CULTUS MOUNTAIN
SHERIDAN MOUNTAIN

LATE-SUCCESSIONAL RESERVE ASSESSMENT

DESCHUTES NATIONAL FOREST
BEND/FT. ROCK RANGER DISTRICT
1996

REGIONAL ECOSYSTEM OFFICE

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MEMORANDUM

DATE: January 27, 1997

TO: Robert W. Williams, Regional Forester, Forest Service, Region 6

FROM: Donald R. Knowles, Executive Director

SUBJECT: Regional Ecosystem Office Review of the Cultus/Sheridan Late-Successional Reserve Assessment, Deschutes National Forest

Summary
The Regional Ecosystem Office (REO) and the interagency Late-Successional Reserve (LSR) Work Group have reviewed the Cultus/Sheridan LSR Assessment (LSRA). The REO finds that the Cultus/Sheridan LSRA provides a sufficient framework and context for future projects and activities within the LSR. Future silvicultural and salvage activities described in this LSRA that meet both the criteria and objectives of the LSRA and the Standards and Guidelines (S&Gs) in the Northwest Forest Plan (NFP) are exempted from subsequent project-level REO review.

Basis for the Review
Under the S&Gs for the NFP a management assessment should be prepared for each large LSR (or group of smaller LSRs) before habitat manipulation activities are designed and implemented. As stated in the S&Gs, these assessments are subject to REO review. The REO review focuses on the following:

First, the review considers whether the assessment contains sufficient information and analysis to provide a framework and context for making future decisions on projects and activities. The eight specific subject areas that an assessment should generally include are found in the NFP (S&Gs, page C-11). The REO may find that the assessment contains sufficient information and/or may identify topics or areas for which additional information, detail, or clarity is needed. The findings of the review are provided to the agency or agencies submitting the assessment.

Second, the review considers potential treatment criteria and treatment areas addressed in the LSRA. When treatment criteria are clearly described and their relationship to achieving desired late-successional conditions is also clear, subsequent projects and activities within the LSR(s) may be exempted from REO review, provided they are consistent with the LSRA criteria and NFP S&Gs. REO authority for developing criteria to exempt these actions is found in the S&Gs (pages C-12, C-13, and C-18).

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Scope of the Assessment and Description of the Assessment Area

Cultus—The LSRA addresses the 18,000-acre Cultus LSR, located in the Deschutes Province on the Bend/Fort Rock Ranger District, Deschutes National Forest. Much of the Cultus LSR is occupied by dry mixed conifer forest that is characterized as a "fire climax" ecosystem. Many of these forest stands are heavily stocked and at high risk for insect and disease infestation and catastrophic fire.

Sheridan—The LSRA also addresses the 31,030 acre Sheridan LSR, located in the Deschutes Province on the Bend/Fort Rock Ranger District, Deschutes National Forest. Two-thirds of the LSR is classified as forested lavas. The LSR also contains almost 3,000 acres of mixed conifer wet plant association group. Therefore, most of this LSR has only moderate fire risk. Insect and disease risk varies from low to high within the LSR.

Review of the Assessment

Documents submitted for review include the Cultus/Sheridan LSRA and fire plan. These documents contain several process papers which support the conclusions of the LSRA. REO had previously received a LSR overview document from Deschutes National Forest (September 1, 1995) that sets the context for site-specific LSR Assessments.

The LSRA and the associated overview document provide an excellent description of the area and identify important conditions and processes, disturbance regimes, historic and current uses, and their implications for future management. Plant and animal species of interest or concern and connectivity within the LSRs and with other LSRs are also addressed.

The LSR assessment team considered habitat needs for late-successional species and defined acceptable levels of risk of loss from large-scale stand-replacement events to help determine a logical, sustainable mix of fire-climax and late-successional structure. Late-successional stand conditions necessary for late-successional species were compared with stand conditions that were considered sustainable under east Cascades fire regimes, determined in part by stand density and fuel loading. The LSRA proposes a strategy for retaining, to the greatest extent practicable, habitat for late-successional species. This is balanced with conditions where maintaining suitable habitat may put LSRs at an unacceptable risk to large-scale stand replacing disturbances.

The difference between "suitable habitat" and "sustainable habitat" required the determination of a balance of vegetative conditions that would allow the LSRs to function as intended and be sustainable in the short and long term. The following considerations were factored into quantifying the desired balance:

- Habitat threshold for late-successional old-growth associated species.
- Context of the LSRs within the surrounding landscape and management allocations.
- The "upper management zone" (UMZ) for each "plant association group" (PAG). The UMZ for a given PAG is that point at which tree suppression or mortality begins due to competition.
- The historic range of variability.
- The cycling of structural stages to provide different habitat through time.

Cultus—The Forest has divided the Cultus LSR into eight management strategy areas (MSA) based on: (1) common plant association groups (PAGs), (2) known late-successional associated species, (3) rural interface areas, (4) common silvicultural opportunities, and (5) common fire management strategies. For each MSA the LSRA discusses existing conditions for wildlife, botany, and invertebrates; forest dynamics; insect and fire risk; the social context; and risks. For each MSA, the document also presents treatment criteria, displays management options and identifies monitoring needs. Descriptions of conditions that characterized silvicultural treatments were presented in tabular format with the following categories of information presented for each PAG: snag and downed wood levels (in number of logs, tons per acre and ft^3), canopy cover, canopy layers, and density measures (including the number of trees per acre by broad tree size class).

Sheridan—Criteria for developing treatments are described for each of 4 seral classes within each PAG. Under each seral class is a description of (1) the existing stand condition, (2) objectives and thresholds for action, (3) treatment strategies, (4) a description of the resulting stand after treatment, and (5) how the treatment meets LSR objectives. The LSR is divided into eight MSAs. Current conditions, goals, objectives and management recommendations are described for each MSA. The treatment criteria by PAG and seral class provides sideboards for treatment in specific vegetative conditions; treatments are then further refined by MSA goals and objectives, thus providing guidance for designing future activities within the LSR.

Assumptions

The assessment raised the issue of fragmentation for both LSRs. This is primarily due to the forest road network. REO's consistency finding assumed that the Land and Resource Management Plan strategy for reducing open road volume is being followed.

Additional Comments

Historic Range of Variability (HRV) has been used in this document to help understand historic vegetation composition and fire regimes. While HRV may help determine the amount of late-successional (climactic-climax) habitats that can be sustained through time across the landscape, it should not be the sole determinant. Late-successional habitat within LSRs should be maintained outside the historic range of variability to the extent sustainable, especially for the current planning period and until the more sustainable portions of the LSRs become fully functional.

Conclusions

Based on documentation submitted with and found in the Cultus/Sheridan LSRA, field visits by members of the interagency LSR Work Group, discussions held with members of the Deschutes National Forest staff, and the above noted assumption, the REO finds that the Cultus/Sheridan LSRA provides a sufficient context and framework for decisions on future projects within each LSR. In addition, silvicultural and salvage activities described in the LSRA, that are consistent with Forest Plan S&Gs and with the respective LSRA objectives and treatment criteria, are exempted from further REO review.

cc: REO Reps, RIEC, Arnie Holden, Bend/Fort Rock Ranger District

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CULTUS AND SHERIDAN
LATE-SUCCESSIONAL RESERVES
ASSESSMENT
October 1996

BEND/FT. ROCK RANGER DISTRICT
DESCHUTES NATIONAL FOREST
SALLY COLLINS, FOREST SUPERVISOR
WALT SCHLOER, DISTRICT RANGER

INTRODUCTION

The Cultus and Sheridan Late-Successional Reserve (LSR) Assessment addresses two individual LSRs: Cultus Mountain LSR (approximately 18,000 acres) and Sheridan Mountain LSR (approximately 31,030 acres). Both are located in the western portion of the Bend/Ft. Rock Ranger District approximately 26 miles and 18 miles respectively southwest of Bend, Oregon in the Eastern Oregon Physiographic Province. These reserves are part of a large, interactive system that was designated by the Record of Decision (ROD) for the Northwest Forest Plan (NWFP 1994) for federal lands in the Pacific Northwest that are within the range of the Northern Spotted Owl. The assessment has been guided by the Deschutes National Forest's LSR Overview document (1995) and by the preceding Cascades Lakes Watershed Analysis (1995). See vicinity map and landsat map.

PURPOSE AND NEED

The NWFP requires that "A management assessment should be prepared for each Late-Successional Reserve (or group of smaller Late-Successional Reserves) before habitat manipulation activities are designed and implemented." (ROD page C-11). The purpose of the LSRs is "...to protect and enhance conditions of late-successional and old growth forest ecosystems, which serve as habitat for late-successional and old growth related species including the northern spotted owl." The ROD specifies the essential components for the assessments (ROD page C-11), which focus on the past, current and desired vegetative conditions as they are limited and affected by the natural physical and biological processes inherent to a particular area.

Specific objectives of the LSR Assessment include: 1) Determine the Desired Conditions for the vegetative resources within the LSRs in order to achieve the Standards and Guidelines that are specified within the NWFP; 2) Identify opportunities for short and long-term management actions to improve the sustainability of habitats for late-successional habitat dependent species; 3) Identify actions to reduce risks associated with epidemic insect and disease infestations and related risks of large-scale fire events to the extent practical; and 4) Address the issue of connectivity between LSRs.

METHODOLOGY

A core team of resource experts, which included the following disciplines: silviculture, soil science, geology, wildlife biology, botany, recreation management and fire management, was assembled to conduct the assessment. Support was provided by persons knowledgeable in Geographic Information Systems (GIS), forest management, logging systems and forest pathology. The assessment area was evaluated by the interdisciplinary team for its historic and current condition. Desired conditions were then determined within the context of the land's capability, management limitations and needs of late-successional species. Specific projects were not developed by the team because they must be addressed in a separate Environmental Assessment that evaluates the direct, indirect, and cumulative effects of any management actions.

HISTORIC AND CURRENT CONDITIONS AND PROCESSES

The landscapes within the LSRs have been influenced in only a minor fashion by hydrologic processes. Perennial streams are limited (particularly in the Sheridan LSR) and the annual precipitation is dominated by winter snow fall and summer thunderstorm showers. The area does have an abundance of intermittent drainages and a number of natural and man-made lakes.

Prior to non-native settlement, the assessment area was primarily influenced by the processes of volcanic activities, natural fires, and cycles of insect and disease agents. The latter two categories in turn were strongly controlled by the weather cycles of alternating droughts and wet periods. The resulting landscape reflected these processes in the types and conditions of the vegetation which is dominated by coniferous forests. The natural pre-settlement forest was a mosaic of seral and climax stands that were greatly influenced by natural fire regimes. The fires burned relatively frequently, but occurred more often in the lower, drier areas of the landscape and less frequently in the higher, wetter areas. Fire resistant tree species such as ponderosa pine and Douglas-fir often dominated areas of frequent fires. Less frequent fire events allowed thin barked species such as mountain hemlock, white fir and lodgepole pine to become more plentiful. Fire also helped maintain natural meadows and shrub-dominated sites by killing invading trees.

After settlement and the establishment of methods to control natural fires, the vegetation character of the area slowly changed. This was particularly true of the lower elevation areas that had relatively frequent fires prior to control actions by humans. The utilization of the vegetation for both wood products and as forage for domestic livestock also had profound effects on the vegetative composition, structure, and arrangement across the landscape. Large areas were harvested using regeneration methods such as clearcutting, which removed significant amounts of vegetative biomass. Natural fires normally left a wider variety and distribution of material on the ground than that left by modern logging. This has influenced soil productivity, water retention, and the micro-site conditions that affect the establishment of trees, forbs and grasses. This in turn affected various wildlife species in both positive and negative ways.

Presently, both LSR areas have a much larger component of thin barked tree species such as lodgepole pine and white fir. Historic natural fires killed those species and favored the more resistant ponderosa pine and Douglas-fir. This build-up of species has significantly increased the amount of potential fuels for future fires in the area. Recent fires have been much larger and hotter than those of historic times due to the accumulation of these fuels. Lack of frequent fires has contributed to increased stand densities, creating conditions favorable for insect and disease epidemics. High densities mean increased competition between trees for the limited resources of soil nutrients and water. This competition and stress generally lowers tree resistance to insects and diseases, which may result in high levels of mortality. Tree mortality has greatly added to the amount of existing and future fuels on the forest floor. Increased stand densities and the change in species composition have heightened the potential for large-scale wildfires. White fir, as an example, has a denser crown and lower-growing branches than ponderosa pine, contributing to the fuel ladder that allows fire to reach tree crowns within stands.

The changes in the ecological processes just described, as well as to the fire frequency within the existing stands and many related vegetative conditions, have actually improved habitat conditions for some wildlife species. The northern spotted owl, for example, requires heavy canopy cover for its security and dispersal of young. Increased tree mortality due to overstocked conditions benefits many wildlife species including the pileated woodpecker, black backed woodpecker and American marten. However, as ground fuels build up and more dead standing material is present on site, there is an increase in the probability and risk of losing this habitat through large-scale wildfires, which may have negative long-term effects on species like the spotted owl.

The LSRs presently have a wide variety of plant and wildlife species dependent on late-successional forests. The northern spotted owl, as an example, is present in both the Cultus and Sheridan LSRs. There are 5 owl sites in the Cultus unit and 1 site in the Sheridan unit. The home ranges of the owls are relatively large (3,000 acres). The majority of the Cultus LSR is classified as a Critical Habitat Unit (CHU) by the U.S. Fish and Wildlife Service (USFWS) and, as such, the CHU needs to meet the primary constituent elements as outlined by the USFWS, or formal consultation will be required prior to any vegetative manipulation. Each of the other late-successional species within the assessment area also has specific habitat requirements.

In addition to discussions centered on the physical and biological settings of the LSRs, the team evaluated elements of human origin that have or will affect future management objectives. Included were cultural resources, recreation, roads, timber management, developments, grazing, etc. Timber harvest, wildfires (human caused) and recreation have had the most significant effects on the vegetation within the assessment areas. Due to these activities, the landscape has become fragmented, causing disjunct vegetative conditions for species dispersal between late-successional old growth habitats.

THE ASSESSMENT PROCESS

The interdisciplinary team utilized all available information to better describe and identify those conditions that would meet the direction in the NWFP for providing quality habitats for late-successional species. In order to provide a scientific basis for describing these conditions, the team defined ecological vegetative units in the assessment using Plant Association Groups (PAGs). Each PAG is comprised of a number of plant associations, defined by productivity and site conditions, and is a product of disturbance regimes (e.g., natural fire) and the variables of soils, slope, land type, precipitation, etc. They include: Mountain Hemlock PAG (14% Cultus/12% Sheridan), Mixed Conifer Wet PAG (10% Cultus/28% Sheridan), Mixed Conifer Dry PAG (45% Cultus/33% Sheridan), Ponderosa Pine Wet PAG (0% Cultus/2% Sheridan), Ponderosa Pine Dry PAG (0% Cultus/13% Sheridan), Lodgepole Pine Wet PAG (15% Cultus/7% Sheridan), Lodgepole Dry PAG (5% Cultus/4% Sheridan), and Unique PAGs: Engelmann Spruce, Meadow/Shrub, Riparian/Shoreline, and Rock/Cinder (11% Cultus/1% Sheridan). Each PAG was mapped using aerial photography or reconnaissance field surveys and can be identified on the ground. This was done for the entire assessment area and is foundational to determining the desired conditions for the LSRs.

The PAGs were paired with management objectives for the assessment area to develop Management Strategy Areas (MSAs). Ten MSAs were developed (see Tables 1 and 2) and include objectives for the LSR goals described in the ROD. The MSAs provide a stratification of this large landscape that incorporates both natural land capability and special management considerations. In order to better describe the capabilities of the PAGs, which ultimately control our ability to manage for Desired Conditions, the team added a special MSA category for Forested Lava areas of the landscape. Due to the thin soils in these areas, the land cannot sustain forests as dense as in those with deeper soils. In addition, a Research Natural Area MSA (which supersedes LSR standards and guidelines) and a public safety MSA were designated and are specific to these objectives.

Indicator wildlife species were selected to represent each PAG, and their habitat requirements described in detail in order to establish a foundation on which to build management options for desired conditions. The species are all typically found in the assessment area and represent a range of habitat requirements. The indicator species included: boreal owl, northern bald eagle, great gray owl, northern goshawk, black-backed woodpecker, northern spotted owl, American marten, pileated woodpecker, white-headed woodpecker and flammulated owl. The suitable habitat criteria were assessed by PAG for the indicator species and included such factors as trees per acre, canopy cover, snags, logs, acreage of habitat needs and the structural arrangement of this habitat. The latter category addressed the number of trees needed by seral stage from very young (sapling) to very old (large trees). This information was a critical link in communication between the various resource specialists in the process of defining desired conditions within the context of each MSA with its inherent physical, biological and management capabilities and limitations.

The primary challenge for management is how to provide suitable habitat for the diversity of late-successional old growth (LSOG) species across the landscape through time while reducing the risk of large-scale disturbances and loss of population viability, i.e., inadequate suitable habitat to maintain a breeding population. In east-side Forests, two situations occur which include "climatic climax" where cool, wet sites reach climax through long fire intervals where fire vulnerable species dominant; and "fire climax" where drier conditions allow more frequent fire events and fire dominated species are prevalent. Northern spotted owls, for example, require the conditions created within climatic climax stands. However, other species require fire climax stands to maintain populations. It is acknowledged that climatic climax stands may not be sustainable over long periods of time.

The team synthesized all the described information to identify a desired range of habitat condition by PAG based on stand density index. A component of stand density index (SDI), called the upper management zone (UMZ), was used to help define, measure and compare desired habitat conditions by PAG. UMZ is usually calculated at about 70% of the maximum stand density index value, which for our analysis was based on individual plant associations. UMZ is defined as the density at which a suppressed class of trees begins to develop. This is the point where competition between trees for resources is sufficient to slow tree growth and decrease tree resistance to insect and disease outbreaks. Trees in this weakened condition may be more susceptible to large-scale disturbances. As expected, the suitable habitat conditions often exceed the UMZ risk limit. However, in some cases this is greater than the sustainable density defined for these plant associations, which means that there is some risk to losing these habitats through natural disturbance processes. Refer to Chapter IV for more in-depth information.

Potential treatment methods were identified that could be used to achieve desired conditions. These methods are described in the assessment under Treatment Criteria, which include LSOG Protection and Enhancement methods. LSOG protection methods prescribed which may be used to reduce risk to large-scale disturbances include: tree culturing, thinnings, salvaging, hazard tree removal, reforestation and fuels reduction. LSOG enhancement methods include late-successional habitat acceleration and nesting, roosting, and foraging (NRF) habitat cycling for spotted owls through thinnings, tree culturing for eagle habitat, creating small canopy openings, prescribed fire, precommercial thinning, diversity plantings, and meadow restoration. There is some overlap of benefits between the two treatment methods, but together they describe most practical management treatments currently available.

Finally, the team developed an implementation schedule specific to each MSA and prioritized the LSOG protection treatments. Needs that are immediate in order to provide protection from large-scale disturbance events or to restore critical habitat functions are listed as Priority 1. These should be attained within the next 10 years. Priority 2 treatments would generally be applied beyond 10 years. Some priority 2 treatments would be applied earlier and some priority 1 treatments would be delayed since current conditions may make them too risky to implement immediately, or because conditions do not warrant attention until further vegetative growth within the stands occurs. LSOG enhancement treatements are developed and specific to individual MSAs. These may be implemented inconjunction with other treatements.

THE OUTCOME

The following tables provide an overview of the various opportunities for treatments within the Cultus and Sheridan LSRs. As noted earlier, each project will be further verified and designed at the site scale through the National Environmental Policy Act (NEPA). The summary also describes those factors that may preclude treatments or otherwise increase the complexity or risk of treatments.

TABLE 1—CULTUS LSR SUMMARY
SHORT-TERM TREATMENT POTENTIAL (ACRES)*

MSA	High	Moderate	Low	Notes**
A Mt. Hemlock	UND***	UND	80	Higher elevations
B Mixed Conifer Wet	UND	UND	1,330	
C Mixed Conifer Dry	UND	390	1,100	
D Lodgepole Wet	70	190	1,060	
E Lodgepole Dry	100	UND	310	
F Unique Habitats	UND	UND	UND	
G RNA	UND	UND	UND	Research Natural Area
H Public Safety	UND	UND	UND	
Subtotals	170	580	3,880	

TABLE 2—SHERIDAN LSR SUMMARY
SHORT-TERM TREATMENT POTENTIAL (ACRES)*

MSA	High	Moderate	Low	Notes**
B Mixed Conifer Wet	UND	UND	UND	
C Mixed Conifer Dry	UND	UND	UND	
D Lodgepole Wet	UND	UND	UND	
E Lodgepole Dry	UND	UND	UND	
F Unique Habitats	UND	UND	UND	
H Public Safety	UND	UND	UND	
I Forested Lavas	UND	380	6,620	Thin soils
J Ponderosa Pine	UND	UND	UND	Includes Wet and Dry types
Subtotals	UND	380	6,620	

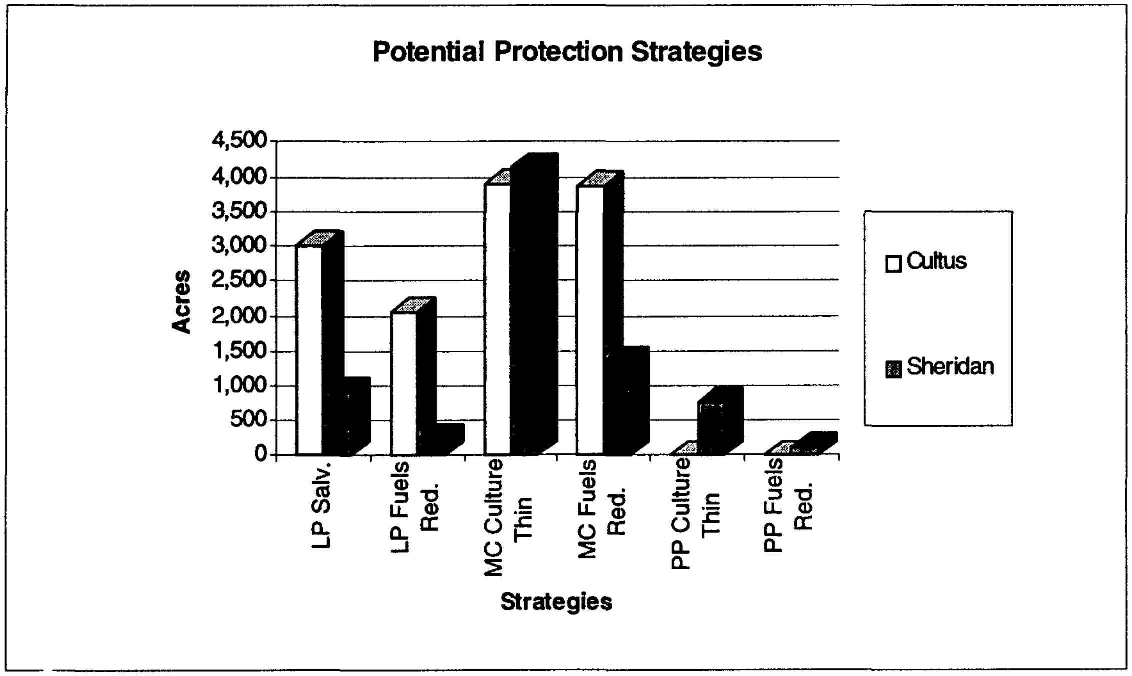
* The potential treatment acreages are categorized by the complexity of the site situations and probability of successful treatment. These are broad treatment summaries and include all the various types described in the assessment. **High** potential equates to a very good probability of implementing successful treatments with low complexity. **Low** potential equates to a low probability of implementing successful treatments. Site situations that have constraints, such as being in a roadless area, high treatment costs, poor access, steep slopes, fragile soils, low opportunity or need (e.g., past harvest), close proximity to nesting owls or eagles, etc., greatly increase treatment complexity. Treatment potential ranking may or may not equate to the priority for treatment, e.g., 1 (generally short-term) or 2 (generally long-term).

** Special Notes: All treatments will require evaluation and cumulative effects analysis mandated by the NEPA process, including a biological assessment that will be reviewed by USFWS. Nearly all of the Cultus LSR is designated as a Critical Habitat Unit for the northern spotted owl by USFWS. This designation is qualified with constituent elements that have to be met prior to treatment activities. If these constituent elements are met, then formal consultation will not be required. Many sites which overlap management and/or regulatory constraints, and cannot be described adequately in a summary table, have been incorporated into the treatment potential ratings. Some MSAs are specific to a particular LSR. The Research Natural Area MSA is specific to the Cultus LSR. The forested lava MSA and ponderosa pine wet and dry MSA are specific to the Sheridan LSR. The MSA for ponderosa pine combines the Wet and Dry PAGs.

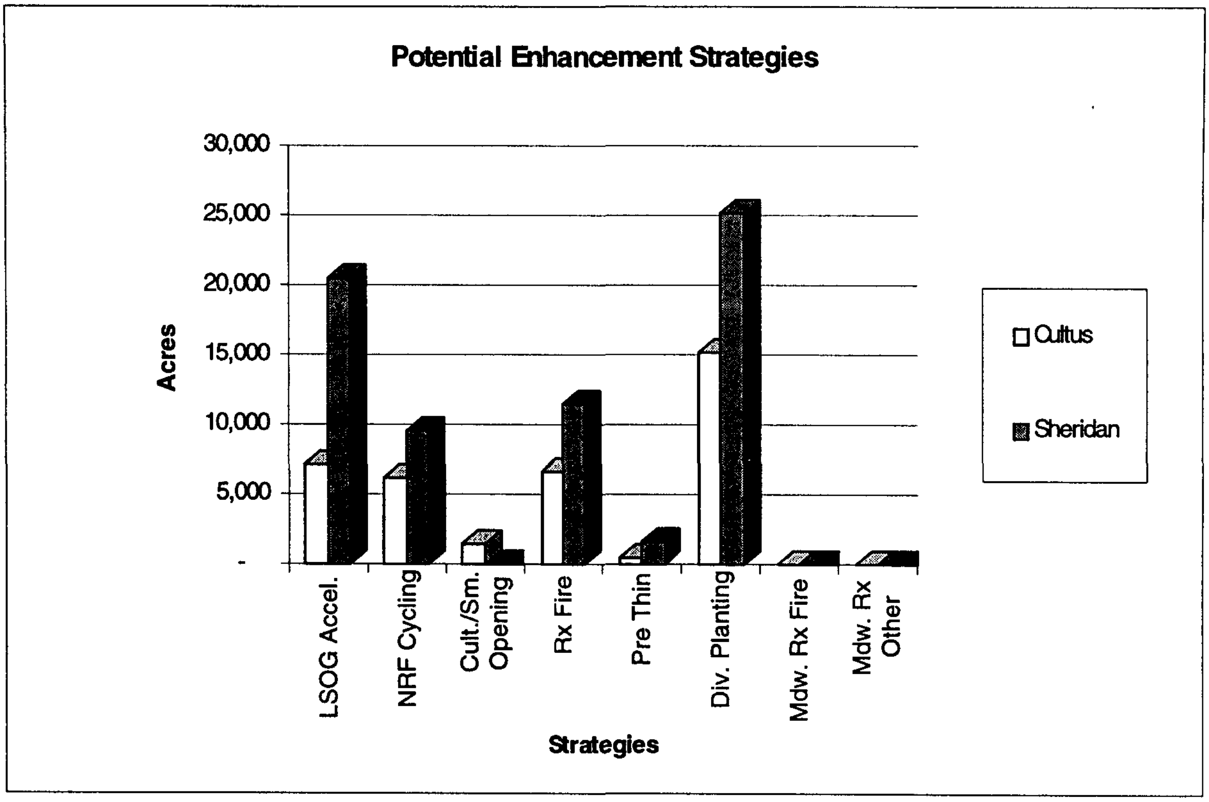
*** UND: Undetermined amount of acres, does not preclude the opportunity to treat stands if a need is determined. Further specific data and analysis is necessary to determine if treatments are needed.

The following bar graphs illustrate the potential protection and enhancement strategies within each LSR. Acreages within the graphs display combinations of strategies for both short and long term opportunities. Acreages represented are based on the existing vegetative condition. Acres to be treated annually and over time would be determined with a site specific analysis insuring that all LSR objectives are met.

GRAPH 1:



GRAPH 2:



PROPOSED CHANGES TO THE LSR BOUNDARIES

The LSR assessment team proposes to increase the Cultus LSR boundary in two areas on the west and south sides of the LSR. The rationale is that the CHU is not totally contained within the Cultus LSR. On the west LSR boundary, approximately 37 acres are outside of the LSR boundary. On the south LSR boundary, approximately 64 acres area outside the LSR boundary. In both of these areas the CHU boundary follows a section line while the LSR boundary follows roads or goes cross country. The proposed boundary change would reduce the risk of activities occurring within the two locations without addressing the CHU. The team recommends changing the Cultus LSR boundary to encompass the CHU boundary in its entirety. Refer to Map 12 in Chapter 3.

MEETING THE CHALLENGES

The LSR assessment is analogous to planning a long journey. It identifies the routes and methods of reaching our goals within the context of the landscape, including many diverse barriers and processes beyond our control. We have a good map, good vehicles and good drivers, but the variables of the road are sometimes unpredictable. By necessity the assessment can only be so specific. Individual projects must still be fine-tuned at the site specific level, which will be done through an environmental analysis for lands planned for treatment within the LSRs. As with our trip, good planning will reduce the cost and prevent errors in our journey, and we must make investments along the way to ensure success and a high quality result. Throughout this effort the ROD objectives, standards and guidelines will serve as a guide to judge the treatments and our progress towards meeting the needs of late-successional species and the ecosystem function upon which they depend. Individual project monitoring will assess the success of implementation and evaluate the effectiveness of the projects in meeting the objectives, standards and guidelines for LSRs as specified in the NWFP. All monitoring results will be used to adjust management approaches and techniques in order to meet the direction for adaptive management.

A copy of the complete assessment may be reviewed at the Bend/Ft. Rock Ranger District. Cooperators may obtain a copy upon request to the District:

Bend/Ft. Rock Ranger District
Deschutes National Forest
1230 NE Third St., Suite A-262
Bend, OR 97701

Specific questions may be addressed to members of the interdisciplinary team members at the Bend/Ft. Rock Ranger District unless otherwise noted. (541) 383-5564.

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The team would like to extend their appreciation for the many persons who provided assistance by reviewing the draft documents including those in the U.S. Fish and Wildlife Service and the Oregon Department of Fish andWildlife.

The responsible officials for this assessment are:

Sally Collins, Forest Supervisor

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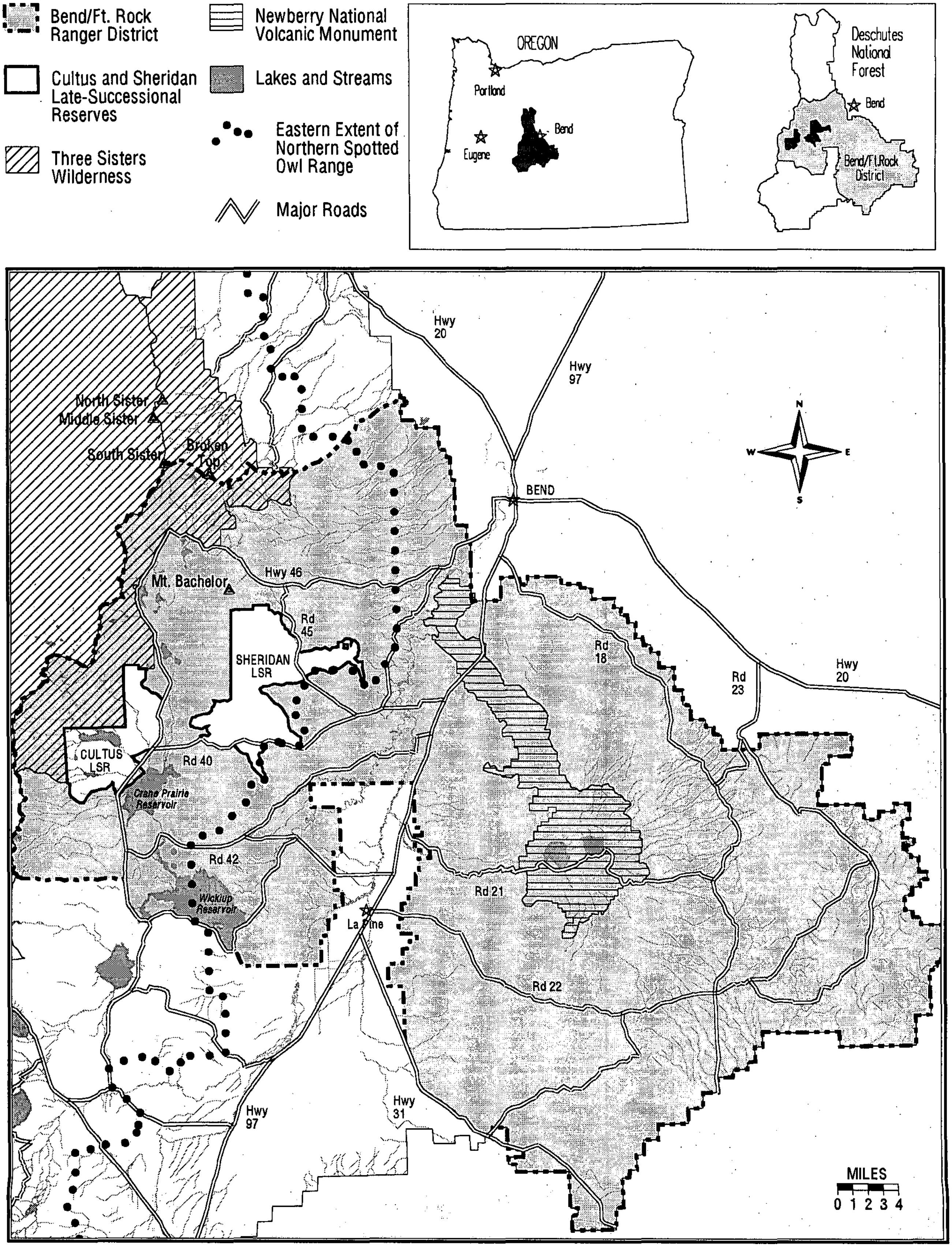
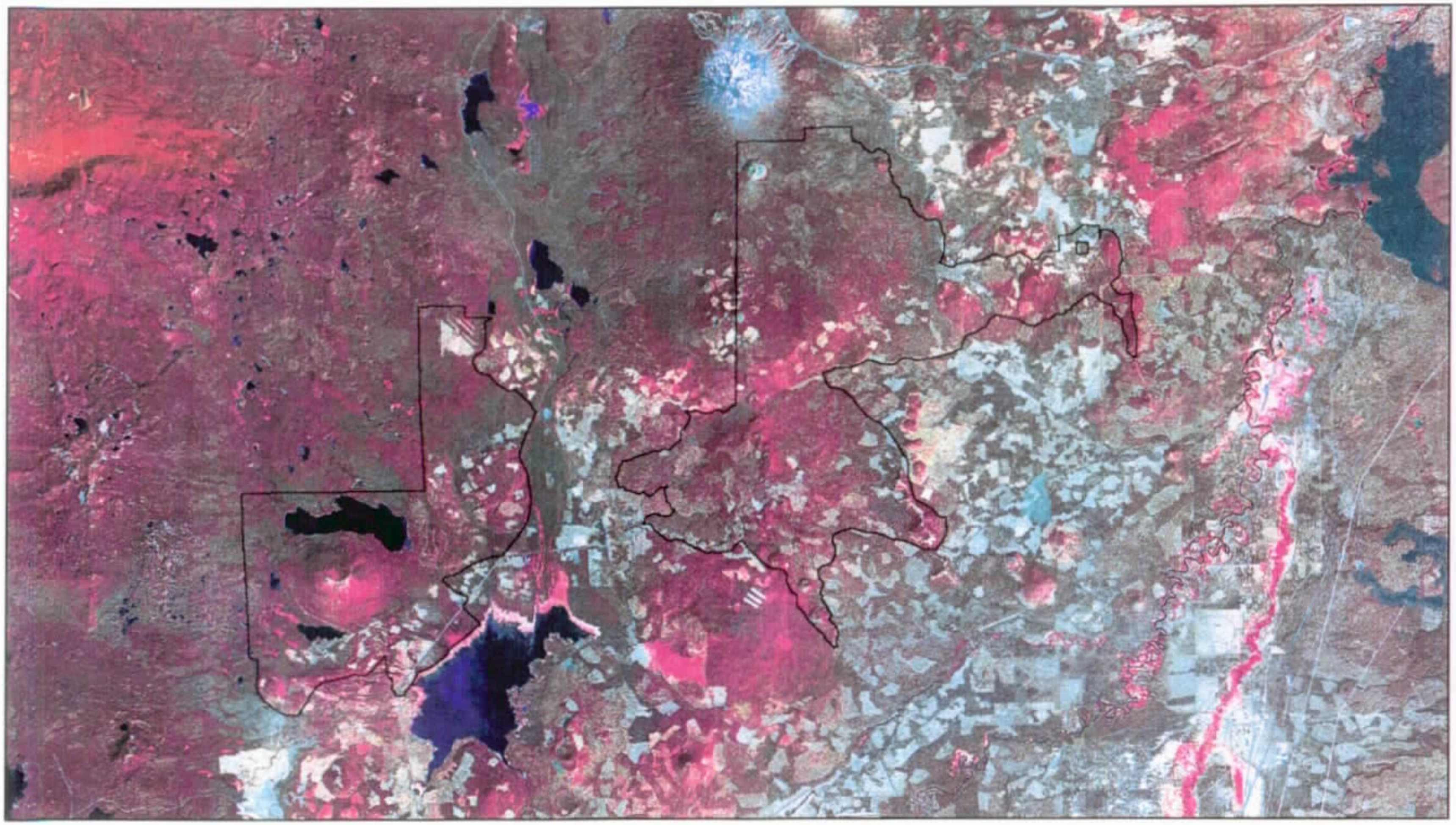
CULTUS AND SHERIDAN LATE-SUCCESSIONAL RESERVES VICINITY MAP



MAP 2 -- LANDSAT IMAGE OF LSR AREA



CHAPTER I: BACKGROUND

A. INTRODUCTION

B. CONNECTIVITY

C. FOREST VEGETATION

D. MANAGEMENT STRATEGY AREAS

I. BACKGROUND

I. A. INTRODUCTION

The 1994 Northwest Forest Plan (NWFP 1994) designated certain key areas of Pacific Northwest forests as Late-Successional Reserves (LSRs). These reserves are to be managed:

> ***"To protect and enhance conditions of late-successional and old growth forest ecosystems, which serve as habitat for late-successional and old growth related species including the northern spotted owl. These reserves are designed to maintain a functioning, interacting, late-successional and old growth forest ecosystem."***

The Northwest Forest Plan also instructed national forests in the Pacific Northwest to prepare Late-Successional Reserve (LSR) Assessments for areas with these special characteristics.

LSR Assessments include the following eight elements:

1. A history and inventory of overall vegetative condition within the reserve (Chapter II).
2. A list of late-successional associated species known to exist within the reserve, and information on their locations (Chapter III).
3. A history and description of current land uses within the reserve (Chapter II).
4. A fire management plan (Chapter VI).
5. Criteria for developing appropriate treatments (Chapter IV).
6. Identification of specific areas that could be treated under those criteria (Chapter IV).
7. A proposed implementation schedule tiered to larger scale plans (Chapter IV).
8. Proposed monitoring and evaluation components to help evaluate if future activities are carried out as intended and achieve desired results (Chapter V).

This LSR assessment covers the Cultus Mountain LSR (Regional #0-56), which is approximately 18,000 acres, and the Sheridan Mountain LSR (Regional #0-54), which is approximately 31,030 acres, hereafter called Cultus and Sheridan LSRs, as designated in the NWFP. This LSR assessment serves as a bridge between the Cascade Lakes Watershed Analysis (Deschutes National Forest 1995) and more site-specific environmental documents to be published after this LSR Assessment is reviewed and evaluated.

Issues relating to aquatic resources, riparian resources, and water quality and water quantity are not addressed in this document in that the NWFP links these issues primarily to the Aquatic Conservation Strategy, ROD page B-9 (NWFP 1994). Such issues are most coherently addressed through Watershed Analysis. Prior to completion of this LSR Assessment, the Cascade Lakes Watershed Analysis addressed these issues in detail. The reader should refer to this analysis for discussion of aquatic related issues and proposed restorative treatments.

I. B. CONNECTIVITY

The Deschutes National Forest Late-Successional Reserve Overview (1995) emphasized that the integrity of late-successional ecosystems is dependent on providing connectivity between individual LSRs. Connectivity between suitable habitats is especially important east of the Cascade crest near the edge of the range of the northern spotted owl and other species. The Cultus and Sheridan LSRs are at the eastern edge of the owl range. Consequently, this Assessment includes information on the characteristics of the habitat outside the LSRs in connective corridors, and outlines proposals for improving connectivity between the two LSRs.

I. C. FOREST VEGETATION

Forest vegetation is described throughout this document based on the concept of potential natural vegetation of a given site. Potential natural vegetation provides a measure of the capability of the land to produce and sustain vegetation that provides wildlife habitat. The historic vegetative composition and dynamics of the LSRs and surrounding land area are discussed in Chapter II using broad vegetative groups such as lodgepole pine and mixed conifer. This was done to ease the tracking within the document of any changes in vegetative conditions over time. The broader groups used to describe historic conditions were then sub-divided into smaller groups that are more specific to moisture regimes and species composition to describe the current vegetative conditions.

Current vegetative conditions described in this analysis utilized work completed in a Forest-wide vegetation mapping project completed in the fall of 1995. Individual plant associations across the Forest were mapped at a 90% + confidence level. This mapping is highly correlated to the plant association mapping completed for the Cascade Lakes Watershed Analysis, which mapped the potential vegetation that a specific soil type would support based on information from the Deschutes Soil Resource Inventory of 1979. These associations and series were then grouped by their climax species, site potential, and productivity into similar Plant Association Groups (PAGs) using the categories listed in the Deschutes WEAVE (1994) document, version 1.12. (WEAVE is the acronym for Watershed Evaluation and Analysis for Viable Ecosystems). Minor site specific plant association mapping changes were made for this project based on new information. The table below and map in Chapter II shows the PAGs, based on potential natural vegetation, that are found across the landscape within the Cultus and Sheridan LSRs. Refer to Process Papers for more information.

TABLE I-1—CURRENT VEGETATION: % & ACRES

Plant Association Group	Common Abbreviation	Lumped PAGs For Analysis	Approximate Acres	% LSRs
Mountain Hemlock	MH	MH	6,160	13
Mixed Conifer Wet	MCW	MCW	10,640	22
Mixed Conifer Dry	MCD	MCD	18,380	37
Lodgepole Pine Wet	LPW	LPW	4,980	10
Lodgepole Pine Dry	LPD	LPD	2,060	4
Ponderosa Pine Wet	PPW	PPW	700	1
Ponderosa Pine Dry	PPD	PPD	3,980	8
Engelman Spruce	MCW	Unique	\	
Rock or Lava	Rock	Unique	2,120	5
Meadows	Meadow	Unique	/	

Individual plant association groups have unique disturbance regimes that affect their long-term stability and sustainability across the landscape. These regimes are discussed in Chapter II of this Assessment by broad area vegetative groups. Each PAG also provides LSOG habitat for a specific set of wildlife species. The discussion of the species associated with each PAG and their specific habitat requirements is reserved for Chapter III. Chapter IV describes the Management Overview, including the desired condition, treatment methodologies, implementation schedule, and management strategy areas.

I. D. MANAGEMENT STRATEGY AREAS

In order to develop specific management objectives, Management Strategy Areas (MSAs) were developed for this assessment. Management Strategy Areas represent areas where desired conditions are determined to meet the unique capability of different land types. Sets of treatment opportunities are identified for each MSA that move the land toward a specified desired condition. These treatment opportunities are developed, summarized and displayed in Chapter IV, Management Overview.

The predominant management objective for the Late-Successional Reserves is to maintain and enhance the late-successional forest on the landscape. The habitat requirements for late-successional indicator species, defined in Chapter III, represents an appropriate desired condition for each PAG. Each PAG, consequently, is considered an MSA for this assessment.

The assessment team then reviewed management direction and resource data to determine if additional considerations needed to be included. This review yielded three exceptions which warranted creation of additional MSAs. These exceptions are:

- With the signing of the ROD, the 1990 Deschutes National Forest Land and Resource Management Plan (LRMP) was amended to include provisions of the NWFP. The ROD directs that standards and guidelines from the ROD be applied to LSRs unless standards and guidelines from the underlying LRMP allocations are "more restrictive or provide greater benefits to late-successional related species." Such restrictions occur in one of the LRMP management allocations, Research Natural Areas. The ROD also says that RNAs are exempt from standards and guidelines as outlined in that document. The two RNAs within the Cultus LSR are proposed RNAs and still need to be designated and a management plan written for them. The team decided to treat these RNAs as if they were designated. Thus, a separate MSA, (MSA G), was developed.
- Certain areas in the LSR have additional objectives assigned that are coequal and not conflicting with the objectives detailed in the ROD. An example of this in the Cultus and Sheridan LSRs are areas of high human use. Forest recreation is not generally incompatible with late-successional forest objectives; however, issues of public safety and the value of recreation developments merit concurrent consideration in developing management strategies. These areas were used to form MSA H.
- PAGs reflect the land's capability to produce and sustain late-successional habitats. While capabilities are reasonably uniform within PAGs, one additional subdivision is necessary to improve the analysis. Forested lavas, because of the interspersion of hummocky lava rock outcrops and small amounts of soil, cannot sustain habitats as dense as in other locations. There is a high potential for reducing long-term productivity through standard stand maintenance operations. In addition, regeneration efforts within some of the forested lava area is difficult at best. Therefore, the forested lava area was delineated on a map and designated as MSA I.

Ten MSAs were developed to completely depict management opportunities in this assessment. The MSAs developed for this assessment are listed below. More information may be found in Chapter IV.

MSA A - Mountain hemlock PAG with LSR objective

MSA B - Mixed conifer wet PAG with LSR objective

MSA C - Mixed conifer dry PAG with LSR objective.

MSA D - Lodgepole wet PAG with LSR objective.

MSA E - Lodgepole dry PAG with LSR objective.

MSA F - Unique habitats PAG with LSR objective.

MSA G - Research Natural Area objective including all PAGs.

MSA H - LSR and Public Safety objectives including all PAGs.

MSA I - Forested lavas with LSR objective including all applicable PAGs.

MSA J - Ponderosa pine wet and dry PAGs with LSR objective.

CHAPTER II: THE LANDSCAPE

II. THE LANDSCAPE

II. A. THE PHYSICAL SETTING

In Central Oregon, landforms and the ecosystems that they support are the legacy of the intertwined histories of volcanoes, glaciers, and climates. Along the Cascades crest, continuous sheets of ice have advanced and receded several times. New volcanoes erupted during and between each Ice Age, blocking a number of ancient drainages and covering glacial landforms with soil forming material that currently supports vegetation on these sites. The existing landscape of lake basins, volcanic buttes, volcanic lavas and glacial moraines is a result of these cycles.

II. A. 1. GEOLOGY

Much of the crest of the Cascade range is less than 200,000 years old and was covered by a glacial ice cap during the last major glacial advance (30,000 to 22,000 years ago). By 22,000 years ago the glacial ice was beginning to retreat and volcanism associated with the Mt. Bachelor volcanic chain began. Continuing eruptions built Mt. Bachelor and Sheridan Mountain, along with many other buttes and extensive fields of lava, over the next 12,000 years. The resulting 121 square mile area was a largely barren area of lava flows and cinder cones. Downwind from cinder cones, deposits of fine cinders provided limited areas of soil-forming material. Glacial deposits to the west also provided an early source of fine material for wind to deposit on some of the lava areas.

Approximately 7,700 years ago the eruption of Mt. Mazama, 62 miles to the south, deposited 12 to 24 inches of white ash over the LSRs. This eruption provided the first soil material for most of the Mt. Bachelor/Sheridan Mountain volcanic chain. In many areas this ash has moved downward into the cracks and rubble of the lavas where it provides a limited soil for vegetative growth. In areas of the LSRs not covered by lavas from the Mt. Bachelor/Sheridan Mountain volcanic chain, the Mazama ash buried the existing soils and altered the existing vegetative associations to varying degrees.

