is low because of the un-fragmented nature of the wilderness. There has been very little timber harvest in the area and no natural openings. Once the created openings succeed into cover, there will be no forage openings created in this emphasis area because it is within an LSR.

Avenue/Cedar Swamp/E. Creek/Owl Creek: This Moderate Emphasis area receives high elk use in the lower elevation, northern portion. This are provides access to good forage and riparian areas. Southern portions are extremely steep, north aspect slopes that do not receive much elk use. Abundant private ground zoned for timber production could influence future use of the area. Once the created openings succeed into cover, there will be no forage openings created in this emphasis area because it is within an LSR. However, abundance meadow habitat will continue to provide forage.

Castle-Taylor: This Moderate Emphasis area is entirely winter range, and supports a healthy herd. The animals heavily use the riparian zone of West Fork Horse Creek. HEs is low because of the lack of timber harvest and the abundance of private residences in the area. HEf is low, but private pasturelands are probably providing abundant forage.

WILDLIFE GUILDS

The Willamette National Forest utilized a process developed by Mellen et al. (1994) for identifying and mapping habitat for wildlife guilds at a landscape scale. The process was applied to the entire Willamette National Forest. A description of the guilds is listed in the Wildlife Appendix. The following is an analysis of the results for terrestrial and special habitat guilds.

Early Seral Species

There are 43 species in the watershed (15%) that based on life history information use early seral habitat as primary breeding and/or foraging habitat. These species were grouped into 4 guilds. The amount of quality habitat currently on the landscape for these species is listed in Table 3-14.

Table 3-14: The number of early seral species in the Horse Creek watershed, and the percentage of the total available early seral habitat that is suitable or non-suitable quality.

Guild	# Species	% Suitable	% Non-Suitable
TLME	3	62	38
TMME	2	62	38
TSME	14	93	7
TSPE	24	89	11

Currently early seral habitat comprises 11,401 acres or 11% of the watershed. The majority (>60%) of the early seral habitat is suitable for these guilds based on patch size and distribution on the landscape.

It is unknown whether the amount and distribution of this habitat type is adequate to maintain viability of these species. The majority (roughly 90%) of this habitat type is currently lacking structural components (snags and down woody material) critical for successful reproduction of **all** of the species in these guilds. This fact reduces the potential species' richness and population levels within early seral forests currently on the landscape.

Early seral forest has been created almost exclusively through timber harvest in the past 80 years, with the exception of small burns in the wilderness. Early seral will continue to be created in the matrix portions of this landscape on Foley Ridge, and the newly created openings will contain structural components important to these species. The majority of this watershed is LSR and Wilderness, and future creation of early seral habitat will be limited to fires (prescribed and management ignited) in these areas. The watershed is currently trending outside of its historic range of variability for this habitat because of fire exclusion. Prescribed Natural Fire Plans and Management Ignited Fire Plans for the Wilderness areas may provide the greatest opportunity for providing high quality early seral habitat in the future.

Mid Seral Species

There are no species in the watershed that primarily use mid-seral habitat for breeding and/or foraging. There are species, however, that can use early and mid (5 species) or mid and late (11 species). Because these species have the flexibility to use more than one habitat type, they have been classified as *generalists*. The availability of habitat for these species is summarized in Table 3-15.

Table 3-15: Habitat for species that can use a combination of early/mid seral forest or mid/late seral forest in the Horse Creek Watershed; and the percentage of the total available habitat that is suitable or non-suitable.

Guild	# Species	% Suitable	% Non-Suitable
TSGML	11	96	4
TSGEM	5	99	1

Currently mid and late seral habitat comprises 80,534 acres or 79% of the watershed, and the majority is of suitable in terms of patch size and distribution. Early and mid seral habitat comprises 59,683 acres or 59% of the watershed. The majority is suitable, though the discussion on missing structural components described above for the early seral species applies here as well. Species with the plasticity to use mid and late seral habitat generally require structural elements of snags, large green trees, and large down material to maximize potential use by mid seral habitat. Greater than 90% of the existing mid seral stands have been created from historic fires, with the remainder resulting from past harvesting. We do not have good data to estimate the amount of structural elements retained in the existing mid-seral stands. To provide for the highest potential species richness in the mid seral stands, structural elements will need to be present.

Late Seral Species

There are 12 species in the watershed (4%) that based on life history information use late seral habitat as primary habitat for breeding and/or foraging. These species were grouped into 3 guilds. The amount of quality habitat currently on the landscape for these species is listed in Table 3-16.

Table 3-16: The number of late seral species in the Horse Creek Watershed, and the percentage of the total available late seral habitat that is suitable or non-suitable.

Guild	# Species	% Suitable	% Non-Suitable
TLML	6	88	12
TMML	2	96	4
TSPL	4	97	3

Currently late seral habitat comprises 31,787 acres or 31% of the watershed. The majority is high quality in terms of patch size and distribution. This habitat type appears to be well-distributed throughout the landscape. Approximately 91% of the existing late seral habitat for these guilds is in no harvest allocations, including wilderness, late successional reserves, and riparian reserves.

These species do not require large contiguous tracks of late successional habitat. They are either mosaic species (goshawk, spotted owl) or patch species (red tree vole, brown creeper). The viability of the large home range, mobile, mosaic species is moderate to high under the Northwest Forest Plan. Concerns exist for the low mobility patch species, such as the red tree vole, and managing the landscape to provide high probability of flow is important to maintain their viability (see red tree vole discussion). There is a high potential for future connectivity in this landscape because of the no-harvest allocations of wilderness and LSR (Map 3-22). However, because of the low density of spotted owl sites in the extreme western portion of this watershed, a no-harvest allocation based on the 1990 LMP Pileated Woodpecker/Pine Marten Management Area would be desirable to fill a "hole" in the small LSR network.

Contrast Species

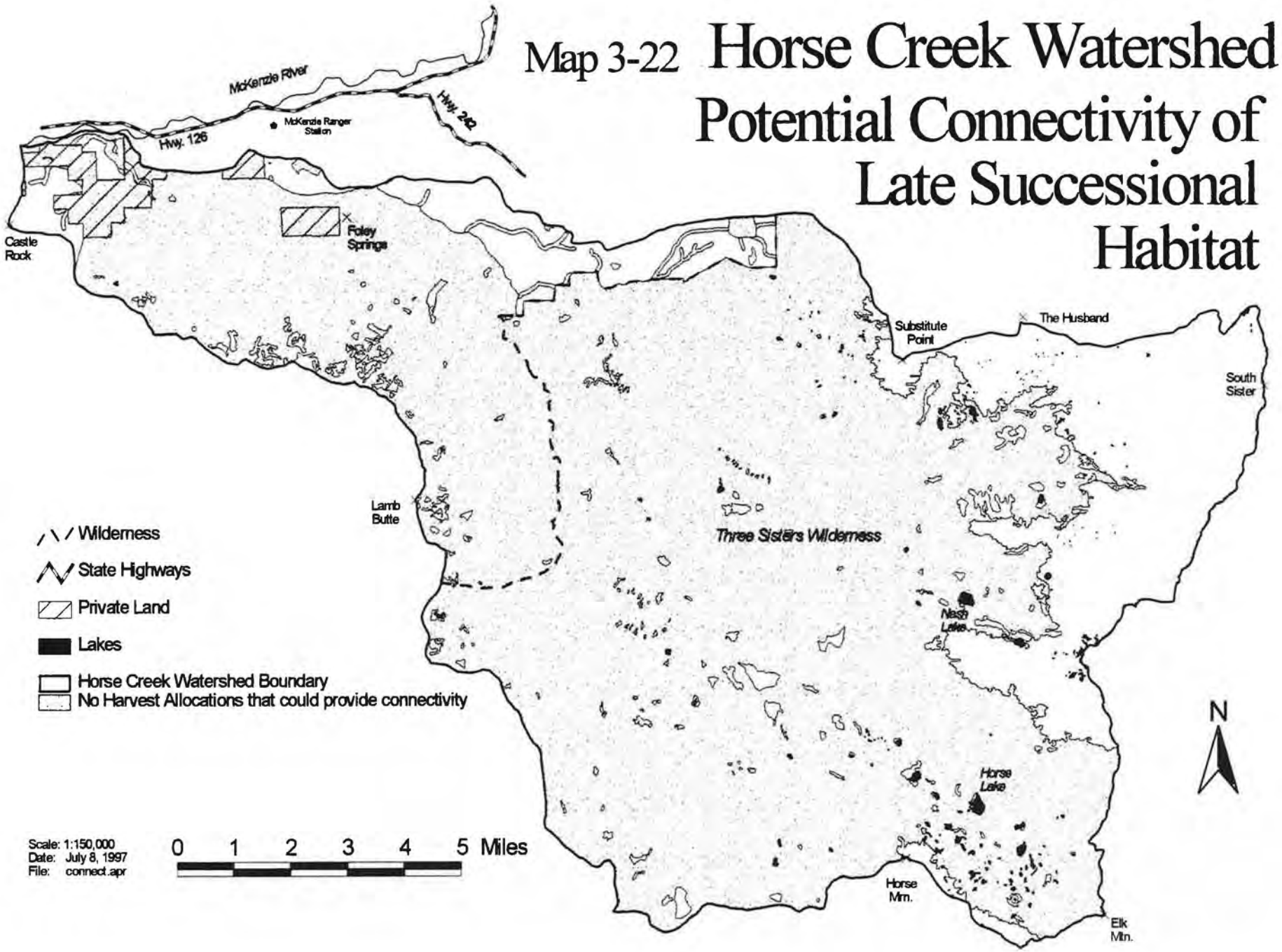
There are 14 species in the watershed (5%) that based on life history information use edge habitat between early seral and other older forests as primary habitat for breeding and/or foraging. These species were grouped into 3 guilds. The amount of quality habitat currently on the landscape for these species is listed in Table 3-17.

Table 3-17: Contrast species in the Horse Creek Watershed and the percentage of the existing contrast habitat that is suitable or non-suitable.

Guild	# Species	Suitable	Non-suitable
TLC	7	42	58
TMC	4	43	57
TSC	3	47	53

The majority of the watershed is not providing edge habitat. What is available is most abundant in the harvested areas in the Foley Ridge and Wapiti areas. There is high-quality edge habitat in the Wilderness between late successional forest and natural meadows that are not included in this analysis. The creation of this habitat type will be limited in the future because of reduced harvest levels in the remaining matrix lands, however fire disturbance in the wilderness or LSR under PNF or MIF plans could provide habitat in the future. Viability analysis for these species should occur to determine the amount of habitat required to maintain these populations.

Map 3-22 Horse Creek Watershed Potential Connectivity of Late Successional Habitat



Generalist Species

There are 115 species in the watershed (39%) that are considered generalists. They can use several different seral stages as primary habitat for breeding and/or foraging. These species were grouped in 3 guilds: TLGG (9 species), TMGG (20 species), and TSGG (86 species). These species can be found throughout the watershed. In general, there are few concerns for their viability. Management strategies that retain structural elements within all seral stages and provide a diversity of forested habitats throughout the landscape will benefit these species. Ninety-six percent of these species use snags for breeding, and 84% use large woody debris.

Special Habitat Species

There are 27 species in the watershed (9%) that are highly associated with special habitats such as wetlands, caves, meadows, and ponds. Special habitats are protected through Standards and Guidelines in the Forest Plans. The only known threat to these ecosystems at this time is grazing by pack animals in some wilderness meadows. The majority of the special habitats within the watershed are not at risk to loss of integrity.

Flow between these habitats should be ensured over time to maintain genetic diversity, and long-term plans to manage connecting habitats should be considered in any landscape design. This can be accomplished through canopy closure maintenance, contiguous areas with large woody debris, and protected riparian areas.

Riparian Species

The riparian reserve strategy outlined in the Northwest Forest Plan (1994) assumes that the reserves will provide protection for riparian-associated species and dispersal habitat on the landscape for forest-dwelling species. The following discusses the condition of the Horse Creek Watershed riparian network and evaluates the potential for success of the riparian reserve strategy on this landscape.

