LATE-SUCCESSIONAL RESERVE ASSESSMENT FOR GOOSENEST LSR # RC-363

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KLAMATH NATIONAL FOREST

TABLE OF CONTENTS

INTRODUCTION....1
How to use this LSR Assessment....3
Previously identified Issues and concerns in Goosenest LSR....3

DESCRIPTION OF GOOSENEST LSR....5
Biogeographic context....5
Biophysical setting....6
Natural Vegetation....8
Native species community....13
History of Resource Management....14

CURRENT CONDITION....18
Introduction....18
Criteria for assessing "functioning" LSR....18
Vegetation databases....18
Vegetative condition....19
Fuels and potential wildfire effects....24
Watershed condition....25
Species account....33
Conclusions....44

DESIRED CONDITION....47
General desired attributes....47
True fir/Red fir community....49
Mixed conifer community....51
Ponderosa pine community....53
Lodgepole pine community....53
Riparian reserves....54
Desired practices and processes....55
Management of suitable habitat for TES species.... 58

CRITERIA AND POSSIBLE TREATMENTS....59
Objective 1. Accelerate the development of future late-successional forest habitat....60
Objective 2. Retain, restore and protect watershed functions that promote high quality habitat for native fish and other aquatic organisms....61
Objective 3a. Protect existing stands of late successional forest habitat by reducing factors contributing to stress-related tree mortality....63
Objective 3b. Protect late successional and mid/dense forest habitat by reducing risk of stand-replacing fire....63
Objective 4. Improve connectivity within the LSR....64

Objective 5. Improve habitat for northern spotted owls....65
Objective 6. Foster protection and re-establishment. of native fish communities....65

IMPLEMENTATION SCHEDULE....67
Standards and Guidelines....67
Proposed projects:
Muskgrave bald eagle nest stand protection....67
Bogus Burn plantation thinning....69
Juanita Lake mixed conifer restoration....69
Lodgepole pine thinning....70
Shovel Creek young-stand thinning....71
Inventory of road-related sediment sources and channel obstruction....72
Inventory meadow-associated stream reaches....72
Harris Creek road improvement....72

LITERATURE CITED....73

APPENDICES
A. Maps and figures....77
B. Fire Plan....78
C. Late-successional Species....90
D. Cumulative Watershed Effects....91
E. Habitat Classification and Suitable Habitat Definitions....99
F. M onitoring Plan....101

List of Figures and Illustrations

Figure 1. Vicinity map of Goosenest LSR.
Figure 2. Topographic map of Southern Cascades Mountains.
Figure 3. Land ownership pattern and watershed boundaries for Goosenest LSR area.
Figure 4. Forest communities within Goosenest LSR.
Figure 5. Riparian Reserves and associated landforms in Goosenest LSR.
Figure 6. Vegetation condition within Riparian Reserves in Goosenest LSR.
Figure 7. Succession of seral states for stream channels.
Figure 8. Existing aquatic habitat conditions by watershed in Goosenest LSR.
Figure 9. Locations of TES species within Goosenest LSR.
Figure 10. Present distribution of fish assemblages in Goosenest LSR watersheds.
Figure 11. Suitable nesting/ roosting habitats for northern spotted owls.
Figure 12. Locations of terrestrial restoration projects within Goosenest LSR.

Illustration 1&2. Current condition in True Fir stands.
Illustration 3&4. Current condition in Mixed Conifer stands.
Illustration 5&6. Current condition in Ponderosa Pine stands.
Illustration 7&8. Current condition in Lodgepole Pine stands.
Illustration 9&10. Desired condition in True Fir stands.
Illustration 11&12. Desired condition in Mixed Conifer stands.
Illustration 13&14. Desired condition in Mixed Conifer and True Fir stands on S-W aspects.
Illustration 15&16. Desired condition in Ponderosa Pine stands.
Illustration 17&18. Desired condition in Lodgepole Pine stands.
Illustration 19. 1975 aerial photograph showing unregenerated clearcuts, 1955 - 1975.
Illustration 20. 1995 aerial photograph showing unregenerated clearcuts, 1975 - 1995.

INTRODUCTION

The Record of Decision on Management of Habitat for Late-Successional and Old-Growth Forest Related Species within the Range of the Northern Spotted owl **(ROD)** established a network of Late-Successional Reserves **(LSR)** and accompanying management standards and guidelines.

The network of reserves is intended to provide late-successional forest (LSF) habitat, provide for populations of species that are associated with late-successional forests, and to help ensure that late-successional species diversity will be conserved. The large number of candidates for federal listing, species of special concern, and those associated with late-successional forests highlights the importance of timely implementation of an ecosystem-based strategy to conserve biological diversity. Because a number of at-risk riparian associates and fish species are associated with late-successional forests, protection and restoration of riparian and aquatic habitats is an important element in managing these reserves. This direction was incorporated into the Klamath National Forest's Land and Resources Management Plan **(LRMP).**

Standards and guidelines for management of the LSRs are detailed in the LRMP and may be found in several sections including Forest-wide standards and guidelines and Management Area 5 direction.

The ROD specifies that a management assessment should be prepared for each LSR before habitat manipuation activities are designed and implemented. The purpose of the assessment is to develop a strategy for the LSR and to provide information to decision-makers responsible for managing for LSR goals and objectives. In addition, this assessment includes an analysis of aquatic and riparian conditions consistent with the Aquatic Conservation Strategy (ACS) in order to provide for fishery protection and restoration in conjunction with LSR managemnt.

In brief, the assessment should cover; inventory of vegetative conditions, a list of late-successional forest associated species, a history and description of current land uses, a fire management plan, criteria for developing appropriate treatments, identification of treatment areas, a proposed implementation schedule, and proposed monitoring and evaluation components.

In this assessment we attempt to develop a desired condition that integrates aquatic, riparian and upland habitats, recognizing the important relationships among these landscape components. Many upslope processes such as fire and insect outbreaks influence stream processes such as sedimentation and inputs of large woody material. Conversely, riparian habitats provide essential habitat components for terrestrial wildlife. For example, vegetation and other habitat components related to mesic conditions result in disproportionately high use of these areas by terrestrial wildlife. Terrestrial species such as small mammals may exhibit higher reproductive success in riparian zones, and act as a source for upland populations (Doyle 1990). Dense grass habitats in subirrigated moist meadows provide essential habitat for montane voles, a species not associated with upland forest habitats. Montane voles were the primary prey of the Upper Rock

Creek spotted owl pair (Ogan, unpub data), which foraged in meadow habitat along the creek. Montane voles and pocket gophers in meadow systems are also the primary prey resource for great gray owls.

Late-successional forests are those forest seral stages that include mature and old-growth age classes (ROD). The structure and composition of these forests vary by forest type, site capability, and fire regime. Typically, late-successional stands include live old-growth trees, standing dead trees (snags) and fallen trees or logs.

Late-successional forests also include non-forested habitats exibiting late seral conditions such a wet meadows. In addition, stream channels and their associated riparian plant communities exibit features which characterize various successional stages. In meadows, late-seral stream features may include a narrow meandering channel with densly vegetated undercut banks or well shaded, deep pooled, features in confined forested habitats. In either case, late-seral stream and riparian conditions are generally representative of high quality habitats for fish and wildlife (although not meeting the definition of LSF) .

Among the more important components of late-successional forests are the processes that sustain them. The intensity and relative importance of these processes varies with climate, elevation, aspect and plant community, but they typically play an important role in creating and maintaining late-successional forest composition and structure. Examples of natural processes are diseases such as mistletoe and root rot which kill individual trees or groups of trees, creating gaps, snags, logs and nesting substrates for wildlife species. Wildfire is another important natural process, playing a dramatic role in maintaining disclimax Douglas-fir and pine communities.

In Douglas-fir forests, other features may include multiple canopy layers with smaller understory trees. In wet climates on productive sites, these characteristics may begin to develop at as early as 80 years. In drier pine-dominated forests, stands are more open with relatively fewer snags or logs. On dry sites, stands may not develop old-growth characteristics for over 140 years.

The management objective within LSRs is to protect and enhance conditions of late-successional and old-growth forest ecosystems, which serve as habitat for plant and animal species including the northern spotted owl (ROD). Protection includes reducing the risk of large-scale disturbance, including stand-replacing fire, insect and disease epidemic, and major human-caused impacts.

The California Cascades Province has repeatedly been identified as an area of elevated risk to large-scale disturbance due to changes in characteristics and distribution of mixed-conifer forests resulting from past fire suppression. Risk reduction efforts are encouraged where they are consistent with the overall LSR objectives and management guidelines.

This paper documents the assessment process for the Goosenest LSR (RC-363), located in the California Cascades Province, eastern Klamath Basin (Figure 1.). It is a mapped LSR which

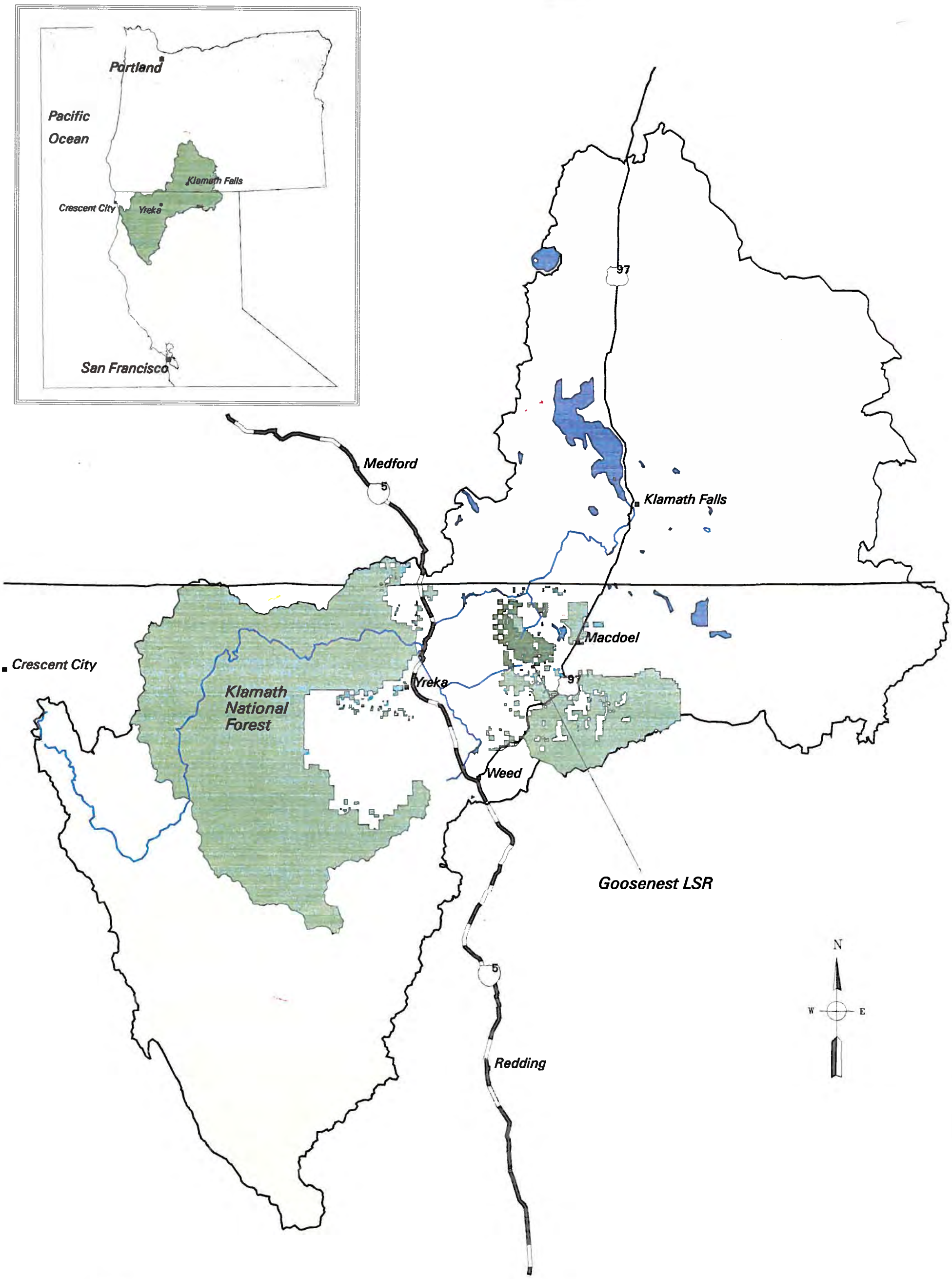


FIGURE 1. Location of Goosenest LSR in Klamath Basin, Northern California.

incorporates designated Critical Habitat for northern spotted owls.

HOW TO USE THIS LSR ASSESSMENT

The primary purpose of this assessment is to describe the current condition of the LSR, describe a desired future condition for the LSR, and to provide criteria by which restoration and maintenance projects may be prioritized and planned. At this landscape level of resolution, site-specific project planning is not appropriate. Spatial analyses are limited to description of desired stand sizes, distribution of community types relative to fixed landscape features such as slope, aspect, and elevation, and a few specific proposed activities. The assessment serves to guide management planning for the LSR, it is not a management plan.

There are four primary sections in this document. The first section is a **Description of the LSR** in terms of natural processes and potential natural plant and animal communities. This section is important in evaluating a desired future condition. The second section describes the **Current Condition** of the LSR, including the recent changes leading to this condition. The third section proposes a **Desired Future Condition** for the LSR, incorporating elements from section 1 with known processes and risks. Comparison of Current Condition with Desired Future Condition enables the identification of situations or areas requiring management, and the assessment of risk. Finally, the **Criteria and Possible Treatments** section expands on comparison of current condition and desired future condition and identifies appropriate management techniques to obtain desired conditions. This section also identifies and proposes a number of maintenance and restoration projects based on this process.

The geographic boundaries used in this LSR assessment fall within two catagories: (1) KNF administered lands within the boundaries of the Goosenest LSR and, (2) mixed ownership lands within sub-watershed encompassing the LSR. For the most part, terrestrial issues are largely assessed within the LSR, while watersheds provided a more appropriate geographic framework to perform fisheries, hydrology, geology and cummulative effects analysis. Therefore, the reader needs to be alert to circumstances where watershed conditions differ from those within the LSR.

PREVIOUSLY IDENTIFIED ISSUES AND CONCERNS IN THE GOOSENEST LSR

References to habitat conditions within the Goosenest LSR have been made in several recent documents related to forest management issues in the Pacific Northwest. The conclusions drawn from these references provide the foundation for this Assessment, along with site-specific data and appropriate citations from published and 'gray' literature.

The **Final Draft Recovery Plan for the Northern Spotted Owl** (USFWS 1992) contains numerous references to habitat conditions and desired management practices in the California

Cascades. Appendix E (Forest Protection Guidelines for the Northern Spotted Owl) and Appendix F (Managing Stands for Northern Spotted owl Habitat) provide information on the roles of fire and silviculture in maintaining late-successional habitat in fire-adapted ecosystems. Many of the assumptions and methodologies followed in these appendices were incorporated into this assessment.

In **FEMAT**, Appendix V-A (Physiographic Provinces and Subprovinces) the following description of the California Cascades Subprovince is given: "Fire plays an important role in the California Cascades in maintaining fire-adapted pine communities. Because of modern fire suppression, mixed conifer communities have increased, gradually replacing pine-dominated stands. If the objective is to manage a portion of the landscape in fire-dependant old-growth forests, then management must include understory thinning and understory burning".

The **FEIS for the Pesident's Forest Plan** (USDA, USDI 1994a; Appendix G, p.G-20) provides additional information on the importance of fire in the California Cascades. "The California Cascades Province has repeatedly been identified as an area of concern in management of spotted owl populations. As with other east-side provinces, this is due in part to the inherent ecological inability of the area to grow and maintain suitable spotted owl habitat. Current levels of habitat are believed to be at least partially the result of fire suppression (which may have allowed habitat to develop where it would not naturally occur), versus harvest of other habitat".

DESCRIPTION OF GOOSENEST LSR

Biogeographic Context:
The 39,770-acre Goosenest LSR is situated in the northernmost portion of the California Cascades, a narrow band of montane forest vegetation bounded to the east and west by the unforested Shasta Valley and Butte Valley (Figure 2). Forested habitats within this band provide the sole dispersal habitat for forest dwelling wildife moving between the Oregon Cascades and the Mt. Shasta area, Rainbow Mountains, and Sierra Nevada ranges. The Goosenest LSR encompasses a large proportion of the forested habitat within the California Cascades north of Mount Shasta, and therefore provides a critical link in metapopulation structure of forest-dwelling organisms such as northern spotted owls (Thomas et al. 1990, Woodbridge and Cheyne 1995).

Connectivity among population centers of organisms is a critical aspect of regional habitat planning and management. Different organisms disperse and colonize habitats at different rates, therefore connectivity must be assessed at several scales. Fine-scale dispersers (terrestrial salamanders, some plants and insects) must be assessed at the level of individual patches of suitable habitat, whereas others such as northern spotted owls may disperse up to 40 miles before settling in a territory (USFWS 1992, USDA,USDI 1994), and require landscape and regional level assessment. Broad scales of analysis are, in many cases, also the most appropriate analysis scale for evaluating connectivity of aquatic systems and fish populations.

To the north, the Goosenest LSR provides connectivity to the Bureau of Land Management-administered Hamaker Mountain/Surveyor Peak area. The 34,554-acre Jenny Creek LSR is located approximately 6.2 miles to the northwest, however the highly fragmented "checkerboard" pattern of land ownership of both LSRs provide poor connectivity. Stringers of densely forested habitats in drainages such as Shovel Creek, Jenny Creek, Fall Creek, Tom Creek and Indian Creek provide important corridors through the sparsely-vegetated Klamath River canyon and adjacent uplands.

Connectivity of the Goosenest LSR with forested habitats to the south is limited. South of the LSR, densely forested habitats typically occurred on the upper slopes of Goosenest Mt., Miller Mt, Herd Peak, Deer Mt. and the Whaleback; but this habitat has largely been removed or fragmented by timber harvest in recent years. Much of the landscape between the LSR and Mt. Shasta is lower-elevation eastside ponderosa pine and sage steppe vegetation and provides limited dispersal habitat for forest-dwelling organisms. The closest LSRs to the south are clustered on the southern and eastern flanks of Mt. Shasta, 22 to 30 miles from the Goosenest LSR (Fig. 2).

Relative to other LSRs in the Klamath Province, the Goosenest LSR is unique in it's isolation from forested habitats of the Klamath Mountains and Modoc Plateau. To the west, the Shasta Valley is dominated by unforested agricultural and grazing lands and constitutes a 12 to 35-mile

wide barrier to dispersal. To the east, agricultural and sage-steppe vegetation of the Butte Valley and southern Klamath Basin also provide a wide barrier to dispersal, and constitute the eastern boundary of the range of the northern spotted owl.

The Goosenest LSR is also uniquely situated from an aquatic standpoint as well, its waters providing connectivity between the upper and middle Klamath River Basin and adjacent tributaries draining southern Oregon and northern California.

Biophysical setting:
Assessment of the ecological function of the Goosenest LSR requires clear understanding of the roles of climate, topography, geology, and vegetation in developing and maintaining late-successional habitats in the California Cascades Province.

Climate:
Located 76 miles inland from the Pacific Ocean, the Goosenest LSR is buffered from coastal climatic influence. Summers are warm and dry, winters are cold and relatively dry. The growing season is typically short; varying from 50 to 100 frost-free days. Average annual precipitation varies from 10 inches on the floor of Butte and Shasta Valleys to 35 inches at higher elevations. Most precipitation occurs as snow between October and May, with occasional summer thundershowers. The north-south orientation of the California Cascades acts to intercept north Pacific cyclonic storms which release moisture in a gradient; increasing with elevation and decreasing as storms pass east over the crest (Figure A-1). This rainshadow effect results in reduced precipitation on the eastern portion of the Goosenest LSR and in the Butte Valley. The Klamath River canyon and Little Shasta drainage allow passage of moisture-bearing weather systems into the northern and southern portions of the LSR. Rain on snow flood events, which alter stream channel conditions, occurred in 1964.

Physiography:
Relative to the adjacent Klamath Mountains, topography within the Goosenest LSR is gently sloped and has few river or stream gorges (Figure 2). The landscape consists of volcanic uplands of moderate relief formed by the coalescence of several Pliocene/Pleistocene volcanos. These uplands are bounded to the north by the Klamath River canyon and a lava plateau, to the west by the Bogus Creek drainage and Shasta Valley, and to the east by the lake deposits of Butte Valley. The pattern of coalescing volcanos continues to the south. The LSR is dominated by the broad gentle shield of 6993-ft. Eagle Rock volcano, ringed to the east and south by the smaller, steeper Ball Mountain, Butte Mountain, McGavin Peak and Secret Spring Mountain. Somewhat isolated to the south, the Willow Creek volcano forms a relatively steep conical mountain.

Geology and Soils:
The Goosenest LSR is underlain by the volcanic rocks of the Western and High Cascades. The older Western Cascades consist of tuffs, breccias, lavas, and volcanic sandstones ranging in age from 11-40 million years. These rocks are buried beneath the younger (0.1-11.0 million years)

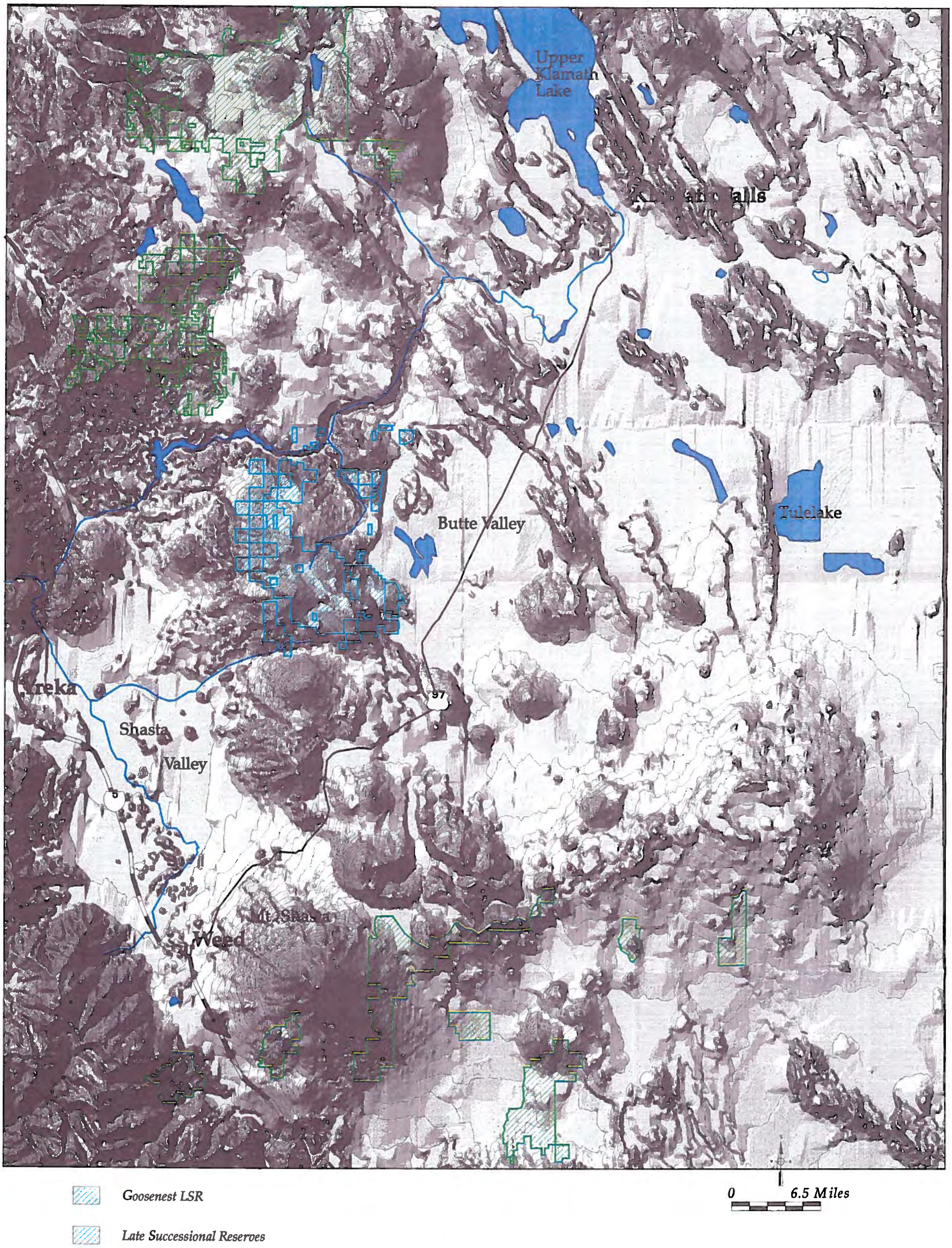


FIGURE 2. Topographic map of the Southern Cascade Mountains and Late Successional Reserves.

basaltic and andesitic lavas of the High Cascades (Appendix A-12). Most of the volcanos, such as Eagle Rock, Ball Mountain, Butte Mountain, Willow Creek Mountain, and McGavin Peak, are 2-11 million years old (Pliocene), but theGoosenest volcano is younger (0-2 million years). The Klamath River, as well as some tributaries such as Little Shasta, Bogus and Shovel Creeks, have have cut through the High Cascade lavas, exposing the rocks of theWestern Cascades in the Klamath River gorge and along the western and southern margins of the LSR (Appendix A-12). This exposure of the weak tuffs and breccias of the Western Cascades along canyon walls resulted in the development of large landslides over the past few million years (Appendix A-11). The largest of these forms the ampitheater on the north flank of Secret Spring Mountain . Most of these landslides are inactive under modern climatic conditions, but notable exceptions occur at Deer Creek and in section 1 east of Milk Creek where active earthflows and translational slides have been identified (Appendix E). Shallow, rapidly moving landslides (debris flows) occurred in the Muskgrave Creek watershed in 1964. Despite the high elevation of the LSR, it was not extensively glaciated in a manner similar to adjacent areas (Butte and Antelope Creeks). As a result, the only evidence of glaciation consists of minor cirques, glacial deposits, and outwash (Appendix A-11).

There are 4 major classes of soils within the Goosenest LSR (young soils formed from pyroclastic material; residual soils formed from volcanic flow material; residual soil with pyroclastic influence; and wetland soils). All are derived from weathered volcanic material and vary mainly in drainage qualities and depth. Younger soils associated with recent volcanic activity tend to be excessively drained and droughty, resulting in sparse forest cover. Most of the soils within the LSR are residual soils derived from volcanic ash or lava flow material, and are typically well drained loams. In terms of available water capacity and nutrient storage, these soils are limiting to plant growth. Water capacity and nutrient storage do not limit plant growth in wetland soils (Shovel Creek and Little Shasta meadows).

Aquatic Systems:
The geologic history of the Klamath River has not been studied in detail. However, most evidence indicates that the river has followed a course similar to the present one for 10 million years or more, and has been able to maintain its westerly course by cutting through the Klamath Mountains as they underwent several periods of uplift. In addition, the Klamath Basin may have drained a much larger area than it does presently, including parts of southern Idaho. If this description is correct, then the reach of the Klamath River through the Goosenest LSR has maintained a direct link to the Pacific Ocean for at least 10 million years. However, Basin and Range extension, which began about 10 million years ago, influenced the connectivity of waterways and riparian areas by creating isoloated, internally-draining basins and disrupting streamcourses. Thus, parts of the upper basin were periodically isolated from the Klamath River, allowing the development of unique aquatic species.

In comparison with Late Successional Reserves in the Klamath Mountains, the Goosenest LSR has few perennial streams (average 1.5 mi. stream per mi.^{2}). The final destination for most streams in the LSR is the Klamath River, although a few streams on the eastern portion of the LSR drain into the Butte Valley, presently a closed basin. Figure 3 illustrates the sub-watershed

network for tributary drainages which serve as geographic units for fisheries, hydrology, geology and cummulative effects analysis.

Streams on the western portion of the LSR drain into Bogus Creek, which is a tributary of the Klamath River. These include Parker Creek, Cold Creek, Steep Trail Creek, and Iron Creek. To the north, Indian Creek and Deer Creek drain directly into the Klamath River at Copco Lake. The central portion of the LSR is drained by Shovel Creek and Little Shasta River. Both Shovel Creek and Little Shasta River have their headwaters in the large meadow systems occupying the depression between Willow Creek Mountain and Eagle Rock. These are moderate gradient streams for much of their length with most low (< 5%) gradient reaches occuring in headwater areas within the LSR. Shovel Creek drains northward into the Klamath River, while Little Shasta drains to the south and east into the Shasta River and eventually into the Klamath. In the eastern part of the LSR, Prather Creek, Muskgrave Creek, Harris Creek and Ikes Creek drain into Meiss Lake, a sump lake on the floor of the Butte Valley. The portion of the LSR draining into Butte Valley is the recharge area for the Butte Valley aquifer used to irrigate crops.

Natural Vegetation:
The effects of climate, topography, geology and soils within the LSR combine to produce a series of ecological conditions that are expressed as different plant communities. These communities occur as gradients, but may be differentiated by dominant plant species, structure, and disturbance regimes. For the purposes of this assessment, communities will be classified based on dominant tree species (Figure 4).

1) Ponderosa Pine / Oregon White Oak / Western Juniper Community (POJ):
This community occurs at the lowest elevations within the Goosenest LSR, typically below 4500 feet, and occupies xeric sites and areas with shallow soils. Ponderosa pine is the dominant conifer within this community, developing open stands of large trees with sparse understories. Common shrubs within this community include curlleaf mountain mahogany, bitterbrush, and greenleaf manzanita. Other conifers occurring at low density are incense cedar and Douglas-fir, particularly in drainages or on north-facing slopes. As elevation and precipitation increase, the proportion of Douglas-fir, incense cedar and white fir increases and the community grades into a mixed-conifer community. Western juniper typically occupies the ecotone between open grassland/ shrub-steppe and upslope forested habitats. Oregon white oak occupies an intermediate position, at lower elevation and on less capable soils than ponderosa pine.

Disturbance Regime:
Frequent low-intensity fires in pine stands maintained low vertical diversity by reducing brush and young saplings in the understory, while acting to increase horizontal diversity by killing small patches of trees in a mosaic pattern over time (Smith 1994, Laudenslayer and Darr 1990). Fires return intervals ranged from 8 to 32 years (mean = 16) (Skinner, unpub.). Stand sizes tend to be small (3 to 37 acres), often expressed as clumps of even-aged mature trees occurring in a fine-scaled mosaic of small openings and younger clumps. Frequent low-intensity fire also acted to reduce coverage by brush species, and favor perennial grasses such as Idaho fescue. Oregon white oak is top-killed by moderate-intensity fire, but resprouts and will persist in a regime of

frequent low- to mderate-intensity fire. After attaining maturity, white oak resists low-intensity fires and will form open stands with little understory.

2) Mixed Conifer Community (MC):

Mixed conifer communities occur at intermediate elevations (4300 to 5800 ft.), and support a mixture of tree species including Douglas-fir, ponderosa pine, sugar pine, incense cedar, and white fir. This community is found on sites with higher moisture and/or deeper soils than pine communities, but is still considered to be a xeric forest type and is strongly affected by frequent low-intensity fire and intertree competition for moisture. Stand size and structure are strongly affected by slope position and aspect; north and east-facing slopes are more mesic and support relatively dense, structurally complex stands. Conditions on south and west-facing slopes are drier and support open, pine-dominated forest stands. At higher elevations, mixed conifer may occupy steep drainages, but eventually grades into true fir communities.

Disturbance regime:

The dominant disturbance factor affecting stand structure, species composition and seral stage distribution in mixed conifer stands is wildfire. Low- to moderate intensity fires burned frequently (3 to 59 years; median = 12 years) (Taylor and Skinner *in prep.*) , creating forest patches with open understories and wide tree spacing, and favored fire-resistant species such as ponderosa pine, Incense cedar, and Douglas-fir. This effect was highly variable over time and space, resulting in a mosaic of stand conditions across the landscape. Moderate-intensity fires consumed woody debris while simultaneously killing individual trees and small patches of trees; resulting in both loss and recruitment of snags and coarse woody debris. Fires typically occurred during late summer and fall, coinciding with increased frequency of lightning and generally lower fuel moisture.

Other disturbance factors such as insects, pathogens and windthrow have localized effects and act to cause mortality of individual trees or small groups of trees. In mixed conifer forests, mistletoe is widespread and affects regeneration of Douglas-fir in infected stands. The accumulation of dead mistletoe "brooms" at the bases of infected trees may have predisposed these trees to higher-intensity fires, which would act to eliminate the infection source. Insects, particularly western pine beetle, existed at endemic levels and likely caused mortality to individual trees or patches of trees during prolonged periods of low moisture.

3) True Fir Community (TF):

Stand structure and landscape pattern in true fir communities differ dramatically from lower elevation mixed conifer and ponderosa pine communities. White fir and Shasta red fir dominate these communities, which also may include ponderosa pine, sugar pine and lodgepole pine as minor components. These communities occur at higher elevations within the LSR (5800 to 6600 feet), and are associated higher precipitation, greater snowpack and lower temperatures than mixed conifer communities. Under natural conditions, true fir stands are typically dense and exhibit multilayered canopies and multiple age classes. Growth of shade-tolerant white fir and

red fir seedlings and saplings in the subcanopy often produces a dense, suppressed lower canopy (less prevalent in xeric forest types). Canopy closure in multistoried stands frequently exceeds 100 percent. In mature stands, windthrow and heart rot fungus produce numerous defective trees. True fir stands often exhibit extremely high fuel loading, and high numbers of small-diameter snags. The forest floor typically is dominated by woody debris and sparsely vegetated. Understory shubs include greenleaf manzanita and gooseberry.

Disturbance Regime:
Increased moisture and cooler temperatures act to reduce the occurrence of fire within this type, resulting in higher tree density and accumulation of woody debris. Large fires were less frequent and of higher intensity, resulting in stand replacement at larger scales (up to 100s of acres) than in drier forest communities; however numerous small low-intensity fires acted to create a fine-scale mosaic of regenerating conifers. Fire history studies on true fir in the California Cascades showed a mean fire-free interval of 41 years (range 17-65 years) (Taylor and Halpern 1991) . This produces larger stand sizes and lower landscape-level horizontal diversity in true fir communities. At the stand level, stands exhibit a complex age structure of clumped regeneration following fire and windthrow.

Disturbance factors such as insects, pathogens and windthrow may have important local effects, but typically act to kill single trees or groups of trees (within-stand effects). Heart rots and conk fungi are prevalent in white fir stands, causing mortality to individual trees and creating snags. Of particular importance in stands dominated by white fir is the fir engraver beetle (***Scolitus ventralis***), which causes top-kill and branch-kill and may reach epidemic levels in drought-stressed stands. These effects combine to thin stand density or create small canopy gaps, but typically do not occur at stand-replacement levels. Large-scale windthrow events may create large canopy gaps (up to several acres) but typically result in small openings involving a few trees.

4) Red Fir Community (RF):
This community occurs at the highest elevations in the Goosenest LSR (>6600 ft) and is dominated by Shasta red fir and white fir, with minor components of ponderosa pine, sugar pine, and mountain hemlock. Lodgepole pine may form pure stands within areas otherwise dominated by red fir, or may occur as a minor component within red fir stands. Red fir are highly tolerant of shade, and can germinate, survive and grow under a closed canopy for up to 60 years and retain the capacity to regain normal growth after release (Helms 1985). This permits development of multiple canopy layers, and rapid regeneration of canopy gaps caused by death of overstory trees. Red fir can survive and grow at high tree densities; this combined with it's high degree of shade tolerance make red fir stands very stable ecologically, even when disturbed. Natural red fir stands on good soils are characterized by their large size, high tree density, and relatively simple even-aged structure.

Disturbance Regime:
Cooler temperatures, increased moisture, and deep snowpack act to reduce the occurrence of fire

in red fir habitat. As a consequence, red fir forests have been little changed by the suppression of fire during the last 100 years. Red fir habitats occur at the highest elevations within the Goosenest LSR, and are subject to frequent lightning-caused fire ignitions. However, low fire potential in red fir stands typically mitigates against fire spread, resulting in small fires and low impacts at the landscape level. Mean fire return intervals in red fir forests in the California Cascades have been estimated at 41 years (range 17-65 years) (Taylor and Halpern 1991). Lightning fires create small forest gaps, often spotting to and from large down logs, and produce a fine-grained pattern of stand ages. Under dry conditions, however, high accumulations of woody fuels can result in stand-replacing fires and relatively large openings.

Windthrow, insect outbreaks and pathogens kill individual trees and create canopy gaps or larger openings in red fir forests. In the absence of timber harvest, however, red fir stands tend to be resilient to these events, and are largely within their natural range of variability. Root diseases, particularly ***Heterobasidium annosum***, may become more prevalent in red fir stands as a result of timber harvest.

5) Lodgepole Pine Community (LP):

Lodgepole pine typically forms nearly pure stands in cold-air basins, areas of poorly drained soils, and adjacent to wet meadows. On these poor sites lodgepole pine outcompetes other conifers and comprizes a climax community, whereas on better sites lodgepole is a pioneer early seral species. These stands are typically dense and contain high tree densities and levels of snags and down woody debris, and low structural diversity. Lodgepole pine is a relatively short-lived species, dependant on moderate-to high-intensity fire to regenerate stands. Understories in lodgepole pine stands tend to be open and nearly devoid of vegetation other than regenerating conifers. At meadow margins lodgepole stands may be parklike with dense growth of grasses and forbs.

Due to a usually-dense stand structure and lodgepole's intolerance of shade, stands become increasingly suseptible to major impacts by damaging agents as age increases. As discussed, this onset of decadence may be prolonged due to lodgepole's ability to carry excessive stand densities.

Because of lodgepole's intolerance of shade and its aggressive seeding pattern, it tends to grow in even-age patches. Patch or stand size is often determined by the interaction of the topography, the damaging agent(s) and stand replacing fire. Horizontal diversity is always low but may increase some as stands start to break apart with advancing age.

Disturbance Regime:

Low-intensity fires may have acted to reduce stand density and regeneration; however the short (70-100 years) lifespan of this species necessitates infrequent stand-replacing fire to maintain dominance by lodgepole pine. This forest type exhibits a cycle typified by overstocking, which leads to moisture stress and predisposition to insect attack and subsequent large-scale tree mortality. Following insect outbreaks, accumulation of woody fuels creates a high potential for

stand-replacing fires. In the absence of fire, dead lodgepole pine may accumulate in huge quantities, forming a dense understory layer of stacked small-diameter logs.

Fuel concentration and fire risk is low in newly initiated stands, but increases with increasing stand age. Due to the nature and location of the community type, low intensity fire is infrequent and as a result, fuel loads continually build until a major disturbance, such high intensity fire, re-initiates stand development.

6) Wet Meadow Community:

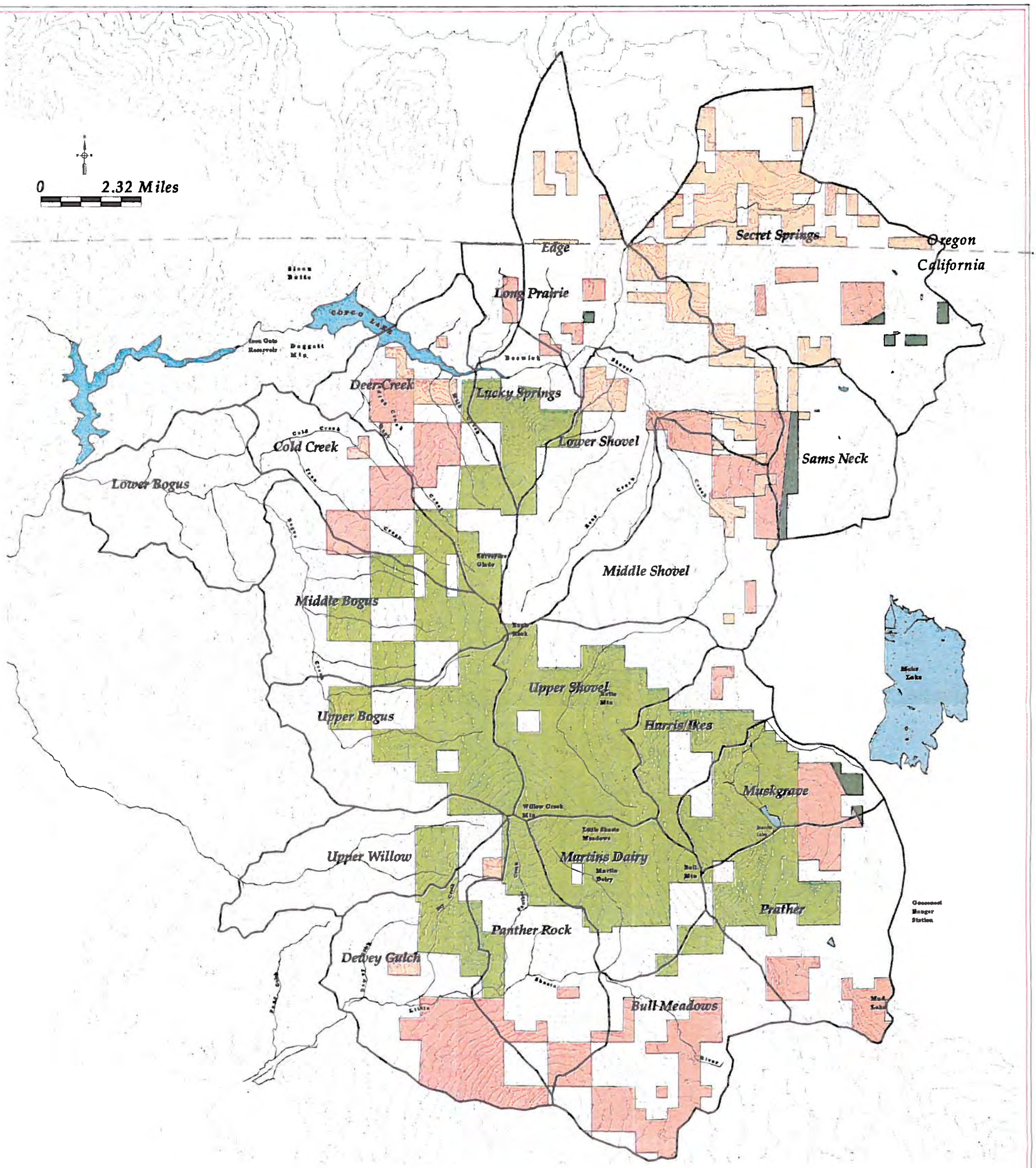
Wet meadows are important components of diversity within montane forest ecosystems. In the Goosenest LSR, natural meadow systems are associated with Shovel Creek and Little Shasta River, and smaller tributaries draining into the Butte Valley basin. In general, meadows appear to be associated with three distinct land features: (1) alluvial deposits (partly glaciated in origin) within the broad open valley at the heads of Shovel Creek and Little Shasta River, (2) hummucky landslide features with springs, and (3) streamside alluvial terraces with springs. Vegetation within wet meadow habitats is dominated by sedges, grasses, forbs, and occasionally willow and water birch. Wet meadow communities are found in association with other mesic and upland vegetation communities. These inclusions can be dominated by upland grasses and shrubs, such as kentucky bluegrass, low sage, big sage, and gooseberry. Cohesiveness is provided to otherwise erodible soils by their well developed root mats. In addition, vegetation provides roughness, increasing friction between the stream-bank interface, and decreasing the energy available for erosion, bedload and fine sediment transport. Quaking aspen, cottonwood, birch, and lodgepole pine are also important components of wet meadow communities.