Approximately 2,100 years ago, the eruption of Rock Mesa (approximately 8 miles northwest of Mt. Bachelor) deposited a couple of inches of coarse pumice over the northern part of the Sheridan LSR and the northeastern part of the Cultus LSR. This is the final source of parent material from which soils in the area are derived. Others include glacial tills and outwash, wind blown glacial fines, Mazama ash, and locally derived cinders. There is a minimal influence of bedrock-derived soils within the LSR areas.

LAND TYPES

Based on the geology and soils, 14 land types were identified in the Cascade Lakes Watershed Analysis Area. Seven of these occur within the Cultus and Sheridan LSR Areas.

LAND TYPE 2 (SHERIDAN LSR)

This land type consists of the 22,000 to 10,000 year old basaltic lava flows associated with the Mt. Bachelor/Sheridan Mountain volcanic chain. A significant feature of this land type is the lack of surface water. The highly porous nature of the lavas allows any moisture which falls on the surface to rapidly percolate downward. In some areas, the water continues to move downward until it reaches the regional water table. In other areas, it encounters an impervious layer and begins to move laterally until it emerges in springs outside this landtype. Vegetation in this land type is largely mixed conifer at lower elevations and hemlock at higher elevations. Soils are typically volcanic ash and pumice over basaltic lavas. In many areas, significant amounts of overlying ash and pumice have moved downward into the lavas so that the vegetation on the flows appears to be growing out of nearly barren rock; such areas are called "forested lavas." Slopes within this land type are generally less than 15%, except in some of the higher elevations where slopes of 15% to

30% occur. The lava flows within the Sheridan LSR contain many known caves and there are likely many additional caves which have not been discovered.

LAVA TYPE 2C (SHERIDAN LSR)
This land type consists of the 22,000 to 10,000 year old basaltic cinder cones which are the source of the lava flows of Land Type 2. The vegetation of these cinder cones is typically similar to the surrounding Land Type 2, with the north slopes providing wetter, cooler sites. The slopes of most of these cinder cones are greater than 30%.

LAND TYPE 4 (CULTUS LSR)
This land type is made up of glacial moraines of Suttle Lake Age (30,000 to 22,000 years old) and marks the eastern extent of glacial advance. Cultus and Little Cultus Lakes are held behind glacial moraines in glacially scoured basins. The vegetation of this land type varies greatly, including lodgepole pine, mixed conifer, hemlock, and true fir stands. The soils are typically volcanic ash and pumice over glacial tills. Slopes within this land type are generally less than 15% with small areas of steeper slopes (15% to 60%) on some well defined morainal features.

LAND TYPE 5 (CULTUS LSR)
This land type is made up of glacial outwash deposits of Suttle Lake Age around Crane Prairie. The Deschutes River, Snow Creek, Cultus River, Deer Creek, and Cultus Creek all flow across this land type. All generally lose water into the glacial outwash gravels. The percolating water moves downward to the surface of the underlying LaPine Basin sediments. The vegetation of this land type is largely lodgepole pine with areas of wet meadows. The soils are typically volcanic ash and pumice over glacial outwash deposits. Slopes within this land type are less than 15%; much of the area is less than 5%.

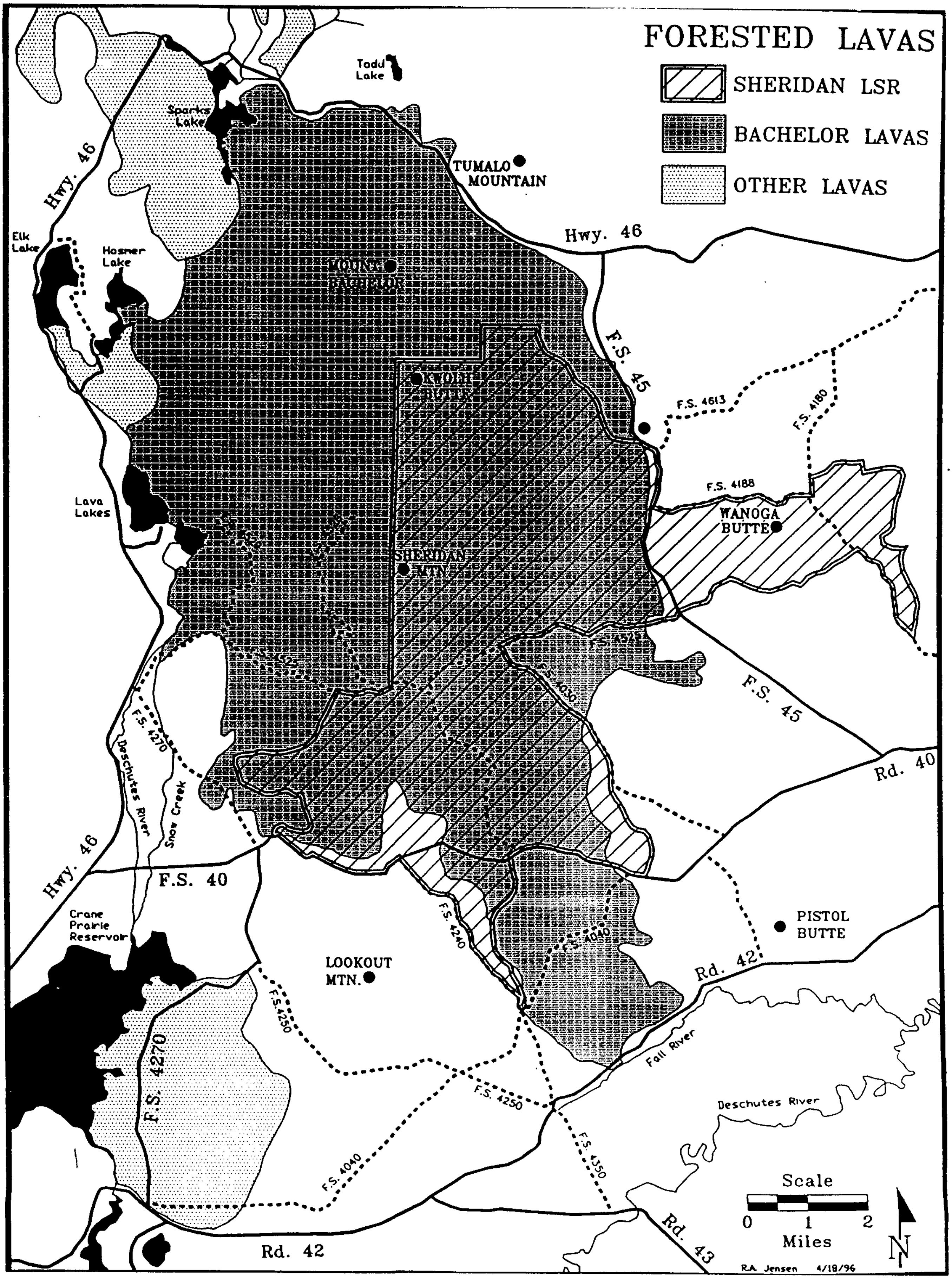
LAND TYPE 7 (CULTUS LSR)
This land type is the dacite dome of Benchmark Butte. The dome is steep sided with slopes of 15% to 60% but is nearly flat on top. A large spring at the south base of Benchmark Butte feeds the Cultus River. The vegetation of this land type is mixed conifer. The soils are volcanic ash and pumice over the broken rubbly surface of the dome.

LAND TYPE 8 (CULTUS AND SHERIDAN LSR)
This land type is made up of unglaciated areas, which are pre-glacial in age and include Cultus Mountain and the Kuamaksi-Wanoga area. The vegetation of this land type includes areas of lodgepole, mixed conifer, and hemlock. The surface soils are volcanic ash and pumice over older buried soils developed on lava flows and ashflows. Slopes are typically 15% to 30% except on Cultus Mountain where they are 30% to 60%.

LAND TYPE 9 (SHERIDAN LSR)
This land type is made up of cinder cones of pre-glacial age, which were not glaciated, including Kuamaksi, Pitsua, and Wanoga Buttes. The vegetation of these cinder cones is typically similar to the surrounding land types with the north slopes providing cooler, wetter sites. Most of these cinder cones contain slopes that are greater than 30%.

FORESTED LAVAS
The term "forested lavas" refers to areas where forests are growing on lava flows. These areas have, over geologic time, accumulated varying amounts of soil. In some cases there is little or no visible surface soil. However, soil pockets do exist in cracks, depressions and open spaces among rocks. The general impression within these forested lavas is that the trees and vegetation are growing out of rocks, not soil (Biglor et al. 1991).

MAP 3 -- FORESTED LAVAS



Within the Sheridan LSR, forested lavas comprise approximately 23,460 acres of land, or about 76% of the LSR. These lavas are part of an extensive field of lava flows and cinder cones called the Mt. Bachelor Volcanic Chain. Geologists from the U.S. Geological Survey mapped this area in the late 1980s and published their work in 1992. Refer to forested lava map.

Over long periods (eons) of time, lava flows gradually weather and accumulate enough soil to support limited growth of trees and other vegetation. The youthfulness of the lavas in this area has limited the amount of soil currently present which, in turn, constrains the amount of biomass that these sites can support.

Two general types of flows make up the lavas of these areas. Rubble flows have a hard, solid core surrounded on all sides by loose, rubbly material consisting of large rocks, gravels and sand size particles. These were produced by the shearing and fracturing of the top of the lava during the original flow. Core drilling has found that the rubble is usually 5 to 20 feet thick (Chitwood 1996). This material is often crushed and used as aggregate for roads.

In rubble flows, a tree seed may fall on one of three different microsites. It may fall on a site where soil has accumulated and is near the surface of the flow. These sites are generally receptive to seedling germination and survival. At a second site, the seed may fall into a deep crack or space between rocks. It may germinate, but darkness does not allow photosynthesis to take place. The seedling generally does not survive. At a third site, soil cannot be seen at the surface but is among the rocks only a short distance below the surface. This situation has the potential for germination and growth; however, the growth rate may be very slow until exploratory roots find other pockets of soil.

The other general type of lava flow in forested lavas is called inflated lava. These flows result from the impressive swelling or inflation of active lavas. In his paper, "Inflated Basaltic Lava - Examples of Processes and Landforms From Central and Southeast Oregon" (1994), Larry Chitwood, Geologist for the Deschutes National Forest, describes this process in the following way:

> *"Flow fronts, which initially advance rapidly, slow down as the lava fans out. Eventually, flow advance ceases when the strength and viscosity of a developing crust cannot be overcome by internal hydraulic pressures. But molten lava continues to flow into the system. The result is inflation. The surface crust rises, tilts, and cracks in complicated patterns."*

The cracks and depressions within this type of flow become locations for soils to accumulate. Vegetation is found primarily within these soil-filled areas which are often referred to as "flower pots." Terry Brock, a former Deschutes NF Soil Scientist, noted in his Soil Note #4, 1988, that:

> *"We have just begun to understand that the trees that have established in the lavas have a different rooting character than do those in non-lava areas. On the broken lava areas, we see that most of the roots are concentrated in the cracks between lava chunks...some fine roots have been seen in the roofs of caves more than 15 feet below the surface. ...Trees may establish in small pockets that have filled with sand and organic soil by wind erosion. These resemble flower pots and they may only be able to support a single species of plants. What would result is total occupation of the rooting volume and would not allow an entire plant community to become established (sic)."*

Chitwood estimates that 70% of the forested lavas are of the rubble flow type and 30% the inflated flow type (Chitwood 1996).

In Central Oregon, the most recent and important single event that deposited soil material across the landscape was the immense eruption of Mt. Mazama about 7,700 years ago. Ash from several other volcanic eruptions, as well as silt and sand from great windstorms, has been accumulating on these lava flows for the past 10,000 to 20,000 years.

IMPLICATIONS

There is a large gap in the knowledge and understanding of the ecological processes occurring on forested lavas. Even though the forests growing here may look similar to those growing on non-lava areas, ecological processes may, in fact, be very different. For example, Dave Perry, an Ecological Scientist with Oregon State University and the Cascade Center for Ecosystem Management, suggests that trees growing on forested lavas are not water limited. Therefore, thinning to reduce competition and stand densities may not be beneficial (Chitwood 1996). Past silviculturists on the Bend Ranger District of the Deschutes National Forest have found that trees growing on forested lavas are not water stressed and continue to exhibit good growth rates through the growing season.

Stand structure and densities vary in the stands found on forested lavas when compared to those on non-lava areas. David Danley, Director of the Sunriver Nature Center, analyzed stand exam information from similar stands on and off lava flows in 1991. His interpretations indicated that the forested lavas have significantly fewer trees per acre than on similar non-lava sites. He also noted that the existing trees on forested lava sites tended to be older than trees on the similar non-lava sites. This trend seems to disappear in the larger diameter tree classes. He also notes that the establishment systems for vegetating these sites are very different, even though the climax plant associations and total biomass produced may be similar.

Regeneration of harvest areas within the forested lavas have had varying degrees of success. Some harvested areas have had better regeneration success and are 80% stocked three years after planting. Other areas could not be regenerated at all by artificial means due to the type of lava flow and lack of soil material. Most available information indicates that natural regeneration time is significantly greater on forested lavas than on forests with little visible lava.

In addition to the slow re-seeding of forested lavas after harvest, silvicultural prescriptions that relied on natural regeneration caused a major shift in vegetative species. Ponderosa pine was lost, while lodgepole pine and white fir were increasing. Questions began surfacing as to whether or not this shift in vegetation was desirable. Other questions also arose including: can vegetation be enhanced by management practices to reach a desired condition more quickly once vegetation becomes established?; can desired vegetative conditions be sustained over time or will they fall apart more quickly on the forested lavas?; and how resilient are these forests to change?

It is acknowledged that more questions than answers exist about the biology and vegetative response in forested lavas. As a result, a research study between the Pacific Northwest Research Station and Oregon State University was initiated in the early 1990s. Preliminary findings of this research have found the presence of a thick and often extensive mycorrhizal mat within the organic litter and duff layer on these sites. The mycorrhizal mats were found to cause a chemical reaction that may be the key reason why the ponderosa pine can become established and grow on sites where we would not expect it to live (Youngblood 1996). Specific management implications of these initial findings are not known at this time. The study will attempt to answer these and other questions and provide recommendations for management activities within the forested lavas. The research study is scheduled to be completed by the end of the 1997 calendar year. Implementation of management activities from that point in time forward, should preceed slowly and be monitored to determine if the treatments were succesful. The intent is to not repeat the same kind of treatements that have served to create the problems we face today in this area.

II. A. 2. SOILS

The following section identifies physical characteristics of the soil resource within the Cultus and Sheridan LSRs and explores the ways in which these characteristics may affect the capabilities of the landscape to support and develop Late and Old Successional stands.

PHYSICAL CHARACTERISTICS

As outlined in the Cascade Lakes Watershed Analysis, the soils within the analysis area are derived from a variety of parent materials including glacial outwash, glacial till, igneous basaltic lava, locally produced cinders and tephras comprised of pumice and ash.

The primary parent material comprising the root zone of trees and other vegetative plants within the two LSR areas is the ash and sand-sized pumice tephra from Mt. Mazama.

The available water-holding capacity of Mazama pumice and ash is less limiting to vegetative growth than the amount and timing of annual rainfall. Soil moisture curves for these soils show that much of the water within the profile is held at tensions that can be overcome by translocation processes. Inhibited growth can occur during dry summer months of below normal moisture years when moisture is in short supply.

Some soil profiles within the Cultus and Sheridan LSRs include buried soil material within the rooting zone that is derived from glacial events and older volcanic tephras. While usually not significant contributors of additional nutrients to vegetative growth, they can provide additional water to roots during the growing season. In the case of the older volcanic ash, higher water retention is due to the slightly finer texture of this material. The combination of fines and gravels that constitutes the glacial till impedes downward flow, holding higher amounts of water at this interface. The glacial outwash is sorted by size, with this uniformity generally consistent with depth. This layer slows, but does not completely impede, downward flow of water at its interface with the Mazama ash above it.

IMPLICATIONS

The young age of soils within the LSRs is the primary limitation to their productivity. Youth has limited the development of the mineral A horizon to less than a few inches in most areas, making this layer very valuable as the primary storage layer of soil organics and available nutrients. Fine organic material incorporated into the mineral soil is a substrate utilized by bacteria and mycorrhizal fungi instrumental in converting organic forms of nutrients into inorganic, plant-useable forms.

Furthering the value of this horizon is the limited annual input of biomass contributed by the vegetative communities present on site. Historic soil carbon levels varied by plant association and fire return intervals, but were generally less than 10% by volume under natural conditions. While fire suppression has increased live understory biomass and organic material on the soil surface in some areas, harvest activities utilizing whole tree removal and fuel piling treatments have removed much of this gain in other areas. The largest increases of surface organics due to fire suppression have occurred primarily within the mountain hemlock, dry mixed conifer and ponderosa pine plant associations, and to a lesser extent within the lodgepole pine PAG.

Specific nutrient limitations of soils derived from Mazama pumice and ash have been shown to be nitrogen, sulphur and phosphorus. Plots fertilized with these nutrients have induced positive growth responses in the short term to support this finding. While not a limitation that prohibits vegetative growth, it is one that reduces the ability of plants to resist stress conditions brought about from drought or from detrimental impacts to the soil resource incurred as a result of management activities.

While not documented in terms of forest health, the additional water provided by buried soil substrates should help trees and vegetation on site resist drought and competition within stands of higher densities.

MANAGEMENT IMPACTS

Management activites within the Cultus and Sheridan LSRs that have impacted the soil resource over the past 75 years include harvest and recreational entries. Harvest activities have occurred to varying degrees within both LSR areas, under primarily shelterwood and partial removal prescriptions. Tables II-1 and II-2 show the varying types and extent of prescriptions on record within these LSRs. The extent of impacts to the soil resource within the LSRs from ahrvest activities is relatively low due to the types of prescriptions and precentage of the area actually entered. Approximately 31% of the total acres within the Cultus LSR and 28% of the total acreage within the Sheridan LSR have been entered in the recent past.

These entries utilized ground based harvest and skidding systems that generally compact an average of 30% of a given activity unit. The compaction of the soil resource results from repeated machine traffic over a given piece of ground. Research has shown that multiple machine trips will increase the bulkdensity of the soil above the 20% allowable by regional standards for pumice and ash soils. Within an activity unit this occurs on skid trails and landings utilized for harvest and to varying degrees between skid trails where harvest machinery has traveled to reach additional trees. Harvest units in which tree were hand felled generally have lower amounts of compaction than those in which machines were used for cutting and skidding operations.

Recreational activities within the two LSR areas have also impacted the soil resource, primarily in the form of compaction, the displacement of surface organics and the subsequent removal of live vegetation in areas of recurring foot and recreational vehicle traffic. Foot traffic impacts are primarily located along riparian corridors associated with perennial streams or lakes and are more prevalent within the Cultus LSR. Off highway vehicle use is more prevalent within and around the Sheridan LSR and has impacted primarily upland soil types as trail widths increase and various breaches occur.

LANDFORM POSITION

Landform position is a prominent component of a soils productivity and development. The Cultus LSR is located within a basin created by topographic rises to the east, west and north. These landforms combine to trap air flowing in from the west and force it to drain south toward the heart of the LaPine Basin. As a result, morning surface temperatures are often below freezing, even during the summer growing months. Some moderation of these effects occurs on the mid to upper elevation slopes on Cultus mountain and Benchmark Butte.

The southern end of the Sheridan LSR is also affected by cold air drainage, while the northern end is moderated somewhat by the presence of the Bachelor chain of volcanic landforms that includes Sheridan Mountain. Cold air making it over this crest tends to drain through the LSR area to the southeast, although there are many days throughout the year when cold air accumulating in the LaPine Basin backs up into the Edison Butte area.

The elevation within the Cultus LSR ranges from 4,450 to 6,759 feet and from 4,400 to 6,890 feet within the Sheridan LSR. These mid-range elevations contribute to colder soil temperature regimes which reduce the length of time that biotic activity can occur within the soil profile.

The slopes of buttes within the LSRs have also influenced the depth of Mazama soils and the resulting productivities. The tephra was originally deposited on bare cinders in many areas and has been relocated downslope by wind and water. Re-deposited accumulations in some areas exceed four to five feet. Many of the upslope source points are now void of Mazama material and have reduced productivity, especially on southern and southwestern aspects.

IMPLICATIONS

The Cascade Lakes Watershed Analysis discussed the effects of landscape position and surrounding landforms on the productivity of soils within this area. Slope aspect and basin relief are the two primary landform characteristics affecting the LSRs ability to establish and support vegetation.

The depth of surface organics and the mineral soil A horizon can vary significantly by aspect. Past disturbance factors such as fire, mechanized harvest and fuel piling activities also have influenced the current status of these layers. Management entries need to minimize disturbance to these soil layers, especially on the thinner south and west aspects, in order to maintain and enhance soil productivity and vegetative growth.

Basin relief often acts as a cold air sink that can inhibit seedling establishment and growth due to radiation frost. Effects can be pronounced with Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco), white fir (*Abies concolor* (Gord. & Glen.) Lindl.) and occasionally ponderosa pine (*Pinus ponderosa* Dougl. ex Loud.). Once established, growth is generally affected until the seedling can gain a height of three feet or more. Maintaining a stand canopy to provide thermal cover can offset these effects.

A higher incidence of frost heave damage and mortality is also found in basin areas. The removal of down woody material from a site can exacerbate these effects by directly increasing daily thermal fluctuations on site. Moderation of these effects can be accomplished by maintaining 6 to 12 tons per acre of down woody material exceeding 3" in diameter on the soil surface. Spring planting can also be used to circumvent the high susceptibility to damage during the early years of a natural regenerated seedling.

II. A. 3. CLIMATE

The Cultus and Sheridan Mt. LSRs are within the major geographical area called Oregon's high plateau, a region that is bordered by the Cascades on the west and several minor mountain ranges on the south and east. Due to generally high elevations, the plateau has cool temperatures and receives the majority of its precipitation in the form of snow during the winter. The plateau's distance from the coast, coupled with its location east of the Cascades, causes its annual precipitation to be lower than in the mountainous areas surrounding it. Temperatures fluctuate considerably during each day and throughout the year. At the Wickiup Dam weather station, State of Oregon Meteorological Department, which has an elevation of 4,360 feet, the average maximum temperatures range from the high 70s in the summer to the mid 40s in winter. Average minimum temperatures range from near 40 in the summer to the high teens during the winter. Precipitation at Wickiup Dam is around 0.7 inches in the summer months and averages 21 inches for the year (Taylor and Bartlet 1993).

The weather data collected from Round Mountain remote automated weather station (RAWS), indicates that the winter lows average in the low 20s and the summer high temperatures are in the mid-80s. Mean precipitation for the 31 years of data at Round Mountain is at 42 inches a year. The wind speeds in the summer average about 7 to 10 miles per hour, with the windiest months being January, February, and March. The primary wind direction is from the south-southeast in the beginning of the year and average west-southwest during the summer months. The average means for herbaceous fuel moistures show mid-March to be representative of a quick green-up with fuel moisture at 200% and then dropping in late May below 30%.

IMPLICATIONS

Cryic soil temperatures limit the length of the growing season during which biologic activity can occur within the soil. Maintaining organic cover on the soil surface can reduce the extreme fluctuations in temperature that inhibit seedling establishment and growth.

The presence of a snowpack can moderate the low end soil temperatures during the winter season, allowing in some years for an earlier return to soil temperatures high enough for biologic activity. While the removal of canopy cover has been shown to increase the total snowpack accumulation on a given site, the maintenance of canopy can slow the rate of snow melt on the same site.

Precipitation is generally not limiting in these areas, although a low snowpack or lack of summer rains can reduce the amount of water available for plant uptake during the summer growing season. Maintaining organic litter and coarse woody debris on the soil surface can increase moisture retention on site across all plant associations in these areas.

II. B. THE SOCIAL SETTING

II. B. 1. RECREATION

The Cultus and Sheridan LSR areas are located just south of the Three Sisters and Mt. Bachelor recreational areas. In all seasons, a variety of motorized and non-motorized activities occur within and adjacent to these LSR areas.

CULTUS AREA

Cultus and Little Cultus Lakes draw thousands of visitors each summer for recreational activities. Cultus Lake draws significantly more motorized use than Little Cultus Lake due to its larger size and the absence of a boating speed limit. Water skiing, jet skiing and fishing are the primary motorized activities on Cultus Lake. Wind-surfing and sailing are also popular because of the steady prevailing winds. Overnight facilities include both developed and undeveloped campgrounds along with private lodging. Forest Service Campgrounds include the automobile accessible Cultus Campground and the boat or hiker accessed West Cultus Campground. Total capacity of these two campgrounds is around 100 spaces. Private lodging is found at Cultus Lake Resort, which operates under a special use permit from the Forest Service and is open from May through October. The resort has a restaurant, store, marina, and 20 cabins available for rent. Additional camping in the area can be found at Little Cultus Lake Campground, Deschutes Bridge Campground and Cow Camp Campground, which features a horse camp and corral. Refer to Map 4.

Dispersed recreational opportunities in the Cultus area are provided by the extensive trail system around and near the lakes. These trails provide hiking, horseback riding and mountain biking opportunities throughout the area. Many of these trails also provide access to the Three Sisters Wilderness for hikers and horseback riders. This 320,000 acre wilderness bounds the Cultus area immediately to the west and draws recreational use primarily between May and October. The area is bordered on the east by the Cascade Lakes Highway, which is a scenic byway and a popular summer drive. Winter recreational use of this area is minimal after the Cascade Lakes Highway is closed by snowfall. Only occasional snowmobile or cross-country skier activity occurs within the Cultus area, with most winter use occurring on the winter recreation trail systems centered around the Dutchman Flat and Mt. Bachelor areas to the north.

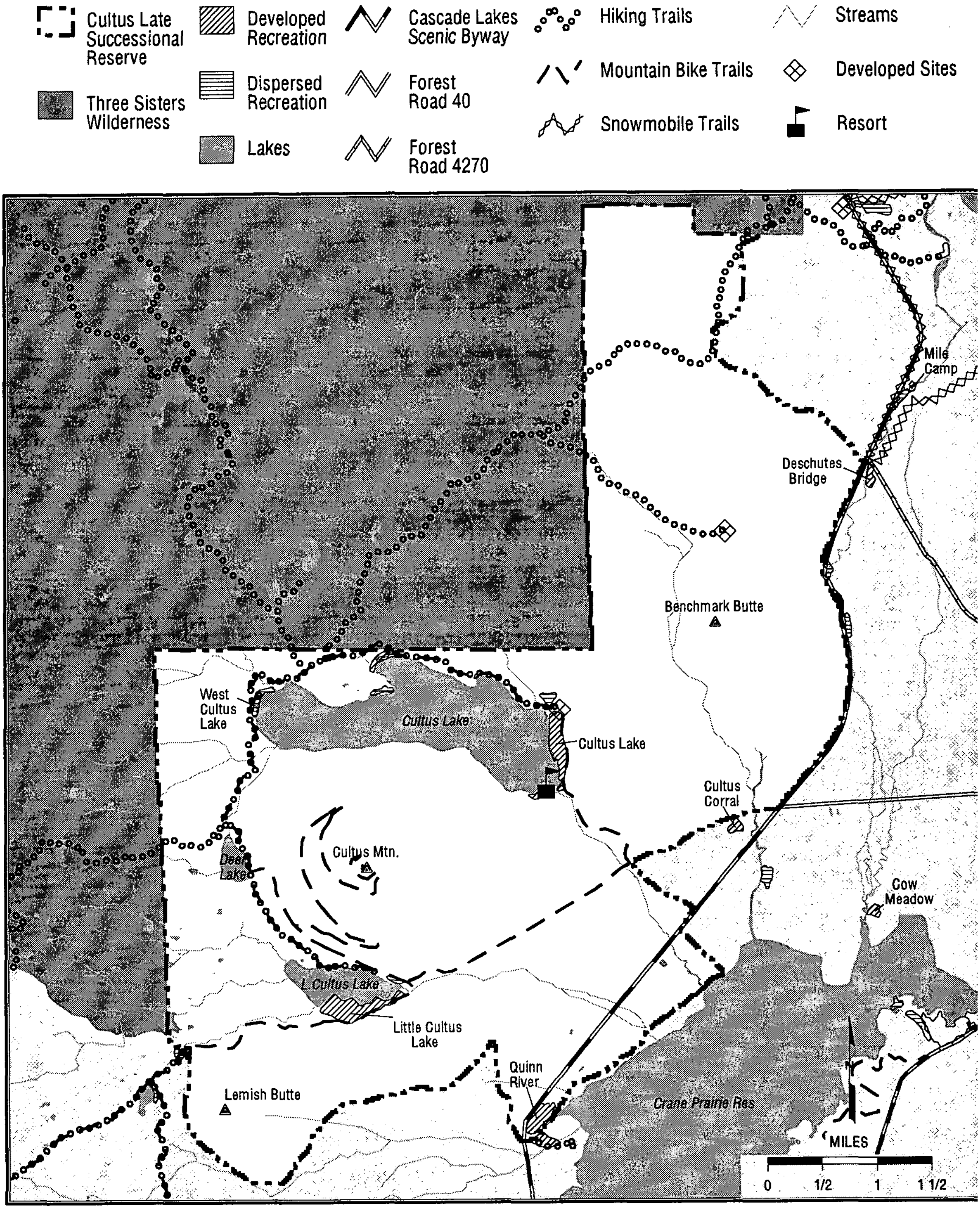
SHERIDAN AREA

The Sheridan area provides primarily day use oriented recreational opportunities. There are no developed campgrounds in the immediate area, although dispersed camping does occur off of forest roads and trailheads in the area. A mix of motorized and non-motorized recreation occurs in this area during both the summer and winter months. In winter, Edison snopark is a popular trailhead for snowmobilers and cross country skiers. Designated cross country and snowmobile trails are connected to this snopark, including an old trappers' trail that cuts west across the Sheridan Butte area and connects up with the Cascade Lakes Scenic Highway some 10 miles to the west. Refer to Map 5.

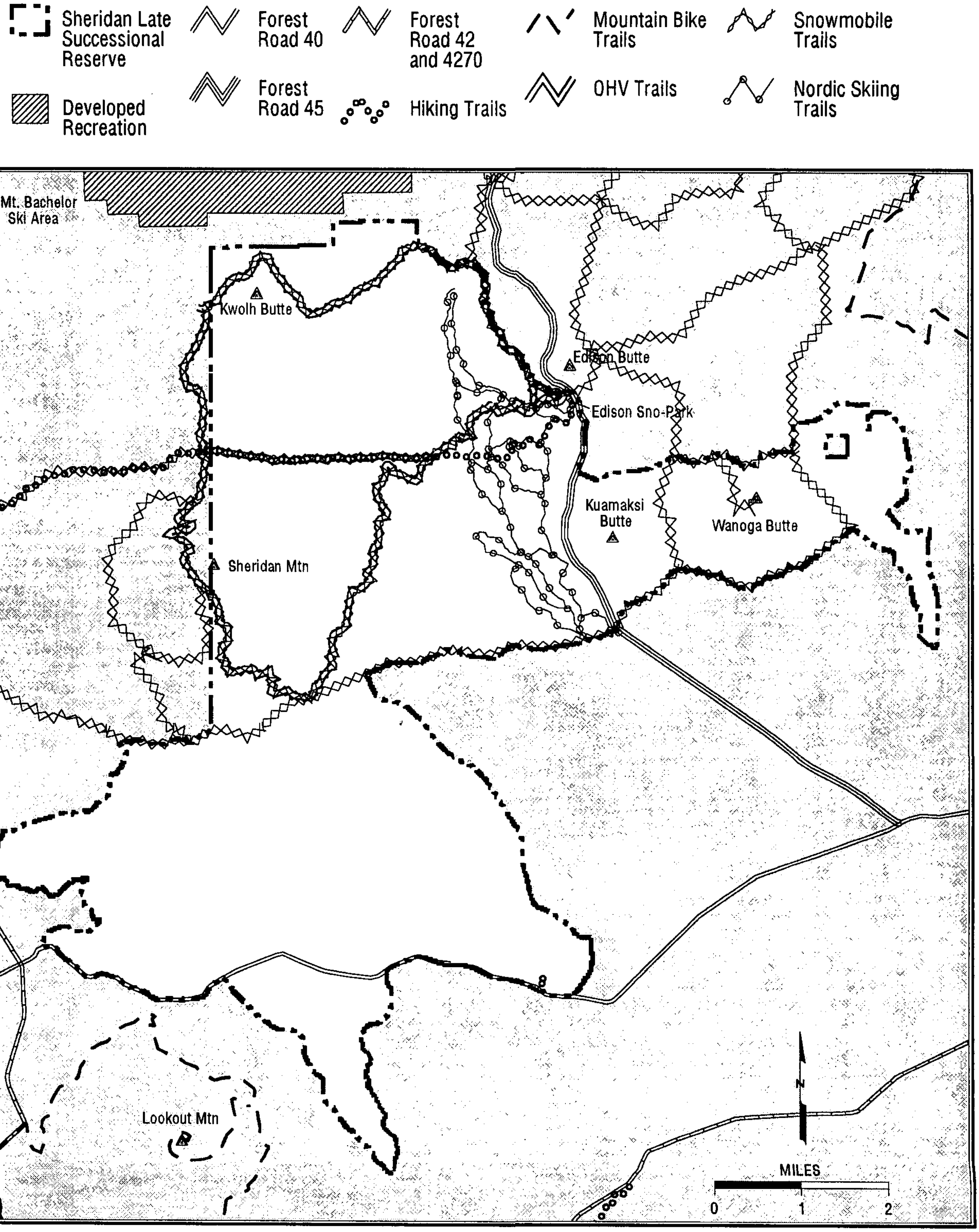
In the summer, off-highway vehicle (OHV) users and mountain bikers make extensive use of the same trail system used by winter recreationists. There are 25 miles of designated OHV trails in the Sheridan LSR. These trails are also used by adventurous mountain bikers. Some special events are also staged in this area, including OHV "poker rides," mountain biking events, ski races, and "mini-triathlons," depending on the season.

This area also features a number of lava caves, and is used extensively by spelunking groups from around the Northwest. The forested lava fields in the Sheridan area offer outstanding scenery, which draws sightseers who are attracted to areas a little off the beaten track. Overall, the area has moderate recreational use.

MAP 4 -- DEVELOPED AND DISPERSED RECREATION
Cultus Late-Successional Reserve



MAP 5 -- DEVELOPED AND DISPERSED RECREATION
Sheridan Late-Successional Reserve



RECREATION RISKS TO THE LSRS

The Cultus and Sheridan LSRs are unique areas, within which various natural resources face risks associated with heavy recreational uses. Late-successional species and their habitats face potential loss that must be addressed or mitigated in order to maintain populations within these areas. Some of these threats to population and habitat are outlined here:

FIRE

In areas where people camp and explore during the summer months, there is always a risk of human-caused fire. Forty to fifty percent of all fires on the Deschutes National Forest are human-caused, including arson and accidental fire starts. Any time people are building campfires in areas with high fuel loads, there is a risk of fire escaping into the forest and destroying trees. This risk is extremely hard to quantify. What is known however, is that a forest with lower fuel loads would sustain less damage than a forest with high fuel loads because the heat damage, soil sterilization, and spread of the fire would be lessened. Refer to the Fire Management Plan in Chapter VI.

SOIL COMPACTION AND EROSION

Soil disturbance from recreational activities near developed campgrounds and along heavily used trails can reduce the ability of the land to support vegetation. OHVs, mountain bikes, hikers and horses can all compact and displace the soil resource, potentially slowing or obstructing growth of vegetation. Erosion from disturbed soils can also result from wind and water events in some heavily used areas. This is a special concern in riparian areas along lake shores and creeks.

WILDLIFE DISTURBANCE

Some species of animals (eagles, raptors and owls) have limited tolerances for human disturbance. Menacing, harassment, or even simply continuing human presence can interfere with these species' ability to reproduce, feed themselves, care for their young, or accumulate the necessary resources to survive the winter. Increasing numbers of people recreating in these LSR areas has increased the amount of disturbance to these species of wildlife. Disturbances range from occasionally forcing an animal off its nest or out of its preferred habitat to actual damage or harm from wounding or killing. In addition to year round campers and day use recreationists, hunting and mushroom pickering in the fall contribute to some wildlife disturbance. This additional pressure though may not significantly impact the wildlife because they are in better physical condition and are better able to tolerate the additional pressure.

MISCELLANEOUS

Humans can impact these areas in others ways. Large numbers of motorized vehicles (cars, OHVs, boats, snowmobiles, etc.) can impact air quality, which in turn may affect lichen populations sensitive to airborne pollutants. Renegade campers and recreationists have also disregarded posted regulations and actually cut down live trees with axes or saws. Some trees are girdled or damaged by hatchets, knives, and other tools. Trees have also been used for target practice, causing additional damage. Heavy recreation use concentrated in one area may cause soil compaction. Wildlife may be disturbed by loud motors on boats and recreation activities that occur near nest trees during nesting season. There is also the risk of escape campfires by irresponsible recreationists.

II. B. 2. CULTURAL RESOURCES

Native Americans used the forested and lakeside areas in and around the LSRs for a variety of reasons. Archaeological sites indicate that Indians used areas around the lakes and buttes for hunting and fishing camps. The relatively high elevation of these areas probably limited most of the use to the fair weather seasons of spring, summer and fall.

Klamath, Molalla, Tenino, and Paiute Tribes all used these areas for many centuries. Some of their activities included hunting for deer, elk, and other animals, fishing, berry picking, and reed gathering. Many of the lake shores, wetlands, and riparian areas appear to have supported large populations of waterfowl in historic times, drawing Indian hunters to the area. A number of important cultural sites around many of the high Cascade Lakes are still in good condition.

The earliest EuroAmerican explorers and settlers began arriving in these areas in the middle and late 1800s. Because of the remoteness of the area, there were few permanent settlements. Use of these areas was primarily limited to hunting, fishing and exploring.

The Cascade Lakes Highway was built in the 1920s, and nearby Crane Prairie Reservoir was formed in 1922. These events, combined with the construction of the first mountain lodges and resorts in the 1930s, drew increasing numbers of recreationists to the area. Overnight stays were the primary recreational uses during this period due to the continued remoteness of this area from a primary urban center. Still, the number of people visiting the area was far less than the intensive recreation occurring today.

Mt. Bachelor Ski Resort was constructed in the late 1950s, and this brought a second "wave" of recreationists to the Cascade Lakes area extending recreational use to four seasons. Today, the primary uses of the LSR areas remain developed and dispersed recreation.

II. B. 3. ROADS

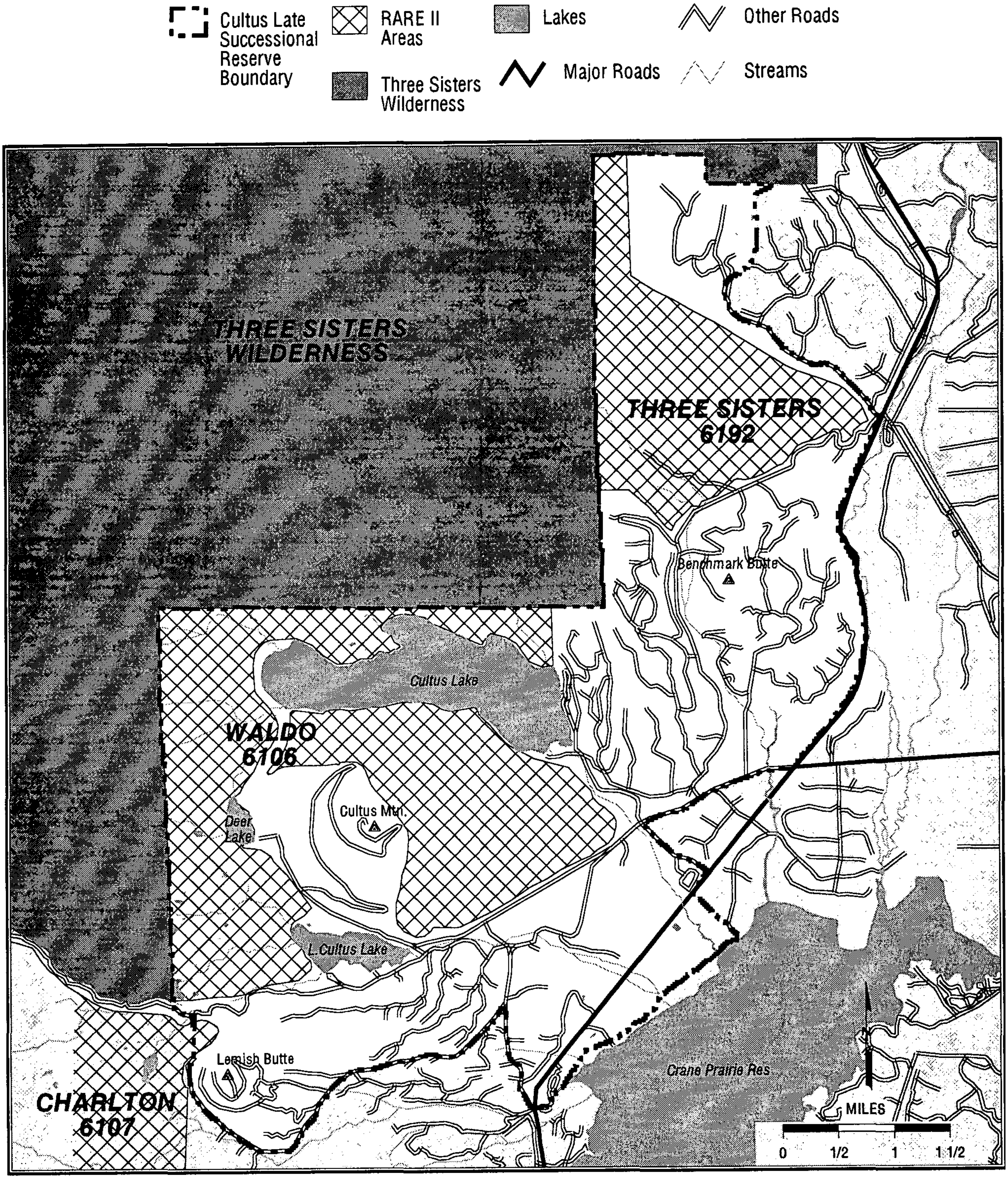
The principal access road to the Cultus LSR area is Route 46, also known as the Cascade Lakes Highway. Road 45 from Sunriver to Edison Snopark is the principal access road for the Sheridan LSR area. Aside from these principal routes, both LSRs have a network of "primitive" roads originally constructed for logging activities or for access to developed campgrounds. Some of the roads are abandoned and now serve as recreational trails.

In addition to the roaded portions, both LSRs contain areas that were Rare II inventoried roadless areas that are referenced in the LRMP FEIS Appendix C. Portions of the Three Sisters Roadless Area (#6192), the Charlton Roadless Area (#6107) and all of the Waldo Roadless Area (#6106) are in the Cultus LSR. About one quarter of the West & South Bachelor Roadless Area (#6195) is in the Sheridan LSR. Some other areas in both LSRs that are outside of designated roadless areas are also essentially unroaded due to remoteness and steep terrain. These areas remain somewhat primitive and undeveloped. Refer to maps 4 and 5.

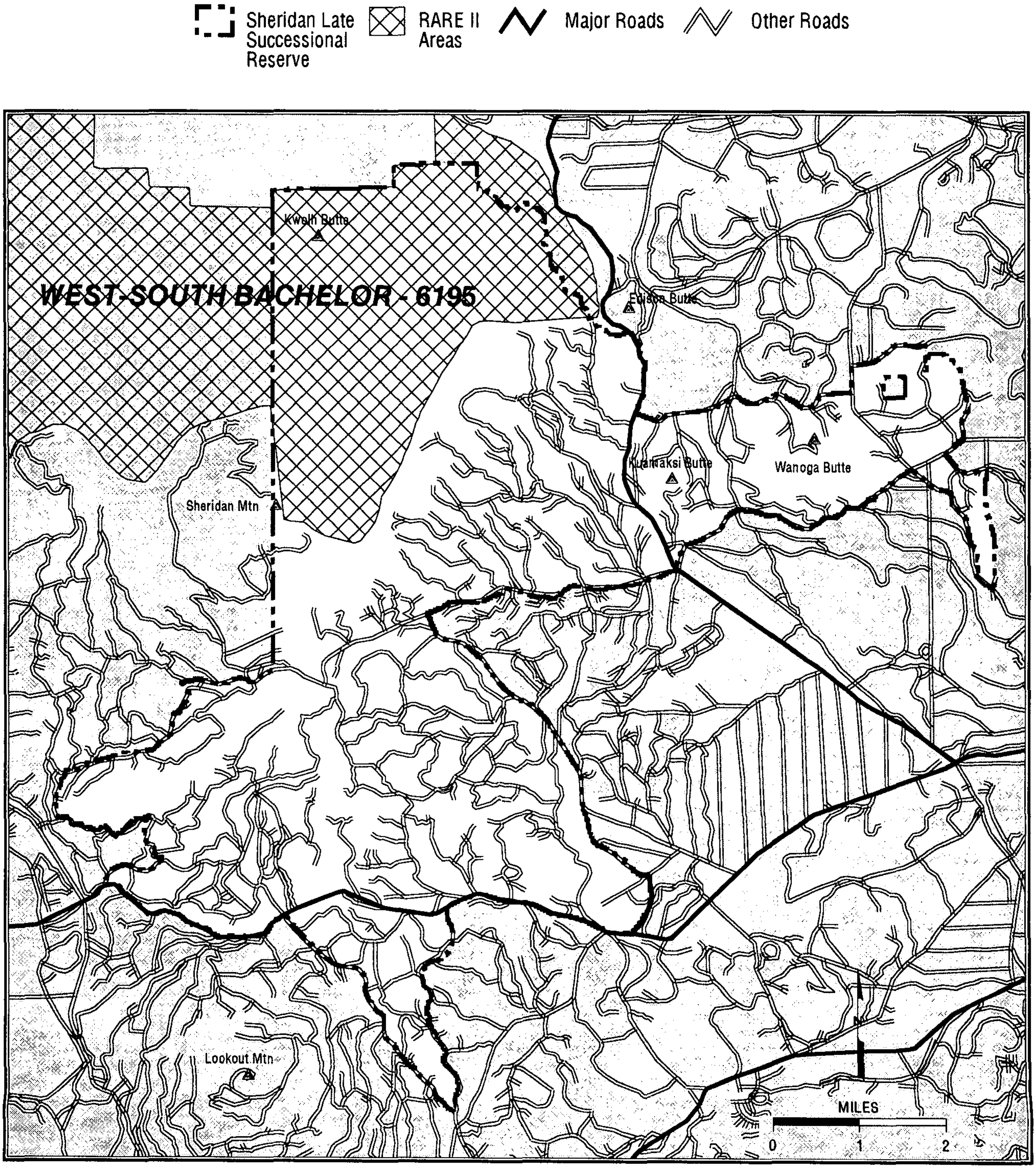
The overall road density in the roaded portion of the Cultus LSR, excluding Off Highway Vehicle trails, is 5.1 miles of road per square mile. In the Cultus LSR, the middle portion and the areas around campgrounds have the highest open road density. Some of these roads have seasonal closures and are gated. Cultus Mountain has one, lightly-traveled primitive road to the top. This LSR is adjoined by the Three Sisters Wilderness to the west, which has no roads.

The overall road density in the roaded portion of the Sheridan LSR is 4.8 miles of road per square mile. Roads are concentrated in the southern portion of the LSR, away from Mt. Bachelor. Refer to Maps 6 and 7.

MAP 6 -- TRANSPORTATION NETWORK and RARE II AREAS
Cultus Late-Successional Reserve



MAP 7 -- TRANSPORTATION NETWORK and RARE II AREAS
Sheridan Late-Successional Reserve



II. B. 4. TIMBER

Although native Americans probably cut trees for a number of purposes, and undoubtedly set fires in selected areas, the primary impacts on trees in these LSR areas has come from man's activities in the 20th century. Central Oregon logging started in earnest around 1910, although the initial quarter century of activity was generally confined to lower elevation stands that were within easy reach of population centers.