There are 60 species of wildlife within the watershed that use riparian areas as primary habitat for breeding and for feeding. The Wildlife Appendix displays riparian-associated species and the stream classes used as primary habitat. Approximately 30% are migrating waterfowl that primarily utilize the water column. Twenty-two percent of the riparian associated species require mid or late seral forests adjacent to class 1-3 streams, lakes, and ponds. Table 3-18 displays the current condition of forested areas in riparian areas of all allocations. Map 3-23 displays the potential riparian area network in this watershed.

The intermittent nature of class 4 streams probably precludes primary use by most species. However, the Dunn's salamander and the Cascade Salamander may use these areas, particularly where there are seeps or pools that hold water into the summer.

Map 3-23 Horse Creek Watershed Riparian Areas

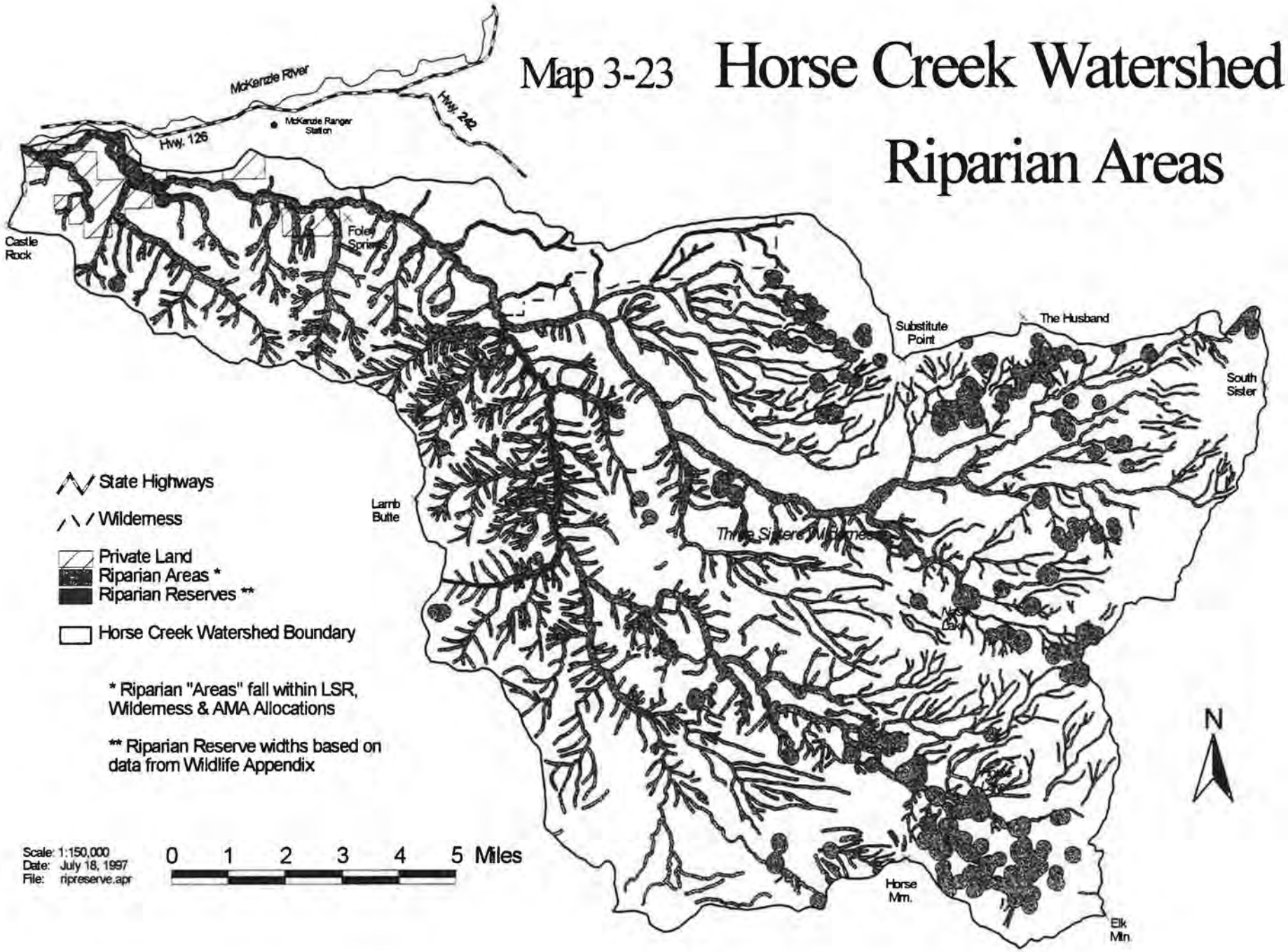


Table 3-18: Forested condition of riparian "areas" in the Horse Creek Watershed. ("area" includes the stream and the adjacent landscape extending a distance equal to an Interim Riparian Reserve width as defined by the 1994 ROD and displayed in the Wildlife Appendix)

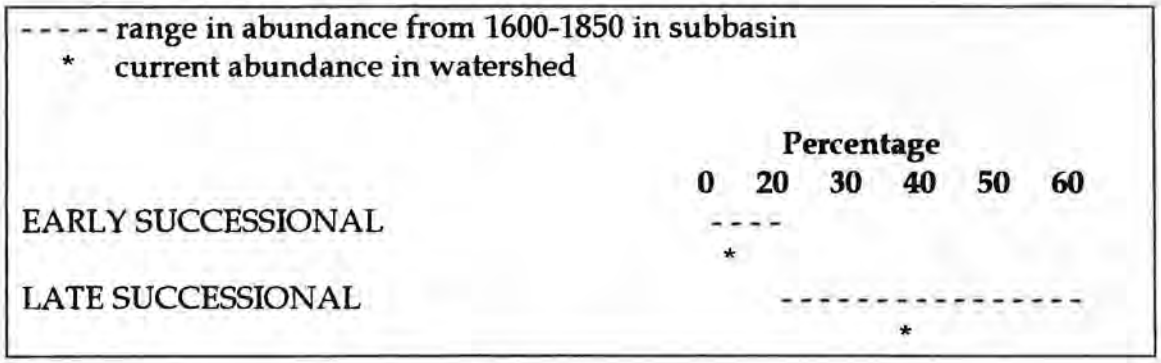
CONDITION OF FOREST* IN RIPARIAN AREA	STREAM CLASS I	STREAM CLASS II	STREAM CLASS III	STREAM CLASS IV	% OF TOTAL RESERVE NETWORK
Early Seral Forest	56	111	175	596	4
Mid Seral Forest	773	2086	1767	8531	52
Late Seral Forest	1452	1276	1347	5409	38
Non-Forested	50	253	349	831	6
Percentage of Total Reserve Network	9	15	15	61	

*See Silviculture Appendix for definitions of stand conditions

The riparian area network (based on interim reserve widths in all allocations) totals over 30,000 acres for this watershed, which is 30% of the entire landbase. The majority of the riparian areas (>97%) lie in the wilderness and late successional reserve, where they will either continue to be or will develop into late successional stands, barring wildfire disturbance. Riparian reserves occur only on Class III and IV streams in matrix lands in this watershed, and the team recommended that their widths follow the interims from the Northwest Forest Plan in these areas.

The REAP report (1993) modeled the range of early and late seral habitat that occurred in the McKenzie subbasin between 1600 and 1850. Table 3-19 displays this range of variability and compares it to current habitat abundance. The watershed is currently within the range of natural variability of the subbasin for these habitats. However, early successional habitat is trending outside of the historic range, due to fire exclusion in the wilderness.

Table 3-19: Historical range of stand conditions in the McKenzie basin between 1600-1850 compared with current abundance in the Horse Creek Watershed.



Considerations for Forest Management

If reductions in interim riparian reserve widths from the Northwest Forest Plan (1994) are proposed, additional analysis is recommended for several species (Riparian Reserve Module 1997). Table 3-20 displays the risk factors associated with species at the greatest risk following changes in reserve management.

Table 3-20: Wildlife species most at risk to changes in riparian reserve management.

SPECIES	RISK FACTORS	DISPERSAL CAPABILITY	ABUN-DANCE	HABITAT USE
P. Dubium	road maintenance in rockslide areas, loss of hardwood woody debris in riparian habitat, desiccation	Restricted	Rare	Mesic parts of riparian zone not seasonally flooded
N. Spotted Owl	fragmentation and conversion of Late successional habitat	Broad	Rare	Late successional forests
Marten	fragmentation and conversion of Late successional habitat, loss of large woody debris	Broad	Uncommon to rare	Late successional habitat in riparian zones
Red Tree Vole	fragmentation and conversion of Late successional habitat	Broad	Rare	Mid and late successional forests
Tailed Frog	loss of streamside habitat, increased temperatures, sedimentation	Broad	Rare	Requires cool, fast flowing streams
Cascade Torrent Salamander	loss of headwater, intermittent, and seep habitat	Restricted	Rare	Requires water to breed
Dunn's Salamander	Loss of riparian habitat	Broad	Common	Does not require water to breed

The team recommended that class 1-2 streams maintain the Northwest Forest Plan interim reserve widths to protect the hydrological function, plant community, fish and wildlife habitat. This recommendation should reduce concerns for the majority of species listed in Table 3-20.

The team recommended that Class IV streams may receive variable widths after additional site-specific analysis is conducted and a landscape design is completed. Re-creating patterns similar to those that resulted from past disturbance events would be the impetus for alterations to class IV streams.

The Northwest Forest Plan interim riparian reserves for class IV streams appear to have been prescribed to perform 3 functions for wildlife, and these factors would require consideration in the development of a landscape design:

1. Dispersal habitat for terrestrial upland species such as the spotted owl, marten, and red tree vole. Dispersal for the upland terrestrial species can be provided by other landscape patterns not necessarily related to Class IV reserve distribution. Well-distributed patches of late successional habitat linked by patches of mid seral forest in a pattern similar to the 50-11-40 "rule" would adequately provide for this function. Within this landscape, the majority of all stream classes are part of large no-harvest allocations, such as wilderness and late successional reserves. The majority of the existing late successional habitat in class IV reserves would be retained, ensuring adequate dispersal habitat for these terrestrial species.

2. Dispersal habitat for species associated with the wetted portion of the riparian buffer such as tailed frog and Cascade Torrent salamander. Reserves that maintain shade over the channel to maintain the microclimate could allow continuing use of the wetted portion of the channel to be used for dispersal.

3. Breeding habitat for species such as the Cascade Torrent salamander. Breeding habitat functions for amphibians listed in Table 3-20 could be provided for by maintaining high quality cover on critical portions of class IV streams. Reserves or no-harvest buffers of a width that adequately protects the water quality and temperature of seep areas should be a high priority. Surveys for Dunn's and Cascade salamanders should be a priority in class IV reserves proposed for reduced riparian reserve.

Fire Impacts to Wildlife

Table 3-21 displays the potential impacts of fire on the habitat for species of concern in this watershed. Direct impacts to the species are varied, and would depend on the timing and intensity of the fire event. Generally, expected impacts could include displacement, death to individuals from smoke inhalation and heat, and starvation from loss of prey base. The critical time period when fire could have the greatest direct impacts is prior to fledging.

Table 3-21: Short and long-term impacts of fire to habitat for species of concern in the Horse Creek Watershed.

	SHORT TERM			LONG TERM	
SPECIES	**LOW INTENSITY**	**HIGH INTENSITY**		**LOW INTENSITY**	**HIGH INTENSITY**
Threatened & Endangered					
Spotted Owl	0	-		+	-/+
Bald Eagle	0	-		+	-/+
Peregrine falcon	0	-/+		+	-/+
Sensitive					
Sandhill Crane	0	-		+	+
Harlequin Duck	0	0/-		0	0/+
Red-legged frog	0	0/-		0	0/+
Wolverine	0	0		0	0
Big-eared Bat	0	-/+		+	+/-

	SHORT TERM			LONG TERM	
SPECIES	**LOW INTENSITY**	**HIGH INTENSITY**		**LOW INTENSITY**	**HIGH INTENSITY**
Species of Concern					
Great Gray Owl	0	-		+	+
Black-backed woodpecker	+	0/-		0	0/+
3-Toed Woodpecker	+	0/-		0	0/+
Red tree vole	0	-		+	-/+
Goshawk	0	-/+		+	-/+
Spotted Frog	0	0/-		+	0/+

0 = Neutral impact to habitat
+ = Positive impact to habitat
- = Negative impact to habitat
-/+ = Mixed impacts
0/+ = Mixed impacts

HORSE CREEK WATERSHED ANALYSIS

CHAPTER 4

SIGNFICANT FINDINGS AND RECOMMENDATIONS

INTRODUCTION

The following Tables summarize significant findings and recommendations documented in the Horse Creek Watershed Analysis. Information to support the recommendations can be found in Chapter 3.