Disturbance Regime:

Natural disturbance factors influencing wet meadow systems include elk, beaver, climate, landslides, floods, and fire to some extent. Meandering stream channel networks are often associated with wet meadows, constantly eroading and depositing streambank in concert with the structural resistance provided by riparian vegetation. In absence of significant sediment delivery, meadow channels are infrequently changed by flood events since functioning floodplains serve to dissipate much of the energy inputs. Climate plays a role in the timing and duration of floods and droughts, influencing watertable levels and frequency of landslides. In this way, climate can effect vegetative and channel succession. Grazing by livestock and supression of fire have reduced the distribution of aspen in meadows within the LSR while increasing the coverage of lodgepole pine, which has developed dense stands on former meadow sites.

7) Forested Riparian Community

Stream associated plant species common within the Goosenest LSR include willow, alder, and aspen. The life cycle of riparian vegetation is often maintained by periodic disturbance such as flooding, which in the case of alder creates pointbars and sediment accumulation necessary for seedling establishment. Densly forested stream corridors are also associated with mixed confer



LSR

AMA

Other KNF

BLM

Analysis Watershed Boundaries

FIGURE 3. Ownership pattern, Klamath Nationl Forest land management designation and analysis watershed boundaries for the Goosenest Late Successional Reserve (LSR) assessment.

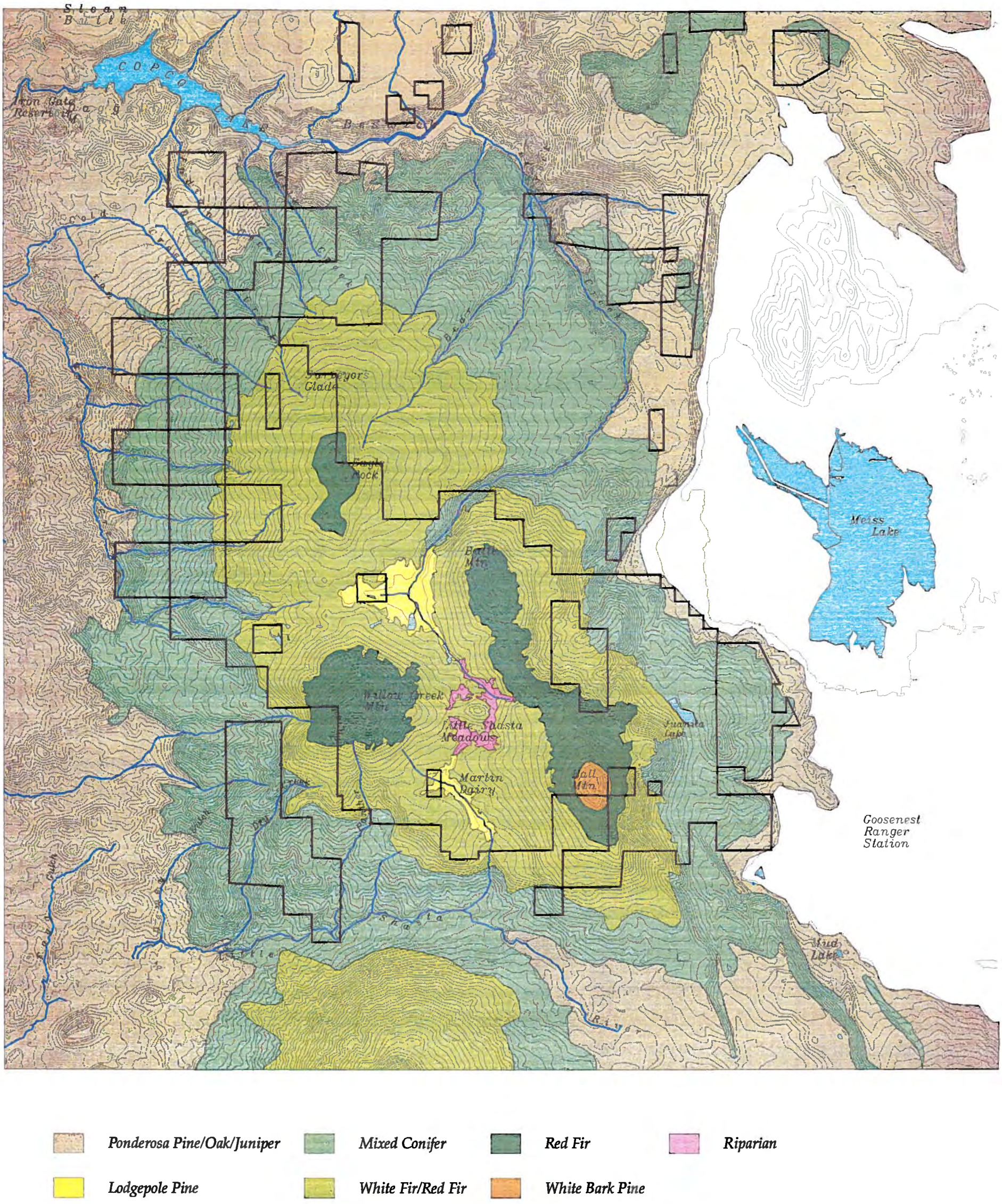


FIGURE 4. Forest communities within the Goosenest LSR and surrounding area.

species such as Douglas fir, ponderosa pine, lodgepole pine, white fir and red fir. While vegetation serves a role in streambank stability and filtering sediment, it also provides a source of food for aquatic organisms and course woody material (CWM) for aquatic/riparian habitat.

Disturbance Regime:
Floods, debris torrents, and fire are the dominant natural disturbance processes influencing the seral condition of riparian vegetation along stream channels within the Goosenest LSR. A well functioning riparian system is in dynamic equilibrium with streamflow and agradation/ degradation processes producing change with vegetative, geomorphic, and structural resistance. The channel network adjusts in form and slope to transport surface runoff with limited pertubation of channel and associated riparian plant communities. Because stream channel and vegetative interactions are often strongest in lower gradient reaches, vegetative conditions within these can be diagnostic of watershed conditions. Significant watershed disturbance is often manifested by a dominance of early seral stream-side vegetation combined with accelerated rates of channel aggradation or degradation. Increases in the quanity of sediment delivery or frequency of debris torrents can be associated with timber harvest, road construction, and grazing.

Native Species Community:
The presence, distribution and abundance of species endemic to the LSR assessment area can be an useful indicator of environmental conditions and degree of human related influences. Some species are more commonly accepted as "indicator" species than others due to availability of data or commodity value. The following discussion describes individual species or species assemblages native to the Goosenest LSR.

Fish: Watersheds comprising the Goosenest LSR are geographically located at the headwaters of the lower Klamath River hydrologic unit and border the downstream end of the upper Klamath River hydrologic unit; the division between the upper and lower Klamath River probably occuring in the vicinity of the Spencer Creek confluence. Mixing between the these once isoloated basins has resulted in local native fish assemblages which include fishes evolved from both upper and lower systems. Fifteen native fish species occupied the Klamath River watersheds within the vicinity of the Goosenest LSR Assessment area including rainbow trout, blue chub, Klamath tui chub, Klamath speckled dace, Lost River sucker, Klamath largescale sucker, Klamath smallscale sucker, Pacific lamprey (resident form), Pit-Klamath brook lamprey, shortnose sucker and marbled sculpin (Figure 10). Of these inland or resident species, rainbow trout, Klamath speckled dace, Klamath smallscale sucker, and marbled sculpin represent the tributary fish community while the remaining species are more commonly associated with the mainstem Klamath River. In absence of barriers to migration, most tributaries also supported anadromous species such as coho salmon, chinook salmon, steelhead, and pacific lamprey. Based upon habitat availability Bogus Creek, Shovel Creek, and the Little Shasta River were the significant anadromous fish producing watersheds prior to reservoir and dam construction. Sturgeon were also native to the Klamath River in this area, but were last reported before the turn of the 20th century.

Evidence suggests native fish occupying tributaries of the isolated Butte Valley basin share similarities with fish originating from the lower Klamath River and possibly the Pit River system. Connection with the Klamath River occurred during the Butte Valley paleo-lake period, which incompassed modern Meiss Lake and provided connectivity to Ikes, Muskgrave and Harris Creeks in the north and Butte and Antelope Creeks to the south. During periods when the Butte Valley paleo-lake overflowed, linkage with the Klamath River was established as waters drained through Sam's Neck down Rock Creek on the northern perimeter of the LSR. Fish species native to the Butte Valley likely became established during periods when connectivity between basins permitted intra-basin passage. Native species include rainbow trout, marbled sculpin, speckled dace, and Klamath small-scale sucker.

There are few records on which to base an assessment of historic wildlife populations in the Goosenest LSR area. Analysis of habitat relationships and species' range maps suggests that many late-successional dependant species were more numerous and better distributed in the past, but specific data are not available. Habitat for species that require dense stands or high levels of coarse woody material may have been somewhat limited by the pervasive effects of frequent wildfire. Records exist for large carnivores and harvested species, and permit general comparison of historic and current occurrence. Reports of two large carnivores, the gray wolf and grizzly bear, appear in settler's journals and trapper's records. These species were incompatible with livestock production and were extirpated from northern California in the late-1800's. The last grizzly bear in the LSR area was reported shot in 1892 (Merrill 1957).

Trappers records provide important information on distribution of beaver, a keystone species which has a profound effect on the aquatic and riparian systems it inhabits. Intense trapping pressure during the early European contact period, combined with numerous reintroductions in later years, make interpretation of historic distribution difficult. Records from Hudson's Bay Company suggest that beaver were widely distributed in Shasta Valley and Klamath river tributaries (CDFG 1990); it is therefore likely that they occupied the LSR area. Occupancy by beavers had a profound effect on the hydrology and vegetation of montane riparian systems. Ponding caused by beaver dams resulted in higher water tables, increased meadow extent and dominance of grasses and forbs.

History of Resource Management

Land Ownership:

The Goosenest LSR encompasses 39,770 acres of Forest Service-administered lands in a pattern of intermixed ownership with private timberlands. About 16 sections (10240 acres) exist as disjunct parcels in a "checkerboard" pattern with privately-owned timberlands. The central "core" of the LSR consists of 36 sections (23040 acres) (Figure 2).

Most of the National Forest lands within the Goosenest LSR (>60%) were acquired through donation and land exchanges during 1938 to 1943. These lands were previously owned by

private timber companies, most notably Schmidt Timber Company and West Macdoel Timber Company. These lands had largely been logged prior to transfer to Forest Service administration.

Land Management Activities:
The relatively gentle terrain within the Goosenest LSR has permitted a long history of timber harvest, beginning in the 1890's. Early timber harvest (pre-railroad logging) consisted of selective harvest of pine and cedar for fence posts, firewood and boards for local use, and was largely limited to the eastern and western slopes of the LSR. During this early period small sawmills operated within the LSR, using horses, oxen, and later, steam tractors. In the early 1900's several companies operated in the LSR, and narrow-gauge railroad logging became the primary method. During railroad logging (1909-1925), mixed conifer and pine stands on the accessible eastern slopes were largely removed. During this period the eastern slopes of McGavin Peak and Ball Mountain were heavily harvested. Improved transportation and higher demand for lumber resulted in a dramatic increase in harvesting during the postwar era.

Approximately 29% of NFS lands within the Goosenest LSR have undergone intensive timber harvest (shelterwood, regeneration harvest) with >75% of the overstory removed. An additional 43% had moderate (25-75% removal) harvest intensity. The remaining 28% has had light (<25% overstory removed) or no harvest.

Wildfire and Fire Suppression:
American Indians used fire to influence watersheds on the Klamath for possibly several thousand years. Until the early part of this century, they ignited fires to enhance values that were important to their culture. Early American settlers to this area used fire to improve grazing, to expose rock and soil for mining, and to improve travel routes (Wills and Stuart 1994).

The Klamath National Forest was established in 1905. One of the main charges of the Forest was management of the timber reserves. Uncontrolled fires were believed to be detrimental to the growing of trees. In the early years Rangers were spread thin and fire suppression conflicted with local interests, so many fires in this area were still allowed to burn. This practice continued until after World War I, when more personnel were made available to fight fires. After 1920, suppression of all fires was attempted as fire suppression forces grew, as did the ability to aggressively enforce fire prevention policies.

Fire occurence records have been maintained for the Goosenest LSR starting in 1922. From 1922 to 1994, 224 fires have occured that required fire suppression. Of these fires, 33 were person-caused and 191 were lightning caused.

Two major fires occurred within the LSR; in 1926 and again in 1957. The 1926 fire affected 15,484 acres, largely in the mixed conifer zone, on the northern and western slopes of Eagle Rock. At the northwestern corner of the LSR, the 1957 Bogus Fire consumed approximately 6,000 acres of mixed conifer and ponderosa pine forest, pine plantations, brush and grass within the LSR, and an additional 4,000 acres on the north side of the Klamath River. After the Bogus

fire, National Forest land that was capable of supporting conifers was salvage logged, slash treated and replanted. Private land within the LSR had limited slash treatment and reforestation. On private lands, untreated residual slash from salvage harvest poses an internal risk of high intensity wild fires.

Grazing:
Domestic livestock were first introduced into the Butte Valley and eastern portion of the Goosenest LSR area as early as 1858-1865. Early grazing by sheep and cattle was concentrated in lowlands (Shasta and Butte Valley) and gentle lower slopes in the POJ zone. Meadow systems (Shovel Creek, Little Shasta) recieved heavy use in summer, by both sheep and cattle. Regulated grazing began in the 1940's with the acquisition of additional private timberlands through land exchanges and donations. Grazing allotments were established, grazing use was gradually reduced. Upper Shovel Creek meadow and Little Shasta meadow were fenced and reseeded in 1947 and 1949, and permananent exclosures were constructed in 1987.

Roadbuilding:
Following settlement of Butte and Shasta Valleys, early development of transportation systems in the Goosenest LSR focused on connecting these areas. In 1864 the Ball Mountain road connected the Little Shasta area with Butte Valley, and in 1887 the Topsy Grade Road provided a route along the Klamath River to Dorris and Klamath Falls. During the early 1900's a multitude of trails and minor roads were developed, largely to service logging activities. These were largely converted to roads by the end of the 1970's. In the mid-1980s the Goosenest Ranger District implemented a Road Management Area program - much of the Goosenest LSR lies within the Ball Mountain Road Management Area. Within the Road Management Area, vehicle use is restricted to main collector roads from August 15 to March 30. This closure acts to restrict activity on most FS roads during periods of stress for elk and mule deer, and to reduce road maintenance needs.

Water development:
Surface water development within the vicinity of the Goosenest LSR assessment consists principly of impondments and diversions. In some areas, spring, meadow and wetland enhancement have also occurred. While positive terrestrial and aquatic benifits may be derived from some types of water development activities (e.g., development or enhancement of wetlands), dams and diversions often have negative effects on connectivity of aquatic habitat.

Major development of Klamath River water resources began in the late 1800's and consisted primarily of impoundments supporting mining and farming operations. Water development in the upper Klamath River basin which consists of an extensive system of drains and canals associate with the Klamath Reclamation Project has substaintially altered downstream water quality and quantity in the mainstem within the Goosenest LSR assessment area. Three Klamath River hydo-electric impoundments affecting LSR watershed aquatic resources include Copco No.1 (constr. 1917), Copco No. 2 (constr. 1925), and Irongate (constr. 1960-61)

Reservoirs. No provisions for upstream fish passage were provided for at these sites, significantly changed the distribution and abundance of both resident and anadromous fish in the middle and upper Klamath River sub-basins. The dams have also altered the the available habitat on the Klamath River by converting approximately 10 miles of river to lake habitat.

Stream diversions occur within every major watershed within the aquatic LSR assessment area and include terminal, surplus return, and inter-watershed diversions for agriculture, domestic and community water use (few on NFS lands). Inter-watershed diversions occur from the Cold Creek, Upper Bogus, and Secret Springs watersheds. Prior to 1987, water was pumped periodically from Miess Lake through a diversion which routed water down Rock Creek, eventually draining into the Klamath River. This inter-watershed diversion operated when farmlands adjacent to Meiss Lake were indundated by major storm runoff, until additional wetlands were developed adjacent to the State Butte Valley Wildlife Area. Significant water diversions occur downstream, and outside, of the aquatic LSR assessment area in the Little Shasta River. The age of most diversions varies with some dating back to early settlement. The impacts associated with operation of water diversions vary based upon the type, location, season of use, proportion of surface water diverted and presence/maintenance of fish screen(s). Connectivity within the aquatic system and inter-watershed transfer of exotic fish species has also occurred incident to diversion operations.

CURRENT CONDITION

Introduction

An initial step in assessing the current condition of the LSR is to determine how well it is functioning. For the purpose of this document, "functioning" is defined, and will be assessed, using the following factors:

1) Amount and distribution of late successional and old-growth forest habitat
2) Resiliency to large scale disturbance
3) Connectivity of late successional and old-growth forest habitat within the LSR
4) Contribution to northern spotted owl recovery

Analysis Area:
This assessment documents habitat conditions within the 39,770-acre Goosenest LSR and adjacent parcels of FS-administered lands in the Goosenest AMA and lands not within the range of the northern spotted owl (see Fig. 3.). Quantitative analyses and figures given in tables are based on LSR acreage only. Watershed analyses are based on a larger scale and include adjacent private and BLM lands in Oregon.

Vegetation Databases Used in Assessment:
Due to the large-scale nature of this analysis, current vegetative condition was assessed using 1989 LANDSAT Thematic Mapping data. The original 117 classification types were re-grouped to portray meaningful seral stages for habitat assessment within the LSR. Seral stage information is portrayed for each vegetation community type in Table 3. The Forest LMP vegetative layer (timber type) was also stratified by seral stage and vegetation community for comparison with the Landstat data. Seral stage data obtained from the 2 databases generally correlated very well. LANDSAT data was selected for use in the LSR assessment because of its recent origin (1989 compared with 1977) and inclusion of fewer unclassified acres (408 acres versus 9574 acres).

Use of aerial imagery has several limitations. It adequately addresses numbers 1 and 3 of above but poorly addresses number 2, resiliency to large scale disturbance. Aerial imagery also does not address finer-scale components of habitat quality such as condition of understory vegetation, snags and down logs.

Soils information was derived from Order 3 surveys conducted by U.S. Forest Service. This information highlighted low site areas such as shallow soils, rocky areas and saturated soils incapable of supporting dense late-successional habitat.

Vegetative condition:
The Goosenest LSR supports 6 forest community types; true fir (TF), red fir (RF), mixed conifer (MC), pine/oak/juniper (POJ), lodgepole pine (LP), and whitebark pine (WP) (Table 1, Figure 4). For some analyses in this assessment, the RF and TF community types may be considered together as true fir. This vegetative type along with the MC and the POJ communities account for almost all of the acres within the LSR. The LP and WP communities occupy very restricted, specialized sites. Community boundaries were established by stratification of the Forest Timber Strata into similar types and partial verification through field-checking.

Within the LSR, dense late successional habitat occupies 3,697 acres or only about 9% of the total area Table 2, Figure 12). Habitats considered suitable for breeding and/or foraging by northern spotted owls (late/dense, late/open and mid/dense) occupy 14097 acres or about 35% of the LSR area. An additional 29% is composed of previously harvested mid-mature stands (mid/open). Early successional stages are prevalent on the landscape and occupy about 25% of the landbase. Noncapable lands, which also include some unclassified sites, covers about 10% of the area. Approximately 75 - 85% of the LSR is capable of producing late successional forests with at least 20% canopy closure.

Table 1. Forest communities within the Goosenest LSR.

Forest Community Type[1]	Acres	Percent
Ponderosa Pine/ Oak/Juniper	1274	3%
Mixed Conifer	13590	33%
True Fir	18299	42%
Red Fir	4909	10%
Lodgepole Pine	1057	3%
Whitebark Pine	198	--

[1] uncapable and unclassified acres not included

Order 3 soils mapping indicated 3 broad FS site classes present within the LSR (Figure A-3). FS site class 3 was primarily present within the MC community while the true fir community was dominated by FS site class 4. Neither site class is limiting for the production of late seral stage habitat. This level of soil mapping is not intensive enough to highlight specific areas within these community types that would be site limited in terms of producing late-successional habitat. Order 3 mapping did illustrate a large zone of FS site class 6, incapable of producing late seral stage habitat, associated primarily with soils portraying the influence of high water

tables. This area is largely associated with meadow/lodgepole areas situated in low-gradient drainages. Within the Goosenest LSR, soil moisture is often the primary limiting component within the site quality equation. This is especially dominant on south facing aspects, and the effect is more pronounced at lower elevations. In general, such sites will not support the stand basal area that individual site trees may indicate.

Table 2. Size class and density of forest stands within the Goosenest LSR. See Appendix E for a description of classification scheme.

Vegetative Condition	Acres	Percent
Late-successional - open	2105	5%
Late-successional - dense	3697	9%
Mid-successional - open	11708	29%
Mid-successional - dense	8295	21%
Early seral/ sapling/ pole	9975	25%
Other (non-capable)	3990	10%

Several widespread phenomena have helped shape the current LSR vegetative structure. These large-scale impacts generally have transcended vegetative community boundaries. Specific changes within a distinct community type will be discussed following the general discussion.

The relative wet climatic conditions for the majority of this century, combined with suppression of wildfire, have changed the vegetative composition, structure, and pattern in the LSR, particularly in lower-elevation mixed conifer and ponderosa pine communities (Kilgore and Taylor 1979, van Wagtendonk 1985, Hughes and Brown 1991, FEMAT 1993, USFWS 1992). The vegetative composition in the LSR has shifted from fire-adapted, shade intolerant conifers to more shade tolerant non-fire adapted conifers such as white fir. Stand structure has also changed with a denser shade tolerant understory not only found on cooler north and east aspects but also on normally more sparse south and west aspects. Stand density has also increased dramatically throughout the LSR.

The recent drought, starting in the mid 80's and extending into 90's, has exerted stress on all vegetative communities within the LSR. Effects on tree survival are most evident where stand densities have exceeded critical basal areas, and competition for moisture is severe. Moisture stress is expressed as increased tree mortality due to insect and disease attack. In general, this impact is most pronounced on the easterly half of the LSR, with Butte and Ball Mountains exhibiting high mortality (>10% of stand) in some areas. To date, root and other diseases have not been a significant vector at the landscape level within the LSR. Most disease impacts have operated at the microsite level, creating "gaps", within stand canopies. Mistletoe infections are thought to be significant within portions the LSR, but whether this vector is operating at a

desired level is unclear. Severe infections are present within specific areas (e.g Steep Trail Creek) where they act to kill large overstory trees and prevent regeneration of the stand.

Railroad logging occurred for several decades in the early part of the 1900's and took place primarily in the southeast and northwest areas of the LSR. Primary activity occurred in the POJ and MC communities. Most large trees were harvested, with the exception of those that were in inaccessible locations. Early harvest practices, extending well into the post war era, focused on cutting of large trees. Clearcutting became a widespread harvest method in the MC and TF communities in the 60's and the 70's. Harvesting began in mid 70's in the true fir community, employing clearcut, shelterwood and sanitation prescriptions. Difficulty in accessing and harvesting timber in high-elevation RF and TF communities has resulted in better representation of late- successional habitats in these types.

Early successional stages are prevalent on the LSR landscape and give an indication of the degree of late successional fragmentation. Approximately 25% of the LSR landbase is composed of early successional forest vegetation (table 2). These early seral stages are capable in time of growing into suitable late successional habitat.

A large number of clearcuts in higher-elevation true fir areas remain unforested, in some cases for over 40 years (Illus. 19 & 20). In some watersheds (Upper Shovel and Upper Willow) unregenerated clearcuts accounts for 15-20% of the landbase. Harsh conditions limits the success of reforestation efforts on these sites, and intermediate steps such as planting lodgepole pine may be necessary before true fir and ponderosa pine can be established.

The Bogus Fire of the mid '50's occurred in roughly the northern 1/3 of the LSR. This intense burn, along with the associated salvaging, removed many acres of later/dense from this area. This burn also occurred primarily in POJ and MC community types. Reforestation of this burn, where successful, has currently resulted in dense, overstocked pine stands. Numerous understocked plantations, dominated by brush and grass, are also present as a result of the Bogus Fire.

Vegetative Community Composition:

Table 3. Seral stage composition of vegetative communities within the Goosenest LSR.

	POJ	MC	TF	RF	LP	WBP
Tot. Acres[1]	1274	13590	18299	4907	1057	198
% Capable	79%	96%	92%	77%	96%	39%
Acres (%) LS/OG[2]	11 (1%)	1177 (9%)	3619 (20%)	818 (17%)	177 (17%)	0
Acres (%) Owl Suit.[3]	175 (14%)	3208 (24%)	7801 (43%)	2357 (48%)	513 (49%)	
Acres (%) Early Seral	280 (22%)	3594 (26%)	4611 (25%)	1039 (21%)	418 (40%)	33 (17%)

[1] includes uncapable ground within each veg. community
[2] Acres include late/dense, late/open, and mid/dense seral stages
[3] Acres include late/dense, late/open, mid/dense and small/dense seral stages

As illustrated in Table 1, the Goosenest LSR is dominated by true fir, MC and POJ communities. Only a few percent of the LSR landbase is found in LP and WP community types. As a result, discussion will focus on the three dominant community types.

Red Fir and White Fir Communities - (Illus. 1 and 2)
Together the RF and WF communities occupy about 46% of the LSR landbase. As a result, almost half of the LSR acreage, the central core, is occupied by vegetation communities that are able to support dense stands with a high average percent crown cover. However, presently only about 12% of this community type (or 5% of the entire LSR landbase) is in late-successional condition. As Table 3 indicates, this exceeds by several percent the amount of late/dense within any other community type. Approximately 40% of the capable ground within the true fir community is occupied by the late/dense, late/open and mid/dense habitat types. The mid/dense seral stage is the major habitat contributor. Early successional stages are also prevalent within the community and account for 43% of the capable landbase.

Due to the higher moisture and longer fire return interval within the true fir community and the ability of these stands to carry relatively high basal areas, critical stocking levels may not be as apparent or real as within the downslope mixed conifer zone. However, areas of stress-related mortality are evident in pockets throughout this community. Insect-induced mortality (Scolytus, etc.) is very evident on the upper east-facing slopes of Ball and Butte Mountain. High mortality is currently occurring in the overstory of old-growth red fir on the south slope of Butte Mountain. Larger trees, in the 24 to 30" DBH are affected.

Although these communities have been relativley less affected by fire suppression, trends toward

overstocking have resulted in denser understories and higher fuel loading than the natural fire regime would have historically allowed. Resiliency of larger trees to fire impacts is compromised by the development of these "ladder" fuels, particularly on south- to west-facing slopes. The openings and patches of 'burned out' fuels that were historically present are now occupied by dense young fir.

Mixed Conifer Communities - (Illus. 3 and 4)
The Mixed Conifer community is roughly equal in extent to the WF community. However, only 6% of the community landbase is in late/dense condition, and approximately 38% of the area is in early successional stages (Table 3). The mid/dense seral stage is significant within this community type, accounting for about 20% of the capable landbase. Due to the contribution of this age class, 27% of the community consists of habitat suitable for nesting by northern spotted owls.

Supression of natural fire has had significant effects on the vegetative structure within the MC community. Shade-tolerant white firs have increased greatly in stands within the MC zone. This effect has been exacerbated by past thinning and overstory removal harvests, which reduced the relative proportions of large fire-resistant species. Critical stand basal areas have been exceeded over widespread areas, resulting in severe stress and reduced resistance to insects and disease processes. Tree mortality caused by scolytis and pine beetles is evident throughout the MC community, including several areas of high (>10% of stand) mortality. The easterly half of the LSR, particularly the lower slopes of Ball and Butte Mountain, is significantly impacted. The encroaching white fir understory also creates a significant fuel "ladder" problem, placing larger trees at risk to fire impacts normally able to be endured.

Accumulated fuels resulting from tree mortality have resulted in increased fire risk in mixed conifer stands within the LSR. These fuels, and fuel ladders created by white fir in the understory, are not reflected in Fire Behavior Potential models, and are currently increasing with annual mortality.

Ponderosa Pine/ Oregon White Oak/ Western Juniper Communities - (Illus. 5 and 6)
The Ponderosa pine community has been dramatically altered in extent, species composition and structure from its' historic condition. Presently this community covers 1274 acres within the LSR, however it is likely that it historically had a significantly greater extent. Timber harvest and suppression of wildfire have acted in concert to convert many pine sites to a mixed-conifer community, particularly at the upper elevations within the community.

Ponderosa pine communities exist at lower elevations within the Goosenest LSR and have a long history of timber harvest. Late-successional habitat is essentially non-existent within this community type (< than 1% of the community landbase). Approximately 51% of the community is in early seral stages.

There are two primary stand types evident in the present ponderosa pine community. In unharvested or selectively harvested stands, suppression of wildfire has resulted in encroachment of shade-tolerant species such as white fir into stands historically dominated by ponderosa pine (Laudenslayer et al. 1989). In harvested stands, dense stands of young pines (natural or planted) have formed closed-canopy stands where growth is retarded. Over time, stand basal areas have increased beyond critical levels, with resultant stress to the remaining pines. Ponderosa pine is especially sensitive to density-induced mortality (Schultz 1996). Encroachment of white fir into pine stands tends to eliminate regeneration by pine, which requires bare mineral soil for germination. In many locations, white firs now occupy the overstory while pine stumps are evident on the forest floor. Encroaching white firs and other mixed conifer species are more evident in upper part of the historic pine belt. Fire suppression has also allowed the encroachment of western juniper in the lower elevations of the pine zone. Western juniper now forms nearly pure stands in former pondreosa pine communities.

Lodgepole Pine Community - (Illus. 7 and 8)
The age and physical structure of lodgepole pine stands within the Goosenest LSR have been dramatically altered by fire suppression. Presently, stands are densely stocked with suppressed, small diameter trees. Severe intertree competition has resulted in numerous outbreaks of western pine beetle, causing high levels of tree mortality and subsequent fuels accumulation. Current management of density and fuels typically entails fuelwood permits, which result in removal of snags and down material and leave small suppressed trees on site.

Lodgepole pine stands in this area are typically associated with riparian areas, meadows and cold air basins where growth of other conifer species is limited. Risk of stand-replacing fires in these conditions is relatively low, however the excessive accumulation of fuel in many lodgepole stands suggests that under severe weather conditions a catastrophic fire could occur, placing adjacent conifer stands at risk. The low-quality wildlife habitat provided by dense young lodgepole pine stands does not offset the benefits of thinning them.

Fire and Potential Wildfire Effects
Through effective fire suppression and with only limited use of prescribed fire there has been a shift in the fire regime within the LSR. Effective fire suppression has radically altered the historic fire regime, and a large portion of the LSR has not burned in 40 to 80+ years (Figure B-1). This alteration in a dominant disturbance regime has had a dramatic effect on forest composition, structure, and landscape pattern.

Duff layers have increased in depth, accumulations of available fuels in all size classes have increased, and the amount of vegetative biomass has increased. Prior to fire suppression many stands were open, tree crowns were separated, areas with continuous conifer overstory were limited to the north and east aspects, and perennial riparian areas were less influenced by fire. The effects of these changed conditions include increases in dead and live fuel, development of fuel ladders, and a closed canopy that can sustain a crown fire. At the 90th percentile weather (ie. expected weather during late summer), the ground fuels easily burn with flame lengths

Illustration 1 & 2. Current condition True Fir stands in the Goosenest LSR. Upper photo; typical structure within dense early-mature WF stand. Lower photo; typical stand after overstory removal.

Illustration 3 & 4. Current condition in Mixed Conifer stands in the Goosenest LSR. Upper photo; dense WF understory with pine overstory. Lower photo; dense mid-mature MC stand with fuels buildup and ladder fuels.

Illustration 5 & 6. Current condition in Ponderosa Pine stands in the Goosenest LSR. Upper photo; dense, suppressed young stand. Lower photo; dense mid-mature stand with mortality and fuels buildup.

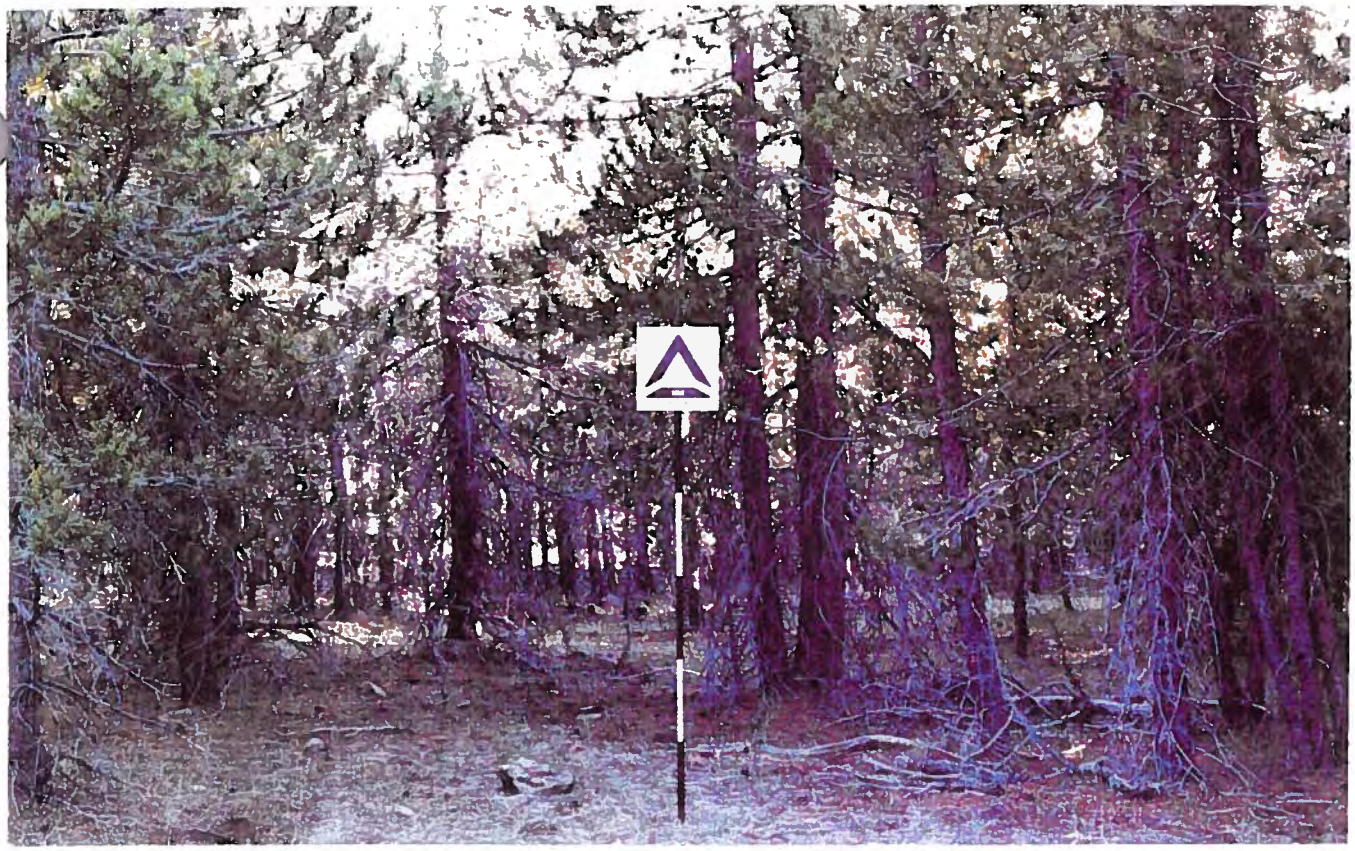


Illustration 7 & 8. Current condition in Lodgepole Pine stands in the Goosenest LSR. Upper photo; dense early-mature stand. Lower photo; extremely dense young stand with high fuel accumulation.

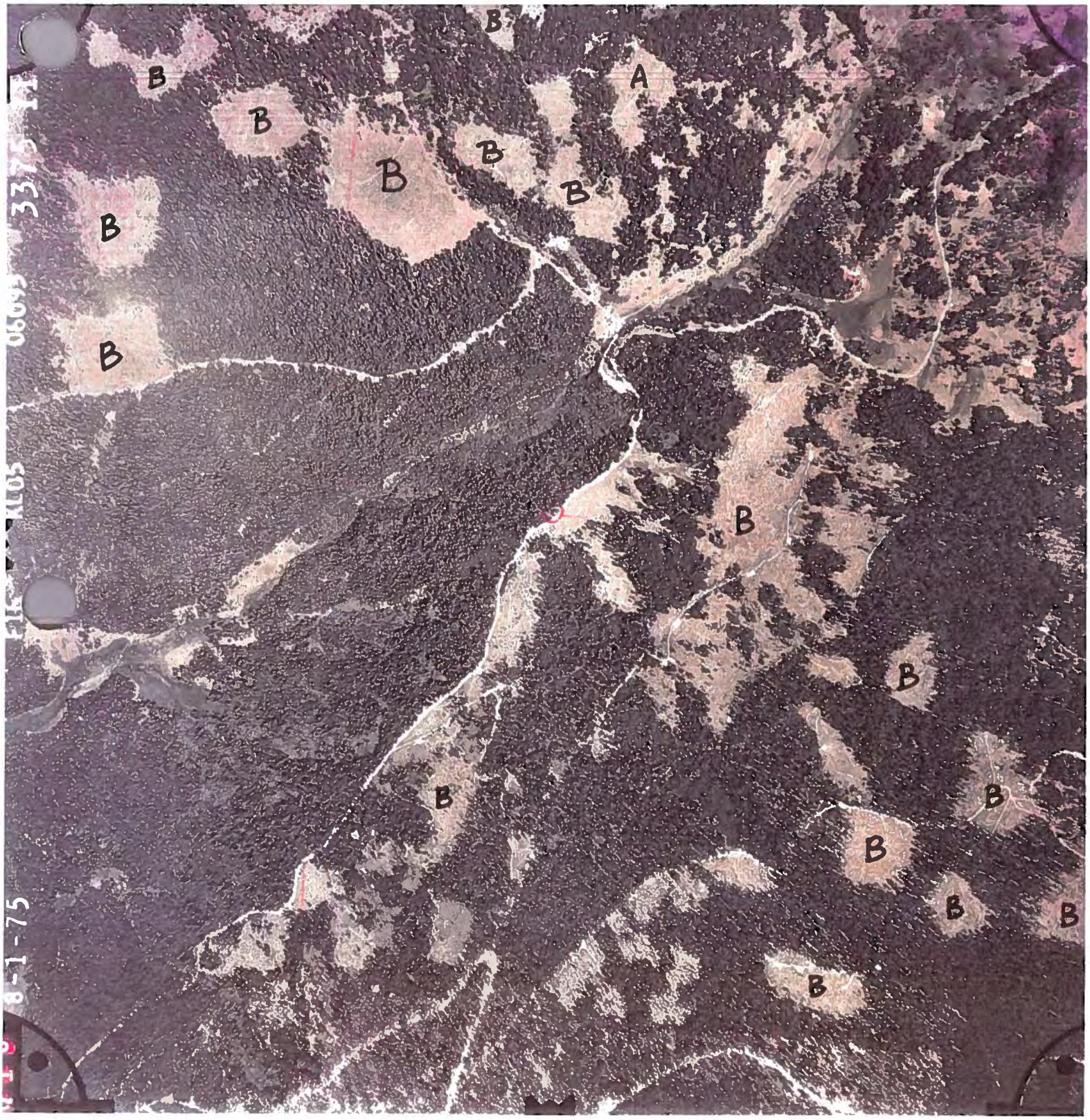


Illustration 19. 1975 aerial photograph showing unregenerated clearcuts in W Butte Mountain and Upper Shovel Creek area. A= pre-1955 clearcuts. B= pre-1975 clearcuts.

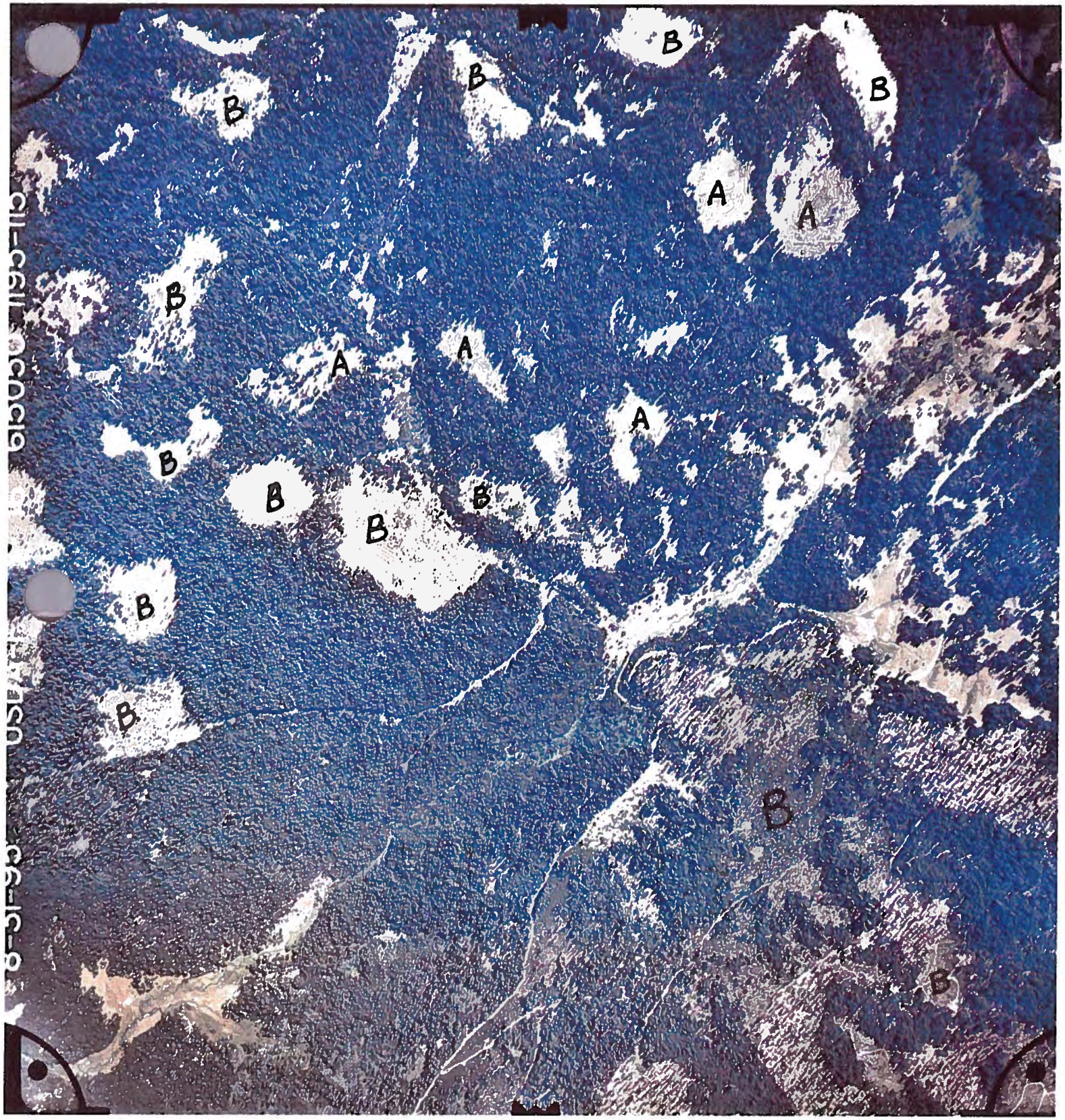


Illustration 20. 1995 aerial photograph showing unregenerated clearcuts in W Butte Mountain and Upper Shovel Creek area. A= pre-1955 clearcuts. B= pre-1975 clearcuts.

greater than four feet. These flame lengths will cause torching of the understory vegetation, which preheat and cause torching of the larger trees that were previously resistant to fire. Combined with steep slopes, light winds, and dry conditions, this individual torching will advance to running crownfires and large stand replacing events.