Cultus Lake Lodge and its associated cabins were constructed in the 1930s from local lumber. There were few buildings that also used native wood, including summer homes along the Cascade Lakes Highway. The first "commercial" timber sales did not occur until the 1950s. The principal species cut were lodgepole pine (*Pinus contorta* Dougl. ex Loud.) and ponderosa pine with a very small component of mountain hemlock (*Tsuga mertensiana* (Bong.) Carr.). These were not large commercial sales. The Sheridan LSR was harvested originally in the 1950s. Most of these sales were broad area salvage or selection type harvests. Lodgepole pine over 9" diameter breast height (dbh) was also used for the construction of log homes, and high grade pine was used by local mills for a variety of timber products. Virtually all sales took an estimated 20 - 30% of the standing trees.

A second wave of cutting occurred in the 1970s in both areas. A variety of prescriptions were implemented near Sheridan Mountain, Lemish Butte and Benchmark Butte which primarily took mixed conifer and lodgepole pine in selected areas within the LSRs and near the fringes of the LSR boundaries. Part of the emphasis in this round of cutting was actually to construct roads into the forest for fire protection and access. Again, the predominant trees taken were ponderosa pine and lodgepole pine although in some areas there were large amounts of white fir removed. Mountain hemlock was also removed but to a much lesser degree because of its low product value. The road network in parts of the LSR areas have provided easy access for management activities in the last twenty years. Portions of the LSRs that are essentially unroaded have had little or no harvest activity.

CULTUS LSR

Since the 1970s, approximately 53% of the available roaded acres (~10,800 ac) within the Cultus LSR has been harvested. Repeated entries in some areas causes this percentage to be slightly underestimated. The following table shows acres harvested within the Cultus LSR since the 1970s, excluding the acres of broad area salvages that occurred during the 1950s and 1960s. For clarification, non-roaded areas are defined as the inventoried Rare II areas that overlap into portions of the LSRs.

TABLE II-1—CULTUS LATE-SUCCESSIONAL RESERVE RECENT HARVEST RECORD

Acres Harvested	Harvest Code	Description
1,180	HSH	Shelterwood
3,400	HPR	Partial Removal
40	HOR	Overstory Removal
200	HCC	Clear Cut
350	HTH	Commercial Thin
490	HFR	Final Removal
10	HSV	Mortality Salvage

SHERIDAN LSR

Approximately 35% of the available roaded acres (~24,400 ac) within the Sheridan LSR area have been harvested. Again, this percentage may be underestimated due to repeated entries over the same piece of ground. The following table shows acres harvested within the Sheridan LSR since the 1970s, excluding the broad area salvages of the 1950s and 1960s:

TABLE II-2—SHERIDAN LATE-SUCCESSIONAL RESERVE RECENT HARVEST RECORD

Acres Harvested	Harvest Code	Description
1,190	HSH	Shelterwood
4,750	HPR	Partial Removal
20	HOR	Overstory Removal
440	HCC	Clear Cut
710	HTH	Commercial Thin
920	HFR	Final Removal
10	HSV	Mortality Salvage
10	HSL	Selection Cut
190	HCR	Seed Tree w/Reserve Trees
260	HSA	Sanitation Cut
30	HSP	Special Cut

II. C. THE BIOLOGICAL SETTING

II. C. 1. HISTORIC VEGETATIVE COMPOSITION AND STAND DYNAMICS

Landscape patterns and patches are difficult to determine within a historic frame of reference. Insect and disease disturbances and fire events would create patches and patterns across the landscape. The number of patches, the size of patches, the vegetation affected, and the spatial patterns across the landscape would be determined by environmental conditions.

Insect activity within the LSRs in a historical context would have been endemic in scope and may not have caused large scale disturbance patches and patterns. Endemic activity would have probably occurred in small patches, creating small holes across the landscape as compared to today's large scale epidemic insect activity and associated patches.

Root diseases alter vegetation by changing the structure and species composition within the disease centers. Based on present root disease activity, it is safe to say that root diseases have been active in a historical sense also. The most notable would be within the mountain hemlock zone where these disease centers are a normal part of the ecological successional processes.

Historic fire events were of varying intensities and sometimes covered large areas. The magnitude and intensity of the fires were historically determined by the time of the ignition (late spring to fall), the weather at the time of and following the ignition, and the climatic conditions in the previous years. Given all these variables, fire patterns ranged from 1 - 20,000 acres in size, possibly larger.

Accurate determination of historical patches are difficult, if not impossible, to ascertain without intensive soil horizon and pollen analysis.

Present day fires vary in intensity, but the size is usually determined by resource availability and resistance to control.

VEGETATION COMPOSITION AND STAND DYNAMICS

Vegetative composition, canopy cover and stand dynamics are described in a historical context in the following section. This historical vegetative condition is described by the major vegetative types found in the area at the present time. This will allow for tracking between historical discussions and current discussions. Current vegetative conditions dscribed by plant association groups are found in section II.C.2 of this chapter. The vegetation types used for this purpose are mountain hemlock, mixed conifer, ponderosa pine, lodgepole pine and unique. Canopy cover is defined as the ground area covered by a crown as delimited by the vertical projection of its outermost perimeter (Society of American Foresters 1971).

Historic vegetative composition in the LSR areas is defined at a landscape level, on a very coarse scale, from 1882 - 1884 cadastral maps and notes, 1903 Cascade Forest Reserve Surveys, and 1953 mapping and historical atlas information. Notes from the cadastral and Forest Reserve surveys reference tree and shrub species with common names that are difficult to associate with current species names. For example, 'lovely fir' is mentioned often in the notes without a reference to a specific tree species. It is assumed that this refers to the true firs that exist in the area today. Shrub species mentioned in the notes such as buck brush, laurel, myrtle, greasewood and chaparral have a variety of current species as possible descriptors. Inferring which current species they represent is difficult. As a result, the historic species names are mentioned here to provide the reader with background information as to the variety and changes of vegetation over time.

The sections on historic stand dynamics discuss the primary disturbances that have played a role in shaping the historic vegetative condition over time. Fire frequencies and intensities were determined to be the primary influences on stand dynamics based on fire ecology research and the professional judgment and observations of area specialists. Insects and disease were also assumed to have played a role in shaping the historic forests, although there is little information available to quantify this.

Fire exclusion over the past 60 years or so and subsequent human activities of the past 40 years or so have shifted the primary stand dynamic elements from fire to harvest activities and associated roading, and insect and disease outbreaks. The associated increase in insect and disease activity has augmented the fuel loadings in most of the vegetative groups found within the LSRs. The insect and disease activity has been categorized as epidemic in many stands and has increased the risk of crown fire behavior to extreme levels in some areas of the LSRs. Refer to the Disturbance Elements Section later in the document for more specific information on these conditions.

Information from the Deschutes National Forest (NF) Timber Depletion Atlas (1950-1970s) was used to analyze changes in vegetation from harvesting practices during the past 50 years. Harvesting practices from the 1970s to the present day were analyzed using the harvest layer and an associated data base located in GIS. This information was analyzed at a coarse scale across the landscape.

MOUNTAIN HEMLOCK VEGETATION TYPE

VEGETATIVE COMPOSITION

Mountain hemlock is mentioned in association with fir, spruce and pine in the 1882 - 1884 cadastral survey notes. This vegetation is referred to as scrubby or small in size within portions of the Cultus LSR. In the Sheridan LSR, areas of the mountain hemlock vegetation type are found in association with heavy pine and fir. The reserve notes also indicate these species had little value for lumber or any other purpose. A scattering of western white pine (*Pinus monticolor* Doug. ex D.Don) is noted west of what is now Little Cultus Lake. Understory shrub species include willow, huckleberry, alder, buck brush and laurel. Some small lodgepole pine and dense firs were also noted.

STAND DYNAMICS

The two primary disturbance agents in this vegetative type are fire and laminated root rot (*Phellinus weirii*). Each of these affect the structural patterns, densities, and species composition of the mountain hemlock vegetative type over many hundreds of years. Stand conditions also develop with overall changes in climate and topography. Dickman and Cook (1988), propose that the system is still reestablishing its equilibrium following the transition from the warm, dry conditions of 4,000 to 7,000 years ago to the more recent cooler climatic conditions. The warmer, dry conditions probably shortened the fire return intervals of these sites, helping to maintain pines as a larger component of this type. The more recent cooler climatic conditions favor a more abundant, broader distribution of mountain hemlock, and therefore more laminated root rot. Since equilibrium is established slowly, it may never be reached as climatic shifts may re-direct vegetation patterns in different directions.

Fires are a primary disturbance agent in the high elevation hemlock forests. Because the major tree species are fire sensitive and fire return intervals are so long, most fires became stand replacement events regardless of fire intensity. Tree mortality from these events tended to be high in these stands due to thin bark, shallow roots and low to the ground crowns. The lichen component of these stands that grow in the crowns of the early seral trees also provided a nearly perfect fine, flammable fuel when dry (Vickery 1996). This is one vegetative type where stand replacement fires tended to be the rule, rather than the exception.

Laminated root rot is a natural component of the mountain hemlock ecosystem and has developed over time in conjunction with this vegetation type. This is the primary disease agent occurring within the mountain hemlock vegetation type. Root rot pockets contribute to the varied structural characteristics present. The root rot centers expand at a rate of about one linear foot per year and each year the trees on the edges of the openings become infected. Root rot centers are revegetated with lodgepole pine and mountain hemlock. As the vegetation within the root rot pockets becomes established, it provides cover for wildlife and diversity in stand structure.

Hemlock dwarf mistletoe, (*Arceuthobium tsugense*), is an occasional gap former which also affects the mountain hemlock component of the stand. Infected trees eventually die and create small openings in the stand.

Minimal harvest activity has occurred within the mountain hemlock vegetative zone on the Deschutes National Forest. These areas are not currently managed for timber production. Where harvest activity has occurred in the past, regeneration of hemlock has been difficult to attain. Lodgepole pine has been planted to regenerate these stands. Research is almost non-existent for the Central Oregon mountain hemlock areas.

CANOPY COVER

Canopy cover within the mountain hemlock type was probably historically similar to the moderate levels existing today, since the majority of the stands present are still within the lengthy historic fire return intervals of this vegetative type. Composition of vegetative canopies would change as older stands were disturbed by root rot pockets, creating openings usually regenerated by lodgepole and hemlock seedlings. The range and configuration of canopy cover across the landscape also changed as these openings developed into mid-seral successional stages and mid-seral developed into late and old successional stages. Within the associated lodgepole pine stands, canopy cover may be less than it was historically, due to recent mountain pine beetle mortality.

VEGETATIVE TRENDS

- Mountain hemlock types are moving toward late-successional forests which provide unfragmented and unroaded refugia for wildlife species.
- Root rot pockets are regenerating to lodgepole pine and mountain hemlock and provide a different type of canopy cover for wildlife species.
- Past harvest areas have been regenerated to lodgepole pine.

MIXED CONIFER VEGETATION TYPE

VEGETATIVE COMPOSITION

Historically, mature stands within the mixed conifer forests were primarily composed of early seral species of ponderosa pine mixed with climax species of fir and spruce. The 1882 - 1884 cadastral notes indicate heavy spruce, fir and pine with understories of chaparral for the areas southwest of Little Cultus Lake. The Cultus mountain area (Saddle Mountain in the survey notes) was described as having a scattering of large pine on its east side in addition to having a history of large fires that covered almost one half of the township and range. Spruce, heavy pine and chaparral are also noted on other areas of Cultus mountain.

The mixed conifer areas in the Sheridan LSR indicate heavy pine, fir and spruce with dense undergrowth of myrtle, manzanita, greasewood, currant and pine. The 1903 Cascade Forest Reserve notes also mention good quality yellow pine (old growth ponderosa pine) and an open forest in the mixed conifer areas of the Sheridan LSR. At higher elevations, the pines become somewhat smaller and branchy and mix with lodgepole pine. Shrub vegetation was light and consisted of manzanita, laurel, huckleberry, with a few young lodgepole pine. Mountain hemlock is also present in small amounts within both LSRs. Drier mixed conifer sites were composed of a larger amount of ponderosa pine, except on the north side of buttes where soil and moisture were more abundant and able to support a more true mixed conifer forest. The Reserve notes for these drier sites describe a contiguous stand of yellow pine with minor amounts of lodgepole pine. The lodgepole had little or no commercial value.

STAND DYNAMICS

Historically, the mixed conifer forests show the most frequent fire activity of all eastside forests, although cooler, wetter sites have longer fire return intervals (Agee 1994). In the moister mixed conifer sites more vegetation is produced, yet reduced fire starts are generally attributed to the moister fuel conditions. The wetter fuel conditions also reduce the spread and intensity of fires on these sites.

Historic fire intensities and frequencies ranged from frequent, low intensity fires to infrequent, high intensity fires. This is classified as a moderate severity fire regime with a mix of low, moderate, and high intensity fires.

Many of the historic mixed conifer vegetation type areas were more open in appearance than they are today. Ponderosa pine was a more dominant component as frequent, low intensity fires kept these areas in a condition less likely to burn under severe fire weather conditions (Agee 1994). Fires that did occur after extended fire-free periods were generally more intense stand replacement fires that consumed trees and forest floor debris in large patches of 250 to 500 acres across the landscape. Fires burning under these conditions typically killed 70 to 80% of the overstory, compared to a mortality of roughly one third under less dramatic fire conditions. The openings created varied in size as a result of weather conditions, fuel loadings, stand structure and species composition at the time of a fire.

Intermediate and low intensity fires also occurred within this vegetation type. Larger patches created by stand replacement fires were reduced in size or had their densities reduced and species composition altered. This tended to result in a clumpy, uneven-aged structure across the landscape composed of smaller even-aged pockets.

The exclusion of natural fire processes from the mixed conifer landscape over the past 60 years or so has contributed to an increase of later seral species susceptible to insect and disease agents, and the development of complex and larger fuel beds. Fire exclusion and management practices have allowed species with less fire resistance, such as lodgepole pine and true firs, to become established in higher numbers in stands of this vegetation type.

Human management activities have taken place within the LSRs since the early 1950s. Approximately 40 to 50% of the mixed conifer areas within the Cultus LSR and 60 to 70% of Sheridan LSR have been harvested with various prescriptions and methods. These harvest activities have contributed to a variety of shifts in structure, density and species composition that are apparent in the existing stand conditions.

Areas where harvest activities have occurred are composed of small to medium/large structure and early to mid-seral stages. Portions of the mixed conifer stands which have not been impacted by harvest activities, or have been less impacted by salvage-type prescriptions, consist of medium/large structural characteristics and mid, late, and some old growth seral stages. Stands described by the Cascade Forest Survey as fairly contiguous stands of fire climax species (ponderosa pine) with 1/2 to 20 acre openings are now more fragmented and varied across the landscape. Some areas have regularly spaced openings generally ranging from 20 to 40 acres in size. Areas that have been selectively harvested are stocked with a larger amount of true fir as a codominant and remnants of large ponderosa pine in the overstory.

The shifts in structure and seral stage, density and species composition associated with fire suppression and harvest activities have lead to an overall increase in susceptibility of these stands to various insect and disease agents. Increased stand densities have increased the mortality of pine trees from bark beetle attacks. Lodgepole pine have been under attack for many years, with a great amount of mortality occurring in the Cultus mountain and Cultus Lake areas over the past ten years. Lodgepole pine in the Lava Lake, Elk Lake and Hosmer Lake areas have seen an increase in mountain pine beetle (*Dendroctonus ponderosae* Hopkins) activity over the past several years. Large ponderosa pines are highly susceptible to attack by western pine beetle (*Dendroctonus brevicomis* LeCorte).

True firs found in the mixed conifer vegetation type have also been affected by changes in stand densities and composition. Susceptibility to attack from Douglas-fir engravers (*Scolytus ventralis* LeCorte) and defoliator insects has increased. These agents have been noted on the yearly Forest Pest Management aerial survey and are currently occurring at endemic levels within the two LSRs.

Canopy Cover

Historic canopy covers within the mixed conifer type were probably the most variable and are difficult to estimate. It is thought that this type was composed of a higher percentage of ponderosa pine as an overstory component than exists today. Many stands also had a mix of fir species in both the overstory and the understory, although the overall stand density was probably lower under a normal fire regime. The exclusion of fire as a disturbance element has allowed shade-tolerant species to proliferate in many stands, thereby increasing canopy cover. At the same time, there are some areas of high harvest activity where canopy cover has been reduced. The true fir dominated areas on buttes and mountains are probably as dense as they were historically, unless management activities have reduced stocking levels. The overall change in canopy cover within this type is the highest among the vegetation types present within the LSR areas.

Trends in Vegetation

Note: Severity of trends within the mixed conifer vegetation type is gradated across the moisture regimes found within this type.

- Change in forest species composition, structure and canopy closure from predominately ponderosa pine to a mix of true firs and some ponderosa, western white pine and Douglas-fir.
- Overall decrease in forest health resulting from overstocked conditions that favor insect and disease infestations.

PONDEROSA PINE VEGETATION TYPE

Vegetative Composition

Cadastral surveys completed in 1882 - 1884 mention the ponderosa pine type as a mix of heavy pine, pine with fir, and some dense small pine pockets. Ground vegetation described with the survey indicated dense myrtle, manzanita and laurel pockets. The reserve notes describe the area as an open forest with a heavy stand, probably meaning that the area had a dense stand of large diameter ponderosa pine trees covering a large amount of acreage. Timber consisted mostly of yellow pine (old growth ponderosa pine) and was of good quality. Undergrowth was light and consisted of laurel and manzanita with some lodgepole pine.

STAND DYNAMICS

Ponderosa pine forests of central Oregon were fire adapted ecosystems. Fires burned frequently and were generally of low intensity, resulting in a minimal needle layer accumulation and a relatively low amount of large-sized ground fuels. Shade tolerant species, such as fir, were able to establish themselves on moist sites between fire events, but were generally burned out when fire returned. Portions of the pine seedling and sapling component were usually able to survive fire events, with some dog hair thickets being thinned or eliminated completely. Surviving trees became overstory replacements as a stand continued through a fire climax driven system.

While periodic fires served to maintain ponderosa pine in many ecotonal areas, they also affected the shrub composition and abundance on these sites. Several reports indicate that regular burning substantially reduced shrub cover and increased grass cover on more xeric sites, while bitterbrush was noted as being readily eliminated by periodic fire events (Franklin and Dyrness 1973). Other shrubs such as *Arctostaphylos* sp. and *Ceanothus* sp. may increase following fire events as the heat from burning aids the germination of seeds of these species.

Fire suppression activities during the past 60 years have changed the dynamics within the ponderosa pine vegetation type. The removal of regular fire disturbance from ecotonal areas has allowed climax species such as true firs and lodgepole pine to attain dominance (Franklin and Dyrness 1973). The bitterbrush shrub component of this vegetation type, along with the organic litter layer, have also increased as a result of this suppression. Cochran and Hopkins (1991) theorize that the productivity of these sites has increased from historic levels due to the increased source of organic nutrients from the litter layer and the larger amounts of nitrogen fixed on site by the bitterbrush and ceanothus shrub components. This increase in forest floor biomass can also increase the intensity of fire events when they do occur, as evidenced by the Pringle Fire on the Bend District in 1995.

Since the early 1900s, human management activities such as timber harvesting have occurred within the LSRs. There are no ponderosa pine forests within the Cultus LSR.. Approximately 80% of the ponderosa pine forests within the Sheridan LSR have been harvested. Harvest prescriptions have generally been shelterwood and selection type activities. Vegetative treatments contribute to a variety of shifts and changes in structure, density and species composition over time. Shelterwood and selection harvests allow for an increased shrub component as more sunlight reaches and warms the ground. Selective logging in areas transitional to fir species accelerates the successional trend toward dominance by these species (Franklin and Dyrness 1973). This may occur on moister ponderosa pine sites situated on the north aspect of buttes, where evapotranspiration is slightly reduced compared to warmer aspects.

Other effects of fire exclusion and harvest activities include an increase and in-growth of shade tolerant species such as firs and hemlocks, and the increase of opportunistic species such as lodgepole pine. Changes in densities have placed an additional stress on older trees, predisposing them to attacks by insects and disease. The most common insect to attack stressed ponderosa pine is the western pine beetle, while the mountain pine beetle is also an occasional attacker. Selective cutting has provided a large food base for the root decay fungus *Armillaria ostoyae* by increasing the host type trees within these stands. In some cases root disease is spreading rapidly resulting in an increase of successful attacks and subsequent mortality occurring in even the more resistant ponderosa pines.

Fire exclusion and harvest activities have also altered the structural character of ponderosa pine stands to a state that has enhanced the ability of western dwarf mistletoe (*Arceuthobium campylopodum*) to spread and intensify. Mistletoe infected ponderosa pine shelterwood harvests supporting fully stocked understories of young ponderosa are maintaining mistletoe across all size classes within the stand. This is not a condition likely to have existed historically.

CANOPY COVER

The ponderosa pine type had a lower canopy cover historically than that existing today. Historic, frequent ground fires favored widely-spaced large diameter trees and a minimal understory. Some variation in canopy cover occurred with the presence of pockets of regeneration and pole to sawtimber size trees. Aspect also influenced stand density and species composition within this type. Over time, as lodgepole pine and white fir have invaded the understory, the canopy cover has increased within this vegetative type.

VEGETATIVE TRENDS

- Change in forest species composition, structure and canopy closure from predominantly ponderosa pine species to a mix of lodgepole pines and true firs.
- Overall decrease in forest health resulting from overstocked conditions favoring insect and disease infestations.

LODGEPOLE PINE VEGETATION TYPE

VEGETATIVE COMPOSITION

Historically, the lodgepole pine areas were a mix of open land recently disturbed by fire, areas of regenerating lodgepole in the seedling to sapling size classes, areas of pole to small size diameter trees, and areas with some degree of mortality due to insect outbreaks. Large diameter lodgepole pine in these areas were an exception reserved for better sites associated with creeks and meadow areas.

STAND DYNAMICS

Historic fire regimes in association with insect cycles, were probably the primary disturbance agents within the lodgepole pine vegetation type. This discussion focus on the lodgepole pine vegetative type in general due to the small percentage of lodgepole pine asociated with the LSRs. Most fires were the result of lightning strikes attracted by large trees on buttes. Climatic conditions usually drove the fires downslope and into the lodgepole pine areas (Hopkins 1996). Stand replacement fires of variable sizes appear to be the main fire pattern in this vegetative type. This pattern suggests that while fires were usually small in size, large fires occurred at 20 to 40 year intervals and affected 50 to 1,000 acres. These larger fires usually burned 70% of the basal area of a stand. Intermediate and low intensity fires probably occurred between stand replacement fires, dividing many of the larger patches. Moister lodgepole pine sites supporting immature stands can have periodic, cool, smoldering-type fires capable of thinning without burning the whole stand. Light fuel loadings, fuel beds that are densely shaded, and a relatively short fire season tend to inhibit fire behavior in the stands until they reach maturity.

Timber harvesting has occurred within the lodgepole pine type since the early 1900s. Harvest prescriptions past and present have been primarily salvage sales, clearcuts, and clearcuts with reserve trees. Commercial thinnings removing small diameter trees to create a well spaced stand have occurred to a minor extent. The most recent harvest activities have been aimed at removing beetle killed trees. The Cultus LSR has had approximately 30% of its area in lodgepole pine harvested to some degree. Approximately 60% of the lodgepole pine type within the Sheridan LSR has received some kind of harvest treatment. The majority of these areas are now regenerating with an over-abundance of lodgepole seedlings.

The exclusion of natural fire processes from these stands over the past 60 years has contributed to an increase in longevity and stem density within many of these stands. This has caused an overall increase in insect and disease activity, with an epidemic outbreak of mountain pine beetle affecting these stands over the past decade. Lodgepole pine within the Cultus LSR has been hit the hardest, with mortality occurring on as much as 80% of the basal area of these stands. If natural fires had not been suppressed it is thought that the stands that escaped the natural fire regimes would be the ones affected by epidemic levels of insect activity.

The dynamics of the lodgepole pine type are such that nature would burn this insect induced mortality, creating new openings and allowing for the regeneration of a new stand. Dead standing trees with red needles and red needled witches brooms become instant candles when fire reaches the brooms. This occurred in the Four Corners Fire in 1994. Dead trees that have fallen over or blown down create massive acreage of jackstraw timber that become high fire hazard areas. These stands usually have overstocked understories associated with them that create and help fuel the fire ladder. The risk of extreme crown fire behavior is very high within the late stages of the lodgepole pine type. While the disturbances historically described are a part of the natural processes in these forests, the extensive mortality that has resulted may not be socially acceptable along scenic corridors and surrounding developed recreational facilities. Public safety is a primary concern associated with these conditions.

Lodgepole pine dwarf mistletoe (*Arceuthobium americanum*) is an important agent affecting vegetation patterns in the historic lodgepole pine forest. The witches brooms and dead trees in mistletoe centers were undoubtedly a cause of differentially hot burns, creating variety on the landscape. Dwarf mistletoe probably contributed to habitat diversity by providing small openings in the relative uniformity of the lodgepole pine forest.

Salvage operations removing only dead trees have often left mistletoe infected green trees in the overstory. Well spaced live mistletoe infected trees were not likely a common historical occurrence. More likely, these trees would have been consumed by fire , allowing for a less affected understory to regenerate. Wide spread mistletoe distribution has resulted across the landscape.

CANOPY COVER

Historically, canopy cover within the lodgepole pine vegetative type in general is estimated to have been at lower levels than is present today. The lodgepole pine type areas were most likely in a mosaic of open areas with minimal regeneration; denser stands of a more even-aged character; and older overstocked even-aged stands, where conditions approached those favoring epidemic insect outbreaks. The dense monoculture stands that exist in these LSRs today were not the norm historically. Canopies within the lodgepole type are much denser today due to lack of natural stand replacement fire regimes that would have resulted in multi-aged stands. Many of these canopies, however, are actively being reduced by mountain pine beetle-induced mortality and harvest activities. .

VEGETATIVE TRENDS

Note: Severity of trends within the lodgepole pine vegetative type are variable across the moisture regimes of stands found in this type.

- Increase in insect activity and associated mortality in lodgepole pine forests.
- Overall increase in dwarf mistletoe incidence and severity.

UNIQUE VEGETATIVE TYPE

VEGETATIVE COMPOSITION

The unique vegetative type includes Engelmann spruce spruce (*Picea engelmannii* Parry ex Engelm.) bottomlands and meadows. The Engelmann spruce bottomlands are found mainly in association with the moist mixed conifer sites near creeks and rivers within the Cultus LSR. They may also be found in association with lodgepole pine types in moister areas. Meadow areas are normally found associated with creeks, rivers and lakes within the Cultus LSR.

STAND DYNAMICS

Historically, fires and fluctuations of the hydrologic regimes played a larger role in maintaining the open character of meadows by controlling shrub and tree encroachment along meadow edges. With fire exclusion, tree species such as lodgepole pine, mountain hemlock and Engelmann spruce have become established along the edges and interior of most meadows, thus, decreasing the size of meadow openings.

Little historical information is available specific to the Engelmann spruce areas. Their ecological development has been naturally progressing over time and will continue to do so unless interrupted by human or natural disturbance events.

No management has occurred within the unique areas although some areas are being impacted by recreation activities. Impacts may be enough to set the meadows back to an earlier seral state and may have long term detrimental impacts on plant diversity, associated soil quality, and vegetative structure.

Vegetative Trends

- There are currently fewer acres of meadows presently than the amount existing historically.
- Engelmann spruce areas are progressing through natural succession without human intervention.
- Meadow areas are being impacted by recreation use.

II. C. 2. CURRENT VEGETATIVE COMPOSITION AND STAND DYNAMICS

INTRODUCTION

The following section discusses the current composition and condition of vegetation within the PAGs identified in the introduction of this document. Plant association groups are composed of individual plant associationsthat are grouped together based on site productivity. Refer to process papers for more information. This information is a baseline condition to which the "desired" habitat conditions for species that utilize LSOG vegetation are compared. These PAGs also form the basic groupings for recommending management actions, depending on their unique characteristics and needs. Refer to Map 8.

VEGETATIVE OVERVIEW

Mountain hemlock plant association groups are found at higher elevations within both LSRs. Lodgepole pine is associated with the mountain hemlock PAGs and has been under attack by the mountain pine beetle. Laminated root rot is a natural component of the mountain hemlock ecosystem creating openings within stands. These root rot pockets are being naturally regenerated with lodgepole pine and mountain hemlock.

The majority of the vegetation within the LSRs is composed of the mixed conifer plant associations. The dominant climax species in these associations are white fir with minor amount of Douglas-fir. Ponderosa pine, lodgepole pine, and to a lesser extent western white pine. Throughout much of the area though some of these species are now subordinate to the true firs. The mountain pine beetle has been active in the mixed conifer PAG areas within the Cultus LSR, attacking and killing a high percentage of the associated lodgepole pine. Diseases such as armillaria root rot are present in the Sheridan LSR and have become aggressive pathogens, attacking and killing the more resistant pine species. Overall forest vegetative conditions range from being overstocked and at a high risk to extreme crown fire behavior and insect and disease epidemics, to areas of more open, widely spaced trees remaining from past harvest activities with a lower potential risk to crown fires or insect outbreaks and in some cases an increase in root rots.

Ponderosa pine plant associations are found only within the Sheridan LSR. Stands that have not been harvested are typically composed of overstories of ponderosa pine with dense understories of lodgepole pine and ponderosa pine. These stands are overstocked, stressing the ponderosa pine and increasing their susceptibility to attacks by western pine beetle and root disease. These vegetative conditions also create a high risk of crown fire behavior due to the fuel ladders and multi-storied stand conditions. At the other end of the vegetative condition range are stands that have been harvested, which are generally described as stands of widely spaced large diameter trees with a regenerating single layer understory. The risk to crown fire behavior in these stands ranges from low to moderate. In some instances, stands that have been harvested are at risk to disease agents that may cause greater amounts of damage than if the stands had not been harvested.

The lodgepole pine plant associations are found in cold air drainage pockets and high water table areas. These stands have been under attack by the mountain pine beetle for approximately the past decade, dramatically changing the structure of the stand that existed prior to the infestation. These attacks have resulted in mortality rates of as much as 80% of the basal area of the stand. Lodgepole pine is naturally regenerating the openings created by the beetle-induced mortality. At the other end of the scale are areas that have been harvested and are now open in appearance with a widely scattered overstory of lodgepole pine and a regenerating lodgepole pine understory. The risk to extreme crown fire behavior is low to moderate within these areas. Mistletoe is prevalent throughout the lodgepole pine areas.

The unique plant association group is composed of rock, meadows, grass, and Engelmann spruce areas. Most meadows are being encroached upon by tree species, thus reducing the total meadow area. Frequent fires probably kept the meadows in a more open condition with little encroachment. The Engelmann spruce areas are found in association with the wet lodgepole pine and wet mixed conifer areas. Most of the spruce vegetation is considered to be within a mid to late/old structural stage.

The following tables are an overview of the acres of land categorized by plant association group and by seral stage within each LSR. The acre figures in the following tables are based on 1988 raw ISAT data which consists of 25 meter square pixel data and are rounded to the nearest tenth.

TABLE II-3—CULTUS LSR (18,000 ACRES)

PAG	Early Seral Stage Ac	%	Mid Seral Stage Ac	%	Late/Old Growth Stage Ac	%	Total PAG Ac
MH	90	4	840	34	1,500	62	2,430
MCW	70	4	440	25	1,290	71	1,800
MCD	1,180	14	2,240	28	4,630	58	8,050
LPW	380	14	1,590	58	830	30	2,800
LPD	30	2	640	67	300	31	970
UNIQUE	210	11	340	17	1,400	72	1,950

TABLE II-4—SHERIDAN LSR (31,030 ACRES)

PAG	Early Seral Stage Ac	%	Mid Seral Stage Ac	%	Late/Old Growth Stage Ac	%	Total PAG Ac
MH	80	2	1,540	41	2,110	57	3,730
MCW	470	5	5,440	62	2,930	33	8,840
MCD	550	5	5,860	57	3,880	38	10,290
PPW	50	7	430	62	220	31	700
PPD	370	9	2,270	57	1,340	34	3,980
LPW	270	12	1,310	59	640	29	2,220
LPD	20	2	660	61	410	37	1,090
UNIQUE	100	55	50	30	30	15	180

PATCHES AND PATTERNS OVERVIEW

Human-caused disturbances and fire suppression activities have created a different patch size and pattern within the LSRs and surrounding areas than that which existed historically. The most noticeable changes are the openings created by harvest activities. Insect and disease patches are becoming more pronounced due to current vegetative conditions which favor insect and disease infestations. The natural mosaic fire pattern has been altered by fire suppression and harvest. Fires that do occur will most likely be stand-replacing versus low-intensity ground fires. Landscape patches and patterns are very different today from what probably existed historically.

Of the two LSRs, harvest activities are more prevalent within Sheridan. These activities have created a range of openings and patterns, including some very open areas. Silvicultural treatments that are shelterwood and selection types have left scattered large trees within some units. Artificial or natural regeneration has most likely occurred, and in some instances shrub recovery has been prolific. Canopy cover has dropped significantly compared to the surrounding un-harvested forest. Thinning treatments have left more trees on the landscape and reduced the canopy cover, but not to the extent of selection type treatments. Shrub and tree regeneration are not as great, or may be non-existent within thinning treatment areas. This is normal for thinning regimes. Salvage treatments would not have significantly altered the amount of tree vegetation or canopy cover as compared to surrounding un-harvested forests. A few holes would occur and may regenerate naturally with trees or shrubs.

The most notable insect-created pattern within the LSRs has been the recent mountain pine beetle outbreak in dense stands of pure lodgepole pine. Lodgepole pine tree pockets in association with the mountain hemlock and mixed conifer PAGs have also been experiencing attacks of the mountain pine beetle. In these areas, canopy cover has been reduced or eliminated, creating small holes within the mixed conifer vegetative zones and large holes within the mountain hemlock zone. However, most beetle attack activity is occurring outside of, but adjacent to, both LSRs where the pure, dense lodgepole stands occur. The consequences of these attacks will have an effect on the connectivity and amount of habitat between the LSRs.

Other insects have the potential to cause major vegetative changes that can create additional patches and patterns. The mixed conifer area is imminently susceptible to attacks by defoliator insects and bark beetles. This does not mean attacks will happen, but, given the existing condition of the vegetation, the potential exists for outbreaks. If an outbreak occurs in epidemic proportions, large patches may be created across the landscape since the mixed conifer vegetative zone is the largest within both LSRs.

Root diseases have also contributed to landscape patterns and patches. As a root disease center expands, trees on the edges of the openings become infected and eventually die. These openings are then colonized by species that are more resistant to the root disease, regenerating a new stand. The more resistant species are generally lodgepole pine and western white pine, which add to species diversity of the forested landscape. Thus, forest structure and species diversity are altered, creating patches and patterns. Root disease pockets are easily identified within the mountain hemlock zone from aerial photography interpretation.

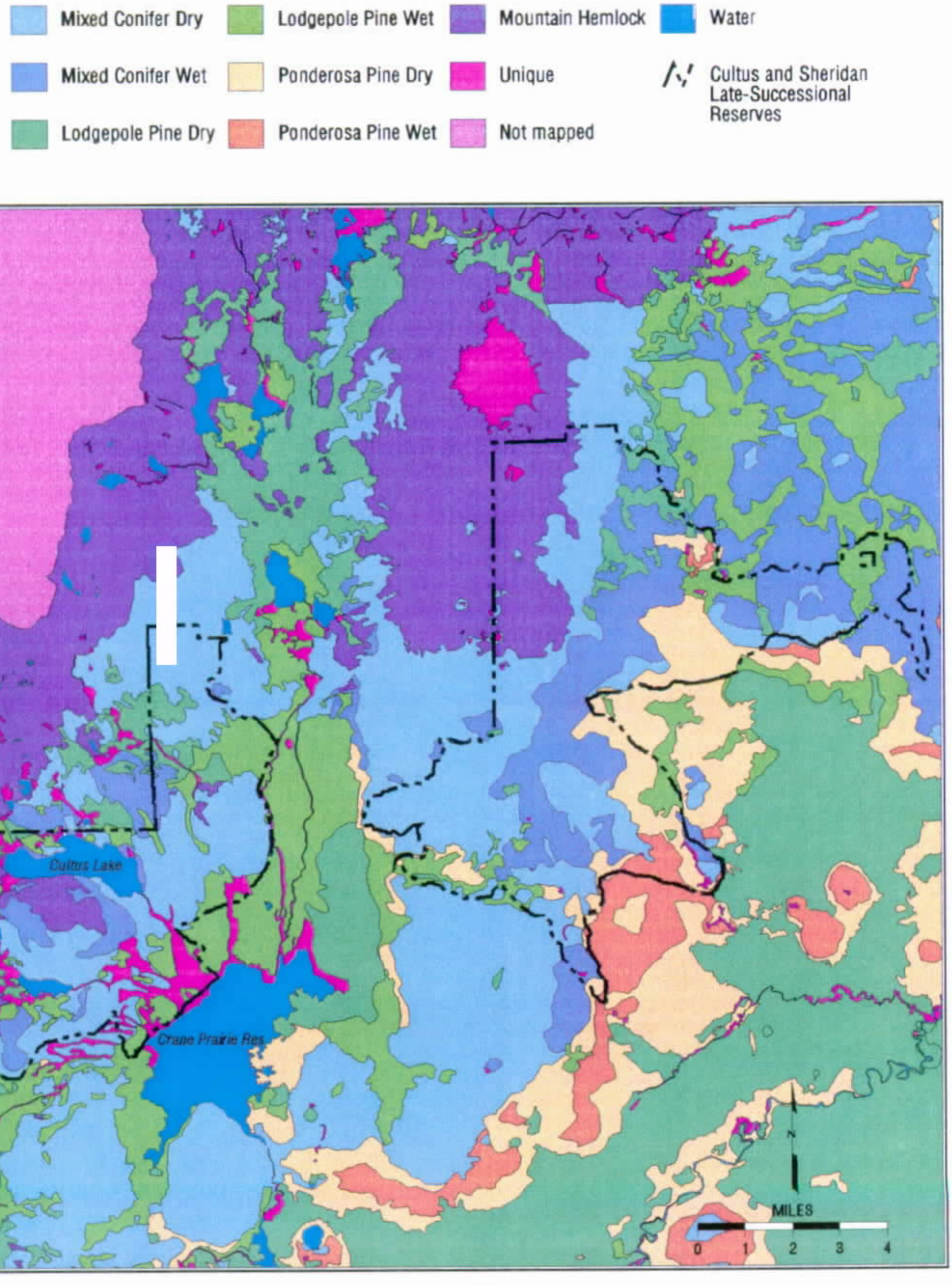
Fire patterns and patches today will differ greatly from historic patches and patterns. Fire events are expected to be intense stand-replacement fires, and may cover an area greater than 1,000 acres even though fire ignitions will be aggressively suppressed. This is espeiclaly true within the Cultus LSR where large contiguous patches of crown fuels exist. The potential for > 1,000 acre fires within the Sheridan Lsr though is much less due to past harvesting practices that have created openings within the vegetation. Existing high vegetative stocking levels, contiguous fuel ladders and high fuel loadings are very noticeable on the ground and from the air.

CANOPY COVER OVERVIEW

Canopy cover (sometimes referenced as crown cover) is the ground area covered by a crown as delimited by the vertical projection of its outermost perimeter (Society of American Foresters 1971). Canopy closure is the progressive reduction of space between crowns as they spread laterally (Society of American Foresters 1971). For this analysis, canopy cover is the term used as defined above.

The Cultus LSR has a greater number of acres with a high percentage of canopy cover as compared to canopy cover that exists in the Sheridan LSR. Refer to Map 9. Much of the landscape within the Sheridan LSR is classified as forested lavas, which generally support lower amounts of vegetation and canopy cover.

MAP 8 -- PLANT ASSOCIATION GROUPS
Cultus and Sheridan Late-Successional Reserves



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The following table displays the existing condition of canopy cover by acres and percentage of the total acres within each LSR by canopy cover group. These figures are also based on the 1988 raw ISAT data which consists of 25 meter square pixel data and are rounded to the nearest tenth.

TABLE II-5—CANOPY COVER ACREAGE AND PERCENT BY CANOPY COVER GROUP

	Cultus LSR:	18,000 Ac	Sheridan LSR:	31,030 Ac
	% of LSR Ac	LSR Ac	% of LSR Ac	LSR Ac
Rock/Sparsely Veg/Grass	1%	150	<1%	150
Shrub Cover 0 - 100%	1%	180	1%	180
Tree Cover 11 - 25%	7%	1,180	10%	3,250
Tree Cover 26 - 40%	6%	1,110	25%	7,690
Tree Cover 41 - 55%	7%	1,250	18%	5,610
Tree Cover 56 - 70%	18%	3,310	13%	4,180
Tree Cover > 71%	60%	10,820	32%	9,970

Note: These acreages are slightly overestimated due to mountain pine beetle induced mortality within a large portion of the lodgepole pine PAG area in the Cultus LSR, as well as harvest activities that have occurred in both LSRs since 1988.

CURRENT VEGETATIVE CONDITIONS

Plant association groups were used to analyze the current vegetative condition of the LSRs. Plant associations are classified using the 'potential natural vegetation' concept. This is the biotic community that would become established if all successional sequences were completed without interference by humans under present environmental conditions' (USDA FSM 2060.5) (USDA 1988). The classification is based on the potential vegetation that would occupy the site in the absence of fire. Productivity is used to 'validate' the concept that associations do indicate a set of specific environmental conditions. Individual plant associations that classify the vegetation for the LSRs were lumped together into broader groupings as per the WEAVE guide. The groupings were developed by lumping specific individual plant associations by plant series and then further subdividing these series into wet and dry classifications based on site productivity. Refer to Process Papers.

MOUNTAIN HEMLOCK PAG

The mountain hemlock vegetative types are currently within the range of natural variability and are shifting towards a more vegetative 'climatic climax' hemlock forest. This forest is characterized by a range of conditions, from dense stands with closed canopies of pure mountain hemlock to stands with mixes of tree species where mountain hemlock is still a dominant or co-dominant tree species. Structurally, the majority of the mountain hemlock is composed of medium to large size structure and is multi-sized and multi-storied. Compositionally, the old growth encompasses both older forests of early seral species, such as fire dependent species, and forests in later successional stages dominated by shade tolerant species.

The only harvest activity that has occurred within the mountain hemlock PAG was on Sheridan Mountain. These were not able to be regenerated back to hemlock and were planted with lodgepole pine. The lodgepole pine has been successfully established on these acres and has been pre-commercially thinned to date.

Laminated root rot is a natural component of the hemlock ecosystem and is the major disease agent affecting the mountain hemlock areas. Openings are created and then naturally regenerated with less susceptible tree species, such as lodgepole pine. Eventually, mountain hemlock will begin to also regenerate within these root rot pockets. The following tables display the acres within this PAG by seral stage and canopy cover.

(Note: *Very little has been done to date to define seral stages for the mountain hemlock areas due to insufficient data for the Central Oregon mountain hemlock areas.*)

TABLE II-6—CULTUS LSR, MOUNTAIN HEMLOCK PAG

TOTAL PAG ACRES: 2,430

SERAL STAGE	ROCK, GRASS, SHRUB 0-100%	TREE CANOPY COVER				
		11-25%	26-40%	41-55%	56-70%	71%+
E	11 Ac	10 Ac	6 Ac	-	39 Ac	26 Ac
M	-	2 Ac	40 Ac	21 Ac	335 Ac	439 Ac
L	-	8 Ac	6 Ac	125 Ac	85 Ac	1,278 Ac

TABLE II-7—SHERIDAN LSR, MOUNTAIN HEMLOCK PAG

TOTAL PAG ACRES: 3,730

SERAL STAGE	ROCK, GRASS, SHRUB 0-100%	TREE CANOPY COVER				
		11-25%	26-40%	41-55%	56-70%	71%+
E	27 Ac	18 Ac	25 Ac	-	-	5 Ac
M	-	37 Ac	539 Ac	217 Ac	78 Ac	667 Ac
L	-	41 Ac	212 Ac	125 Ac	653 Ac	1,081 Ac

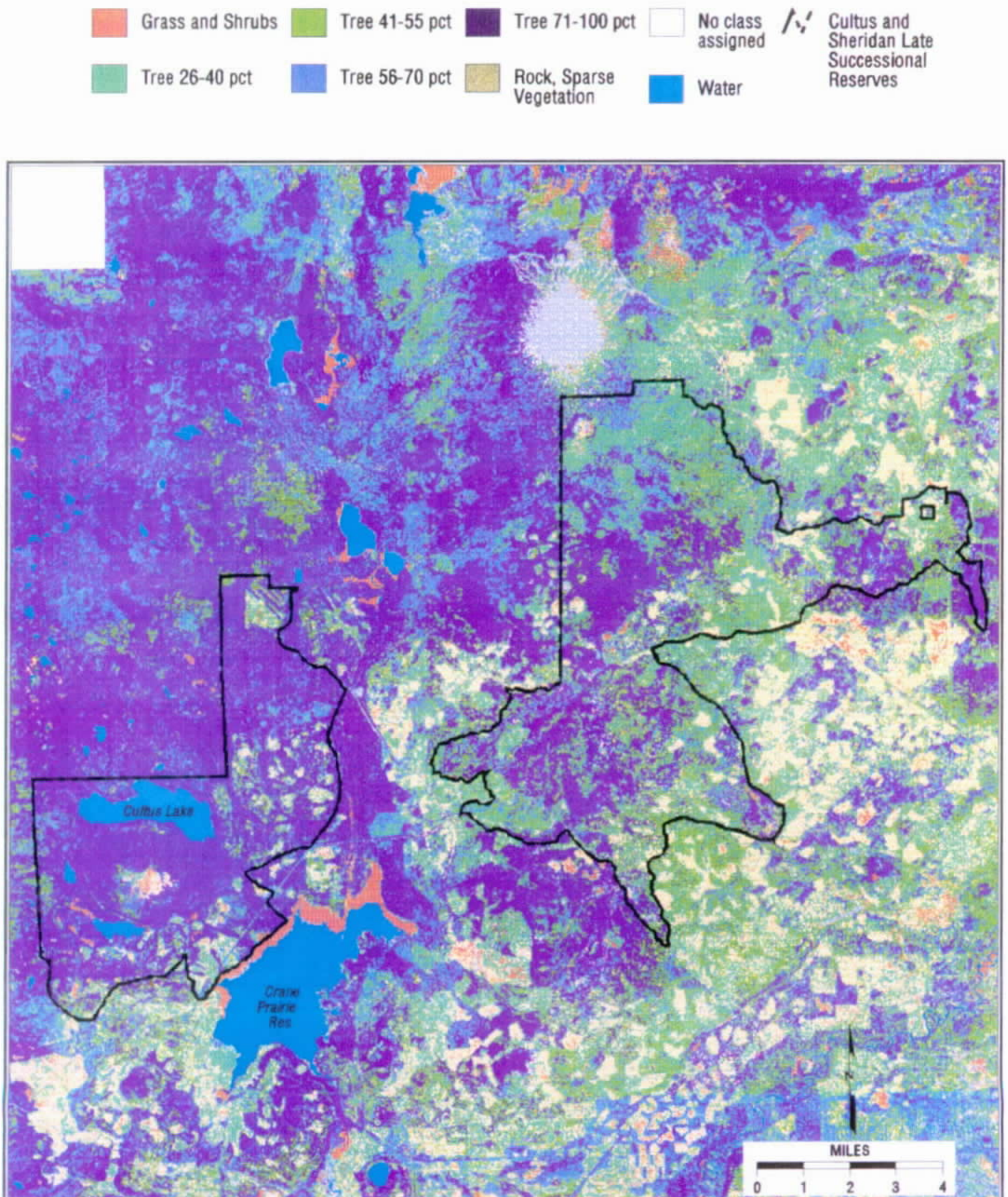
MIXED CONIFER WET PAG

Current vegetation within the mixed confer wet PAG is composed of dense stands of multi-storied structures consisting of white fir, lodgepole pine, Douglas-fir, scattered residual ponderosa pine and a few scattered western white pine, sugar pine (*Pinus lambertiana* Dougl.), mountain hemlock, and shasta red fir (*Abies magnifica* Murr. var. *shastensis* Lemm.) tree species. White fir is invading into the understory as it is a more shade tolerant species.