Table 4-1: A summary of significant findings and recommendations documented within the watershed analysis. Detailed information to support these recommendations can be found in Chapter 3. The McKenzie RDMA evaluates all potential projects listed in watershed analyses at the beginning of each fiscal year, and determines their priority in the context of personnel availability, funding, and potential for resource impacts.

SIGNIFICANT FINDING	RECOMMENDATION	ACTION REQUIRED
AQUATIC HABITAT AND FISHERIES		
There has been a reduction in channel complexity (LWD and pools per mile, 40-50%) as a result of stream cleaning and flooding (1964 flood and 1933 moraine failure on South Sister)	Identify opportunities to restore channel complexity and recruitment frequencies based on historic levels in lower and upper Horse Creek. This could include LWD management, opening channels, or vegetation treatment in the riparian zone.	DEVELOP IMPLEMENT PLAN COORDINATE
One significant human-placed fish barrier currently exists in the watershed on Pothole Creek.	Improve fish passage at culvert barrier on Pothole Creek. A plan and finances has been established to correct this problem.	IMPLEMENT PLAN
Bull trout spawning/rearing habitat within in Horse Creek/Separation Creek is incomplete.	Based upon previous probes, focus future probes on Separation Creek (RM 0-4) and Horse Creek (in the Eugene Creek area). Include temperature in data collected. Actively coordinate increased survey efforts and data collection with ODFW. Establish redd index reaches.	COORDINATE WITH ODFW. SURVEY
Spring Chinook numbers have declined in the watershed.	Participate in monitoring efforts of spring chinook with resource agencies. Efforts would include establishment of index spawning reaches and juvenile rearing surveys.	MONITOR AND COORDINATE W/ODFW

SIGNIFICANT FINDING	RECOMMENDATION	ACTION REQUIRED
AQUATIC HABITAT AND FISHERIES cont.		
Brook trout are a threat to native cutthroat trout populations in the Horse Lake Complex, Nash Lake, and upper Horse Creek; and a threat to native bull trout wherever they occur in the watershed.	Participate in brook trout management with resource agencies. Monitor bull trout spawning/rearing for impacts by brook trout. Recommend no stocking of any trout species in lakes with reproducing native populations. Develop brook trout reduction program with resource agencies.	COOPERATE W/ODFW. DEVELOP BROOK TROUT PLAN TO REMOVE FROM WATERSHED
The extent of the impact of hatchery spring chinook and summer steelhead on wild spring chinook and native "redside" rainbow trout populations is unknown.	Assist resource management agencies in monitoring wild spring chinook and "redside" rainbow trout populations.	COOPERATE WITH RESOURCE AGENCIES
Introduced non-native trout in high lakes is likely impacting native fauna.	Determine high lakes biota and water quality in managed and un-manged lakes. Provide stocking recommendations to ODFW based on results.	CONTINUE HIGH LAKES INVENTORIES
Bull trout and Chinook are presently species at risk in the watershed.	Maintain or enhance habitat necessary to both species. Restoration of predator species (bull trout) requires restoration of prey species (spring chinook).	IMPLEMENT RESTORATION
1964 flood significantly altered channel pattern, complexity, and riparian vegetation	Recognize potential impacts of large flood events when planning management within floodplain and slide-prone upslope areas.	INFO FOR FUTURE PLANNING
1996 flood caused relatively insignificant channel changes. Localized bank cutting/bar deposition occurred.	Monitor vegetative recovery on depositional bars. Continue cross-sectional profiles to track channel changes.	MONITOR
Pre-1964 flood, lower Horse riparian vegetation dominated by conifers; post-1964 flood, areas dominated by hardwoods.	Silvicultural activities within the floodplain to promote conifer growth should reflect historic conditions.	INFO FOR FUTURE PLANNING

SIGNIFICANT FINDING	RECOMMENDATION	ACTION REQUIRED
AQUATIC HABITAT AND FISHERIES cont.		
Water temperature in Horse Cr. meets anadromous temperature standards, but does not meet current bull trout standards as set by DEQ. However, background temperatures have only been minimally influenced by human activity.	Continue water temperature monitoring station in lower Horse Creek. Install temperature instrument in Separation Creek. Work with DEQ, USFWS, and ODFW to determine appropriate standards based on site-specific conditions.	INSTALL TEMP INSTRUMENT IN SEP-ERATION CR. DIALOG WITH DEQ/ODFW/US FWS FOR APPRO-PRIATE STANDARDS
Riparian areas on Class I and II streams fall within late successional reserves and wilderness.	Manage for ACS Objectives with consideration for extent of floodplain.	INFO FOR FUTURE PLANNING
Riparian Reserves widths on Class III and IV streams in the watershed could be altered following a Landscape Design if ACSO's can still be met.	Consider historic range of variability of landscape and ACSO's to determine riparian reserve widths.	INFO FOR FUTURE PLANNING

SIGNIFICANT FINDING	RECOMMENDATION	ACTION REQUIRED
SOILS AND WATERSHED		
The frequency of slope failures has trended outside of the historic range of variability due to road construction on slopes greater than 70 percent and/or on unstable soils or landforms, particularly on the FR1993.	Road alignments that are currently contributing to slope failures due to their position on the landscape or soil type should be evaluated for potential re-alignment or decommissioning. Field validate slopes, soils and landforms which should be avoided during future road construction. Full bench construction and end haul of material should be required where road alignments must be constructed on potentially unstable soils or slopes.	IMPLEMENT RESTORATION. INFO FOR FUTURE PLANNING.
The frequency of slope failures has trended outside of the historic range of variability where regeneration harvest has occurred on potentially unstable soils. Known slope failures related to land management occurred on SRI 16, 168, 203 and 612 soil/landform types.	Field validate soils and landforms that contribute to slope failures following regeneration harvest. Implement silvicultural prescriptions that leave sufficient numbers of live trees to maintain a relatively high evapotranspiration demand and an interlocking root network.	INFO FOR FUTURE PLANNING. INVENTORY
Upland grassland communities are uncommon and are decreasing in size due to extension of the fire return intervals through human intervention.	Accurately map grassland communities and the associated soils that were historically maintained by frequent fire. Re-introduce fire to these systems.	MAPPING AND RESTORATION WITH FIRE
The 1990 SRI Atlas (GIS spatial data base) does not reflect the diversity of various soils that occur within the watershed. These soil types include: rock outcrop, unsuited soils; wetlands; soils associated with fire disclimax grassland ecosystems; and soils common to riparian areas.	Accurately map the diversity of soils with project-level surveys. Priority should be given to mapping restrictive soil types (rock outcrop and unsuited soils), grassland, riparian and wetland soils and their associated plant communities.	CORRECT DATA AND INFO FOR FUTURE PLANNING

SIGNIFICANT FINDING	RECOMMENDATION	ACTION REQUIRED
SOILS AND WATERSHED cont.		
As mapped with existing, un-field-verified SRI information, there are soils with high erosion potential throughout the watershed. These soils occur primarily in the Wilderness and within the LSR; however, they are present in the matrix allocation. .	Field verify the erosion potentials of soils on a project-level basis, and incorporate information in project design, adoption of BMP's, and site specific mitigation measures.	INFO FOR FUTURE PLANNING
The majority of soils are site class 4 & 5 (low productivity). These soils are located throughout the watershed, however, the least productive soils occur in the wilderness and steep slopes of the LSR. Matrix land allocations are dominated by higher productivity soils; however, site class 4 and 5 do exist in inclusions in these areas.	Validate soil productivity on a project level basis and adopt silvicultural prescriptions which address the ability to meet desired future conditions.	VALIDATE DATA. INFO FOR FUTURE PLANNING
A site-specific assessment of sediment production from roads and transport mechanisms into the drainage network has not been performed. Specific road alignments that indirectly contribute sediment into Horse Creek have not been determined.	Conduct surveys and map locations where sediment production from roads could enter the Horse Creek drainage network.	SURVEYS
Several residences on the east side of Horse Creek are located within the area potentially subject to flooding during >50 year flood events.	Share this information with landowners.	OBSERVA-TIONAL MONITORING

SIGNIFICANT FINDING	RECOMMENDATION	ACTION REQUIRED
SOILS AND WATERSHED cont.		
Two of the Midpoint ARP values should be updated due to additional information gained since the LMP was finalized in 1990: Lower Horse and Separation Creek.	Change the recommended Midpoint ARP for Lower Horse to 75-80 due to a high landtype sensitivity and high beneficial use of anadromous fish; and change Separation Creek to 70-75 because it is bull trout habitat, and therefore should have a high beneficial use., instead of its current moderate level.	FOREST PLAN REVISION OR NON-SIGNIFICANT AMENDMENT TO PLAN
Though none of the drainages exceed 3.0 miles/square mile of roads, Avenue/Wilelada and Castle/Pothole may experience increased peak flows due to road densities, steep slopes, and shallow soils.	Monitor contribution of these areas to peak flows through a research project.	RESEARCH. INFO FOR FUTURE PLANNING
LWD in the Horse Creek floodplain may be reduced from historic levels because sideslope large woody debris in carried by debris torrents could be intercepted by road 2638.	Review debris torrents intercepted by roads as a source of instream/riparian restoration material. Provide a means of instream and riparian recruitment of sideslope debris torrent material to the Horse Creek floodplain and channel.	RESTORATION
ARCHAEOLOGY		
Majority of known pre-historic sites are on Foley ridge (due to sampling intensity associated with timber sales). Existing data is still sketchy.	Consider developing a broad area research design to identify location of sites.	RESEARCH
Wilderness lake locations have high probability for pre-historic/historic sites from sheep grazing activity. Virtually no surveys have been conducted in the wilderness, resulting in impoverished data.	Consider developing a sample survey for the wilderness in high probability sites.	SAMPLING
In 1872-1938: three allotments for sheep grazing. Probably grazing in 1860's also, but un-alotted.	Conduct archival research into grazing and historic period of Native American presence.	RESEARCH

SIGNIFICANT FINDING	RECOMMENDATION	ACTION REQUIRED
ARCHAEOLOGY cont.		
Rumored conflicts between sheepherders and native Americans may have occurred in the 1860's.	Conduct archival research into grazing and historic period of Native American presence.	RESEARCH
Incursions by northern Pauite is poorly known. May be archaeological sites relating to this that we haven't found yet.	Conduct archival research into grazing and historic period of Native American presence.	RESEARCH
Medicinal plant gathering occurred in Lamb Butte area.	Conduct interviews with Warm Springs Indian Tribe members, and members of the Siletz and Grande Ronde tribes.	INTERVIEWS
We assume that until around 1910, humans caused a fair amount of fires. More of the historical fires were caused by sheep herders than native Americans.	Consider influence of humans in development of existing vegetation during PNF planning.	INFO FOR FUTURE PLANNING
HUMAN USE		
Human use is highly associated with water. Exceptions occur where there are special resources of interest (i.e. James Creek shelter)	Establish and implement monitoring strategy to examine possible impacts of this use on water associated values	DEVELOP MONITORING PLAN MONITOR
AUM's are down from historic levels. AUM's are now recreational stock.	Determine if current grazing levels are compatible with range conditions.	RESEARCH MONITOR
The season of use for grazing is more critical than number of stock.	Monitor meadow and forage condition.	MONITOR
The trail system was develop in 1930's. Changes that have occurred have been in response to resource problems.	Continue monitoring trail condition for associated resource impacts.	MONITOR RECONSTRUCT /RELOCATE SEGMENTS AS NEEDED