Fuel loadings in unmanaged areas is variable due to past fire history, stand ages, and different vegetation types. Fuel accumulations (< 10 tons/acre of dead and down surface fuels) are found primarily in plantations where fuel treatments have been completed (as depicted by Fuel Model 8). Fuel Loadings as high as 60 tons/acre are found in managed and unmanaged stands of mature timber (as depicted by Fuel Model 10) (See Appendix A for a description of each fuel model). Large woody material is seldom uniformly distributed on the landscape. Duff and litter depths are from .5 to 4 inches. (Reference Fuel Model Map). Figure B-2 displays the fuel models for the LSR and Appendix B includes a definition of the fuel models.

Plantations on any slope or aspect are a concern. The density of these plantations is primary concern. The closed nature of these plantations creates a continuous fuel condition with the dense tightly packed crowns. The density and associated dead fuel created by brush increases the likelihood of a crown fire and stand replacing event.

Fire behavior potential modeling was completed for the LSR. Fire behavior potential modeling uses fuel model, topographical factors (slope and aspect), and extreme weather data to predict the resistance to control if a fire was to occur in a given area. **The modeling showed that on National Forests lands, approximately (0%) of the LSR is in a high fire behavior potential condition, 7633 acres (20%) are in a moderate fire behavior potential, and 30,822 acres (77%) are in a low fire behavior potential.** In general, the large proportion of the LSR landscape exhibiting low fire potential is the result of cool, high-elevation fir stands that burn at high intensity only under extreme conditions. Small, scattered areas of High fire behavior potential occur in dense mixed conifer stands with recent drought-induced mortality. Large areas (ie. greater than 200 acres in size) of moderate fire behavior potential which occur on south and west-facing slopes pose extreme risk. This situation currently exists in the Bogus Burn area and the McGavin Peak area (Figure B-3). Description of Fire Behavior Modeling in the Fire Plan in Appendix B..

Watershed Condition:

Riparian Reserves:

Riparian reserves were deliniated based upon interim FEIS ROD widths for federal lands within the Goosenest LSR and are composed of geologically unstable lands (active slides, toe zones, inner gorge) and buffered riparian features (streams, standing water bodies, wet meadows, and springs)(Table 4; Figure 5; Figure A-4). Riparian reserves include those portions of watersheds that directly influence the hydologic, geomorphic, and ecological processes affecting streams, fish habitats, and habitats of other riparian-dependent resources.

Table 4. Composition of interim riparian reserves within Goosenest LSR assessment watersheds.

Owner	Total Riparian Reserves (acres)	Percent of Total Riparian Reserve		Riparian Reserve (acres)					
				Unstable Geology			Buffered Riparian Features		
		Unstable Geology	Riparian Feature	Active Slide	Toe Zones	Inner Gorge	Streams	Water Bodies	Springs
KNF	6619	5%	95%	53	68	261	4969	1257	12
BLM	580	27%	73%	0	36	121	396	26	1
Other[1]	13812	7%	93%	10	254	723	11022	1756	47

[1] Estimates of riparian reserve area on non-federal lands for analysis only; Federally designated reserves do not extend to non-federal ownerships.

Late-Successional Forest in Riparian Reserves:

Based upon interpretation of imagery and mapped forest community type, 21 percent of riparian reserves in the assessment watersheds were composed of late-successional forest and an additional 41 percent of the existing forest vegetation having potential to attain LSF characteristics (Figure 6). Nearly 75 percent of all existing LSF identified within riparian reserves occured on KNF lands (Table 5). Imagery indicates late seral stands within riparian reserves may have decreased by as much as 65 percent or about 4100 acres over the analysis area, with nearly 60 percent of the potential LSF occuring on non-KNF lands. Further analysis of imagery and topography suggest an additional 174 acres (2 percent of the riparian assessed) of the presently non-forested vegetation may have the ability to attain LSF characteristics.

Table 5. Existing and potential area of Late-Successional Forest (LSF) within Riparian Reserves, by ownership.

Owner	Late Successional Forest (LSF) Condition (acres)		
	Existing	Forested Potential	Non-Forested Potential
KNF	1622	1687	118
BLM	5	72	0
Other	533	2407	56
Total	2160	4166	174

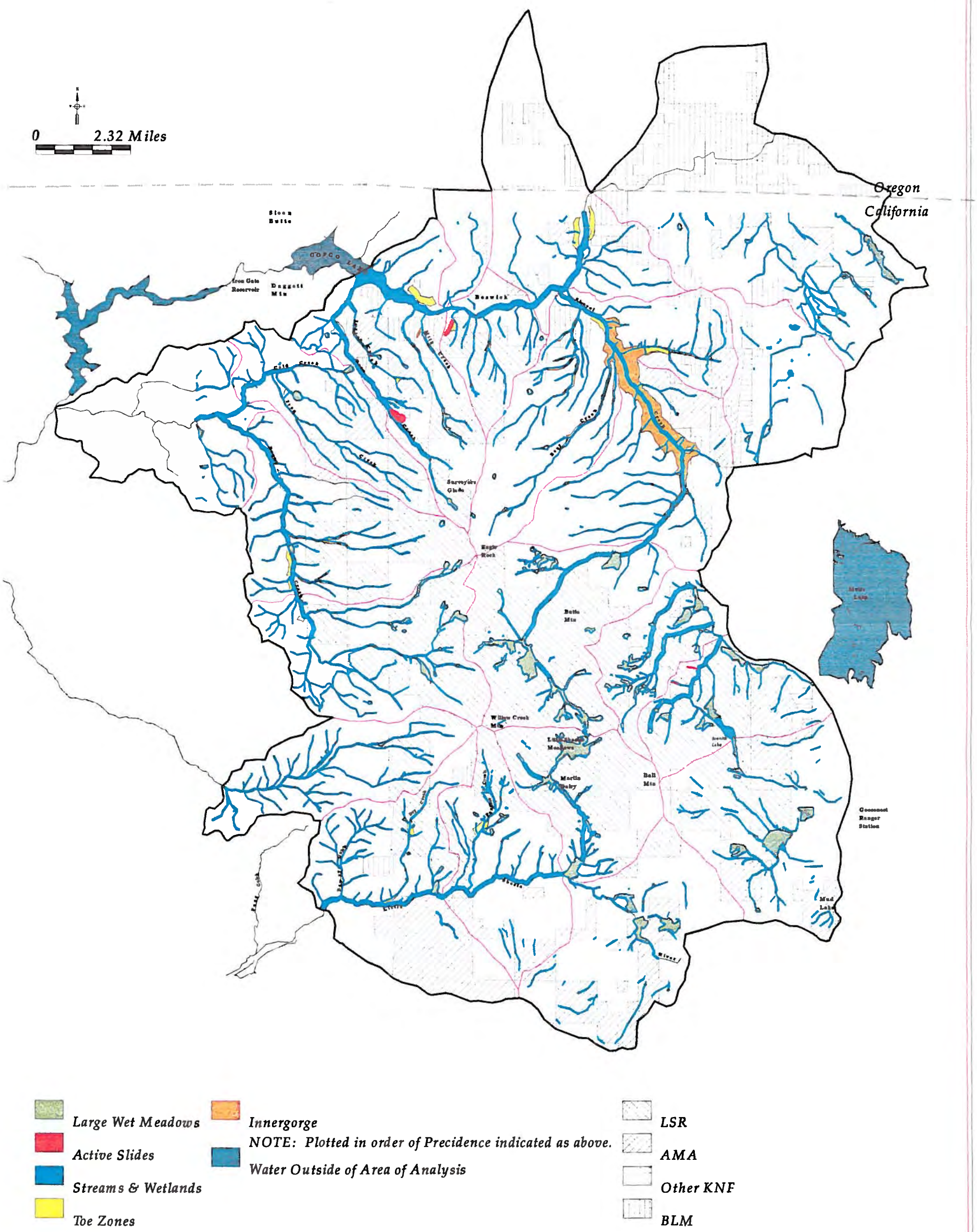


FIGURE 5. Display of riparian reserves, including buffered riparian features and highly unstable lands, extended to all ownerships within the Goosenest LSR. Land managment standards & guidelines apply only to those riparian reserves managed by the Klamath National Forest. Riparian reserves are displayed on private lands for comparitive purposes only.

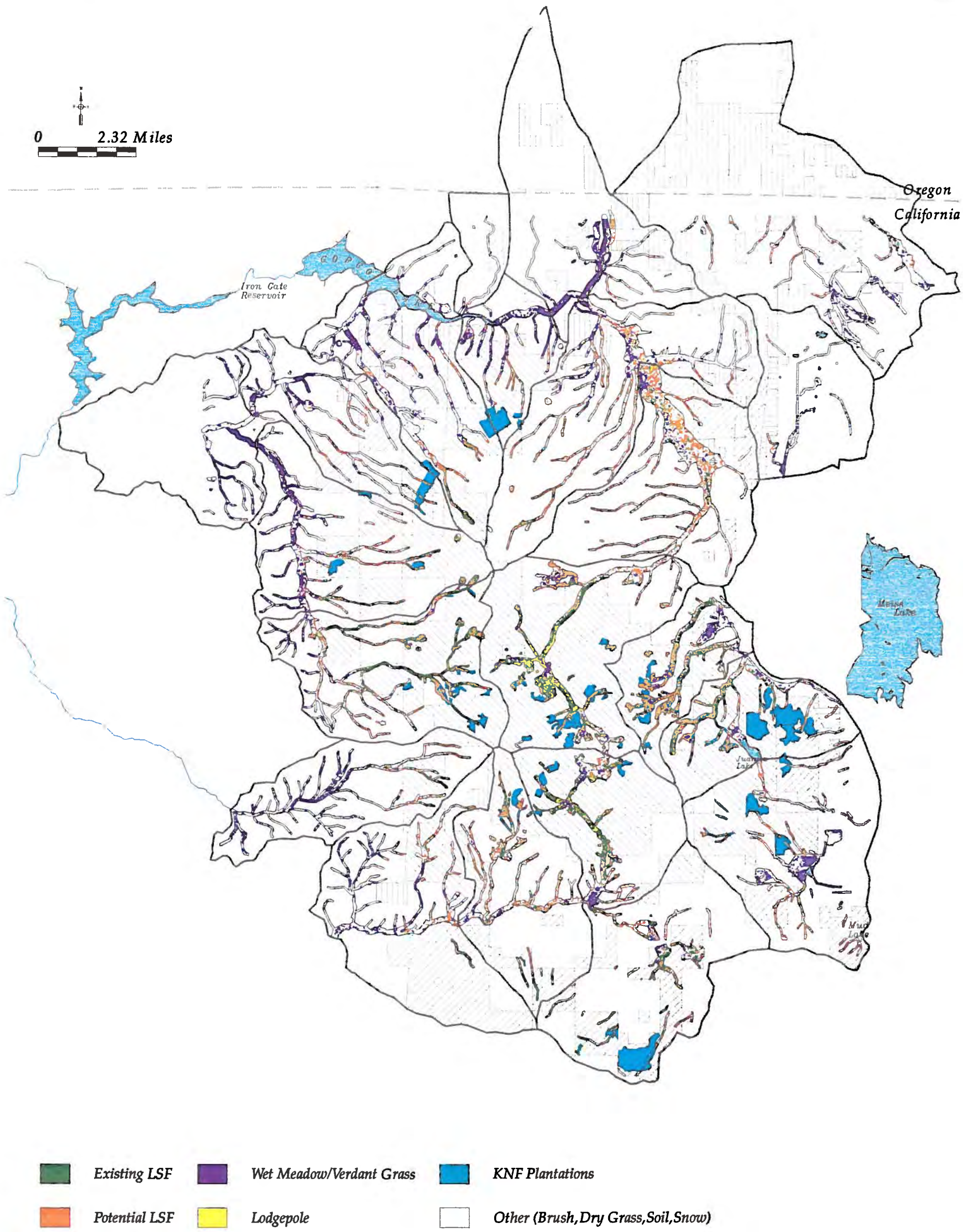


FIGURE 6. Existing condition for vegetation within Riparian Reserves from classified spot imagery and forest community typing. Mapped KNF plantations overlapping Riparian Reserves are displayed for reference and potential silvicultural treatment focused on promoting Late Successional Forest.

Fire in Riparian Reserves

Riparian reserves along perennial water are generally cooler and have higher moisture contents than upslope areas. These conditions generally provide a barrier to fire spread or slow fire spread. The cooler temperatures, moister air, and less flammable vegetation combine to retard fire intensities except in extreme conditions (i.e., drought). Lower intensity fires often top kills shrubs and deciduous trees, many of which resprout. Low intensity ground fires may trigger secondary succession only in lower canopy layers. Occasionally small patches may burn more intensely, killing vegetation through the upper canopy.

Fire effects in upslope vegetation are important to riparian reserves. Effects of upslope fire activity include increased runoff, sedimentation and loss of habitat within the riparian reserve.

The effects of fire suppression have resulted in increased fuel accumulations in all areas, with subsequent increases in potential fire intensity. This increases the potential for damage to riparian vegetation and ground cover which can increase run-off and soil erosion, reduce canopy closure and stream shade, and increase the short-term large wood recruitment to the stream. This becomes a stand replacing event in upslope areas and much of the riparian reserve.

Aquatic Habitat Condition

Little quantitaive stream inventory information was available to assess existing conditions of stream habitat. However, a qualitative assessement of stream conditions was made from field surveys, fish species composition and distribution, and interviews with agency personnel. Overall aquatic habitat condition was ranked for stream channels within assessment watersheds using five equally weighted parameters: **(1) water quality, (2) water quantity, (3) stream connectivity, (4) native fish community integrity, and (5) channel condition**. These parameters were developed by an interagency team of resource specialists and judged to be diagnostic indicators of the functioning condition aquatic habitat. Parameters were rated against natural potential, and only where the particular parameter was applicable (see Appendix D-4 for rating criteria). The parameter " water quantity", for example, was evaluated by comparing the existing hydrograph against the hydrograph expected in absence of man associated disturbances, including the timing and magnitude of the observed differences between the two. Ratings for individual parameters, summarized in Figure D-2, were combined for an overall watershed ranking which is displayed in Figure 8. Spacially, these rankings provide a general indication of the functional condition of the aquatic system within adjacent watersheds composing the Goosenest LSR.

The conditions of stream and riparian areas is often reflective of conditions in the entire watershed, including the uplands. When a disequilibrium between the rates and timing of inputs such as water and sediment occur, preturbation of the channel features and associated riparian-wetland may be manifested if the disturbance is large enough. Stream channel and associated riparian vegetation may reflect large scale or frequent disturbance by exhibiting early successional stage features (Figure 7; Figure A-6). For many fish and wildlife species, optimum conditions coincide with mid- to late-seral vegetative and channel conditions. Low gradient

(<5% slope) stream reaches with low to moderate valley confinement tend to be areas most sensitive to channel disturbance (Figure A-7) and, in the area of the LSR, are often associated with wet meadow features.

Stream channels associated with meadow systems within the LSR appear to be largely represented by early to mid-seral states coenciding with lowered water table levels and xeric vegetative encroachment. Some of these encised channels exhibit little bank stabilizing vegetation and no floodplain. Until degredation is stabilized and channel widening occurs to restore floodplain development, vegetative treatments will likely be temporary, even in the absence of grazing pressure. Although a few of the stream channel restoration projects appear to have arrested channel downcutting, success of mechanical treatments designed to halt channel degradation and restore watertables could be significantly increased in several areas by incorporating hydrologic design principles. Some of the existing channel treatments are inappropriate for low gradient, low confinement channels.

Aquatic Habitat Fragmentation Reservoirs, water diversions and roads can have significant adverse effects on the connectivity of aquatic systems. While all three can influence fish passage, loss of habitat, and routing patterns for coarse woody material (CWM) through the stream system, roads and culverts are often over-looked on all but the largest crossings for their effect on habitat fragmentation.

The current mapped road density within the assessment area averages 2.1 road miles per square mile among watersheds with a total of 527 road/stream crossings (Figure A-9). Road densities vary between watersheds within the LSR, ranging from 0.6 to 3.7 road mi/mi^2. The relative extent of aquatic fragmentation may be compared by indexing the number of road/stream intersects by unit of stream length per watershed. For all ownerships this index ranged from 0.3 to 2.0 road/stream intersects per mile of stream, while KNF administerd lands ranged from 0 to 3.5, the highest occuring in Middle Shovel Creek, Martin's Dairy, and Panther Rock watersheds. This compares with an overall aquatic fragmentaion index of 1.2 indicating more than one crossing for each mile of stream.

Erosion Processes

Surface Soil Erosion Most surface erosion comes from the existing roads that are unsurfaced. Although cut and fill slopes can contribute significant sediment they are expected to revegetate and stabilize within a 10 year period; most roads within the LSR were constructed at least 10 years ago. Unsurfaced roads that have soil with less than 80 percent gravel (by volume) have a high potential to erode and cause non-point pollution to stream courses. Roads that are closer than 100 feet from a stream can yield about 2-1/2 times more sediment as those further away (USDA 1972). This is attributed to erosion of fill material during floods and surface erosion that directly enter stream channels. These areas, represented by road stream crossings are displayed in Figure A-9.

Areas that have sandy or silty soils with low aggregation and have low rock content (gravel, cobble, etc.) are highly sensitive to surface erosion during road construction. The soil subsurface

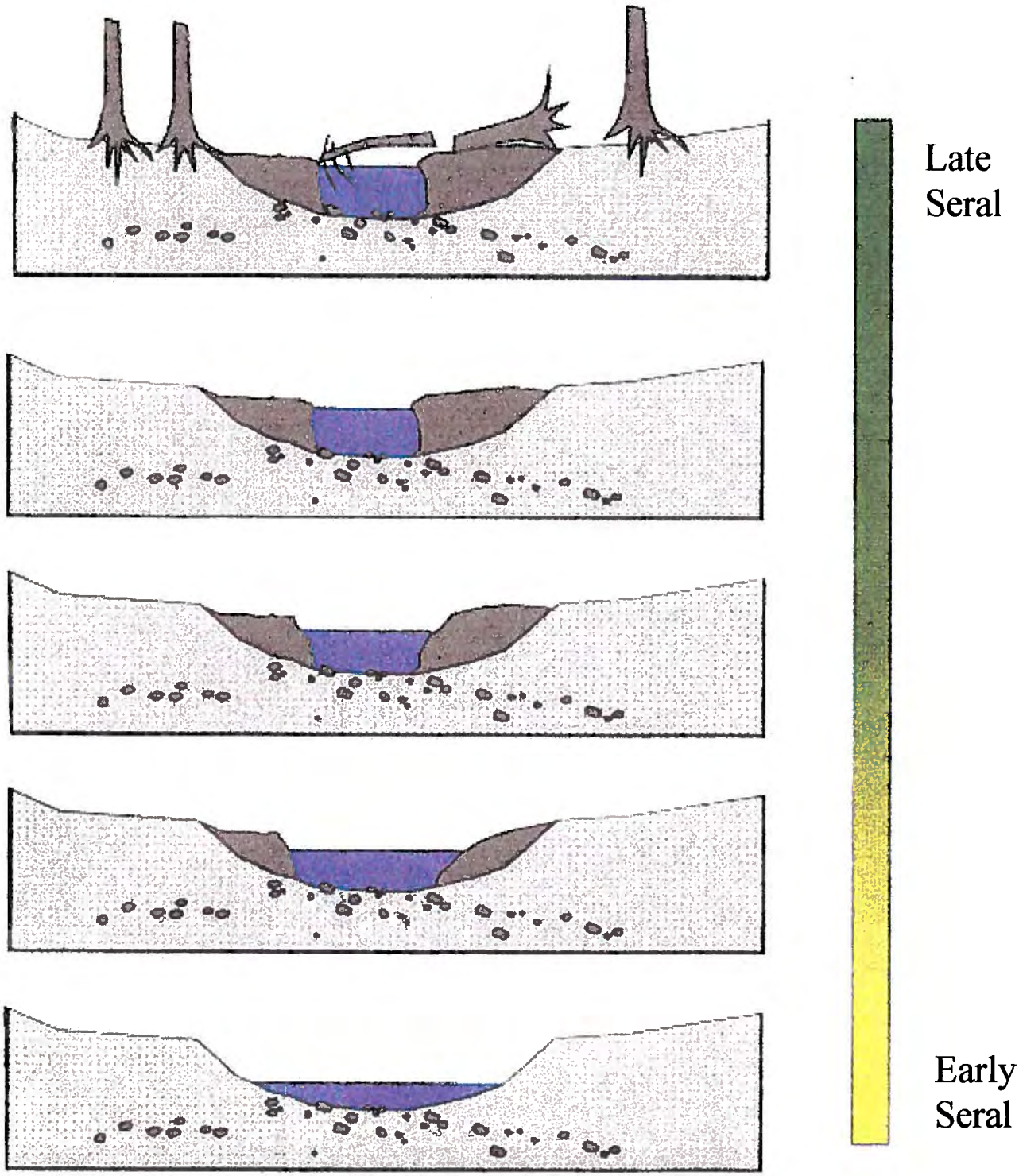


Figure 7. Succession of states for moderately confined stream channels.

is the most susceptible to surface erosion when the soil is exposed due to the poor stability of the soil aggregates and their low aggregation (Figure A-9). Unsurfaced roads have the potential to present cronic erosion and sedimentation during wet weather. Oppourtunities to reduce road related sedimentaion and potential adverse effects are greatest where unsurfaced roads coincide with high and moderately erosive soils in the vicinity of stream channels which is displayed in Figure A-9. Areas of known erosion problems occur along the Little Shasta River where runoff travels down the roadway, eroding the roadbed adjacent to the stream channel.

Similar to roads, burned and harvested areas occuring on highly erosive soils present the greatest potential for elevated sedimentation, particularly in the vicinity of streams (Figure A-8). Where soil cover is maintained or reestablished, erosion is minimized. Soil cover consist of low-growing live vegetation (less than 12 inches high), rock fragments (greater than 1/2 inch in diameter), slash (any size), and fine organic matter (charred or not) that is in contact with the soil surface. Fine organic matter refers to the duff, litter and twigs less than 3 inches in diameter. The dry weight of fine organic matter without woody material is about 0.2 to 3 tons per acre. To alleviate the risk of potential detrimental fire effects, dry weight of fine organic matter with woody material should be less than about 7 tons per acre . Soil cover guidelines for prescribed burning projects in soils consisting of sandy loam or coarser in texture are: 60, 70, and 80 percent for slope classes 0-25, 26-45 and slopes greater than 45 percent, respectively. For soils that are loam or finer in texture, the cover guidelines are: 50, 60 and 70 percent for slope classes 0-35, 36-60, and slope greater than 60 percent (Figure A-3).

Landsliding Few recent or active landslides have been identified in the Goosenest LSR relative to the west side of the Forest. However, those which are known have had a considerable effect upon local riparian environments. The large (30 acres) translational landslide in Deer Creek delivers sediment directly into the channel, and periodically blocks flow. This landslide is identified as a geologic special interest area in the Forest Land Management Plan. Small (less than 1/2 acre) debris flows in the headwaters of Muskgrave Creek generated a debris torrent during the 1964 flood which stripped riparian vegetation from a mile-long segment of the channel downstream. Areas of high landslide potential do not necessarily coincide with areas of high topsoil and subsoil erosion hazard potential (compare Figure A-10 with A-8 and A-9). The reason for this is that different slope processes are involved in surface erosion and landsliding. Landsliding is driven primarily by subsurface water and the physical characteristics of the subsoil and underlying bedrock, whereas, surface erosion is controlled primarily by surface soil characteristics and surface water, and to a lesser degree shallow subsurface water. Additionally, increases in soil clay content may reduce erosion hazard potential, but increase the potential for some types of landsliding. The Goosenest LSR was stratified into three classes of landslide potential (high, medium, and low (Figure A-10). This stratification considers the potential for deep, slow moving landslides (slumps and earthflows), and shallow, rapidly moving landslides (debris flows and avalanches). The generalized geomorphic map (Figure A-11) identifies areas where these two types of landslides are most likely to occur. The potential for slumps and earthflows is greatest in the map unit labeled "landslide deposits", and debris flows are most likely in the map unit labeled "headwalls".

Management Related Landslide Potential- In most watersheds, about 2/3 of the road system is on lands with low landslide potential, and 1/3 is on lands with high and moderate potential (Figure A-10). Thus, watersheds with the greatest length of road built on lands with moderate and high landslide hazard are those most likely to experience road-related landsliding in the future. Upper Shovel, Panther Rock, and Secret Springs are the watersheds with highest liklihood of experiencing such landslides. Table D-1 ranks all the subwatersheds according to the area of roads on land with moderate or high landslide potential. In contrast with the west-side of the KNF, there is little evidence of road-related landsliding in the LSR over the past 50 years other than small slumps in cuts and fills . However, part of the road system was built after 1975, and has not been subjected to landslide- producing storms. The last large landslide-producing storm on the Klamath Forest occurred in 1974.

Timber harvest and intense fire can accelerate landsliding, and while there is strong evidence of this relationship on the west side of the Klamath National Forest, such evidence is not available for the Goosenest LSR. Areas where regeneration harvest or intense fire have occurred on lands with moderate and high landslide potential are those where harvest or fire related lansliding is most likely. Data on regeneration harvest are available (GIS) only for National Forest lands. Such harvest has been greatest in Harris/Ikes, Upper Shovel, and Bull Meadows watersheds. An ocular estimate of total regeneration harvest and intense fire across all ownerships was conducted for this assessment. The watersheds with most acreage in regeneration and intense fire were Cold Creek, Muskgrave Creek, and Prather Creek. Thus, landsliding associated with loss of vegetative cover is most likely in the 6 watersheds listed above. Table D-1 summarizes regeneration/ fire information for all watersheds.

Cumulative Effects

Areas with Watershed Concerns **The KNF LMRP identified the northern 3/4 of the Upper Shovel Creek as an *Area With Watershed Concerns* (AWWC).** These areas were identified by considering the risk of: (a) accelerated landsliding; (b) accelerated surface erosion; (c) adverse cumulative effects. In addition, the presence of special management considerations such as riparian connectivity, occurrence of unique species, and socio-political environment were used in determing AWWC.

A review of LMRP process records revealed that thresholds of concern for the risk of accelerated surface erosion, landsliding and adverse cummulative watershed effects were not exceeded during that evaluation and that unique management considerations were the primary reason Upper Shovel Creek was identified an AWWC. LMRP evaluation of these parameters for Upper Shovel Creek and the surrounding six compartments (not identified AWWC) further identifies the the relative context for the risk determination; the Upper Shovel Creek watershed ranked second for risk of accelerated landsliding, third for risk of accelerated surface erosion, and second for risk of adverse cummulative watershed effects.

New information, consistent with the LMRP data used in the original determination, allowed ranking of the potential for accelerated surface erosion, landsliding and adverse cumulative effects by watershed (Table D-1). Direct comparison with LMP data was not possible since the

LMP used compartment rather than watershed boundaries, but the results are similar to those in the LMP. However, analysis incorporating additional measures of watershed disturbance (ie., grazing, harvest) identified some specific areas of concern (Figure A-5, A-9, Table D-1).

Cumulative Watershed Effects (CWE) This LSR has received many impacts due to mans intensive use of the natural resources starting at the time of the areas settlement. The sum of these are aggregated in the Cumulative Watershed Effects assessments discussed in the current condition chapter. The Riparian Reserve areas are still receiving these impacts. Impacts occur as a result of water diversions, roads, timber harvest, fuels treatments, wild fires, grazing, and recreational uses. Over the past decade the mix and intensity of CWEs has changed due to management changes on both Federal and privately-owned lands. No significant new road construction has occurred on Federal lands within the LSR within the last decade. Timber harvest on federal lands has been halted, large wild fires have not occurred in the last few decades, and grazing and recreation use has remained about the same.

The health and functioning of a watershed area is displayed on several levels. Indicator levels choosen are Riparian Areas, Habitat Conditions, and Cumulative Watershed Effects (CWE). Riparian Areas and adjacent buffers function as key receiving indicators of the health similar to owls indicating the health of LSR forested areas. Figure A-4 displays the location of Riparian Features and Figure 5 displays associated buffers (Riparian Reserve areas). Habitat condition is a group of indices creating a combined physical and biological picture. Figure A-5 and Table D-2 show ratings for five indices of health and function. CWEs are an indicator of how well an area is functioning by looking at amounts and intensities on several types of disturbances that affect Riparian areas, stream systems, water quality, peak flows, flow duration, and aquatic habitats (Table D-1). Watersheds were choosen as units of comparison because juxtaposition, distribution, and location of disturbance is extremely important to the understanding the relativeness to health.

Cumulative Watershed Effects analysis is an attempt at grouping dissimilar changes in an area that affect onsite and/or offsite or down stream resources. For example, a single cumulative effect like erosion from several road segments can cause problems by delivering sediment to a riparian site. Roads plus timber harvest plus grazing plus etc. are multiple or additive effects that can compound the single type effects like sediment to a riparian site. Generally, the more intensive the ground or vegetative disturbance, the amount of disturbance, and / or the length of time of the disturbance is in effect, the sensitivity of the resource, and the rate of recovery determines the magnitude of the CWEs.

All the following types of changes from the natural setting occur in this assessment area. Usually roads cause more disturbance because they keep the land continuously bare, change overland flow patterns, and are in place year after year. Lack of paving, road drainage, and maintaince/use effect intensity of road disturbance. High EHR ratings are an indicator of more inherent road erosion potential (Figure A-9). Roads parallelling a stream course and or intersecting streams and Riparian Reserves cause immediate or point source detrimental effects. Streams are lengthened and overland surface runoff caught and quickly routed directly to a

stream or other riparian feature. This may be in the form of sediment and cause blockage or hazard to aquatic species. Timber harvest has long term effects that gradually recovered over the long life span of a tree. Usually the more trees removed per acre the higher the risk of causing CWEs. Regeneration cutting (clearcuts and shelterwoods) cause the most harvest disturbance. Plantations, if successful, take at least 15-20 years or more (due to high elevation slow growth) to reduce the hydrologic impacts to 2/3 the previous level.

Grazing impacts may vary annually, determined by timing and intensity of vegetative disturbance in an area. Concentrated grazing, such as in or adjacent to water, wet meadows, and other riparian causes multiple problems. Riparian areas are particularly vulnerable to concentrated grazing pressure during periods when upland forage becomes dry and unpalitable and air temperatures are high. This may result in streambank alteration (trampling/chiseling), increased sedimentation, excessive riparian vegetation removal, introduction of fecal material into watercourse, and increased water temperature.

Fuel treatments and wild fires can have effects similiar to timber harvest depending on fire intensity. Fire can compound timber harvest effects when both occur within a short time span in the same proximity. Ground fires which do not kill the trees or brush cause less damage because only ground cover vegetation needs to recover hydrologically. Air quality cumulative effects may be affected in the nearby Class 1 Airshed of the Lava Beds National Park due to fuels burning during the season of park use. Recreation can cause impacts due to off road vehicles (ORV) or campground/hunting camps use in sensitive areas like Riparian Reserves. Intensities of all the above effects can vary within this assessment area due to different management schemes commonly defined by different ownerships.

Dams and diversions cumulatively and individually have changed the natural function and passage of fish in all watersheds in this LSR assessment area. Copco and Iron gate dams along the Klamath River block fish passage by cutting off access to the lower Klamath River. Watersheds of Deer, Long Prarie, Edge, Secret Springs, Lucky Springs, and lower, middle and upper Shovel are affected. These two dams also increase water temperature, add algae, stop needed bedload in the form of rocks and gravels, and regulate lower flows. Secret Springs and lower Shovel watersheds have compounded disturbance to the fisheries by increased temperatures, reduction of downstream riparian vegetation, and water withdrawals in the low flow season due to irrigation. The remaining 13 watersheds in the analysis area have similar temperature, riparian, and withdrawl effects by irrigation. Upper Bogus and the four watersheds in the Little Shasta drainage has fish passage blocked due to summer irrigation withdrawl. The five watersheds flowing into Butte Valley have passage blocked by withdrawls near where the stream meets the valley bottom. Transbasin diversions occur from Cold and upper Bogus watersheds. Musgrave is the least affected since the water diversions are controlled by the National Forest for wildlife, recreation, and fisheries benefits. The positive effects of irrigation is creation of some riparian vegetation in locations not native to the area. Small natural meadows may have been expanded through irrigation. This may or may not benefit riparian dependant organisms.

Species Account

A list of LS/OG-associated plant and animal species known or thought to exist within the Goosenest LSR is provided in Appendix C. Data adequate to permit assessment of population status are not available for most of these species. For most species, formal surveys have not been conducted, and data are limited to presence/absence.

The following species descriptions provide information on the small number of late-successional associated and special emphasis species for which local information has been collected. Species are listed in phylogenetic order.

Vascular Plants:

Formal botanical surveys conducted in the LSR have not detected late-successional forest associated vascular plant species. Species listed in appendix C are presumed to occur based on range maps and habitat descriptions. A single species, the mountain ladyslipper (***Cypripedium montanum***) has been documented immediately outside of the LSR in the Little Shasta River drainage, and in the LSR in Silva Creek (Figure 9). This species is designated a "survey and manage" species under the Presidents Forest Plan.

Cypripedium montanum generally inhabits shady sites within mature conifer forests. Habitat ranges from dry, rocky sites to moist seeps and streamsides in a variety of soil types and plant associations.

Plants in this genus have a complex ecology characterized by underground fungal relationships with other plant species, and frequently obligate pollinators. Populations of ***Cypripedium montanum*** tend to be very small with relatively few plants. These biological and ecological factors are the limiting factors in their reproductive success, and are believed to account for their rarity.

Data collected on the KNF indicate that these species are frequently found in stands that have been thinned or selectively cut, or near roads or trails (Barker 1984). Studies in Oregon and Washington suggest that populations decline when canopy removal and soil disturbance occur. The ecological relationship of this species with fire is not clearly understood. Populations have been reported as thriving after low-intensity fires, whereas others populations have been destroyed by medium or high-intensity fires. The effects of grazing on this species have not been investigated on the Klamath.

Fish:

Contemporary Goosenest LSR fish communities are a mixture of native and introduced exotic species, with the range of some native species significantly decreased (Figure 10). Construction of Copco Dam, followed by completion of Iron Gate Reservoir elimited access by anadromous

salmonids (coho salmon, chinook salmon, steelhead) to tributaries upstream of Bogus Creek, including Shovel Creek, Deer Creek, Long Prairie Creek, Edge Creek, and Indian Creek. In all, more than 220 miles of Klamath River anadromous habitat are estimated to have been rendered inaccessable, including 16 miles within the Goosenest LSR assessment area. Construction of mainstem reservoirs dramatically altered the distribution and abundance of anadromous fish species in the upper and middle Klamath River. A number of non-native species are presently found in Goosenest LSR watersheds, some which are predominantly reservoir dwellers (yellow perch, Largemouth bass, white crappie, black crappie, Sacramento perch, blue gill and golden shiner) and can be occasionally observed occuping the lower reaches of tributaries. Other non-natives, such as brook and brown trout can be found within nearly the entire fish- bearing stream range.

Juanita Lake has been stocked with rainbow, brown and brook trout; other non-native introductions have included golden shiner, largemouth bass, and brown bullhead.

Lost River and Shortnose Sucker

A. Population Size and Distribution: The present distribution of Lost River sucker ***Deltistes luxatus*** and shortnose sucker ***Chasmistes brevirostris*** includes the Klamath River downstream to Copco Reservoir and Iron Gate reservoir respectively (Figure 10). A population of shortnose suckers exists in Copco Reservoir, however information on distribution and abundance of Lost River and shortnose suckers in the remaining river system below the Upper Klamath Lake is largely lacking. The extent which reservoirs (Copco, Iron Gate) have extended their native range is open to interpretation since there is some geologic evidence of a natural lake occurring in the proximity of Copco Reservoir (2-10 thousand years ago).

B. Habitat Use: The proposed rule designating critical habitat includes the Klamath River downstream to Iron Gate dam, including habitat to the extent of the 100 year floodplain, excluding tributary waters (USFWS 1993). Although both sucker species are lake dwelling, they utilize tributaries to spawn. Lost River and shortnose sucker spawning in Klamath River tributaries within the Goosenest LSR has not been documented, however observations of Klamath smallscale sucker entering these tributaries to spawn are frequent. An important component of physical habitat identified for Lost River and shortnose suckers was the availablility of refuge areas from poor water quality conditions, an element which tributaries like Shovel Creek may provide during certain periods.

C. Habitat Condition: Watershed factors cited as contributing to Lost River and shortnose sucker declines include degradation and loss of wetland and riparian habitat, including degradation of water quality and increased sedimentation (USFWS 1993). Water quality, water quantity, runoff timing and watershed conditions are cited as concerns for Shovel Creek (CDFG 1996, LMRP 199?) which is the only tributary of significant size which may contribute directly or indirectly to Lost River and shortnose sucker essential habitat elements.

Amphibians:

Compared with the Klamath Mountains and Coast Ranges, the southern Cascades support relatively few amphibian species. Surveys were conducted in the LSR by Pacific Southwest Research Station and Klamath National Forest personnel during 1989-1992. These surveys detected only one of the late-successional associates listed in FEMAT; the Pacific giant salamander. Other species potentially occupying the LSR, but not detected, are rough-skinned newt, black salamander, Cascades frog, northern leopard frog, and tailed frog. Other amphibian species such as western toad, Pacific chorus frog, western spadefoot toad, and long-toed salamander are found in many habitats in the LSR. Bullfrogs have been introduced into Juanita Lake.

Pacific Giant Salamander

Pacific giant salamanders have been detected at 3 locations within the Goosenest LSR. Known locations of this species are in Shovel Creek, Cold Creek and South Fork Cold Creek. All specimens located were larval forms and neotenates, including a nesting adult neotenate female. Adult terrestrial forms have not been recorded.

Great Basin Tiger Salamander

The genetic origin of tiger salamanders found at Grass Lake (10 miiles south of LSR) and Meiss Lake has been the subject of debate since 1978, when Grass Lake specimens were judged to be California tiger salamanders (Mullen and Stebbins 1978). Subsequent genetic analyses of specimens collected at Grass Lake and Meiss Lake revealed closer affinity to the Great Basin subspecies (Dr. Brad Shaffer, pers. comm.). Isolated populations of this subspecies are located in southern Oregon Klamath Basin, and in Washington. Meiss Lake tiger salamanders may be occupying the LSR in Muskgrave Creek, Seikel Creek, and Prather Creek, which feed into Meiss Lake.

Reptiles:

Western Pond Turtle

This species has been reported at various locations in and adjacent to the LSR. It is abundant in the Klamath River and may inhabit tributary streams such as Bogus Creek and lower Shovel Creek. Western pond turtles have been reported at Juanita Lake, but it is not known if these represent introductions.

Birds:

Bald Eagle

A. Population size and density:

Breeding territories: Currently there are two known bald eagle territories and one communal winter roost within the Goosenest LSR. As is typical for bald eagle nest sites in northern California, both of these sites are associated with water bodies, and are centered on relict stands

of large ponderosa pine.
The Muskgrave Creek territory was first located in 1983. It is located on the eastern slope of Ball Mountain about 1.5 miles north of Juanita Lake, near the eastern boundary of the LSR.
The Lucky territory was first located in 1983. It is located in the Klamath River canyon, at the northern boundary of the LSR. Territory locations are shown on Figure 9.

Wintering population: The Ball Mountain communal night roost is located in the same stand as the Muskgrave bald eagle nest. This roost is used primarily during late winter (January - March), when large numbers of snow and Ross' geese occupy the Butte Valley Wildlife Area . This roost is used by a highly variable number of eagles, ranging from 2 to over 80 eagles. Variability in eagle use of communal roosts in the Klamath Basin and Butte Valley is correlated with availability and location of abundant prey resources such as cholera-killed waterfowl, ground squirrels, and snow geese.

B. Population performance:
The Muskgrave Creek and Lucky territories have been continuously occupied since they were identified in the early 1980's. Results of annual monitoring indicate that reproductive success at these sites (mean = 1.12 young/year) is above the mean for eagles in California (1.03 young/pair; CDFG 1995), and above the recovery plan goal of >1.0 young/pair.

C. Habitat use:
Landscape and stand-level habitat characteristics are dissimilar between the Muskgrave Creek and Lucky bald eagle territories. The Muskgrave creek territory is associated with a small manmade reservoir, Juanita Lake, where the adult eagles do much of their foraging. The eagles have nested in the same well-defined grove of trees since 1984. The nest grove consists of a small (15acres)group of oldgrowth ponderosa pine within a larger stand of mixed conifer forest. The overstory pines in the nest grove are very large (>36" dbh) and open-grown with large lateral limbs.
The Lucky territory is located on a gentle slope within the Klamath River canyon, approximately 1.1 mile from the Klamath River east of Copco Lake. The eagles at this territory have used at least 3 alternate nests since 1983, but have remained within an area of about ½-mile radius. The nest grove consists of scattered large old growth ponderosa pine, intermixed with Oregon white oak and mountain mahogany. Trees used for nesting are very large (>36" dbh) and open-grown with large lateral limbs.

D. Habitat condition:
Plot data collected at both territories were used to assess stand structure and condition in the 2 bald eagle nesting areas. In both cases, stand structure and species composition have been dramatically altered by past timber harvest and decades of fire suppression.

The nest stand at Muskgrave Creek is located in mixed conifer forest, dominated by large overstory ponderosa pine and Douglas-fir. Large size and wide (18-34 feet) spacing of overstory trees, combined with extensive fire scarring of overstory trees, indicate that this stand developed and was maintained under the influence of frequent fire. In the absence of natural fire, this stand

has developed a dense codominant layer and understory of white fir. The closure of the canopy by white fir has eliminated regeneration by ponderosa pine, and caused extreme moisture stress to the overstory. Recent outbreaks of scolytis and western pine beetle have caused extensive mortality in adjacent stands with similar stocking, and are likely to affect the overstory pines used as nest sites by the eagles. In addition to causing potential loss of nest trees, these conditions predispose the stands to stand-replacing fires, fueled by insect-killed trees and ladder fuels. Similar deterioration of nesting habitat has been recorded at eagle territories on the Klamath Basin National Wildlife Refuge (Bear Valley Roost) and Winema National Forest, immediately to the north of the Goosenest LSR.

The Lucky bald eagle territory was extensively burned during the 1957 Bogus Burn, and the overstory pines used for nesting are not currently threatened by overstocking and competition. In the years following the fire, however, mountain mahogany and other shrubs have developed dense canopies and prohibit regeneration by ponderosa pine. Presently there is a lack of young and mid-seral ponderosa pine for replacement of the present nest trees.

E. Preybase relationships:
Prey resources used by bald eagles at the Lucky territory are located entirely outside of the LSR, in Copco Lake and the Klamath River. Prey species identified from remains collected at the nest included (in order of importance) bullhead catfish, American coot, unidentified suckers (Catastomids), and various waterfowl. The Muskgrave eagles prey heavily on bullhead catfish and rainbow trout stocked at Juanita Lake, as well as waterfowl from Butte Valley Wildlife Area. These eagles also take Belding's ground squirrels from agricultural fields in Butte Valley.