Mixed conifer plant associations within both LSRs that have not had some type of harvest activity are in an overstocked condition due to lack of natural fire regimes. They are also at risk to extreme crown fire behavior and insect and disease epidemics. Other areas that have been harvested are not in an overstocked condition and are more open in appearance as compared to adjacent unharvested stands. Harvested stands favor seral species of ponderosa pine and lodgepole pine and also may have a component of Douglas-fir trees. Harvest activities have been minimal in this PAG within the Cultus LSR. Harvest activities have occurred, however, on approximately 50% of the roaded acres of this PAG within the Sheridan LSR.

Although unharvested stands are dense and overstocked, it appears that there are no large scale or epidemic-level insect and disease problems associated with this PAG at this point in time. Root diseases such as armillaria root rot, laminated root rot, and annosus (*Fomes annosus*) do exist within the LSRs. The moister soil conditions of the PAG have probably allowed the vegetation to

MAP 9 -- CANOPY COVER from 1988 ISAT DATA
Cultus and Sheridan Late-Successional Reserves



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remain in a healthier condition than the surrounding areas. As a result, these stands have been more resilient to withstanding epidemic problems to date. The potential for insects and diseases to become major problems within this PAG does exist, although no major insect or disease problems are associated with harvest stands at this time. The potential risk of extreme crown fire behavior in harvested areas is low to moderate.

Vegetative structure within the wet mixed conifer PAG is mostly classified in the mid to late seral successional stages with a high canopy cover percentage. Most species found here are more shade tolerant, such as true firs and mountain hemlock even though minor amounts of shade intolerant species such as Douglas-fir and ponderosa pine are also found. Where lodgepole pine becomes a more dominant/co-dominant component of the stand, the successional stage moves back toward the pole size. The following tables display the acres within this PAG by seral stage and canopy cover.

TABLE II-8—CULTUS LSR, MIXED CONIFER WET PAG

TOTAL PAG ACRES: 1,800

SERAL STAGE	ROCK, GRASS, SHRUB 0-100%	TREE CANOPY COVER 11-25%	26-40%	41-55%	56-70%	71%+
E	9 Ac	29 Ac	7 Ac	-	5 Ac	24 Ac
M	-	4 Ac	20 Ac	34 Ac	164 Ac	219 Ac
L	-	14 Ac	13 Ac	70 Ac	69 Ac	1,118 Ac

TABLE II-9—SHERIDAN LSR, MIXED CONIFER WET PAG

TOTAL PAG ACRES: 8,840

SERAL STAGE	ROCK, GRASS, SHRUB 0-100%	TREE CANOPY COVER 11-25%	26-40%	41-55%	56-70%	71%+
E	94 Ac	178 Ac	187 Ac	-	-	12 Ac
M	-	523 Ac	1,021 Ac	889 Ac	651 Ac	2,354 Ac
L	-	124 Ac	380 Ac	909 Ac	392 Ac	1,131 Ac

MIXED CONIFER DRY PAG

Current vegetation within the dry mixed conifer PAG is composed of dense stands of multi-storied structures with components of white fir, lodgepole pine, Douglas-fir, scattered large residual ponderosa pines with a few scattered western white pine, sugar pine and mountain hemlock. The lodgepole pine, along with varying amounts of white fir, have invaded the understory over time. Numerous shrub and some grass species are also present. Overall canopy cover percentage has increased. Approximately 50% of the dry mixed conifer PAG has canopy covers that are greater than 70%.

Vegetative composition of the mixed conifer dry PAG are significantly outside the historic range of variability (HRV) in terms of seral stage, canopy closure, patch size and distribution. Departures from HRV are probably the most dramatic within this PAG and within similar connective areas between the LSRs.

Mixed conifer plant associations within both LSRs that have not had some type of harvest activity in the past are in an overstocked condition due to lack of natural fire regimes. These stands are at high risk of extreme crown fire behavior and insect and disease epidemics. Other areas that have been harvested are not in an overstocked condition and are more open in appearance as compared to adjacent unharvested stands. Harvested stands favor seral species of ponderosa pine and lodgepole pine and may have a minor component of Douglas-fir trees. The potential risk of extreme crown fire behavior in harvested areas is low to moderate. Harvest activities have occurred on approximately 50% of the roaded acres of this PAG in the Cultus LSR and on approximately 40% of the roaded acres of this PAG within the Sheridan LSR.

This PAG has the greatest potential to be impacted in the future by insect and disease disturbance events, although it appears no insect attacks of epidemic proportions have occurred to date. However, the mountain pine beetle is attacking the lodgepole pine associated with this PAG and has had a larger impact on the associated lodgepole pine within the Cultus LSR than the Sheridan LSR. Armillaria root rot is a major disease affecting the pondersoa pine vegetation within this PAG. Hit the hardest are areas of shelterwood and selection type harvests where management activities have exacerbated the occurrence and spread of this disease. Bark beetles are often found in conjunction with armillaria root rot and will further stress the tree, all of which result in mortality of the large and small size trees. The following tables display the acres within this PAG by seral stage and canopy cover.

TABLE II-10—CULTUS LSR, MIXED CONIFER DRY PAG

TOTAL PAG ACRES: 8,050

SERAL STAGE	ROCK, GRASS, SHRUB 0-100%	TREE CANOPY COVER 11-25%	26-40%	41-55%	56-70%	71%+
E	146 Ac	578 Ac	214 Ac	37 Ac	35 Ac	170 Ac
M	-	145 Ac	218 Ac	282 Ac	832 Ac	756 Ac
L	-	111 Ac	214 Ac	438 Ac	433 Ac	3,437 Ac

TABLE II-11—SHERIDAN LSR, MIXED CONIFER DRY PAG

TOTAL PAG ACRES: 10,290

SERAL STAGE	ROCK, GRASS, SHRUB 0-100%	TREE CANOPY COVER 11-25%	26-40%	41-55%	56-70%	71%+
E	64 Ac	208 Ac	239 Ac	-	-	38 Ac
M	-	460 Ac	1,591 Ac	1,105 Ac	427 Ac	2,327 Ac
L	-	172 Ac	608 Ac	701 Ac	1,037 Ac	1,361 Ac

PONDEROSA PINE WET PAG

The ponderosa pine wet plant association groups occur only within the Sheridan LSR. Ponderosa pine is the major species associated with this PAG, with minor amounts of other species present, most notably lodgepole pine as ingrowth and white fir on moister sites. Shrub species have become major components of the understory in some stands and compete with seedlings for nutrients and water resources.

The wet ponderosa pine sites have the highest productivity within this plant association. Natural regeneration of these sites has a higher chance of survival and more productive growth when compared to the drier sites. As a result, the wet ponderosa pine sites are able to support more total vegetation than the dry sites.

Almost all of this PAGs acres have been harvested at one time or another by treatments that range from broad area salvages to seed tree with reserve tree prescriptions. Most areas are relatively open in appearance, with overstories consisting of scattered large diameter pine and understories comprised of regenerating ponderosa or lodgepole pine seedlings. Areas that have not been harvested have denser stands with an intermediate-size tree component.

Risks of insect and disease outbreaks is high due to overstocked conditions in areas of no harvest activity and due to the drought of the past 8 or so years. The risk of extreme crown fire behavior ranges from low to high within this PAG. The following table displays the acres within this PAG by seral stage and canopy cover.

TABLE II-12—SHERIDAN LSR, PONDEROSA PINE WET PAG

TOTAL PAG ACRES: 700

SERAL STAGE	ROCK, GRASS, SHRUB 0-100%	TREE CANOPY COVER 11-25%	26-40%	41-55%	56-70%	71%+
E	3 Ac	16 Ac	31 Ac	-	-	-
M	-	65 Ac	147 Ac	107 Ac	41 Ac	66 Ac
L	-	29 Ac	40 Ac	68 Ac	69 Ac	8 Ac

PONDEROSA PINE DRY PAG

The ponderosa pine plant dry association group occurs only within the Sheridan LSR. Ponderosa pine is the major species associated with this PAG, with minor amounts of lodgepole pine present as ingrowth. Planting is the preferred method to regenerate ponderosa pine, since natural regeneration of this species to acceptable stocking levels cannot generally be relied upon. This is due to shrub species having become major components of the understory in some of these stands, resulting in the competition with seedlings for nutrients and water resources.

Approximately 70% of this PAG has been harvested at one time or another by treatments ranging from broad area salvages to removal cuts. Most areas are relatively open in appearance, with overstories consisting of scattered large diameter pine and understories comprised of regenerating ponderosa or lodgepole pine seedlings. Areas that have not been harvested have denser stands with an intermediate-size tree component.

Risks of insect and disease outbreaks is high due to overstocked conditions in areas of no harvest activity and due to the drought of the past 8 or so years. The risk of extreme crown fire behavior ranges from low to high within this PAG. The following table displays the acres within this PAG by seral stage and canopy cover.

TABLE II-13—SHERIDAN LSR, PONDEROSA PINE DRY PAG

TOTAL PAG ACRES: 3,980

SERAL STAGE	ROCK, GRASS, SHRUB 0-100%	TREE CANOPY COVER 11-25%	26-40%	41-55%	56-70%	71%+
E	40 Ac	182 Ac	146 Ac	-	-	5 Ac
M	-	326 Ac	993 Ac	553 Ac	47 Ac	348 Ac
L	-	208 Ac	355 Ac	366 Ac	341 Ac	70 Ac

LODGEPOLE PINE WET PAG

Lodgepole pine wet PAG is considered highly seral and climax throughout Central Oregon. This species is very opportunistic and can be found in pure stands, as well as a component of the ponderosa pine, white fir and mountain hemlock vegetative types. The wet lodgepole pine occupies sites with imperfectly drained soils.

Within the Cultus LSR, the wet lodgepole areas have been under a mountain beetle attack for approximately the past decade. The larger diameter trees are mostly dead, with the smaller diameter, precommercial-size trees and regeneration currently comprising the majority of the green component of these stands. Stands in the southern portion of the Cultus LSR have been dead for a longer period of time than stands in the northern portion of the LSR. Within the Sheridan LSR, the beetle attacks are not as extensive and do not seem to be in epidemic proportions. Most of these stands have been harvested and now are composed of a scattered lodgepole pine overstory with understories of lodgepole regeneration.

Approximately 50% of the wet lodgepole pine within roaded areas of the Cultus LSR have been harvested while approximately 80% of the wet lodgepole in the Sheridan LSR have been harvested. Treatments in the past range from clearcuts to seed tree cuts with green reserve trees.

Roughly 50% of all lodgepole pine wet vegetation is structurally composed of mature stands (9 to 20.9 inch diameter class). In wet lodgepole pine sites adjacent to riparian areas, trees may attain larger diameters due to better site conditions. The diameter size of a majority of the lodgepole within this class, however, is mainly found at the smaller end of the 9-20.9-inch diameter range. The other 50% or so of the lodgepole pine wet vegetation can be classed as early seral due to past harvesting practices that have changed the stand structure. The following tables display the acres within this PAG by seral stage and canopy cover.

[**Note:** *Canopy cover percentages and therefore associated acreages for wet and dry lodgepole pine PAGs are overestimated due to mountain pine beetle mortality of the past decade or so (Tables II-14 through II-17).*]

TABLE II-14—CULTUS LSR, LODGEPOLE PINE WET PAG

TOTAL PAG ACRES: 2,800

SERAL STAGE	ROCK, GRASS, SHRUB 0-100%	TREE CANOPY COVER 11-25%	26-40%	41-55%	56-70%	71%+
E	50 Ac	144 Ac	83 Ac	-	40 Ac	60 Ac
M	-	46 Ac	145 Ac	47 Ac	658 Ac	697 Ac
L	-	35 Ac	49 Ac	100 Ac	95 Ac	515 Ac

TABLE II-15—SHERIDAN LSR, LODGEPOLE PINE WET PAG

TOTAL PAG ACRES: 2,220

SERAL STAGE	ROCK, GRASS, SHRUB 0-100%	TREE CANOPY COVER 11-25%	26-40%	41-55%	56-70%	71%+
E	29 Ac	108 Ac	123 Ac	-	-	6 Ac
M	-	305 Ac	560 Ac	166 Ac	51 Ac	230 Ac
L	-	168 Ac	107 Ac	120 Ac	212 Ac	36 Ac

LODGEPOLE PINE DRY PAG

Lodgepole pine is considered highly seral and climax throughout Central Oregon. This species is very opportunistic and can be found in pure stands, as well as a component of the ponderosa pine, white fir and mountain hemlock vegetative types.

Most of these lodgepole pine stands are, or were, very dense and are dramatically changing due to the current mountain pine beetle epidemic. Within the Cultus LSR, the larger diameter trees are being killed with as much as 80% of the basal area of this size class experiencing mortality. Within the Sheridan LSR, the beetle attacks do not seem to have reached epidemic proportions and stands are dense and still green. Very little to no harvest activity has occurred within both LSRs as most of the dry lodgepole pine areas are located within Rare II inventoried roadless areas.

Almost all of the dry lodgepole pine vegetation can be classed within the mid to late/old seral structural stage. Within these size classes, the lodgepole does show a size variability at the upper end of the range on better sites. The diameter size of a majority of the lodgepole, however, is mainly found at the smaller end of the diameter ranges. The following table displays the acres within this PAG by seral stage and canopy cover.

TABLE II-16—CULTUS LSR, LODGEPOLE PINE DRY PAG

TOTAL PAG ACRES: 970

SERAL STAGE	ROCK, GRASS, SHRUB 0-100%	TREE CANOPY COVER				
		11-25%	26-40%	41-55%	56-70%	71%+
E	4 Ac	-	-	-	10 Ac	15 Ac
M	-	-	11 Ac	2 Ac	226 Ac	396 Ac
L	-	-	-	22 Ac	27 Ac	255 Ac

TABLE II-17—SHERIDAN LSR, LODGEPOLE PINE DRY PAG

TOTAL PAG ACRES: 1,090

SERAL STAGE	ROCK, GRASS, SHRUB 0-100%	TREE CANOPY COVER				
		11-25%	26-40%	41-55%	56-70%	71%+
E	3 Ac	2 Ac	15 Ac	-	-	-
M	-	24 Ac	286 Ac	192 Ac	4 Ac	156 Ac
L	-	28 Ac	57 Ac	75 Ac	170 Ac	78 Ac

UNIQUE PAG

The unique vegetation within the LSRs consist of Engelmann spruce bottomlands, meadows, and rock/cinder outcrops. The Engelmann spruce bottomlands are found only within the Cultus LSR and in close proximity to wet lodgepole pine and wet mixed conifer areas associated with water and creeks. The meadow areas are also mostly concentrated within the Cultus LSR, either in the Research Natural Areas or in association with creeks draining into Cultus Lake, the Deschutes River, Crane Prairie Reservoir and the Cultus River. Rock/cinder areas are predominately located within the Sheridan LSR and are found on the tops or sides of buttes.

Engelmann spruce bottomlands are mixtures of spruce, lodgepole pine and fir species. The soils are usually very wet with running water in the spring and then boggy and moist during the summer months. In the following tables, within the Cultus LSR, the acres associated with tree canopy cover mainly correspond to the Engelmann spruce areas. Other acres, such as willow ingrowth in meadows, are also represented in the table.

Most of the acres shown in the Sheridan LSR table are rock/cinder outcrops with minimal vegetation that may be in the form of brush, shrubs, and stunted trees species. This explains why acres appear on this table. The following tables display the acres within this PAG by seral stage and canopy cover.

TABLE II-18—CULTUS LSR, UNIQUE PAG

TOTAL PAG ACRES: 1,950

SERAL STAGE	ROCK, GRASS, SHRUB 0-100%	TREE CANOPY COVER 11-25%	26-40%	41-55%	56-70%	71%+
E	133 Ac	44 Ac	8 Ac	-	-	25 Ac
M	-	6 Ac	16 Ac	30 Ac	144 Ac	145 Ac
L	-	6 Ac	19 Ac	41 Ac	105 Ac	1,229 Ac

TABLE II-19—SHERIDAN LSR, UNIQUE PAG

TOTAL PAG ACRES: 180

SERAL STAGE	ROCK, GRASS, SHRUB 0-100%	TREE CANOPY COVER 11-25%	26-40%	41-55%	56-70%	71%+
E	79 Ac	12 Ac	4 Ac	-	-	2 Ac
M	-	14 Ac	17 Ac	11 Ac	2 Ac	8 Ac
L	-	13 Ac	6 Ac	3 Ac	2 Ac	2 Ac

II. C. 3. VEGETATIVE DISTURBANCE ELEMENTS

"The objective of Late-Successional Reserves is to protect and enhance the conditions of the late-successional old growth forest ecosystems, which serve as habitat for late-successional old growth related species including the northern spotted owl," (NWFP 1994). Disturbance elements such as insect and disease epidemics and extreme crown fires are capable of decreasing the habitat value of LSOG forest dependent species and thus may produce dramatic changes across the landscape. The following discussion focuses on crown fire and insects and disease agents, both of which have been identified as the primary disturbance elements and agents of change associated with the vegetation types and conditions found within the LSRs.

CROWN FIRE AS A DISTURBANCE ELEMENT

Fire has historically been a major disturbance element across these landscapes (Agee 1993). The magnitude of disturbance has changed significantly in some plant communities due to the absence of fire for over 90 years. Where fire was once low intensity and high frequency and sometimes very large, the effects were relatively negligible except in understory vegetation and fuels. Contemporary fires are not as expansive due to fire suppression, but the intensity and potency of fires has increased notably. While several fire starts occur annually within the LSRs, only a very small percentage build into a large scale high intensity fires. Managing for LSOG conditions would mean that the risk for crown fire would remain high. The effects of these fires on LSOG stands would be severe, usually leaving a nearly barren landscape before going out. This correlates directly with the increase in the amount or tons of available fuels.

Two fires, one in 1994 and one in 1995, which were in close proximity to the LSRs and within the Cascade Lake Watershed, illustrated how fire presently interacts as a disturbance agent. These fires were both aggressively attacked by ground and air resources. The fire behavior was very similar, but the fuels were not. Both fires presented a threat to the public and were extremely hazardous to firefighters.

> The Four Corners fire was ignited by lightning on July 24, 1994. It was reported by Round Mountain Lookout and several fire fighting resources were dispatched to the incident. The fire was burning in a mature stand of dense lodgepole pine. Mountain pine beetle mortality was about 50 - 60 percent. Most of the dead trees were standing with needles attached. Ground fuels were relatively light, but there were large patches of heavy down fuels and ladder fuels where mortality had occurred several years previous to 1994. The fire made the transition from ground fire to crown fire within 30 minutes. The fire was moving south at approximately 16 - 24 feet per minute. The fire began to display extreme fire behavior characteristics: horizontal roll vortices, 150 - 300 foot flame lengths, and long range spotting. Energy release was between 7,000 - 8,500 BTUs/ft/squared. Crane Prairie Campground and Resort were evacuated. Spot fires were ignited within the campground as the fire moved into a thinned stand of ponderosa pine and returned to the ground as a very intense ground fire. It was contained the next day at approximately 1,500 acres.
>
> The Pringle fire was ignited by an illegal firewood cutter on September 3, 1995. An initial attack engine was close by and was on the scene within 25 minutes. The fire was burning in a stand of mature ponderosa pine with dense patches of lodgepole and ponderosa pine regeneration in the understory. Ground fuel loadings in this stand were light to moderate, having been treated to some extent in the past. Ground fuels were primarily a result of natural mortality in the understory. The fire began torching and then crowning and escaped this effort. The fire was being driven by south wind and spotted over the Deschutes River. The fire was moving at approximately 10 - 16 ft per minute and producing 50 - 150 foot flame lengths. A shift in wind direction begin to push the fire to the east toward a large sub-division, which was evacuated. The fire moved into a heavily thinned stand of mature ponderosa pine and dropped back to the ground. It was contained the next day at 874 acres.

Both of these fires demonstrated fire behavior in stands where live and dead fuel have built up due to three closely related conditions:

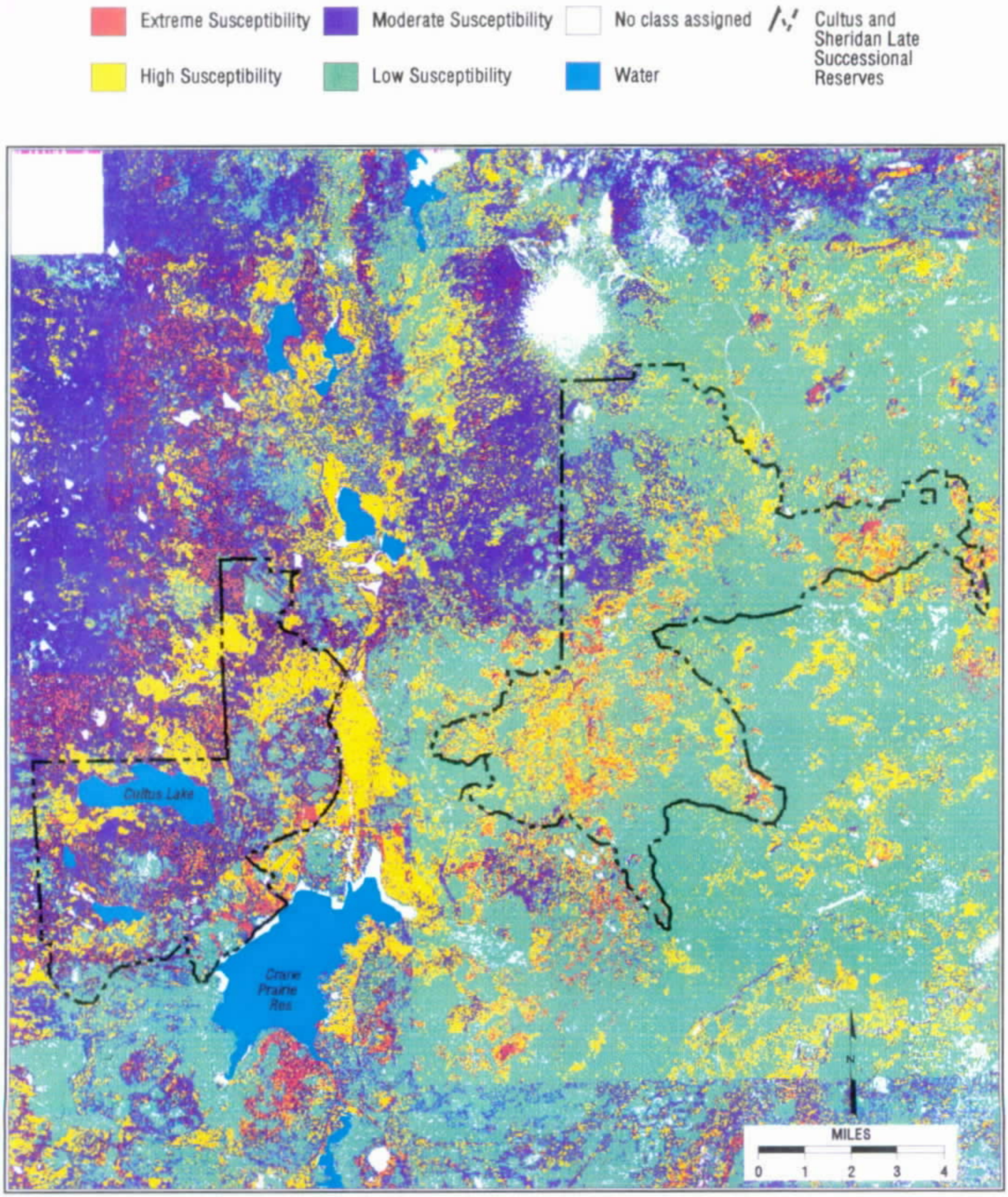
- ♦ Good site productivity.
- ♦ Long term exclusion of fire from fire adapted systems.
- ♦ Mountain pine beetle mortality.

These elements made these stands extremely susceptible to crown fire. Refer to Map 10. Crown fire susceptibility is a function of surface fuels and crown fuel load. It has been defined, for this analysis, in terms of potential crown fire behavior. In closed canopy stands where there are sufficient ground fuels to provide a means for fire to enter the crowns, the susceptibility is high or extreme. The effect will be near-complete stand destruction. Where canopies are more open and surface fuels loads lighter, susceptibility will be moderate or low. The effects can be measured as percent mortality of the overall stand.

The Four Corners fire burned through a stand that was rated extremely susceptible to crown fire, while the Pringle fire burned through a stand that was rated highly susceptible. Both of these fires were ignited and burned under moderate weather conditions. Fuels moistures were relatively low and there were heavy volumes of material available to fuel the heat engine of the fire. Both fires significantly slowed and decreased in intensity when they reached an area where crown fuel load and arrangement changed. Both of these fires left large patches where all understory vegetation was totally consumed. All overstory vegetation was killed and partially consumed.

The same fuel situations found in these fires are present in the LSRs. The Cultus LSR has large contiguous patches of crown fuels with a great potential to burn in patches greater than 1,000 acres despite full suppression efforts. Mixed conifer stands within the Sheridan LSR typically have dense, closed canopies, broken by pockets of mortality. Shrubs, regeneration, and ground fuels offer avenues for fire to enter the crowns.

MAP 10 -- CROWNFIRE SUSCEPTIBILITY RATING
Cultus and Sheridan Late-Successional Reserves



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INSECT AND DISEASE AGENTS OF CHANGE

MOUNTAIN PINE BEETLE

The mountain pine beetle has been by far the most significant mortality agent throughout the LSRs in recent years (Eglitis 1996). Extensive tree mortality has been mapped every year from 1989 to 1995, with varying degrees of intensity and shifting "hot spots" from one year to the next. The Cultus LSR has been affected by the beetle to varying degrees, from a high of 10 trees killed per acre per year to lows of one tree per acre per year since 1989. The Sheridan LSR has received light and scattered beetle-induced mortality of one tree per acre or less being attacked. This information is based on interpretation of Forest Pest Management Aerial Detection Survey mapping. Observers doing this mapping from airplanes can only see the largest trees in the stand and thus mortality levels are probably being underestimated each year (Eglitis 1996). Many of the affected stands have around 100 trees per acre greater than nine inches dbh, which is prime for beetle infestations. Therefore, there is still the potential for additional mortality to occur even in stands where the beetle has been active for the past several years. Overall as the beetle epidemic progresses, up to 80% of the basal area of a stand may be killed.

Most at risk from mountain pine beetle infestations are the wet and dry lodgepole pine PAGs. These PAGs have been under attack since about 1989 with no real differentiation by the beetle between the two. Lodgepole pine pockets that occur within the mixed conifer dry PAGs are also being attacked and killed by the beetle. The beetle has concentrated on attacking lodgepole pine trees, with minimal activity on the ponderosa pine host thus far. The lodgepole pine component of the mountain hemlock PAG may also be at risk to beetle attacks, particularly in stands where tree densities are high.

Widespread tree mortality resulting from outbreaks of several years' duration can influence the ecosystem. Often, large areas of trees are killed and short term habitat is created for cavity nesting species that would not otherwise exist. Fire hazard (the risk of a fire start) is increased because of excessive amounts of dry fuel in dead trees. Large areas of recently dead and dying trees are not visually pleasing and may create a negative visual and recreational impact.

Silvicultural treatments can reduce the risk of epidemic beetle attacks before they occur. The key in all treatments is to reduce stocking levels so that individual tree health and vigor is maintained, while still providing suitable habitat for LSOG dependent wildlife species. This can be accomplished by initiating various thinning regimes. Stands can be regenerated to reduce the potential for beetle attack as well. Salvaging dead lodgepole pine resulting from epidemic beetle outbreaks can reduce the consequent increase in fire hazard, but will not stop the outbreak, since stand conditions that favored the outbreak have not been altered (Eglitis 1996).

WESTERN PINE BEETLE

The life cycle of the western pine beetle is similar to the mountain pine beetle, although the insect is more host-specific to the ponderosa pine tree. This beetle activity has been concentrated within the Sheridan LSR area. The most significant patch consisted of 80 trees that were attacked and killed in 1995, and 50 trees in another patch that were killed in 1989 (Eglitis 1996). These attacks have been concentrated on the sides of buttes within the Sheridan LSR. Other attacks have been lower in intensity.

At risk to epidemic attack by the western pine beetle is the larger diameter ponderosa pine tree component of the mixed conifer dry PAG. These trees are stressed due to drought, competition and other factors. Numerous tree classifications have been developed to guide management of trees at risk to various insects. One of the best known classification systems was developed by Keen for interior ponderosa pine in northern California and the Northwest (Miller and Keen 1960). Keen's classification is based on the two major factors of age and crown vigor. Vulnerability of loss from epidemic levels of bark beetles is closely correlated with growth rates and the various life cycle stages of the ponderosa pine. Older trees with thin crowns and slow growth rates are most likely to be attacked and killed by the beetle.

Silviculture treatments which reduce stand densities in the immediate vicinity of selected trees will help to control epidemic levels of beetle attacks. Care should be taken though, as diseases such as armillaria may be present, and may prompt a change in treatment strategy.

FIR ENGRAVER

The fir engraver also belongs to the family of insects called bark beetles. This beetle attacks most species of fir in the western United States. Engraver activity was significant in 1989 in the Cultus LSR from Cultus Lake north. Nearly 700 trees were killed in an area covering 3,000 acres between Cultus Lake and Lava Lake on the west side of Forest Road 46. Two small patches of 40 trees were noted within the Sheridan LSR at this time also. Since 1989, outbreaks within the Cultus LSR have been light (less than 20 trees per patch), while within the Sheridan LSR there has been a slight increase in engraver outbreaks and patch size (up to 75 trees per patch) (Eglitis 1996).

True fir species that are a component of the mixed conifer dry and wet PAGs are most susceptible to attacks of fir engraver.

Even though the initial engraver attacks may occur 'by chance', once the attractant is emitted they can attack en masse. This mass attack coincides with drought conditions as per observations made in California and Oregon. Precipitation of 20 to 25 inches defines an extreme risk to white fir of attacks by the engraver beetle. White fir within this precipitation zone are usually at the lower elevation end of their range and are just out of the foothills in the dry mixed conifer sites. Precipitation in the 25 to 30 inch range poses a high risk of attack and over 30-40 inches poses a medium risk of attack. Risk for fir engraver is low for moisture zones above 40 inches. As drought and engraver attacks become prolonged, the beetle will move up into the moist high elevation sites and also cause mortality of these trees (Eglitis 1996).

In non-drought years, most engraver attacks occur in conjunction with root disease. Silvicultural treatments that keep trees in a healthy, vigorous growing condition will help manage the engraver at endemic population levels.

DOUGLAS-FIR BEETLE

Douglas-fir beetles (*Dendroctonus psuedotsugae*) are one of the larger bark beetles. The life cycle of this beetle is similar to that of the mountain and western pine beetles. Presence of this beetle within the LSRs is suspected, but data is not available for verification.

The Douglas-fir tree component of the mixed conifer PAGs is especially at risk. The beetle infests trees damaged by windfalls, fire-scorch or defoliation during epidemic cycles. Outbreaks generally develop following extensive windthrow or large fires. The outbreaks will be sporadic and of short duration, but are likely to kill large numbers of trees. Populations tend to build up in the downed and damaged trees and move into adjacent green trees. Populations can also increase in trees affected by drought, or trees defoliated by other insects. Damage is greatest in dense stands of mature Douglas-fir trees (Eglitis 1996). Trees associated with root rot are also susceptible to attack. Various fungi introduced by the beetle also contribute to tree mortality.

Reducing stocking levels through thinning regimes can help to maintain health and vigor of individual trees and reduce susceptibility to epidemic levels of beetle outbreaks. Endemic levels are acceptable and important as a source of future snags.

WESTERN SPRUCE BUDWORM

Western spruce budworm (*Choristoneura occidentalis*) is one of the most widely distributed and destructive defoliators in Western North America. The budworm was first reported in the United States in Oregon in 1914, but was not recognized as a destructive insect until the 1920s when outbreaks were also reported in Idaho. Douglas-fir and white fir are the tree species most at risk to the western spruce budworm.

Conditions favoring outbreaks are large expanses of pure or almost pure host trees species, all-aged stands composed primarily of host species with multi-layered canopies, and host stands growing on warm, dry sites. A common feature of budworm outbreaks appears to be physiological stress on host trees.

Silviculture practices that maintain trees in a healthy, vigorous condition will serve as one technique to help reduce the risk to epidemic levels of budworm attacks. Within the area of an outbreak though, stands should be managed to reduce the number of pure or almost pure host species and work towards maintaining a mosaic of stand ages and types. Within an infested stand, a diversity of species should be maintained while keeping the host component down. Health and vigor of trees may be maintained through thinning regimes. Conversion of stands to seral species will also help in managing the risk of budworm epidemic attacks.

ARMILLARIA ROOT DISEASE

Armillaria root disease is a soil fungus native to Central Oregon. It can exist as a saprophyte on dead woody material for decades, or as a lethal tree parasite. Armillaria spreads from colonized stumps or infected trees to nearby healthy trees. This occurs by mycelial extension across root contacts and grafts, and less often by rhizomorphs which can grow several feet through soil to healthy roots (Maffei 1996). Trees species have varying amounts of resistance to the disease due to natural biochemical agents. This resistance fades, however, when the tree is under stress, creating pockets of mortality, or in some cases wiping out an entire stand over time. Stress elements include overstocking, drought, and soil compaction. Insect regulators are often found in conjunction with Armillaria and can contribute to mortality.

Human activities such as partial cutting and fire suppression have provided a large food base for the root decay fungus. This has caused an elevated level and abundance of Armillaria in the Sheridan LSR, within the mixed conifer dry PAG. The resulting impacts to vegetation are high, as evidenced by the mortality of ponderosa pine trees of all sizes, which have moderate resistance to the disease. Douglas-fir trees have some resistance to the disease and are not experiencing the mortality the pines are. In the mixed conifer dry PAGs adjacent to both LSRs, Armillaria is found on white fir and ponderosa pine trees and is producing the characteristic root rot patches. The disease is present within both LSRs but information is not available to determine the extent of the disease.

The consequences of armillaria root rot infections are mixed. In its early stages, the disease creates canopy gaps and snags that are representative of a late-successional forest. These conditions are considered ideal for the prey base of the spotted owl. As the mortality continues, an opening is created at a scale that is no longer suitable for owl foraging. The opening is likely to persist for decades, unless resistant species are introduced.

Silvicultural treatments have a variety of effects on an infected stand. Generally speaking, stocking level control favoring resistant species is advised to improve the resistance of the residual stand (Maffei 1996). If the stocking level control is attained through an overstory removal, however, an imbalance between inoculum in the soil and host biomass may be triggered, producing accelerated mortality in the residual stand. Unless resistant species are introduced into Armillaria pockets, the site may remain unforested for decades. Improper use of mechanical equipment that compacts the soil may also accelerate tree mortality as well (Maffei 1996). Accelerated rates of infection are not desirable within the LSRs, although the smaller, more naturally occurring disease centers help to create diversity within habitats.

WHITE PINE BLISTER RUST

White pine blister rust is caused by the fungus *Cronartium ribicola*. The disease was introduced into North America in the early 1900s from Europe. The rust is not native to Europe, but is thought to have originated in Asia. The introduction of the rust has resulted in one of the most serious disease outbreaks in North America, with some stands being completely destroyed.

The host species are five-needle pines including western white pine and white bark pine (*Pinus albicaulis* Engelm.). *Ribes* species (gooseberry plants) are the alternate hosts. The blister rust is infecting western white pine trees that are found in the mixed conifer dry and wet PAGs, as a minor species in the understory. White bark pine is suspected to occur in minor amounts at the higher elevations within the LSRs as an associated species within the mountain hemlock zone, and may also be infected with the rust. Quantitative information on blister rust is not readily available at this time. However, the loss of trees presently in forest stands due to the blister rust would be a negative impact to the ecosystem. There would be a decrease in the abundance of these pines, which would cause a shift in species diversity.

Several management alternatives are available when dealing with the blister rust. The most important is to choose genetically improved trees with rust resistance when starting a new stand or planting to maintain or enhance species diversity. Reducing the *Ribes* component (alternate host) in the immediate vicinity is also effective. Pruning of lower branches up to a height of the average highest canker reduces the probability of lethal canker establishment. Cankers appear to have little or no effect on tree growth until they become stem cankers that have encircled the bole of the trees.

DWARF MISTLETOES

Ponderosa pine and lodgepole pine dwarf mistletoes are present within the mixed conifer PAGs and lodgepole pine PAGs of the LSRs. These parasites were historic native components of forest ecosystems, but human influences such as partial cutting and fire exclusion have served to increase the intensification, spread, and severity of the mistletoes to unnatural and unmanageable levels in many forest stands. The dwarf mistletoes are small, leafless, parasitic plants that depend on their hosts for survival.

Dwarf mistletoe infections have significant effects on their hosts. Tree growth is slowed with heavy infections of mistletoe, thus lengthening the amount of time it will take for a tree to develop old growth characteristics. Heavy infections also weaken the tree, making it more susceptible to other mortality agents. The length of time a large tree is maintained within a stand may be reduced due to its weakened condition. Heavy infections within all canopy layers of a stand may preclude the growth of trees to the point where it is difficult, at best, to grow trees that would become old growth and exhibit big tree characteristics.

Silvicultural treatments are effective in helping to control mistletoe infections. Stands that can gain the most from intermediate treatments should receive high treatment priority, such as advanced regeneration and pole size stands. Pruning heavily infected lower branches can be an effective treatment to reduce the spread and infestation of the disease to a desirable understory species. Reducing stocking levels will release trees, increase their health and vigor and allow them to outgrow the vertical spread of the disease. The removal of mistletoe-infected large trees over a stand of uninfected small trees is another treatment opportunity. Thinnings can be effective treatments in stands lightly infected with mistletoe. In stands more heavily infected, the thinnings may not be effective and may actually be more detrimental. Total eradication of mistletoe is not feasible, nor is it desirable. Reducing the amount and the intensity of infection, to maintain lower mistletoe levels over time, is preferred.

OTHER AGENTS OF CHANGE

Several other agents of concern, defoliators and root rots, are discussed in this section. These agents may not produce dramatic changes on the forest vegetation as a whole, yet do pose a threat given certain environmental conditions such as prolonged drought.

The factors that make forest vegetation susceptible to budworm defoliation are the same factors that make forest vegetation susceptible to Douglas-fir tussock moth (*Orgyia pseudotsugata*) outbreaks. The Douglas-fir tussock moth is a defoliator that is not currently found within the LSR. Yet, this moth could have more devastating affects on a stand in drought conditions than the budworm (Eglitis 1996). These affects would be seen in the dry mixed conifer area, where stands have a high component of fir species. Retaining fir species at levels that may be favorable for late-successional wildlife species (outside HRV) would put this vegetation at high risk for epidemic level outbreaks of the tussock moth.

The pandora moth (*Coloradia pandora*) has been attacking the ponderosa pine and lodgepole pine in the eastern portion of the Sheridan LSR since 1992. The moth has a 2 year cycle with caterpillars eating the newest needles on the trees one year and the moth laying its eggs on the tree the next year. There is the slight possibility that low-vigor trees may be stressed further by defoliation and that there could be elevated mortality in these trees from subsequent bark beetle attacks. This effect is expected to be minimal within the LSR. There are no known silvicultural treatments that could lessen these attacks. The naturally occurring virus is the most effective population control.

Indigenous root diseases include laminated root rot and annosus root rot. The laminated root rot is found within the mountain hemlock vegetative type and has evolved as a natural component of this ecosystem. These root rot pockets are being naturally regenerated to lodgepole pine (a more resistant species). Silviculture treatments that introduce additional resistant species can be used to help control the disease and to increase species diversity as long a LSR objectives are still met.

Annosus root rot seems to flourish where management activities have occurred that favor the spread of the disease. Most conifers are attacked by this fungus, but the way in which the host is affected and the resulting type of damage differ. A pine host is killed outright. Firs and hemlocks are seldom killed outright, but growth and vigor may be affected. The best means of inhibiting the spread of this disease is to borax the tree stumps greater than 18 inches in diameter within 48 hours after harvesting.

II. C. 4. SPECIAL BOTANICAL COMPONENTS

Dr. Jerry Franklin, University of Washington professor, believes that "We cannot and should not divide the world simply into commodity lands and reserves, because the future of biological diversity is in the Matrix." (Franklin 1996).

The maintenance of well-distributed, functional groups of non-vertebrate species is an important challenge to ecosystem managers and is essential to maintain forest function and health. Sedentary species, i.e. lichens, fungi, bryophytes, vascular plants, mollusks, and arthropods, will benefit from small fragments of old forest left within the Matrix lands. This is true for all PAGs. These species play important functional roles in the ecosystem, such as influencing natural succession and nutrient cycling. Maintenance of these organisms in the Matrix is essential to long-term forest productivity as well as biological diversity (FEMAT 1993).

Since many of these organisms require moist, cool microclimates and do not tolerate exposed conditions, it is recommended to provide patches (rather than single trees) of green trees of various sizes, ages, and species within the Matrix. Small patches of late-successional forest within the Matrix, including snags and logs, provides a diverse mosaic of stand conditions and habitat for dispersal and maintenance of these organisms (FEMAT 1993).

The NWFP expands biodiversity concerns beyond vertebrate species such as the Northern spotted owl. It incorporates a variety of species associated with late-successional forests which play key roles in ecosystem function, including plant and invertebrate species. To this end the plan requires "survey and manage" provisions for selected species for all land allocations (ROD page C-4).

The "survey and manage" standard and guideline provides benefits to species of fungi, lichens, bryophytes, vascular plants, invertebrate animals, and other species. The standard and guideline contains four "survey and manage" strategy levels for selected species, which are to be implemented over various timeframes:

1. **Manage known sites.** This strategy should receive the highest priority of the four categories. Activities implemented in 1995 and later must include provisions for these known sites.

2. **Survey prior to ground-disturbing activities.** Efforts to design protocols and implement surveys should be started immediately. Development of survey protocols must begin in 1994 and proceed as soon as possible. Surveys must be completed prior to ground-disturbing activities that will be implemented in FY 1999 or later.

3. **Extensive surveys.** Conduct extensive surveys for the species to find high-priority sites for species management. This strategy is recommended primarily for species whose characteristics make site and time-specific surveys difficult, and for species that may take many years to locate, due to dependence on specific conditions. Surveys under this strategy must be underway by 1996.

4. **General regional surveys.** The objective is to get additional information and to determine necessary levels of protection. Species intended to benefit from this standard and guideline are the arthropods, the fungi species that were not classed as rare and endemic, bryophytes, and lichens. These surveys are expected to be both extensive and expensive, but the information from them is critical to ecosystem management. They will be initiated no later than FY 1996 and are to be completed within ten years.

Little specific information exists on most "survey and manage" species. Most habitat descriptions are based on few records and will be broadened as new sites are discovered. The following discussion is an effort to assess and apply existing information.

FUNGI

No known fungi surveys have been conducted within the Cultus and Sheridan LSRs, although small ones have been done nearby at Elk Lake, Devil's Lake, and near Mt. Bachelor.

There are no known "survey and manage" species occurrences within the two LSRs. However, there are sites nearby. At Elk Lake, there was a sighting of *Gastroboletus subalpinus* in the early 1980s. A survey of a portion of the lake shore in the fall of 1995 did not relocate this species, but did find another species, *Cantharellus subalbidus.* A 1984 survey located *Nivatogastrium nubigenum* and *Rhizopogon evandens* (no variety given) in the general vicinity of Mt. Bachelor (exact locations are unknown). A 1995 survey at Devil's Lake found a species new to science, *Gautieria pterosperma*, which is not listed as a survey and manage species but its status is unknown.

A review of NWFP Appendix J2, which discusses known information on species of concern, lists eleven species as occurring within the Deschutes National Forest; two others have been added to this list since the NWFP was produced. They can all be considered as having potential habitat within the Cultus and Sheridan LSRs. Survey and manage strategies are noted for each species:

BOLETE—*Gastroboletus subalpinus*

Probably ectomycorrhizal with lodgepole and whitebark pine, and possibly other Pinaceae at elevations from 4,500 feet to timberline. Known site — Elk Lake, Bend/Ft. Rock Ranger District. S&M 1&3. Appendix J2-102.

RARE BOLETE—*Gastroboletus ruber*

Closely associated with old growth mountain hemlock as an ectomycorrhizal fungus. This rare endemic is found at upper mid- to high elevations in mature to old growth forests with a well-developed humus layer. Known sites — Cabot, Carl, and Shirley Lakes, Mt. Jefferson Wilderness Area, Sisters Ranger District. S&M 1&3. Appendix J2-109.

FALSE TRUFFLE—*Nivatogastrium nubigenum*

Inhabitant of brown-cubical-rotted coarse woody debris on xeric sites at mid- to high elevations, in mature to old growth forests or stands with an abundant legacy of large coarse woody debris. Known site — Three Creeks Lake, Sisters Ranger District, near Mt. Bachelor, Bend/Ft. Rock Ranger District. S&M 1&3. Appendix J2-110.

FALSE TRUFFLE—*Rhizopogon truncatus*

Located in stands of mixed conifers, including Douglas-fir, yellow and white pines, true firs, and mountain hemlock, in moderate to dry sites at relatively high elevations. Known site — Yoran Lake, Crescent Ranger District. S&M 3. Appendix J2-111.

RARE FALSE TRUFFLE—*Alpova alexsmithii*
Mature and old growth forests of the Cascade Mountains at mid to upper mid elevations, probably ectomycorrhizal with true firs, and possibly other Pinaceae. Known site — Carl Lake, Sisters Ranger District. S&M 1&3. Appendix J2-115.

RARE FALSE TRUFFLE—*Rhizopogon flavofibrillosus*
Associated with mature to old growth mixed conifer forests at mid- to upper mid elevations, and occurs as ectomycorrhizal associates of the Pinaceae. Known sites — Three Creeks Lake, Sisters Ranger District, and Cultus Lake, Bend/Ft. Rock Ranger District. S&M 1&3. Appendix J2-122.

RARE FALSE TRUFFLE—*Rhizopogon evadens* var. *subalpinus*
Occurs in upper mid elevations as ectomycorrhizal fungus of true firs, and possibly other Pinaceae. Known site — Wickiup Plain, Bend/Ft. Rock Ranger District, and east slope of North Sister, Sisters Ranger District. S&M 1&3. Appendix J2-133.

FALSE TRUFFLE, RARE UNDESCRIBED TAXA—*Hydnotrya* sp. nov., *Martellia* sp. nov.
Endemic to old growth Pacific silver fir/mountain hemlock forests of the type locales at 6,000 feet. Known site — Shirley Lake, Mt. Jefferson Wilderness Area, Sisters Ranger District. NOTE: The site notation in Appendix J2 incorrectly identifies Shirley Lake as in the Willamette National Forest. S&M 1&3. Appendix J2-151.

RARE TRUFFLE—*Elaphomyces anthracinus*
Found in mature ponderosa pine stands and is a probable ectomycorrhizal associate of pines as well as a wide variety of other ectomycorrhizal hosts. Known site — Riverside Campground, Sisters Ranger District. S&M 1&3. Appendix J2-156.

RARE TRUFFLE—*Elaphomyces subviscidus*
Ectomycorrhizal associate with mature to old growth pines and probably other Pinaceae at mid elevations. Known site — Three Creeks Lake, Sisters Ranger District. S&M 1&3. Appendix J2-157.

RARE CHANTERELLES—*Cantharellus subalbidus*
Ectomycorrhizal associate with a variety of conifer and mixed forests. Known site — Elk Lake, Bend/Ft. Rock Ranger District. S&M 3&4. Appendix J2-159.

CHANTERELLES—*Gomphus - Gomphus floccosus*
Mycorrhizal associate with mature, late-successional conifer forests. Known site — Dark/Scout Lake area, sighting from 1970s by Maret Pajutee, Sisters Ranger District. S&M 3. Appendix J2-162.

UNCOMMON GILLED MUSHROOM—*Ectomycorrhizal - Hygrophorus caeruleus*
Montane late-successional forest ecosystems. Known site — Metolius Basin, Sisters Ranger District. S&M 1&3. Appendix J2-168.

A review of species' ranges and habitat requirements found at least 44 additional species which may have potential habitat (though there are no known sites on the Deschutes National Forest), in the Cultus and Sheridan LSRs. Most of these fungi are mycorrhizal or ectomycorrhizal species which are found in association with specific host tree species.

LICHENS

One "survey and manage" lichen species has been documented near the Cultus and Sheridan LSRs:

AQUATIC LICHEN—*Hydrothyria venosa*
Found in clear, cold streams within old growth forests between 1,800-6,500 feet. Known site — Green Lakes area and Golden Lake, Bend/Ft. Rock Ranger District. S&M 1&3. Appendix J2-241.