SIGNIFICANT FINDING	RECOMMENDATION	ACTION REQUIRED
Wild and Scenic		
There are 2 streams eligible for Wild and Scenic evaluation that do have outstanding remarkable values.	Validation of this analysis will occur in a Forest-level suitability study EIS. This will involve the public.	FOREST-LEVEL PLANNING
These eligible rivers will be protected with Forest Plan direction until study is completed and Congress determines if the rivers are to be designated.	Any activities that may take place within ¼ mile of these streams must be evaluated to determine if they will alter the ORV's.	INFO FOR FUTURE PLANNING
FIRE		
Fires are generally smaller in size now than historically because of suppression efforts, resulting in early seral forests trending outside of the natural range of variability, and the pattern of forested stands shifting to a smaller average patch-size, particularly in the wilderness.	Investigate re-introduction of fire in the wilderness, either through PNF or MIF, to re-establish historic regimes.	RE-INTRODUCE FIRE
High intensity fires >5000 acres in size are possible under current vegetation conditions in the absence of active suppression.	MIF may be an option to reduce risk of large fires that would otherwise conflict with other resource values.	INFO FOR FUTURE PLANNING
VEGETATION		
White bark pine may be reduced due to changes in associated vegetation and increased in disease (blister rust)	Monitor for resistant trees. Develop a select-tree program.	MONITOR
Insects (spruce budworm) and disease (Mistletoe/Canker) have increased with fire suppression.	Investigate treatment of Pacific silver fir to reduce stress and subsequent insect and disease infestations.	INFO FOR FUTURE PLANNING
All white pines in watershed have been significantly reduced by blister rust.	Emphasize planting disease-resistant white pines in areas within historic range.	INFO FOR FUTURE PLANNING

SIGNIFICANT FINDING	RECOMMENDATION	ACTION REQUIRED
VEGETATION cont.		
More phelinus will be seen as more stands develop late successional characteristics. This may become impactive to campgrounds and other recreation sites.	Monitor progress of disease. Areas of high recreation use should consider site conversion to hardwoods and resistant conifers.	MONITOR
Many of the stands in the matrix allocation have high density conditions contributing to stress. This is a result of natural conditions created by stand replacement fires at the turn of the century.	Emphasize stocking control through precommercial thinning and commercial thinning to increase growth and vigor on remaining trees. Use prescribed fire where appropriate.	INFO FOR FUTURE PLANNING
There has been a loss of old growth system function from edge effect in leave blocks.	Opportunity for large block, minimum fragmentation strategies may be appropriate in these areas.	INFO FOR FUTURE PLANNING
Historically, fires driven by east winds have had the most significant affect on landscape diversity.	This orientation could be used as a guide for shaping future landscape patterns.	INFO FOR FUTURE PLANNING
Fire is critical for maintenance of meadow vegetation and subalpine habitat.	Prescribe low intensity surface burns in dry meadows and subalpine areas.	RESTORATION
The size class for un-managed, older stands in Forest GIS vegetation layer is overestimated. This will significantly overestimate timber volume and habitat on the landscape whenever size class is used as the primary field for queries.	Fix database as soon as possible with field collected information. Re-calculate resources based on new information.	DATA CORRECTION
Olallie Ridge Research Natural Area is surrounded by an LSR.	Manage young stands in the LSR to develop late-successional & old-growth characteristics. Monitor and manage for invasive non-native & noxious weeds.	INFO FOR FUTURE PLANNING

SIGNIFICANT FINDING	RECOMMENDATION	ACTION REQUIRED
SPECIAL HABITATS / PLANT SPECIES OF CONCERN		
Appendix J2 of the 1994 Forest Plan FSEIS listed several recommendations for the Lamb Butte Scenic Area that have yet to be investigated.	Investigate changing land allocation for Lamb Butte to be an RNA or Mycological SIA. Survey & manage known fungi sites & habitat.	SURVEY. INVESTIGATE LAND ALLOCATION CHANGE OR ADD EMPHASIS OF MYCO-LOGICAL SIGNFICANCE IN AN SIA IMPLEMENTA-TION GUIDE
Horsepasture Mountain is one of the most floristically diverse area in the entire Western Cascades.	Non-forested habitat types and associated plant communities need to be field verified & entered into GIS.	FIELD VERIFICATION
During this century, tree invasion & establishment in many of the meadows was promoted on cold/ wet sites by warmer, dry weather. Conversely, this process was promoted on warm/dry sites by cold, wet weather.	Maintain integrity of the plant communities and habitat types. Monitor and manage for invasive non-native & noxious weeds.	MONITOR AND MANAGE

SIGNIFICANT FINDING	RECOMMENDATION	ACTION REQUIRED
SPECIAL HABITATS / PLANT SPECIES OF CONCERN cont.		
Mesic & wet meadows at James Creek, Separation Meadow, & Buck Meadow are impacted by human/packstock use.	Develop a management plan that could include recommendations for rehabilitation such as closing and rehabilitating heavily impacted campsites; continued use of riparian and trail setbacks; educational signs; pellet food for stock animals.	REHABILITA-TION EDUCATION. COORDINA-TION W/MAN IN THE BIOSPHERE PROGRAM
Conifer encroachment is occurring in some higher elevation meadow habitats.	Prescribe ignition or natural fire where possible. Mechanical thinning of conifers may be necessary in specific meadows.	INFO FOR FUTURE PLANNING
Human traffic is impacting Wickiup Plains because of the erosive soils. The actual acres impacted, however, is extremely small (<0.25 acres or 0.002% of the entire community).	Investigate the recreation use & impacts to the area. Make recommendations to improve habitat conditions and to mitigate future negative impacts; manage stock and foot traffic moving through Wickiup Plains.	INVESTIGATE IMPACTS. RESTORE
Subalpine/alpine plant communities are most at risk to global warming impacts.	Monitor subalpine/alpine plant communities for changes. Coordinate long term field studies with the scientific community.	MONITOR. RESEARCH
No comprehensive plant surveys have been done in wilderness for rare plants or noxious weeds. No surveys for survey and manage species have occurred in the watershed.	Initiate field reconnaissance for rare plants and non-native plant species. Establish survey protocol for wilderness rangers to record non-native plants in the wilderness.	SURVEY

SIGNIFICANT FINDING	RECOMMENDATION	ACTION REQUIRED
SPECIAL HABITATS / PLANT SPECIES OF CONCERN cont.		
Significant quantities of weeds are located adjacent to roads to trailheads: weeds have the potential to move into the wilderness.	Survey trailheads to determine type & quantity of weeds. Treat weeds to prevent entry into wilderness areas. Place weed educational signs at trailheads to inform the public.	SURVEY AND TREAT
The sensitive plant, Adder's tongue, near Owl Creek is being impacted by aggressive vegetation in the meadow. This is one of only six populations in Oregon.	Manually remove encroaching vegetation. Continue to monitor population.	RESTORATION AND MONITORING
WILDLIFE		
The only known breeding sandhill cranes on the District are in this watershed	Develop monitoring strategy to assess extent of population. Consider re-location of trail and/or campsite to reduce impacts if necessary.	MONITOR. DEVELOP SITE PLAN
Spotted frog populations within and adjacent to this watershed may be negatively impacted by sport fish stocking	Survey habitat to determine population extent, and develop Conservation Agreement with USFWS. Increase awareness of ODFW to known populations, and reach agreements to reduce stocking in populated habitat.	SURVEYS DEVELOP CONSERVA-TION AGREEMENT
High Emphasis elk areas in wilderness do not meet HEc or HEs and can not meet with existing forest types.	Develop alternative model thresholds with ODFW that realistically reflect the condition of the landscape or redefine habitat definitions to reflect the habitat potential for higher elevation forested communities.	COORDINAT-ION W/ODFW
Impacts from hunters in wilderness camps is increasing.	Develop hunter's ethics material, and locate at trailheads.	EDUCATION

SIGNIFICANT FINDING	RECOMMENDATION	ACTION REQUIRED
WILDLIFE cont.		
HEr could be increased in 2 elk emphasis areas with the closure/decommissioning of roads 2643-485, 2643-469, and road into Rainbow Falls viewpoint.	Investigate with recreation and soils/hydrology the decommissioning/closure of these roads.	ROAD CLOSURE/-DECOMISS-IONING
Potential Habitat for Threatened, Endangered, Sensitive, and other species of concern has not been systematically surveyed in the wilderness.	Develop strategy for conducting surveys for these species. Use the Wilderness Implementation Guide.	INVENTORY
Gaps in the small LSR network occur in the extreme western portion of the watershed because of the low density of historic spotted owl sites.	Retain pileated/pine marten area 296, of which 141 acres is in Horse Creek Watershed and 22 acres is in Upper McKenzie Watershed	INFO FOR FUTURE PLANNING

APPENDICES

APPENDIX A

WATERSHED ANALYSIS TEAM

WATERSHED ANALYSIS TEAM

TEAM LEADER	Cheryl Ann Friesen, District Wildlife Biologist, Resources Staff
TEAM	Rich Pyzik, Fisheries Biologist, McKenzie and Blue River RD's Dawn Pozzani, GIS Specialist, McKenzie RD's Al Brown, Forester, McKenzie RD Pat Ford, Botanist, McKenzie and Blue River RD's Michelle McSwain, Hydrologist, McKenzie and Blue River RD's Phil Raab, Recreation Staff, McKenzie RD John Phillips, Soil Scientist, McKenzie and Blue River RD's John Orbeton, Fire Behavior Specialist, McKenzieRD Eric Bergland, Archaeologist, McKenzie and Blue River RD's Shane Kamrath, Wildlife Biologist, McKenzie RD Lisa Lyon, Wildlife Biologist, McKenzie RD Gene Skrine, Silviculturist, McKenzie RD Dave Bickford, Fisheries Biologist, McKenzie and Blue River RD's Jane Kertis, Ecologist, Siuslaw NF, Supervisor's Office

APPENDIX B

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APPENDIX C

ADDITIONAL DATA

SILVICULTURE APPENDIX

OVERVIEW OF DEVELOPMENT PATTERNS
(Adapted from Oliver and Larsen 1990).

Stand development after a stand-replacing disturbance—

Stages of development:

Stand Initiation Stage:
Growing space is reoccupied following a stand-replacing disturbance, such as fire.

Stem Exclusion Stage:
Occurrence of new tree stems is excluded by limits on light or moisture. The canopy is closed and crowns recede.

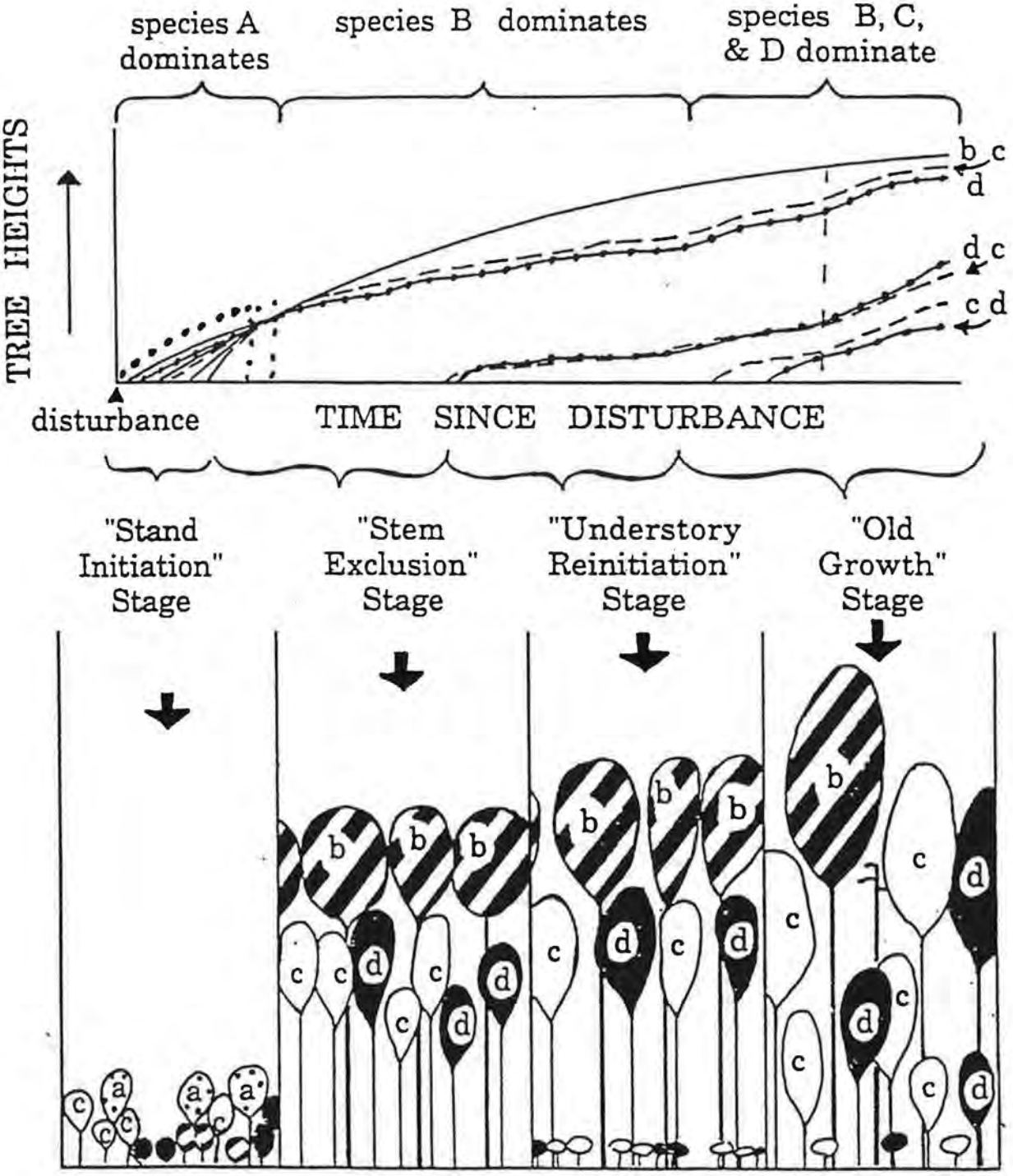
Understory Re-initiation Stage:
Second cohort established under older overstory. Mortality in the overstory creates growing space for new trees in the understory.