Northern Goshawk
The Klamath National Forest, in cooperation with universities and other agencies, has conducted a long-term study of the ecology and population dynamics of northern goshawks on the Goosenest RD and surrounding lands from 1985 to the present. This information is contained in published literature (Detrich and Woodbridge 1994, Woodbridge and Detrich 1994, DeStefano et al. 1994) as well as Master's theses by Leslie Rissler (1995; Utah State University), Bonnie Allison (in prep., Southern Illinois State University) and Robert McCoy (in prep. Humboldt State University).

A. Population Size and Density:
Northern goshawks are relatively abundant within the Goosenest LSR (Figure 6). Complete surveys (R-5 protocol 1992) of the LSR area detected 12 territories, 9 of which had been monitored for 5 to 10 years. Territory locations are shown on Figure 9. Density of traditional (occupied at least 3 of 5 years) territories was 1.07/1000 ha., similar to high densities reported in other studies. Nearest-neighbor distance between these territories was 1.3 to 6.1 km, averaging 3.25 (SE=0.34) km (Woodbridge and Detrich 1994). Spacing appeared to be reduced around landforms such as meadows and riparian systems, where goshawk territories were clumped. Occupancy of specific forest stands by northern goshawks is also affected by presence of

northern spotted owls. In 4 cases where goshawk nest groves were colonized by owls, the goshawks either moved to alternate stands, or abandoned the areas altogether. Alternately, owls abandoned their nest stands when goshawks nested in them.

B. Population Performance:

Occupancy and annual reproductive success at goshawk territories within the LSR were monitored from 1985 to the present. Territories were occupied by at least one adult goshawk in 71% of monitored territory-years, and breeding attempts were observed in 63%. Rates of occupancy and breeding were likely underestimated due to the secretive behavior and annual movements of nesting goshawks observed in this study (Woodbridge and Detrich 1994). Productivity for 52 nest attempts averaged 1.93 young per attempt (range = 0-4). Rates of occupancy at 11 nest stands with at least 5 years of monitoring were positively correlated with stand size (R_s=0.88, P=0.008). Occupancy rates of stands <20 ha were typically <50%. At approximately 40 ha rose to 75-80% and was nearly 100% for stands >61ha (Woodbridge and Detrich 1994).

C. Habitat Use:

Northern goshawks nest in all forest communities within the Goosenest LSR. Territories are associated with the larger remaining patches of mid-to late-successional forest habitat. Nest stands occupied by northern goshawks are highly variable in species composition and structure, ranging from open mid-mature pine stands to dense mature red fir and white fir stands. In general, occupied nest stands exhibit high canopy closure (mean = 75%) and large dbh (mean = 17.9 in). Stand density index (SDI) in gohawk nest stands averaged 328. Understory density in goshawk nest stands tend to be low; significantly lower than in spotted owl nest stands (Rissler 1995). Goshawk nest stands frequently showed signs of recent fire, and supported significantly fewer white fir saplings than spotted owl stands (Rissler 1995).

D. Habitat Condition:

Goshawks tend to select structurally open forest stands for nesting and foraging (Rissler 1995, Austin 1993, Reynolds et al. 1992). Under natural conditions, open stand conditions were maintained in mixed conifer and pine forests by frequent low-intensity fire. With the advent of effective fire suppression, fire-susceptible shade-tolerant species such as white fir have increased in density in these stands, reducing their suitability for goshawks. In the Goosenest LSR, goshawks clearly select open-structured stands, relative to what is available (Rissler 1995). Many nest stands show evidence of recent fires, or mechanical thinning activity. In true fir communities, nest stands are frequently associated with natural or manmade openings such as meadows, riparian zones, roads, and skid trails which provide access into dense stands. Foraging habitats may be very open, as evidenced by the high proportion of golden-mantled ground squirrels, a species typically found in openings. Radio-tagged goshawks on the Goosenest RD foraged heavily in meadows (Austin 1993); on some occasions males from 2-3 territories were all utilizing the same meadow system.

E. Preybase Relationships:

Food habitats of goshawks nesting in the Goosenest LSR have been investigated by Woodbridge

et al. (1988) and McCoy (1995). Analysis of pellets collected at nests, and direct observation of adults at nests, show that goshawks prey on a wide variety of mammalian and avian prey, but depend primarily on a small suite of medium-sized species. Douglas' squirrels (40%), golden-mantled ground squirrels (21%), chipmunks (8%), and Steller's jays (5%) make up about 75% of the diet (McCoy 1995). Foraging goshawks are very opportunistic, and have been observed exploiting gulls and jays attracted to grasshopper outbreaks in meadow systems on the Goosenest RD.

Northern Spotted Owl

The Klamath National Forest has conducted a long-term study of population dynamics and habitat use by northern spotted owls on the Goosenest Ranger District from 1988 to the present. This information is contained in a report to the US Fish and Wildlife Service (Woodbridge and Cheyne 1995) and in Master's theses by Leslie Rissler (1995; Utah State University) and Aaron White (in prep.; University of Arkansas). Analysis of spotted owl pellets were conducted by George Steiger (1991) and Chet Ogan (1996) of the Pacific Southwest Research Station.

A. Population Size and Density:

The majority of forested habitats within the Goosenest LSR have been surveyed to R-5 protocol at least once for northern spotted owls. Most large-scale surveys have been conducted in conjunction with timber sales, however in recent years (1989 to present), known territories and patches of suitable habitat have been surveyed as part of long-term monitoring project.

Results of long-term monitoring of spotted owl territories in the Goosenest LSR suggest that the population is dynamic and that total number of occupied sites will vary depending on the timeframe assessed. Colonization of new territories, abandonment of traditional territories, and the annual detection of non-territorial 'floaters' all cause fluctuation in the number of territories observed in a given year. In addition, losses of individuals at established territories results in changes in pair status at some territories each year. The maximum number of occupied territories observed between 1990 and 1995 was 12 pairs and 1 territorial single (Figure 12); the resulting density ranges from 0.15 to 0.21 territories/mi^2 annually (0.26-0.41owls/mi^2). This density is lower than density reported by Franklin et al. (1990) in the Klamath Province (0.65 owls/mi^2). There has been an apparent increase in the number of occupied territories within the Goosenest LSR since 1992; with new pairs of marked owls colonizing previously unoccupied sites. The stability of these new territories over a period of several years, as well as occupancy of traditional territories, must be assessed before an increasing population trend can be determined.

B. Population Performance:

Reproductive parameters for northern spotted owls nesting within the Goosenest LSR and adjacent AMA and private timberlands have been monitored since 1988. Occupancy rates for 10 territories with more than 5 years of continuous data averaged 71.4% (range =16% to 100%). During 69 territory-years of monitoring at these sites, an average of 0.69 young/occupied site were produced (range = 0.16 - 1.25). A subset of 6 territories with 7-8 years of continuous

monitoring data produced 1.12 young/year (0.56 female offspring/adult female). These estimates include years when territories were occupied by single territorial adults, and are likely underestimates. Overall, reproductive performance of owls in the LSR is comparable to upper estimates made in demography studies elsewhere (SAT 1993).

The ability of spotted owls to disperse is an important factor determining population viability. Monitoring of movements and subsequent breeding sites of colormarked adult and juvenile owls within the LSR has provided valuable information on dispersal and connectivity of habitat. Forty-two adult and 34 fledgling owls were marked between 1988 and 1995. On 21 occasions owls were recaptured that were new replacements at traditional territories or colonizers at newly established territories. Of these 21, 2 were marked adults from other territories (adult dispersal), and 8 were marked recruits from natal sites within the study area (natal dispersal), and 2 were immigrants marked as fledglings in Oregon. Mean natal dispersal distance moved within the LSR was 17.5km, and the immigrants from Oregon dispersed 43 and 39km (Figure 11). These findings suggest that spotted owls are surviving and successfully dispersing throughout the LSR area. More importantly, dispersal from the southern Oregon Cascades subregion demonstrates connectivity to the north. To the south, however, dispersal by owls in or out of the LSR has not been observed (Woodbridge and Cheyne 1995).

C. Habitat Use:

Suitability of habitats for northern spotted owls is a function of forest composition and structure, as well as elevation, availability of water, preybase, competitors and predators. Caution should be exercised when predicting owl abundance based on simple habitat classification. At elevations above 6000 feet, snow depth and short growing seasons create additional constraints to occupancy by owls and some other wildlife species. Similarly, most spotted owl territories within the Goosenest LSR are located within 200 feet of a source of free water; suggesting that areas of late-successional habitat outside of this range may be of reduced suitability. Research conducted in the Goosenest LSR indicates that northern goshawks and spotted owls tend to exclude each other from occupied stands, further reducing the capacity of the LSR to support owl territories in proportion with structurally suitable habitat.

Habitats occupied by breeding northern spotted owls in the California Cascades are frequently characterized as limited in distribution, highly fragmented, and structurally dependant on past fire suppression. Low precipitation and temperatures, and high elevation act to reduce the overall potential of lands within this province to support dense late successional habitat suitable for spotted owls (FEIS G-20, USFWS 1992). Presently, stands occupied by owls may be characterized by 4 primary elements:

- steep slopes adjacent to riparian
- north to east aspects
- mixed conifer or lower-elevation white fir
- dense late successional habitat , or mid-successional with legacy trees

Suppression of wildfire in xeric mixed conifer forests in the California Cascades has increased the availability of dense stands suitable as habitat for spotted owls (FEIS G-20). Dense understories of 15 to 70-year old white fir have developed in Douglas-fir and ponderosa pine

dominated stands that were formerly maintained in an open condition by frequent low-intensity fire. This process is apparent in most owl territories within the Goosenest LSR. It is likely that under historical conditions, spotted owl habitat was somewhat confined to drainages and north-facing slopes.

Nest stands occupied by northern spotted owls are highly variable in structure and species composition. Most nest sites are located in mixed conifer stands ranging in condition from old growth to mid-successional stands with residual old trees. True fir stands at higher elevations are occasionally occupied, however these sites exhibit low occupancy and may be ephemeral. In general, occupied nest stands exhibit high canopy closure (mean = 83%) resulting from multiple canopy layers. Multilayered structure typically occurs in small patches within otherwise more open stands, often in association with patches of large trees remaining from previous harvest. Nest stands have high density (SDI=275.73) and large mean tree diameter (18 in.). Nest stands supported large numbers of saplings <5 feet tall, and numerous trees < 10" dbh. (Rissler 1995)**(see Illus. 8 and 9).**

Habitat suitability and use is also affected by the presence of predators and competitors. The northern goshawk, in particular, affects stand suitability by providing nest structures that are commonly used by spotted owls. Conversely, goshawks are very aggressive towards owls and may force them out of otherwise suitable stands. Goshawks have also been reported to prey on spotted owls in the California Cascades (Woodbridge et al. 1988).

D. Habitat Condition

We assessed the vegetative composition of spotted owl home ranges by analyzing LANDSAT thermal mapping data within 1.3-mile radius circles centered on the nest site (Figure 12). Home-range studies in other areas have demonstrated that owl home ranges (as delineated with radio-telemetry) are rarely circular, and may contain multiple areas of concentrated use distant from the nest site. In the absence of telemetry data for owls within the Goosenest LSR, we selected the 1.3-mile radius as the best available approximation of owl home range size (median = 3,300 acres) in the Klamath Province (FEIS 1994). Home range size data are not available for the California Cascades Province.

The proportion of suitable habitat within spotted owl home ranges varied from 21% to 50 % (mean = 33%) (Table 6.). See Appendix E for the definition of suitable habitat used in this assessment. Only two home ranges contained >40% suitable habitat, and three contained <25%. For this assessment, we define "suitable habitat" as coniferous forest habitat consisting of trees 12 inches dbh and greater, with canopy closure of 60% and greater. The existence of successful owl pairs in areas of apparently low 'suitable habitat' may be explained by prey habitat relationships (see preybase relationships), or by inadequacies in current definitions of suitable habitat.

Many "home range" analysis areas contain significant proportions of previously harvested forest. In the absence of fire, these stands typically develop high densities of Douglas-fir and white fir, and exceed critical density thresholds. Tree growth is slow, disease and insect outbreaks are

widespread, and species composition tends toward white fir. Under these conditions, stands are unlikely to develop desired mixed conifer LS/OG structure. In addition, risk of stand-replacing fires is increased by high fuel loadings and ladder fuels created by the continuous conifer understory. Other home ranges are more open and show signs of recent fire, suggesting that high understory density is not a prerequisite for owl occupancy.

Table 12. Acreage (percent) of suitable habitat within 1.3-mile radius "home range" analysis area at 12 northern spotted owl territories in the Goosenest LSR.

		Home Range Composition		
Territory	ID#	Late-mature[1]	Mid-mature[2]	Total Suitable
Butte Mountain	KL-2348	886 (26%)	433 (13%)	1319 (39%)
Silva	KL-2197	522 (15%)	315 (9%)	837 (25%)
Chandler Glade	KL-2194	1158 (34%)	513 (15%)	1671 (50%)
Upper Rock Ck.	KL-2244	947 (28%)	416 (12%)	1363 (40%)
Bull	KL-2199	337 (10%)	376 (11%)	713 (21%)
Harris Creek	KL-2309	277 (8%)	598 (18%)	875 (26%)
Lucky Spring	KL-2191	256 (7%)	530 (16%)	786 (23%)
Ikes Creek	KL-2196	567 (17%)	584 (17%)	1075 (32%)
Muskgrave Ck.	KL-2198	296 (9%)	737 (22%)	1033 (31%)
Bear Wallow	KL-2299	1141 (34%)	338 (10%)	1479 (44%)
Bogus Creek	KL-2195	340 (10%)	383 (11%)	723 (21%)
Shovel Creek	KL-2193	821 (24%)	340 (10%)	1323 (39%)
Stove Springs[3]	KL-0316	188 (6%)	550 (16%)	738 (22%)
Negro Creek[3]	KL-0317	197 (6%)	482 (14%)	697 (21%)

[1] >24" dbh, >60% canopy closure
[2] 12-24" dbh, >60% canopy closure
[3] on Timber Products Co. Owned land

E. Preybase Relationships:

Results of analyses of pellets and prey remains collected at spotted owl territories in the Goosenest LSR from 1984 to 1994 (Ogan, unpub. data) suggest that the owls diet is dominated by 4 mammalian species; northern flying squirrels (39%), dusky-footed woodrats (35%), montane voles (36%) and northern pocket gophers (7.6%)(note-multiple prey items in a pellet

result in >100% totals). The owls' use of woodrats may be a key element explaining their ability to occupy home ranges dominated by previously harvested stands. Other studies (Carey et al. 1992, Carey and Peeler 1995) have demonstrated that spotted owls that prey on woodrats have significant smaller home ranges than owls preying primarily on flying squirrels. In addition, owls foraging for woodrats frequently used edges and patches of younger seral stage forest, where woodrats are abundant (Zabel et al. 1995). Woodrats are abundant in a variety of forest types and seral stages, provided that large amounts of coarse woody debris (natural or logging slash) are available for cover. Woodrat nests are an obvious feature of lower-elevation MC and PP stands within the LSR. Heavy use of montane voles, a species associated with open, grassy habitats, was recorded at one site (Upper Rock Creek) adjacent to a small meadow along the creek and a large grassy clearcut on private land. This territory has subsequently been abandoned by the owls.

Great Gray Owl

Great gray owls have been observed on two occasions near the Goosenest LSR. A road-killed adult owl was found on Hwy 97 at Grass Lake in 1986, and another owl was reported at the eastern margin of the LSR in February 1996. Tape-broadcast surveys (Forsman and Bryan 1985) were conducted in Shovel Creek and Little Shasta meadows in 1985 and 1986, but no owls were detected. Feather searches along meadow margins within the LSR and adjacent suitable habitats were also unsuccessful.

Considering the close proximity (<30 miles) of occupied territories on the Winema National Forest and Lakeview BLM district to the north, failure to detect great gray owl territories in true fir/lodgepole - meadow habitats in the Goosenest LSR is suprizing. In 1987 the KNF conducted a study comparing occupied habitats on the Winema NF to structurally similar habitats on the Goosenest RD (Miller 1988). This study found no difference in forest structure adjacent to meadow systems, but detected significant differences in height and density of grass cover, and abundance of prey species (pocket gophers and montane voles). Meadows in the Goosenest RD supported little residual grass cover, primary habitat constituents for montane voles. Occupied meadows on the Winema NF supported taller, denser grass cover, and had significantly higher rodent abundance.

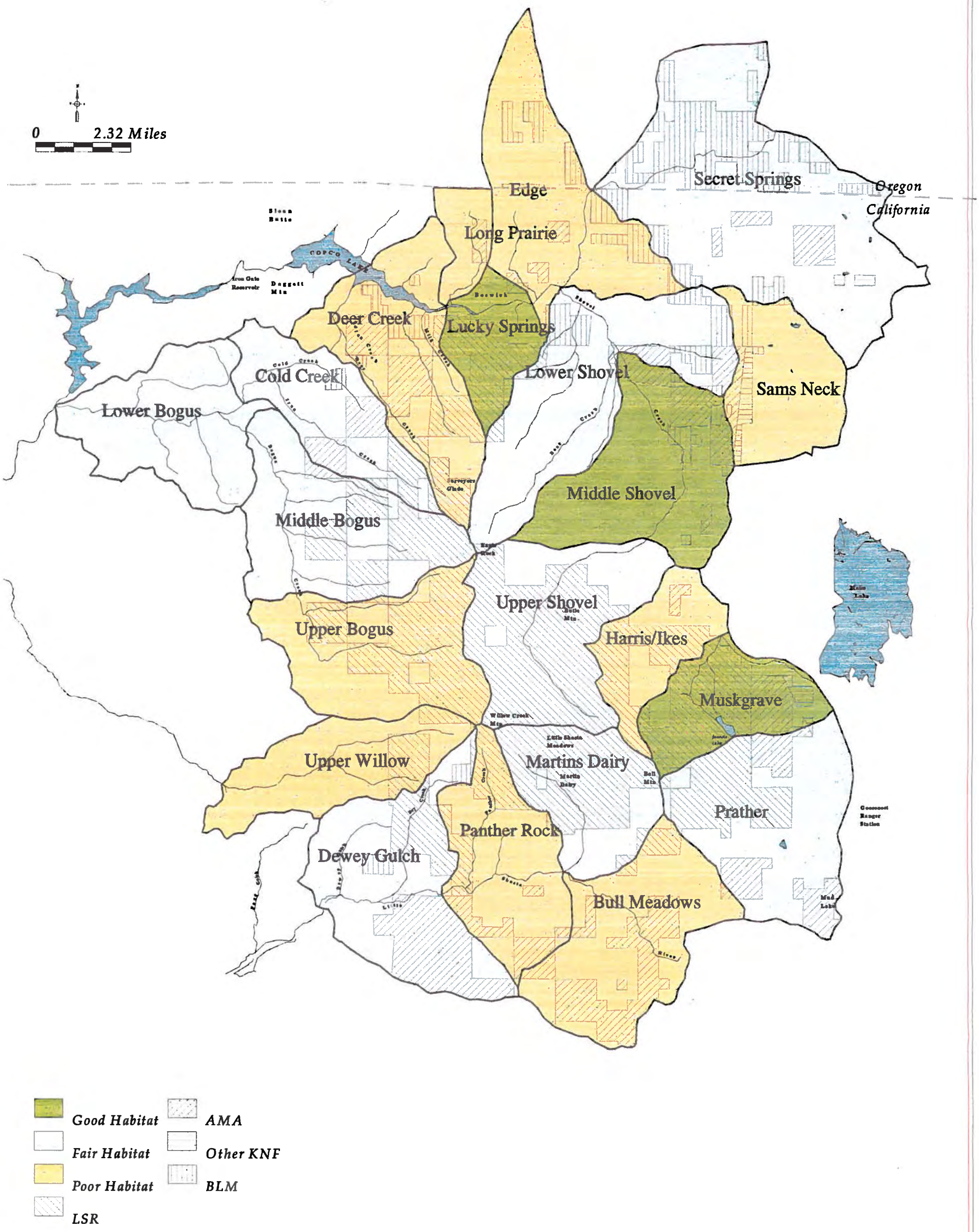
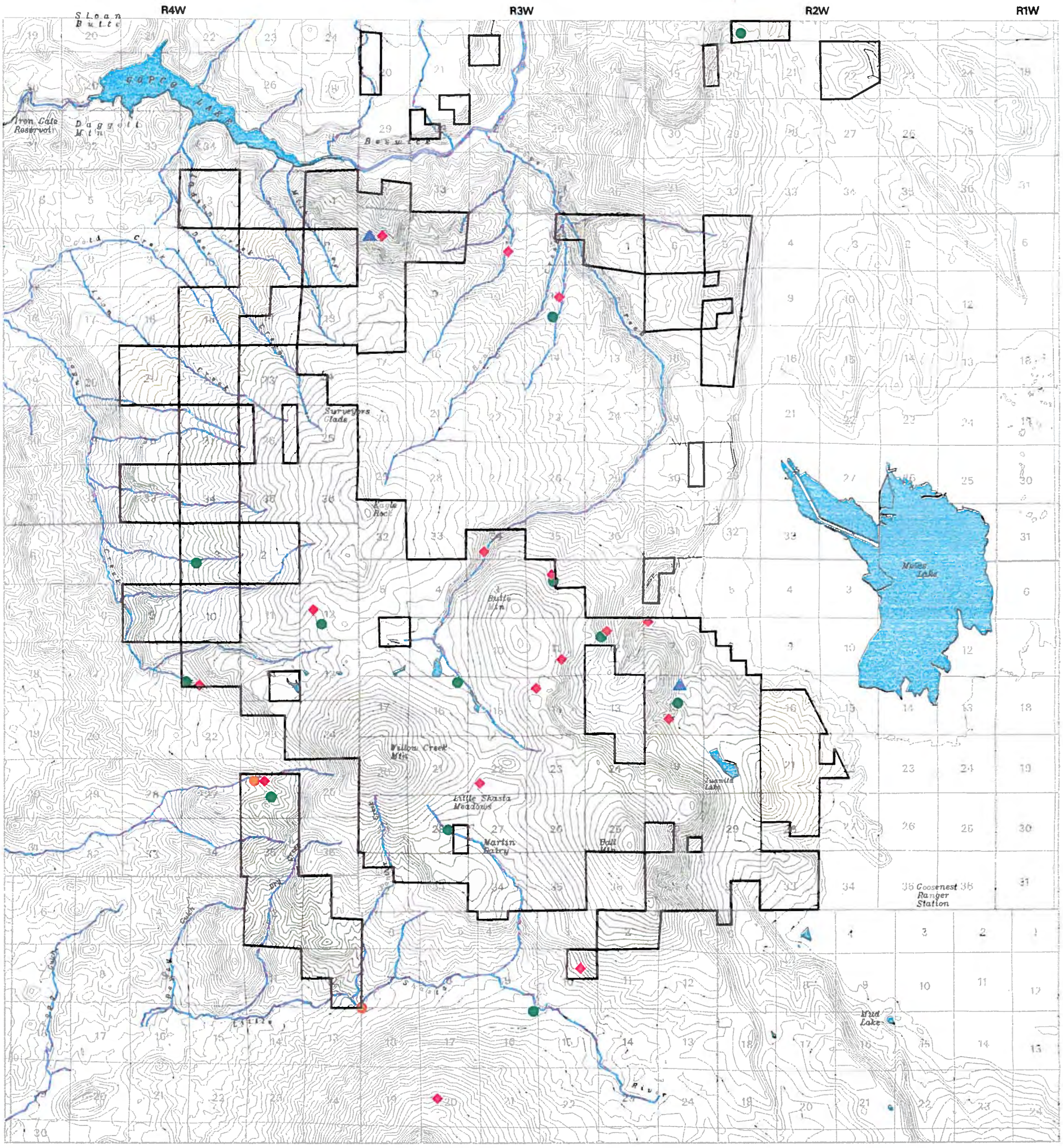
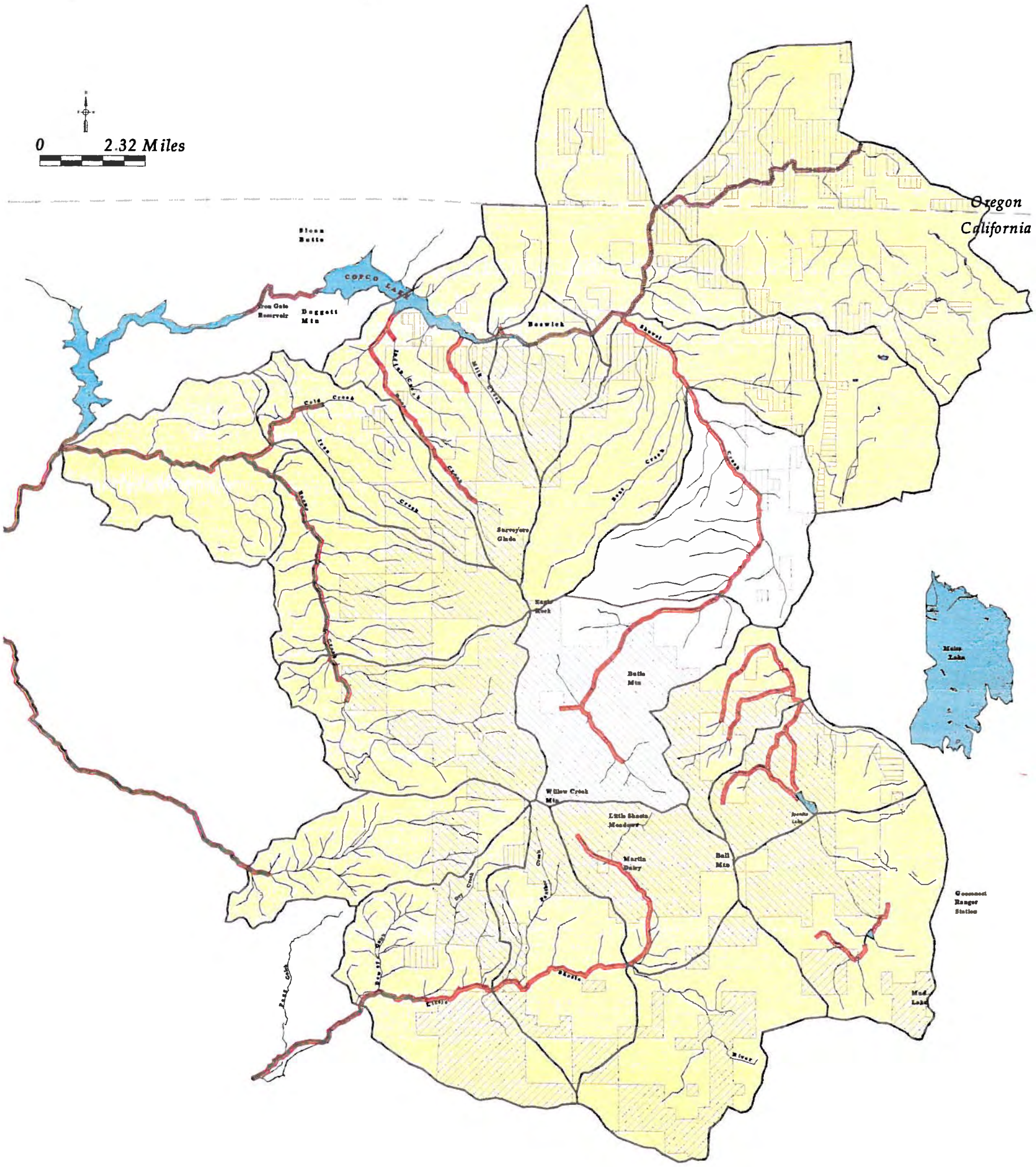


FIGURE 8. Description of existing aquatic habitat conditions, by watershed, relative to habitat potential for Goosenest LSR Watersheds



Late Successional Reserve
Adaptive Management Area
Spotted Owls
Goshawks
Bald Eagles
Mountain Ladyslipper

FIGURE 9. Location of Threatened, Endangered and Sensitive wildlife and plant species in the Goosenest LSR and vicinity.



LSR
AMA
Other KNF
BLM
Exotic/Introduced Species
Tributary Community
Klamath River Community
Anadromous Species

FIGURE 10. Present distribution of native and non-native fish assemblages within the Goosenest LSR assessment area

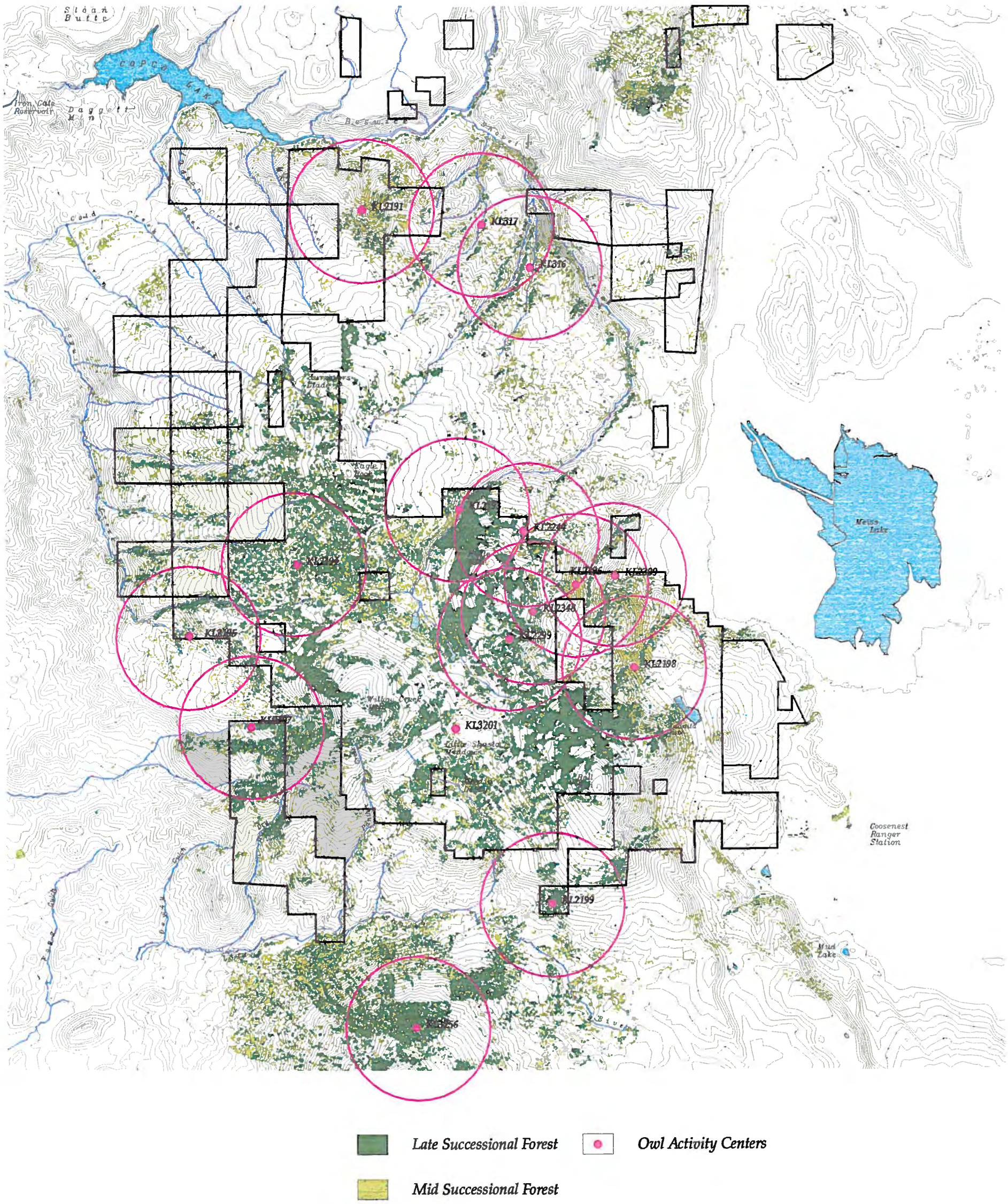


FIGURE 11. Suitable nesting and roosting habitat and 1.3 mile-radius "home range" analysis areas for Northern Spotted Owls in the Goosenest LSR and vicinity

CONCLUSIONS:

Based on the factors used to assess functioning of the LSR, the following conclusions are drawn:

1. Amount of late-successional and old growth forest habitat:
The LSR is presently not meeting this component of "functioning ". Currently, approximately 5802 acres, or 16% of the capable land base, support LS/OG coniferous forest habitat. Based on assessment of past timber harvest and existing early-successional forest patches, we estimate that under historic conditions (pre-1920's) the LSR area supported 75 to 85% late-successional habitat. Presently, 1,600 acres (50% of capable acres) of riparian reserve within the LSR is presently in late-successional forest.

Existing LS/OG habitats are inequitably distributed among forest communities within the LSR . Most LS/OG habitat is concentrated in true fir and red fir communities at higher elevation (>5800 ft.). These communities provide lower-quality habitat for several late-successional dependant wildlife species, including northern spotted owls and some amphibians. Lower-elevation mixed conifer communities contain little LS/OG habitat compared with historic conditions.

Plant succession within the mixed conifer and ponderosa pine zones is not progressing towards increased LS/OG forest habitat. Suppression of natural fire, a fundamental disturbance process within these communities, has resulted in changes in tree density, fuel profiles, species composition, tree growth and structure. Future LS/OG forest stands developed under these conditions will exhibit different structure and function than natural stands. On these drier sites, stands developed from dense white fir encroachment tend to have low species diversity, smaller size trees and logs; and constitute lower-quality owl habitat relative to late-successional mixed conifer habitats.

Stream channel and riparian succession in wet meadow areas is in early seral condition in many areas. Channel downcutting and lowered water tables shift riparian vegetation to more xeric species. While channel degradation may have been arrested in some areas, a trend toward late seral habitat form is not certain.

2. Resiliency to large-scale disturbance:
Forest communities within the LSR differ relative to this objective. Fire-adapted communities such as Ponderosa pine and mixed conifer are not currently meeting this component of "functioning", whereas true fir and red fir communities are in somewhat better condition.

Resiliency to stand-level overstory mortality due to insects and disease: Presently much of the mixed conifer and ponderosa pine communities within the LSR do not meet this component of "functioning". High stand density, typically related to encroachment by white fir in the absence of natural fire, has resulted in moisture stress and reduced the resistance to insect and disease attack. Mortality levels exceed 10% of stand in several well-defined areas within the mixed conifer community, particularly on east-facing slopes of Ball and Butte Mountains.

Resiliency to stand-replacing fire: Much of the LSR has been classified as Low to Moderate fire behavior potential. To some extent, this results from high snowpack and short fire season in upper-elevation fir forests. However, areas of moderate fire behavior potential exist in the mixed conifer zone, frequently in or adjacent to existing LS/OG habitats already very limited in extent. In many mixed-conifer stands the risk of stand-replacing fire is related to fuel ladders created by encroaching white fir, and to recently accumulated fuels resulting from recent drought-induced mortality. These areas constitute a much larger proportion of the LSR than would be expected under natural conditions, and reduce the ability of the LSR to function over the long term.

Resiliency to infrequent flood events: The natural sensitivity of land features (soils, geology, hydrology) combined with land use intensity influences the resiliancy of aquatic systems to large scale disturbance. Because the manifestation of human and natural disturbances on streams may require large-scale mechanisms (ie., floods) to fully trigger adverse impacts, the relative condition (in time and space) of both in-channel and upland components determines watershed resiliency.

Although land features which have moderate to high sensitivity to disturbance (i.e erosive soils, landslide-prone areas, riparian reserves) comprize a relatively small proportion of the, land use intensity is fairly high throughout much of the assessment area. In part, due to mixed ownership patterns, functioning aquatic habitat is not well distributed within the LSR. Due to the early seral stage of stream habitats associated with meadows, present conditions afford little resiliancy to infrequent disturbances such as flood events.

3. Connectivity of late-successional and old growth forest habitat:

Fine-scale Connectivity: Connectivity of LS/OG habitat within the Goosenest LSR is poor, and the LSR currently is not meeting this component of "functioning". Existing LS/OG forest habitat is concentrated in the central core of the LSR in upper-elevation true fir communities. LS/OG habitats in lower-elevation mixed conifer typically exist as small, isolated patches in drainages. Continuity of late-successional forest cover is strongly fragmented by areas of overstory removal, shelterwood harvests and some clearcuts. At lower elevations, natural fragmentation caused by low site potential and open ponderosa pine stands further reduces connectivity. "Checkerboard" ownership within and adjacent to the LSR boundaries further reduces connectivity of late-successional forest habitat.

Regional connectivity: Connectivity of late-successional forest habitats in the California Cascades is low, and reduces the value of LSR habitats in maintaining populations of late-successional dependant organisms in this subregion. To the south of the LSR, the effects of natural barriers created by xeric eastside pine and steppe communities are exacerbated by extensive past harvest of mixed conifer and true fir habitats between the LSR and Mount Shasta. Large tracts of privately-owned timberlands occupy this zone, reducing options for future connectivity. The Management Plan for the Goosenest Adaptive Management Area will address connectivity of LS/OG habitats between the LSR and Mount Shasta.

4. Contribution to northern spotted owl recovery:

According to recovery goals, the Goosenest LSR should support 6 pairs of northern spotted owls. With 14 activity centers (12 pairs, 2 territorial singles), the LSR is meeting this component of functioning. Of equal importance is the stated role of this LSR in maintaining potential genetic flow (metapopulation level) to northern and California spotted owl populations to the south. Movement of colormarked owls from Oregon into the Goosenest LSR suggests that flow occurs from the north, however it is unlikely that there is effective connectivity with southern populations.

Of the spotted owl territories currently known in the LSR, 11 (79%) fall short of meeting the minimum habitat requirements by which "take", under the Endangered Species Act, is assessed (i.e 500 acres of suitable habitat within 0.7 mile, and 1330 acres within 1.3 mile radius). Six territories with long (6-8 yrs.) histories of occupancy and successful reproduction contained only 21 to 39% suitable habitat, suggesting that the "take" guidelines, current definitions of suitable habitat, or estimated home range size may be inappropriate for the California Cascades subregion.

Habitat conditions within most spotted owl home ranges in the Goosenest LSR is functioning poorly in terms of long-term sustainability. Many home ranges contain significant proportions of dense forest with suppressed understories and are at moderate to high risk of insect attack, with subsequent increased fire potential. At such high densities, stand development is unlikely to attain old-growth characteristics in the absence of fire or active management.

DESIRED CONDITION

General desired attributes:
The desired condition within LSRs is to provide late-successional and old growth forest in which structure and composition are consistent with site conditions and natural ecological processes. The quantity, patch size and connectivity of late-successional forest habitats are important spatial attributes of the desired condition.

Species composition is an important attibute of late-successional forests. Relative abundance of fire-resistant species, diversity and stability of cone and seed crops, and ability to withstand drought are important species-specific traits that determine the long-term function of forest stands under different ecological conditions.

Important structural attributes include live old growth trees, standing dead trees, fallen trees or logs on the forest floor, and logs in streams. Additional important elements include typically include multiple canopy layers, smaller understory trees, canopy gaps, and patchy understory. These structural characteristics typically develop when forest stands are between 80 and 140 years of age, depending on site conditions, species composition, and history of site disturbance.

Within-stand decadence leading to the production of coarse woody material (CWM) would be prevalent upon the landscape but not at levels that would signicantly increase the risk of a major, stand replacing event. Stand density measurements, stand mortality rates and current and predicted fuel loads can serve as indicators of major risk. Critical levels of each indicator will vary by site class, vegetation community type and aspect. In general, decadence and mortality are often density-related, implying that most of the stands at the landscape level would be below some mortality-inducing density. However, the mortality/decadence relationship varies by community type. Mortalilty is closely linked with stocking density in pine communities, somewhat less so in mixed conifer communities and weakly linked with mortality in true fir communities (Schultz, 1996). This "background" mortality in the past interacted with historical fire regimes, which resulted in most stands being at or below normal stocking. Background mortality rates in California range from .2% to .5% of the standing volume per acre per year (Schultz 1996). This process decreased the number of stems per acre but allowed the remaining trees to grow and the stand to increase in basal area. For a variety of reasons, however, a small number of stands experienced excessive fuel buildup due to phenomena such as root disease pockets, blowdown or they simply "missed" burning at a normal frequency. This promoted hot fires when the stands did burn, leading to a mosiac of size and age classes on the landscape. In general, to have sustainable "old" stands, a constant low rate of background mortality is required, along with a few openings with regeneration (Schultz, 1996).

A generalized Desired Condition for the Goosenest LSR would be to promote and maintain late-successional conditions in the maximum amounts sustainable through time. However, dramatic differences in late-successional forest structure and process exist between forest community types within the LSR, and **no single Desired Condition will be appropriate for the entire landscape.**

As illustrated in FEMAT, broad calculations using the frequency of stand replacing events indicate that historically the percentage (high-average) of stands classified as late seral approached 65-70% of the landbase at the landscape level. The remaining landbase would be occupied by stands in the mid and early seral stages. They would demonstrate a spectrum of ages, ranging from 0 to 100-150 years, depending on the length of time since the last major disturbance and the time required for the community type to attain late seral qualities. At most points in time, the amount of landbase in early successional stages was a small component on the landscape.

Within each community, desired condition varies in accordance with site capability, which is influenced by elevation, slope, aspect and soil conditions. In particular, the influence of slope aspect in determining moisture regimes and subsequent forest structure follows a measurable pattern of mesic north and east-facing slopes supporting denser, more structurally complex stands, versus relatively xeric conditions on south and west-facing slopes. A similar effect is created by slope position. Conditions on lower slopes in the bottoms of drainages tend to be sheltered and more mesic, and support denser vegetation than drier midslope and ridgetop locations.

As previously noted, the Goosenest LSR lies in a zone of decreasing marine influence and increasing great basin effect. On more xeric sites, site tree information coupled with the use of traditional yield tables can provide potential stand basal area thresholds sustainable over time in this LSR. Use of drought-indicative plants to develop sustainable stand basal areas is advised. This approach was first described by MacLean and Bolsinger (1973) and later adapted for specific use in Siskiyou County by Neil McKay (1985). The need to develop site-specific basal area guidelines will generally decrease with increasing elevation and for stands found on more north-easterly aspects or in sheltered drainages. Basal area parameters listed below for each community type are based on calculations involving normal yield tables and assume no site limitations.

Spatial relationships among stands of different size, seral stage, structure, and fuel loadings will vary depending on community type, site capability and past management. In true fir communities, stand sizes tend to be larger (60-200+ acres) but poorly defined, with many small openings. Mixed conifer stands will be intermediate, with moderate stand size (20-120 acres) and more structural differentiation between stands. Ponderosa pine stands tend to be very small (6-40 acres) and form a fine-grained matrix of clumps and scattered trees. In general, a desired condition for the LSR is to develop larger stands with late-successional characteristics and sustainable density and fuels profiles. For several decades, however, spatial relationships will be strongly affected by existing landscape pattern.

The following description of desired conditions for the Goosenest LSR is organized by forest community type, site capability and slope aspect.

True Fir Community/ Red Fir Community
North and East facing slopes / Drainage Bottoms, capable sites (Illus. 11 and 12)
Conifer species should be dominated by white fir and Shasta red fir with a much smaller component of ponderosa pine, sugar pine and lodgepole pine. Species composition should form a gradient, with red fir and lodgepole pine dominant at higher elevation and white fir, ponderosa pine and Douglas-fir at lower elevations.