Regional lichen surveys were conducted in 1994 and 1995 on the Deschutes National Forest. One plot was censused in the Cultus LSR and three were censused in the Sheridan LSR; no survey and manage species were found. However, elsewhere on the Forest, the following survey and manage species were located and have potential habitat in the two LSRs:

RARE NITROGEN-FIXING LICHEN - *Lobaria hallii*
Riparian forests, usually where sheltered and moist. Known site — First Creek, Sisters Ranger District. S&M 1&3. Appendix J2-228.

RARE NITROGEN-FIXING LICHEN—*Pseudocyphellaria rainierensis*
In hyper-mesic Cascadian old growth forests. Known site — Metolius River Subbasin, Sisters Ranger District. S&M 1,2,3. Appendix J2-228.

PIN LICHEN—*Calicium* sp.
Occurs in sheltered microsites with high atmospheric humidity provided by old growth forest conditions, often on the underside of large leaning trees. Known site — Green Ridge, Sisters Ranger District. S&M 4. Appendix J2-234.

RARE FORAGE LICHEN (arboreal)—*Bryoria tortuosa*
Low elevation, mesic, mixed deciduous-coniferous forest habitats, most commonly pine and oak. Known site — Bend/Ft. Rock Ranger District. S&M 1&3. Appendix J2-223.

RIPARIAN LICHENS—*Cetrelia cetrarioides, Collema nigrescens*
Moist riparian hardwood forests. Known sites — *Cetrelia*: Ft. Rock Ranger District. *Collema*: First Creek, Sisters Ranger District. S&M 4. Appendix J2-239.

NITROGEN-FIXING LICHENS—*Lobaria pulmonaria, Nephroma helveticum, Nephroma resupinatum, Peltigera collina, Pseudocyphellaria anomala, Pseudocyphellaria anthraspis*
Low to mid elevation moist forests, riparian areas. Known sites — Sisters Ranger District. S&M 4. Appendix J2-232.

BRYOPHYTES

No known surveys for bryophytes have been performed in the Cultus and Sheridan LSRs. A review of the NWFP Appendix J2, which discusses known information on species of concern, does not list any known sites in the LSRs or the Deschutes National Forest. However, species information on bryophytes in the Appendix is incomplete. One species has known sites on the Deschutes National Forest:

LIVERWORT—*Tritomaria exsectiformis*
On shaded moist soil or rocks or rotting wood, especially near springheads. Known sites — Jack Creek, Sisters Ranger District, and Tumalo Falls, Bend/Ft. Rock Ranger District. S&M 1&2. Appendix J2-94.

A review of bryophyte species listed on Table C-3 in the ROD identifies other species that may have potential habitat in the LSR. Most of these species are associated with riparian areas and/or the mixed conifer wet plant association group.

LIVERWORT—*Marsupella emarginata* var. *aquatica*
Streamside rocks in splash zone, middle to higher elevations. Known site — stream draining Waldo Lake, Willamette National Forest. S&M 1&2, Appendix J2-89.

MOSS—*Scouleria marginata*
On rocks in splash zones of streams, usually grows mixed with more common *Scouleria aquatica*, just above level of mean summer flows. Subject to inundation in winter, it needs clean water and cool temperatures. S&M 4. Appendix J2-91.

MOSS—*Thamnobryum neckeroides*
Grows on shaded, moist organic soil and rocks in thickets of willow, vine maple and Sitka alder at middle to higher elevations, occurring at margins of avalanche tracks, seepage areas, and bases of talus slopes, especially in headwall areas. S&M (not on table C-3). Appendix J2-92.

VASCULAR PLANTS

One "survey and manage" species has been located within the Cultus LSR and has potential habitat within the Sheridan LSR as well:

SUGAR STICK—*Allotropa virgata*
Occurs in closed-canopy pole, mature, and old growth seral stages in Douglas-fir and true fir in elevations from 250-10,000 feet on inland sites. This species is not abundant and may not emerge above ground or flower every year. *Allotropa* is not restricted to old growth but its largest populations occur there. Large woody debris and a history of past fires also appear to be important habitat components. This species has small, ephemeral seeds, obligate relationships with a mychorrhizal fungus and a vascular plant, and thus is slow to establish itself. Known sites — Jack Creek area and Black Crater trail (Levack 1995), Sisters Ranger District; Davis LSR, Crescent Ranger District; Lemish Butte and Cultus Mountain, Bend/Ft. Rock Ranger District. S&M 1&2. Appendix J2-249.

MOUNTAIN LADY SLIPPER—*Cypripedium montanum*
Additionally, habitat may exist within the LSRs for this species. Rather broad range of habitats; specific moisture and temperature regimes may be less critical than the presence of specific symbiotic fungi. Known site — near Abbott Creek, Sisters Ranger District. S&M 1&2. Appendix J2-280.

SENSITIVE PLANTS

There are two sensitive plant species present within the LSRs. Neither species is closely associated with late-successional old growth forest.

JEPSON'S MONKEYFLOWER—*Mimulus jepsonii*
Within Cultus LSR, Jepson's Monkeyflower (*Mimulus jepsonii*) occurs, located in the relatively flat areas between and around the buttes in lodgepole dry, lodgepole wet, and mixed conifer PAGs. This is an early seral species requiring ashy bare soil substrates and openings in which to germinate. These openings historically were likely created by active soil erosion, animal activity, or other natural disturbances. This species is also currently found in areas such as trail and skid roads. It appears to be more dependent upon precipitation amounts, slope position, disturbance, and open canopy conditions than on a particular PAG.

GREEN-TINGED PAINTBRUSH—*Castilleja chlorotica*
Just barely entering Sheridan LSR is the Green-tinged Paintbrush (*Castilleja chlorotica*); large populations occur adjacent to the LSR to the east and south. This species requires open canopy conditions and in lodgepole pine, has been found exclusively on rocky lava domes. Within the ponderosa pine PAG, it does not appear confined to the domes but is associated with shallow, rocky soils. Two small, isolated populations were found in 1995 in openings within the mixed conifer PAG. Elsewhere on the Forest, large populations occur in nonforest/sagebrush habitats.

Other sensitive species which have potential habitat within the LSRs include *Agoseris elata, Artemisia ludoviciana ssp. estesii, Aster gormanii, Astragalus peckii, Botrychium pumicola, Calamagrostis brewerii, Carex livida, Cymopterus nivalis, Gentiana newberryi, Hieracium bolanderi, Lobelia dortmanna, Lycopodium complanatum, and Ophioglossum vulgatum.*

NOXIOUS WEEDS

Noxious weeds are aggressive non-native plants that can invade and displace native plant communities and cause long-lasting management problems. By simplifying complex plant communities, weeds also reduce biological diversity.

Noxious weeds within the Cultus and Sheridan LSRs are presently confined to the major roadways: Highway 46 and Forest Road 40. There is primarily Spotted Knapweed (*Centaurea maculosa*) and some Diffuse Knapweed (*Centaurea diffusa*) present. There is one area of Canada Thistle (*Cirsium arvense*) between the LSRs at roadside, just south of Little Lava Lake.

There are other weeds present on the Forest but they are not presently found in the LSRs. Over time, these exotics could invade the area. They include: Dalmatian Toadflax (*Linaria dalmatica*), St. John's Wort (*Hypericum perforatum*), Common Toadflax (*Linaria vulgaris*), Scot's Broom (*Cytisus scoparius*), Bull Thistle (*Cirsium vulgare*), Tansy Ragwort (*Senecio jacobaea*), and Dyer's Woad (*Isatis tinctoria*).

Noxious weeds are most likely to invade areas that experience ground-disturbing activities or continual disturbance, such as roadsides, harvest units, campgrounds, and trails. Seeds are readily dispersed by vehicles, equipment, humans, and pack animals.

II. C. 5. DIVERSITY CONCERNS OF SPECIAL HABITAT TYPES

ENGELMANN SPRUCE BOTTOMLANDS

Engelmann spruce is present as a component of the wet mixed conifer PAG within the Cultus LSR. These areas are associated with the Cultus River, Cultus Creek and other intermittent stream beds and near reservoirs and lakes. A circa 1953 map shows approximately 1,800 acres of Engelmann spruce. Approximately 100 acres of spruce were detected through 1988 ISAT data. However, the forest plant association mapping project, completed in 1996, mapped 1,601 acres of Engelmann spruce within the Cultus LSR. The data sets are different for each of the above, so comparisons and trends are difficult at best to determine. This plant vegetation type was lumped into the unique PAG for ease of landscape level analysis for this project.

SHASTA RED FIR AND WESTERN WHITE PINE

Along the flanks of the Cascade Mountains and other high elevation buttes and mountains, shasta red fir and western white pine are be found. Western white pine is found within both LSRs while shasta red fir is found only in the Cultus LSR.

Western white pine is found within the wet and dry mixed conifer PAG as small diameter understory trees. It is suspected that the western white pine is in decline due to the white pine blister rust. Verification of this suspicion is recommended. Shasta red fir is found in scattered amounts within the range of the mountain hemlock PAG and the wet mixed conifer PAG. Field verification and mapping is recommended to determine the range of shasta red fir and its association with other species.

DOUGLAS-FIR

Douglas-fir trees are found in association with the wet and dry mixed conifer PAGs. The tree may sometimes occur as a large size component of the overstory or as a smaller diameter tree of the understory. The circa 1953 mapping shows approximately 5,000 acres of Douglas-fir within the LSRs. The 1995 forest vegetative mapping project mapped 147 acres of the Douglas-fir plant association, of which 99% is within the Cultus LSR. The 1988 ISAT data, (which classifies tree crowns seen only from above), did not show any Douglas-fir as a major species, yet did pick it up as a minor component. Again, the data sets are different for each mapping project, so comparisons and trends are probably not accurately reflected and are difficult to determine. Field verification and mapping is recommended prior to initiation of management activities.

II. C. 6. RECOMMENDATIONS

The mountain hemlock types within the Cultus and Sheridan LSRs are currently within the range of natural variation and are shifting towards a more 'climatic climax' hemlock forest. Ecological processes should be allowed to continue as they are a natural component that helps to create patterns and patches across the landscape.

Within the LSRs, development and maintenance of late-successional conditions will favor the fungi, lichens, bryophytes, and vascular plant species of concern (i.e. "survey and manage" species) described in this section. However, the Regional Forester's two sensitive species discussed earlier will generally not benefit from these conditions. Both Jepson's Monkeyflower and Green-tinged Paintbrush are open-canopy inhabitants, and in the case of the monkeyflower, requires bare ground and disturbance for germination.

Historically, periodic fire within the lodgepole and mixed conifer PAGs likely created and maintained Jepson's Monkeyflower habitat. Fire, thinning and salvaging (disturbance) has been known to create habitat for this species. Providing a small amount of habitat in early-seral conditions within the vicinity of known population centers (i.e. between Crane Prairie and Cultus Lake), located in the lodgepole and mixed conifer PAGs is beneficial to the maintenance and enhancement of this species.

For Green-tinged Paintbrush, which has a moderate probability of small, isolated populations occurring within the Sheridan LSR, it is important to maintain the open-canopy character of any lava domes encountered within the lodgepole PAGs. Within the mixed conifer and ponderosa pine PAGs, harvest thinning and salvage to reduce fire and insect damage will create openings which will provide potential habitat for this species. The reduction of competition from manzanita and ceanothus will also benefit this species.

Outside of the LSRs, in matrix lands, it is vital to the dispersal and maintenance of the "survey and manage" organisms, as well as to the health of the ecosystem, to retain selected, well-distributed patches of old growth.

CHAPTER III: LATE-SUCCESSIONAL OLD GROWTH DEPENDENT AND/OR ASSOCIATED SPECIES

A. OVERVIEW

B. MANAGEMENT INDICATOR SPECIES

C. SURVEY AND MANAGE SPECIES

D. OTHER SPECIES OF CONCERN

E. NON-NATIVE/INTRODUCED SPECIES

F. DISPERSAL AND CONNECTIVITY

III. LATE-SUCCESSIONAL OLD GROWTH DEPENDENT AND/OR ASSOCIATED SPECIES

III. A. OVERVIEW

Cultus and Sheridan LSRs have a variety of plant association groups within them, several of which are not conducive for northern spotted owls but do provide habitat for many LSOG wildlife species. Within the PAGs found in the LSRs, 279 species are found or are suspected to occur. Approximately 139 wildlife species are associated with late-successional old growth seral stage stands, of which approximately 118 use the LSOG habitats for primary and secondary breeding, roosting and foraging but may use other habitats also. In this latter group approximately 40 species demonstrate selection for late and old structure for primary breeding, roosting and foraging and tend not to utilize other habitat structures. The information was obtained through queries from the Deschutes Wildlife Habitat Relationship Database. Ten indicator species were selected from the 40 to represent habitat characteristics for each of the PAGs. Selection of the indicator species was largely based on the amount of habitat information available for the 40 species. Each indicator species was evaluated to insure they would meet the essential habitat components of other species that utilized the same habitat types. Using published research and local monitoring documents for the indicator species, a general habitat description is provided in narrative form for each species. Then a summary table (Table III-4) was constructed using additional research information to demonstrate a range of habitat structural characteristics. Later in the document the habitat characteristics of the indicator species were combined with other indicator species that utilize the same PAGs to develop a description of essential habitat characteristics for each PAG.

III. B. MANAGEMENT INDICATOR SPECIES

The following are general descriptions of each of the ten management indicator species (MIS) that were selected to represent the late-successional old growth dependent and/or associated species:

III. B. 1. SPECIES DESCRIPTIONS

AMERICAN MARTEN—MOUNTAIN HEMLOCK PAG

The American marten (*Martes americana*) is listed as a Sensitive species in the Vulnerable category by the Oregon Department of Fish and Wildlife (ODFW). This species occupies a relatively narrow range of habitat types, living in or near mature coniferous or mixed forests (Strickland et al. 1982). More specifically, they associate closely with late-successional old growth stands of mesic conifers (mature lodgepole pine, subalpine fir, and mixed conifer forests in the Pacific Northwest), especially those that contain large quantities of standing and down snags and other coarse woody material (CWM). These structural characters provide habitat for plant and animal species martens feed upon. Most marten dens are within 330 feet of water (Jones and Raphael 1992), emphasizing the importance of undisturbed riparian areas. The marten displays both arboreal and subnivean activity. They prefer stands with a 40-60% canopy cover, and are rarely use sites greater than 1,300 feet from meadows (Marshall 1992). They prefer densely forested areas to forage and rest in and rarely known to use large openings. The American marten will avoid stands of less than 30% canopy cover (Spencer, Barrett and Zielinski 1983). Martens may inhabit talus fields above treeline (USDA 1994). A variety of structures are used for dens, including trees, logs, and rocks. Typical habitat contains an average of 18 snags per acre (Martin and Barrett 1991) and down logs ranging 8-20 per acre (Becker 1990). Marten use a variety of travelways, since the animal can use various habitats (lodgepole pine, ponderosa pine, and mixed conifer).

Home range of this species within the LSRs is unknown, but it is known to travel upwards of fifteen miles a day in search of food. Average home ranges are 0.8-1.2 mi^2 for males and 0.4 mi^2 for females (Strickland et al. 1982). The marten is an opportunistic feeder and its diet includes a wide variety of animal and plant material. There is considerable seasonal variation in the diet. During the summer, mice, voles, and shrews constitute an important part of the animal's diet, while in the winter, the marten concentrates on larger prey items such as the snowshoe hare, Douglas' squirrel, and ruffed grouse. The marten also consumes birds and their eggs, chipmunks, reptiles, amphibians, fruit, insects, nuts, and berries when in season (Marshall 1992). Martens tend to be shy, however, they occasionally seem to be fearless of humans. They may be strongly attracted to human structures and human foods, so at times they may seem locally abundant and tame (Hayward and Verner 1994). This impression usually is transient. Martens are often seen along the riparian areas within and adjacent to the Cultus LSR. Occasionally marten are seen within the Sheridan LSR.

BOREAL OWL—MOUNTAIN HEMLOCK PAG

Boreal owls (*Aegolius funereus*) are listed as a Sensitive species in the Undetermined Status category by the ODFW. Boreals in the Cascades occur in subalpine forest habitats that are characterized by subalpine fir and Engelmann spuce including lower elevation transition forests. These latter habitats within the Deschutes NF include mountain hemlock and red fir. The boreal is a secondary cavity nester and nests primarily in cavities excavated by pileated woodpeckers and northern flickers. Nest sites generally occur in lower elevations of the home range. Habitats typically contain 2-3 snags larger than 15 inches in diameter. Habitats usually contain canopy cover varying between 30-63% with nesting occurring in more open canopies and roosting in denser canopies both winter and summer. Boreals favor old forest and avoid openings and young stands, except in the early spring immediately following snowmelt when they forage in these areas until lush vegetation develops. Diet includes red-backed vole, deer mouse, birds, non-forest voles (*Microtus spp.*), northern flying squirrel, and insects. The home range for the boreal is 4.5 mi^2 in the summer and 5.6 mi^2 in the winter. (Hayward and Verner 1994). No recent or historical sightings have been recorded and no surveys have been done to locate the owl within the LSRs, but potential habitat exists in both LSRs. Sightings from surveys by ODFW have located boreal owls on Mt. Bachelor and to the north in the Tumalo Creek drainage in mountain hemlock habitats.

PILEATED WOODPECKER—MIXED CONIFER WET & DRY PAGS

The pileated woodpecker (*Dryocopus pileatus*) is listed as a Sensitive species in the Critical category by the ODFW. Pileated woodpecker habitat is typically found within the mixed conifer associations and predominately on the Deschutes NF in those areas containing a high component of mature white fir. Pileated woodpeckers tend to inhabit old growth and mature stands in Oregon, and older forests on the eastside of the Cascades (Marshall 1992). Their preferred foraging substrates include large diameter (31 inches dbh or greater) live and dead trees and coarse woody material. The birds forage by excavating into wood and scaling or chipping bark seeking carpenter ants, which are their primary diet item. Pileated nesting habitat typically contains greater than 3 snags per acre and an average of 40 down logs greater than 15 inches in diameter per acre with a canopy cover of 60% or greater (Bull and Holthausen 1985 and 1992). Pileated woodpeckers excavate a new cavity nest each year in trees exceeding 21 inches dbh. Nests are typically 20 to 80 feet above the ground. Roost cavities are located in live or dead trees greater than 20 inches dbh. Average home range per pair is 1.6 mi^2 (Bull and Holthausen 1985). Sighting have been recorded in both LSRs with characteristic foraging snags found frequently.

NORTHERN SPOTTED OWL—MIXED CONIFER WET PAG

The spotted owl (*Strix occidentalis*) is federally and ODFW listed as a Threatened species. Spotted owls are associated with mature and overmature dense mixed conifer forests, which is preferred nesting, roosting, and foraging habitat (NRF) on the Deschutes NF. These habitats usually consist of a large tree overstory with at least one other canopy layer present, which creates a dense, closed canopy condition. Components that are typical of spotted owl habitat include: multi-layered canopies, closed canopies (70-100%), large diameter trees (50-70 TPA of 9-16 inches dbh, 20-30 canopies, closed canopies (70-100%), large diameter trees (50-70 TPA of 9-16 inches dbh, 20-30 TPA of 16-25 inches dbh, and 12-19 TPA of > 25 inches dbh), abundance of dead or defective standing trees (>16/ac of 9-16 inches dbh, >6/ac of 16-25 inches dbh and >5/ac greater than 25 inches dbh), and abundance of coarse woody material (>8/ac 16-25 inches dia. and >5/ac >25 inches dia.) (Gerdes et al. 1995). Blocky shaped stands with a minimum area of 40 acres of high quality habitat are considered suitable for spotted owl occupancy and use.

The Cultus and Sheridan LSRs are contained within the OR Eastern Cascade Physiographic Province which includes all forested lands in Oregon east of the crest of the Cascades and north of the Klamath Mountains province within the range of the spotted owl. Key regional issues involving the OR Eastern Cascade Physiographic Province include:

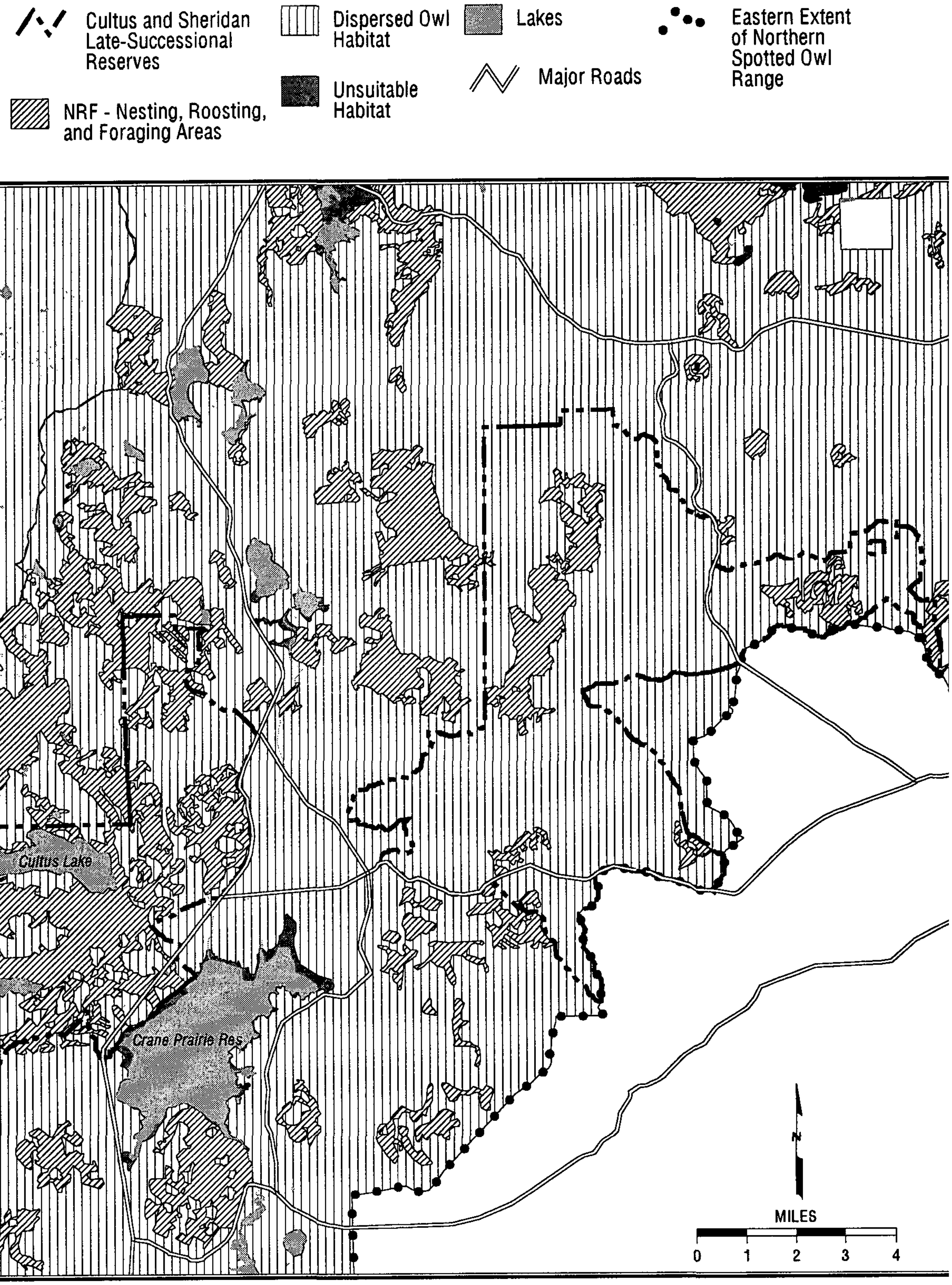
1. The continuing reduction and increased fragmentation of spotted owl habitat necessary to meet the species' life history requirements,
2. The resultant increased threat of isolation of spotted owl populations, and
3. The exacerbation of poor habitat conditions for dispersing individuals. Spotted owls on the eastside of the Cascades are on the fringe of their range (see Map 11).

Eastside habitats are much more dynamic and prone to a higher risk of large-scale disturbance events than westside types. Habitats take longer to reach desired structure components and may not sustain this structure for long periods of time. Eastside owls are critical in the evolutionary process, with a higher probability to adapt to environmental and climatic changes in the future than westside owls. Therefore, maintenance of these habitats could be critical to the long-term viability of the species. The USFWS is concerned with the existing degraded condition of owl habitat and the low owl population levels in the Eastern Cascades province. The north-south distribution of spotted owls through the central portion of this province is adequate, with the exception of the southern Deschutes NF area. Distribution is spotty in the southern Deschutes area due to natural and harvest related fragmentation. USFWS conservation objectives are:

1. Increase the amount of suitable habitat within the home range radius (1.2 mile) of resident spotted owls in the Southern Deschutes Area of Concern (Thomas et al. 1990) as rapidly as possible. Consider using silvicultural practices to speed recovery where such practices are appropriate and known to be effective. Encourage the development of habitat components where lacking.
2. Maintain and improve dispersal habitat throughout the province, particularly across lower elevation passes along the crest of the Cascades.
3. Maintain all existing and future resident spotted owls within the Southern Deschutes Area until populations recover sufficiently to provide stable breeding units (USFWS 1996).

Within the Cultus LSR there is a Critical Habitat Unit (CHU OR-6). The CHU is not entirely contained within the LSR, since approximately 100 acres lie outside in two different areas (See Map 12). The CHU is a land designation by the USFWS to provide protection of habitat under the Endangered Species Act, which stipulates that the areas containing those physical and biological

MAP 11 -- SPOTTED OWL RANGE AND HABITAT
Cultus and Sheridan Late-Successional Reserves



attributes that are essential to a species conservation may require special management considerations or protection. The CHU OR-6 was established to provide for essential nesting, roosting, and foraging habitat and also to assist in providing dispersal habitat for spotted owls in the central portion of the OR Eastern Cascade Physiographic Province. The Interagency Scientific Committee (Thomas et al. 1990) identified the Southern Deschutes Area of Special Concern given the area's importance in maintaining a wide distribution of occupied plant community associations throughout the entire range of the subspecies. Unit OR-6 is central to this identified area and will help ensure range-wide distribution of this subspecies since it lies along the owl's existing eastern limits within the OR Eastern Cascade Physiographic Province (USFWS 1996). This land designation requires consultation on management activities that may affect the following primary constituent elements:

1. Space for individual and population growth, and for normal behavior;
2. Food, water, or other nutritional or physiological requirements;
3. Cover or shelter;
4. Sites for breeding, reproduction, rearing of offspring; and
5. Habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of a species.

Five spotted owl pairs reside within or directly adjacent to the Cultus LSR and one pair resides within the Sheridan LSR. (A map of the spotted owl locations is confidential and distribution will be limited to USFWS and Forest/District personnel.) To date the only other owls on the Bend/Ft. Rock District have been singles, and one spotted owl with a barred owl was located in the Three Sisters Wilderness. None of the LSR owl pairs were reproductive during 1995; reproduction has historically been low among all of the pairs. Three of the LSR owl pairs are in a "take" situation due to past harvest treatments (refer to discussion after Table III-2). The owls are using mixed conifer wet, mixed conifer dry, mountain hemlock habitats with Shasta red fir component, and Engelmann spruce habitats as NRF habitat. Approximately 8,830 acres or 49% of Cultus LSR and 3,430 acres or 11% of Sheridan LSR currently exist in suitable NRF habitat.

Table III-1 demonstrates acres potentially available within the PAG compared to what is suitable NRF habitat. Much of the reduction within the mixed conifer PAGs has been due to past harvest treatments. Past treatments reduced late-successional old growth habitat structure, created fragmentation problems and removed dead and dying trees and down logs, which are a key components to many late-successional old growth species. These areas will not provide suitable NRF for a minimum of 100 years. Within the mountain hemlock PAG, suitable NRF habitat occurs when below 6,000 feet elevation if Shasta red fir is present, which is susceptible to heartrot to provide cavities for nesting. Engelmann spruce habitats are typically adjacent and/or integrated with mixed conifer or lodgepole pine in areas of saturated or moist soils. Spruce stands associated with mixed conifer stands provide many habitat components (good prey base, dense canopy, large down logs and multi-layered structure) for spotted owls.

TABLE III-1—NRF WITHIN PAGS

PAG	Acres of Existing NRF by PAG within each LSR	Acres of Existing and Potential Vegetation by PAG within each LSR	Percent of NRF by PAG
CULTUS LSR (TOTAL APPROX. ACRES 18,000)			
MH	1,430	2,430	59%
MCW*	1,240	1800	69%
MCD	4,620	8,050	57%
UNIQUE	1,260	1,950	65%
SHERIDAN LSR (TOTAL APPROX. ACRES 31,030)			
MH	800	3,730	22%
MCW*	850	8,840	10%
MCD	1,620	10,290	16%

* Key PAG for spotted owl habitat.

Several PAGs, with a variety of tree structural stages, make up each owl pair's home range. A GIS query, using 1988 ISAT was used to further specify the habitat and tree structure stages. From the query, Table III-2 was developed to help describe the habitats within each home range (home ranges 2,995 ac. each). The acreage will differ from the total acreage within the radii due to bodies of water, roads, rocky areas, or unassigned data. All acres that are in LSOG structure may not provide NRF habitat due to past harvest treatments (e.g., fragmentation effects, canopy reduction, etc.) or limited natural capability (lava intrusions, rock, or soil type). Figures in parenthesis are acres outside the LSR but within the radii (these acres are not included in Table III-1). (Habitat acreage's are calculated for each owl pair. Acreage does not consider overlap, thus total acres are inflated and do not represent actual ground acres.)

MAP 12 -- CRITICAL HABITAT UNITS
Cultus Late-Successional Reserve

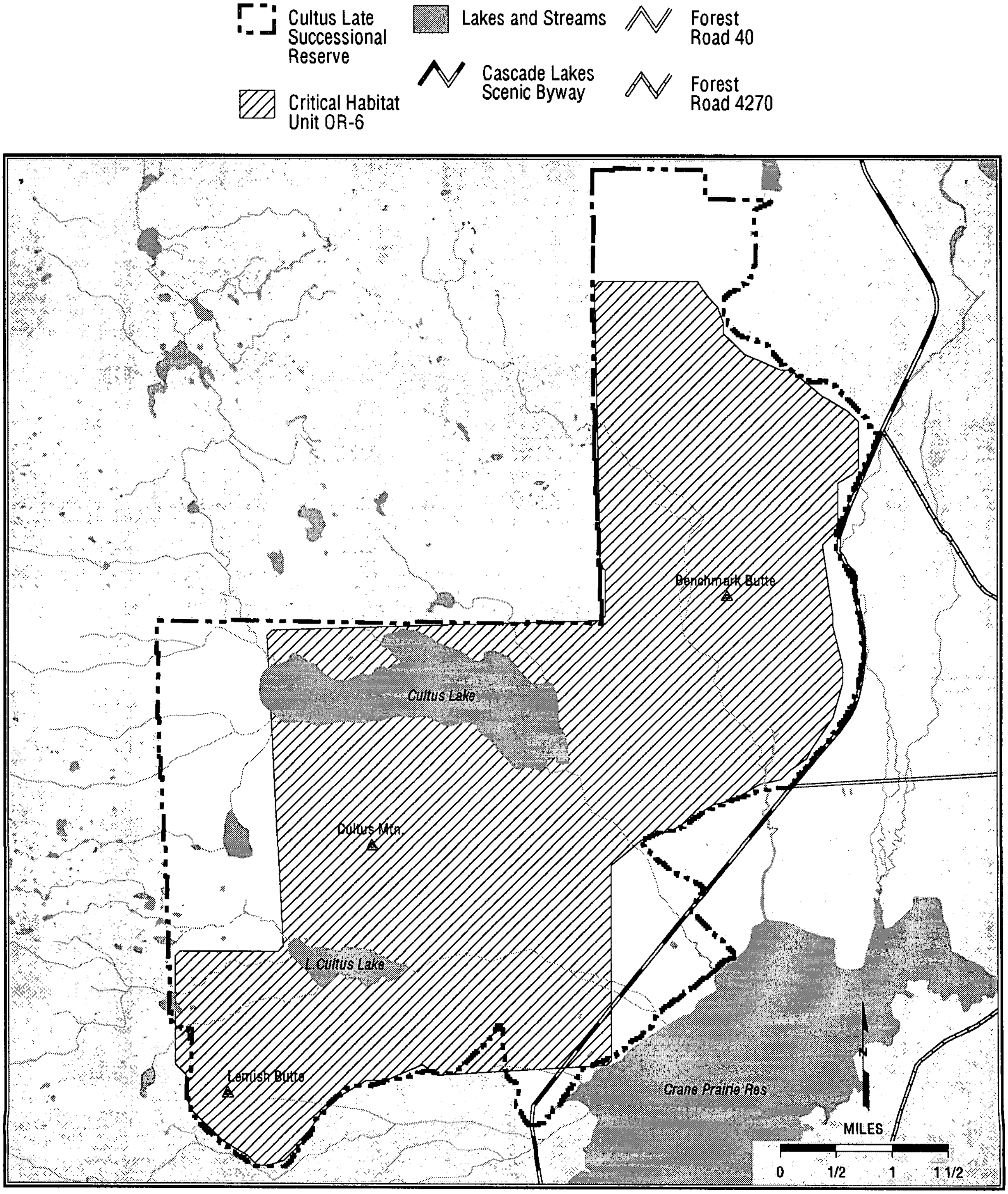


TABLE III-2—PAG AND TREE STRUCTURE ACRES WITHIN SPOTTED OWL HOME RANGE

PAGs	"Nest Grove" Activity center (70 acres)				"Core Area" Activity center to 0.7 mile radii (1000 acres)				"Home Range" Activity center to 1.2 mile radii (2955 acres)			
Stand Structure*	Early	Mid	Late	Old	Early	Mid	Late	Old	Early	Mid	Late	Old
Owl # 1001 (Cultus Mt. pair)												
MH						25	25	75	5	65	55	235
MCW		5	15	35	5	30	85	210	20	90	115	345
MCD				10	10	30	20	275	165	220	125	585
LPW									25	80	30	25
UNIQUE						5	5	45	5	35	15	185
Total Acres per structure			15	45	15	90	135	605	220	490	340	1,375
Owl # 1002 (Applejack pair)												
MH						5			5	40	15	20
MCW		10 (+5)	5 (+5)	30 (+10)	10	95 (+60)	25 (+30)	115 (+270)	10	100 (+120)	25 (+50)	140 (+505)
MCD					30	25	20	15	85	140 (+10)	100 (+5)	210 (+10)
LPW					5	40 (+5)	10	5 (+5)	15	185 (+20)	60 (+5)	25 (+15)
LPD						80 (+35)	25	10 (+10)	10 (+10)	235 (+310)	75 (+70)	30 (+25)
UNIQUE						10	(15)	10	(10)	205 (+30)	10 (+15)	15 (+20)
Total Acres per structure		10 (+5)	5 (+5)	30 (+10)	45	260 (+100)	80 (+45)	155(+285)	125 (+20)	775 (+470)	285 (+145)	440 (+575)
Owl # 1003 (Benchmark pair)												
MH					5	20	10	10	10	50	20	20
MCW									10	40 (+10)	20 (+5)	85 (+60)
MCD	10	20	5	25	140	265	165	270	300	670	405	690
LPW		5	5		5	50	20	10	15	205 (+15)	80 (+5)	45 (+10)
LPD									10	40	10	
UNIQUE										10	5	10
Total Acres per structure	10	25	10	25	150	335	195	290	345	1,015 (+25)	540 (+10)	850 (+70)
Owl # 1004 (Deer Lake pair)												
MH						85	20	155	40	410 (+5)	205 (+10)	560 (+5)
MCW		10		35		50	25	270		60	30	290

TABLE III-2—PAG AND TREE STRUCTURE ACRES WITHIN SPOTTED OWL HOME RANGE (continued)

PAGs	"Nest Grove" Activity center (70 acres)				"Core Area" Activity center to 0.7 mile radii (1000 acres)				"Home Range" Activity center to 1.2 mile radii (2955 acres)			
Stand Structure*	Early	Mid	Late	Old	Early	Mid	Late	Old	Early	Mid	Late	Old
MCD				20	5	45	30	190	95	105	115	360
LPW						15	5	5	5	60	20	5
LPD										30	5	15
UNIQUE						5		15	35	45	20	150
Total Acres per structure		10		55	5	200	80	635	175	710 (+5)	395 (+10)	1,380 (+5)
Owl # 1005 (Sheridan Mt. pair)												
MH						20	40	70	10	145 (+10)	140 (+5)	295 (+5)
MCW					75	135	35		135	575	220	5
MCD		30	25	15	35	285	200	80	80 (+65)	525 (+70)	360 (+40)	140 (+25)
UNIQUE										5		
Total Acres per structure		30	25	15	110	440	275	150	225 (+65)	1,250 (+80)	720 (+45)	440 (+30)
Owl # 1006 (Lucky Lake pair)												
MH										(30)	(5)	(40)
MCD	5	10		55	115 (+5)	165 (+70)	110 (+50)	315 (+155)	165 (+40)	335 (+410)	220 (+255)	455 (+720)
LPD										100 (+35)	40 (+20)	5
Total Acres per structure	5	10		55	115 (+5)	165 (+70)	110 (+50)	315 (+155)	165 (+45)	435 (+445)	260 (+280)	460 (+760)
Gross % Late/Old for all pairs, w/in LSR (+ other acres)	70%		295 ac.		59%		3,560 ac.		53%		9,415 ac.	

* Structure taken from Deschutes Wildlife Habitat Relationships Model and GIS. It is a general definition and varies by PAG and site productivity.

Early......... less than 1.0 inches dbh,

Mid........... 1.0 inches dbh to 8.9 inches dbh,

Late .... 9.0 inches dbh to 20.9 inches dbh,

Old .... 21.0 inches dbh and greater.

The following table (Table III-3) documents the amount of confirmed existing NRF habitat within a 0.7 mile (core area) and 1.2 mile radius (home range radius of a spotted owl) around each owl activity center. If there is less than 50% suitable NRF habitat within the 0.7 mile radius (1000 acres, core area) or less than 40% within the 1.2 miles radius (2955 acres), then the owl is considered to be in the "take" category by the USFWS. This implies that further degradation or modification of the habitat which results in a change from NRF to non-NRF will constitute a "take" under the Endangered Species Act. These guidelines provided by the USFWS will also help assist in determining priorities for treatments to promote suitable habitat within the home range and landscape levels.

TABLE III-3—HABITAT WITHIN 0.7 MILE AND 1.2 MILE RADII

	Activity Center to 0.7 Mile Radius (1,000 ac.)		Activity Center to 1.2 Mile Radius (2,955 ac.)	
Owl Number	**NRF Acres[1]**	**% NRF**	**NRF Acres[2]**	**% NRF**
CULTUS MOUNTAIN LSR				
1001	740	74%	1,715	58%
1002	180 (+330)	51%	420 (+590)	34%
1003	410	41%	1,160 (+80)	42%
1004	625	62%	1,305 (+5)	44%
1006	425 (+205)	63%	660 (+930)	54%
SHERIDAN LSR				
1005	425	42%	1,050	35%

The Recovery Plan for the Northern Spotted Owl Final Draft (USFWS 1992) described several threats to the Eastern Oregon Cascades Physiographic Province. The assessment of the level of threat from habitat-related concerns was complicated by the limited information about habitat used by owls in this province.

- **Declining Habitat**: Moderate threat due to timber harvest, disease outbreaks, and insect infestations are reducing habitat levels. (The Bend Ranger District biologists rate declining habitat as a moderate to high threat locally.)
- **Limited Habitat**: Moderate threat, because natural conditions inhibit forest development into suitable NRF habitat. Assessment was hampered by very little telemetry research conducted within the province for habitat that owls are selecting.
- **Declining Populations**: No population studies (fecundity and survival) have been conducted to assess the impact of threat.

[1] Acres within parenthesis are outside the LSR but within the 0.7 mile radius.

[2] Acres within parenthesis are outside the LSR but within the 1.2 mile radius.

- **Low Populations**: Moderate threat, population of owls are very low, primarily due to the inherently low potential for suitable habitat and to the extent of timber harvest where habitat does exist.
- **Distribution of Habitat and Populations**: Severe threat, compounded by the narrow linear shape of the owl's range east of the Cascade crest in Oregon.
- **Province Isolation**: Moderate threat, due to high-elevation subalpine and non-forested conditions along much of the Cascade crest. The eastern Oregon Cascades province is relatively isolated from the western Oregon Cascades province.
- **Predation and Competition**: Predation threat is considered unknown, due to lack of intensive surveys for great horned owls, northern goshawks, or barred owls. Competition threat is considered low.
- **Vulnerability to Natural Disturbances**: Severe threat, the potential for large-scale loss of owl habitat from fire is higher here than in any other Oregon province.

"The number of owls on the Forest probably varied significantly through time depending on the amount of available habitat. Currently, the Deschutes NF has 34 owl pairs utilizing fragmented habitat, of which only a few are reproductively successful on an annual basis. This number may be the highest density of owls the Deschutes NF has yet experienced and may not be sustainable over time. Never-the-less, this plan is designed to provide enough suitable habitat for all current owl pairs within the LSRs" (Process Paper - Desired Late-Successional Reserve Condition 1996). It is acknowledged that as we move towards sustainable vegetative conditions owl densities may vary with the LSRs. Chapter IV describes the framework to provide suitable habitat over time to maintain all existing owl pairs. This cannot be accomplished over night, rather may take many decades to achieve the desired mix of vegetative stages that will provide sustainable owl habitat.

NORTHERN BALD EAGLE—MIXED CONIFER DRY PAG

The bald eagle (*Haliaeetus leucocephalus*) is federally and ODFW listed as a Threatened species. Suitable nesting and roosting habitat for this species is characterized by the presence of large (mature) trees, generally greater than 32 inches dbh (species is variable). On the Deschutes NF, ponderosa pine and Douglas-fir trees with large open limb structures are preferred for nesting. Typical nest sites are in areas that offer a clear flight path and good visibility of the surrounding terrain (Stalmaster 1987). Nests consist of a bulky platform of sticks located in the super-canopy of a tree or on a cliff. Both living and dead trees are used for nesting, but they must be sturdy enough to support the weight of nesting material which may accumulate for many years. Overstory consists of canopy cover ranging from 20-40%, 1-30 TPA with a mean dbh of about 44 inches , second layer consists of canopy cover ranging from 20-40%, about 40 TPA with a mean dbh of about 20 inches with overall canopy cover <70% (Lehman 1980). Home ranges can be from 1-2 mi^2 but can vary from 10-15 mi^2 with distances between occupied nests of 0.6-2 miles (Stalmaster 1987).

Prey availability, usually within one mile of their nesting territory is another habitat attribute. The predominate prey during the nesting season and the summer are fish from large water bodies that are generally greater than 90 acres. Perching trees are typically within 165 feet of the waterbody and are usually the tallest snag along the shoreline with a panoramic view and open exposure on at least one side. They will also consume waterfowl and other birds, mammals up to approximately rabbit size, and a variety of carrion (Stalmaster 1987). Currently one bald eagle pair resides within the Cultus LSR along the Deschutes River and another pair is west of Quinn River Campground. Eagles are often seen foraging at Cultus, Little Cultus, and Deer Lakes in the nesting season. During mild winters eagles are occasionally seen along the rivers and lakes in the area.

FLAMMULATED OWL—MIXED CONIFER DRY AND PONDEROSA PINE WET PAGS

The flammulated owl (*Otus flammeolus*) is listed as a Sensitive species in the Critical category by the ODFW. The flammulated owl nests in cavities in open-canopied mature ponderosa pine and mixed conifer dry stands near forest openings, and roosts in dense mixed conifer dry stands which afford protection from avian predators (Marshall 1992). The flammulated will avoid pure stands of ponderosa pine for roosting, they prefer ponderosa pine for roost trees within mixed conifer stands (Hayward and Verner 1994). Foraging occurs in forest openings and open-canopied stands in ponderosa pine, mixed conifer dry and grassland-forest edge. Flammulated owls feed on insects such as grasshoppers and moths. Studies have found that nest trees have an average dbh of 28 inches (Bull, Wright and Henjum 1990) with a canopy closure less than 50% (Goggans 1985). Nests are typically constructed in a vacated woodpecker cavity. Adult home range sizes vary from the incubation period to the fledgling period, being 48 to 14 acres respectively (average is 25.5 acres) (Marshall 1992). Sightings have been recorded within and adjacent to the Sheridan LSR, however there are no sightings within the Cultus LSR. No surveys have been done to locate the owl, but habitat exists and is expected to increase in the future as desired conditions are met.

WHITE-HEADED WOODPECKER—PONDEROSA PINE WET AND DRY PAGS

The white-headed woodpecker (*Picoides albolarvatus*) is listed as a Sensitive species in the Critical category by the ODFW. White-headed woodpecker habitat occurs mainly in open-canopied ponderosa pine and mixed ponderosa pine forests on the eastside of the Cascades. Stand characteristics include at least ten trees per acre greater than 21 inches dbh or two trees per acre greater than 31 inches dbh, multiple understory layers and at least one snag per acre (Blair 1993).

The species forages primarily on the trunks of living trees for insects and in the crowns for ponderosa pine seeds. A foraging preference has been shown in Central Oregon for trees exceeding 20 inches dbh. Most foraging for insects occurs near the ground since insect populations are most abundant in the deepest bark furrows and cracks in the tree's bole.

Nest cavities are usually within 15 feet of the ground in dead trees having heartrot. Nests are located in or on the edges of forest openings or clearings. Cavities are also used for roosting (Marshall 1992). Nests and roosting trees are ponderosa pine with a mean of 31 inches dbh and 24 inches dbh, respectively. The mean canopy cover in nest sites and roosting sites were 24% and 44%, respectively.

White-headed woodpeckers reached their highest density in areas that contained > 37% canopy cover in old growth ponderosa pine. Home ranges vary from 0.8-1.3 mi^2 in contiguous and fragmented sites respectively (Dixon 1995). No recent or historical sightings have been recorded and no surveys have been done to locate the woodpecker, but habitat exists and is expected to increase in the future as desired conditions are met. The white-headed woodpecker will represent both the Ponderosa Pine Wet and Dry PAGs.

BLACK-BACKED WOODPECKER—MIXED CONIFER DRY, LODGEPOLE PINE WET AND DRY PAGS

The black-backed woodpecker (*Picoides arcticus*) is listed as a Sensitive species in the Critical category by the ODFW. The black-backed woodpecker is associated with lodgepole pine and mixed conifer forests in Oregon and Washington (Marshall 1992). Currently, black-backed woodpeckers are fairly common within the LSRs due to an extensive mountain beetle infestation within the lodgepole pine stands. This species tends to select mature and overmature lodgepole and ponderosa pines (with a mean dbh of 11"), which have been dead < 5 years or are live. A critical factor is that heart rot is present. The black-backed woodpecker is known to summer roost in defective lodgepole pines having concave western gall rust cankers, mistletoe clumps, and other deformities (Marshall 1992). Primary forage species are bark beetles which are prolific across the forest since the recent epidemic of the mountain pine beetle. Other preferred habitat include frequently burned over areas having fire killed trees that are infested with bark beetles. The black-backed woodpecker forages on the dead conifers by flaking away large patches of loose bark rather than drilling into it, in search of larvae and insects. Trees used for foraging have generally been dead three years or less. Mean canopy cover in nest sites is 24% and roosting sites is 40%. Foraging and roosting stands typically have a mean dbh of 10 inches and 11 inches, respectively (Goggans, Dixon and Seminara 1988). The estimated home range for a pair of black-backed woodpeckers is 1.5 mi^2 (individuals, 430 acres) during bark beetle epidemics; larger areas are needed after the epidemic subsides.