Old-growth Stage:
Multi-cohort, multi-strata stands with large, old trees.

Stand Development after minor disturbances—

Uneven-Age, All-aged, Multi-cohort:
These stands develop after disturbances that leave much of the original stand intact. Minor disturbances can include fire, logging, windthrow, insects and diseases. Single trees or cohorts become established in the created openings. The number of ages can be affected by the degree and frequency of the disturbance.

Development Patterns



Stand development descriptions used throughout the Horse Creek Watershed analysis.

TREE SIZE DESCRIPTION	STAGES OF DEVELOPMENT (C.Oliver 1990)	WILDLIFE HABITAT DESCRIPTION	DBH	SERAL STAGE	SIZE CLASS	PSME SITE IV	ABGR SITE III	TSHE SITE II	TSHE SITE III	ABAM SITE IV	ABAM SITE V	TSME SITE IV
SEEDLING	Stand Initiation	Grass/forb/shrub	>6" TALL	EARLY	1	E	E	E	E	E	E	E
SEEDLING AND SAPLING	"	Open Sapling-pole	1" - 5"	EARLY	1.5	E	E	E	E	E	E	E
SAPLINGS	"	"	1" - 5"	EARLY	2	M	E	E	E	E	E	E
SAPLINGS AND POLES	Stem Exclusion	"	1" - 5"	EARLY	2.5	M	M	M	M	M	M	M
POLES	"	Closed Sapling Pole	5" - 9"	MID	3	M	M	M	M	M	M	M
POLES AND SMALL TREES	"	Open Small Conifer	5" - 9"	MID	3.5	M	M	M	M	M	M	M
SMALL TREES	"	Closed Small Conifer	9" - 21"	MID	4	M	M	M	M	M	L	M
SMALL & MEDIUM TREES	Understory Reinitiation	"	9" - 21"	MID	4.5	L	M	M	M	L	L	L
MEDIUM TREES	"	Large Conifer	21" - 32"	LATE	5	L	L	L	L	L	L	L
MEDIUM AND LARGE TREES	"	"	21" - 32"	LATE	5.5	L	L	L	L	L	L	L
LARGE TREES	Old Growth	Old Growth	32" - 48"	LATE	6	L	L	L	L	L	L	L
LARGE AND GIANT TREES	Old Growth	"	32" - 48"	LATE	6.5	L	L	L	L	L	L	L
GIANT TREES	Old Growth	"	> 48"	LATE	7	L	L	L	L	L	L	L

PSME: Douglas-Fir
ABGR: Grand Fir
TSHE: Western Hemlock
TSME: Mt. Hemlock
ABAM: Pacific Silver Fir

WILDLIFE APPENDIX

Table W-1: Availability of suitable habitat for spotted owls that use the Horse Creek Watershed.

Activity Centers within the Horse Creek Watershed

Site Name	Habitat w/in 1.2 mile radius	Site Name	Habitat w/in 1.2 mile radius
Buck Meadows	2131	Nash Lake	1493
Castle Creek	2199	O'Leary Mountain	2193
Cedar Swamp	1986	Pasture Creek	2317
Corral Draw	1303	Roney Creek	2587
Harvey Creek	2503	Separation Creek	2542
Harvey-Horse Creek	2674	South Substitute Point	2604
Honey Creek Falls	2115	Sphinx Lake	1942
Horse Pasture Mountain	2414	Substitute Point	2334
King Creek	2372	Tokatee Lakes	2621
Lower King Creek	1805	Upper Foley Ridge	2270
Lower Roney Creek	2435	Upper Horse Creek	2656
Lower Separation Creek	2741	Upper Rainbow Creek	2219
Middle Harvey Creek	2672	Upper Separation Creek	2547
Middle Horse Creek	1795	Wild Horse Creek	2487
Mosquito Creek	2375		

Activity Centers outside of the Horse Creek Watershed, but home range extends into watershed boundary

Site Name	Habitat w/in 1.2 mile radius	Site Name	Habitat w/in 1.2 mile radius
Cougar Creek	1833	Ollalie Airstrip	772
East Fork McKenzie River	2337	Pat Saddle	1968
Lawder Mountain	1892	Payne Spring	2049
Lost Branch	1688	Proxy Creek	1342
Lost Creek	1857	Proxy Point	1488
Lower Foley Ridge	1664	South Station	977
McDuff Peak	2084	Upper East Fork	1570
North Proxy Point	995	White Branch	1624

Table W-2: 50-11-40 analysis of Quarter-townships within the Horse Creek Watershed.

QUARTER-TOWNSHIP	% QUARTER-TOWNSHIP MEETING 11-40
16064	64.4
16051	73.8
16054	50.8
16072	90.9
16062	70.3
16073	66.9
16063	73.3
16052	85.6
16053	67.2
17084	59.8
17071	70.1
17074	69.6
17651	98.5
17061	72.1
17064	64.9
17051	87.1
17083	87.6
17072	74.4
17073	97.0
17652	98.1
17062	86.1
18084	64.7
18071	57.8
18074	74.9
18651	96.6
18061	96.1
18083	80.1
18072	94.3
18073	83.8
18652	95.3
18062	90.9
19071	93.8

Table W-3: Elk Emphasis Area modeling results for the Horse Creek Watershed. Habitat effectiveness ratings for size and spacing of forage and cover areas (HEs), forage quality (HEf), cover quality (HEc), open road density (HEr), and overall habitat effectiveness (HEsrcf). ( ) indicates analysis on winter range portion only. (*) indicates no winter range.

HIGH EMPHASIS AREAS

HE VALUE	SEPARATION HONEY	HARVEY SPINX	RONEY	HORSE LAKE	EUGENE
Hes	0.41	0.37	0.29	0.27	0.34
HEc	0.47 (0.54)	0.47 (0.52)	0.56 (0.59)	0.42 (*)	0.44 (0.52)
Hef	0.71	0.75	0.75	0.75	0.75
HEr	0.87	1.00	1.00	1.00	1.00
Hesrcf	0.58	0.60	0.59	0.54	0.58

MODERATE EMPHASIS AREAS

HE VALUE	SWAMP/ CASTLE/ TAYLOR	CASTLE/ MOSQUITO/ PASTURE/ POTHOLE	NORTHSIDE HORSE	AVENUE/ CEDAR SWAMP/ E.CREEK OWL	KING
HEs	0.37	0.65	0.62	0.79	0.38
HEc	0.57	0.52	0.43	0.50	0.57
HEf	0.33	0.53	0.40	0.48	0.49
HEr	0.45	0.52	0.40	0.48	1.00
HEsrcf	0.42	0.55	0.46	0.55	0.57

Table W-4: Species that use riparian habitat primarily for breeding and/or foraging by stream class.

SPECIES	STREAM CLASS
Habitat: Water column of riparian reserve only	
American coot	1
American widgeon	1
Blue-winged teal	1
Canvasback	1
Cinnamon teal	1
Common loon	1
Eared grebe	1
Gadwall	1
Greater scaup	1
Green-winged teal	1
Horned grebe	1
Lesser scaup	1
N. Pintail	1

SPECIES	STREAM CLASS
Habitat: Water column of riparian reserve only	
Pacific Loon	1
Red-throated loon	1
Redhead	1
Ruddy duck	1
Surf scoter	1
Western grebe	1
Pied billed Grebe	1

Habitat: Water column and open condition on bank	
Canada goose	1
Killdeer	1
Mallard	1
Habitat: Water column and open condition on bank	
Water vole	1-3 4?
W. Pond turtle	1

Habitat: Water Column and bank/generalists	
Dunn's salamander	1-3 4?
Bald Eagle	1
Common egret	1
Common egret	1
Great Blue heron	1,2
Green backed heron	1,2
Osprey	1
Pied-billed grebe	1
Ring-necked duck	1
Beaver	1,2
Mink	1,2
Muskrat	1,2
River Otter	1,2
Pacific Water shrew	unknown

SPECIES	STREAM CLASS
Habitat: Water column and mid/late seral bank	
Cascade torrent salam.	2,3 4? (seepy areas)
Pacific giant salamander	1,2 3?
Tailed frog	2,3
American dipper	1,2
Barrow's goldeneye	1
Belted kingfisher	1,2
Bufflehead	1
Common goldeneye	1
Common merganser	1
Harlequin duck	1,2
Hooded merganser	1
Wood duck	1,2
Water shrew	1,2,3

Habitat: No water column use--needs open plant community on bank	
Common yellowthroat	1-3
Marsh Wren	1
Yellow-breasted chat	1-3
Spotted Sandpiper	1-2

Habitat: No water column use--generalist in adjacent forest	
American redstart	1,2
Bank swallow	1
N. roughwinged swallow	1,2

Habitat: No water column use--mid/late seral adjacent forests	
Red-eyed vireo	1,2
White-footed vole	1,2

SPECIES	STREAM CLASS
Habitat: No water column use--deciduous riparian vegetation required	
Downy Woodpecker	1,2
Warbling vireo	1,2,3?

Table W-4: Recommended riparian reserve widths for the Upper McKenzie Watershed. This table was created by comparing ROD default reserve widths to the WNF LMP riparian buffer widths. The range between the two sets of direction is shown in this table if the LMP buffer was greater than the ROD default.

Riparian Reserve Area-	TSHE Reserve Width 180'SPT*	ABAM Reserve Width 150' SPT	PSME Reserve Width 140' SPT	ABGR Reserve Width 140' SPT	TSME Reserve Width 100' SPT
Class 1 *	360' - 400'	300'- 400'	300'- 400'	300'- 400'	300'- 400'
Class 2	360'	300'	300'	300'	300'
Class 3	180'	150'	150'	150'	150'
Class 4	180'	150'	140'	140'	100'
Class 5	no buffer				
Constructed Ponds and Reservoirs	180'	150'	150'	150'	150'
Wetlands >1 ac *	180' - 600'	150' - 600'	140' - 600'	140' - 600'	100' - 600'
Lakes and Natural Ponds *	600'	600'	600'	600'	600'
Wetlands <1 ac *	180' - 600'	150' - 600'	150' - 600'	150' - 600'	150' - 600'
Unstable and Potentially Unstable areas *	180'	150'	140'	140'	100' - 125'

* SPT = SITE POTENTIAL TREE

* Individual prescriptions will be based on site-specific conditions and fall within the range specified by the Willamette Forest Plan as amended.