Dense stands of red and white fir will occur on north and east facing slopes at elevations above 6000 feet. These species are shade tolerant, and will develop high tree density (60-100% canopy closure) and multiple canopy layers, and accumulate high amounts of downed woody material. The presence of a suppressed understory of small trees will reduce mean tree diameter estimates, but diameters of dominant firs should exceed 30 inches.

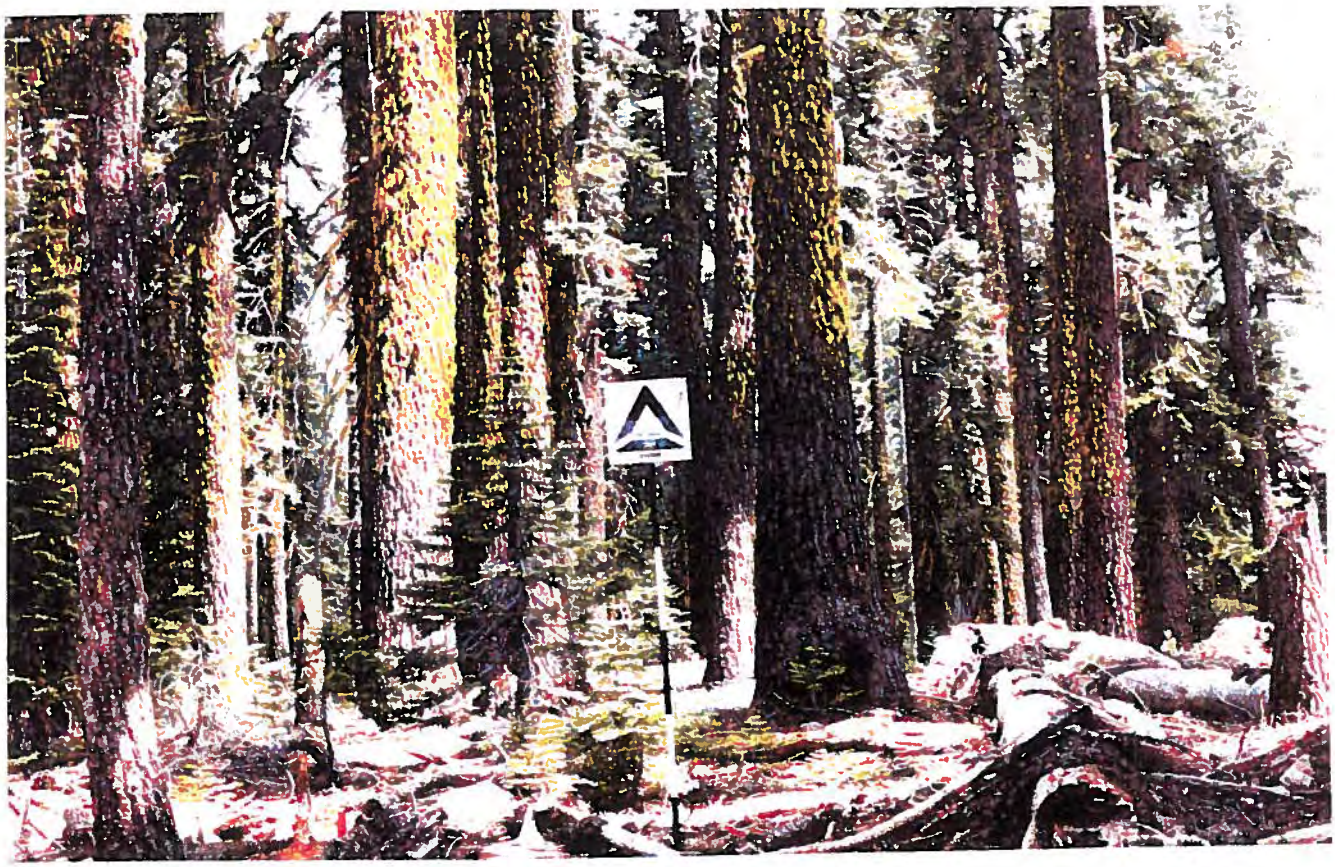
Desired basal area for most late successional stands in the TF community type will average approximately 70% of normal (Schumacher, 1926). Basal areas for the larger trees will range from 175 sq. ft. per acre on the lower sites to about 330 sq. ft. on the higher sites. Stands dominated by red fir will support higher basal area than white fir stands. With overstory trees generally ranging from 24" to 36" dbh and greater, the number of overstory trees per acre will range from 25-55 trees on the lower sites to 35-70 on the higher sites. This assumes the average tree age is 150 years.

Patches of elevated basal area exceeding 90-100% of normal will also be present, comprizing 10-20% of the community. For stands in this condition, basal areas will average about 250 sq. ft. on poor sites to over 400 sq. ft. on better sites. Average tree numbers per acre would be increased accordingly. Stands exceeding normal basal areas for the site would be scattered upon the landscape and not exceed 10 to 25% of the landbase. However, as mentioned previously, mortality is weakly linked to stocking density within this community type and suggested basal area limits upon a portion of the landbase is very subject to revision. Generally these stands will support more trees and greater average basal areas than comparable sites dominated by white fir. For example, for red fir stands located on FS site class 5 at 70% of normal (Schumacher, 1928) would have a basal area of 319 sq. ft. Average numbers of large trees per acre, ranging in size from 24" to 36" dbh, would be 65 - 100.

Decadence should be present in the form of broken, deformed and diseased large trees, standing dead trees, and coarse woody debris. Numbers of snags 15" and larger in dbh, will average about 4-6 per acre. Higher numbers of snags will correspond to densely stocked, better quality sites. Coarse, woody debris, exceeding 15" dbh, will average 8-15 logs per acre.
Within-stand gaps caused by treefall and fire are prevalent, but overall stand crown closure will exceed 60-70 percent. Horizontal diversity will be greatest in early seral stages and in stand gaps until canopy closure occurs. Early seral stages will on the average account for less than 10-15% of the community landbase.

Fuel loadings, though higher than in lower-elevation vegetative communities, will be discontinous and variable in nature over most of the vegetative community. To reduce risk from

Illustration 9 & 10. Desired condition for True Fir stands. Upper photo; closed-canopy late-successional stand. Lower photo; late-successional red fir stand with open structure.



stand replacing fire, fuel loads should range from 6 to 40 tons/acre. These fuels should be dominated by larger diameter material. In old-growth stands, fuel loads may exceed 40 tons/acre, primarily in the form of scattered large logs. Fuel loads exceeding this should exist in scattered pockets less than 25 acres in size, and contribute to only a small portion of the community landbase. At lower elevations (interface with MC communities) desired fuel loads will be reduced (5-14 tons/acre) due to increased fire potential.

As late seral stage habitat will account for 60-70% of the community landbase, connectivity within the type will be high. The community type also forms a contigous core within the LSR, contributing to high potential connectivity.

Red Fir Community
True Fir Community
South and West Facing Slopes, Capable Sites (Illus. 15 and 16):
Red and white fir will dominate species composition but other xeric site adapted species such as ponderosa pine will increase in number. Sugar pine may be a common stand associate. On extreme droughty sites, even at high elevations, ponderosa pine may form almost pure stands.

As the proportion of xeric species increases, average basal area and crown closure will decrease in comparison with more conventional true fir stands. This effect will be greatest on the most droughty sites. The expected basal area will be more reflective of the dominant species occuring on the site. Individual tree size may be comparable with those encountered on more protected aspects, however, spacing will be more variable. Generally, spacing between large trees will be wider. Density may also be more clumped, indicative of either a more active fire regime or the scattered presence of deeper soil pockets. Canopy closure will also reflect site variability and will generally range from 35% to 60% and reflect the clumped distribution of trees.

Decadence, in terms of snags and CWD per acre, decreases relative to true fir sites occuring on more northerly aspects because of fewer residual trees per acre and an increased fire frequency. Numbers of snags, 15" and larger in dbh, will average about 2-4 per acre. Coarse, woody debris, exceeding 15" dbh, will average 4-10 logs per acre.

Stands are poorly defined because of the scattered distribution of trees. Overall horizontal diversity will increase with increasing percentage of non-shade tolerant species. Decreased average crown closures illustrated by pine dominated stands allow greater development of the shrub/forb vegetative layers.

Fire frequencies may approach that of lower elevation vegetative communities. As fire frequencies increase on south slopes and depart from values expected for RF/WF communities, average fuel loads per acre will also decrease.

Mixed Conifer Community

North and East Facing Slopes/ Drainage Bottoms, capable sites: (Illus. 13 and 14)

Conifer species should be dominated by Douglas-fir with a mixture of ponderosa pine, sugar pine, incense cedar and white fir. White fir should be a minor component of the stand, however stand percentages of this species will vary with elevation and aspect. White fir will increase in number in this vegetative type as elevations increase and as sites become more protected and mesic. The more structurally complex late seral stage conditions within this type will occur on north and east slopes. It is desirable to have dense stands with total canopy closure >60% and tree species best suited to the site conditions. It is desirable to have multi-layered stands scattered throughout these aspects, especially on moist sites or lower on slopes.

Desired basal area for late seral and old growth stands will be in the range of 70-80% of normal (Dunning & Reineke, 1933). Basal areas for the larger trees will range from 200 - 225 sq. ft. per acre on the lower sites to 245 - 280 sq. ft. per acre on the higher sites. With overstory trees generally ranging from 24" to 40" dbh and greater, the number of overstory trees per acre will range from 30 - 60 trees/acre. Numbers of trees per acre will vary depending on the size of the overstory trees. As in the true fir community, about 10-20% of this community will exceed 90-100% of normal basal area stocking. Old growth plot data for this community type are very limited, but the few that are available indicate very low stand basal areas. Whether these plots were located in representative old growth areas or were located on sites with restricting limitations is not known, but careful on-site inspections are necessary to apply basal area guidelines. Moisture limitations on the Goosenest LSR may be more prevalent than previously thought.

Decadence should be present or even obvious in the stand, snags and coarse woody material should be common, although in varying concentrations throughout the stand. Deformed, broken and diseased trees would also be common enough to provide numerous nesting and roosting substrate opportunities for wildlife. Snags should average 4-7 per acre and down logs would average 10-20 per acre. Snags will occur scattered and/or concentrated in clumps. Sugar pine,and especially doug-fir, are long-standing snags. Most white fir and ponderosa pine snags are on the ground within 10-12 years (Schultz, pers. comm.). Generally fuel conditions will be such that flame lengths would be <4 feet and rate of spread <20 chains per hour (1 chain = 66 feet)

There will be gaps created by natural mortality where early seral vegetation is present. Gap size will be variable with the more shade intolerant species favored in the larger openings and in the center of smaller openings. Horizontal diversity will be greatest in the largest openings and decrease in time as growth of within-gap and perimeter vegetation continues.

Dense, closed canopied stands of late successional and old growth habitat within this vegetative type will occur primarily in riparian stands associated with stream courses, and on the lower ½ of north-facing slopes. The upper reaches of the Little Shasta River, Willow Creek, Parker Creek and Bogus Creek on the west side of the LSR, and Shovel Creek and its tributaries to the north,

Illustration 11 & 12. Desired condition for Mixed conifer stands on good sites in Goosenest LSR. Upper photo; mid-mature stand with scattered fuels. Lower photo; open late-successional stand with large logs.

will produce dense, highly connected stands, connecting the pine lowlands with the upper true fir types. The lower slopes of Butte and Ball Mountain, although drier than the west side of the LSR, should support relatively dense MC stands.

Mixed Conifer Community
South and West Facing Slopes, capable sites: (Illus. 15 and 16)
Ponderosa pine will be the dominant conifer species, but will be intermixed with Douglas-fir, sugar pine, and incense cedar. These stands will generally be open grown with canopy closure ranging from 25-55%. Hardwood species, if present, will consist of Oregon White Oak. White oak will generally form pure stands in locations with low average soil depth. They are especially prevalent on exposed, southerly ridges.

Desired basal area for late seral and old growth stands will be in the range of 60-70% of normal (Dunning & Reineke, 1933). Basal areas for the larger trees will range from 165-195 sq. ft. per acre on the lower sites to 210-245 sq. ft. per acre on the higher sites. With overstory trees generally ranging from 24" to 36" dbh and greater, the number of overstory trees per acre will range from 20-50 trees on the lower sites to 35-70 trees on the higher sites. Numbers of trees per acre will vary depending on the size of the overstory trees. Approximately 10-20% of the community will support denser stands with 70-100% of normal basal area.

Decadence will be present in most of the stands. Snags and large woody debris will be less prevalent, especially large concentrations, than in more mesic mixed conifer sites. Snag densities of 2-4 per acre will be desirable. The desired range of down woody debris is 5-10 logs per acre. Generally fuel conditions will be such that flame lengths will be <4 feet and rate of spread <20 chains per hour.

Due to the more exposed nature of the sites and dominance of shade intolerant species in adjacent stands, most patches will approach an even-age structure. A diversity of age patches will be scattered over the landscape on these aspects, but a majority of the stands will contain late mature to old growth characteristics.

Open stand types should occur on drier midslopes in drainages throughout the LSR, particularly in Steep Trail, Parker, Bogus and Cold Creeks, and the Little Shasta River. On the east side of the LSR, midslopes in Harris, Ikes, Muskgrave and Upper Rock Creek should also be of this structure.

Ponderosa Pine Community: (Illus. 17 and 18)
The ponderosa pine community should occur on elevated flats and upper slopes below 5000ft. throughout the LSR. In the western portion of the LSR, ponderosa pine communities should occur below 4500 ft. Outside of drainage bottoms, the Klamath River canyon is dominated by pine communities.

Sites will be dominated by ponderosa pine, which may form pure stands in some locations. On dry sites at lower elevation within the community, oregon white oak and western juniper may be stand associates. On more northerly aspects or in more mesic areas within the community, doug-fir, incense cedar and sugar pine are common stand associates.

Desired basal area for late seral and old growth stands within the community type will be approximately 60% of normal (Meyer 1961). Basal areas for the larger trees will be about 85 sq. ft. per acre on the lower sites to 155 sq. ft. per acre on the higher sites. Crown closure will average from 20 to 50%. With overstory trees generally ranging from 16" to 30" dbh and greater, the number of overstory trees per acre will range from 15-30 trees on the lower sites to 30-55 trees on the higher sites. Numbers of trees per acre will vary depending on the size of the overstory trees. Scattered patches of denser conditions will occupy 10-20% of the community, typically in 'flowerpots' of deeper soils in in drainages.

Due to a frequent fire interval and a lower number of trees per acre than in other community types, the corresponding number of snag and CWM numbers are also lower. Snags, greater than 15" dbh will range from 2 to 4 per acre. Ponderosa snags, like true fir snags, are relatively short-lived, with most falling under the age of 12 years. CWM, greater 15" dbh at small end, will average from 4 to 6 pieces per acre, or 5-10 tons per acre.

Due to the shade intolerance of the species, climax ponderosa stands will contain many small, even-aged groups rather than a true unevenaged structure (Burns and Honkala, 1990). Horizontal diversity will decrease as "group" age increases. Due to more open canopy structure, horizontal diversity at all stand ages will be greater than in upper elevation communities. Openings within the matrix of tree groups will be occupied by grasses, shrubs such as bitterbrush and sage, and young pines.

Lodgepole Pine Community: (Illus. 19 and 20)
Within its formal community type, lodgepole pine will form almost pure stands. Lodgepole is considered a fire-dependent species, similiar to knobcone pine. This distinguishes it from all other community types within the LSR. Due to this fact, management of this species within the LSR will depart from natural, historical patterns to avoid placing adjacent stands of other community types at risk because of stand replacing fire. This scheme should be followed at least until fuel loadings within adjacent stands are decreased and fire frequencies have increased to historical levels. In associated communities, lodgepole forms a much smaller component of the

Illustration 13 & 14. Desired condition for Mixed Conifer and some True Fir stands on south- to west-facing slopes in Goosenest LSR. Upper photo; open late-successional stand of fire-adapted species. Lower photo; higher-elevation ponderosa pine/red fir stand.

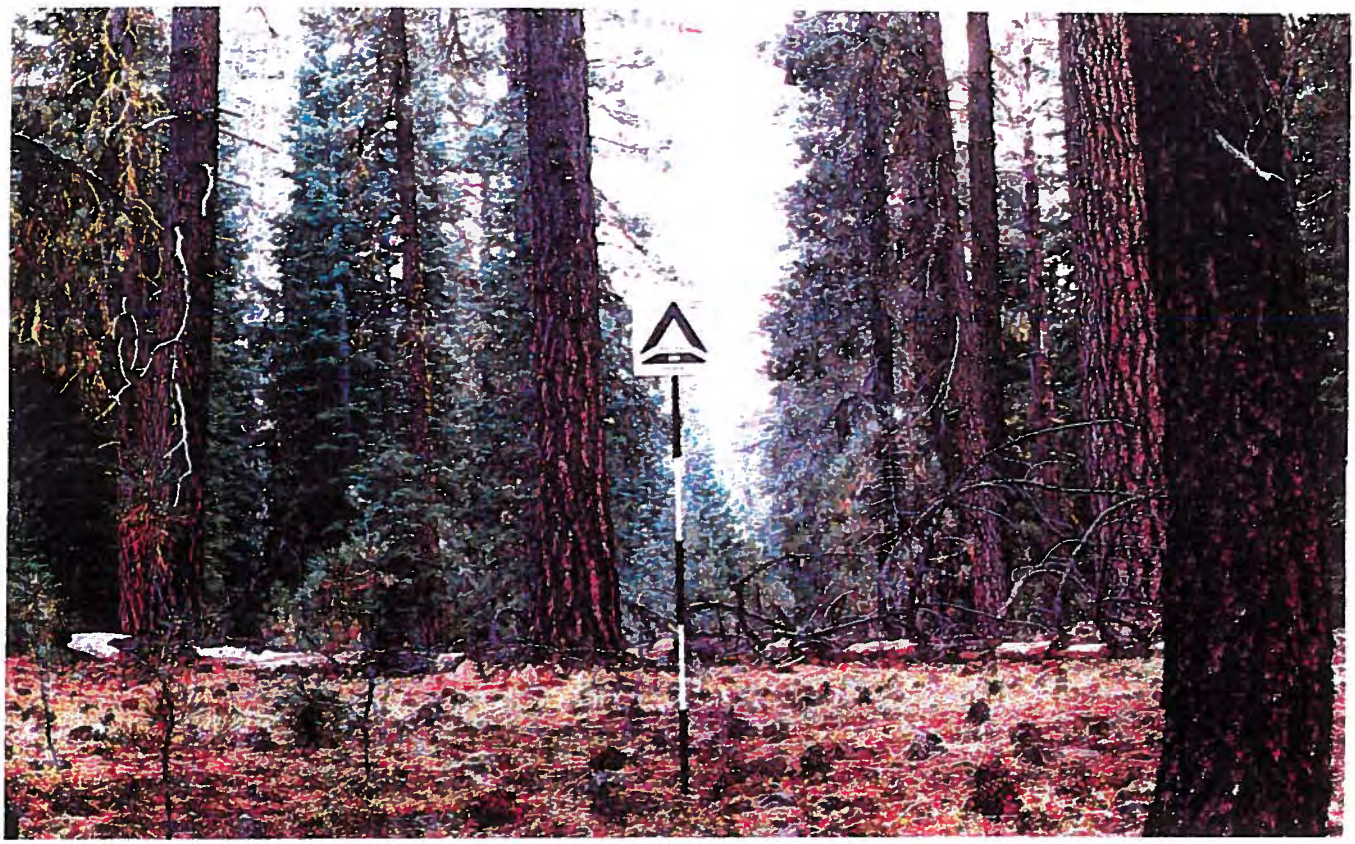


Illustration 15 & 16. Desired condition for Ponderosa Pine stands in the Goosenest LSR. Upper photo; late-successional stand with clumps of regeneration. Lower photo; mid-successional stand with signs of recent fire.

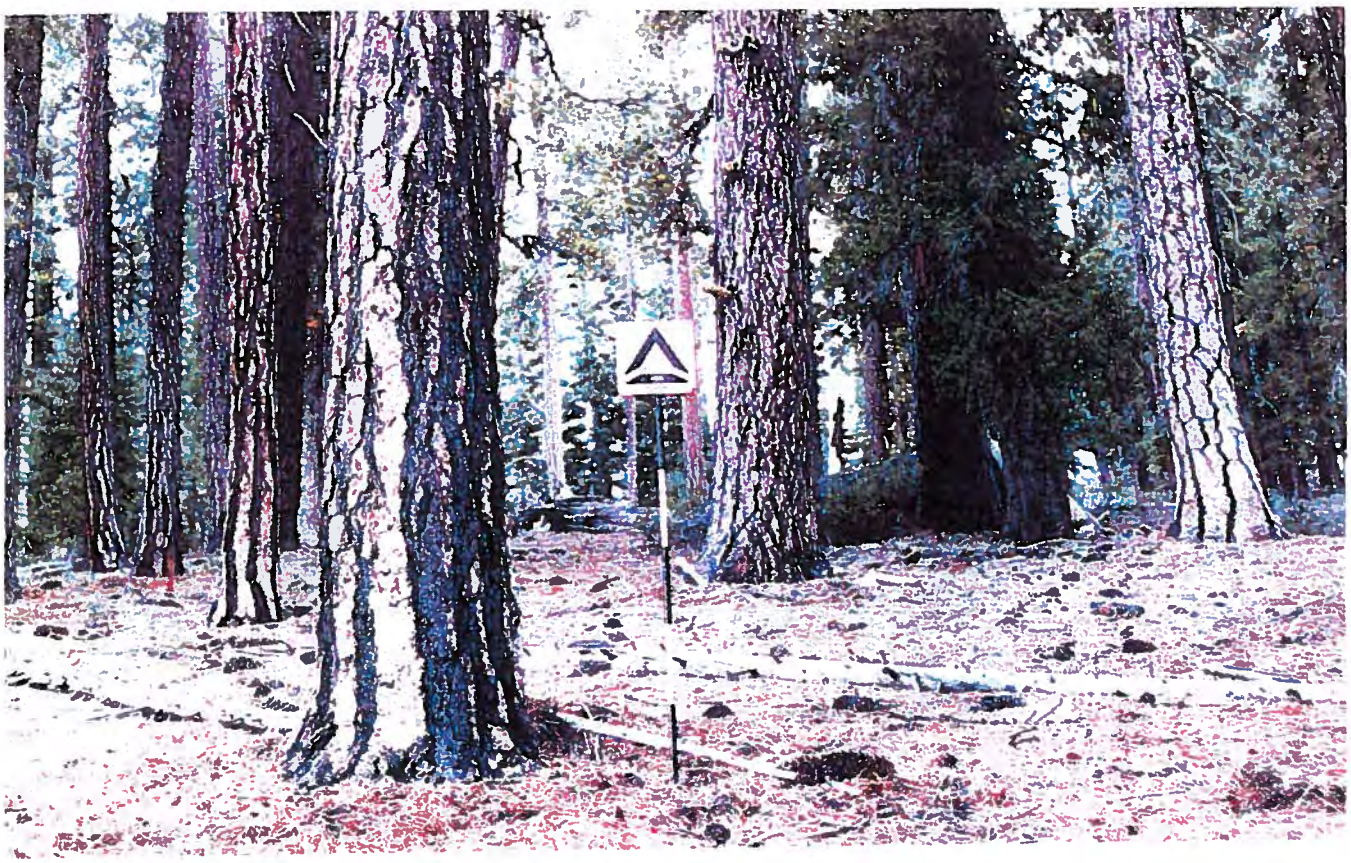


Illustration 17 & 18. Desired condition for Lodgepole Pine stands in the Goosenest LSR. Upper photo; dense multi-aged stand with moderate fuels. Lower photo; open late-successional stand with low fuels.

stand, but apparently increases in composition as the fire interval increases.

Due to the nature of stand replacing fire, which is the disturbance factor initiating most stand development and lodgepole's aggressive seeding pattern, stocking density can be extremely high. Initial stocking density may often approach 100,000 seedlings per acre. Lodgepole is also able to tolerate very dense stocking for prolonged periods of time. Under these conditions, average tree diameter will be only a few inches after several decades of growth. A desired condition for the lodgepole community within the Goosenest LSR would be to maintain some form of initial stocking control following major distrubance over about 50% of the landbase. Ideally, treated acres would be scattered throughout the community to avoid excessive areas of similar stocking and fuel loads. The remaining area will be allowed to develop in a natural sequence. This process will be described in more detail in the Implementation Schedule.

Riparian Reserves

Unstable Land Component Since these landtypes can occur across all 6 of the plant communities tracked in this LSR assessment, desired vegetative conditions can only be stated in general terms. Various species are appropriate, in concert with site potential. All the unstable lands share the following desired conditions: Maintenance of dense vegetative cover (depending on site capability) at all times; avoidance of soil/rock disturbances such as those associated with road construction; maintenance of favorable surface and subsurface runoff patterns (avoiding concentration of water in unstable areas); resistance to high intensity fire in accordance with the pre-settlement fire regime; maintenance of a mixture of site-adapted trees, brush, and shrubs of varying age classes to avoid the situation where one component of the vegetation, such as the conifer overstory, reaches old age and dies at the same time. Slope stability objectives for vegetative conditions must be integrated with the biological needs on these lands.

Inner Gorge- It is desireable to maintain a dense cover of deep-rooted species, and those with high transpiration rates, according to site capability. The slope stability objective is to maximize root support, but this is tempered by other biological needs.

Active Slumps, Earthflows, and Translational Slides- Vegetative cover which maximizes deep water withdrawal is the primary objective. In addition, maintenance of root support along the steeper portions of slide is important where the mechanical reinforcement of roots can reduce the rate of shallow debris flows.

Recent Debris Flow- Establishment of site-adapted deep-rooted species is the primary objective.

Toe Zone of Slumps/Earthflows- Same as active earthflows, with emphasis on root support, since these lands are generally steep and prone to shallow debris flows.

In addition, there is a need to manage the vegetation within the hydrologic catchment which drains through the toe zone. Removal of vegetation upslope of these areas influences their stability, and thus, it is desireable to maintain an appropriate cover (depending on site conditions) within catchment areas upslope from the toe zones.

Riparian Feature Component The seral condition of vegetative and associated riparian features (springs, wet meadows, perrenial and non-perrenial streams, lakes, ponds) are in most cases interrelated. Habitat elements, important to defining the quality of habitat available to fish and wildlife species (ie., food, cover, space, microhabitat conditions), correspond to the successional

state exhibited by riparian features. Because of the interdependence of the vegetation associated with riparian features, the type and extent of vegetative manipulation (ie., harvest, grazing), relative to site potential, needs to be planned in consideration of Desired Future Conditions for terrstrial and aquatic habitats within riparian reserves.

Wet Meadows, Springs- it is desirable to maintain deep-rooted native grasses and shrubs, consistent with site capablity to minimize soil erosion, filter and trap sediment, maintain stability of stream banks, provide floodplains for water storage, dissipate water velocities, maintain water-table elevation, moderate water temperatures and provide cover to terrestrial and aquatic species. Stream channels associated with meadows should exhibit mid to late-seral characteristics if intended to provide optimum habitat conditions for native fish community and many wildlife species (Appendix A-6).

Fish-Bearing Streams- adequate vegetation is provided to provide the functions desribed for wet meadows, but includes vegetation consistent with forested stream system potential as well. In addition, forrested systems should provide course woody material to sustain diverse ponding and channel charateristics to provide habitat elements including water depth, duration and temperature necessary to support native fish species and asociated riparian dependent wildlife. This includes maintenance of vegetative corridors which provide connectivity between LSF stands. Stream channels should exhibit mid to late-seral characteristics if intended to provide optimum habitat conditions for native fish community and many wildlife species (Figure 7, Appendix A-6).

Intermittent Streams- same as fish bearing streams

Lakes and Ponds- same as fish bearing streams

Desired practices and processes

It is assumed that plantations are capable of supporting mature and late successional forest, and therefore, the desired condition is to manage them as such. Residual snags and down logs from the previous stand will be desired components to maintain within these plantations. In the interim, the stands should be healthy and fast growing with stocking levels and fuel accumulations that reduce the likelihood of loss to catastrophic fire.

In the Klamath Province, prior to fire suppression, fire was more frequent, less intense and an integral part of the internal dynamics of a typical stand. The introduction of prescribed fire and prescribed natural fire to the LSR will help encourage the processes and attributes that define late-successional and old-growth ecosystems. It is expected and even desirable to have low to moderate intensity fires burn in LSRs. Low intensity fires reduce fine fuels and ladder fuels, create a seedbed for a diversity of herbaceous plants, and create a patchy understory. Moderate intensity fires are desirable if they create small openings in the canopy of <5 acres in size. This allows for regeneration of forest stands and creates snag patches and concentrations of down woody debris which are important prey base habitats. Burn openings are most desirable if they occupy only a small percentage (5-10%) of the stands providing habitat.

In addition, the introduction of a fire cycle similar to that which occurred in pre-suppression times, will reduce the risk of catastrophic, stand-replacing fires. Large stand replacing, high intensity fires are not desirable within LSRs. Management tools such as underburning, thinning, salvage logging, and other fuel reduction methods should be used to reduce the possibility of this kind of fire occurring. Geographic features such as slope, aspect, soil erodibility, and elevation, as well as fuel types need to be examined and priorities for an active fuel reduction program established. In addition, watershed conditions, recovery rates and trend, need to be considered with respect to existing levels of disturbance by watershed. It is preferable to treat large blocks (contiguous areas > 200 acres) of vegetation. Treatments may be needed to ensure that fuel continuity is variable over the landscape. It is not desireable to have the same fuel condition found over large blocks of the landscape. The goal of the burning program should be to break up large blocks of high fuel concentrations, particularly in drier MC and POJ communities. Because existing watershed conditions vary, fuel treatments will need distribution in space and time.

Fuel treatments need to be balanced with other LSR objectives (such as ACS , cumulative watershed effects objectives). Lands adjacent to LSRs, with high fire hazards should be examined for possible treatments to prevent catastrophic fires. Areas downslope or downwind of prevailing wind patterns should be especially examined.

Stocking densities are so elevated within some areas and community types, that re-introduction of a historical fire cycle may not be currently desireable. In many stands, especially with the pine and the mixed conifer communities, species composition and densities have departed from historical patterns. Fire exclusion has allowed intensive understory development, especially by white fir in the MC type. A similar process has occurred within the pine community. Due to the presence of these "ladder" fuels and the general increase in fuel loads because of increased density, overstory trees may be jeopardized by natural fire. Several cycles of carefully regulated prescriptive burning may be required to move stands toward a historical and sustainable structure. In extreme cases, it may be necessary to physically remove some understory material from most of the area (as in piling) or even off of the site. As historical and sustainable structures are restored to these communities, prescribed natural fire can be allowed upon the landscape. There are several benefits to having stands adapted to a prescribed natural fire regime. The need for prescribed burning is decreased as is the need to artificially manipulate stands to avoid some future catastrophic mortality.

Another desired process is the restoration of a background mortality rate. In California, a background mortality rate would remove .2 to .5% of standing volume per year (Schultz 1996). Vectors responsible for background mortality are insects and disease, as discussed in section 1. However, it appears that mortality is maintained at background levels provided most stands are maintained at or below some critical density. As discussed, this relationship is strongest within the pine community and weakest within the true fir community. This background mortality rate interacted with the historical fire regime to provide for the continuance of the type.

In summary, it is apparent that background mortality rates, historical and sustainable stand

structures and historical fire patterns are all linked. Site specific assessment will be required for most areas to determine degree of departure from historical patterns and the "steps" required to return to this desired condition. In some areas, dealing with unwanted "ladder" fuels or fuel loads will be required before the initiation of a burning program. In other areas, underburning could be initiated now. In general, it appears if stands are able to be returned to and tolerate a natural fire regime, background mortality rates and sustainable structures will also develop.

Another desired condition is to minimize the negative effects of roading within the LSR, including a reduction in the amount of road-related sediment within the watershed. Standards and guidelines for LSRs state that road construction is generally not recommended unless potential benefits exceed the cost of habitat impairment. Additionally, standards and guidelines for key watersheds prescribe that existing system and nonsytem road mileage be reduced. No additional road construction, for the purpose of LSR habitat management, is recommended at this time.

Possible **conflicts** with other resource prescriptions may occur. Reduction in conflicts can be approached thru both preventing additional impacts and reduction of existing disturbances. Where a prescription is **beneficial** for all resources, projects become highly desired. Conflicting prescriptions can occur if carefully orchestrated to minimize impacts to other resources. Some prescriptions can cause too much adverse impact or push a resource over its threshold and not be able to naturally recover. Lands contributing to CWE upslope or upstream of Riparian Reserve areas can be analyzed by identifying the contributions to the problem and prioritized for the most gain in disturbance reduction. Overall goals can be established by watershed area. Following are a list of general goals by individual type of disturbing to water and riparian resources:

1) Maintain road densities less than 2 mi./mi.^{2}.
2) Decommission or upgrade roads which present slope stability hazards, reroute hillslope drainage, or have high surface erosion potential.
3) Signing and or vehicle control can reduce recreation damage by ORV in Riparian Reserve areas.
4) Deferred harvest when greater than 15% of the acres in a first order stream are regeneration cuts or where 60% of the watershed is past 25% Basal Area harvested.
5) Timber harvest to make a stand healthy may need to be spread a longer over time period like a decade.
6) Fuels reduction can be scattered over time, dispursed over many smaller units, and be carried on with less intensity. The goal for CWE is breaking up high fire risk patterns rather than reducing all high fire risk acres.
7) Grazing in Riparian Reserves will not retard or prevent attainment of ACS objectives. **Recovery rate of riparian vegetation and late-seral stream channel characteristics does not differ significantly from ungrazed situations.** Appropriate stream channel treatments (riparian planting, bank stabilization, grade control) are used when and where warranted relative to channel state. Natural recolonization of beaver is not discouraged.
8) Irrigation diversions can allow for Riparian Reserve vegetation and stream channel maintaince flows and fish passage at the diversion site as well as in the stream during low flows. Irrigation diversions can bypass some flows in the summer months for maintaince

of aquatic species, riparian vegetation maintenance, maintenance of channel configuration, and to allow fish passage.

Management of Suitable Habitat for Threatened and Endangered Species

In many cases, forest stands indentified as being at high risk to insect epidemic or catastrophic fire are also serving as habitat for species protected under the Endangered Species Act. Proposals to reduce risk of habitat loss will be developed with collaboration with the US Fish and Wildlife Service, and the costs and benefits of each project will be assessed at the project level. For the purposes of this Assessment, however, the general philosophy behind treatment of suitable TES habitat is an important component of the LSR objectives, and will be briefly described here.

Prioritization of treatments within suitable TES habitat will be based on several factors, including present occupancy by TES species, level of suitability, patch size, current threats and level of risk. A careful cost-benefit assessment, including evaluation of adjacent habitats, will be conducted to determine whether a proposed project best meets the objective of protecting or maintaining TES habitat.

In general, treatment of suitable TES habitat will be designed to retain the structural components of suitable habitat, while reducing risk to acceptable levels. For example, reduction of intertree competition and risk of insect outbreak in suitable northern spotted owl habitat might consist of removal of 30% of the small-diameter stems in a given stand, follwed by a light underburn to reduce small fuels and kill regenerating conifers. This activity would be conducted in a mosaic pattern, leaving patches of denser habitat, but reducing stand density overall. Target stand structure would remain within the range of occupied stands elsewhere in the LSR.

CRITERIA AND POSSIBLE TREATMENTS

Management activities within LSRs must be consistent with the objectives, policies, standards and guidelines set for these lands. These have been established in the ROD for the President's Forest Plan and the Forest Land and Resources Management Plan. Accomplishing these objectives will ensure the desired future condition for the LSR is met.

LSRs are designated with the objectives to maintain, protect, and restore conditions of late successional and old growth forest ecosystems, which serve as habitat for associated wildlife. Treatments designed to provide these habitat conditions through time support the objectives for LSRs.

In provinces which are in a condition of elevated risk to large scale disturbance, management which goes beyond the guidelines contained in the ROD may be considered. "Levels of risk in those LSRs are particularly high and may require additional measures. Consequently, management activities designed to reduce risk levels are encouraged in those LSRs even if a portion of the activities must take place in currently late-successional habitat. While risk reduction efforts should generally be focused on young stands, activities in older stands may be appropriate if: (1) the proposed management activities will clearly result in greater assurance of long-term maintenance of habitat, (2) the activities are clearly needed to reduce risks, and (3) the activities will not prevent the LSR from playing an effective role in the objectives for which they were established" (USDA, USDI 1994b). As described in the Introduction of this assessment, maintenance of existing late-successional habitat, and development of future habitat, will often require active management in the form of underburning and underthinning.

Opportunities for habitat protection and restoration benefiting riparian dependent resources are found in every watershed of the assessment area. Conflicting management objectives between federal, state, and other land owners occur within the LSR area, presenting both oppourtunities and obsticales toward fully achieving LSR goals. Geographic prioritzation of FS actions aimed at restoring and maintaing LSR/Aquatic function may be necessary (based upon available resources, technical capabilities, ability to coordinate goals with other agencies/ownerships) to achieve LSR/ACS goals in a timely manner.

The following are specific objectives which should be used to direct planning of the eco-restoration and maintenance program within and adjacent to the LSR. They were developed from conclusions based on how well the LSR is currently functioning. Under each objective, specific criteria have been developed to identify proposed treatments and general treatment areas. **The objectives, criteria and potential treatments are intended to identify situations triggering further analysis, planning and implementation - they do not specify spatial or temporal extent of restoration projects. A more detailed description of the specific potential projects which have been identified at this time are included in the "Implementation Schedule" section.**

Objectives

1. Accelerate the development of future late successional forest habitat and provide resiliency from large scale disturbances over time. Large blocks of habitat are preferable over isolated, smaller parcels.

2. Retain, restore, and protect watershed functions, landforms, and seral conditions that promote high quality habitat for native fish and other aquatic dependent organisms.

3. Protect existing stands of late and mid-successional forest habitat by:
   a. reducing factors contributing to stress-related tree mortality, both within and adjacent to the LSR.
   b. reducing the risk of stand replacing wildfire within and adjacent to the LSR.

4. Improve the connectivity of late successional forest habitat within the LSR.

5. Improve northern spotted owl habitat.

6. Foster protection and re-establishment of native fish communities.

Objectives, Criteria and Possible Treatments

Objective 1. Accelerate the development of future late successional forest habitat

Criterion a. If existing forested stands are capable of developing into, but are currently not in a late successional or old growth forest condition, then treat to accelerate growth and development of desired stand characteristics.

Treatments include mechanical thinning or thinning by use of prescribed fire. The areas identified as being in greatest need of this type of treatment include:
1) plantations older than 10 years and natural pole stands (higher priority)
2) plantations less than 10 years in age (lower priority)
3) stands and community types that are significantly altered in terms of density and/or species composition from a desired and sustainable late seral structure (higher priority). An example would be increased white fir density within mixed conifer stands. Increased densities of encroaching understory or codominant vegetation may jeopardize other desired dominant and codominant associates.

Criterion b. If large areas have been affected by a stand-replacing disturbance, then reforest to accelerate the development of habitat. Past reforestation failures occuring in plantations and shelterwoods will also be included in this category.

Treatments required to accomplish the desired reforestation will depend on the length of time since the stand-replacing disturbance and the current vegetative condition of the site. Reforestation of recently disturbed sites may not require any additional effort beyond planting. Reforestation of areas disturbed greater than 2-3 years prior may require appropriate site preparation methods. Specific areas that have been identified for this treatment include locations of unregenerated clearcuts in higher-elevation fir communities on Eagle Rock, Willow Creek Mt., and in Shovel Creek Divide. In many cases, reforestation with lodgepole pine may be required to provide a suitable microclimate for regeneration of firs.

Objective 2. Retain, restore, and protect watershed functions, landforms, and seral conditions that promote high quality habitat for native fish and other aquatic dependent organisms.

Criterion a. Where stream channels and riparian habitats exibit early-seral characteristics (see Figure 7, Appendix A-6) assess extent and cause. Use appropriate analysis to develop management actions for arresting habitat degradation and developing an improving trend toward DFC of mid to late seral conditions consistent with site potential.

Treatments are designed to address mechanism or management action manifesting early-seral condition (e.g recreation, grazing, road or culvert placement) rather than degraded habitat features alone (e.g gullying, unstable stream banks, xeric vegetation encroachment).

Almost all wet meadows and many of the spring/seep areas have been heavily grazed. In some cases, heavy grazing in the early 1900's converted meadows to exotic grasses and forbs, and dramatically reduced the capacity of these sites. Known problem areas include large meadows like Chandler Glades and upper Bogus Creek, Flat Springs to Iron Creek, Snackenburg Creek, Lucky Springs, south side of Butte Mountain above Burnt Camp, Garvey Glades, Shovel Creek Meadows, Little Shasta Meadows, Martin's Dairy, Bull Meadows, and along the Little Shasta River. Many opportunities exist, and can be used individually or in combination to address site specific riparian resource needs. Best actions usually involve changing timing of grazing, amounts of key riparian species not grazed, reduction in channel impacts, and restoration.

Criterion b. Where roads occur in Riparian Reserves (Figure 5,Appendix A-9 and A-10) or have the potential to adversely affect these areas, determine potential for adverse on-site as well as cumulative effects associated with the roads. Assess opportunities for reducing erosion and sedimentation, improving stream crossing structures to reduce the adverse effects to riparian and aquatic habitat. Proximity to riparian features and fish-bearing habitat should be used as a prioritization criterion.

Treatments include: realignment, outsloping where appropriate, upgrading of stream crossings to facilitate fish passage and handle 100 year flow events, surfacing, revegetation, slope stabilization (such as with subsurface drains or rock buttresses) decommissioning.

Segments of the 46N05 road system can be changed from insloped to outslope within the Harris Creek watershed in Section 7 thru 14 (approximately 5 road miles). Additional reductions in cronic sediment delivery could be obtained through asphalt surfacing of road segments parralleling Harris Creek. Coordination of multiple impacts/disturbances can be reduced thru combined planning of all ownerships.

Criterion c. Where roads are outside Riparian Reserves, but in areas of high or moderate surface erosion hazard (Figures A-8 and A-9), assess suitability for erosion reducing measures. Proximity to Riparian Reserves, and potential for adverse effects should be used as a prioritization criterion.

Treatments include surfacing or seasonal closure of roads, revegetation of cuts and fills, decommissioning.

Criterion d. Where roads occur outside of Riparian Reserves and coincide with areas of moderate landslide hazard (Figure A-10), determine the potential for slope failure, and assess suitability for slope stabilization measures. This includes abandoned roads not in the GIS database such as that in section 1 of Lucky Springs watershed.

Treatments include subsurface drainage, buttressing of unstable slopes, reinforcement of road fills, correction of surface drainage problems, realignment, obliteration, revegetation.

Criterion e. Where vegetation or soil disturbing activities such as timber harvest, prescribed burning or road construction are proposed within or in close proximity to Riparian Reserves, assess the potential which these activities may have for accelerating surface erosion, landsliding or altering hydrologic function.

Treatments (mitigations) include (a) avoiding the Riparian Reserve, or moving activities further away; (b) use of special road designs such as installing subsurface drainage where a road crosses an unstable area; (c) reducing the magnitude of the activity, such as lowering fire intensity, or reducing the number of trees to be removed.

Criterion f. Where cumulative watershed disturbance is of concern (see Table D-1; sediment delivery and hydrologic function ratings 3 or 4).