GREAT GRAY OWL—MIXED CONIFER DRY, LODGEPOLE PINE WET AND DRY PAGS

The great gray owl (*Strix nebulosa*) is listed as a Sensitive species in the Vulnerable category by the ODFW and a Survey and Manage species in the NWFP. Great gray owls inhabit open forests or forests with adjoining deep-soiled meadows. Appropriate habitat is provided by lodgepole pine or mixed conifer dry forests of mid to late structural stages (i.e., lodgepole over 70 years of age, ponderosa over 200 years of age). The majority of great gray owl nest sites are within 0.2 miles of a meadow. Openings other than meadows (i.e. clearcuts, shelterwoods) may also be used for foraging. The key factor is vegetation within the opening averages 8 inches high and is grass dominated (Bull, Henjum and Rohweder 1988). Openings typically range from 15-247 acres in size (Bryan and Forsman 1987). Canopy cover in nesting areas is > 60% with a range of 52-99%, and male owls will forage in open stands with canopy covers of 11-59% (Hayward and Verner 1994). The owl will utilize vacant goshawk or red-tailed hawk nests in large trees or snags (> 23 inches dbh) adjacent to meadows. They also use cavities, natural platforms formed by dwarf mistletoe infections, artificial platforms or broken-topped dead trees (Marshall 1992). Owlets leave the nest before they can fly, so an important habitat component includes dense cover or leaning trees to allow owlets to climb to perches above-ground. Average home range size is 30 mi^2 and over 60 mi^2 for first year juveniles (Marshall 1992). Great gray owls have been observed in both LSRs near clearcuts within mixed conifer stands or stands that have had numerous partial cuts.

NORTHERN GOSHAWK—MIXED CONIFER DRY, LODGEPOLE PINE WET AND DRY PAGS

The northern goshawk (*Accipiter gentilis*) is federally listed as Species of Concern and ODFW lists the goshawk as a Sensitive species in the Critical category. Habitat is typically characterized by older and mature forest types with a high degree of canopy cover and/or dense overhead foliage, with limited understory vegetation. It is known to use both mixed conifer and lodgepole pine plant associations in the late and old seral stages on the Deschutes NF. Presence of goshawks have been documented within the LSRs and future surveys are scheduled to assist in nest location. The presence of many riparian areas also contributes to habitat suitability. Nest trees are frequently the largest tree in the stand and are near small breaks in the canopy (Marshall 1992). Stands suitable for nesting range from those containing few mature trees but numerous smaller understory conifers to those with mature canopies and few understory trees. Goshawks prey below the canopy on a variety of birds and mammals including jays, woodpeckers, quail, grouse, robins, tree and ground squirrels, hares and rabbits. Nesting habitat canopy cover will range from 44-85% (Squires and Ruggiero 1996). Home ranges are generally 6-15 mi^2 per pair and distance between nests averaged 3.4 miles (Marshall 1992).

III. B. 2. CONSOLIDATION OF RESEARCH INTO STRUCTURE ELEMENTS

Table III-4 summarizes described habitat structures for the various late-successional old growth indicator species, together with research and Forest monitoring data that provide additional habitat descriptors. Ground cover (CWM, shrubs, grasses and forbs) is not discussed in the table though it is a critical element for the indicator species. All are predatory and rely on ground cover to support the prey base they live on to one degree or the other. Only logs, an element of CWM, will be described in the table. Note, that after each species an abbreviated identifier is shown (i.e., American Marten (AM)). Within the habitat structure the reader will notice an (*) which separates different references. The habitat characteristics are then followed by a reference identifier code (i.e., A, B, AA, BB, etc.), the key to which is listed after the tables.

TABLE III-4—HABITAT STRUCTURE CHARACTERISTICS SUMMARY SHEET FOR INDICATOR SPECIES

Species	PAGs	Snags	Logs	Canopy Cover	Canopy Layers	Tree Size/ Trees per Acre	Basal Area	Home Range	Special Features
American Marten (AM)	MH	*18/ac >31 in. dbh 13' tall (X), *class 2 & 3 (R) * 20-35/ac (A) *>20 in. dbh at rest sites >31 in. dbh at den sites (S)	*8-20/ac (H) *16/ac > 31 in. dia. and 33' long (X) *>20 in. dia. at rest sites >31 in. dia. at den sites Intermediate decay class (S)	*40-60% at rest and forage sites Avoids stands <30% (Y) *71% ave overall (w/roads), 83% ave in forested stands (R)	*2-3 (S)	*Rest Sites >20 in. dbh - 50% >39 in. dbh- 50% (S) *20-30 in. dbh (R) Den Sites *>31 in. dbh (S) *31-49 in. dbh (U)	*130-260 ft^2/ac (W), *126-252 ft^2/ac (U) *409-474 ft^2/ac (R)	Female *3.9 mi^2 (S), *.3-1.4 mi^2 (W), *1 mi^2 (A) Male * 6.7 mi^2 (S), *.6-3.2 mi^2 (W), *2-4 mi^2 (A) *1-2 mi^2 (U)	*w/in 1-5 mi^2 retain ≥50% of forest stand in mature/OG for linkage, blocks of mature/OG must be linked to provide connectivity (A) *Needs at least 160 acre blocks of suitable habitat (X)
Boreal Owl (BO)	MH	*2-3/ac > 15 in. dbh 1-7/ac >15 in. dbh at nest sites 2.4/ac >15 in. dbh at roost sites (Q)		*30-63% *Roosting- Winter-58% Summer- 63% 44% average at roost sites 26-34% at nest sites (Q)	*2-3 (Q)	Nest Sites *23 (± 6) TPA, >15 in. dbh 1-9 in. dbh, 161± 66 TPA *Roosts: Winter 656 TPA, 1-9 in. dbh, 67 TPA, >9 in. dbh Summer 1060 TPA, 1-9 in. dbh 84 TPA, >9 in. dbh Combined 6 TPA, >15 in. (Q)	*78 (± 14) ft^2/ac Roosting- Winter 113 ft^2/ac Summer 130 ft^2/ac (Q)	Winter *5.6 mi^2, Summer 4.5 mi^2 (Q)	

TABLE III-4—HABITAT STRUCTURE CHARACTERISTICS SUMMARY SHEET FOR INDICATOR SPECIES (continued)

Species	PAGs	Snags	Logs	Canopy Cover	Canopy Layers	Tree Size/ Trees per Acre	Basal Area	Home Range	Special Features
Pileated Woodpecker (PWP)	MCW & MCD	* ≥3/ac >20 in. dbh (F) *Forage >12 in. dbh (U)	*Recommended 40/ac ≥ 15 in. dia. Mean density 117/ac ≥ 15 in. dia., long dead logs were preferred. (F)	* ≥ 60% (F)	*2-3 (U)	*28 in. dbh , roosts (G) *>8 in. dbh >20 in. dbh, roost >9 in. dbh, foraging >21 in. dbh, nest tree (U)		*1.6 mi^2(F) *543 ac/pair (U)	*Roost stands of Grand fir >4/ac > 20 in. dbh live & dead (G)
Northern Spotted Owl (NSO)	MCW	*8/ac ≥ 16 in. dbh(L) * >5/ac (>25 in. dbh) >6/ac (16-25 in. dbh) 16/ac >25 in. dbh (N) *>16/ac (9-16 in. dbh) 12/ac >15 in. dbh (DD)	*15/ac ≥ 10 in. dia. (L) * >8/ac (16-25 in. dia.) >5/ac (>25 in. dia.) (N) *15/ac >15 in. dia. (DD)	*60-65% (L) *70-100% 63-67% (N) *75% (DD)	*2-3 (N)	*Overstory - ≥ 8 TPA, ≥ 21 in. dbh 2Layer - ≥ 82 TPA, ≤ 21 in. dbh (L) *70-90 TPA, 5-9 in. dbh 50-70 TPA, 9-16 in. dbh 20-30 TPA, 16-25 in. dbh 12-19 TPA ,> 25 in. dbh (N) * Overstory - 22 TPA ≥ 25 in. dbh 2Layer - 280 TPA (DD)	*180-210 ft^2/ac (Range 135-350 ft^2/ac) (N)		*>40% white fir understory > 8 in. dbh, Patch size, 40-200 acres of suitable habitat (L)

TABLE III-4—HABITAT STRUCTURE CHARACTERISTICS SUMMARY SHEET FOR INDICATOR SPECIES (continued)

Species	PAGs	Snags	Logs	Canopy Cover	Canopy Layers	Tree Size/ Trees per Acre	Basal Area	Home Range	Special Features
Bald Eagle (BE)	MCD			*Overstory <20% (Range 20-40%) 2 Layer - 20-40% Overall - 20-40% (<70%) (T)	*1-2 (T)	*Overstory - 8.5 TPA, >44 in. dbh (Range 1-30 TPA) 2Layer - 40 TPA ,20 in. dbh (T)		*10-15 mi² Distance between occupied nests .6-2 miles (AA)	*Nest tree has open flight path and panoramic view, Perching w/in 165' of H2O, typically in snags, tallest tree along shoreline w/panoramic view & open exposure on at least one side One or more alternate nests are common (AA)
Flammulated Owl (FO)	PPW MCD	* > 28 in. dbh (H) * 22 ± 4.7 in. dbh, 28 ± 5.7 in. dbh (Q) *11.8 - 22.8 in. dbh, nests in snags (U)		* <50% (O) *35-70% (Q)	* >1 Roosts >2 (Q)	*28 in. dbh, nest trees 134 ± 59 TPA, 238 ± 182 TPA Roosts - 800 TPA (Q) *>19.6 in. dbh (H) *7.8-19.6 in. dbh surrounding stand (O)	*103 ± 84.6 ft²/ac Roosts - 562 ft²/ac (Q)	Male * 25 ac (U)	*Roost- select PP w/in MC stands, avoids pure PP (Q)

TABLE III-4—HABITAT STRUCTURE CHARACTERISTICS SUMMARY SHEET FOR INDICATOR SPECIES (continued)

Species	PAGs	Snags	Logs	Canopy Cover	Canopy Layers	Tree Size/ Trees per Acre	Basal Area	Home Range	Special Features
White-headed Woodpecker (WHWP)	PPW PPD	Nests * >31 in. dbh (J) * > 18 in. dbh (Range 9-39 in. dbh), nests (U) *1/ac, 26 in. dbh nests, (B) Roosts * >24 in. dbh (J) *45/100 ac 10 in. dbh, 82/100 ac 12 in. dbh, 45/100 ac 20 in. dbh (K) *Decay Class 2-4 (J)		* Nests < 26% (B) * 24%(mean) Roosts 44% (J)	* > 1 (B)	*Nest Areas ≤166 TPA (K) * Foraging > 20 in. dbh (U) *10 TPA > 21 in. dbh or 2 TPA > 31 in. dbh >24 in. dbh, forage nest ave. 26 in. dbh, (range, 8-31 in. dbh) (B) *Mean 31 in. dbh, nest 24 in. dbh, roost 29 in. dbh, forage (J)	* ≥ 40 ft^2/ac lg trees Nest sites 15-22 ft^2/ac (J)	*.8-1.3 mi^2 In contiguous stands, 524 ac (J) *1.7 mi^2 (0.18-3mi^2) 261 ac in pure OG stands (B)	* Home ranges should contain > 37% OG (J) * Forages in live trees, secondarily use snags (B)
Black-backed Woodpecker (BBWP)	LPW LPD MCD	* >11 in. dbh (U) *>60% MPP (V)		* Nest mean in uncut stands, 24% Roost mean >40% (V, P)		*Mean 11 in. dbh of nest trees; Mean 8 in. dbh stem size at nest sites (V,P) *Mean 14.6 in. dbh, nest (V) *Mean forage stands, 10 in. dbh; all trees used for foraging, 15 in. dbh; LPP used for foraging, 14 in. dbh; LPP used for roost trees, 11 in. dbh > 4 in. dbh, 503 TPA,(P)	*Roost sites Mean, 115 ft^2/ac Forage Sites mixed conifer, 363 ft^2/ac, mixed conifer dominated by LPP, 413 ft^2/ac; LPP 411 ft^2/ac Nest sites -LPP, 79-112 ft^2/ac; mixed conifer dominated by lpp, 136 ft^2/ac (P)	*1.5 mi^2 956 ac/pair (Y) *Mean 430 ac (I)	*Roosts in gall rust cankers, trunk scars, or mistletoe (U), * Nests in snags dead < 5 years old, Heart rot critical key factor in nest selection (V)

TABLE III-4—HABITAT STRUCTURE CHARACTERISTICS SUMMARY SHEET FOR INDICATOR SPECIES (continued)

Species	PAGs	Snags	Logs	Canopy Cover	Canopy Layers	Tree Size/ Trees per Acre	Basal Area	Home Range	Special Features
Great Gray Owl (GGO)	LPW LPD MCD		* >8 in. dia.w/in forage sites (E)	*Foraging 11-50% (U) *Nesting > 60% (range 52-99%) (Q) *11-59%, males at forage & roost sites (E,Q) *Juveniles, 50%, ≥60% (E)		*Mean stick nests, 23 in. dbh Mean broken top nests, 31 in. dbh (U,E) *Perch and forage trees, 10 in. dbh (E)		Adults *11.6 mi² (Q) *30 mi² (U), *26 mi² (D) Juvenile *60 mi² (U) *61 mi² (D)	*Owlets need dense cover or leaning trees (U) Openings *Nests w/in 0.2 mi of opening (U) *Size range 15-247 ac (C) *Plant height averages 8 in., grass dominated (E)

TABLE III-4—HABITAT STRUCTURE CHARACTERISTICS SUMMARY SHEET FOR INDICATOR SPECIES (continued)

Species	PAGs	Snags	Logs	Canopy Cover	Canopy Layers	Tree Size/ Trees per Acre	Basal Area	Home Range	Special Features
Northern Goshawk (NG)	LPW LPD MCD	*25-75/ac, 8-10 in. dbh, pine forest type 5-15/ac, 7-12 in. dbh, pine/fir forest type 5-70/ac, 6-20 in. dbh, fir forest type (M)	*50-85/ac, 9-10 in. dbh, pine forest type 65-70/ac, 9-11 in. dbh, pine/fir forest type 40-190/ac, 5-9 in. dbh, fir forest type (M)	Nesting *44-85% (Z) *>40% (CC) *79%, good (I) *≥70% Recommend >90% (BB) *49-74%, pine forest type 71-91%, pine/fir forest type 70-94%, fir forest type (M)	> 1 (I)	*Nest Stands Mean dbh, 11 in. 526 TPA (Z) *Nest Area Mean nest tree 12.4 in. dbh (range 7-20 in. dbh) Mean nest tree, 29 in. dbh Mean nest area, 13 in. dbh 53.8 TPA (Z) *Ave on the east side, 14 in. dbh (BB) *Ave. stand size, 17 in. dbh (CC) *Mixed Conifer >25 TPA >20 in. dbh, good nesting habitat (I) *2.5-4.9 in. dbh, 86 TPA 4.9-8.9 in. dbh, 225 TPA 8.9-15.9 in. dbh, 192 TPA >15.9 in. dbh, 7 TPA (Z) *Nest Pine type 20-33 in. dbh; Pine/Fir type 28-39 in. dbh; Fir type 19-39 in. dbh Pine type >11 in. dbh, 30-40 TPA; >20 in. dbh, 10-25; TPA Pine/Fir type >11 in. dbh 45-110 TPA, >20 in. dbh, 20-25 TPA, Fir type >11 in. dbh, 35-110 TPA, >20 in. dbh, 20-45 TPA(M)	*217 (range 148-283) ft^2/ac 221 ft^2/ac in nest areas (Z) *30-92 ft^2/ac, live trees (CC) *Pine type 152-179 ft^2/ac, live & dead, Pine/Fir type 116-181 ft^2/ac, live & dead, Fir type 143-262 ft^2/ac, live & dead, Pine type 1-4.9 in. dbh, 20-25 ft^2/ac; 5-8.9 in. dbh, 95-160 ft^2/ac; 9-14.9 in. dbh, 15-20 ft^2/ac; 15-20.9 in. dbh, 0-10 ft^2/ac; 21-24.9 in. dbh, 10-20 ft^2/ac; 25-31.9 in. dbh, 5-10 ft^2/ac; 32 in.+ dbh, 0-10 ft^2/ac Pine/Fir type 1-4.9 in. dbh, 25-35 ft^2/ac; 5-8.9 in. dbh, 30-95 ft^2/ac; 9-14.9 in. dbh, 55-105 ft^2/ac; 15-20.9 in. dbh, 10-35 ft^2/ac; 21-24.9 in. dbh, 0-10 ft^2/ac; 25-31.9 in. dbh, 5-10 ft^2/ac, 32 in.+ dbh, 0-15 ft^2/ac Fir type 1-4.9 in. dbh, 5-45 ft^2/ac; 5-8.9 in. dbh, 25-70 ft^2/ac; 9-14.9 in. dbh, 5-115 ft^2/ac; 15-20.9 in. dbh, 5-40 ft^2/ac; 21-24.9 in. dbh, 5-20 ft^2/ac; 25-31.9 in. dbh, 5-25 ft^2/ac; 32 in.+ dbh, 0-10 ft^2/ac (M)	*6-15 mi^2 (BB,CC) *0.8 mi^2 if there is a lot of suitable habitat (BB)	*Nest tree is usually the largest w/in the stand and near small breaks in canopy (U) *Fully suitable stands contain 2 alternate nest stands within 0.6 miles of each other >20 acres (I)

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III. C. SURVEY AND MANAGE SPECIES

The standards and guidelines in the ROD (NWFP 1994) were designed to provide benefits to amphibians, mammals, birds, arthropods and mollusks. There are four component levels:

1. Manage known sites. Management of known species sites should receive the highest priority of these four categories. In most cases, the appropriate action will be protection of relatively small sites, on the order of tens of acres. For some species the appropriate action will include the use of specific management treatments.
2. Survey prior to ground-disturbing activities. Survey for species and manage newly discovered sites. Surveys should be designed for maximum efficiency, focusing on the likely range and habitats of the target species.
3. Extensive surveys. Conduct extensive surveys for the species to find high-priority sites for species management. Specific surveys prior to ground-disturbing activities are not a requirement. Rather, the surveys will be done according to a schedule that is most efficient, and sites will be identified for protection at that time. It is recommended primarily for species whose characteristics make site and time-specific surveys difficult.
4. General regional surveys. The objective is to survey for the species to acquire additional information and to determine necessary levels of protection.

The primary objective for the LSR Assessment is to document both the current status of information on these species as well as data gaps. Many of these species have habitat requirements that overlap with others such as the Northern spotted owl.

III. C. 1. ARTHROPODS

The geographic extent of the arthropods is described in the FEIS (NWFP 1994) as southwestern Oregon and south into California to the southern limits of the range of the northern spotted owl. But within the same group description it describes the southern region of the northern spotted owl range. To be conservative we will assume that southwestern Oregon includes all of the northern spotted owl range and would therefore include portions of Deschutes NF. Similar non-habitat factors are associated with all four groups of arthropods: Global climate change may pose a long-term risk to this species group, as climate changes would affect the disturbance regime and distribution of plant communities. Frequent and broad scale application of insecticides has an adverse affect on this functional group. Survey Strategy is the also the same for all four groups, strategy 4 - conduct general regional surveys.

The following descriptions are taken from the FEIS Appendix J2, Results of Additional Species Analysis of the Northwest Forest Plan, 1994. (NOTE: South Range refers to the southern range of the northern spotted owl.)

CANOPY HERBIVORES (SOUTH RANGE)

This functional group reflects a diversity of taxa which occupy forest canopies. As a group they are sensitive to a forest disturbance regime where any change in overstory species composition will be reflected in distribution of this group. Past timber harvests of low elevation forests in the planning area have reduced the diversity of habitats available for this group. Also, past management practices such as fire suppression have changed tree species composition, and combined with recent drought have increased physiological stress on forests in the southern portion of the northern spotted owl range. There is a high degree of endemism and species richness for this functional group in southern portion of the range of the northern spotted owl. This reflects the complex mosaic of habitats and environments (variations in plant communities, fire histories and interactions). Some species may be very restricted, while others are more broadly distributed.

COARSE WOOD CHEWERS (SOUTH RANGE)

This functional group is dependent on the dead wood of downed logs and snags. Functionally, the group is very important in nutrient cycling in the ecosystem by facilitating the release of nutrients. The past history of natural and anthropogenic disturbances in the southern region of the owl's range has fragmented the mature forested landscape, thus increasing the likelihood of the local extirpation of species of coarse woody material feeders specifically associated with the conditions found in mature forests. Arthropods dependent upon large CWM are especially vulnerable to reduced population levels or extinction. Knowledge of CWM chewers in the southern region is inadequate to allow even speculation on possible species extinction that have already taken place.

LITTER AND SOIL DWELLING SPECIES (SOUTH RANGE)

Litter and soil arthropods and their habitats differ between the southern and northern ranges. The climate variables in the south result in greater fragmentation of mesic habitats. The patchiness of the habitats, the complexity of the litter layer itself because of more diverse origins (related to the greater species richness of the vegetation, and higher fire risks), makes extirpation more likely in the south than in the northern, more mesic, environments with more uniform vegetational types. The same problems associated with the fragmentation and patchiness of the CWM resource occur with the litter and soil resource but at even a finer scale. The textural and organic diversity found in the litter reflects the diversity of the plants overhead. The greater occurrence of broadleaf evergreen plants, with new different chemical characteristics, influence the litter/soil biota, adding to the complexity. Local extinction patterns have not been considered in any significant way. The influence of past disturbances is highly significant. When the litter layer is burned, regardless of the source of the fire, the impact upon the organisms is extensive. Insect density may be reduced by as much as 90%. Also when soil compaction or erosion occurs, often as a result of logging or road building, soil and litter organisms are impacted. Thus, management practices which have resulted in increased likelihood of intense fire, or which have already negatively impacted soil/litter organisms are important factors.

UNDERSTORY AND FOREST GAP HERBIVORES

A broad group with some species very restricted and other widely distributed. Distribution of arthropods reflects distribution of vegetation. Species associated with forest gaps are especially vulnerable to disturbance. As for other arthropod groups, species richness and diversity is greater in the southern region of the range of the northern spotted owl. Past natural and anthropogenic disturbances of the landscape will likely affect future conditions. Forest harvest and subsequent replanting is likely to have produced vegetation patterns different from the natural disturbance such as fire. These differences will likely be reflected in the associated insect fauna at all trophic levels. Lack of accurate inventory and survey information for this region makes it impossible to assess the impact of past actions.

III. C. 2. MOLLUSKS

These species have not been identified on the Deschutes NF, but given the general geographic range may have historically been present or may currently be present. Only surveys will determine if these mollusks exist on the Forest within the northern spotted owl range. Survey Strategies for mollusks are 1 - manage known sites and 2 - survey prior to activities and manage sites.

The following descriptions are taken from the FEIS Appendix J2, Results of Additional Species Analysis of the Northwest Forest Plan, 1994.

LAND SNAILS

Helminthoglypta hertleini—The species range is in south central Oregon and north central California. None of the currently known species locations are on federal lands. However, species experts think that some portion of the species range is on federal land. The species habitat is wet talus sites, so the species is partially riparian associated, but further information is needed to test the strength of the association.

Trilobopsis tehamana—The species is weakly associated with riparian zones. Some of its locations are in rockslides, but these are probably within riparian areas. Protect species habitats throughout northern spotted owl range.

SLUGS

Prophysaon dubium—Species is a partial riparian associate, but is also found in rockslide areas. Species range is very large, but not particularly well known. It known range currently includes Pierce County, Washington; Clackamas and Hood River Counties, Oregon; and Trinity County, California. It is not known how much of the intervening area is actually occupied by the species. The range may contain some large gaps.

RIPARIAN (AQUATIC) SNAILS

Juga (Oreobasis) n. sp. 2—Restricted to springs in small drainages associated with the Columbia River at low elevations. Prefers gravel substrate and unpolluted water. Central and eastern Columbia Gorge on Oregon side only in Hood River and Wasco Counties, including sites in Mt. Hood National Forest. Known from a total of eight sites.

Lyogyrus n. sp. 1 Columbia duskysnail—Occurs in springs and spring outflows, from low to high elevations, in cold, pure, well oxygenated water. Prefers soft substrates and slow current velocities and springs without macrophytes, but they may be found in larger springs with water cress Rorippa and water hemlock Circuta. Dusky snails have a one year life span. Distribution is poorly known, but the species is known to occur in a LSR area adjacent to the Columbia River on the Oregon side.

III. C. 3. AMPHIBIANS

None of the survey and managed amphibians are known or suspected to exist within the northern spotted owl range of the Deschutes NF.

III. C. 4. AVIAN

Great Gray Owl—Survey strategies - 1 & 2. Strategy 1 - manage known sites and 2 - survey prior to activities and manage sites. Refer to the late-successional old growth species section for habitat details.

III. C. 5. MAMMALS

The following descriptions are taken from Appendix J2, Results of Additional Species Analysis of the Northwest Forest Plan, 1994.

RED TREE VOLE

The Oregon red tree vole (*Phenacomys longicaudus*) is unique among mammals in that it spends most of its life in the canopy of coniferous trees and eats needles of conifer trees. The red tree vole is more abundant in late-successional old growth forest than young forest and appears to be closely associated with older forests. Because they are small and live almost exclusively in the canopy of conifers, they probably have limited dispersal capabilities. Past forest management practices have resulted in fragmentation and conversion of late-successional old growth forests to young, even-aged forests, and these practices are believed to have reduced numbers of red tree voles. The red tree vole occurs only in the Cascade and Coast Ranges of western Oregon and potentially exists on the eastside of the Cascades in the coniferous forest types. Survey strategy 2 - survey prior to activities and manage sites.

BATS

These species have been identified as potentially existing on the Deschutes NF, but given the general geographic range, may have historically been present or may currently be present. Surveys have been initiated in the summer of 1996, which are currently concentrating on bridges, to identify species within the Forest. The current surveys do not address roosting that occurs under bark, rock crevies, or caves. Survey strategies for the bats are 1 - manage known sites and 2 - survey prior to activities and manage sites.

The following descriptions are taken from the FEIS Appendix J2, Results of Additional Species Analysis of the Northwest Forest Plan, 1994.

Fringed myotis *(Myotis thysanodes)*—ODFW listed as Sensitive species in the Vulnerable category. Occurs in mixed-conifer and mixed-evergreen forests with relatively dry moisture regimes in the Coast Range and southern Cascade Range of Oregon, in scattered localities in the Cascade Range in Washington, and throughout spotted owl range in California. Found from near sea level up to 6,000 feet. This bat is a gleaning species that forages at or within the forest canopy, primarily in riparian habitats. Roost and hibernation sites are generally in crevices occurring in caves, mines, and old wooden bridges and buildings, although snags and large trees also appear to be important. One colony has been found in a fire-scarred redwood in California, and individuals have been found in conifer snags in southern Oregon. Individual maternity roosts may consist of hundreds of individuals, but in this region, colonies appear to be smaller (30-40 individuals). Generally found in close proximity to mature forests. The fringed myotis is known to have strong site-fidelity, which may make it particularly sensitive to isolation of populations due to forest fragmentation. Past actions such as timber harvesting activities that involve removal of large snags and decadent trees has eliminated roosting habitat. Disturbance of caves and mines and removal of surrounding vegetation has eliminated hibernation and night roost sites. The fringed myotis is thought to be a permanent resident on the Forest.

Silver-haired bat *(Lasionycteris noctivagans)*—ODFW listed as Sensitive species in the Undetermined Status category. A migratory species that occurs in forests throughout spotted owl range during summer. This species is strongly associated with old growth forests for both roosting and foraging. All known day and maternity roosts are in crevices in large snags and decadent trees; it rarely enters caves. Maternity colonies are small aggregations of 8-10 females, and most give birth to twins. Silver-haired bats forage by pursuing prey over dense, mature forests near streams and ponds, feeding on a wide variety of arthropods. Known to follow stream corridors when traveling from roosts to foraging sites. Past actions of harvesting of old growth has eliminated roosting and foraging habitat. They are a migratory species that may be affected by conditions on winter range, as far south as southern California. Therefore, populations in the Pacific Northwest may be impacted, as the silver-haired bat is thought to be a summer resident on the Forest.

Long-eared myotis *(Myotis evotis)*—ODFW listed as Sensitive species in the Undetermined Status category. They occur in forested habitats up to 9,000 feet elevation. This bat forages by both gleaning and pursuing moths and beetles at the edges of mature forests, especially in riparian zones. Natural roosts are in crevices in caves, mines, snags and trees; hibernation sites are generally in caves and mines. Small water sources, such as ponds in forest clearings appear to be important for this species. The long-eared myotis is a moderately gregarious species. It occurs throughout spotted owl range with the exception of the northern Cascade Range in Washington. Past actions such as timber harvesting activities that involve removal of large snags and decadent trees has eliminated roosting habitat. Disturbance of caves and mines and removal of surrounding vegetation has eliminated hibernation and night roost sites. Bats are sensitive to human disturbance and loud noises especially during hibernation. Cave exploration, or timber harvesting and road building activities near caves and mines, may result in their abandonment as hibernacula. The long-eared myotis is a permanent resident on the Forest.

Long-legged myotis *(Myotis volans)*—ODFW listed as Sensitive species in the Undetermined Status category. They occur in coniferous forest habitats, especially ponderosa pine forests. This bat is an aerial forager that pursues insects high over the forest canopy, feeding almost exclusively on moths. Spends considerable time foraging in drainages of tributary and intermittent streams. Natural roost sites, including day roosts and maternity roosts are in trees, snags, and rock crevices. Hibernacula and night roosts are caves, mines, and large rock crevices. A moderately gregarious species that occurs throughout spotted owl range with the exception of the east side of the southern Cascade Range in Washington. Past actions such as timber harvesting activities that involve removal of large snags and decadent trees has eliminated roosting habitat. Disturbance of caves and mines and removal of surrounding vegetation has eliminated hibernation and night roost sites. Non-habitat factors of pesticide accumulation in insect populations may affect all bat populations. Bats are sensitive to human disturbance and loud noises especially during hibernation. Cave exploration, or timber harvesting and road building activities near caves and mines, may result in their abandonment as hibernacula. Recent findings using newly developed radio-telemetry technology indicate that snags and large, decadent trees may be far more important as roost sites for bats than has been previously thought. The long-legged myotis is a permanent resident on the Forest.

Pallid bat *(Antrozous pallidus)*—ODFW listed as Sensitive species in the Vulnerable category. Occurs east of Cascade Crest in Washington and Oregon, in the southern Coast Range in Oregon, and throughout spotted owl range in California. Pallid bats are found in dry forest such as mature oak woodlands in California and ponderosa pine forests in southern Oregon and northern California. They appear to be more abundant in late-successional old growth than in young forests. Natural day and maternity roosts and hibernation sites are in crevices in caves, mines, snags, and broken-top trees. Pallid bats forage widely along riparian zones by pursuing arthropods low to the ground. Past actions creating the loss of mature oak woodlands and ponderosa pine forests and elimination of large snags in southern Oregon and northern California has reduced populations by eliminating roosting and foraging habitat. They are a migratory species and are likely only a summer resident on the Forest.

III. D. OTHER SPECIES OF CONCERN

The following species demonstrate selection for LSOG structure forests for primary breeding, roosting, and foraging and tend not to utilize other habitat structures. These species descriptions will complete the approximately 40 species that rely on LSOG structure habitats. However, some species in this group may use other, younger successional forest stages. The described species will be grouped by the habitat structure that they require for viable populations. All mammals and avian species identified by the assessment have been documented within the Late-Successional Reserves. Various amphibian species are known or suspected to exist within the LSRs, however none are presently considered to be obligate or strong associates of LSOG habitat.

III. D. 1. LARGE TREE USERS

NORTHERN THREE-TOED WOODPECKER

The northern three-toed woodpecker (*Picoides tridactlus*) is considered rare in Oregon, listed by ODFW as a Sensitive species in the Critical category. It resides in lodgepole pine, spruce and true fir forests, generally found at elevations above 4500 feet. They select for mature or old growth lodgepole to excavate cavities in dead or occasionally live trees having heartrot with a mean diameter of 11.0 inches dbh. Roosts are located mainly in cavities in very soft snags located in dense, unlogged stands of lodgepole or mixed conifer with lodgepole (Marshall 1992). Studies on the Deschutes found this woodpecker to be closely associated with spruce (Goggans, Dixon, Seminara 1988).

WILLIAMSON'S SAPSUCKER

The Williamson's sapsucker (*Sphyrapicus thyroideus*) is considered a Sensitive species in the Undetermined Status category by the ODFW due to removal of older trees with heartrot, loss of snags and the fragmentation of late-successional old growth mixed conifer and ponderosa pine habitats. Habitat is mature and old growth ponderosa pine and mixed conifer forests at 3,500 to 6,500 feet elevation. Average nest tree diameter is 27 inches. The Williamson's is a poor excavator and requires live or recently dead trees with advanced wood decay. They prefer habitat with 75% canopy closure, basal areas with less than 162 ft^2/ac, 2-3 canopy layers, and more than 4 dead trees per acre (Marshall 1992).

NUTHATCHES (PYGMY, WHITE-BREASTED, RED-BREASTED)

The pygmy nuthatch (*Sitta pygmaea*) is typically found in ponderosa habitats and is listed by ODFW as a Sensitive species in the Vulnerable category. Ponderosa habitats for the pygmy include open stands with less than 70% canopy, nest and roost cavities located in large dead or decaying ponderosa exceeding 20 inches dbh. Excavating its own nest, roost cavities exceed nest cavities in size and can house 100 or more birds, mean roost tree size is 28 inches dbh . These roost cavities are critical for winter survival (Marshall 1992). The white-breasted (*Sitta carolinensis*) is associated with ponderosa and mixed conifer habitats, while the red-breasted (*Sitta canadensis*) is associated with lodgepole, mixed conifer and mountain hemlock habitats. White-breasted and red-breasted nuthatches can excavate their own nest cavity in soft or decayed trees or utilize cavities made by others species (Thomas 1979). The pygmy and white-breasted nuthatches rely on late and old growth structure habitats, the red-breasted nuthatch utilize late-successional old growth habitats for primary and secondary breeding, roosting and foraging but may use other habitats also.

VAUX'S SWIFT

The Vaux's swift (*Chaetura vauxi*) is a neotropical migrant bird that requires large hollow trees or snags for nesting and roosting associated with late-successional old growth habitats. They may have communal roosts. The swift utilizes cavities excavated by pileated woodpeckers. Their diet consists of flying insects, particularly over water bodies. Little is known about other habitat elements that are necessary. The swift's habitat is declining due to loss of large snags and fragmentation.

WATERFOWL (WOODDUCK, HARLEQUIN, BUFFLEHEAD, COMMON MERGANSER, BARROW'S GOLDENEYE, COMMON GOLDENEYE)

Woodducks (*Aix sponsa*), harlequin (*Histrionicus histrionicus*), bufflehead (*Bucephala albeola*), common merganser (*Mergus merganser*), Barrow's goldeneye (*Bucephala islandica*), and common goldeneye (*Bucephala clangula*) all utilize existing cavities near water for breeding. The harlequin, bufflehead and Barrow's goldeneye are listed by ODFW as Sensitive species in the Undetermined Status category. These waterfowl species are associated with late-successional old growth habitats, relying on large tree structure with cavities for nesting. Other life needs are met by aquatic habitats. Habitats are being reduced where increases of recreation within riparian areas occur. Areas used by recreationists displaced birds attempting to nest within cavities. Recreationists create disturbance, cut trees for campfires or the Forest Service will remove trees for safety reasons.

OTHER SECONDARY CAVITY USERS

Barn owl (*Tyto alba*), barred owl (*Strix varia*)(see later discussion), and northern saw-whet owl (*Aegolius acadicus*) forage on small mammals, birds and insects. Mountain bluebird (*Sialia currucoides*), ash-throated flycatcher (*Myiarchus cinerascens*), house wren (*Troglodytes aedon*), and winter wren (*Troglodytes troglodytes*) mainly forage on insects but also utilize seeds. Big brown bat (*Eptesicus fuscus*), California myotis (*Myotis californicus*), and little brown myotis (*Myotis lucifugus*) will also utilize loose bark and natural crevices for cover and prey on insects. Other wildlife species that utilize LSOG habitats for primary and secondary breeding, roosting and foraging but may use other habitats also are: northern pygmy owl (*Glaucidium gnoma*), tree swallow (*Tachycineta bicolor*), mountain chickadee (*Parus gambeli*), western flycatcher (*Empidonax difficilis*), and northern flying squirrel (*Glaucomys sabrinus*). These species will use cavities constructed by primary excavators. The northern pygmy owl is ODFW listed as a Sensitive species in the Undetermined Status category. Many of the species in this group are neotropical migrants.

BARK USERS

The brown creeper (*Certhia americana*) constructs nests under loose bark within ponderosa and mixed conifer forests, where it forages on insects and seeds. The bats listed above also use the loose bark to roost. Thick bark that is characteristic of dominant trees in a LSOG forests is needed to provide concealment and thermal protection for these species.

PLATFORM USERS

Osprey (*Pandion haliaetus*) typically construct nest platforms in or near the top of large trees that have deformed or broken out tops. Typically the tree is in the supercanopy providing a panoramic view of the area. Colonies and/or single pairs of great blue heron (*Ardea herodias*) will construct rookeries within large trees to nest and roost. Osprey, bald eagles, and great blue heron rely on large structure trees for nesting and roosting but forage in other habitat types (i.e. lakes, rivers, and wet meadows/marshes). Raptors, such as merlin (*Falco columbarius*) and red-tail hawk (*Buteo jamaicensis*) construct platforms within the canopy of late to old growth trees.

MAMMALS

The wolverine (*Gulo gulo*) is listed federally as a Species of Concern, by the USFS R-6 as Sensitive and by ODFW as Threatened. Wolverine habitat can be found in mountain hemlock plant associations at elevations ranging from 6,000 feet to above timberline. During the winter, wolverine move to lower elevations where the habitat is comprised of mixed conifer and lodgepole pine. Wolverine prefer timbered areas and avoid large openings and areas with human occupancy. They often den in rock crevices or beneath talus. Late-successional old growth habitats are utilized as primary and secondary foraging areas, but denning typically occurs above timberline.

Fisher (*Martes pennanti*) is listed federally as a Species of Concern and by ODFW as Sensitive species in the Critical category. Fishers are usually found in mixed conifer forests containing a variety of stand ages. Selection of habitat is determined mostly by food availability, but is also influenced by the presence of continuous overhead cover, proximity to denning sites, and abundant coarse woody material. The fisher is an opportunistic feeder and frequently prey on porcupines. A staple in the fisher's diet is the snowshoe hare, while mice, squirrels, and birds can also comprise a large portion of it. Riparian areas are critical for movement and foraging for the fisher. Engelmann spruce habitats are preferred during the summer months. Their resting sites include hollows in live trees, snags, logs, stumps, witches brooms, squirrel and raptor nests, brush piles, rockfalls, and holes in the ground. Fishers are competitive with marten for denning sites which occur in cavities of live or dead trees, or hollow logs and rock substrates. The fisher avoids large openings, humans and areas with low canopy closure. The fisher relies on late and old growth structure to provide denning cavities, resting areas, and foraging, with little or no usage within younger structural habitats.

AVIAN

Other neotropical migratory and resident species that rely on late-successional old growth habitats on the eastside for primary and secondary breeding, roosting, and foraging include; Townsend's warbler (*Dendroica townsendi*), ruby-crowned kinglet(*Regulus calendula*), Hammond's flycatcher (*Empidonax hammondii*), Clark's nutcracker (*Nucifraga columbiana*), red crossbill (*Loxia curvirostra*), white-winged crossbill (*Loxia leucoptera*), evening grosbeak (*Coccothraustes vespertinus*), and black-headed grosbeak (*Pheucticus melanocephalus*). These species are not generally identified with younger structural habitats.

III. E. NON-NATIVE / INTRODUCED SPECIES

Non-native and/or introduced species may have an undesirable affect on native late-successional old growth associated habitat species. Undesirable affects include preying on native species, parasitization of nests and competing for late-successional old growth habitat. These non-native species include, but not inclusively, barred owl, hybrid wolf-dog crosses, brown-headed cowbird and bullfrogs.

Barred owls (*Strix varia*) have spread into the northwest from Canada and the eastern United States. Barred owls use LSOG, edge and fragmented habitats for primary breeding, roosting and foraging. The barred owls displace or may breed with northern spotted owls. Where habitat is limited spotted owls that have been displaced may not survive. Breeding between species is possible but whether offspring are capable of reproduction is not known. Barred owls tolerate more fragmented habitats and may be able to adapt to global climate changes more readily than spotted owls. Barred owls have been documented within and adjacent to the Cultus LSR.

Hybrid wolf-dog crosses (*Canis sp.*) have been released into forested landscapes due to owners not wishing to comply with Oregon State Regulations concerning possession and raising of this crossbreed dog. The wolf-dog becomes a predator that may have different prey selections than the pure wolf strain. Much is unknown of the effects of this introduction. The wolf-dog may pose a threat to ground based late-successional old growth species by predation. Probable wolf-dog sightings have been documented along the eastside of the Cascades in the Deschutes National Forest.

Brown-headed cowbirds (*Molothrus ater*) are a non-native that originated in the Great Plains and were associated with the American bison. Due to introduction of livestock and clearing of lands the cowbird has spread both westerly and easterly. Brown-headed cowbirds parasitize by laying eggs within the nests of other birds. The cowbird eggs typically hatch before others and may push out other eggs reducing native species offspring. Young cowbirds are very aggressive, taking food from young native birds and wearing parental native birds to a frazzle feeding them. Many young native birds starve to death from lack of food. The brown-headed cowbird poses a threat to songbird populations along riparian zones, edges or small openings within late-successional old growth habitats. Brown-headed cowbirds are present throughout the Forest and the LSRs.

Bullfrogs (*Rana catesbeiana*) are opportunistic feeders, annihilating other amphibian species from the habitat and preying on young waterfowl or other smaller animals. The bullfrog's motto is, "If it fits through my mouth, I eat it." The bullfrog not only will eliminate other amphibian species but could have detrimental effects on other species that are associated with riparian areas. The bullfrog poses a threat to young waterfowl that utilize the late-successional old growth habitats. Bullfrogs are found along the Deschutes and Little Deschutes River, but it is not known how far they range up the Deschutes River.

III. F. DISPERSAL AND CONNECTIVITY

Dispersal is the movement, usually one-way and on any time scale, of plants or animals from their point of origin to another location where they subsequently produce offspring (FEMAT 1993). Typically, wildlife dispersal is done by juveniles leaving the parents territory and seeking new suitable habitat to establish their own territory or by displaced adults that have lost their habitats due to timber harvest, wildfires, insect epidemics, or human disturbance. Dispersal habitat supports the life needs of an individual animal during this time. It generally satisfies needs for foraging, roosting, and protection from predators (FEMAT 1993). Dispersal habitat generally does not provide the habitat attributes to support reproduction and may not support enough resources to rear young. Connectivity is a measure of the extent to which habitats are linked and meet the needs for breeding, feeding, dispersal, and movement of LSOG-associated wildlife and fish species (FEMAT 1993). In essence, connectivity measures the effectiveness of providing dispersal habitat that allows wildlife to occupy suitable habitats and thereby better assure population viability. In the case of the northern spotted owl connectivity needs to be maintained between suitable NRF habitats, e.g., within and between LSRs. Dispersal connectivity also must be provided at the landscape scale, e.g., within and between geographic provinces. Limits to intra-provincial owl movement may exist due to natural (topographical, geological) or human caused fragmentation. This problem is exacerbated in the Cultus and Sheridan LSRs because suitable habitat may be naturally fragmented by intrusions of lava and other forest types, as well as by certain types of timber harvest, resulting in only a narrow band of suitable habitat. Actions or events resulting in a relatively small loss of habitat could block dispersal through this narrow band and in turn greatly restrict the ability to sustain range-wide distribution of owls. (USFWS 1996)

Fragmentation reduces the size and connectivity of stands that compose a forest (FEMAT 1993). "No single factor has been a greater cause of declines in wildlife populations than loss of habitat. And no one aspect of changes in habitat conditions has been more insidious and difficult to understand than that of fragmentation. Fragmentation affects quality of habitat of a given species in subtle ways. It changes types and quality of the food base. It changes microclimates by altering temperature and moisture regimes. It changes availability of cover and brings species together which normally have little contact, and thus may increase rates of nest parasitism, competition, and predation." (Morrison, Marcot and Mannan 1992)

Wilcove (1987) identified four ways that fragmentation can lead to local extinction: A species can be initially excluded from the protected patches. Patches can fail to provide habitat because of decrease in size or loss of internal heterogeneity. Fragmentation creates small, more isolated populations that are at greater risk from catastrophes, demographic variability, genetic deterioration, or social dysfunction. Fragmentation can disrupt important ecological relationships; this can cause secondary extinctions from loss of key species and adverse influences of external alien environments and edge environments.

Fragmentation inherently occurs as natural openings, such as lakes, rivers, meadows, cinder cones and talus areas. Fragmentation or breaks in the connectivity also result from induced methods that may be irretrievable or retrievable. Irretrievable fragmentation is induced by the development of surfaced roads, powerlines, rock pits and building sites. However, the majority of fragmentation occurring within the forest and the LSRs is retrievable. Retrievable fragmentation includes wildfires, harvest treatments, native surface roads, areas of insect invasion or disease pockets, and areas of blowdown. This fragmentation may take a few to many decades to once again provide connectivity with eventual re-establishment of the large continuous stands. Whereas, connectivity would not be re-established with the irretrievable or natural fragmentation. There is an edge created by the different patches created by fragmentation. According to Hansen and di Castri, 1992, there is good evidence that edges vary in their affects on ecological processes and organisms depending on the nature of the edge (e.g., type of adjacent patches, degree of structural contrast, orientation, etc.). The degree of contrast within the edge between the old growth stand and the disturbance varies depending on the type of disturbance. For example, high contrast would include old growth next to a clearcut or shelterwood unit and low contrast would be a old growth stand next to a mature or small tree stand with large tree interspersed.

Morrison, Marcot, and Mannan (1992) describe providing adequate patch sizes also helps maintain patch-interior conditions. Forest fragments are subject to drying and invasion by early successional plant species along edges and at large openings. A rule of thumb is that such effects occur at least two tree heights or approximately 400 feet (120 m) into the forest stand from an edge, road, or large openings. Thus, a forest fragment less than or about 80 acres (30 ha) in size consists only of edge. Some environmental conditions, such as equable temperature and moisture regimes, are found only in interiors of forest stands. They are important for species such as spotted owls, which select roosts within old forests They are important for species such as spotted owls, which select roosts within old forests for their cool, equable temperatures (Barrows 1981). Thus, for protecting interiors of forests for wildlife species closely associated with old-growth temperature conifer forests of the western United States, a starting guideline would be to provide a patch size of at least 80 acres.

Map 13 demonstrates the existing fragmentation within and adjacent to the LSRs. Inherent, irretrievable, high and moderate retrievable sources of fragmentation were mapped. A buffer of 400 feet was placed on the edges of the fragmentation sources to determine location of habitat patches. The map aids in assessing dispersal habitat for wildlife species that require less fragmented habitats.