WILDLIFE OF HORSE CREEK WATERSHED

= DOCUMENTED; S = SUSPECTED; Q = QUESTIONABLE

	Species	Common name	Class	Presence
	RACAT	Bullfrog	A	S
	RANCA	Cascade frog	A	D
	RHCA	Cascade torrent salamander	A	S
	ANFE	Clouded salamander	A	D
	PLDU	Dunn's Salamander	A	S
	ENES	Ensatina	A	D
	AMMA	Long-toed salamander	A	S
	AMGR	Northwester salamander	A	D
	BAWR	Oregon slender salamander	A	D
	DITE	Pacific giant salamander	A	D
	PSRE	Pacific treefrog	A	D
	RAAU	Red-legged frog	A	D
	TAGR	Roughskin newt	A	D
	RAPR	Spotted frog	A	D
	ASTR	Tailed frog	A	D
	PLVE	Wester red-backed salamander	A	S
	BUBO	Western toad	A	D
	MEFO	Acorn woodpecker	B	Q
	BOLE	American bittern	B	S
	FUAM	American coot	B	Q
	COBR	American crow	B	S
	CIME	American dipper	B	S
	CATR	American goldfinch	B	S
	FASP	American kestrel	B	D
	SERUT	American redstart	B	S
	TUMI	American robin	B	S
	ANAAM	American wigeon	B	Q
	CAAN	Anna's hummingbird	B	S
	MYCI	Ash-throated flycatcher	B	S
	HALE	Bald eagle	B	D
	COFA	Band-tailed pigeon	B	S
	RIRI	Bank swallow	B	S
	TYAL	Barn owl	B	Q
	HIRU	Barn swallow	B	S
	STVA	Barred owl	B	D
	BUIS	Barrow's goldeneye	B	Q
	CEAL	Belted kingfisher	B	D
	THBE	Bewick's wren	B	S
	CYNI	Black swift	B	S
	PIAR	Black-backed woodpecker	B	S
	PAAT	Black-capped chickadee	B	S
	ARAL	Black-chinned hummingbird	B	S
	PHME	Black-headed grosbeak	B	S
	DENI	Black-throated gray warbler	B	D
	DEOB	Blue grouse	B	S
	ANDI	Blue-winged teal	B	Q

WILDLIFE OF HORSE CREEK WATERSHED

D = DOCUMENTED; S = SUSPECTED; Q = QUESTIONABLE

Species	Common name	Class	Presence
BOGA	Bohemian waxwing	B	S
LAPH	Bonaparte's gull	B	Q
AEFU	Boreal owl	B	S
EUCY	Brewer's blackbird	B	S
SPBR	Brewer's sparrow	B	S
CEAM	Brown creeper	B	S
MOAT	Brown-headed cowbird	B	S
BUAL	Bufflehead	B	Q
PSMI	Bushtit	B	S
LACA	California gull	B	Q
CACAL	California quail	B	S
STELCA	Calliope hummingbird	B	Q
BRCA	Canada goose	B	D
AYVA	Canvasback	B	Q
STCA	Caspian tern	B	Q
CACAS	Cassin's finch	B	S
BOCE	Cedar waxwing	B	D
PARU	Chestnut-backed chickadee	B	S
SPPA	Chipping sparrow	B	S
ANCY	Cinnamon teal	B	Q
NUCO	Clark's nutcracker	B	D
HIPY	Cliff swallow	B	S
CAALB	Common egret	B	Q
BUCL	Common goldeneye	B	Q
GAIM	Common loon	B	Q
MERME	Common merganser	B	D
CHMI	Common nighthawk	B	D
CORCO	Common raven	B	S
GAGA	Common snipe	B	Q
GETR	Common yellowthroat	B	S
ACCO	Cooper's hawk	B	S
EMOC	Cordilleran flycatcher	B	Q
JUHY	Dark-eyed junco	B	S
PHAU	Double-crested cormorant	B	Q
PIPU	Downy woodpecker	B	S
CAALP	Dunlin	B	Q
EMOB	Dusky flycatcher	B	S
PODNI	Eared grebe	B	Q
ANPE	Eurasian wigeon	B	Q
STVU	European starling	B	S
COVE	Evening grosbeak	B	S
OTFL	Flammulated owl	B	D
PAIL	Fox sparrow	B	S
ANST	Gadwall	B	Q
LAGL	Glaucous-winged gull	B	Q
AQCH	Golden eagle	B	D
RESA	Golden-crowned kinglet	B	S

WILDLIFE OF HORSE CREEK WATERSHED

= DOCUMENTED; S = SUSPECTED; Q = QUESTIONABLE

	Species	Common name	Class	Presence
	ZOAT	Golden-crowned sparrow	B	S
	EMWR	Gray flycatcher	B	S
	PECA	Gray jay	B	S
	ARHE	Great blue heron	B	D
	STNE	Great gray owl	B	D
	BUVI	Great horned owl	B	D
	AYMA	Greater scaup	B	Q
	ANAL	Greater white-fronted goose	B	Q
	TRME	Greater yellowlegs	B	Q
	BUST	Green-backed heron	B	S
	PICH	Green-tailed towee	B	S
	ANCR	Green-winged teal	B	D
	PIVI	Hairy woodpecker	B	S
	EMHA	Hammond's flycatcher	B	S
	HIHI	Harlequin duck	B	D
	CAGU	Hermit thrush	B	S
	DEOC	Hermit warbler	B	S
	LOCUC	Hooded merganser	B	D
	POAU	Horned grebe	B	Q
	ERAL	Horned lark	B	S
	CARME	House finch	B	S
	PADO	House sparrow	B	S
	TRAE	House wren	B	S
	VIHU	Hutton's vireo	B	S
	CHVO	Killdeer	B	Q
	CHGR	Lark sparrow	B	S
	PAAMO	Lazuli bunting	B	Q
	OCLE	Leach's storm petrel	B	Q
	CAMI	Least sandpiper	B	Q
	CAPS	Lesser goldfinch	B	S
	AYAF	Lesser scaup	B	Q
	TRFL	Lesser yellowlegs	B	Q
	MELE	Lewis' woodpecker	B	Q
	MELI	Lincoln's sparrow	B	Q
	ASOT	Long eared owl	B	S
	LOSC	Long-billed dowitcher	B	Q
	OPTO	MacGillivray's warbler	B	S
	ANPL	Mallard	B	D
	CIPA	Marsh wren	B	S
	FACO	Merlin	B	D
	SICU	Mountain bluebird	B	S
	PAGA	Mountain chickadee	B	S
	ORPI	Mountain quail	B	S
	ZEMA	Mourning dove	B	S
	VERU	Nashville warbler	B	S
	COAU	Northern flicker	B	S
	ACGE	Northern goshawk	B	D

WILDLIFE OF HORSE CREEK WATERSHED

= DOCUMENTED; S = SUSPECTED; Q = QUESTIONABLE

	Species	Common name	Class	Presence
	CICY	Northern harrier	B	D
	ICGA	Northern oriole	B	S
	ANAC	Northern pintail	B	Q
	GLGN	Northern pygmy owl	B	D
	STSE	Northern rough-winged swallow	B	S
	AEAC	Northern saw-whet owl	B	D
	ANCL	Northern shoveler	B	Q
	LAEX	Northern shrike	B	Q
	STOC	Northern spotted owl	B	D
	PITR	Northern three-toed woodpecker	B	D
	SENO	Northern waterthrush	B	S
	CLHY	Oldsquaw	B	Q
	COBO	Olive-sided flycatcher	B	S
	VECE	Orange-crowned warbler	B	S
	PAHA	Osprey	B	D
	GAPA	Pacific loon (Arctic)	B	Q
	EMDI	Pacific slope flycatcher	B	S
	CAME	Pectoral sandpiper	B	Q
	FAPE	Peregrine falcon	B	D
	POPO	Pied-billed grebe	B	Q
	DRPI	Pileated woodpecker	B	D
	PIEN	Pine grosbeak	B	S
	CAPI	Pine siskin	B	S
	FAME	Prairie falcon	B	D
	CARPU	Purple finch	B	S
	PRSU	Purple martin	B	S
	LOXCU	Red crossbill	B	S
	PHFU	Red phalarope	B	Q
	SITCA	Red-breasted nuthatch	B	D
	SPRU	Red-breasted sapsucker	B	D
	VIOL	Red-eyed vireo	B	S
	SPNU	Red-naped sapsucker	B	S
	BUJA	Red-tailed hawk	B	D
	GAST	Red-throated loon	B	Q
	AGPH	Red-winged blackbird	B	S
	AYAM	Redhead	B	Q
	LADE	Ring-billed gull	B	Q
	AYCO	Ring-necked duck	B	Q
	PHCO	Ring-necked pheasant	B	Q
	COLI	Rock dove	B	S
	SAOB	Rock wren	B	S
	LEAR	Rosy finch	B	S
	BULA	Rough-legged hawk	B	Q
	RECA	Ruby-crowned kinglet	B	S
	OXJA	Ruddy duck	B	Q
	BOUM	Ruffed grouse	B	S
	SERUF	Rufous hummingbird	B	D

WILDLIFE OF HORSE CREEK WATERSHED

= DOCUMENTED; S = SUSPECTED; Q = QUESTIONABLE

	Species	Common name	Class	Presence
	PIER	Rufous-sided towhee	B	S
	GRCA	Sandhill crane	B	D
	PASA	Savannah sparrow	B	S
	APCO	Scrub jay	B	S
	CHSE	Semipalmated plover	B	Q
	ACST	Sharp-shinned hawk	B	S
	CHCA	Snow goose	B	Q
	TRSO	Solitary sandpiper	B	Q
	VISO	Solitary vireo	B	S
	MELME	Song sparrow	B	S
	POCA	Sora	B	Q
	ACMA	Spotted sandpiper	B	D
	CYST	Steller's jay	B	S
	MEPE	Surf scoter	B	Q
	BUSW	Swainson's hawk	B	Q
	CAUS	Swainson's thrush	B	S
	VEPE	Tennessee warbler	B	S
	MYTO	Townsend's solitaire	B	S
	DETO	Townsend's warbler	B	S
	TABI	Tree swallow	B	D
	CYBU	Trumpeter swan	B	Q
	CYCO	Tundra swan (whistling)	B	Q
	CAAU	Turkey vulture	B	D
	IXNA	Varied thrush	B	S
	CHVA	Vaux's swift	B	S
	POOGR	Vesper sparrow	B	S
	TATH	Violet-green swallow	B	S
	RALI	Virginia rail	B	Q
	VIGI	Warbling vireo	B	S
	ANSP	Water pipit	B	S
	SIME	Western bluebird	B	S
	AEOC	Western grebe	B	Q
	TYVE	Western kingbird	B	S
	STUNE	Western meadowlark	B	Q
	OTKE	Western screech owl	B	S
	PILU	Western tanager	B	D
	COSO	Western wood-peewee	B	S
	SICAR	White-breasted nuthatch	B	S
	ZOLE	White-crowned sparrow	B	S
	PLCH	White-faced ibis	B	Q
	PIAL	White-headed woodpecker	B	Q
	ZOAL	White-throated sparrow	B	S
	LOLE	White-winged crossbill	B	S
	MEFU	White-winged scoter	B	Q
	MEGA	Wild turkey	B	Q
	SPTH	Williamson's sapsucker	B	S
	EMTR	Willow flycatcher	B	S