Treatments (mitigations) prior to construction of new roads, skid trails and landings, site analysis (incorpoating hydrologic, geologic and CWE), is strongly recommended. Road maintainence and activities associated with road recommissioning (ie., brushing, fallen tree removal, and loose rock removal) will not cause significant adverse impacts. Road recommisioning actions requiring more intensive actions (ie., ditch cleaning, reconfiguration of road prism should receive analysis as described above. Road related activities within Riparian Reserves would be limited to road reconstruction or decommissioning beifiting riparian dependent resources.

Objective 3a. Protect existing stands of late successional forest habitat by reducing factors contributing to stress-related tree mortality.

Criterion a. If stocking exceeds desired basal area for the community type, especially over large contiguous areas (>100 acres), then treat in order to reduce the potential for stress-related mortality. Stands which may be most prone to stress-related mortality include overstocked conditions, often indicated by an undesired shift in species composition. As above, abnormally high concentrations of white fir within the mixed conifer community or within the pine community may indicate the need for treatment. Areas in and adjacent to current insect or disease outbreaks are also a higher priority. **(See Management of habitats for Threatened and Endangered Species)**

Treatments may include underthinning or underburning or combinations thereof. Due to dense stocking, some sites may require removal of undesired vegetation from the area. Desired spacing and basal area targets will be dependent upon the aspect, site quality and the community type. In larger size class stands, treatments should emphasize removal of small diameter trees. As discussed previously in the document, density-related mortality is linked most strongly with the pine and mixed conifer community. These 2 community types would be the highest priority for treatment under this objective. Large, desireable old-growth trees, especially ponderosa pines, may require such treatments as "dripline thinning" to promote their survival.

Objective 3b. Protect late successional and mid/dense forest habitat by reducing risk of stand replacing fire.

Criterion a. If stand structures assume a non-sustainable form, as the extensive development of undesired "ladder" fuels, especially over large contiquous areas (100 acres), then treat to reduce the potential for crown fires. Elevated basal areas, undesired species composition, and accumulation of fuels following insect or disease outbreak as in Objective 3 above, may serve as an indicator of this condition. Objectives 3a and 3b are linked in purpose and many stands may fit into both categories. Objective 3a targets the removal of material that would lead to increased mortality and future increased fire risk, while Objective 3b focuses on stands that currently are in a structural form placing them into elevated risk from stand replacing fire. Stands which may be most prone to crown fire include dense early and mid-successional stands (greatest susceptibility), followed by more open young stands (moderate suseptibility), and late-successional stands (lower susecptibility). **(See Management of habitats for Threatened and Endangered Species).**

Treatments may include underthinning or underburning. In late-successional stands, treatments should again emphasize removal of small diameter trees. Target stand structure should be a balance between desired late-successional structure and acceptable levels of risk. Ladder fuels and smaller-diameter fuels should the primary targets of risk-reduction prescriptions.

Criterion b. If existing fuels conditions create large areas where desired flame lengths and rate of spread are exceeded, then treat to reduce small ground fuels. The most hazardous situations are where desired condition is exceeded on south-facing slopes, on west-facing slopes, or throughought areas of high fire behavior potential exceeding 100 acres in size.

Treatments may consist of prescribed fire, manual fuels reduction, or mechanical fuels reduction. See "Implementation Schedule, for a more detailed description of a potential project.

Criterion c. If areas of high or moderate fire behavior occur adjacent to late successional and old growth forested stands, then reduce the immediate threat to the late successional stands.

Treatments may include prescribed underburning, development of fuel break buffers, or manual fuels reduction.

Criterion d. If areas of low fire behavior are situated such that they can protect or serve as buffers to areas of higher fire behavior, then maintain them in a condition of low fire behavior.

Treatments include prescribed underburning and manual fuels reduction. The most desireable areas for this type of treament currently exist in areas within or adjacent to the LSR which are currently in a low fire behavior potential.

Criterion e. Where large scale disturbances have occurred such that hazardous fuels conditons will develop (ie. insect-killed mortality), then treat through reduction of future fuel loadings.

Treatments may include the removal of standing dead trees. The locations where this treatment may occur at this time include the east-facing slopes of Ball Mountain and Butte Mountain, in mixed conifer communities.

Objective 4. Improve connectivity within the LSR:

Criterion a. If isolated or disconnected parcels of late successional and old growth forest habitat occur, then improve connectivity. Improvement in connectivity is especially critical and needed within the mixed conifer community.

Treatments include thinning or underburning to accelerate growth and development of desired stand characteristics, or reforestation to establish new stands. In areas of mixed ownership, where connectivity is especially critical, pursue possible land exchanges. Potential areas for treatment include the Bogus Burn area, Secret Springs and McGavin Peak areas, and in Steep Trail Creek.

Criterion b. Where connectivity of stream and riparian habitats in impaired or broken, restore connectivity. Emphasis on restoration of stream connectivity in forested corridors to promote downstream movement of course woody material. Fish bearing stream reaches where juvenile or

adult migration is impaired should also receive priority for potential treatment.

Large-scale connectivity issues, such as operations of Klamath River reservoirs, is a contempory issue throughout the basin and has implications on the successful implimentation of the ACS. This issue is best addressed through active participation with agencies and goups such as the Klamath River Task Force, Klamath Project Operations Plan group, and Federal Energy Regulatory Commission (FERC).

Treatments may include removal or modification of stream crossings, modification in quantity or timing of water diversions (special use permits), vegetative treatments including planting of riparian species or silvicultural actions within riparian reserves focused on attainment of ACS objectives. Areas of past timber harvest in riparian reserves are priority for treatments to accelerate LSF.

Objective 5. Improve habitat for Northern Spotted Owls.

Criterion a. If an activity center is currently deficit in acres of suitable habitat (500 acres within 0.7 miles of an activity center and 1330 acres within 1.3 miles of an activity center.), then treat early seral stands to accelerate growth and development to desired stand characteristics.

Treatments may include thinning through underburning or mechanical treatment, or reforestation to develop new stands. The highest priority areas identified for this treatment include plantations and pole stands within 0.7 miles of an activity center (higher priority) and plantations and pole stands within 1.3 miles of an activity center.

Criterion b. If no activity center is known, but topography and community type suggest that a suitable territory could exist in the future, then treat stands to accelerate growth while maintaining adequate density. Priority should be given to mid-mature stands in drainages (Steep Trail Creek, Hell's Canyon Creek) and north-facing slopes above perennial streams.

Treatments: same as for Criterion a.

Objective 5. Foster protection and re-establishment of native fish communities.

Criterion a. Where water diversions have the potential to entrain fish species, or are likely to transfer fish beteen watersheds, flowing or standing waters then install appropriate barriers to prevent fish entrainment. Priority should be given to preventing inter-watershed fish species transfers.

Treatments include installation and maintenance of fish screens or other mechanical barriers; relocation of diversion; or modified/ discontinued use of diversion.

Criterion b. Where physical barriers, including culverts, diversion dams, and dewatering of channels, block access by native anadromous or resident fish to historically occupied habitat explore feasible mechanisms to reestablish passage. Maintain natural morphological barriers. Priority should be focused on watersheds within the range of Klamath Province steelhead and coho salmon (eg., Little Shasta River and Bogus Creek).

Treatments include removal/modification of migration barriers, modification to timing/quantity of water withdrawls, coordination with California Department of Fish and Game.

IMPLEMENTATION SCHEDULE

The previous section identified criteria that indicate the need for restoration projects , and identified management techniques that could be used to achieve habitat objectives. These were described in a generalized, non-spatial context; i.e could be applied at any point in time or space where the habitat criteria are met. The following section will provide a more detailed discussion of specific high-priority projects that are likely to be initated in the forseeable future.

Implementation of restoration projects in the Goosenest LSR will be dependant on a number of factors including priority, feasibility, planning timelines, and availability of resources. Individual projects will require NEPA assessment and, under Section 7 of the ESA, consultation with the USFWS. **It is important to note that thinning or underburning activities are unlikely to affect more than 2-5% of the LSR landbase annually, even with adequate financial resources. In addition, long-range planning will likely be affected by changes in current condition such as large-scale insect epidemics, and stand-replacing fires.**

Standards and Guidelines

The Aquatic Conservation Strategy and corresponding Riparian Reserve Standards and Guidelines must be followed when management activities are proposed in LSRs: these are located on pages B-11 and C31-38 in the ROD. In addition, The Klamath National Forest Land Management Plan discusses direction, policies, and Standards and Guidelines for LSRs. For the most part these coincide with the President's Forest Plan, but in some cases are more conservative. Specific guideance for management projects within LSRs is given on pages C-11 to C-19 of the ROD.

Proposed Projects

1) Muskgrave Bald Eagle nest stand protection

This project involves active management of mixed conifer stands on the eastern slope of Ball Mountain (Figure 4, 9) in the vicinity of the Muskgrave Creek bald eagle territory. The intent of this project is protection and maintenance of old-growth ponderosa pine and Douglas-fir that are threatened by advanced regeneration of white fir and Douglas-fir in the absence of fire. This activity is included among territory maintenance actions prescribed in the Recovery Plan for the Bald Eagle, and therefore does not require review by REO. However, as the project's focus is restoration of desired mixed conifer structure and reduction of risk to insect epidemic, we have included it as representative of future projects in this forest type.

Criteria met: Objective 3a - protect existing LS/OG stands from stress-related mortality.
The old-growth pine stands in this area have developed dense understories of white fir and Douglas-fir and are overstocked. Outbreaks of western pine beetle and scolytis are causing tree mortality in pockets throughout the area and threaten the overstory pines which have no replacements in the codominant layer or understory.

Techniques: Three principal treatments will be employed individually or in combination.
1) Dripline thinning around large overstory pines to reduce stress due to competition. All trees will be removed from an area corresponding to the radius of each overstory tree's canopy. Any young pines within the dripline would remain. All harvested material will be removed from site, unless down logs are lacking. Fuels treatment would be accomplished by lop and scatter or hand piling methods.
2) Thinning of small-diameter white fir from understory: Within a 250-acre area surrounding the nest site, small-diameter white fir and Douglas-fir will be removed from the understory to reduce basal area below critical thresholds. All dominant and codominant overstory trees will be retained, and intermediate trees (12" - 18") will be assessed based on remaining stand density. Wide openings (25" radius) would be created around any young ponderosa pine. Dense patches of white fir may be removed to create small (5 acre) openings for regeneration of ponderosa pine. Only a small proportion of the 250-acre area is currently in LS/OG condition, much of the area consists of younger stands with remnant patches (5-25 acres) of LS/OG habitat. All harvested material will be removed from site, unless down logs are lacking. Fuels treatment will be accomplished by lop and scatter (if underburned) or hand pile and burn methods.
3) Underburning of thinned stands: If post-treatment assessment of stands within the eagle project area indicate the need for underburning, a low-intensity prescribed burn may be implemented. Reduction of light fuels and undesireable tree regeneration would be the primary motivation for underburning. Underburning may also be selected as a maintenance tool to reduce WF regeneration at regular intervals (e.g. 10-year period).

Timing: This project is a high priority for completion in 1997. Recent outbreaks of insect activity in adjacent stands suggest that the remaining overstory pines are at high risk, and there are no replacement nest trees to maintain this eagle territory. Seasonal restrictions to minimize disturbance to nesting eagles, roosting eagles (winter), and adjacent spotted owls will necessitate careful coordination and planning to accomplish project objectives during the short (August-October) window of opportunity.

Costs/Benefits of Project: The primary benefit of this project is short and long term protection of suitable nest trees for the Muskgrave Creek bald eagles. Risks of both insect attack and catastrophic fire will be significantly reduced. Based on tree mortality process in bald eagle territories on Upper Klamath Lake, it is very likely that all suitable nest trees will be lost to western pine beetle infestation in the near future if current stand density is maintained.

This project may cause short-term reduction in suitable habitat for other LS/OG dependant species. Project specifications will be designed to preserve stand structure suitable for nesting by northern goshawks, but marginal for northern spotted owls. The amount of suitable nesting/roosting habitst in the adjacent Muskgrave spotted owl territory will be reduced, but it is unlikely that the current stand density in the upslope area where the eagles nest could be sustained over time. Without project implementation, current rates of insect- and disease-induced overstory mortality in the general area are likely to reduce habitat suitability in the forseeable future.

2) Bogus Burn Plantation Thinning
The 1957 Bogus Fire removed ponderosa pine and mixed conifer forest at the north end of the LSR adjacent to the Klamath River canyon (Figure 13). Following this high-intensity burn, large openings were reforested with ponderosa pine, regardless of the original forest cover. Currently these plantations are densely stocked and relatively uniform in structure. Fire potential is moderate to high in these plantations, largely due to ladder fuels in the lower limbs of the pines. Few other tree species are present, and natural regeneration is limited due to close spacing of pines.

Criteria met: Objective 1. Accelerate the development of future late successional forest habitat; a. Treatment of existing young stands capable of developing into late-successional forest.

techniques: Hand and mechanical thinning to variable spacing ranging from 16 to 25 feet, with 40' spacing on some drier pine sites. Thinning will target smaller-diameter trees, no selection for deformed trees. Any Douglas-fir, incense cedar or hardwoods would be retained. Spacing will be variable, to create a range of conditions in the future stands. Approximately 10-15% of the area will remain untreated. All current large woody material in the stands will be retained, some additional material (boles of thinned trees) may be left on-site if CWM is lacking. Felled material will be removed from site - this may be accomplished by sale of tree boles or chips, remaining material will be hand-piled and burned.

timing: It is desireable to begin thinning in 1997, with the objective of at least 200 acres/year for 4 years.

Cost:Benefit The stands proposed for treatment do not currently provide suitable habitat for late-successional species, and are not likely to develop into late-successional habitat within an acceptable timeframe. Fire risk is increasing, and there is little diversity or production of large-tree characteristics. A variable thinning prescription will allow increased growth rates, and small openings will foster colonization of the site by Douglas-fir.

3) Juanita Lake mixed conifer restoration
The east-facing slopes of Ball Mountain (Figure 13) were severely burned in a fire in the 1920s. Currently, this area supports a mosaic of small patches of late-successional Mixed Conifer forest, interspersed in a matrix of young white fir. The early mature (10 - 16" dbh) white fir are currently at extremely high density, and are experiencing rapid mortality caused by Scolytis. Stress on mature stands is expressed as pine beetle attacks on ponderosa pine; numerous overstory pines have died since 1992. The rapid accumulation of fuels in this area is likely incressing fire risk into the High category. In addition, the potential of these stands for development into late-successional habitat is diminishing. This project proposes to apply a variety of prescriptions to these stands to reduce stocking, move species composition towards fire-resistant species, and develop stands with sustainable late-successional characteristics.

Criteria met: Objective 1. Accelerate the development of future late successional forest habitat; a. Treatment of existing young stands capable of developing into late-successional forest. Objective 3. Protect existing late-successional forest; a. Treatment of existing LSF stands to reduce stress and risk of insect outbreaks. Objective 4. Improve connectivity, and Objective 5. Improve northern spotted owl habitat.

Techniques: In dense young- to early mature white fir stands; hand thinning from below, leaving all trees > 18", and all ponderosa pines and cedars. Spacing will be variable, ranging from 15 to 35 feet depending on tree sizes and species. Dripline thinning may be employed to protect existing mature overstory and predominant pines and Douglas-fir. Overall prescription will be to maintain a mosaic of stand densities, favoring cedar, pine and Douglas-fir, with all current large-tree character retained. Small patches of sapling/pole white fir may be removed to create openings for regeneration of ponderosa pine. Dense untreated stands will comprize 10-15% of the project area. All existing coarse woody material will be retained on-site. Merchantable material will be removed and sold, some smaller material may be sold as chips. Slash will be hand-piles and burned, or sold as chips.

Timing: This project should be planned during 1996 and 1997, with implementation beginning in 1997. Thinning units should be prioritized and treated over a 2-3 year period.

Cost:Benefit Analysis: Treatment of stands on the slope above Juanita Lake may affect suitable habitat for northern spotted owls, however the young white fir currently occupying the site typically does not provide high-quality habitat for this species. Single owls have been detected in this area, but occupancy by a pair is unlikely. Project design will mitigate or minimize effects to owls by retaining all patches of late-successional habitat, and by intermediate prescriptions that maintain 60% canopy closure in portions of the project area. Loss of suitable owl habitat must be considered in light of the rapid loss of overstory trees that this area is currently experiencing, and the increased risk of stand-replacing fire in the near future. Thinning of stands will reduce inter-tree competition for moisture, and reduce future mortality and fuel accumulation. In the long-term, development of stands of fire-adapted species such as Douglas-fir, ponderosa pine and incense cedar will allow sustainable late-successional structure preferred by spotted owls in the California Cascades.

4) Lodgepole Pine Thinning
Burnt Camp, Lodgepole Station areas
Lodgepole pine stands in the Burnt Camp/ Lodgepole Station (Figure 13) area exhibit extremely high density and poor structural characteristics. Many older stands have small diameter (4-7") caused by competition, insect-induced mortality in these stands frequently exceeds 50%. High stocking and elevated fuel loads create a high potential for stand-replacing fire, and place adjacent late-successional stands, including occupied spotted owl and goshawk habitat, as risk. In addition, opportunities for development of high-quality late-successional lodgepole pine habitat are being lost as these stands fade.

citeria met: Objective 3, protect existing stands of late-successional forest; b. Reduce risk of stand-replacing fire.

techniques: hand or mechanical thinning from below, retaining all trees > 10"dbh and other species such as red fir, ponderosa pine, and mature white fir. Desired spacing will range from 8-16 feet, with dense unteated patches comprizing 10-20% of the project area. All harvested material to be removed from site and sold as fuelwood, poles or chips. Small diameter fuels would be hand-piled and burned, large diameter fuels would be left on-site.

timing: project planning during 1996 and 1997, implementation during 1998 and 1999.

5) Shovel Creek Thinning

Several large stands of mid-mature true fir and mixed conifer on the eastern side of the Shovel Creek drainage (Figure 13) are densely overstocked and exhibit signs of suppression (slow growth, mortality, high fuels accumulation). Stand structure is highly variable, and portions of the project area may be considered late-successional. Currently, diameters within these stands range from 8 to 16 inches, with occasional larger overstory trees remaining from previous fires. Age of intermediate trees ranges from 80-120 years, but diameter growth has been limited by suppression. These stands do not currently provide suitable habitat for spotted owls or northern goshawks.

criteria met: Objective 1. Accelerate the development of future late-successional forest habitat, criterion a; treat existing forested stands capable of developing into late-successional forest. Objective 3b. Protect existing stands of late-successional forest, criterion c; Treat adjacent stands that exhibit high/moderate fire potential.

techniques: mechanical and hand thinning from below, to variable spacing dependant on slope position and species composition. In stands containing Douglas-fir, spacing should average 20-25 feet (range untreated - 40 feet), with Douglas-fir, ponderosa pine and incense cedar favored. All larger trees will be retained, as will all snags and down logs. The objective will be a fine-scale mosaic of variable density, with discontinuous fuels and a more open understory. In stands dominated by true firs, desired stand density will be higher, with spacing ranging from 15-20 feet. Small-diameter fuels will be piled and burned, or broadcast burned if prescription can be met.

timing: This project is of moderate priority, with implementation scheduled in 1998 and 1999.

cost:benefit: This project is intended to reduce intertree competition and stress, and subsequently reduce the potential for insect epidemic and excessive tree mortality. These processes are occurring in adjacent stands and are likely to affest stand structure in the near future. In addition, reduction of excessive ladder fuels and small woody material will result in lower fire behavior potential, and allow for prescribed fire in this area. Currently, the cumulative risk of stand degradation through catastrophic fire is moderate, and risk to insect-induced

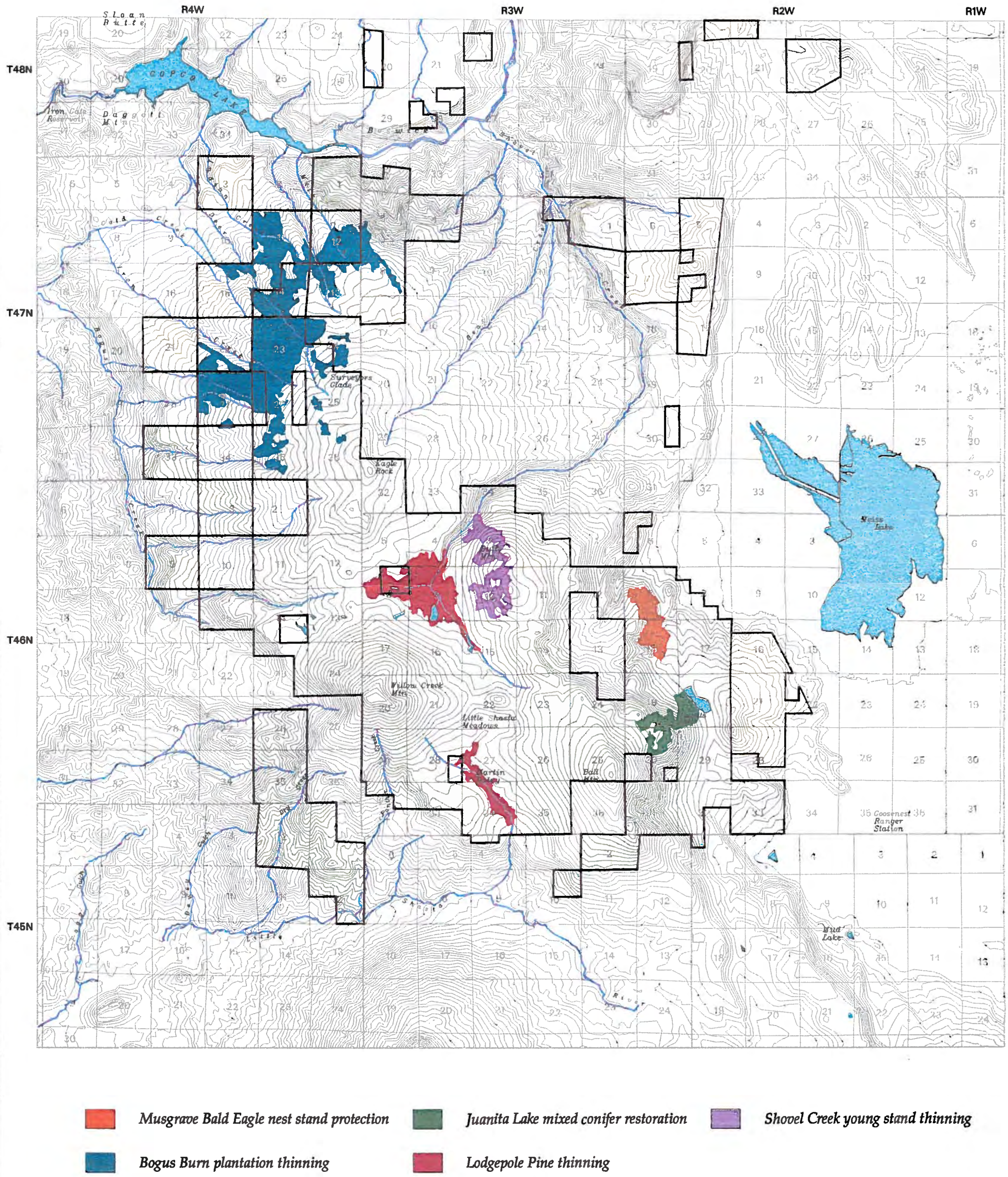


FIGURE 12. Locations of terrestrial projects identified in implementation schedule.

mortality is high. Implementation of this project is designed to maintain dense areas in sufficient quantity to provide suitable habitat for northern spotted owls, and is not expected to dramatically reduce habitat availability for this species in the short (5-20 years) term. In the longet term, thinning will increase tree growth and accelerate development of desireable stand structure such as large-diameter trees and snags, and eventually large-diameter logs.

6) Inventory of Road-Related Sediment Sources and Channel Obstructions-

criteria met: 2-b, 2c, 2d
techniques: Utilize results of Goosenest LSR to design inventory and prioritize watersheds; will require engineering/soils/geologic/hydrologic skills.
timing: Summer 1996

7) Contract Preparation and Implementation- (Develop and Implement a Contract for a Watershed Restoration Project to Reduce Road-Related Sediment and Improve Channel Crossings as Needed)-

criteria met: 2-b,2-c,2-d
techniques: Prepare contract to correct problems identified in item 6 above; will require engineering skills plus some soil-geology/hydrology.
timing: Prepare contract in Fall, 1996; implement in summer 1997.

8) Inventory Meadow Associated Stream Reaches- Determine seral state of meadow associated stream channels using vegetative and channel features to determine trend. Develop implementation plan and schedule which identifies and prioritizes treatments, including likelyhood of success. Where possible utilize existing habitat inventory information.
criteria met:
techniques: implementation plan will require fisheries skills plus range/soil/geology/hydrology.
timing: Conduct field inventories summer 1996, prepare plan in Fall 1996; initiate implementation of treatments in summer 1997.

10) Harris Creek Road Improvement - Opportunities exist for reducing the impacts created by the main road in Harris Creek. It is insloped with much of it parallelling in close proximity to the stream. This has altered the normal hydrologic pattern of this drainage. It is also a main sediment delivery problem due to the erosion delivery directly to the creek. Restoration such as outsloping and asphalt surfacing will help restore hydrologic function and sediment delivery.
criteria met:
techniques: implementation plan will require fisheries skills plus engineering/soil/ geology/hydrology.
timing: Conduct inventory summer 1996, prepare plan in Fall 1996; initiate implementation of treatments in summer 1997.

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APPENDIX A FIGURES

Figure A-1 **Distribution of average annual precipitation (rainfall and snow) for the Goosenest LSR assessment area.**

Figure A-2 **Historic (pre-dam) distribution of native fish assemblages within the Goosenest LSR assessment area.**

Figure A-3 **Soil cover recommendations for prescribed burns. Based on soil mapping units and slope classes.**

Figure A-4 **Riparian features, using interim Record of Decision (ROD) definitions, by watershed for the Goosenest LSR assessment area.**

Figure A-5 **Cumulative watershed effects**

Figure A-6 **Succession of seral states for alluvial valley-bottom and wet meadow stream channels.**

Figure A-7 **Low-gradient stream reaches within the Goosenest LSR assessment area.**

Figure A-8 **Erosion hazard rating map of topsoil within the Goosenest LSR assessment area.**

Figure A-9 **Erosion hazard rating map of subsoil with roads and road/stream intersects.**

Figure A-10 **Landslide hazard map**

Figure A-11 **Distribution of general geomorphic features within Goosenest LSR assessment area.**

Figure A-12 **Distribution of bedrock types within the Goosenest LSR assessment area.**

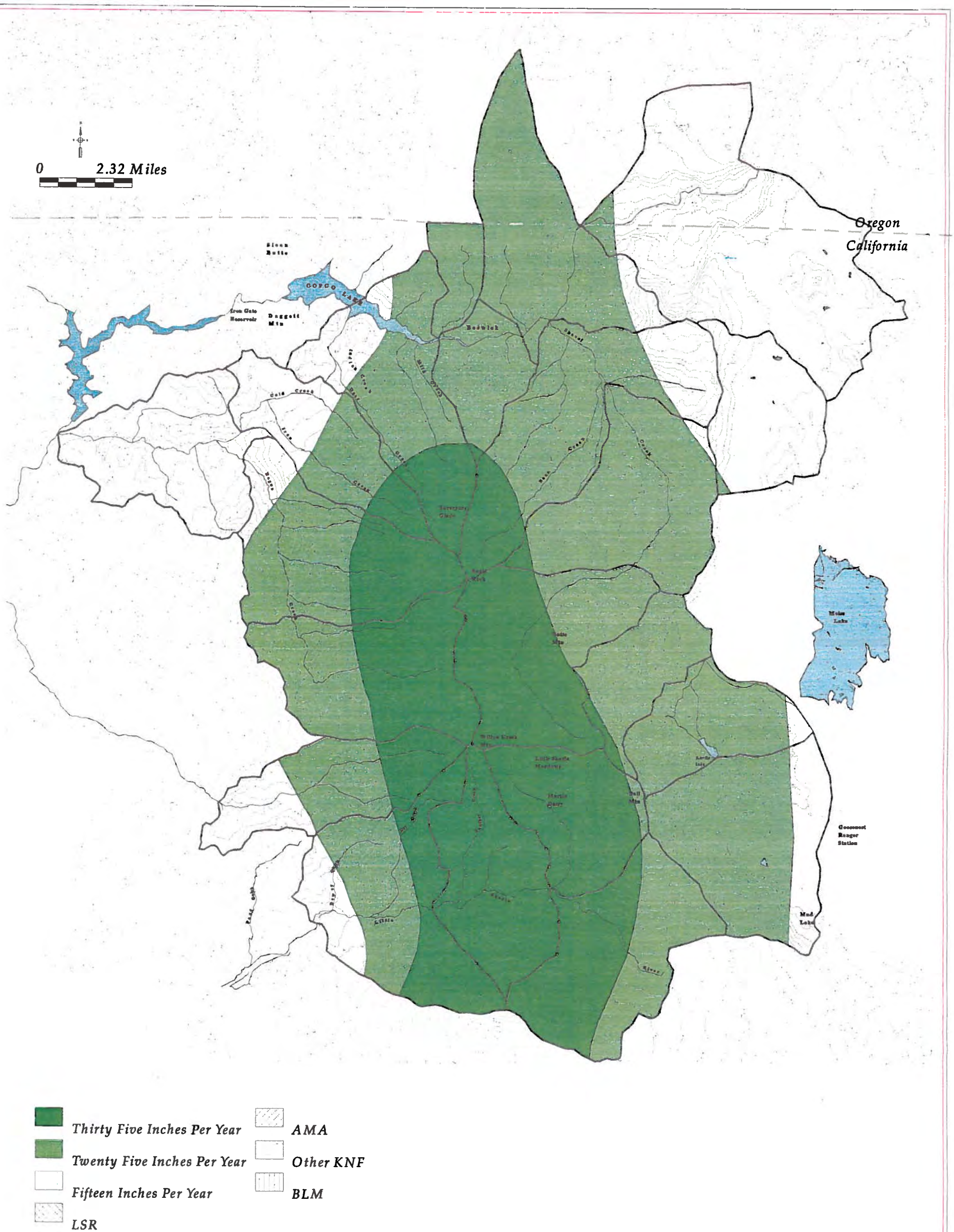
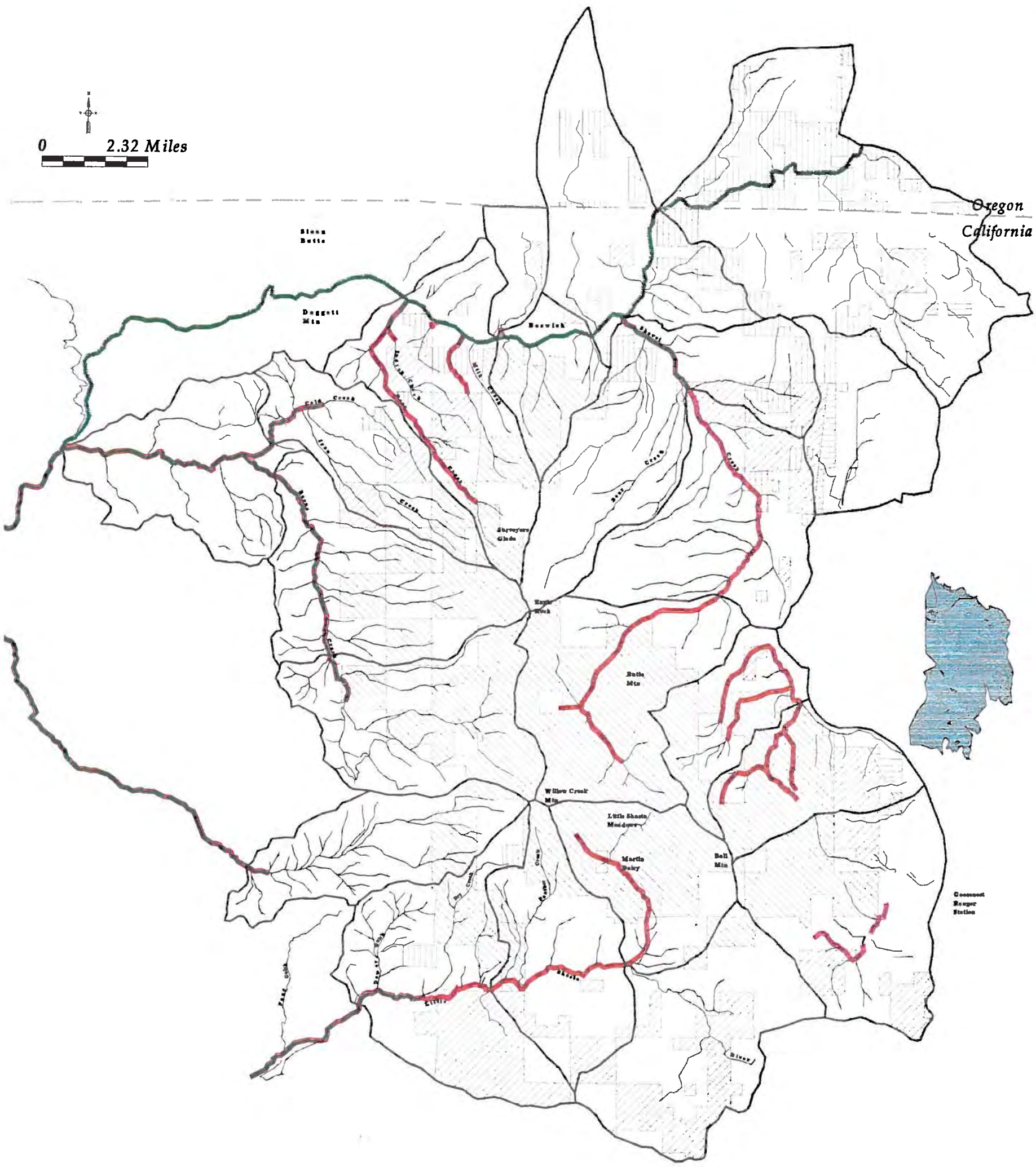


FIGURE A-1. Distribution of average annual precipitation (rainfall & snow) for the Goosenest LSR.



LSR
AMA
Other KNF
BLM

Tributary Community
Klamath River Community
Anadromous Species

FIGURE A-2. Historic (pre-dam) distribution of native fish assemblages within the Goosenest LSR assessment area

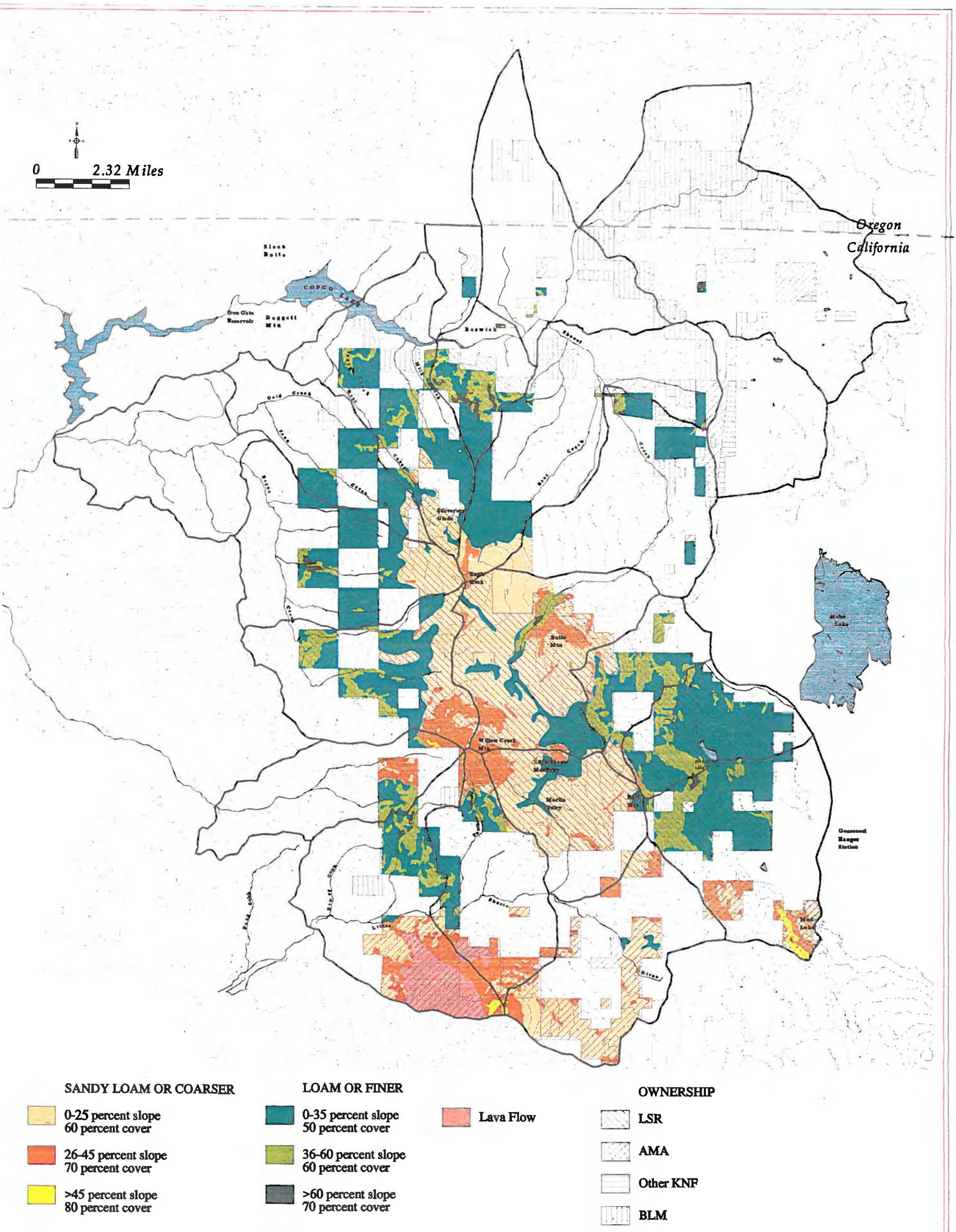


FIGURE A-3. Soil cover for prescribed burns. Based on soil mapping units and slope classes.