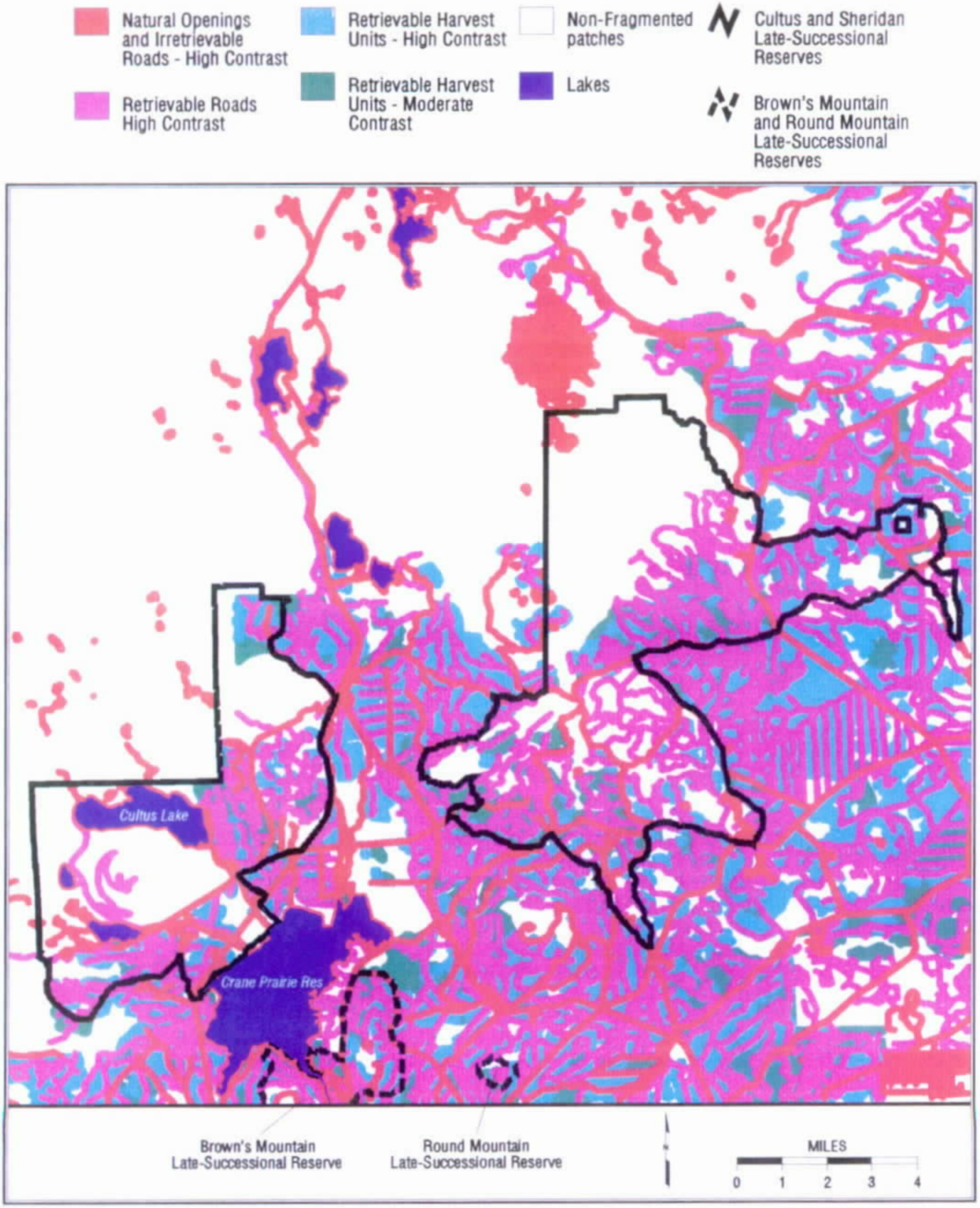
Connectivity between LSRs and other habitat areas is an essential function of the Reserve system. The Interagency Science Team (Thomas et al. 1990) definition of connectivity is used in all Deschutes NF LSR assessments. It is the measure of the extent of intervening habitat that provides for dispersal between suitable habitat for late-successional old-growth dependent species, especially juveniles.

Across the Deschutes NF, and within the Cultus LSR, there are many areas where insect and disease disturbance has degraded or eliminated effective dispersal habitat, primarily within the lodgepole stands. Effective dispersal has been reduced in the Sheridan LSR primarily due to past harvest treatments.

Providing adequate connectivity and dispersal habitat is critical for species viability in the LSRs and the Deschutes NF as a whole. Connectivity between east and west populations is most critical for maintenance of an adequate gene pool, so that populations on the east side do not become more isolated and inbred. Connectivity from north to south is important for Deschutes NF populations as it provides for enhancement of genetic diversity of species at the eastern edge of their ranges.

The weakest link for broad-scale dispersal of late-successional old-growth species is from the southern boundary of the Deschutes NF to Lake of the Woods, with only Crater Lake National Park providing a significant block of suitable habitat.

MAP 13 -- FRAGMENTATION
400 foot buffers on openings, roads, and units
Cultus and Sheridan Late-Successional Reserves



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To the north of the Deschutes NF, the Warm Springs Reservation provides some late-successional old-growth habitat. Some of this habitat is allocated as wildlife habitat under the Tribe's Integrated Management Plan; other habitat exists because of poor economics for harvesting. Currently, connectivity to the north is adequate, but the situation could change with the market making these blocks available for harvest. Losses to wildfire are also a probability. The Reservation also provides habitat that links dispersal to the Mt. Hood NF and thus, potentially across the Columbia River to Washington populations.

Connectivity from east to west is a lesser issue due to the abundance of Congressionally Reserved Areas (wilderness) containing large blocks of late successional old growth habitat. These areas connect with similar blocks and LSRs on the Willamette and Umpqua National Forests.

Connectivity between the Cultus LSR and the Sheridan LSR is provided through the mixed conifer stands north of Deschutes Bridge. The drier ponderosa pine and lodgepole pine stands may provide habitat for prey base species, roosting and protection from predators. However, ponderosa pine stands are limited and provide a minor contribution between LSRs. Movement from the Sheridan LSR to the northeast of Mt. Bachelor or south would be mainly through ponderosa and lodgepole pine. Much of the area between the Cultus, Sheridan and Davis LSRs contains large amounts of lodgepole pine forest, where past harvest treatment units and areas with mountain pine beetle mortality have reduced its effectiveness. In lodgepole pine that has been killed by beetles may still be used as dispersal habitat until the stand begins to "fall apart." A more fragmented connectivity exists through the Browns Mt. LSR, because of timber harvest, insect infestations, and wildfires (Four Corners and Lookout Mt. fires). Dispersal habitat westward on to the Willamette National Forest is intact with little fragmentation, so connectivity is strong in this direction. Connectivity north is good through the Wilderness and Administratively Withdrawn Areas for both Cultus and Sheridan LSRs to the Cache/Trout LSR on the Sisters District. The area to the west of the Cultus LSR is good to the crest of the Cascades due to Wilderness. But directly south of the Cultus LSR the area is heavily fragmented by past harvest treatments and bug killed lodgepole. For the Sheridan LSR, movement south is restricted due to heavily fragmented forests, where the only connectivity exists by moving through Browns Mt. LSR then westward to the crest and the existing habitat located there. Map 14 demonstrates the potential connectivity between LSRs and along the Cascade Range.

The Deschutes National Forest LSR Overview (Gerdes et al. 1995) has been used to determine northern spotted owl dispersal habitat between the LSRs. Two factors in the Overview were applied: 1) For those plant associations with the site capability to meet and sustain the 11-40 standard (11"dbh and 40% canopy cover), or 2) For those plant associations that cannot meet or sustain the 11-40 standard, local forest conditions and biological knowledge of what is likely to be dispersal habitat were evaluated. To determine stands that apply the latter factor, stand densities were evaluated to insure sustainability for at least two decades together with field experience to determine what is functional dispersal habitat. Elements that help determine dispersal habitat include:

1. Percent canopy cover
2. Average stand dbh (>5 inches dbh)
3. Number of hard and soft snags
4. Amount of coarse woody material
5. Amount of area meeting dispersal habitat conditions

Table III-5 following is not inclusive but provides general guidelines. Development of the table guidelines followed the Forest dispersal steps outlined in the LSR Overview but did not define vegetation upper stocking limits. This will need to be accomplished on a site specific level. Field surveys and observations should determine if the habitat meets dispersal habitat requirements.

MAP 14 -- POTENTIAL CONNECTIVITY
400 foot buffers on openings, roads, and units
Cultus and Sheridan Late-Successional Reserves

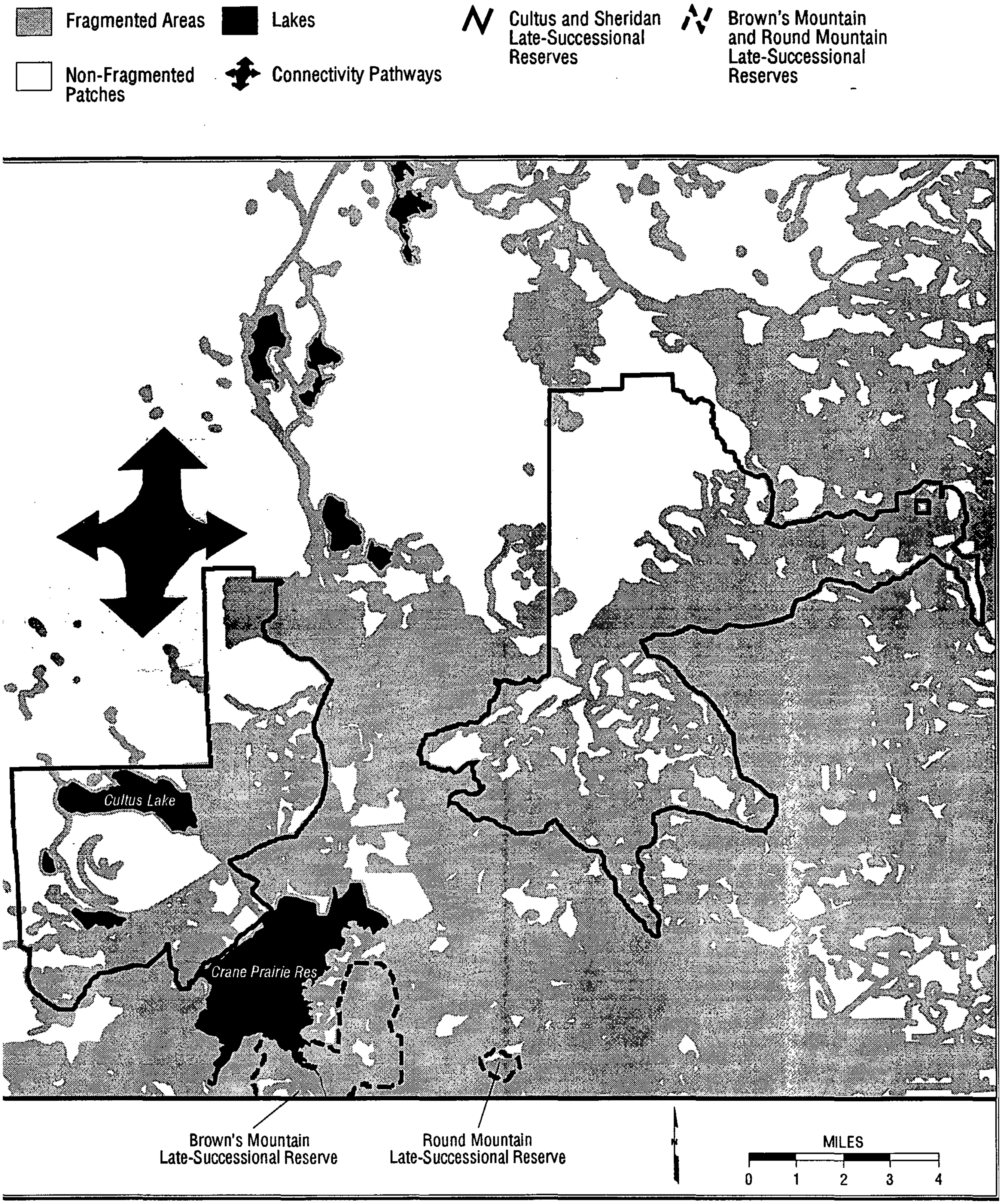


TABLE III-5—GENERAL DISPERSAL GUIDELINES (OWLS ONLY)

PAGs	DBH	%Canopy Cover	Basal Area	Trees Per Acre
MH	11	40	100	140
MCW	11	40	70	100
MCD	11	40	70	95
PPW	8	35	85	155
PPD	9	30	80	140
LPW	9	40	100	200
LPD	9	40	100	200

These dispersal guidelines may be applied to most other avian species that need to avoid aerial predation. Dispersal habitat for ground dwelling species typically need dense ground cover, abundant down logs, greater than 70% canopy closure, undisturbed riparian areas, foraging base, and connecting vegetation to provide linkages between suitable late/old-growth stands. Connectivity for ground-based animals is typically associated with riparian areas, but on the eastside these habitats are limited in area. These areas also generally have a high degree of human development and use within them. Animals will use the riparian zones where possible and when seasonal human disturbance is low. Factors that determine animal usage within riparian zones include: number and location of recreational sites, location and use of trails, type of recreational usage (hiking, skiing, snowmobiling, motorcycling, ATVs, fishing, etc.), and season of use (winter, summer, etc.). When the riparian areas are not acceptable for movement, terrestrial animals will use many of the same connectivity areas as described for avian species above.

Narrow travel linkages and small patches are typically not sufficient to provide for the elements of dispersal habitat. "A generalized solution to linking patches within and across landscapes might be found in providing for a specific kind of matrix. That is, instead of establishing narrow passageways of vegetation with well-defined boundaries which may be at risk from windstorms and other catastrophic events, an alternative is to provide specific vegetation types and cover conditions across the planar landscape. Such a matrix approach does not lock habitat into specific routes and may allow for better resilience and recovery from loss of specific stands from catastrophic events." (Morrison, Marcot and Mannan 1992). Prescribing a matrix over the landscape would be the preferred methods of providing connectivity, narrow travelways would be used where the dispersal habitat is limiting due to past treatments and catastrophic events.

CHAPTER IV: MANAGEMENT OVERVIEW

A. Introduction

B. Desired Condition

C. LSOG Strategies and Implementation Schedule

D. Summary Of Management Strategy Areas

IV. MANAGEMENT OVERVIEW

IV. A. INTRODUCTION

The Northwest Forest Plan states that the objective of Late-Successional Reserves is to protect and maintain late-successional and old growth habitats for the species that are dependent on or are associated with these habitats, including the northern spotted owl. However, the functional structural elements (snags/logs, canopy cover, canopy layers, size structure and any other special features) of these habitats were not described in the Northwest Forest Plan. These descriptions have been left to individual Forests and interdisciplinary teams to develop so that they would be appropriately site specific.

For many dry eastside plant associations, the very stand characteristics that define suitable habitat conditions for climatic climax LSOG dependent and associated species are often unsustainable. Vegetative conditions existing today in eastside forests make them highly susceptible to epidemic insect and disease outbreaks and extreme crown fire behavior. Due to overstocked late-successional conditions, multiple canopy layers and high fuel loadings, there is a risk of not being able to carry these vegetative conditions over time. Since long term maintenance of LSOG habitat, distributed functionally across the landscape is essential for species viability, the dilemma of maintaining habitat conditions in the short term versus a continual supply of suitable habitat for the long term needs to be addressed.

The following chapter defines and describes the vegetative conditions desirable across the landscape within the LSRs. Managing for a variety of vegetative conditions across the landscape over time will help to meet the objectives of the LSR.

IV. B. DESIRED CONDITION

IV. B. 1. DEFINITION OF LATE-SUCCESSIONAL OLD GROWTH HABITAT

In order to manage the LSRs to protect and maintain LSOG forests, it is critical to have a clear understanding of what the term "late-successional old growth" means for this assessment, including the structural features of these forests.

In the frequent fire adapted forests east of the Cascade crest, there are two types of late-successional old growth forests; climatic climax forests and fire climax forests. These two conditions are very different due to their historic fire behavior patterns. Therefore the species that utilize these forests are unique to each type and the relative sustainability of these forests also varies by type.

Climatic climax forests develop with long intervals between high intensity fires. These forests are characterized by dense stands dominated by shade tolerant, climax species with a component of shade intolerant species. Early seral species may dominate the overstory for a period of time, until high densities of late seral species out-compete them for moisture and nutrients. All size classes are usually present and understories are often very dense. These climax communities take a long time to develop, perhaps several hundred years. This is due to the combination of local weather, elevations, aspects, productivity and disturbance agents that do not provide conditions for frequent community level changes. Loss of the climatic climax condition may occur with stand replacement fires.

Conversely, fire climax forests develop with frequent light to moderate intensity ground fires. These stands are characterized by open forests dominated by shade intolerant large trees. In the absence of or suppression of fires, the presence of shade tolerant climax species increases on these sites, resembling the beginnings of a climatic climax condition.

IV. B. 2. DEFINITION OF SUITABLE HABITAT

Suitable habitat is defined as a forest that provides the structural characteristics needed by wildlife species for primary and secondary nesting, denning, roosting, and foraging. The following table, Table IV-1, displays the habitat characteristics identified for the indicator species described in this assessment by plant association group. Three PAGs (dry mixed conifer, wet and dry ponderosa pine) exhibit both fire climax and climatic climax conditions. All other PAGs exhibit climatic climax conditions. Climatic climax habitat features numerous canopy layers, a high degree of snag and log accumulations, and high stand densities. Conversely, suitable fire climax habitat features a range of single to multiple canopy layers, low amounts of snags and logs, and lower stand densities. In both of these late-successional old growth conditions, the large tree component is a critical structural element.

Table IV-1 displays stand element quantities that define suitable habitat conditions for selected indicator species by PAG. It is important to note that these numbers may be adjusted to plus or minus 20% where the conditions dictate. This will provide a range of suitable habitat conditions. In some instances, where desirable and sustainable conditions do not overlap, choosing the lower end of the range may be appropriate, but this should not be used across the landscape. The snag/log numbers are examples and will vary according to size and length of trees/logs found on site that convert to cubic feet per acre or tons per acre. The percentages of snag/log sizes are recommendations based on research, to fulfill indicator species habitat needs. Refer to process papers for more in-depth detail concerning the development of desired habitat conditions and suitable habitat condition.

For this analysis climatic climax plant associations include: 1) all individual plant associations within the mixed conifer wet PAG, 2) individual plant association CW-C2-11 of the mixed conifer dry PAG, and 3) all individual plant associations within the ponderosa pine wet PAG. This split is based on productivity of individual plant associations. Fire climax plant associations include: 1) all individual plant associations within the mixed conifer dry PAG except CW-C2-11, and 2) all individual plant associations within the ponderosa pine dry PAG. Where fire climax plant associations are found on north facing slopes with moister conditions, then these plant associations would be considered as climatic climax. Since this analysis is looking at the landscape level, these splits by slope position were not further defined. Site specific analysis at the project level should describe further refinement.

TABLE IV-1 — SUITABLE HABITAT CONDITION BY PLANT ASSOCIATION GROUP

PAGs	Snags/Logs (Tons/Acre & Ft³/Acre)	Canopy Cover	Canopy Layers	Total Mean		Sapling 1.0 - 4.9"	Pole 5.0 - 8.9"	Small 1 9.0 - 14.9"	Small 2 15.0 - 20.9"	Med 1 21 - 24.9"	Med 2 25 -31.9"	Large ≥ 32"	Special Features and Key Tree Species
MH (Climatic)	25 - 40 tons/ac. or 2700 - 4300 ft³/ac.	ave 70%	2 - 3	**TPA**	275	80	80	17	24	24	25	25	**AM** - Within PAG retain ≥ 50% of forest stand in mature/old growth for linkage, blocks of mature/old growth must be linked to provide connectivity.
Indicators: AM, BO	**Snag guides:** 85% > 21" dbh (examples: 6-15/ac) 15% 15-21" dbh (examples: 2-3/ac)			**BA**	433	4	21	13	42	69	107	177	**Tree Species:** PIMO - Blister rust ABMAS - Heartrot
	Log guides: 100% > 31" dia. and 33' long (examples: 7-24/ac)			**Stand SDI**	620	10	43	23	66	101	148	≥ 187	
MCW (Climatic)	25 - 35 tons/ac. or 2200 - 3100 ft³/ac. **Snag guides:** 60% 9-16" dbh (examples: 9-17/ac) 20% 16-25 dbh (examples: 1-2/ac)	> 70%	2 - 3	**TPA**	357	150	70	70	30	15	12	10	**PWP** - Roosts stands of white fir with > 4 TPA >20" live or dead. **NSO** - ≥ 40% of white fir understory > 8" dbh.
Indicators: PWP, NSO	20% >25"dbh (examples: 1-2/ac)			**BA**	270	7	19	55	53	14	51	71	**Tree Species:** PIPO and PSME - Large Tree component
	Log guides: 60% 16-25" dia. (examples: 7-16/ac) 40% >25" dia. (examples: 3-6/ac)			**Stand SDI**	476	18	37	97	85	66	74	≥ 78	LAOC, TSME, TABR - Species diversity

TABLE IV-1 — SUITABLE HABITAT CONDITION BY PLANT ASSOCIATION GROUP (continued)

PAGs	Snags/Logs (Tons/Acre & Ft³/Acre)	Canopy Cover	Canopy Layers	Total Mean		Sapling 1.0 - 4.9"	Pole 5.0 - 8.9"	Small 1 9.0 - 14.9"	Small 2 15.0 - 20.9"	Med 1 21 - 24.9"	Med 2 25 -31.9"	Large ≥ 32"	Special Features and Key Tree Species
MCD (Climatic)	12 - 24 tons/ac. or 1100 - 2100 ft³/ac.	ave 50%	2 - 3	**TPA**	218	80	50	35	20	15	11	7	**PWP** - Roosts stands of white fir with > 4 TPA >20" live or dead. **GGO** - Young owlets require dense cover and/or leaning trees to escape predation. **NG** - Maintain a diversity of large trees scattered through the stands, especially near small breaks in the canopy.
Indicators: PWP, GGO, NG, BE, FO, BBWP	**Snag guides:** 70% 12-20" dbh (examples: 3-9/ac) 30% > 20" dbh (examples: .75-2/ac)			**BA**	218	4	13	27	35	43	47	49	**BE** - Insure large ponderosa pine and Douglas fir trees of the super canopy provide an open flight path from tree. Maintain large trees, especially snags along riparian edges that provide panoramic views and open exposure on at least one side. **BBWP** - Maintain trees with heart rot, gall rust cankers, trunk scars or mistletoe at just less than epidemic levels. Provide areas of dead or burned trees < 5 years old for foraging and roosting.
	Log guides: 100% > 15" dia. (examples: 5-14/ac)			**Stand SDI**	343	9	27	48	57	66	68	≥ 55	**Tree Species:** PIPO, PSME - Large tree component PILA, LAOC, CADE3, TABR, ABMAS - species diversity

TABLE IV-1 — SUITABLE HABITAT CONDITION BY PLANT ASSOCIATION GROUP (continued)

PAGs	Snags/Logs (Tons/Acre & Ft³/Acre)	Canopy Cover	Canopy Layers	Total	Mean	Sapling 1.0 - 4.9"	Pole 5.0 - 8.9"	Small 1 9.0 - 14.9"	Small 2 15.0 - 20.9"	Med 1 21 - 24.9"	Med 2 25 -31.9"	Large ≥ 32"	Special Features and Key Tree Species
MCD (Fire) Indicators: BE, WHWP, FO	**Snag guides:** BE 1-2 > 25" WHWP,FO 1-5 > 25" **Log guides:** BE 1-2 > 25" WHWP,FO 1-5 > 25"	30-50%	≥ 1	**TPA**	35+	0-80 ± 50%	0-50 ± 50%	0-35 ± 50%	10 ± 50%	7 ± 50%	11	7	
				BA	144	10 total			18	20	47	49	
				Stand SDI	195+				28	31	68	68	
PPW (Climatic) Indicators: FO, WHWP	12 - 24 tons/ac. or 500 - 2200 ft³/ac. **Snag guides:** 50% 18-28" dbh (examples: .5-3/ac) 50% > 28" dbh (examples: .25-1.5/ac) **Log guides:** 100% > 20" dia. (examples: 1-9/ac)	> 40%	≥ 1	**TPA**	187	40	40	40	20	17	20	10	**WHWP** - Old growth should be maintain at > 37% over the PAG. **Tree Species:** PIPO - Large tree component PICO - species diversity
				BA	285	2	11	31	35	49	86	71	
				Stand SDI	433	5	21	55	57	74	124	≥ 78	
PPW (Fire) Indicators: BE, WHWP, FO	**Snag guides:** BE 1-2 > 25" WHWP,FO 1-5 > 25" **Log guides:** BE 1-2 > 25" WHWP,FO 1-5 > 25"	30 - 50%	≥ 1	**TPA**	35+	0-80 ± 50%	0-50 ± 50%	0-35 ± 50%	10 ± 50%	7 ± 50%	11		
				BA	144	10 total			18	20	47	49	
				Stand SDI	195+				28	31	68	68	

TABLE IV-1 — SUITABLE HABITAT CONDITION BY PLANT ASSOCIATION GROUP (continued)

PAGs	Snags/Logs (Tons/Acre & Ft³/Acre)	Canopy Cover	Canopy Layers	Total Mean		Sapling 1.0 - 4.9"	Pole 5.0 - 8.9"	Small 1 9.0 - 14.9"	Small 2 15.0 - 20.9"	Med 1 21 - 24.9"	Med 2 25 -31.9"	Large ≥ 32"	Special Features and Key Tree Species
PPD (Climatic)	10-15 tons/ac. or 900 - 1300 ft³/ac. **Snag guides:** 15% 10-12"dbh (examples: 2.5-5/ac)	ave 40%	≥ 1	**TPA**	180	40	40	40	20	15	15	10	**WHWP** - Old growth should be maintain at > 37% over the PAG.
Indicators: WHWP, NG	30% 12-20"dbh (examples: 1-2.5/ac) 25% 20-31"dbh (es. .25-.75/ac) 30% > 31" dbh (examples: .25-.5/ac)			**BA**	232	2	11	31	35	18	64	71	**NG** - Maintain a diversity of large trees scattered through the stands, especially near small breaks in the canopy.
	Log guides: 100% >20" dia. (examples: 7-15/ac)			**Stand SDI**	394	5	21	55	57	66	93	≥ 78	**Tree Species:** PIPO - Large tree component PICO - Species diversity
PPD (Fire)	**Snag guides:** BE 1-2 > 25" WHWP,FO 1-5 > 25"	30 -50%	≥ 1	**TPA**	35+	0-80 ± 50%	0-50 ± 50%	0-35 ± 50%	10 ± 50%	7 ± 50%	11 ± 50%	7 ± 50%	
Indicators: BE, WHWP, FO				**BA**	144	10 total			18	20	47	49	
	Log guides: BE 1-2 > 25" WHWP,FO 1-5 > 25"			**Stand SDI**	195+				28	31	68	68	

TABLE IV-1 — SUITABLE HABITAT CONDITION BY PLANT ASSOCIATION GROUP (continued)

PAGs	Snags/Logs (Tons/Acre & Ft³/Acre)	Canopy Cover	Canopy Layers	Total Mean		Sapling 1.0 - 4.9"	Pole 5.0 - 8.9"	Small 1 9.0 - 14.9"	Small 2 15.0 - 20.9"	Med 1 21 - 24.9"	Med 2 25 -31.9"	Large ≥ 32"	Special Features and Key Tree Species
LPW (Climatic)	12 - 24 tons/ac. or 1000 - 2150 ft³/ac.	ave 60%	≥ 1	**TPA**	370	150	120	70	20	10			**BBWP** - Maintain trees with heart rot, gall rust cankers, trunk scars or mistletoe at just less than epidemic levels. Provide areas of dead or burned trees < 5 years old for foraging and roosting.
Indicators: BBWP, GGO, NG	**Snag guides:** 50% 11-20" dbh (examples: 3-8.5/ac) 50% > 20" dbh (examples: 1-3.5/ac) **Log guides:** 50% 11-15" dia.			**BA**	158	7	32	55	35	29			**GGO** - Young owlets require dense cover and/or leaning trees to escape predation. **NG** - Maintain a diversity of large trees scattered through the stands, especially near small breaks in the canopy.
	(examples: 13-43/ac) 50% > 15" dia. (examples: 6-19/ac)			**Stand SDI**	278	18	65	96	56	43			**Tree Species:** PIEN, PICO
LPD (Climatic)	8 - 12 tons/ac. or 700 - 1000 ft³/ac.	ave 40%	≥ 1	**TPA**	360	150	170	40					**BBWP** - Maintain trees with heart rot, gall rust cankers, trunk scars or mistletoe at just less than epidemic levels. Provide areas of dead or burned trees < 5 years old for foraging and roosting.
(High eleva-tion LP plant associations including those adja-cent to Mt. Hemlock)	**Snag guides:** 100% ≥ 11" dbh (examples: 13-27/ac)			**BA**	83	7	45	31					
Indicators: BBWP	**Log guides:** 100% ≥ 11" dia. (examples: 34-72/ac)	~~(ave. 40%)~~	~~(≥ 1)~~	**Stand SDI**	164	18	91	55					**Tree Species:** PICO, ABMAS, PIAL, PIMO

TABLE IV-1 — SUITABLE HABITAT CONDITION BY PLANT ASSOCIATION GROUP (continued)

PAGs	Snags/Logs (Tons/Acre & Ft³/Acre)	Canopy Cover	Canopy Layers	Total Mean		Sapling 1.0 - 4.9"	Pole 5.0 - 8.9"	Small 1 9.0 - 14.9"	Small 2 15.0 - 20.9"	Med 1 21 - 24.9"	Med 2 25 -31.9"	Large ≥ 32"	Special Features and Key Tree Species
LPD (Climatic)	8 - 12 tons/ac. Or 700- 1000 ft³/ac.	ave 40%	≥ 1	**TPA**	353	150	120	70	13				**BBWP** - Maintain trees with heart rot, gall rust cankers, trunk scars or mistletoe at just less than epidemic levels. Provide areas of dead or burned trees < 5 years old for foraging and roosting. **GGO** - Young owlets require dense cover and/or leaning trees to escape predation.
(Lower elevations of Lodgepole pine plant associations)	**Snag guides:** 100% ≥ 11" dbh (examples: 13-27/ac)			**BA**	117	7	32	55	23				**NG** - Maintain a diversity of large trees scattered through the stands, especially near small breaks in the canopy
Indicators: BBWP, GGO, NG	**Log guides:** 100% ≥ 11" dia. (examples: 34-72/ac)			**Stand SDI**	214	18	64	96	36				**Tree Species:** PICO

TABLE IV-1 — SUITABLE HABITAT CONDITION BY PLANT ASSOCIATION GROUP (continued)

PAGs	Snags/Logs (Tons/Acre & Ft³/Acre)	Canopy Cover	Canopy Layers	Total Mean		Sapling 1.0 - 4.9"	Pole 5.0 - 8.9"	Small 1 9.0 - 14.9"	Small 2 15.0 - 20.9"	Med 1 21 - 24.9"	Med 2 25 -31.9"	Large ≥ 32"	Special Features and Key Tree Species
UNIQUE HABITATS (CLIMATIC)													
Engelmann Spruce	25 - 35 tons/ac. Or 2700 - 3700 ft³/ac. **Snag guides:** 50% 15-20" dbh (examples: 5.5-11/ac) 50% > 20" dbh (examples: 2.5-5/ac) **Log guides:** 100% ≥ 15" dia. (examples: 21-43/ac)	50 - 100%	2 - 3	**TPA**	275	100	70	40	25	15	15	10	**Tree Species:** PIEN, PICO
				BA	277	5	19	31	44	43	64	71	
				Stand SDI	418	12	38	55	69	63	89	≥ 75	
Aspen	When regeneration is no longer occurring, manipulation would occur in a mosaic pattern throughtout stand.												
Meadows	When tree encroachment reaches a 30% loss of meadow when compared to 1959 photos, meadow restoration would occur.												
Willow Patches	When willow patches reach 80% decadence, treatment of 20% of the willows would occur. This would be random shrubs throughout the patch.												

TREE SPECIES FOR THE SUITABLE HABITAT CONDITION TABLE IV-1

Species code	Scientific Name	Common Name
ABMAS	*Abies magnifica var. shastensis*	Shasta Red Fir
CADE3	*Calocedrus decurrens*	Incense Cedar
LAOC	*Larix occidentalis*	Western Larch
PIAL	*Pinus albicaulis*	Whitebark Pine
PICO	*Pinus contorta*	Lodgepole Pine
PIEN	*Picea Engelmannii*	Engelmann Spruce
PILA	*Pinus lambertiana*	Sugar Pine
PIMO	*Pinus monticola*	Western White Pine
PIPO	*Pinus ponderosa*	Ponderosa Pine
PSME	*Pseudotsuga menzieii var. glauca*	Douglas Fir
TABR	*Taxus brevifolia*	Pacific Yew
TSME	*Tsuga mertensiana*	Mountain Hemlock

IV. B. 3. COMPARISON OF SUITABLE HABITAT WITH SUSTAINABILITY

This assessment defines on-site vegetation sustainability as a condition that is not likely to experience significant negative changes in habitat quality as a result of epidemic insect or disease outbreaks or large-scale wildfire.

Suitable habitat (both climatic climax and fire climax) was compared with on-site vegetative sustainability by each plant association group. Stand density index and fuel profile descriptions were used as quantifiers of sustainability. These factors best determine the Deschutes NF vegetative conditions and best represent the risk to bark beetle epidemics and/or extreme crown fire behavior. Bark beetle attacks and high intensity wildfires were chosen as indicators since these disturbance agents are the most common cause of significant and unexpected large tree mortality (large trees are a critical element of both climatic climax and fire climax types, and take the longest time to replace). Risk to bark beetle attack was measured using stand density index stocking guides developed by Cochran et al. 1994, for the Blue Mountains. Adjustments were made for plant associations groups that occur on the Deschutes NF (Booser and White 1996). Fuel profiles were determined using the Snaglog Model (Morehead and Vickery 1996), equating tons per acre and cubic feet per acre that translates into wildlife habitat requirements. Photo series for quantifying forest residues (tons per acre) and the risk of large-scale wildfire were displayed by plant association group. Table IV-2 displays these comparisons. Also displayed are the number of acres represented by climatic and fire climax PAG of the existing habitat that currently meets or exceeds the sustainable density, upper management zone (UMZ) of individual stand density indices.

Suitable climatic climax habitat structural characteristics and densities are different than vegetative conditions necessary for long term sustainability. Suitable climatic climax habitat is defined as a range of conditions, based on plant associations, needed for NRF habitat. **Long term habitat sustainability is identified as the density at which risk to epidemic insect, diseases and large-scale wildfires is low.** The comparisons of these two vegetative conditions results in different structural characteristics and vegetative densities. Comparisons between these conditions were made using stand density index (SDI) and the upper management zone. For example, in the dry mixed conifer vegetative type, structural characteristics that determine suitable habitat conditions as measured by stand density index values, are almost twice the upper management zone.

To illustrate in concept suitable and sustainable habitat conditions as compared to existing habitat conditions, a computer modeling exercise was done. The Stand Visualization System (SVS), developed by R. J. McGaughey and J. B. McCarter, was used with actual Cultus LSR stand exam data. Stand exam #131 is found within the dry mixed conifer PAG and is predominantly a ponderosa pine stand with a mixed conifer understory of true firs and ponderosa pines. This stand description is typical of fire climax dry mixed conifer stands and was modeled as such. The existing stand condition was initially programmed through SVS. Map 15 displays stand 131's existing condition on a 1 acre grid. The smaller insets also show crown widths as seen from above and a cross section of those crown widths. This existing condition was then 'treated' to meet the suitable habitat condition as described by SDI UMZ in table IV-1 for the dry mixed conifer fire climax type. Map 16 displays this suitable habitat treatment of stand 131. The stand was further treated to show the sustainable habitat condition as defined by the SDI UMZ value in table IV-2. Map 17 displays the sustainable habitat treatment.

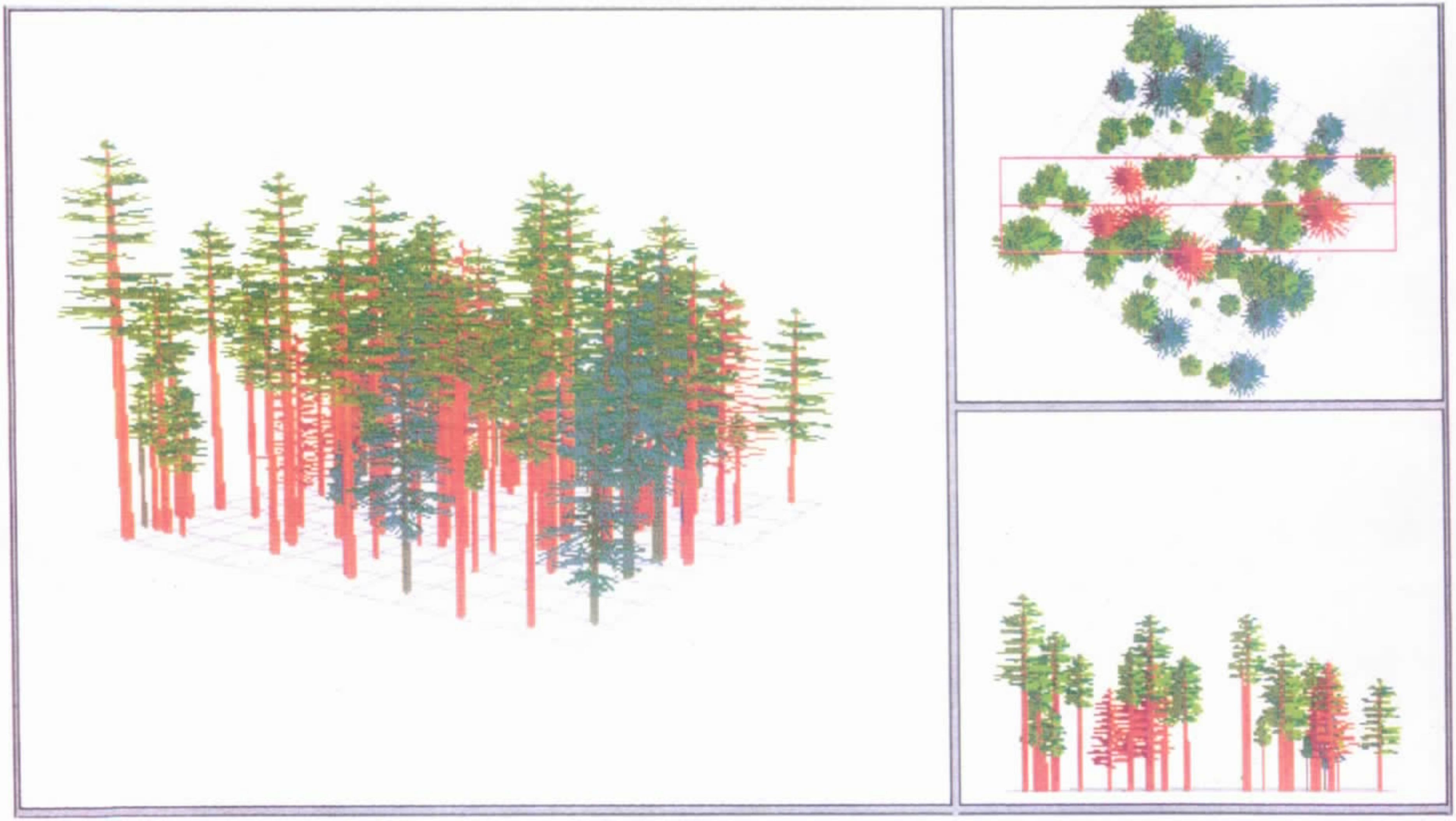
The existing condition, the suitable habitat scenario, and the sustainable habitat scenario represent stand conditions as defined by this document for the Cultus and Sheridan LSRs. The maps visually display what a stand may look like following treatments: the amount of crown closure, the amount of canopy structure and species composition likely to be represented through a variety of treatment applications.

	Stand 131 Existing Condition (per acre)	Stand 131 Suitable Habitat Condition (per acre)	Stand 131 Sustainable Habitat Condition (per acre)
SDI	411	219	155
BA	276	145	101
TPA	141	76	56

While this exercise used a stand whose existing condition exceeded the suitable habitat conditions as described in Table IV-1, other stands whose existing conditions are not greater than the suitable habitat conditions may still need to be treated. In this situation, densities may be reduced to give a better mix of canopy structure and species composition that may meet sustainable habitat conditions for a period of time while growing towards a structural condition that will meet suitable habitat conditions. Similarly, stands that meet neither suitable or sustainable habitat conditions may need treatment to facilitate growth into acceptable conditions over time. The next section addresses cycling habitat over time within the LSRs.

MAP 15 -- STAND 131 EXISTING CONDITION

411 SDI/ac 276 BA/ac 141 TPA/ac



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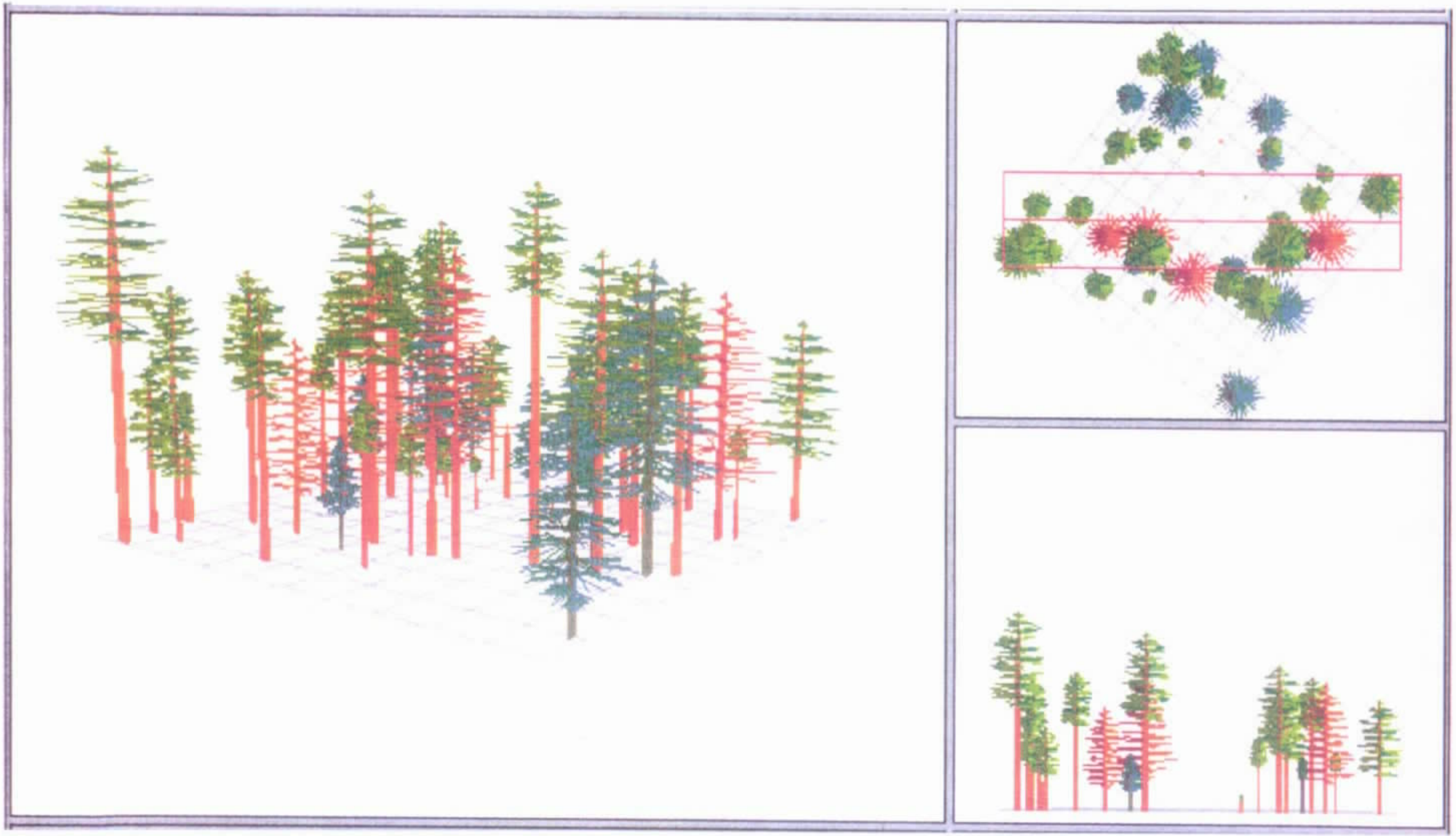
MAP 16 -- STAND 131 SUITABLE HABITAT CONDITION

219 SDI/ac 145 BA/ac 76 TPA/ac



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MAP 17 -- STAND 131 SUSTAINABLE HABITAT CONDITION

155 SDI/ac 101 BA/ac 56 TPA/ac

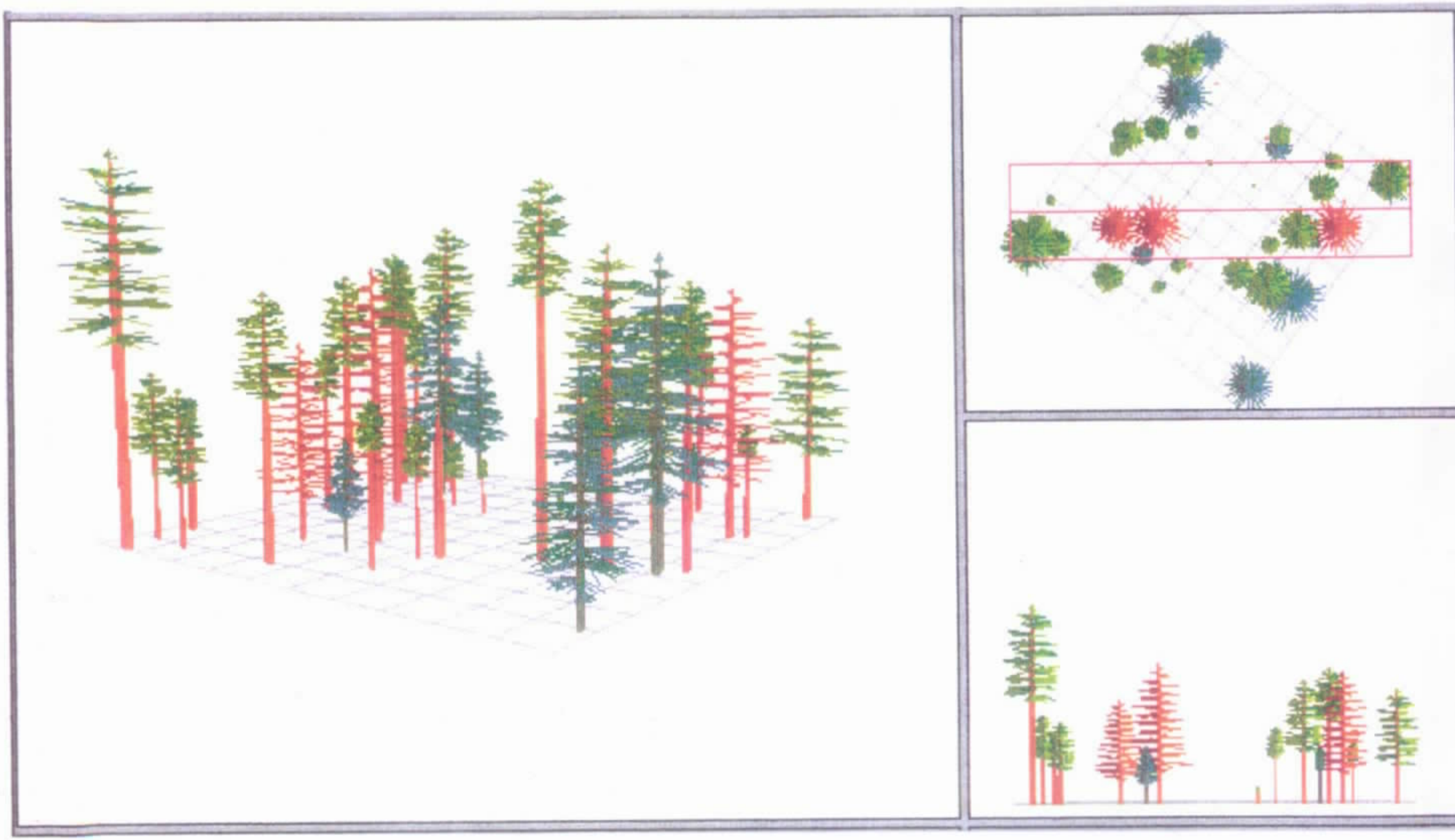

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TABLE IV-2 — SUMMARY AND COMPARISON OF SUITABLE HABITAT, SUSTAINABLE CULTUS AND SHERIDAN LSRS

	SUITABLE HABITAT (1)			SUSTAINABLE (2)		EXISTING CONDITION (3)	
PAG	TPA	DENSITY SDI	FUELS (TONS/AC)	DENSITY UMZ (SDI)	FUELS (TONS/AC)	CULTUS TOTAL ACRES	SHERIDAN TOTAL ACRES
MH	220-330	411-620	25-40	256	< 40	1,030	980
climatic MCW	284-430	365-581	25-35	202	< 35	870	350
climatic MCD	175-261	279-405	12-24	156	<24	17	60
fire MCD	23-294	141-373	LOW	156	LOW	2,843	580
climatic PPW	150-224	347-535	12-24	145	< 24	-	40
fire PPW	23-294	141-373	LOW	145	LOW	-	0
climatic PPD	144-216	313-472	10-15	102	< 15	-	0
fire PPD	8-273	27-216	LOW	102	LOW	-	120
LPW	296-444	222-353	12-24	161	< 24	170	60
LPD	288-432	132-198	8-12	80	< 12	65	0
mid - low elev LPD	282-424	172-259	8-12	161	< 12	55	70

(1)Within the PAG, the plant association that was predominant was used as the comparison. IF there are several major plant associations represented in one PAG, then a range of UMZ's based on those plant associations could be used. For subsequent site specific project analysis, the best site specific data available will be used for density prescriptions, keeping areas below the UMZ in order to sustain or create future suitable conditions, wherever possible, while still providing current, but perhaps unsustainable habitat as well, to meet current suitable late-successional old growth habitat needs.