WILDLIFE OF HORSE CREEK WATERSHED

= DOCUMENTED; S = SUSPECTED; Q = QUESTIONABLE

	Species	Common name	Class	Presence
	WIPU	Wilson's warbler	B	S
	TRTR	Winter wren	B	S
	AISP	Wood duck	B	D
	CHFA	Wrentit	B	S
	DEPE	Yellow warbler	B	S
	ICVI	Yellow-breasted chat	B	S
	DENCO	Yellow-rumped warbler	B	S
	TATA	Badger	M	S
	CASCAN	Beaver	M	D
	EPFU	Big brown bat	M	S
	URAM	Black bear	M	D
	LECA	Black-tailed rabbit	M	S
	LYRU	Bobcat	M	D
	SYBA	Brush rabbit	M	S
	NECI	Bushy-tailed woodrat	M	S
	SPBEE	California ground squirrel	M	S
	MYOCA	California myotis	M	S
	SCOR	Coast mole	M	S
	CALAT	Coyote	M	S
	PEMA	Deer mouse	M	S
	TADO	Douglas' squirrel	M	S
	SOMO	Dusky shrew	M	S
	CEEL	Elk	M	D
	MUER	Ermine	M	S
	MAPE	Fisher	M	S
	MYTH	Fringed myotis	M	S
	SPLA	Golden-mantled ground squirrel	M	S
	URCI	Gray fox	M	S
	CALU	Gray wolf	M	D
	PHIN	Heather vole	M	S
	LACI	Hoary bat	M	S
	MUMU	House mouse	M	S
	MYLU	Little brown myotis	M	S
	MYEV	Long-eared myotis	M	S
	MYVO	Long-legged myotis	M	S
	MUFR	Long-tailed weasel	M	D
	FELY	Lynx	M	Q
	MAAM	Marten	M	D
	MUVI	Mink	M	S
	APRU	Mountain beaver	M	S
	FECO	Mountain lion	M	D
	ODHE	Mule deer and black-tailed deer	M	D
	ONZI	Muskrat	M	S
	GLSA	Northern flying squirrel	M	D
	RANO	Norway rat	M	S
	MYCO	Nutria	M	Q
	MIOR	Oregon meadow vole	M	S

WILDLIFE OF HORSE CREEK WATERSHED

D = DOCUMENTED; S = SUSPECTED; Q = QUESTIONABLE

Species	Common name	Class	Presence
ZATR	Pacific jumping mouse	M	S
SOBE	Pacific water shrew	M	S
OCPR	Pika	M	D
ERDO	Porcupine	M	S
PRLO	Raccoon	M	S
VUVU	Red fox	M	S
ARLO	Red tree vole	M	S
LUCA	River otter	M	D
NEGI	Shrew-mole	M	S
LANO	Silver-haired bat	M	S
LEAM	Snowshoe hare	M	S
SPPU	Spotted skunk	M	S
MEMEP	Striped skunk	M	S
PLTO	Townsend's big-eared bat	M	D
TATO	Townsend's chipmunk	M	S
MITO	Townsend's vole	M	S
SOTRO	Trowbridge's shrew	M	S
SOVA	Vagrant shrew	M	S
DIVI	Virginia opossum	M	S
SOPAL	Water shrew	M	S
MIRI	Water vole	M	S
SCIGR	Western gray squirrel	M	S
THMA	Western pocket gopher	M	S
CLCA	Western red-backed vole	M	S
MYOCI	Western small-footed myotis	M	S
PHAL	White-footed vole	M	S
GUGU	Wolverine	M	D
MAFL	Yellow-bellied marmot	M	D
TAAM	Yellow-pine chipmunk	M	S
MYYU	Yuma myotis	M	S
THSI	Common garter snake	R	S
PIME	Gopher snake	R	S
HYTO	Night snake	R	S
ELCO	Northern alligator lizard	R	S
THOR	Northwester garter snake	R	S
COLCO	Racer	R	S
DIPU	Ringneck snake	R	S
CHBO	Rubber boa	R	S
CONTE	Sharptail snake	R	S
PHDO	Short-horned lizard	R	Q
ELMU	Southern alligator lizard	R	S
SCOC	Western fence lizard	R	D
CLMA	Western pond turtle	R	Q
CRVI	Western rattlesnake	R	Q
EUSK	Western skink	R	D
THEL	Western terrestrial garter snake	R	S

SNAG ANALYSIS

SNAG REQUIREMENTS FOR MANAGING SNAG GUILD IN COMPLIANCE WITH THE 1994 ROD.

Table W-5: Low elevation in the UPPER McKENZIE WATERSHED includes western hemlock and Douglas-fir series. High elevation includes Mountain hemlock, Pacific silver fir, and grand fir.

CAVITY USING SPECIES	100% LEVELS LOW ELEVATION	100% LEVELS HIGH ELEVATION
RED.BREASTED SAPSUCKER	0.45	.45
DOWNY WP	0.16	NP
HAIRY WP	1.92	1.92
RED.BREASTED NUTHATCH	0.76	0.76
WHITE.BREASTED NUTHATCH	NP	0.76
N.FLICKER	0.48	0.48
PILEATED WP	0.06	0.06
BLACK-CAPPED CHICKADEE	2NDARY	2NDARY
WILLIAMSON'S SAPSUCKER	NP	0.33
THREE -TOED WP	NP	0.06
BLACK BACKED WP	NP	ADDED SEPARATELY
MOUNTAIN CHICKADEE	2NDARY	2NDARY
CHESTNUT-BACKED WP	2NDARY	2NDARY
LEWIS WP	NO BREEDING RECORDS	NP
ACORN WP	NO BREEDING RECORDS	NP
WHITE-HEADED WP	NO BREEDING RECORDS	NP
TOTAL	-3.83	4.82

SNAGS TO MEET LOW ELEVATION 40% REQUIREMENT:

.4 X 3.83 = -1.532

SNAGS TO MEET HIGH ELEVATION 40% REQUIREMENT + 100% BLACK BACKED REQUIREMENT:

.4 X 4.82 = 1.928 + .12 FOR BLACK BACKED = -2.048-

Table W-6: Wildlife species that use snags for breeding in early seral habitat by vegetation series.

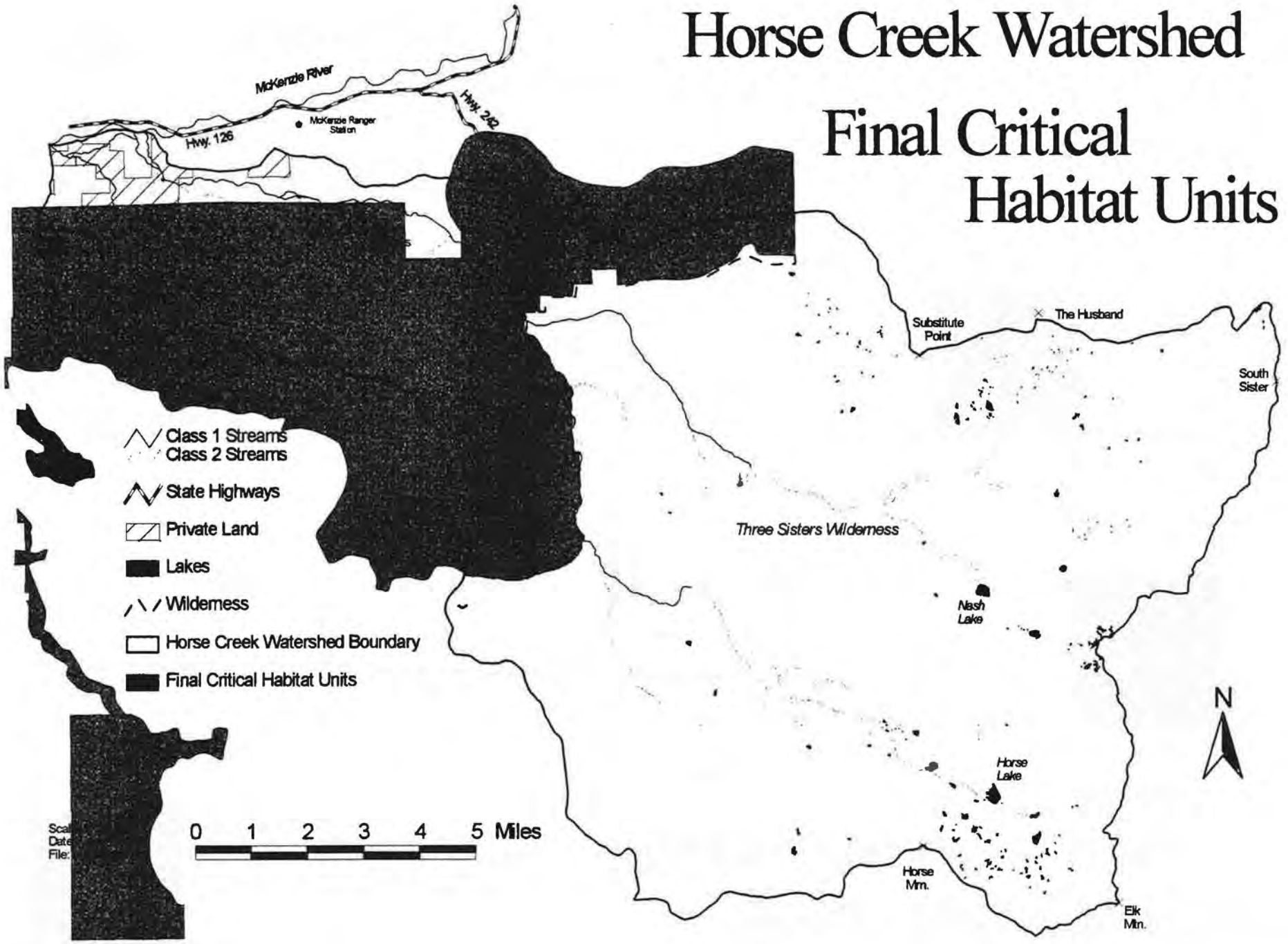
VEG SERIES	# SPECIES THAT PRIMARILY USE EARLY SERAL FOR BREEDING	# SPECIES REQUIRING SNAGS	# SPECIES REQUIRING DOWN WOODY MATERIAL
GRAND FIR	125	36	45
PACIFIC SILVER FIR	103	33	41
WESTERN HEMLOCK	114	32	45
DOUGLAS FIR	120	32	49
MT HEMLOCK	106	34	40

24% OR 78 SPECIES OF WILDLIFE ON THE WILLAMETTE NF REQUIRE SNAGS IN EARLY, MID OR LATE SERAL FORESTED HABITAT BREEDING.

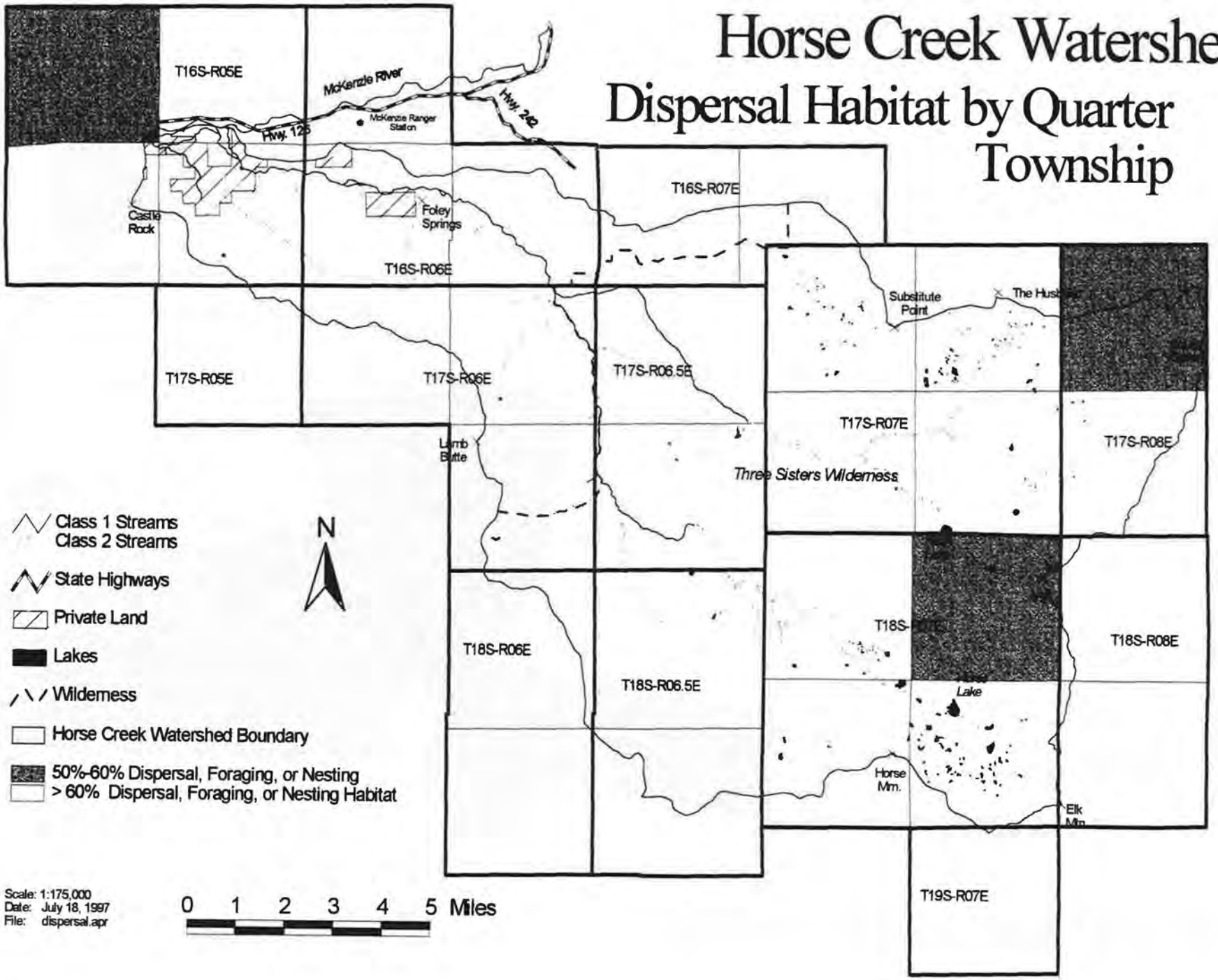
21% OR 68 SPECIES OF WILDLIFE ON THE WILLAMETTE NF REQUIRE DOWN WOODY MATERIAL IN EARLY, MID OR LATE SERAL FORESTED HABITAT FOR BREEDING.