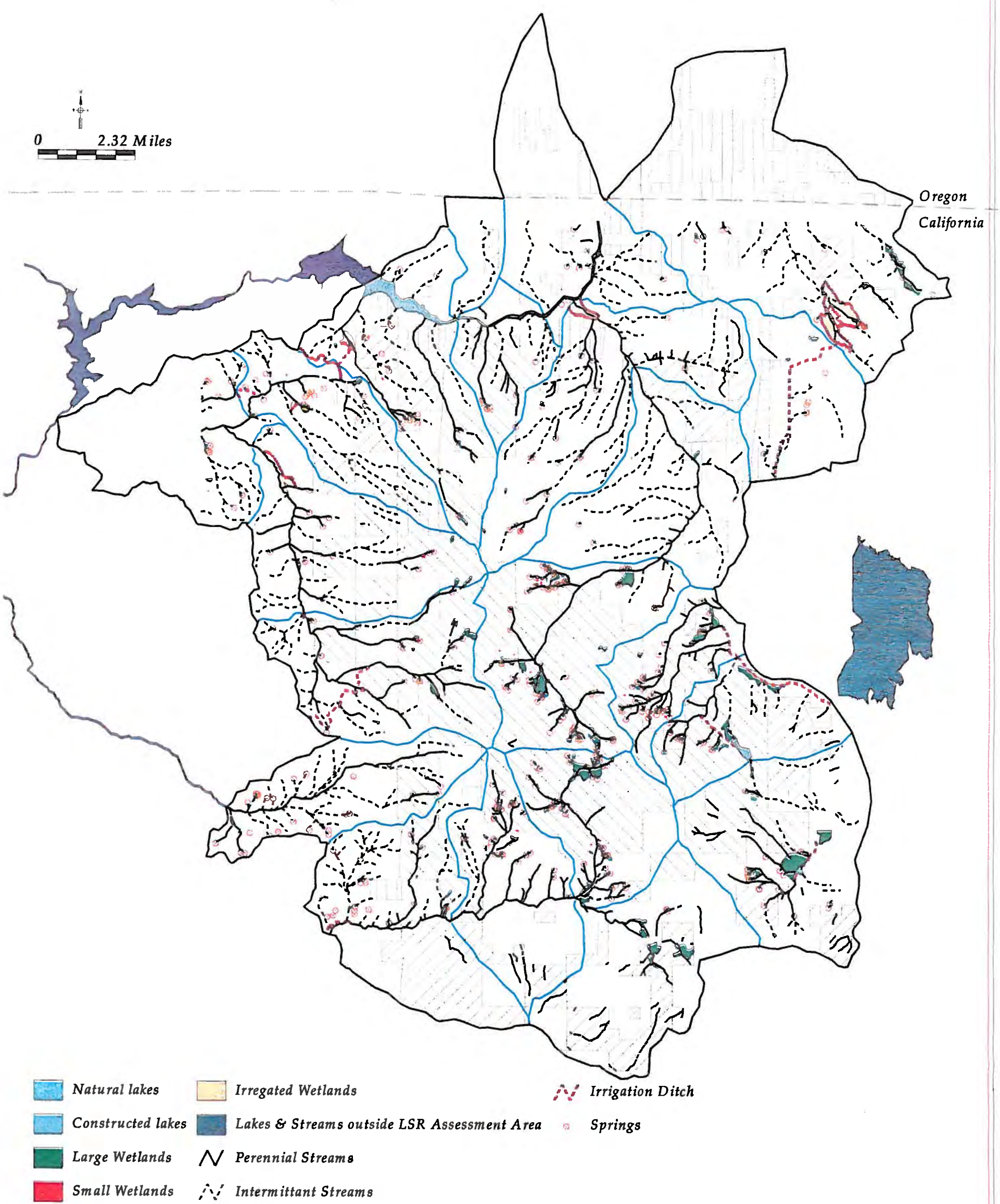


FIGURE A-4. Riparian features, using interim Record of Decision (ROD) definitions, by watershed for the Goosenest LSR assessment area

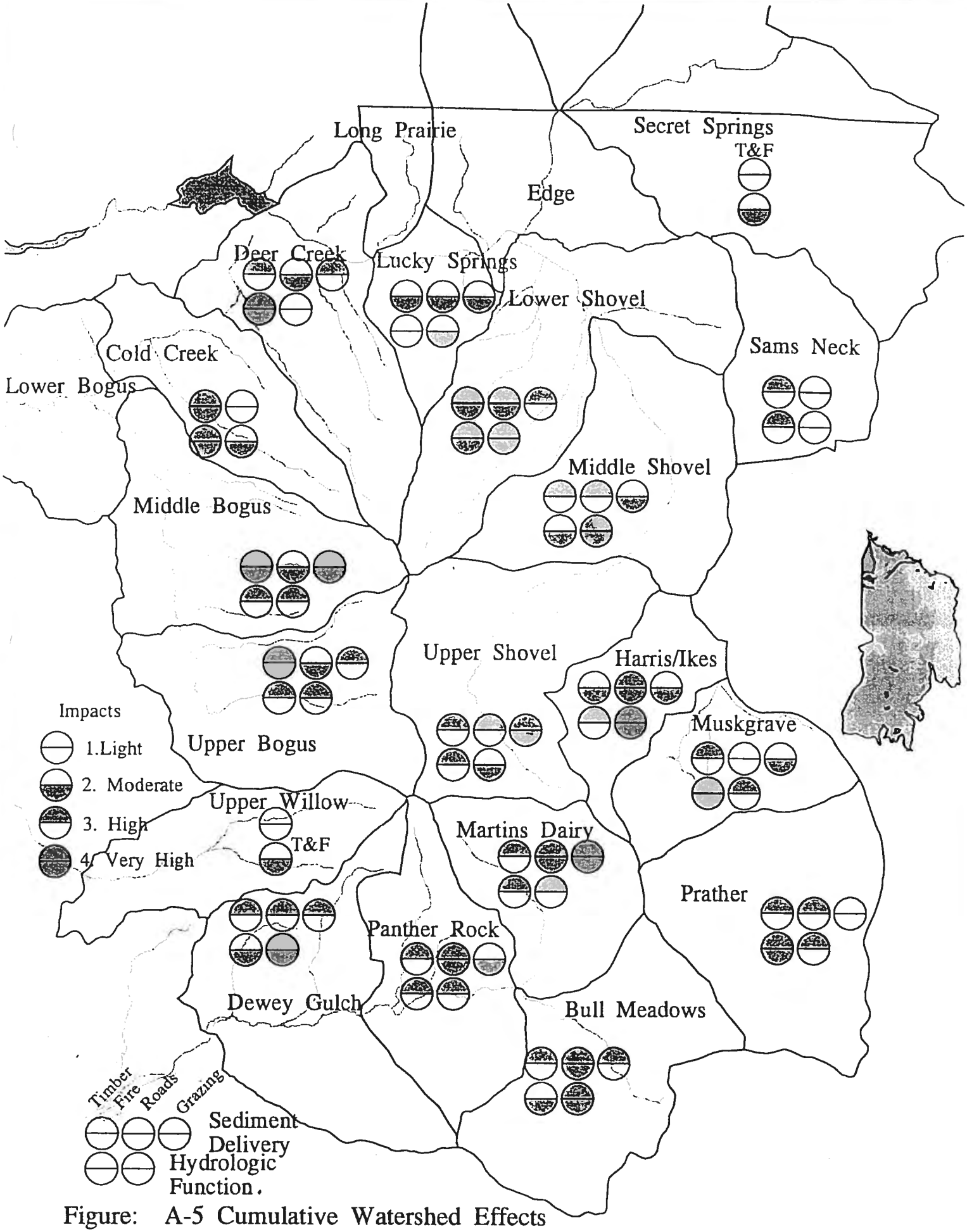
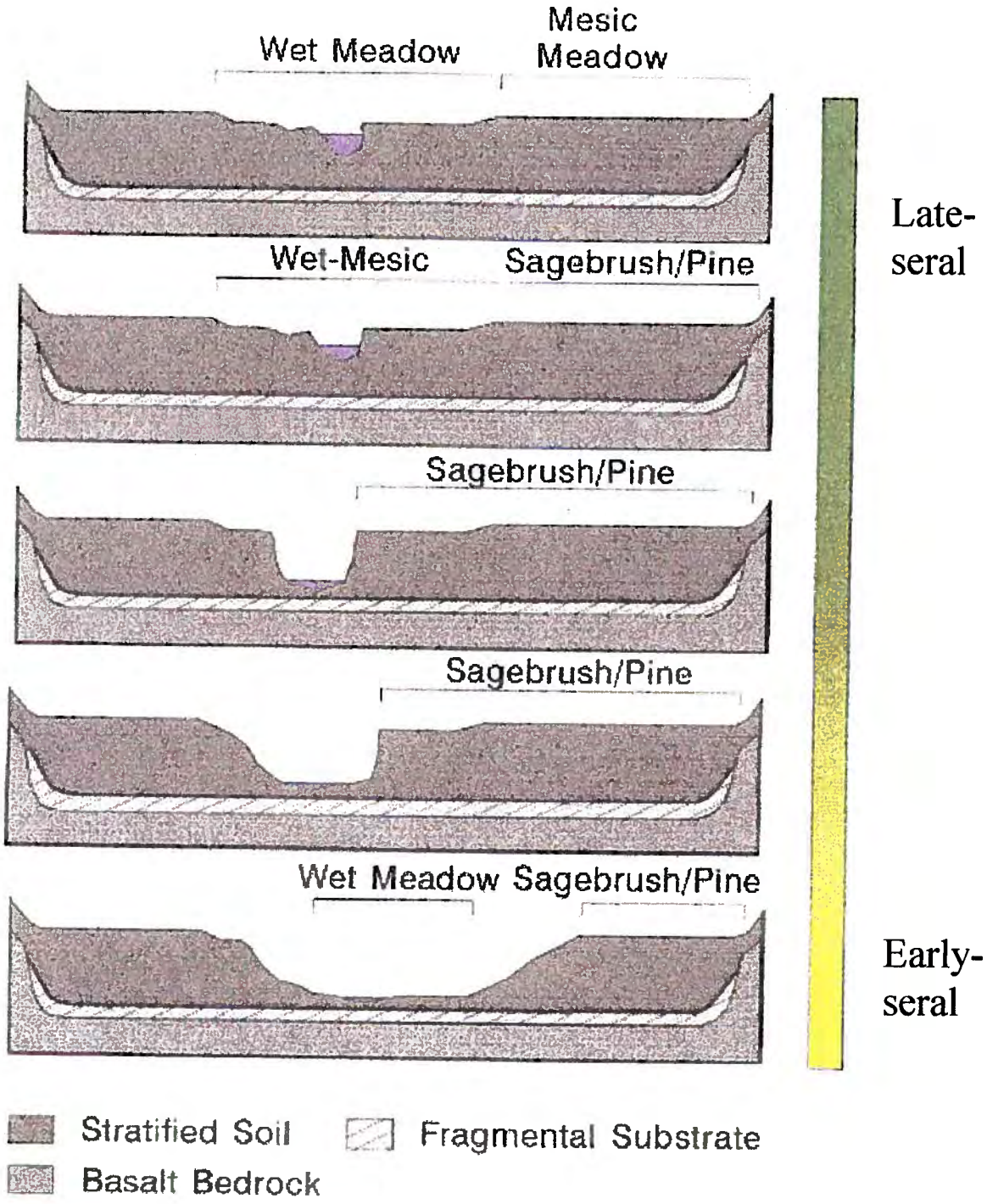
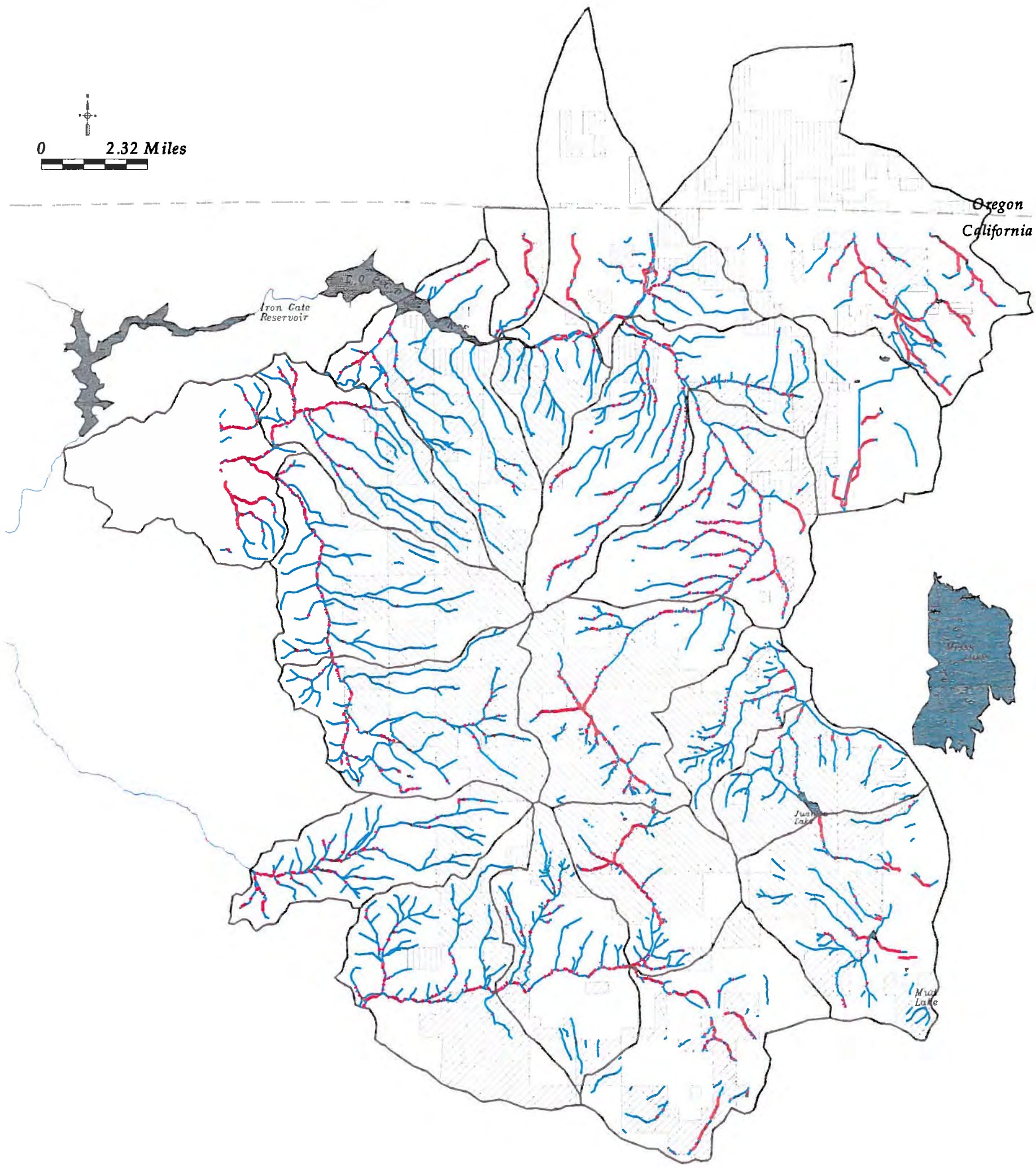


Figure: A-5 Cumulative Watershed Effects



Appendix A-6. Succession of states for alluvial valley-bottom wet-meadow and stream channel (from BLM 1993).



Low Gradient Aquatic Reaches

FIGURE A-7. Low Gradient (<5% Slope) stream reaches within the Goosenest LSR Assessment Area.

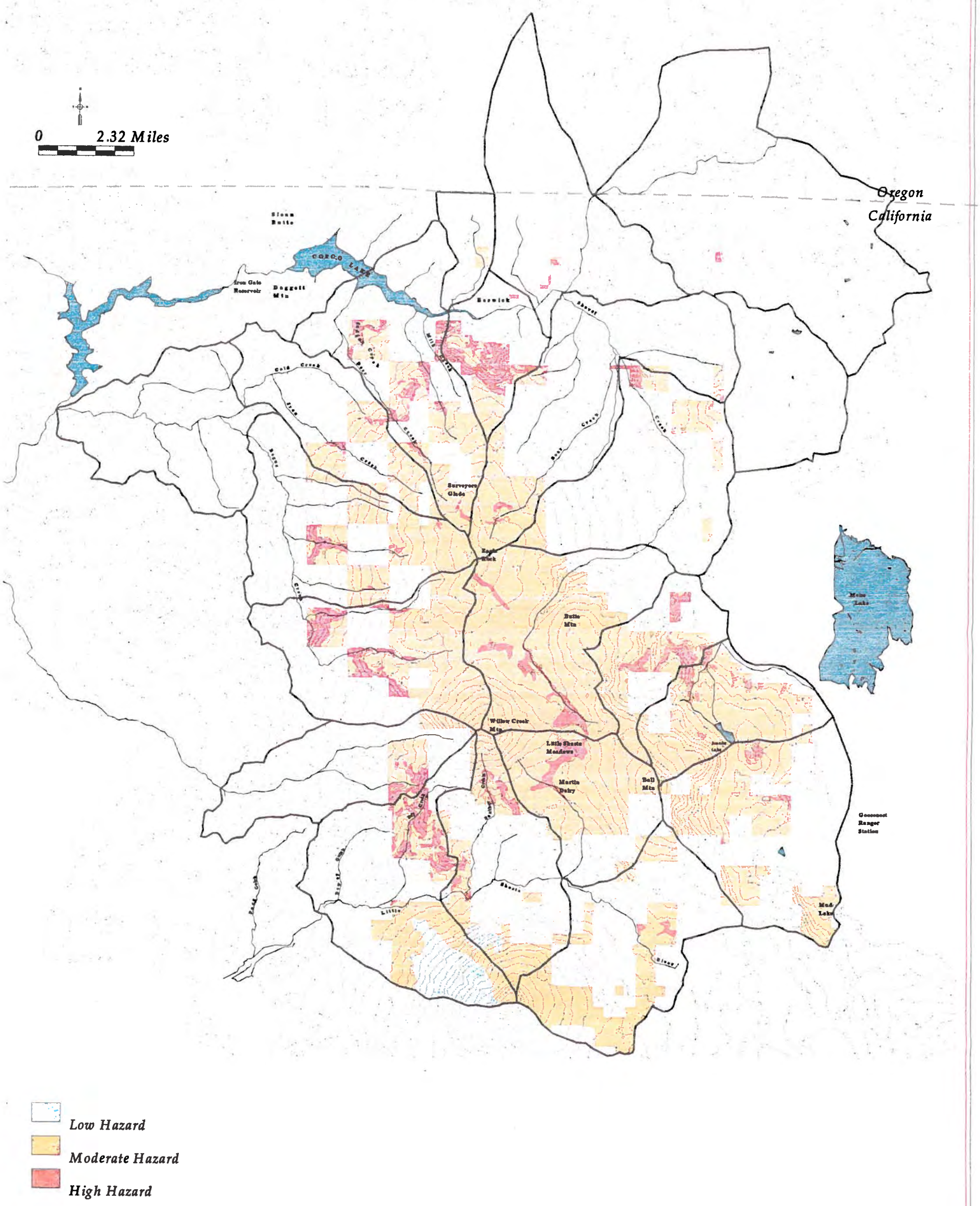
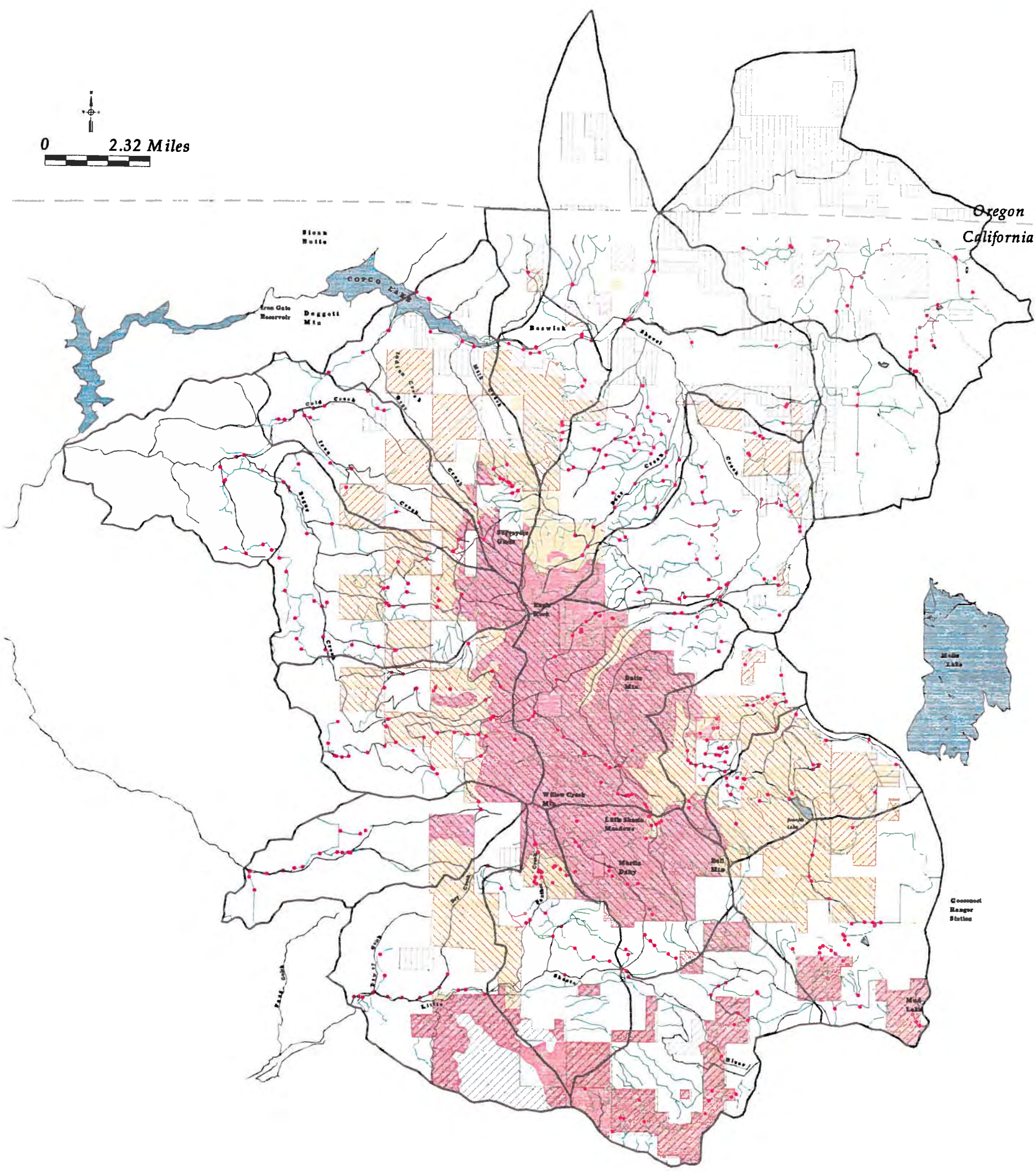


FIGURE A-8. Erosion hazard rating of topsoil.



Low Hazard
Moderate Hazard
High Hazard
LSR
AMA
Other KNF
BLM
Surfaced Roads (Source: TIS)
Unsurfaced or Unknown Surface Roads (Source: TIS)
Road/Stream Intersects

FIGURE A-9. Erosion hazard rating map of subsoil with roads and road/stream intersects.

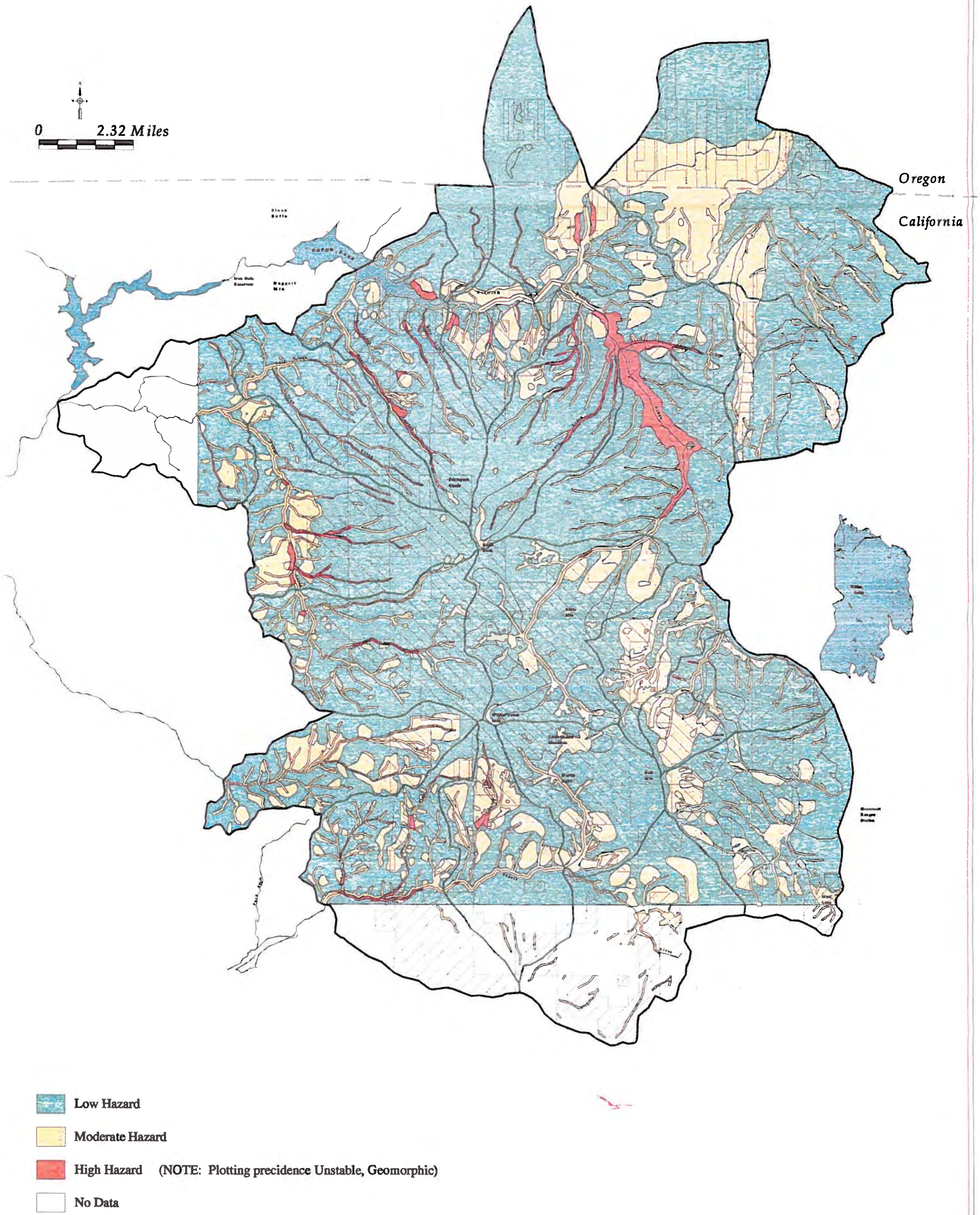


FIGURE A-10. Landslide Hazard Map - displays potential for slumps, and earthflows as well as shallow debris flows. HIGH HAZARD includes active landslides, toe zones of slumps, earthflows and translations, and inner gorges; MODERATE HAZARD includes landslide deposits, headwalls and the remainder of the riparian reserve which is not included in active slides, toe zones, or inner gorge; LOW HAZARD includes glacial deposits, alluvial deposits, hillslopes, and lake deposits.

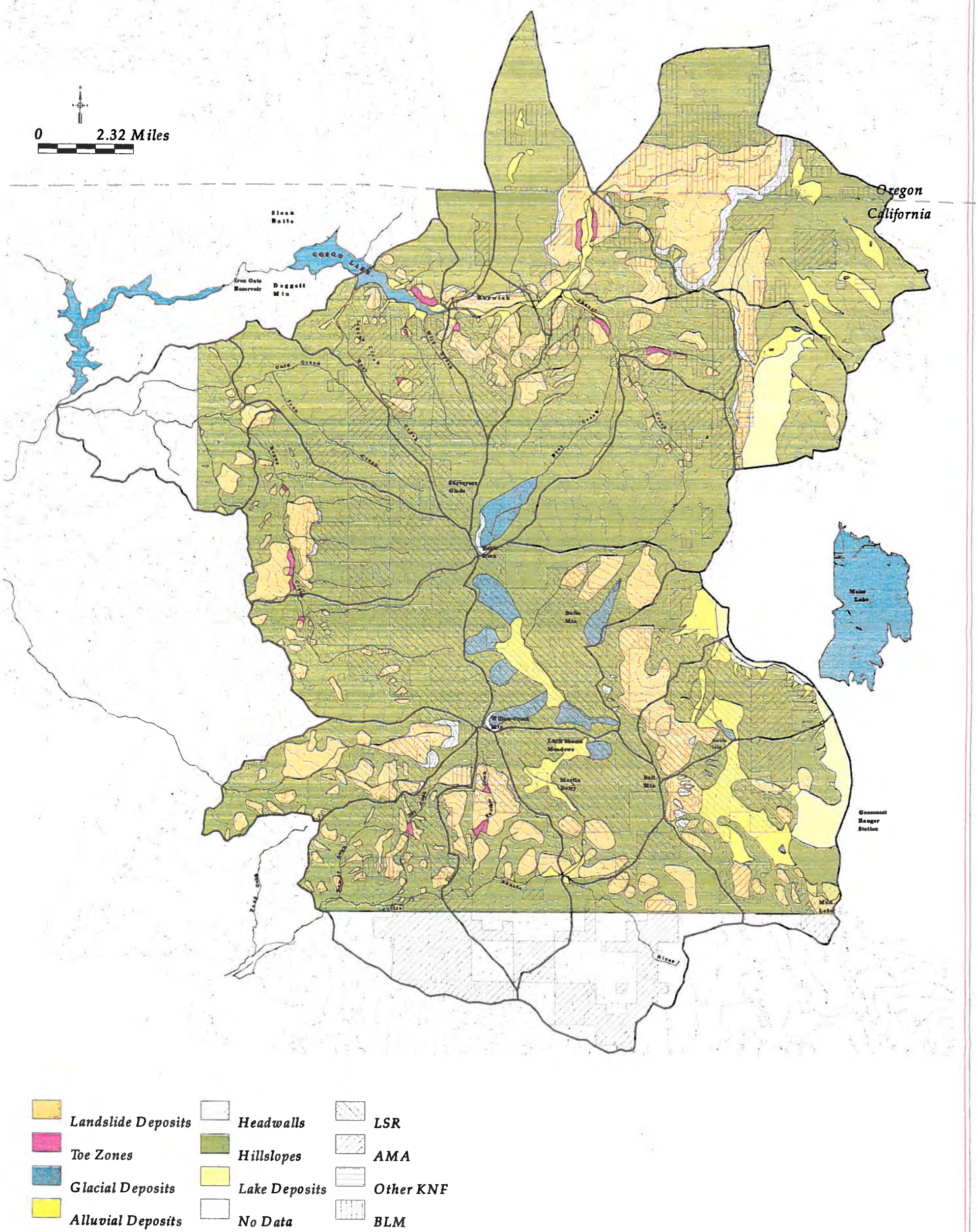


FIGURE A-11. Generalized Geomorphic Map - LANDSLIDE DEPOSITS include slumps, earthflows, translations, and undifferentiated landslides & glacial deposits; TOE ZONES are steep areas along the lower margin of slumps, earthflows or translations; GLACIAL DEPOSITS consist of undifferentiated glacial moraines and talus; ALLUVIAL DEPOSITS include stream alluvium, alluvial fans and fluvio-glacial deposits; HEADWALLS include all landslide source scarps, and glacial cirques; LAKE DEPOSITS include ancient lake deposits as well as modern lakes; HILLSLOPES include the remainder of the landscape not in one of previous categories.

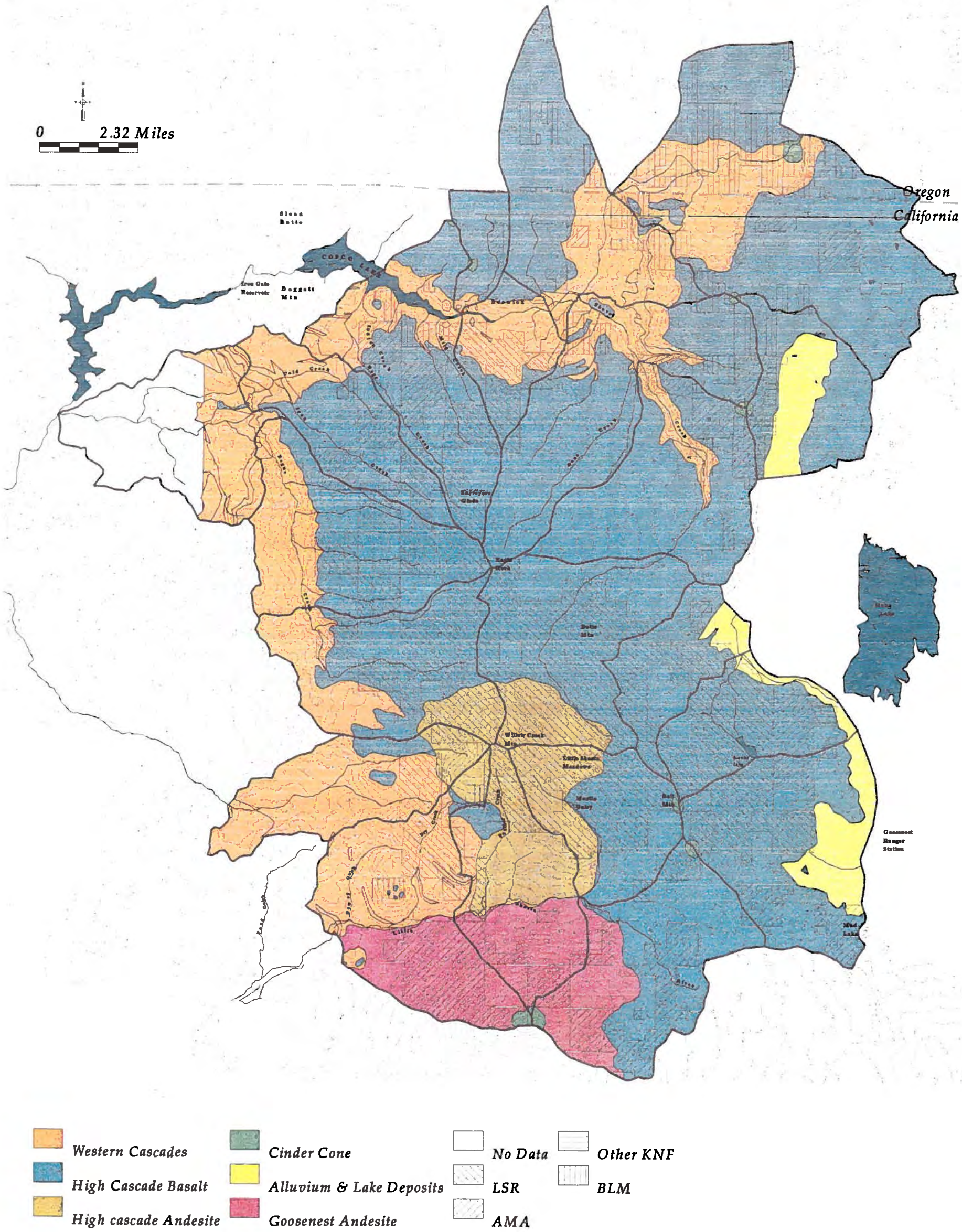


FIGURE A-12. Generalized bedrock map - WESTERN CASCADES includes a variety of Miocene and older volcanic rock, including andesitic, basaltic, and dacitic lavas, andesite & basalt plugs, dikes & sills andesite tuff & breccia, rhyolite domes, and rhyolite & dactic tuff and breccia; HIGH CASCADE BASALTS includes Pliocene and Quaternary basalt flows; HIGH CASCADE ANDESITE consists of Pliocene andesite of Willow Creek Mountain; CINDER CONES consists of Quaternary and Pliocene cinder cones as well as Quaternary pyroclastic deposits; ALLUVIUM & LAKE DEPOSITS consist of stream & valley alluvium plus lake deposits; GOOSENEST ANDESITE consists of the Quaternary andesite flows on the north flank of Goosenest Mountain.

APPENDIX B: FIRE PLAN AND ANALYSIS

The role of fire is an important management issue. This LSR has a long history of large fires. In 1926 a large wild fire consumed 15,484 acres. In 1957 the Bogus fire consumed approximately 6,000 acres within the LSR and approximately 4,000 acres to the north outside the LSR. Developing strategies which reduce risk to future large scale disturbances while maintaining and promoting late-successional forest conditions will be the emphasis of this assessment.

In the Klamath Province, prior to fire suppression, fire was more frequent, less intense and an integral part of the internal dynamics of a typical stand. The introduction of prescribed fire to the LSR will help encourage the processes and attributes that define late-successional and old-growth ecosystems. It is expected and even desirable to have low to moderate intensity fires burn in LSRs. Low intensity fires reduce fine fuels and ladder fuels, create a seedbed for a diversity of herbaceous plants, and create a patchy understory open enough for spotted owl movements. Moderate intensity fires are desirable if they create small openings in the canopy of one to five acres in size. This allows for regeneration of forest stands to begin and creates snag patches and concentrations of down woody debris which are important prey base habitats. Burn openings are most desirable if they occupy only a small percentage (5-10%) of the stands providing habitat.

In addition, the introduction of a fire cycle similar to that which occurred in pre-suppression times, will reduce the risk of catastrophic, stand-replacing fires. Large stand replacing, high intensity fires are not desirable within LSRs. Management tools, such as underburning, salvage logging, and other fuel reduction methods should be used to reduce the possibility of this kind of fire occurring. Geographic features such as slope, aspect, soil erodibility, and elevation, as well as fuel types need to be examined and priorities for an active fuel reduction program established. It is preferable to treat large blocks, greater than 200 acres, of vegetation. Treatments need to ensure that fuel continuity is variable over the landscape. It is not desireable to have the same fuel condition found over large blocks of the landscape. The goal of the burning program should be to break up large blocks of moderate fuel consentrations and maintain the current low fuel rating for the balance of the LSR.

Fuel treatments need to be balanced with other LSR objectives. Lands adjacent to LSRs, with moderate fire hazards should be examined for possible treatments to prevent catastrophic fires. Areas downslope or downwind of prevailing wind patterns should be especially examined.

FIRE MANAGEMENT PLAN

The goals described in the Klamath National Forest Land and Resource Management Plan (1994) are to manage wildland and prescribed fire to reduce unacceptable fuel buildups, which will reduce the severity of future wildfires. Use of prescribed fire, either by itself or in conjunction with other fuels reduction methods, is considered the appropriate method in all management areas. Prescribed natural fire is appropriate in Wilderness and Late-Successional

Reserves.

The LSR contains about 0 acres (0%) of High Fire Behavior Potential. Approximately 7,633 acres (20%) of the LSR is in a Moderate Fire Behavior Potential and 30,822 acres (77%) is in Low Fire Behavior Potential and Approximately 1,360 acres (3%) has no fuel rating. By overlaying identified resource concerns with the Fire Behavior Potential Map (Figure B-3), management opportunities aimed at reducing fuel loadings may be identified. With proper use of prescribed fire and other fuels reduction methods, High Fire Behavior Potential can be reduced, resulting in greater assurance of long-term maintenance of the desired conditions, increased safety to firefighters, and increased effectiveness of fire suppression efforts.

The goal of wildfire suppression in this LSR is to limit the size of all fires while utilizing minimum impact suppression methods in accordance with guidelines for reducing the risk of large-scale disturbances. The goal of the precribed fire program in this LSR is to utilize an aggressive precribed fire program to maintain long-term habitat quality and ecological process within LSRs. When this LSR assessment is approved and abopted some natural fires may be allowed to burn under prescribed conditions. A prescribed burn plan will be developed for specific portins within the LSR that dicribes under what conditions Prescribed Natural Fire (PNF) may be utilized.

Safety is the highest priority for suppression efforts. All actions will be anchored to the standard fire orders and the "watch out" situations. Safety will be the responsibility of everyone involved.

GUIDELINES FOR LOW IMPACT FIRE SUPPRESSION ARE AS FOLLOWS:

For hot-line and ground fuels, allow fire to burn to natural barriers. Use cold-trail, wet line, or a combination thereof, when appropriate. If constructed fireline is necessary, due to fire behavior and/or fire potential, construct the line wide and deep enough to check fire spread. Use burning-out as a fire suppression tool. Minimize bucking and cutting of trees to establish fireline; build lines around coarse woody debris. Utilize dozers only on less than 30% slope. Whenever possible, utilize excavators such as rubber-tired skidders, rather than tracked vehicles.

For hot-line involving aerial fuels, remove only the limbs that have potential for spreading fire outside the fireline. Before felling trees, consider allowing ignited trees or snags to burn out. Safety measures (LCES) and communication with suppression forces are essential if this is allowed to occur. Identify these hazard trees with flagging and/or a lookout. If these burning trees or snags pose a serious threat of spreading and igniting fire elsewhere, extinguish fire with water or dirt whenever possible. If they are causing safety and/or serious control problems, then felling is permissible. If trees have to be cut, align saw cuts to minimize visual impact from more heavily-traveled corridors. Felling of these trees should be the last resort. Surviving trees that have a defect caused by fire can provide valuable wildlife habitat. Consequently, all standing live trees should be retained.

Maps for known spotted owl activity centers and bald eagle nesting areas are available on the District. Minimum impact suppression techniques will be used in all these sites. Aviation and suppression activities will be monitored closely for any environmental effects to these areas.

Guidelines for mop-up of ground fuels will include a minimum amount of spading of hot areas. "Cold trail" charred logs near the fireline; extinguish large woody debris and duff as rapidly as possible. Instead of bucking up large logs, attempt to roll the logs to extinguish the fire. Return the logs to their original position after checking to make sure the area is out. When possible, utilize fold-a-tanks, instead if draft pumping from creeks. If pumps are utilized, use absorbent pads underneath them. Utilize infrared detection to locate spots. This will assist in mop up and will reduce the risk of the fire re-igniting and spreading.

To mop up aerial fuels, remove or limb only those fuels which, if ignited, have the potential to spread fire outside the fireline. If burning trees or snags pose a serious threat of spreading fire brands, extinguish fire with water or dirt whenever possible. Ensure safety of suppression crews at all times. If a snag or green tree cannot be extinguished and is a control problem, a snag/tree can be felled. Align saw cuts to minimize visual impacts, cover stumps with dirt after felling.

LOGISTICS

Logistics in the Late Successional Reserves include incident bases, helispots, and heliports. Interdisciplinary teams will propose sites for these facilities, on a watershed basis. Incident bases will not be located within Riparian Reserves. Evaluate the use of short-term impact camps, such as spike or coyote camps, versus the use of longer-term, higher impact incident base camps. Use existing campsites, whenever possible. New site locations should be on naturally-draining areas, such as sites with rocky or sandy soils, or in natural openings surrounded by heavy timber. Avoid locating camps in meadows. When laying out the camp, define cooking, sleeping, latrine, and water supply locations to minimize the number of trails in camp, thus reducing compaction to the site. Adequately mark trails. Ensure that crews do not clear vegetation or dig trenches in sleeping areas. Use fabric ground cloths for protection in high use areas, such as around the cooking facilities. Use commercial portable toilet facilities. Constantly evaluate the impacts, both short and long term, of the camp. Be sure to include rehabilitation of campsites in the rehabilitation plan.

AVIATION MANAGEMENT

One of the goals for Late Successional Reserve managers is to minimize the disturbance caused by air operations during an incident.

Aviation guidelines for Late Successional Reserves stress use of the minimum size helicopter that can do the job and still meet the intended suppression strategy and objectives. If possible, utilize long-line remote hooks, instead of constructing helispots. Do not construct helibases or

helispots within Riparian Reserves. Preplanned helispots and helibases will be determined by an interdisciplinary team on a watershed basis. If an area is needed that is not included in the preplanned map, consider utilizing natural openings or already-impacted areas, such as landings for logging operations, but avoid areas with high visitor use.

During initial attack, fire managers must weigh the use of retardant versus the probability of initial attack crews being able to successfully control or contain a wildfire. If a determination is made that retardant will prevent a larger and more damaging wildfire, then retardant may be used. Retardant or foam will not be dropped on surface waters, in riparian reserves, or on spotted owl and bald eagle nests.

FIRE REHABILITATION

Rehabilitation will be designed to restore conditions of late-successional and old-growth ecosystems. Rehabilitation is a critical need, arising from the impacts associated with fire suppression and the logistics that support it. The process of constructing control lines, transporting personnel and materials, providing food and shelter for personnel, and other suppression activities will significantly impact sensitive resources, regardless of the mitigating measures described above. During rehabilitation efforts, a resource advisor with expertise on Late Successional Reserves will be available.

REHABILITATION GUIDELINES

Pick up and remove all flagging, garbage, litter, and equipment. Dispose of all trash appropriately. Discourage the use of lines constructed for fire suppression as trails, by covering with brush, limbs, small diameter poles, and rotten logs in a naturally-appearing arrangement. Replace dug-out soil and/or duff and obliterate any berms created during suppression efforts. If control lines have been constructed on slopes greater than 5%, build waterbars. Following is a guide for construction of these waterbars:

Trail Percent Grade	Maximum Spacing Ft.
5-15	150
16-25	100
25-65	50
65+	25

Cover these control lines with coarse woody debris.

Where soil has been compacted from construction of incident base camps, helibases, etc., consider sub-soiling and scattering rocks and dead branches, and/or replanting the area with native plants.

POST-FIRE EVALUATIONS

Post-fire evaluation is important for identifying areas that need improvement, formulating different strategies to add to the fire management plan, and assisting in producing quality work in the future. As part of this evaluation, resource advisors and Interdisciplinary Team members will evaluate this plan to ensure that the intent of the Standards and Guidelines in the ROD have been met.

Post-fire evaluation will consist of data collection, documentation, and making recommendations. The evaluation will occur prior to the departure of the overhead team, so that a copy can be placed in the final fire package. A copy of the evaluation will be given directly to the line officer.

FIRE BEHAVIOR POTENTIAL

Forest Service Manual (FSM) Chapter 5105, defines fuel as combustible wildland vegetative materials, living or dead. FSM, Chapter 5150 on fuel management provides direction to evaluate, plan, and treat wildland fuel to control flammability and reduce resistance to control including mechanical, chemical, biological, or manual means including the use of prescribed fire, to support land and resource management objectives.

The objectives of fuels managment are to:

> Reduce fire hazard to a level where cost effective resource protection is possible should a wildfire ignition occur. Fire hazard is the potential fire behavior (intensity and rate of spread) of a fire burning in a given fuel profile and its ability to be suppressed by fire forces.
>
> Reduce the potential fire severity.

Risk Assessment

In quantitative terms, it is difficult to access the risk of wildfire occurring at a specific location within the LSR and it's effects to the LSR without specific burn-day input. There are many factors that determine fire behavior and the final effect of wildfire. Those factors beyond our ability to control include; location of fire starts, multiple starts (lightning), availablity of fire suppression forces, weather, and topography. Fuels and vegetation that support wildfire are the only factors we can manipulate. Lightning is the major source of fire starts in the Klamath mountains. As many as 50 fires can occur with one lightning storm and each can burn separately or they may burn together as one, creating high intensity wildfires. In 1987, and again in 1994, thunderstorms with very little rain or dry lightning set multiple fires that burned thousands of acres and lasted for weeks. Fire recovery activities continue even today. Under these typical conditions, suppression resources are quickly depleted and fire managers are forced to prioritize which fires will receive what type of response.

The Fire Behavior Potential Maps are designed to accurately describe fire behavior and effects using set criteria. If a wildfire occurs outside the 90th percentile, the predicted fire behavor will

increase or decrease based on the actual weather during the burning period. The production rate of fire suppression forces is based on the assumption that they are available to respond in force. If initial attack forces are not immediately available because they are committed to other fires, a fire will burn unchecked until such time as firefighting resources can be assigned to the fire.

To determine Fire Behavior Potential Classes, a crosswalk was used that converts vegetation type to standardized fuel model. Each vegetative type was assigned a predictive fuel model (Anderson 1982). A fuel model is a set of numerical values that describes a fuel type for the mathematical model that predicts rate of spread and fire intensity (Rothermel 1972) for each vegetative type.

Fuel Model Definitions: To represent a site a model is selected that best depicts the the actual fuels that are available to support fire. This means situations will occur where one fuel model represents rate of spread most accurately and another best depicts fire intensity. In other situations, two fuel conditions may exist, so the spread of fire across the area must be weighed by the fraction of the area occupied by each fuel. Fuel models are simply tools to help the user realistically estimate fire behavior.