Horse Creek Watershed

Final Critical Habitat Units



Horse Creek Watershed
Dispersal Habitat by Quarter Township



Scale: 1:175,000
Date: July 18, 1997
File: dispersal.apr

RECREATION APPENDIX

WILD AND SCENIC RIVER RESOURCE ASSESSMENTS
(HORSE CREEK WATERSHED ASSESSMENT)

HORSE CREEK AND SEPARATION CREEKS

(Note: To qualify as an "Outstandingly Remarkable Value", a river related value must be a unique, rare, or exemplary feature significant at a regional or national level. For regional comparison, the geographic regions defined in the 1989 Statewide Comprehensive Outdoor Recreation Plan (SCORP) for Oregon are used. As used in this analysis the term "low" indicates that the factor being evaluated is not unique among the rivers in the region; "medium" indicates a comparable value; and "high" denotes a value which may be unique, rare, or exemplary.)

Separation Creek (RM 0.0 - 13.0)

Value	Rating
Scenic	
Adjacent landform	Medium
Vegetative diversity	Medium
Color	Low
Distant scenery	Low
Special features	Medium
Cultural impact	High
Summary: Overall rating - Medium	ORV: - No
Recreation	
Rafting and floating	Low
Hiking	Low
Fishing	Medium
Remote dispersed recreation	Medium
Sightseeing/photography	Medium
Interpretation	Low
Summary: Overall rating - Medium	ORV - No
Geology	
Gorges	Low
Caves	Low
Volcanic	Low
Glacial	Low

Summary: Overall rating - Low ORV - No

Water Quality/Hydrology

Runoff characteristics	Low
Number and types of streams	Medium
Flow: Amount and duration	Medium
Hydrologic features	Medium
Value of water for uses	High

Summary: Overall rating - Medium ORV - No

Vegetation/Ecology

Diversity of species	Medium
Number of plant communities	Medium
Significance	Unknown
Cultural importance	Unknown
Quality of habitat	Medium

Summary: Overall rating - Medium ORV - No

Prehistoric

Interest	Low
Interpretive importance	Low
Use	Low
Site eligibility	Low

Summary: Overall rating - Low ORV - No

Historic

Association	Low
Site eligibility	Low

Summary: Overall rating - Low ORV - No

Fish - Anadromous and resident

Habitat quality	High
Diversity of species	High
Value of speices	Medium
Number and size of runs (anadromous	Low
Populations of existing species (res)	High

Natural reproduction	High
Size and vigor	Medium
Recreational importance	Low
Historic significance	Low
Potential significance	Medium

Summary: Overall rating - High ORV - Yes

Wildlife

Populations	Low
Habitat	High

Summary: Overall rating - High ORV - Yes

Horse Creek (RM 0.0 -28.0)

	Ratings		
Value	Seg. 1	Seg. 2	Seg. 3
Scenic			
Adjacent landform	Low	Medium	Low/Med.
Vegetative diversity	Medium	Low	Medium
Color	Low	Low	Medium
Distant scenery	Low	Low	Medium
Special features	Low	Low	Medium
Cultural impact	Low	Low	High

Summary: Seg. 1: Overall rating - Low ORV - No
Seg. 2: Low No
Seg. 3: Medium No

Recreation			
Rafting and floating	Low	Low	Low
Hiking	Low	Low	High
Fishing	High	Medium	Low
Remote dispersed recreation	Low	Low	Medium
Sightseeing/photography	Low	Low	Medium
Interpretation	Low	Low	Low

Summary:	Seg. 1	Overall rating - Low	ORV - No	
	Seg. 2	Low	No	
	Seg. 3	Medium	No	

Geology

Gorges	NA	Low	Low
Caves	Low	Low	Low
Volcanic	Low	Low	Low
Glacial	Low	Low	Low

Summary:	Seg. 1:	Overall rating - Low	ORV - No	
	Seg. 2:	Low	No	
	Seg. 3	Low	No	

Water Quality/Hydrology

Runoff characteristics	Low	Low	Low
Number and types of streams	Low	Medium	Medium
Flow: Amount and duration	Medium	Medium	Low
Hydrologic features	Low	Low	Medium
Value of water for uses	High	Low	Medium

Summary:	Seg. 1:	Overall rating - Medium	ORV - No	
	Seg. 2:	Medium	No	
	Seg. 3:	Medium	No	

Vegetation/Ecology

Diversity of species	Medium	Low	Medium
Number of plant communities	Low	Low	Medium
Significance	Unknown	Unknown	Unknown
Cultural importance	Unknown	Unknown	Unknown
Quality of habitat	Medium	Medium	Medium

Summary:	Seg. 1:	Overall rating - Medium	ORV - No	
	Seg. 2:	Low	No	
	Seg. 3:	Medium	No	

Prehistoric

Interest	Low	Low	Low
Interpretive importance	Medium	Medium	Medium
Use	Low	Low	Low
Site eligibility	Low	Low	Low

Summary:	Seg. 1:	Overall rating - Low	ORV - No	
	Seg. 2:	Low	No	
	Seg. 3:	Low	No	

Historic

Association	Low	Low	Low
Site eligibility	Low	Low	Low

Summary:	Seg. 1:	Overall rating - Low	ORV - No	
	Seg. 2:	Low	No	
	Seg. 3:	Low	No	

Fish - Anadromous and resident

RESOURCE ASSESSMENT CRITERIA

SCENIC: Landscape elements result in notable or exemplary visual features and/or attractions.

a. Adjacent landform: The character of land within about a mile of the river. Steep irregular landforms are evaluated more highly than those with little relief. Diversity is important.

b. Vegetative diversity: Landscapes with the greatest vegetative diversity within the between life forms rate the highest. Seasonal variations are important.

c. Color: Pleasing, vivid or highly contrasting colors are rated higher than uniform, muted colors.

d. Distant scenery: Distant, available views rank highest.

e. Special features: Landscapes which include waterfalls, rock spires, meadows, overhanging rock walls, conspicuous stands of wildflowers, gorges are ranked highest.

f. Cultural impact: Landscapes which have not been adversely affected by man rate highest.

RECREATION: To be an ORV, opportunities are, or have potential to be, unique enough to attract visitors from outside the geographic region; willing to travel long distances to use the river.

a. Rafting and floating: Consider length of season, Class/difficulty, Length of run/river segment, access, flow/volume, free flowing character, level and type of use.

b. Hiking: Consider length of season, diversity of experience, access, difficulty, dispersed camping opportunities.

c. Fishing: Consider unique fish species, unique users, access, level of recognition in the region, species diversity.

d. Remote dispersed recreation opportunities: Consider diversity of opportunities, quality/uniqueness of existing opportunities, level of use, access, character/naturalness, presence of interesting wildlife, scenic quality, number/type of sites and facilities.

e. Sightseeing/photography.

f. Interpretation: Opportunities may be exceptional; potential exists to attract visitors from outside the region.

GEOLOGY: ORV contains feature(s) that are rare, unusual, one-of-a-kind, unique to the region. May be in an unusually active stage of development, represent a "textbook" example and/or represent a unique combination of geologic features.

a. Gorges: Deep gorges are rated higher.
Depth to width ratio: High ratios rate highest.
Length: Longer gorges rate highest.
Flow: Greater volume rates higher rating.
Hydrologic features: number, size and extent of falls, rapids.
Bedrock: Extent or uniqueness of geologic features within gorge.
Naturalness: Pristine quality of area.
Scenic significance
Cultural significance: value to native cultures.

b. Caves: Number, uniqueness, habitat value.

c. Volcanic

d. Glacial

WATER QUALITY/HYDROLOGY

a. Runoff characteristics.

b. Number and types of streams.

c. Flow: Amount and duration.

d. Hydrologic features: springs, seeps, waterfalls.

e. Value of water for uses: recreation, habitat, domestic.

VEGETATION/ECOLOGY

a. Diversity of species: Diversity and number of individual species.

b. Number of plant communities.

c. Significance: Are plants listed, proposed or under review?
Species declining in number or vulnerable to depletion.
Are species at the limit of their ranges?
Are species with restricted ranges?

d. Cultural importance: Historical use/importance of plant to existing or past cultures.

e. Quality of habitat: Extent and quality of habitat.

PREHISTORIC: river or area within the corridor contains a site(s) where there is evidence of occupation or use by native Americans

a. Sites must have unusual characteristics or exceptional human interest value(s).

b. Sites may have national or regional importance for interpreting prehistory; may be rare and represent an area where a culture or cultural period was first identified and described.

c. May have been used concurrently by two or more cultural groups, or may have been used by cultural groups for rare or sacred purposes.

d. Of particular importance are sites or features listed in, or are eligible for inclusion in the National Register of Historic Places.

HISTORIC: River contains site(s) or feature(s) associated with a significant event, an important person, or a cultural resource activity of the past that was rare, unusual or one-of-a-kind in the region.

a. A historic site(s) and/or feature(s) in most cases is 50 years old or older. Of particular significance are sites or features listed in or are eligible for inclusion in the National Register of Historic Places.

FISH - ANADROMOUS AND RESIDENT: The river is internationally, nationally, or regionally an important producer of fish. The river provides or has the potential to provide exceptionally high quality habitat for fish species indigenous to the region.

a. Habitat quality: spawning, nursery and holding areas. Diversity of habitats is an important consideration and could, in itself, lead to determination of ORV.

b. Diversity of species: number of species (native and stocked). Wild stocks and/or Federal or state listed or candidate T,E,S species are significant. Diversity of species is important and could, in itself, lead to a determination of ORV.

c. Value of species: relative values based on commercial, tribal and sport use.

d. Number and size of runs (anadromous): currently established on the river.

e. Populations of existing species (resident): number of fish currently established. Large populations rate higher than smaller ones.

f. Natural reproduction: Self-sustaining natural populations rate higher than stocked populations.

g. Size and vigor: Rivers with larger fish rate highest.

h. Recreational importance: Relative amount of sport and tribal catches or angler day use.

i. Historic significance: Traditional use by natives and have documented sizable native runs or populations.

j. Potential significance: Potential to support larger runs or higher populations.

WILDLIFE: Wildlife values shall be judged on the relative merits of either populations or habitat or native American use or a combination of these conditions.

a. Populations: River contains nationally or regionally important populations of indigenous wildlife species. Important are species considered to by unique or populations of Federal or state listed or candidate TSE species. Diversity is important and could, in itself, lead to determination of ORV.

b. Habitat: Provides exceptionally high quality habitat for wildlife or national or regional significance, or may provide unique habitat or a critical link in habitat conditions for Federal, state listed or candidate TSE species. Diversity of habitats is important and could, in itself, lead to determination of ORV.

Rivers serve as connectors for Spotted Owls.

Rivers presently in old growth condition are more valuable than others. Distribution is important. Maintenance of old growth structure is important.

Riparian areas are important habitats.