The prediction of fire behavior has become more valuable for assessing potential fire damage to resources. A quantitative basis for rating fire danger and predicting fire behavior became possible with the development of mathematical fire behavior fuel models. Fuels have been classified into four groups- grasses, brush, timber, and slash. the differences in these groups are related to the fuel load and the distribution of the fuel among the size classes. Size classes are: 0-1/4", 1/4- 1", 1- 3", and 3" and greater.

Fuel models are simply tools to help the user realistically estimate fire behavior. Modifications to fuel models are possible by changes in the live/dead ratios, moisture contents, fuel loads, and drought influences. The 13 fire behavior predictive fuel models are used during the severe period of the fire season when wildfire pose greater control problems and impacts on land resources.

The following is a brief description of each of the 13 fire behavior fuel models.

GRASS GROUP

Fire behavior Fuel Model 1

Fire spread is governed by the very fine, porous, and continous herbaceous fuels that have cured or are nearly cured. Fires are surface fires that move rapidly through the cured grass. Very little timber or shrub is present.

Fire behavior Fuel Model 2

Fire spread is primarily through cured or nearly cured grass where timber or shrubs cover one to two-thirds of the open area. These are surface fires that may increase in intensity as they hit pockets of other litter.

Fire Behavior Fuel Model 3

Fires in this grass group display the highest rates of spread and fire intensity under the influence of wind. Approximately one-third or more of the stand is dead or nearly dead.

SHRUB GROUP

Fire Behavior Fuel Model 4

Fire intensity and fast spreading fires involve the foliage and live and dead fine woody material in the crowns of a nearly continuous secondary overstory. Stands of mature shrubs, 6 feet tall or more are typical candidates. Besides flammable foliage, dead woody material in the stands contributes significantly to the fire intensity. A deep litter layer may also hamper suppression efforts.

Fire Behavior Fuel Model 5

Fire is generally carried by surface fuels that are made up of litter cast by the shrubs and grasses or forbs in the understory. Fires are generally not very intense because the fuels are light and shrubs are young with little dead material. Young green stands with little dead wood would qualify.

Fire Behavior Fuel Model 6

Fires carry through the shrub layer where the foliage is more flammable than fuel model 5, but requires moderate winds, greater than 8 mi per hour.

Fire Behavior Fuel Model 7

Fires burn through the surface and shrub strata with equal ease and can occur at higher dead fuel moistures because of the flammability of live foliage and other live material.

TIMBER GROUP

Fire Behavior Fuel Model 8

Slow burning ground fuels with low flame lengths are generally the case, although the fire may encounter small "jackpots" of heavier concentrations of fuels that can flare up. Only under severe weather conditions do the fuels pose a threat. Closed canopy stands of short-needled conifers or hardwoods that have leafed out support fire in the compact litter layer. This layer is mostly twigs, needles, and leaves.

Fire Behavior Fuel Model 9

Fires run through the surface faster than in fuel model 8 and have a longer flame length. Both long-needle pine and hardwood stands are typical. Concentrations of dead, down woody material will cause possible torching, spotting, and crowning of trees.

Fire Behavior Fuel Model 10

Fires burn in the surface and ground fuels with greater intensity than the other timber litter types. A result of overmaturing and natural events creates a large load of heavy down, dead material on the forest floor. Crowning out, spotting, and torching of individual trees is more likely to occur, leading to potential fire control difficulties.

LOGGING SLASH GROUP

Fire Behavior Fuel Model 11

Fires are fairly active in the slash and herbaceous material intermixed with the slash. Fuel loads are light and often shaded. Light partial cuts or thinning operations in conifer or hardwood stands. Clearcut operations generally produce more slash than is typical of this fuel model.

Fire Behavior Fuel Model 12

Rapidly spreading fires with high intensities capable of generating firebrands can occur. When fire starts it is generally sustained until a fuelbreak or change in conditions occur. Fuels generally total less than 35 tons per acre and are well distributed. Heavily thinned conifer stands, clearcuts, and medium to heavy partial cuts are of this model.

Fire Behavior Fuel Model 13

Fire is generally carried by a continuous layer of slash. Large quantities of material 3 inch and greater is present. Fires spread quickly through the fine fuels and intensity builds up as the large fuels begin burning. Active flaming is present for a sustained period of time and firebrands may be generated. This contributes to spotting as weather conditions become more severe. Clearcuts are depicted where the slash load is dominated by the greater than 3 inch fuel size, but may also be represented by a "red slash" type where the needles are still attached because of high intensity of the fuel type.

Fire Behavior Potential Classes: Each fuel model is run through the BEHAVE program (P.Andrews; C.Chase, 1989). This program uses fuel model, slope, and weather parameters to predict fire behavior and resistance to control for fire suppression purposes. The 90th percentile weather (historical weather data that describes a typical late summer day) from the most representative weather station was used to model late summer afternoons, typical of late July thru early September. All fuel models were run through each of the two slope classes, to determine increases in fire behavior with increased steepness of terrain. Figure 6 displays the Fire Behavior Potential for the Little North Fork/Crapo LSR.

The output of this is a rating of Low, Moderate, or High fire behavior based on flame lengths, which are good indicators of fire line intensity and resistance to control, and/or rate of spread (ROS), which is also a good indicator of resistance to control.

Using the CONTAIN model of BEHAVE, it was determined whether or not a fire with Low Flame Lengths could be contained by the initial attack forces. These runs indicated that given, typical responce times, terrain, fuels, and available forces, a Low rating had to have a ROS <30 chains per hour, for containment to be accomplished during initial attack.

FIRE BEHAVIOR POTENTIAL CLASSES

Low- Flame lengths <4' and ROS <30 chains per hour
Fires can generally be attacked at the head or flanks by firefighters using handtools. Handline should hold the fire.

Moderate- Flame lengths 4-8'
Fires are too intense for direct attack at the head of the fire by firefighters using handtools. Handline cannot be relied on to hold the fire. Equipment such as dozers, engines, water and/or retardent dropping aircraft can be effective.

High- Flame lengths >8'
Fires may present serious control problems, such as torching, crowning, and spotting. Control efforts at the head of the fire will be ineffective.

Weather Data: The following weather parameters were taken from the data collected at the Mt. Hebron weather station from 1973 through 1994. These parameters are representative of 90th percentile weather conditions.

1 Hour Fuel Moisture	3%
10 Hour Fuel Moisture	4%
100 Hour Fuel Moisture	11%

1000 Hour Fuel Moisture	12%
20 Foot Wind Speed	9 Miles Per Hour

MONITORING PLAN

A. Fuel Reduction Projects (includes prescribed burning, manual fuels treatment, and mechanical fuels treatment):

- Complete a post burn evaluation to determine effectiveness of prescribed burn program in reducing wildfire effects and meeting the overall resource objectives.

- Did the project meet the desired results of reducing fuel conditions to a point of flame length < 4 feet and rate of spread < 20 chains per hour?

- Did the project keep within desired soil cover guidelines from the Forest Resource and Land Management Plan?

- Were moderate intensity burns limited to less than 5-10% of the burn area and were patches created less than 5 acres?

- Over large areas, are snag and down woody requirements still being met following treatments?

FUEL REDUCTION: The implementation of a prescribed burn program is designed to reduce the elevated risk that can be attributed to fire suppression activities and the lack of managed fire in the area for the past 70+ years. These activities will provide for resilient and sustainable late successional habitats that currently exist within the LSR. They will also reduce the risk to younger seral stands allowing them to eventually meet the desired characteristics as late successional habitat. Some of the activities will occur within older stands but these treatments will result in greater assurance of long-term maintenance of these older stands, and will not prevent these older stands from playing an effective role within the LSR. These planned activities are consistent with the standards, guides, and reasoning stated on pages C-12-13 under the section titled "East of the Cascades and in the Oregon and California Klamath Provinces."

HYDROLOGIC FUNCTION and CWE: Monitoring of CWE could be more easily facilitated through updating and suplimenting existing spacial (ie., GIS) and non-spacial (ie.,TIS, fish habitat inventory) data layers. Additional information is needed for project-level planning and implementation. However, updating the existing timber harvest data layer could provide a functional tool for watershed and site-level planning. The existing timber harvest data layer may be improved by adding discriptions such as harvest acres by prescription, percent removal, date of removal, stocking, and hydrologic recovery. Similarly, road surfacing type, inslope lengths, and nearness to riparian features needs to be tied to the roads GIS data base. Grazing intensity and impacts needs to be assessed within project RR areas. Channels need to be surveyed using

standard stability ratings. Sensitive streams and RRs will be monitored to assess improvement rates.

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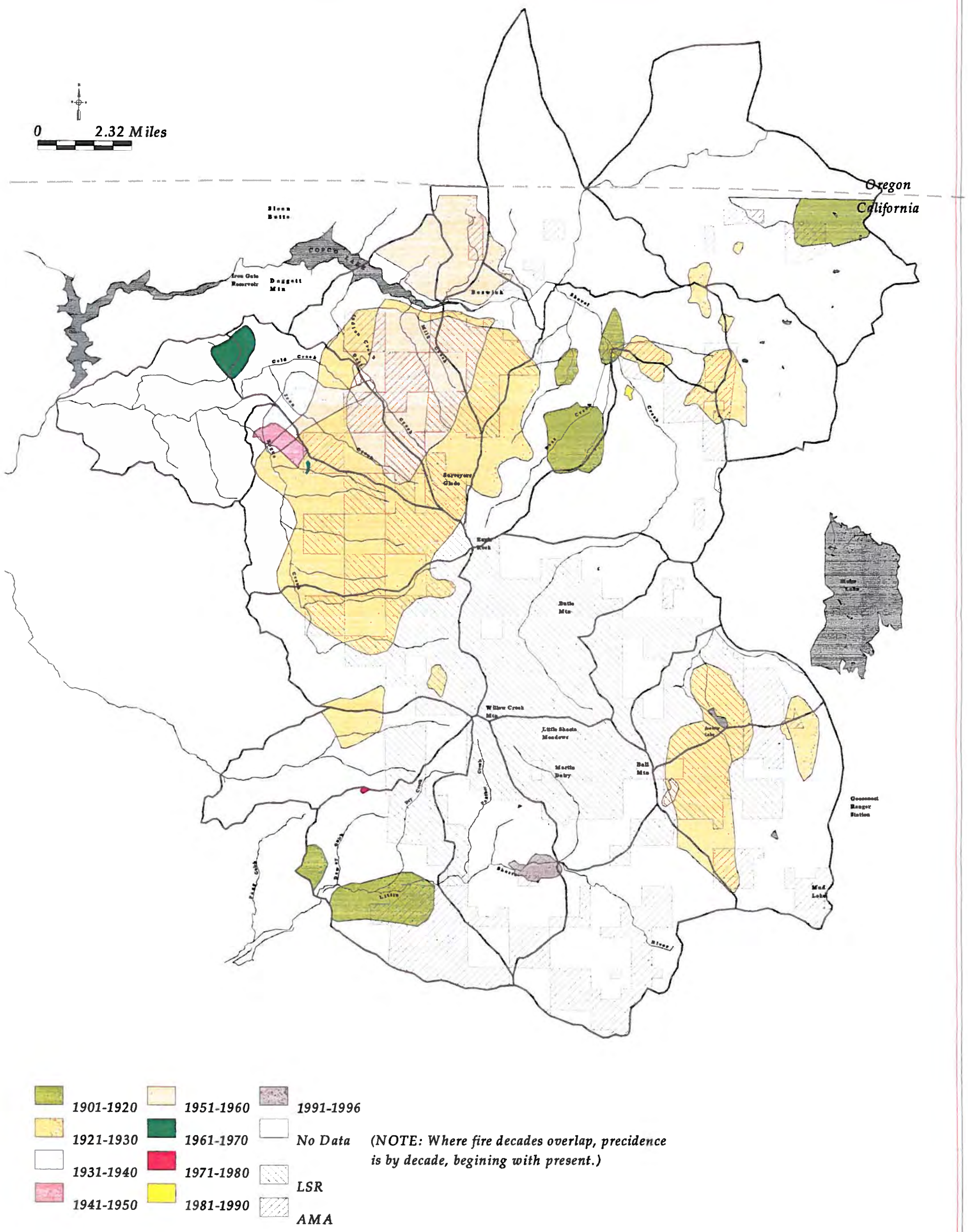


Figure B-1. Location and extent of large fires orrurring within the Goosenest LSR, 1901 to present.

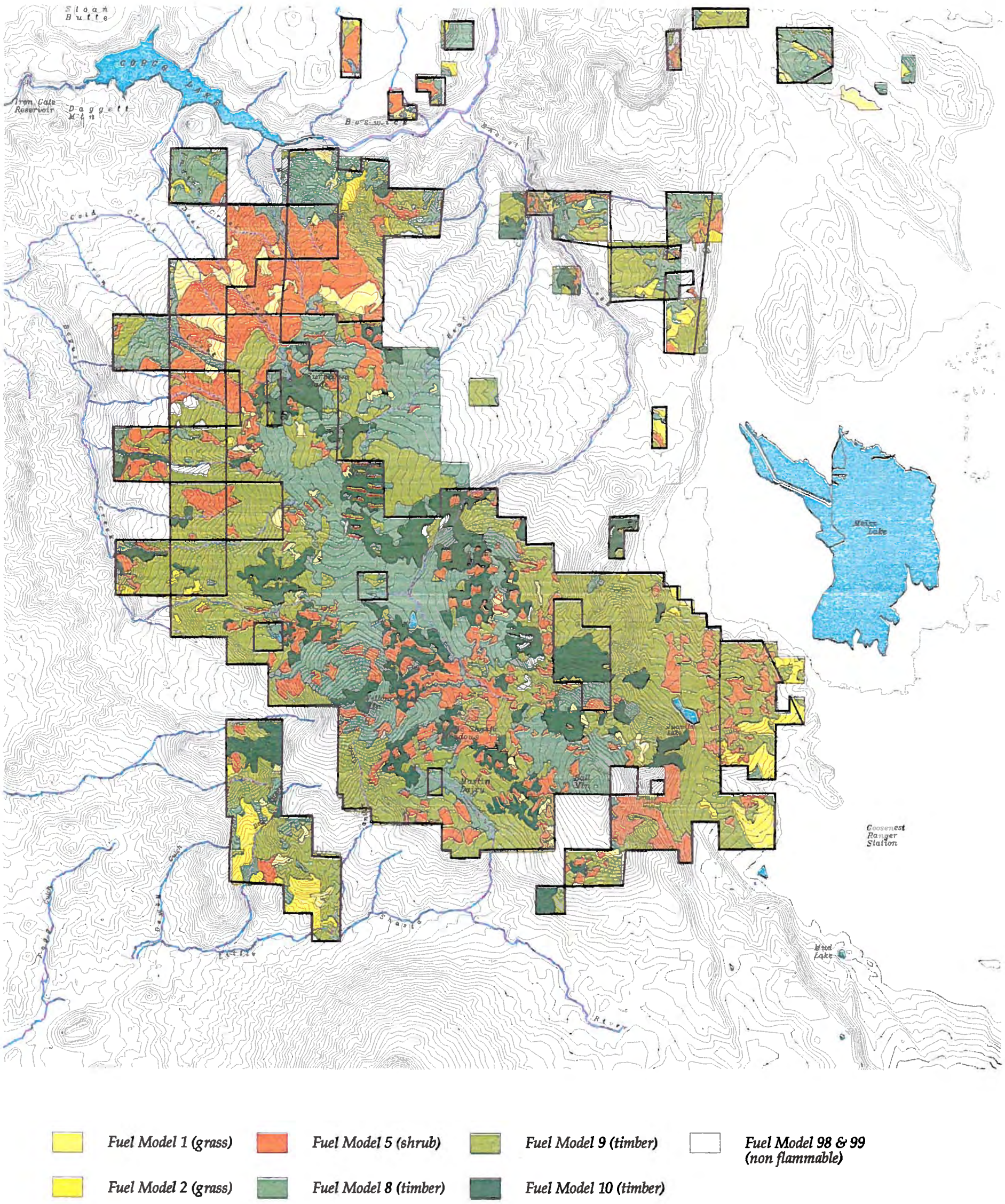
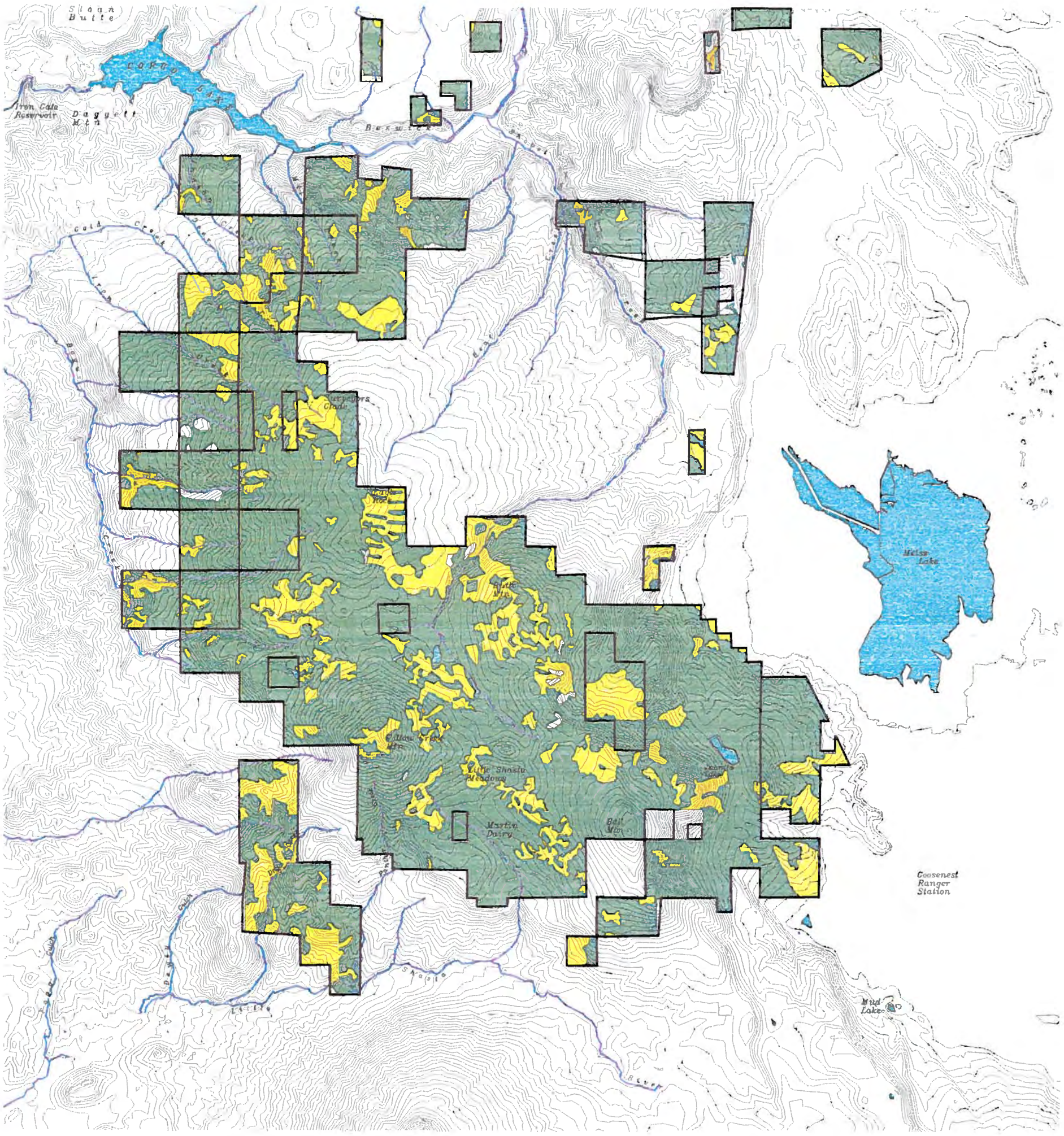


FIGURE B-2. Distribution of fuel loadings in the Goosenest LSR. See text for description of Fuel Models.



Low Moderate

FIGURE B-3. Rating of Fire Behavior Potential based on fuels models, topographic features, and weather data. See text for description of Fire Behavior modeling.

APPENDIX C LATE-SUCCESSIONAL FOREST ASSOCIATED ANIMAL SPECIES

The following list of animal species were identified in the FSEIS as being closely associated with late-successional forest on federal lands within the range of the northern spotted owl, based on criteria developed by FEMAT (1993). Included here are those species known or suspected to occur within the Goosenest LSR.

Known to occur are marked with a **(*)**. ROD Appendix J-2 and C-3 species are noted **(+)**. Klamath National Forest LMP Management Indicator Species are noted **(#)**, Sensitive species are noted **(S)** and Threatened or Endangered species with **(T or E)**.

Amphibians

- Rough-skinned newt
- * Pacific giant salamander
- * Long-toed salamander
- * Cascades frog

Reptiles

- * Northern alligator lizard
- * Rubber boa
- * Northwestern pond turtle

Birds

- * Wood duck
- Common goldeneye
- Barrow's goldeneye
- * Bufflehead
- Hooded merganser
- *+ Common merganser
- * Blue grouse
- * Ruffed grouse
- *S Northern goshawk
- *E Bald eagle
- * Northern pygmy owl
- * Flammulated owl
- * Northern saw-whet owl
- +S Great gray owl
- *E Northern spotted owl
- # Vaux's swift
- *# Pileated woodpecker
- *# Hairy woodpecker
- *# White-headed woodpecker
- Red-naped sapsucker
- *# Red-breasted sapsucker
- * Williamson's sapsucker
- Yellow-bellied sapsucker
- * Western willow flycatcher
- * Pygmy nuthatch
- * White-breasted nuthatch
- * Winter wren
- * Brown creeper
- * Golden-crowned kinglet
- Varied thrush
- * Hermit thrush
- * Warbling vireo
- * Hermit warbler
- * Wilson's warbler
- * Red crossbill

Mammals

- Big brown bat
- California myotis
- + Fringed myotis
- Little brown myotis
- Hoary bat
- + Long-eared myotis
- + Long-legged myotis
- + Pallid bat
- + Silver-haired myotis
- Yuma myotis
- Mastiff bat
- Townsend's big-eared bat
- Shrew-mole
- *+ Marten
- + Pacific fisher
- * Northern flying squirrel
- * Douglas squirrel
- * Chipmunk complex
- * Dusky-footed woodrat
- Western red-backed vole
- * Deer mouse
- *# Elk

APPENDIX D CUMULATIVE EFFECTS

Table D-1. Existing condition ratings for indicators of cumulative effects by watershed for the Goosenest LSR assessment area.

Watershed	Mass Wasting and Surface Erosion					Sediment Delivery			Hydrologic Function	
		Regen Harvest Related Landsliding								
	Natural Landslide Potential	All Lands	KNF Only	Road Related Landslide	Road Related Surface Erosion	Timber Harvest/ Fire	Roads	Grazing	Timber Harvest/ Fire	Roads
Prather	M	H	M	H	L	H	H	L	VH	H
Ikes/Harris	VH	M	VH	H	H	M	VH	M	H	VH
Muskgrave	H	H	L	H	L	H	L	M	VH	H
Sam's Neck	M	L	M	M	L	H	L	–	H	L
Secret Springs	H	L	L	VH	L	L	–	–	M	–
Edge Creek	M	L	L	L	L	–	–	–	–	–
Lucky Spring	VH	M	L	M	M	M	M	M	L	M
Upper Shovel	M	M	H	VH	L	H	H	VH	H	M
Middle Shovel	M	L	L	M	M	H	H	M	M	VH
Lower Shovel	M	M	L	H	M	VH	VH	H	VH	VH
Long Prairie	L	L	L	L	L	–	–	–	–	–
Deer Creek	M	M	M	M	L	H	M	H	VH	L
Upper Bogus	M	L	M	M	L	H	M	H	H	H
Middle Bogus	M	L	L	H	L	M	M	M	H	H
Cold Creek	L	VH	L	L	L	VH	L	–	VH	M
Lower Bogus	L	L	L	L	L	–	–	–	–	–
Upper Willow	VH	L	L	M	L	L	–	–	M	–
Martin's Dairy	M	M	M	M	L	H	VH	VH	H	H
Bull Meadows	L	L	H	M	H	H	VH	H	M	VH
Panther Rock	H	H	M	VH	L	H	VH	M	H	H
Dewey Gulch	M	L	L	M	L	H	H	H	M	M

Natural Landslide Potential (% high & moderate landslide potential) L=0-15 M=16-30 H=31-40 VH=41-45
Regeneration Harvest Related Landsliding:
All Ownerships (% total watershed in regen or fire) L=0-14 M=15-30 H=31-35 VH=36-46
KNF Lands Only (acres regen on high/moderate hazard lands) L=0-20 M=21-35 H=36-85 H=86-120

Road Related Landslide (ac. road high/moderate landslide hazard lands) L=0-20 M=21-35 H=36-55 VH=56-66
Table D-1 (cont.) Discription of criteria used to rank sediment delivery and hydrologic function.

Sediment Delivery and Hydrologic Function Ratings

The rankings came from assessing the 2-3 most common land disturbing activities. The values of 1-4 were used to indicate a range from natural situation. These values cannot be added arithmatically nor averaged since they have differing effects. A high number is an indication of the most limiting problem to future projects. More than one high number indicates problems that are both additive and may be greater than their individual sums. Values of 1 indicates near normal situation while 2 is moderate increase in sediment or negative change in the hydrologic functions of a watershed. A 1 watershed probably will not need further analysis for projects. Watersheds with a 2 may only need project analysis if the projece is where current concentrations of disturbance exist. A 3 value means we should evaluate the watershed further before additional disturbance is added. The very high 4 category indicates rehabilitation and/or recovery is needed **before** additional disturbance is added by a project.

Ratings were adjusted based on several modifiers. Intensity and spreading disturbance out over both time and spatially are key factors of watershed impacts. Disturbances usually are more intensified when in proximity to Riparian Reserve areas. Roads and grazing problems tend to be on small acreages, generate more localized and more intensive effects while timber harvest/fires impacts tend to cover 100s of acres. Road problems occur every year and are usually costly to fix. Grazing damage is most years and can be fixed in a few years at relatively low cost. Timber harvest/fire effects are long lasting and take a long time to repair because of the many decades to grow trees. The cost for correcting these harvest problems can be moderate to high depending on the intensity and acre amount of existing impacts.

Table D-2. Aquatic Habitat Condition Rating Summery for Key Indices by Watershed for the LSR Assessment Area.

Hydro Code 180102...	Watershed Name	Total Score	Channel Stability	Water Quality	Water Quantity	Habitat Connectivity	Fish Community Integrity
05030202	Prather	15	3	4	3	2	3
05030203	Ikes/Harris	12	2	2	2	3	3
05030204	Muskgrave	15	3	3	4	3	3
05030105	Sam's Neck	7	3	1	1	1	1
06020202	Secret Spring	16	3	3	4	3	3
06020204	Edge Creek	11	3	3	3	1	1
06020205	Lucky Spring	19	3	4	4	4	4
06020301	Upper Shovel	18	2	4	4	5	3
06020302	Middle Shovel	19	3	4	3	5	4
06020303	Lower Shovel	18	4	5	2	3	4
06020400	Long Prairie	11	3	3	3	1	1
06030101	Deer Creek	11	3	3	2	1	2
06050101	Upper Bogus	11	4	3	1	2	1
06050102	Middle Bogus	14	4	4	2	2	2
06050103	Cold Creek	18	3	4	3	4	4
06050104	Lower Bogus	18	4	3	3	4	4
06050301	Upper Willow	10	1	3	4	1	1
07040101	Martin's Dairy	17	3	3	4	4	3
07040102	Bull Meadows	11	2	3	2	1	3
07040103	Panther Rock	13	4	3	3		3
07040104	Dewey Gulch	15	4	3	4	1	3

Table D-3. Existing Fish Species Distribution by Watershed for the LSR Assessment Area.

Watershed Name	Klamath River	Bogus Creek	Willow Creek	Little Shasta	Butte Valley Tributaries	Deer Creek	Shovel Creek
Kla Sm Scale	Native	Native	Native	Native	Native	Native	Native
Tui Chubb	Native						
Sht Nose Suck	Native						
Blue Chub	Native						
Lost R.Suck	Native						
MarbledScul	Native	Native	Native	Native	Native	Native	Native
Kla Lg Scale	Native						
Speckled Dace	Native	Native	Native	Native	Native	Native	Native
Pit-Br Lpry	Native						
River Lamprey	Native						
Pac Lamprey	Native	Native	Native	Native		Native	Native
Coho Salmon	Native	Native	Native	Native			Extirp
Chinook Salm	Native	Native	Native	Native			Extirp
Steelhead	Native	Native	Native	Native		Extirp	Extirp
Rainbow	Native	Native	Native	Native	Native	Native	Native
E. Brook Tr	Exotic			Exotic	Exotic		
Brown Trout	Exotic			Exotic	Exotic		Exotic
Green Sunfish	Exotic			Exotic			
Sacto. Perch	Exotic						
Black Crappie	Exotic						
White Crappie	Exotic						
Bluegill	Exotic			Exotic	Exotic		
Pumpkinseed	Exotic			Exotic	Exotic		
Yellow Perch	Exotic						
Lg Mth Bass	Exotic			Exotic	Exotic		
Flathead Min	Exotic						
Brn Bullhead	Exotic			Exotic	Exotic		
Golden Shiner	Exotic				Exotic		
BlackBass	Exotic				Exotic		

Table D-4. Aquatic Habitat Condition rating criteria for diognostic parameters.

Aquatic Habitat Condition criteria were developed to characterize the overall condition of inchannel resources using a few physical and biological diognostic indicators at the scale of a small watershed. The aquatic habitat conditions within a watershed are described through a composite rating of dive eqaully weighted indices. Conditions for each of the five indices range from "low" to "high", coresponding to the narative description in the following tables below. A "Low" ranking is generally indicative of significant changes in the biotic or physical functions of the indices compared to natural potential, while "High" corresponds to conditions expected in the absence of man's influence.

Aquatic Indice Qualification Code -- This field provides the specialist rating a particular indice an oppourtunity to qualify their rating. The basis of this qualification is primarily focused on the type of supporting information used to rank each indices.

1 - ranking based largely upon professional judgement ot information from localized portion of the watershed.
2 - ranking based upon frequent or long-term field observations using proffessional judgement, however little, if any empirical data was used to support ranking.
3 - ranking based upon frequent or long-term observations, supported by empirical data.

Aquatic Condition Indices	Rating						
	no data	low	med/low	med	med/hi	high	indice qualification
Channel Stability							
Water Quality							
Water Quantity							
Habitat Connectivity							
Fish Community Integrity							
Overall Condition							

Fish Community Integrity	
Rating	Definition
low	Few fish present, mostly younger age classes, introduced or warm water tolerant forms; hybrids common; disease, parasites, fin damage, and other anomalies regular. Where historically present, summer and spring run salmonids absent or rare.
med/low	Dominated by omnivores, pollution-tolerant forms, and habitat generalists; few top carnivores; growth rates and condition factors commonly depressed; hybrids and diseased fish often present.
medium	Signs of additional deterioration include fewer intolerant forms, more warm water species present; older age classes of top predators may be rare. Where historically present, summer and spring run salmonids few; salmonid run timing may be compressed.
med/high	Species richness somewhat below expectation, especially due to loss of most intolerant forms; some species with less than optimal abundances or size distribution; community structure shows some signs of stress.
high	Comparable to the best situations without influence of man; all regionally expected species for the habitat and stream size, including the most intolerant forms, are present with full array of age and sex classes; balanced community structure. Where historically present, summer and spring run salmonids common.

Habitat Connectivity	
Rating	Definition
low	Greater than 50% of habitats and/or stream reaches isolated during critical life history phases, within historic spatial and temporal range of native fish species. Emigration and/or immigration impaired by physical, chemical, or biological barriers.
med/low	Greater than 25% of habitats and/or stream reaches isolated during critical life history phases, within historic spatial and temporal range of native fish species.
medium	Seasonal or climatic conditions may isolate habitats or stream reaches due to anthropogenic actions within historic range of native fish species. Impairment of habitat and/or stream reach connectivity confirmed in some headwater and/or minor tributaries within the historic range of native fish species.
med/high	Emigration and/or immigration largely unaltered by anthropogenic actions. Impairment of some habitat and/or stream reach connectivity suspected in some headwater areas and/or minor tributaries within the historic range of native fish species.
high	Physical connectivity of habitats and stream reaches maintained for all life history phases within historic spatial and temporal range of fish species native to the natal watershed.

Water Quantity	
Rating	Definition
low	During most years, extreme flows (low and/or high) depart significantly from a natural (unaltered by anthropogenic actions) hydrograph. Discharges during summer/fall base periods impair fish distribution and abundance and/or extreme flows may be significantly increased or decreased, resulting in changes to channel morphology and stream side vegetation.
med/low	In some years, extreme flows (low and/or high) depart significantly from a natural hydrograph.
medium	Significant departure from the natural hydrograph occurs during periods other than flow extremes (low and/or high). Base flows maintained, however, the timing and duration of mid-range discharges may begin to impair fish distributions and abundances.
med/high	Some minor departure of hydrograph occurs during periods other than base flow discharge, although extreme peaks are maintained.
high	Hydrograph substantially unaltered from natural conditions.

Water Quality (i.e., temperature, DO, pH, conductivity, turbidity, nutrient, chemical)	
Rating	Definition
low	Water quality necessary to maintain fish not met for extended periods. Data show that water quality objectives are continually exceeded or that beneficial uses are not protected, including but not limited to, native cold water fish species.
med/low	Abundance and survivability of native fish species noticeably decreased by existing water quality. Data show that water quality objectives are frequently not met for moderate periods of time.
medium	Water quality necessary to maintain fish not met for short periods, however, abundance and survivability of fish species is not significantly affected. Biological data may show minor changes in fish population densities and distribution, however, direct observation of the water shows biological requirements are supported.
med/high	Water quality objectives exceeded occasionally. No causal impacts on healthy cold water fish population apparent.
high	Water quality objectives necessary to maintain native cold water fish populations met.

Channel Stability	
Rating	Definition
low	Unstable areas constitute a sediment source greater than what is routinely transported over a range of flows, resulting in net aggradation. Debris torrents may cause smaller streams to scour to bedrock. Substrate on channel bed displays widespread mobilization during annual runoff peaks. Vegetative bank protection is sparse, discontinuous, shallow rooted, and largely maintained in an early seral stage. Stream banks show extensive recent erosion along straight reaches, as well as most outside bends in the channel. Channel width-to-depth ratio increasing or generally greater than 10. In non-forested, unconfined systems, active channel mostly non-entrenched in stable (consolidated) materials with few undercut banks, or channel abandoning floodplain through rapid down cutting. Braided common in aggraded areas, pools infrequent and/or partially filled with fine sediment, riffles common but spawning gravels reduced in area and quality.
med/low	Unstable reaches of the channel predominate in areas of critical fish habitats. Aggragation of profiles common in depositional areas. Many reaches experience frequent substrate entrainment. Pools fewer in number and most are partially filled with fine sediment. Riffle to pool ratios high. Spawning gravels are reduced in area and most are impacted by fine sediment intrusion.
medium	Unstable areas constitute a sediment source greater than transported annually, resulting in local aggradation. Freshly mobilized substrate evident over wide corridors of some channel segments or tributaries, but mainly evident over the head of bars or in pool tails. Stream side vegetation is vigorous, deep-rooted, and diverse in age, structure and composition, but discontinuous and sparse in some reaches. Where vegetative condition is high, channel structure, and vertical bank angle are maintained. Unconfined reaches may exhibit width-to-depth ratios greater than 10 and/or braiding. In non-forested, unconfined systems, undercut banks decreasing or increasing, but generally uncommon. Fine sediment deposition is common in many pools and some spawning areas, but overall, average grain size distribution is larger than streams in low or medium/low condition.
med/high	Stable areas constitute the majority of key fish habitats, but some reaches impacted. Sediment inputs successfully discharged over some, but not all, flow ranges. Reaches of braiding, aggradation, and width-to-depth ratios greater than 10 are few and of relatively short length. Streambank erosion limited to these few aggraded reaches and outside meander bends. Pools may occur at frequent intervals, but some will be partially filled with fine sediment.
high	Unstable areas infrequent, with sediment transported by annual flows. Freshly mobilized substrate evident over narrow corridors of most channel segments, but mainly evident over the head of bars or in pool tails. Stream side vegetation is vigorous, deep-rooted, and diverse in age, structure and composition. Vegetation maintains channel structure and vertical bank angle in consolidated materials. Streambank erosion infrequent, occurring on outside bends and localized constriction points. Channel width-to-depth ratio stable or decreasing; generally less than 10. In non-forested, unconfined systems, active channel mostly entrenched in stable (consolidated) materials, with undercut banks common. Braiding uncommon and large pools frequent. Average grain size to gradient ratio is the largest of all streams sampled, with fine sediment deposition minimal in spawning gravels or pool substrates.

APPENDIX E: Habitat Classification and Suitable Habitat Definitions:

The LANDSAT thematic mapping data used to analyze vegetation within the Goosenest LSR was classified into size class and density classes comparable to those used in Land Management Planning. For the purposes of this LSR Assessment, we combined classes into 6 primary groups. These combined classes represent a simplified description of vegetation conditions within the assessment area. Species composition of forest stands was not included in this classification scheme. Instead, we used stand histories, elevation, aspect and other variables to delineate broad forest communities which contained large numbers of size/density polygons. This method allows for classification bsed on potential natural vegetation, rather than current condition. In many cases, current species composition reflects past timber harvest and fire suppression, and dominance of white fir in former mixed conifer and ponderosa pine sites. Within a given forest community type, we used 6 classes of size and density. The following are descriptions of each size/ density class.

Late-successional/ Dense: Polygons with average dbh of 24" and greater, with canopy closure ranging from 40% to 100%. Most of the unharvested stands on capable sites are included in this class, along with partially-harvested stands with advanced regeneration.

Late-successional/ Open: Polygons with average tree dbh of 24" and greater, and canopy closure ranging 10-40%. This class includes many previously harvested stands (shelterwoods, commercial thinning), as well as natural stands on low-capability sites. Old-growth ponderosa pine typically will be classified as 'open'.

Mid-successional/ Dense: Polygons with average tree dbh of 12-24", and canopy closure ranging from 40-100%. This class contains stands naturally regenerated by fire or other events, as well as advanced regeneration following overstory removal. Many dense mid-mature white fir stands fall into this class. In lodgepole pine this class may represent old-growth characteristics.

Mid-successional/ Open: Polygons with average tree dbh of 12-24", and canopy closure ranging from 10-40%. This includes stands of residual trees after thinning or overstory removal, and natural mature stands on low capability sites.

Early-successional/ Dense: Polygons with average tree dbh <12", and canopy closure ranging from 40%-100%. These stands include well-stocked plantations and dense regeneration following shelterwood and diameter-limit harvests. Combinations of young conifers and dense brush are also included in this class.

Early-successional/ Open: Polygons with average tree dbh <12", and canopy closure ranging from 10%-40%. Poorly regenerated clearcuts, brushfields, and very low-capability sites are represented in this class.

Definition of suitable habitat for Northern Spotted Owls:

We used data collected at 12 spotted owl activity centers within and adjeacent to the Goosenest LSR to describe 'suitable habitat' for nesting and roosting by this species. Habitat structure was highly variable among these activity centers, as well within the 1.3-mile radii analyzed. In general, owls occupied stands with high canopy closure and at least scattered large overstory trees.

For the purposes of landscape-level quantification of habitat, we considered 2 size/density classes to be suitable for northern spotted owls: late-successional/ dense and mid-successional/ dense. This classification provides a simplified picture of habitats used by owls, but also recognizes the wide variability in forest structure, particularly tree size classes, that are used by owls in the California Cascades.

APPENDIX F: Monitoring Plan

Monitoring is essential to determine whether LSR objectives are being met, and if the LSR is trending towards a Desired Future Condition. All monitoring projects should be designed by an interdisciplinary group consisting of (at least) a wildlife biologist, fuels specialist, and silviculture/ecologist. Specialists from other agencies including the US Fish and Wildlife Service and National Marine Fisheries Service should be included in design of monitoring for TES species.

1) Implementation Monitoring:
Implementation monitoring determines whether standards and guidelines were followed during management activities within the LSR. In the Goosenest LSR, implementation monitoring will include;

Monitor to assess whether proposed management activities are consistent with the standards and guidelines in the Klamath national Forest Land and Resource Management Plan.

Monitor to assess whether proposed management activies are consistent with the Goosenest LSR Assessment.

2) Effectiveness Monitoring:
Effectiveness monitoring evaluates whether projects/activities meet their intended purpose and desired results. All projects and activities should be monitored to assess their effectiveness in achieving desired results and meeting the purpose and need for which they were designed.

Thinning/ Stand Restoration Projects;

- Did the activity retain adequate levels of snags and coarse woody material?
- Did the thinning project provide for desired species composition?
- Were desired tree spacing specifications met?
- Were desired conditions for fuels levels achieved following the activity?
- Long-term monitoring should include evaluation of growth patterns, recovery of crown closure, species diversity and snag recruitment every 5-10 years to evaluate attainment of desired future condition.

Fuels Reduction Projects;

- Complete a post-burn evaluation to determine effectiveness of prescription and implementation in reducing wildfire effects and meeting overall resource objectives.
- Did the project meet the desired results of reducing fuel conditions to a level supporting <4 ft flame lengths and rate of spread <20 chains/hour?
- Over large areas (100 acres), are snag and down woody material requirements still being met post-treatment?
- Were moderate intensity burns limited to <5-10% of the burn area, and were any openings created <5 acres in size? Were tree mortality estimates acceptable?
- If salvage harvesting used to reduce fuels, were adequate levels of snags retained in all size classes?
- Did salvage harvest meet desired soil cover guidelines from the LRMP?

Reforestation Projects:

- Do survival exams show that adequate stocking levels have been achieved to attain future late-successional characteristics?
- Is the species composition of planted stock likely to represent the natural community?

3) Validation Monitoring:

Validation monitoring evaluates whether a cause-and-effect relationship exists between management activities and the general objectives of the LSR. This process also assesses whether the underlying assumptions used in designing management projects are correct. Validation monitoring must be tiered to specific objectives; in this case the objectives under **Criteria and Possible Treatments** section (page 60-61).

Objectives 1 and 3. Accelerate the development of future late-successional forest habitat and provide resiliency from large-scale disturbance over time. Protect existing stands of late-successional forest habitat by reducing factors contributing to stress-related tree mortality and stand-replacing fire.

- Determine % of capable lands supporting late-successional forest habitat at 10-year intervals.
- Assess occurrence and rate of spread of tree mortality due to insect outbreaks and disease.
- Assess amount and distribution of fuels and monitor risk of catastrophic fire.

Objective 2. Retain, restore and protect watershed functions that promote high-quality habitat for native fish and other aquatic organisms.

- Monitor stream structure and seral stage for selected streams at 10-year intervals.
- Use R-5 protocol to identify stream reaches for Strean Condition Inventory.

Objective 4. Improve the connectivity of late-successional forest habitat within the LSR.

- Analyze size and distribution of late-successional forest habitat at 10-year intervals, assess changes in connectivity.

Objective 5. Improve northern spotted owl habitat.

- Continue monitoring of spotted owl occupancy and productivity within LSR.
- Analyze amount and distribution of suitable owl habitat in the LSR, and within 1.3-mile radii of activity centers, at 10-year intervals.

Objective 6. Foster protection and re-establishment of native fish communities.

- Monitor species composition of fish communities within selected streams (reaches) at 5-year intervals.
- Maintain contact with CDFG to monitor fish introductions, manipulations.