(2) Based on Cochran et al. 1994, Joanna Booser and Jim White developed the paper "Calculating Maximum Stand Density Indexes (SDI) for the Deschutes National Forest Plant Associations", 1996, that was used in determining the above table's values. Cochran advised using the lowest plant association values within the PAGs as the index. Again, the approach here was to use the UMZ of the major plant association (or major plant associations) in the PAG, which pushes management closer to the unsustainable level, but allows leaving more short term suitable habitat. The best available site specific density values will be used when managing specific stands overtime across the landscape, not the lumped PAG value used here for broadscale planning purposes.

UMZ - For most species, the upper management zone is defined as the density level at which a suppressed class of trees begins to develop (Cochran et al. 1994). This is the point at which sufficient competition is happening between trees to cause some trees to begin to slow down in growth, even to the point of death. The primary cause is that, on any given piece of ground, there are limits to the resources available for plant growth. These resources include light, water, nutrients, and growing space. When these limits are reached, loss of plant growth and/or mortality are common elements of the stand. These conditions can be ideal for certain late-successional old growth plant and animal species. However, they are often providing the ideal habitat conditions only after there have been sufficient limitations of previous density levels that allowed a large tree component to develop. Historically, these limitations were provided in drier plant associations by frequent fire intervals which tended to limit development of understories and favored growth of the forest with overstory trees.

In ponderosa pine or lodgepole pine, the UMZ is calculated somewhat differently from the other species. This was recommended by Cochran et al. 1994, to show the level above which higher levels of large tree mortality are much more likely to occur. For these tree species, the UMZ correlates to a high risk threshold for markedly increased tree mortality due to many of the forest pests which are dependent on density and lower tree growth for epidemic levels to be reached. Other factors besides density, such as species composition, must be considered for the density independent forest pests such as the fir engraver beetles and spruce budworm. However, the use of UMZ in stands which are typically not hosts to density dependent pests is still recommended if the desire is to let small trees grow to large trees more quickly and safely especially where large trees are in short supply. This is because the presence of a suppressed class of trees would indicate average tree growth in the stand is beginning to slow down, perhaps significantly.

(3) Total acres within each LSR greater than or equal to sustainable density UMZ as identified on the table by PAG. These are approximate numbers.

IV. B. 4. CYCLING AND SUSTAINING DESIRED LATE-SUCCESSIONAL OLD GROWTH CONDITIONS WITHIN THE LSRS

A process of cycling vegetation over time was needed to ensure that a variety of habitat conditions are represented across the landscape for LSOG dependent and or associated species. Successful management of the Cultus and Sheridan LSRs would result in the satisfaction of two concepts: 1) maintaining minimum critical thresholds over the short term and 2) sustaining habitat above this threshold over the long term.

The Desired Late-Successional Reserve Condition paper (Gerdes, Maffei and Booser 1996) describes in detail, criteria used to build the desired vegetative condition (this paper is included in the process paper section). Three evaluation criteria were used in the consideration and development of the desired condition:

1. Minimum critical habitat thresholds for LSOG species; e.g., the northern spotted owl and the bald eagle;
2. Cycling suitable habitat over time; and
3. Historic range of variability (HRV).

Minimum critical habitat thresholds for LSOG species either have been or can be calculated. These thresholds were used in determining the amount and size structure distribution of suitable LSOG habitat. HRV was used as a frame of reference when addressing all species viability. Through the watershed analysis process, HRV was developed for site-specific plant association groups. Suitable habitat was examined from a spatial stand point, looking at the quantity of, distribution and fragmentation of it across the landscape. This information was used to adjust critical habitat threshold levels above the minimums described by the USFWS and levels described by HRV. When all of the above mentioned information was factored together the percentages for suitable habitat threshold was determined. However, the limited acreage of the mixed conifer wet PAG is an important constraint.

In order to estimate how much suitable habitat could be sustained within the LSRs over time, two approaches were used. First, a conceptual flow model was developed to visualize the cycling of late-successional old growth habitat across the landscape, see Figure IV-1. In this model, landscape vegetation was divided into four stages: 1) preliminary vegetation stage, 2) stable fire climax suitable habitat stage, 3) transition vegetation stage, and 4) climatic climax suitable habitat stage. Transitioning between these 4 vegetation stages, resulting from active or passive management, was theorized.

In the second approach, HRV was used to visualize how natural processes cycle vegetation. Historic range of variability is the range of 'natural vegetative conditions' that were present or that occurred over a period of time when the ecosystem was not significantly affected by European settlement and management (WEAVE 1994). Components of this range include but are not limited to vegetation and animal species, vegetative structural stages or seral stages, canopy cover, and fuel loadings. It is a range of conditions that would most likely contain a viable system of plant communities, animal species and water systems which evolved during the past several hundred years. The HRV numbers used to visualize how vegetation cycles over time was the number of acres within different structural/seral stages by plant association. These figures were developed in the Odell, Metolius and Cascade Lakes Watershed Analysis process.

The four vegetative stages for the conceptual flow model are described in detail as follows:

1. PRELIMINARY VEGETATION
Stands falling into this stage do not satisfy the requirements of either climatic climax or fire climax dependent or associated species. These stands encompass a wide range of structures and densities but share the common characteristics that large trees are not prevalent.

Management of these stands should emphasize growth into the late-successional old growth conditions as quickly as possible. Management activities in high risk stands could move them towards this stage by thinning, to lower susceptibility to bark beetles so existing trees can rapidly continue their development into large trees. Management may also take the form of a prescribed burn to remove hazardous levels of fuels. In the frequent fire adapted ecosystems, lack of management will result in cycling from other stages back into this stage for many stands as a result of insect and disease outbreaks and catastrophic wildfires.

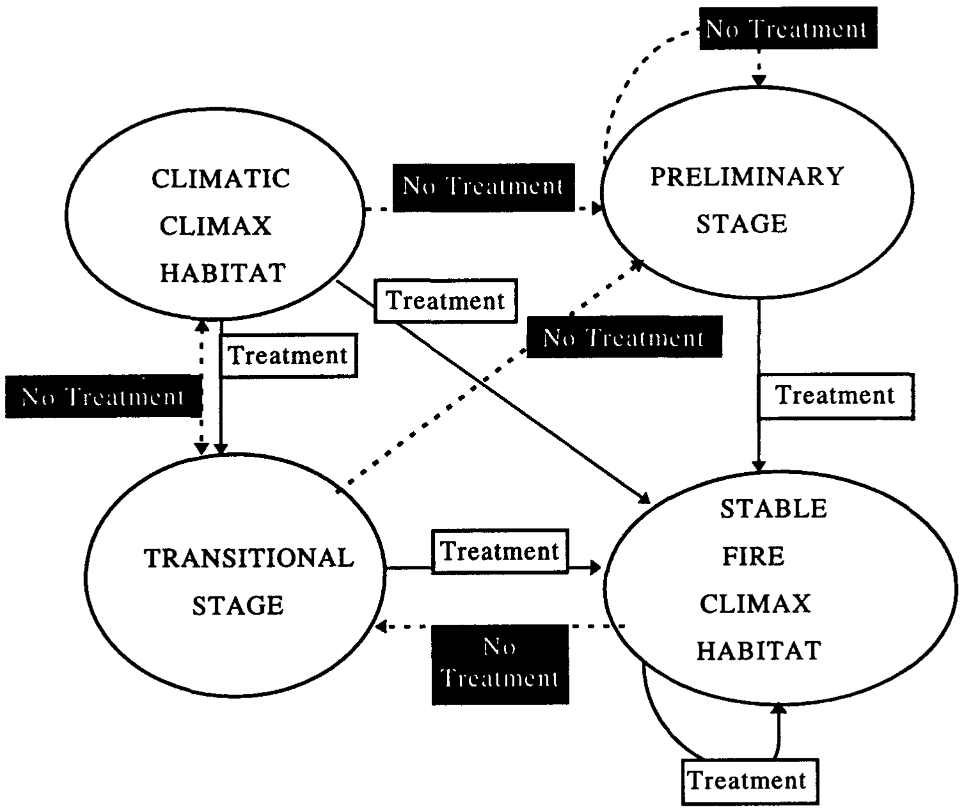
2. STABLE FIRE CLIMAX SUITABLE HABITAT
Stands falling into this stage of vegetation satisfy the requirements for suitable fire climax habitat and they are below the upper management zones. Without density management, or the re-introduction of fire, these stand types often progress into the unstable fire climax stage described below and may progress into unstable climatic climax habitat. Continued density reduction through mechanical thinning or thinning by prescribed fire will maintain stands in this stage.

3. TRANSITIONAL VEGETATION
This is the condition that exists when stable fire climax vegetation increases in density and becomes unstable fire climax vegetation, but is not yet suitable climatic climax vegetation. This condition is above the upper management zone but below the density levels of large tree sizes required to achieve the necessary structural attributes for climatic climax habitat. Management in these stands should focus on developing the large tree component for climatic climax vegetation when the large tree structure is already present. This may be accomplished through tree culturing and thinning prescriptions. Density reduction to return the stand to suitable fire climax conditions may also be accomplished through thinning and prescribed fire prescriptions.

4. CLIMATIC CLIMAX SUITABLE HABITAT
This stage has the structural attributes necessary for climatic climax LSOG i.e., NRF habitat for the northern spotted owl. In most situations, this habitat cannot be managed both to retain these essential characteristics and remain below the upper management zone. In some cases, however, it could be thinned, prior to some natural epidemic event to a fire climax LSOG condition which is stable and could, in a relatively short period of time again grow to be suitable climatic climax habitat. This needs to be done in conjunction with maintaining suitable habitat elsewhere (vegetation cycling). Without treatment, this vegetative stage will revert to some variation of the preliminary vegetation stage or less likely to the transitional vegetation stage.

Under either active or passive management scenarios, many stands would not likely be maintained over time in a climatic climax condition i.e., uneven-aged condition, a variety of species, complex stand structure, high canopy cover. Under active management the desired large tree structure would likely be maintained over time while under the passive management scenario the large tree structure would probably not be maintained over time.

FIGURE IV-1. CONCEPTUAL FLOW MODEL OF CYCLING SUITABLE HABITAT IN RESPONSE TO TREATMENT OR NO TREATMENT



Treatment consists of stocking control measures that result in on site stability and this promotes the growth and retention of large trees.

The following table represents the integration and summation of the above analysis to achieve a proposed distribution of vegetative conditions by PAG across the landscape. If these four stages are well distributed across the LSR, a continual supply of suitable habitat can be maintained over the long term by active and passive management. The objective is to provide long term sustainable suitable habitat for species dependent on or associated with LSOG habitat. Refer to the Desired Late-Successional Reserve Condition process paper for more in-depth information regarding the analysis process.

TABLE IV-3—DESIRED AMOUNTS OF THE 4 VEGETATIVE STAGES

PAG	PRELIMINARY STAGE (1)	SUITABLE HABITAT % FIRE (2)	TRANSITIONAL STAGE (3)	SUITABLE HABITAT % CLIMATIC (4)
MH	15 (0-30)	NA	15 (0-30)	70 (40-70)
MCW	30 (20-40)	NA	10 (0-20)	60 (50-70)
MCD	25 (20-30)	10 (5-10)	25 (20-30)	40 (30-50)
PPW/D	20 (10-30)	55 (40-70)	20 (10-30)	5 (0-10)
PPW/D FORESTED LAVAS	20 (10-30)	5 (0-10)	20 (10-30)	55 (40-70)
LPW/D	40 (20-60)	NA	10 (0-20)	50 (30-70)

Descriptions of the Columns:

(1) Vegetative conditions that are below the upper management zone, thus, sustainable. See FIGURE IV-1, this column relates to the preliminary stage. UMZ defines the point at which a suppressed class of trees begins to develop or high risk threshold of density related insect - indexed mortality for large pines is reached. In other words, the stand can maximize growth with little or no threat from insect attack. When prescribing management in these stands, consideration should be given to the conifer species and diameter mix desired to move these stands towards late-successional old growth suitable habitat conditions.

(2) Suitable habitat — fire climax conditions - as quantitatively described in TABLE IV-1 and IV-2. See FIGURE IV-1, this column relates to the stable fire climax habitat stage (dry mixed conifer and wet & dry ponderosa pine PAGs).

(3) Vegetative conditions that are above the upper management zone but are less than suitable habitat, describes a range of conditions between these two quantitative points. See Figure IV-1, this column relates to the transitional stage.

(4) Suitable habitat — climatic climax conditions - as quantitatively described in TABLE IV-1 and IV-2. See FIGURE IV-1, this column relates to the climatic climax stage.

Stands in column 1 (less than the UMZ) must be managed to provide big trees of long-lived species like ponderosa pine and Douglas fir in a short period of time. Wise management of these stands will set the stage for moving into column 3 (above the UMZ) where these stands should meet the large tree criteria of suitable habitat. Stands in column 3 should continue to be managed to encourage development of large tree structure to replace loss of habitat due to fire, insects , diseases and harvest activity in column 1 and 2 over time.

The mixed conifer dry PAG generated the most discussion and discomfort with relative percentages generated for columns 2-4, both in terms of suitability and sustainability.

Research information displayed in Table III-4 for indicator species was the base starting point for building the desired condition table (Table IV-1) for late-successional old growth habitat conditions. It is very important to note that the LSRs should not be managed for minimums but rather as optimal habitat for late-successional old growth habitats for those dependent on or associated species.

Estimated time frames for how long those late-successional old growth conditions might last and how long it would take to grow those conditions back from a regenerated stand, were considered for various stages and the length of time in each of those stages.

In the dry mixed conifer associations, it was estimated that it would take 250 to 350 years to grow late-successional old growth conditions from a managed regenerated stand.

Depending upon the plant association group, it was estimated that the suitable habitat conditions would last in the wet mixed conifer PAGs approximately 60 years and within the dry mixed conifer PAGs approximately 30 years.

It was also determined that on a 300 year rotation, only 1/6th (about 17%) of the land area could be in a suitable habitat condition on a sustainable basis.

With management, stands in the mixed conifer PAGs, could be kept in a species mix that is fairly resistant to defoliators, and could allow management losses of trees susceptible to bark beetles. This might then allow us to get up to 40% of the PAG in a fairly sustainable suitable habitat condition continuously, with replacement stands coming along in the appropriate structural conditions.

IV. B. 5. DESIRED CONNECTIVITY

Dispersal is the movement, usually one way and on any time scale, of plants or animals from their point of origin to another location where they subsequently produce offspring (FEMAT 1993). Typically, juveniles disperse, leaving their natal territory to seek new suitable habitat to establish their own territory. Displaced adults that have lost their habitats due to timber harvest, wildfires, insect epidemics, human disturbance, etc. also disperse. Dispersal habitat is described as habitat that supports the life needs of an individual animal during movement to new or between suitable reproductive habitat. It generally satisfies needs for foraging, roosting, and protection from predators (FEMAT 1993).

Connectivity is a measure of the extent to which conditions among LSOG forest areas provide habitat for breeding, feeding, dispersal and movement of LSOG associated wildlife and fish species (FEMAT 1993). In essence, connectivity is dispersal habitat that provides linkage of suitable reproductive habitats for dispersing animals. In the case of the northern spotted owl, connectivity needs to be maintained within and between LSRs.

Narrow travel linkages and small patches are typically not sufficient to provide for the elements of dispersal habitat. "A generalized solution to linking patches within and across landscapes might be found in providing for a specific kind of matrix. That is, instead of establishing narrow passageways of vegetation with well defined boundaries which may be at risk from windstorms and other catastrophic events, an alternative is to provide specific vegetation types and cover conditions across the planar landscape. Such a matrix approach does not lock habitat into specific routes and may allow for better resilience and recovery from loss of specific stands from catastrophic events," (Morrison, Marcot and Mannan 1992). Prescribing a matrix over the landscape is the preferred method of providing connectivity.

Historically, it is believed that NRF habitat was limited to the wet mixed conifer and moist north aspects of the dry mixed conifer PAGs. This habitat was distributed in a mosaic pattern, and intermixed with earlier seral stages.

The Deschutes National Forest LSR Overview (Gerdes et al. 1995) has been used to determine northern spotted owl dispersal habitat between the LSRs. Two factors in the Overview were applied: 1) For those plant associations with the site capability to meet and sustain the 11-40 standard (11"dbh and 40% canopy cover), or 2) For those plant associations that cannot meet or sustain the 11-40 standard, local forest conditions and biological knowledge of what is likely to be dispersal habitat were evaluated. To determine stands that apply the latter factor, stand densities were evaluated to insure sustainability for at least two decades together with field experience to determine what is functional dispersal habitat. Elements that help determine dispersal habitat include:

1. Percent canopy cover
2. Average stand dbh (>5 inches dbh)
3. Number of hard and soft snags
4. Amount of coarse woody material
5. Amount of area meeting dispersal habitat conditions

Connectivity, depending upon the structural elements, can be provided across the landscape using the conceptual flow model as a guide (see Figure IV-1). Dispersal connective habitat is provided by the transitional and climatic climax stages. Additional dispersal connective habitat may be provided by preliminary vegetation and fire climax stages, if they provide roosting, foraging and protection from predators. Table IV-4 is not inclusive but provides general guidelines for owl dispersal habitat. Development of the table guidelines followed the Forest dispersal steps outlined in the LSR Overview but did not define vegetation upper stocking limits. This will need to be accomplished on a site specific level. Field surveys and observations should determine if the habitat meets dispersal habitat requirements.

TABLE IV-4—GENERAL DISPERSAL GUIDELINES (NOT INCLUSIVE)

PAGs	DBH	%Canopy Cover	Basal Area	Trees Per Acre
MH	11	40	100	140
MCW	11	40	70	100
MCD	11	40	70	95
PPW	8	35	85	155
PPD	9	30	80	140
LPW	9	40	100	200
LPD	9	40	100	200

IV. B. 6. LATE-SUCCESSIONAL OLD GROWTH STAGES

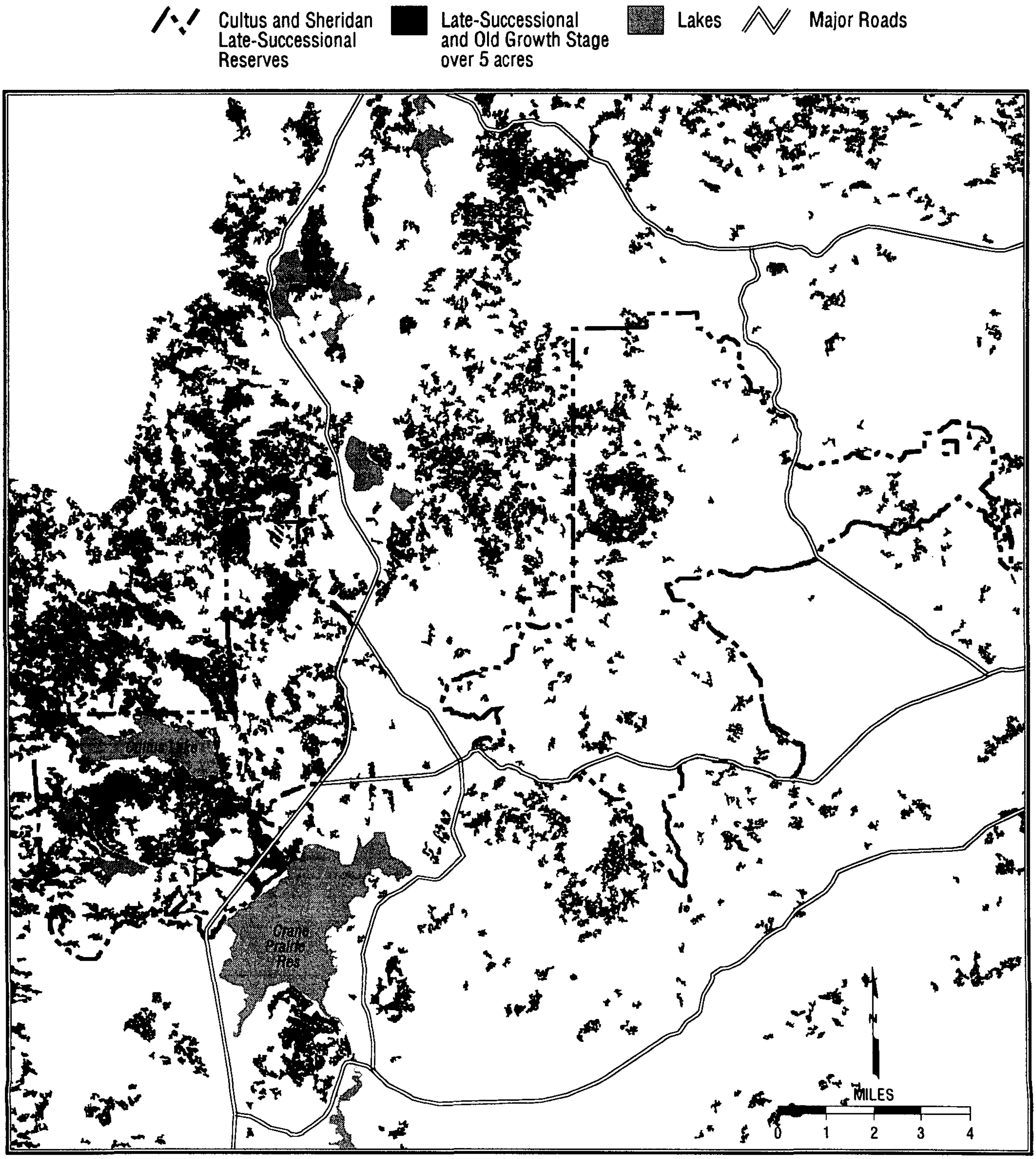
In order to display the amount of LSOG habitat within the LSRs, defined as suitable habitat, a query was made from 1988 ISAT data. Information from this query is the most comprehensive and complete data source available that covers our land base within and surrounding the LSRs. Late and old growth structural characteristics by PAG were queried and an overlay of canopy cover percentages also factored in. A five acre minimum polygon was the query design. The results of this query are shown in Table IV-5. The table displays the acres of each PAG, the acres of LSOG existing habitat by PAG and the percentage of existing LSOG by PAG. Within the Cultus LSR there are 6,170 acres of LSOG habitat which is 34% of the LSR area. In the Sheridan LSR there are 2,260 acres of LSOG habitat which is 7% of the LSR area. Map 18 displays how these acres are distributed across the landscape.

TABLE IV-5—LATE-SUCCESSIONAL OLD GROWTH STRUCTURE >_ FIVE ACRES

PAG	Acres of PAG w/in LSR	Acres LSOG w/in PAG	LSOG/PAG
Cultus LSR (total acres 18,000)			
MH	2,430	1030	42%
MCW	1,800	870	48%
MCD	8,050	2,860	36%
LPW	2,800	170	6%
LPD	970	120	13%
UNIQUE	1,950	1120	57%
Sheridan LSR (total acres 31,030)			
MH	3,730	980	26%
MCW	8,840	350	4%
MCD	10,290	640	6%
PPW	700	40	6%
PPD	3,980	120	3%
LPW	2,220	60	3%
LPD	1,090	70	7%
UNIQUE	180 (Cinder cone)	0	0

Note: Lodgepole pine LSOG acreage is over-estimated due to the mountain pine beetle epidemic that has occurred in this area since 1988. Other LSOG PAG acreages may be over-estimated due to timber sale activity that has occurred since 1988. Acre figures are to be used as guidelines and should be field verified during site specific analysis.

MAP 18 -- LATE-SUCCESSIONAL and OLD GROWTH STAGES
Cultus and Sheridan Late-Successional Reserves



IV. B. 7. SUMMARY OF DESIRED CONDITION

Several conclusions may be drawn from the above discussions. First, in order to effectively manage our LSRs, we must be able to define what the late-successional old growth suitable habitat conditions are for both climatic climax and fire climax forests. The definition must make ecological sense, and must be measurable and practical on the ground. Table IV-1 provides the framework to fully describe suitable habitat conditions for the plant association groups on the Deschutes NF.

Second, most of our suitable climatic climax habitat conditions within our LSRs are often not sustainable in the long term. Meeting suitable climatic climax habitat conditions for late-successional old growth species and keeping the stands above the upper management zone will increase risks to insect, disease and wildfires. Refer to Table IV-2.

Lastly, a strategy of rotating LSOG habitat through time and space across the landscape is appropriate. This seems to be consistent with USFWS minimum thresholds and historic range of variability. However, it may not be achievable on a landscape level in the short term due to quantity, distribution and fragmentation of current suitable mixed conifer LSOG habitat. An aerial view of our landscape shows that almost all of the LSOG habitat is contained within the LSRs. Within and outside of the LSRs, the landscape is heavily fragmented with few residual stands of LSOG habitat.

IV. C. LSOG STRATEGIES AND IMPLEMENTATION SCHEDULE

IV. C. 1. INTRODUCTION

This document is an interpretation of the Northwest Forest Plan. All activities that occur within the Cultus and Sheridan LSRs need to be consistent with the application of the NWFP Standards and Guidelines. Some land area allocations are more restrictive than the NWFP, such as the LRMP Old Growth Management Area, and some areas are exempt from the NWFP standards and guidelines, such as proposed RNA's. If management of these areas does occur, the more restrictive guidelines will apply and prescriptions will be developed within the context of the LSR objectives.

The desired condition, objectives and treatment methodologies are the LSR team's recommendations for managing the Cultus and Sheridan LSRs based on intent of the NWFP and the level of information available on the existing conditions. These recommendations were made for each individual MSAs in the context of the LSR as a whole. For example, recommendations for treatment may be be more conservative in MSA A as compared to MSA C based on the existing condition, objectives, and function of habitat.

These recommendations are not NEPA decisions. Site-specific analysis is needed before any management options can be implemented and may provide additional information on the existing condition which may serve to modify management treatments. Specific treatment objectives would be selected by the project interdisciplinary team and would need to consider the context of the proposed treatment not only within the LSRs but on the landscape as a whole. The management treatments outlined in this chapter are the team's recommendations as to how to meet or move toward the objectives and desired condition.

Management Strategy Areas subdivide the LSRs and further delineate the PAGs into areas with common function and management potential. Ten MSAs were developed to completely depict the future management of the LSRs. A listing of the ten MSAs follows. Acre and percent figures are based on the combined LSR acreage. Refer to MSA map on the following page for a visual overview.

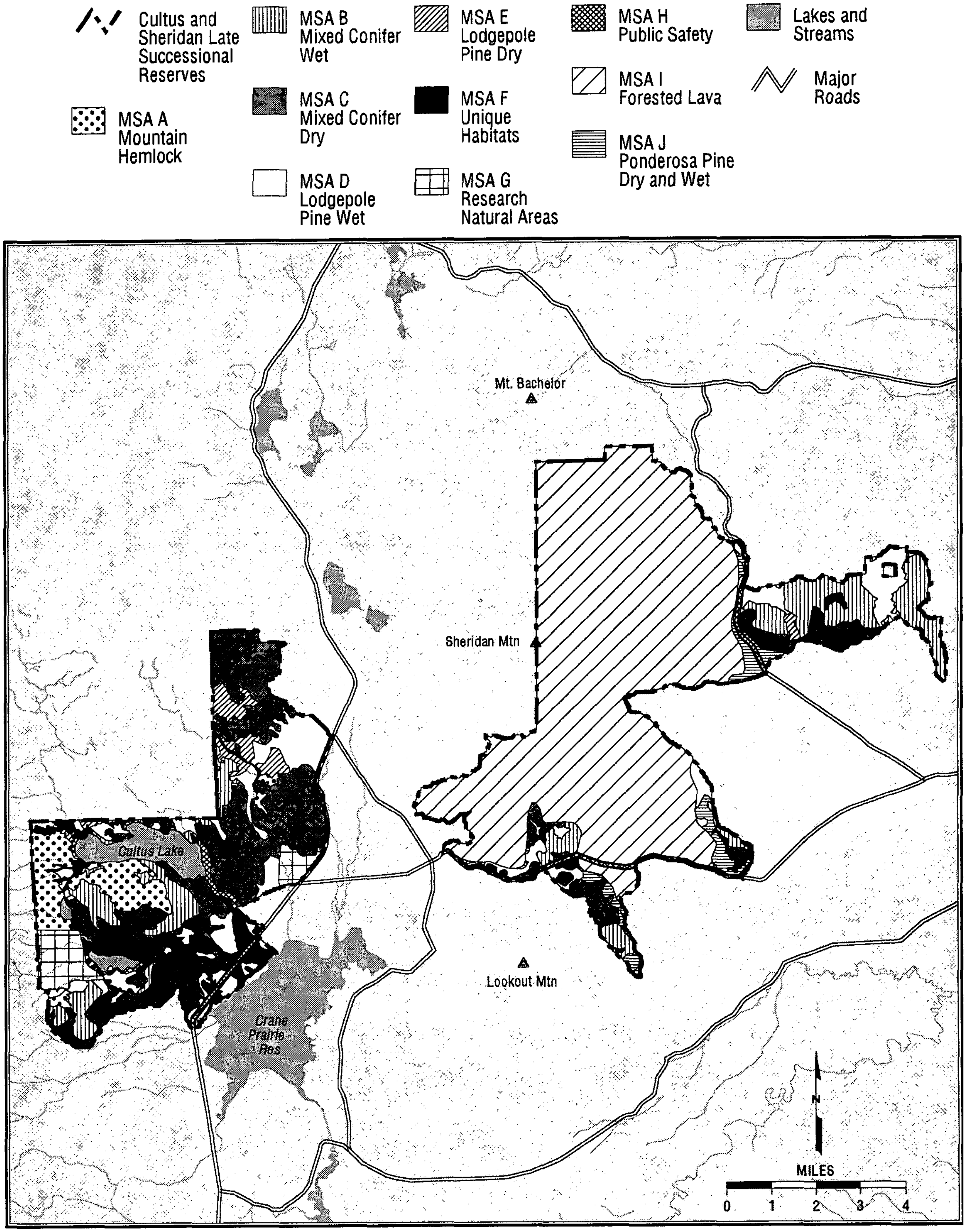
- MSA A - Mountain hemlock PAG: 2,070 acres, 5%
- MSA B - Mixed Conifer Wet PAG: 4,560 acres, 9%
- MSA C - Mixed Conifer Dry PAG: 9,490 acres, 19%
- MSA D - Lodgepole Pine Wet PAG: 3,890 acres, 8%
- MSA E - Lodgepole Pine Dry PAG: 950 acres, 2%
- MSA F - Unique PAG: 1,410 acres, 3%
- MSA G - Research Natural Areas: 1,160 acres, 2%
- MSA H - Public Safety (All PAGs): 1,100 acres, 2%
- MSA I - Forested Lavas (All PAGs): 23,470, 48%
- MSA J - Ponderosa Pine Wet and Dry: 930 acres, 2%

This section recommends strategies and priorities for management to protect and enhance the Cultus and Sheridan LSRs. The focus of these recommendations include protective treatments to reduce the risk of epidemic levels of insects, diseases, and large-scale wildfires, and treatements to enhance late-successional habitat. Protection treatments will normally be short term strategies that deal with existing condition problems. Enhancement treatments are normally long term strategies used to manipulate vegetative conditions, to cycle various types of vegetative conditions over time and to create the mix of desired conditions needed across the landscape.

LSR objectives include: 1) The prevention of those large-scale disturbances by fire, insects and disease, which would limit the ability of the LSR to sustain viable populations of forest species and 2) The acceleration of the development of LSOG forest characteristics, including snags, logs on the forest floor, large trees, and canopy gaps, that enable establishment of multiple tree layers and a diversity of species composition.

An epidemic insect or disease outbreak or a large-scale wildfire will be analyzed across the landscape with consideration of LSR desired conditions. This will help determine what type of treatment activities would be appropriate, where to locate those treatments on the ground, or when treatments may be deferred because the event. Scheduling of activities may be interrupted due to an event or may be enhanced and accelerated where applicable. Most importantly, any treatment prescribed for the event area and surrounding landscape would need to be consistent with LSR objectives 2 and 3 (as stated in the Executive Summary) and recommendations as outlined in the following sections.

MAP 19 -- MANAGEMENT STRATEGY AREAS
Cultus and Sheridan Late-Successional Reserves



IV. C. 2. LSOG PROTECTION STRATEGY

The goal of the LSOG protection strategy is to move the Cultus and Sheridan LSRs towards the desired vegetative condition as quantified in Table IV-1. The focus of the protection strategy is to adjust the existing balance of vegetative conditions in the mixed conifer, lodgepole and ponderosa pine PAGs within and around the LSRs to a more sustainable balance.

Protection strategies are the treatments used to maintain the structural integrity of the LSOG stands and to reduce risk of epidemic insect and disease outbreaks and large-scale wildfires. Enchancement strategies may also be used as protection strategies as the final site specific treatment prescription may very well meet both protection and enhancement objectives. The environmental analysis process will design all prescriptions for the maximum effectiveness. It is recognized that there will still be a risk of these agents even when meeting the desired condition because sustainable conditions and desired conditions do not always match.

The LSR team recommends prioritized protection strategies within selected MSAs based on the existing condition and function as compared to the desired condition. These treatments are normally to be used on a short term basis, within the next 10 years. A discussion of protection treatments accompanies each vegetative group.

TABLE IV-6—LSOG PROTECTION STRATEGIES FOR THE MSAS. PRIORITY 1 IS FOR 0 -10 YEARS AND PRIORITY 2 IS FOR 10 YEARS AND BEYOND.

	MSA									
PROTECTION STRATEGIES FOR RISK REDUCTION	A MH	B MCW	C MCD	D LPW	E LPD	F UNI	G RNA	H PS	I FL	J PPW/D
Tree Culturing	-	P2 (Map 22)	P2 (Map 22)	-	-	-	-	-	-	P2 (Map 24)
Thinning	-	P1 (Map 22)	P1 (Map 22)	-	-	-	-	-	-	P1 (Map 24)
Salvage	-	-	-	P1 (Map 20)	P1 (Map 20)	-	-	-	-	-
Hazard Tree Removal	-	-	-	-	-	-	-	P1 (No Map)	-	-
Reforestation	-	-	-	P2 (Map 20)	P2 (Map 20)	-	-	-	-	-
Fuels Reduction	-	P1 (Map 23)	P1 (Map 23)	P1 (Map 21)	P1 (Map 21)	-	-	P1 (No Map)	-	P1 (Map 25)

MOUNTAIN HEMLOCK PAG PROTECTION STRATEGIES

Mountain hemlock forests are found mainly at higher elevations in unroaded Rare II Inventoried areas. Most natural processes have been allowed to occur over time with the expectation being natural fire events. A minimal amount of past harvest activity has occurred on Sheridan Mountain, where most of this type is located. It is recommended to allow natural processes to continue to occur to the extent possible. Therefore, no protection treatments will be prescribed for the mountain hemlock vegetative type.

LODGEPOLE PINE PAG PROTECTION STRATEGIES

The desired condition of lodgepole pine PAGs in both LSRs is to maintain about 50% of the area in suitable climax habitat at any given time. Currently, the majority of the lodgepole pine trees within the Cultus LSR are dead due to the mountain pine beetle epidemic of the past decade. Lodgepole pine PAGs in the Sheridan LSR are fragmented due to heavy stand manipulation in the past. Lodgepole pine LSOG characteristics are deficient throughout both LSRs.

Within the next decade wildfire is likely to be the greatest risk to these stands due to heavy accumulation of standing and down fuels. Consequently, salvage and manual or mechanical cleanup of coarse woody material above the suitable habitat condition (Table IV-1) are treatments needed to reduce the fire risk in these and adjacent PAGs. Protection treatments adopted must consider suitable habitat conditions by PAG (Table IV-I) and the desired connectivity between LSOG stands.

(a) SALVAGE

Salvage is an appropriate treatment for managing large areas of dead wood at risk to large-scale wildfires. Salvage of dead wood will only be considered after coarse woody material thresholds and threshold of snags to meet wildlife objectives have been exceeded. The salvage area would usually be greater than 10 acres in size and residual live tree canopy closures must be less than 40% (ROD page C-14). For the Cultus and Sheridan LSRs it is recommended that salvage area size be greater than 40 acres and residual live tree canopy closures be lower than the requirements needed for dispersal habitat, refer to Table IV-4. Salvaging operations normally target the 3 to 4 inch in diameter and greater material. If necessary, reforestation efforts may follow a salvage treatment.

In stands where beetle mortality is greater than 80% of the stand, all green residual trees should be left. In stands where beetle mortality is less than 80%, site specific analysis will determine the number of green trees to remain on site. In this case, the analysis would consider reducing the risk of insect and disease spread while maintaining wildlife habitat needs of structure and cover.

Snags and coarse woody material will be retained on site to levels and criteria specified for suitable habitat in Table IV-1. The largest available dead wood on the site should be retained. Where the protection of an adjacent MSA is the objective for salvage activities (fuels reduction), snags and down wood may be retained at the low end of the recommended range. The majority of salvage units should retain dead wood at the high end of the recommended range.

(b) FUELS REDUCTION

If coarse woody material and snags are above the threshold levels of the desired condition, manual or mechanical cleanup may be utilized to reduce the risk of large-scale fire. Typically, cleanup would target dead and down wood less than three inches in diameter to lessen the fire hazard. Large fuels contribute to fire duration and intensity. This could be implemented in unharvested and harvested stands.

Underburning is not an appropriate tool in the lodgepole pine type as lodgepole trees are not fire adapted and cannot survive cambial damage through fire due to its thin bark.

(c) REFORESTATION

Reforestation may be accomplished after a salvage sale either through natural regeneration or planting. Natural regeneration will provide the same tree species on site that existed prior to salvaging. Where appropriate, planting will occur. Either method would be done for the main purpose of increasing stocking levels to perpetuate a new stand for the future. Evaluation of reforestation needs would be done during the planning stage of a salvage sale and prescribed accordingly.

MIXED CONIFER PAG PROTECTION STRATEGIES

As recommended by the Deschutes National Forest Science Team (1996), to attain a sustainable balance of late-successional suitable habitat within the mixed conifer PAGs, approximately 40% of the dry mixed conifer PAG should be in the climatic climax condition and 10% in the fire climax condition (Table IV- 3). The wet mixed conifer PAG may have 60% of the vegetation within the climatic condition and still be considered sustainable.

Currently, 34% of the Cultus LSR and 7% of the Sheridan LSR function as LSOG habitat. Approximately 7% of the combined LSR total acres are in the LSOG fire climax condition and 10% are in the LSOG climatic climax condition.

Within the climatic condition, the majority of the vegetation is at high risk of losing LSOG structural components. Overstocked stands increase competition for water and nutrients. This condition stresses the large diameter ponderosa pine and Douglas-fir which increases their susceptibility to epidemic insect and disease outbreaks. The large tree components are also at high risk to large-scale wildfires due to dense multi-layered canopies. Currently, the white fir and lodgepole pine of the understory and/or as co-dominantes in the overstory, are not considered suitable replacement trees. They are inherently more prone to diseases, are generally short lived and tend not to develop into large trees.

It has taken several decades to develop these conditions. Likewise, it will take several decades to return these conditions back to within their natural range of variation. Retention of the existing function of the LSRs will limit how quickly we can move towards the desired condition.

In some areas of the mixed conifer PAG, it is desirable to retain the existing LSOG vegetation. Passive management will maintain large continuous blocks of habitat, providing new home ranges for dispersing juveniles, providing habitat for other LSOG species, and/or provide connectivity within and between the LSRs. Passive management is an acceptable approach.

The following parameters are recommended to guide active management of existing vegetation to provide a sustainable balance of LSOG conditions within the mixed conifer PAGs (Table IV-3). Management activities may occur in one or more of the parameters to achieve the desired cycling of vegetation stages over time. Existing vegetative condition and maintaining LSOG species would drive how much, where, and when the activities would occur. This process would need to be conducted at a landscape scale in order to meet LSR objectives.

Nesting, roosting, and foraging habitat <u>outside</u> the home range radius (1.2 mile) of the known spotted owl nest sites:

1. Manage stands to within the range of Suitable Habitat conditions (Table IV-1).
2. Manage stands to the Transitional Stage (Table IV-3).
3. Manage stands to the Sustainable Fire Climax Stage (Table IV-3).

Nesting, roosting, and foraging habitat <u>within</u> the home range radius (1.2 mile) of the known spotted owl nest sites that exceed the "take" thresholds identified by the USFWS. This would include the Deschutes LRMP designated Old growth Management Area on the southwest side of Cultus Mountain:

1. Manage stands to within the range of Suitable Habitat conditions (Table IV-1).
2. Manage stands within ranges of the Transitional Stage (Table IV-3).

The goal for protection within the above stands would be to reduce the risk of epidemic levels of bark beetles, fir engravers, western spruce budworm, armillaria root rot and large-scale wildfires. Treatment that could be used to help accomplish this goal include tree culturing, thinning from below and fuels reduction. Use of these protection treatments are tempered given the desired suitable habitat conditions by PAG (Table IV-I) and the desired connectivity between LSOG stands.

Areas identified for no treatment within the next decade include:

1. Riparian Reserves
2. MSA I: Forested Lavas (Sheridan LSR)

The forested lava MSA within the Sheridan LSR will need treatments such as described above, but due to our lack of understanding and knowledge of this ecosystem, treatments will be deferred until on-going research results become known. When research is completed (by the end of 1997), treatments may proceed, but very slowly with results being monitored to determine treatment success. Treatments prescribed though, should be no different than what is being outlined in this document and most likely will be more restrictive.

The following treatment(s) will minimally meet dispersal habitat criteria and function for the northern spotted owl however, they will also provide functional, sustainable bald eagle habitat.

(a) Tree Culturing

In order to reduce the risk of losing the large diameter ponderosa and Douglas-fir due to overstocked conditions, tree culturing may be prescribed. Tree culturing removes all competing trees for a predesignated distance around selected large ponderosa pine and Douglas-fir. Tree culturing reduces competitive stress on the selected trees and alters the microclimate to discourage attacks by bark beetles.

(b) Thinning

Five different kinds of thinning may be used to lower the risk of epidemic outbreaks from a variety of mortality agents. These thinning treatments emphasize thinning from below and may have unique prescription parameters specific to the mortality agent of concern. While thinning is a treatment that has beneficial outcomes, there are inherent risks involved such as further soil disturbance and compaction which may actually enhance the spread of armillaria root disease. These benefits and risks must be considered and analyzed during site specific analysis to determine the appropriate action.

- Thinning to reduce the risk of bark beetle attacks is appropriate for pockets of lodgepole pine and ponderosa pine in association with the mixed conifer stands that may be susceptible to attacks. These pockets are usually small in size and have at least a 5 inch minimum tree diameter.
- Thinning to reduce the risk of fir engraver beetle attacks can be implemented in overstocked mixed conifer stands. Treatment would target a basal area appropriate for the site and LSOG objectives. Emphasis would be on the reduction of the white fir component of the stand. This treatment would be used in areas that receive less than 30 inches of annual precipitation because lack of moisture is a major factor in tree stress and increases tree susceptibility to beetle attacks.
- Thinning to reduce the vegetative risk of western spruce budworm outbreaks can be prescribed in mixed conifer stands that have more than 50 percent of the stand basal area in white fir and Douglas fir. Removal of white fir would be emphasized so that the stand composition after treatment would have less than 30 percent of the basal area in white fir and Douglas-fir. Higher amounts of fir species within the stand render it more susceptible to budworm attacks.
- Thinning to reduce the spread of Armillaria root disease may be prescribed. This treatment would occur in stands that have between 10 and 25% infection with root disease and would reduce the small white fir component of the area. A target basal area appropriate for the site would be established.

- Thinning can serve to lower the risk of large-scale wildfire by reducing the amount of canopy layers and by breaking up the vertical continuity of the fuels. Once the thinning has been completed, the submerchantable component of the stand would need to be reduced either though pre-commercial thinning or fuel reduction treatments. This treatment is targeted for stands with high crown fire potential.

A component of all thinning treatments would be to reduce the number and therefore amount of heavily infested mistletoe trees that are not needed to meet other objectives. This would be incorporated into all prescriptions as necessary, based on site specific analysis.

Within all thinning scenarios, additional post sale activities may be prescribed. Reforestation of armillaria root rot pockets with more resistant species may occur. Pre-commercial thinnings may be used to clean up the residual understory and reduce stocking levels to desired conditions.

(c) Fuels Reduction

Underburning is useful for reducing the fuel beds and stocking levels in stands where fire adapted species dominate or where only disturbances that simulate natural processes are permitted. Generally, this treatment would be used in conjunction with other treatments as appropriate and/or used to simulate a more natural fire regime.

If coarse woody materials are above threshold levels of the desired condition, manual or mechanical cleanup may be utilized to reduce the risk of large-scale fire. Typically, cleanup would target dead and down wood less than three inches in diameter. This could be implemented in unharvested and harvested stands.

PONDEROSA PINE PAG PROTECTION STRATEGIES

The desired condition of the ponderosa pine vegetation would be a mix of approximately 50% of the area in suitable fire climax habitat, 20% of the area in transitional habitat, 5% of the area in suitable climatic climax habitat and 20% of the area in preliminary habitat. Currently, 50% of the ponderosa pine vegetation is within the mid seral stage, which would be comparable to the suitable fire climax vegetative stage.

The densely stocked stands are at risk to bark beetles and wildfires. Trees within dense stands compete for site resources, stressing the larger diameter trees and making them more susceptible to insect attacks. The multi-layered canopy increases the risk of crown fires. Bark beetle are currently found in endemic levels in the ponderosa pine types. Areas where past management activities have taken place are at a lower risk to insect outbreaks and crown fires. Armillaria root rot has become an aggressive pathogen in some areas where shelterwood prescriptions have been implemented, killing the more resistant ponderosa pine trees of all sizes.

It has taken several decades to develop these conditions. Likewise, it will take several decades to return these conditions back to within their natural range of variation. Retention of the existing function of the LSRs will limit how quickly we can move towards the desired condition.

In some areas of the ponderosa pine PAG, it is desirable to retain the existing LSOG vegetation. Passive management will maintain large continuous blocks of habitat, providing new home ranges for dispersing juveniles, providing habitat for other LSOG species, and/or provide connectivity within and between the LSRs. Passive management is an acceptable alternative.

Several management treatments may be initiated in the ponderosa pine types to reduce the risk to insect, disease and wildfires. Tree culturing may be done to reduce the risk of losing the large diameter ponderosa pine trees. Thinning regimes will help reduce overstocking, returning the stands to a stable fire climax condition. Fuels reduction by underburning, manual techniques, or by mechanical clean up of coarse woody materials will reduce the risk to catastrophic wildfires and also serve as the first step in the re-introduction of historic fire regimes.

(a) Tree Culturing

In order to reduce the risk of losing the large diameter ponderosa pine trees, tree culturing may be implemented. Tree culturing removes all competing trees for a predesignated distance around selected large ponderosa pine trees or selected replacement trees. Tree culturing reduces competitive stress on the selected trees and alters the microclimate to discourage attacks by bark beetles.

(b) Thinning

Two different kinds of thinning may be used to lower the risk of epidemic outbreaks from a variety of mortality agents. Although each of these techniques emphasizes thinning from below, each has unique prescription parameters and placement on the landscape. While thinning is a tool that has beneficial outcomes, there are inherent risks involved such as further soil disturbance and compaction which may actually enhance the spread of armillaria root disease. These benefits and risks must be considered and analyzed during site specific analysis to determine the appropriate action.

- Thinning to reduce the spread of Armillaria root disease may be prescribed. This treatment would occur in stands that have between 10 and 25% infection with root disease and would reduce the small white fir and lodgepole pine component of the area. A target basal area appropriate for the site would be established.
- Thinning can serve to lower the risk of large-scale wildfire by reducing the amount of canopy layers and by breaking up the vertical continuity of the fuels. Once the thinning has been completed, the submerchantable component of the stand would need to be reduced either though pre-commercial thinning or fuel reduction treatments. This treatment is targeted for stands with high crown fire potential.

A component of all thinning treatments would be to reduce the number and therefore amount of heavily infested mistletoe trees that are not needed to meet other objectives. This would be incorporated into all prescriptions as necessary, based on site specific analysis.

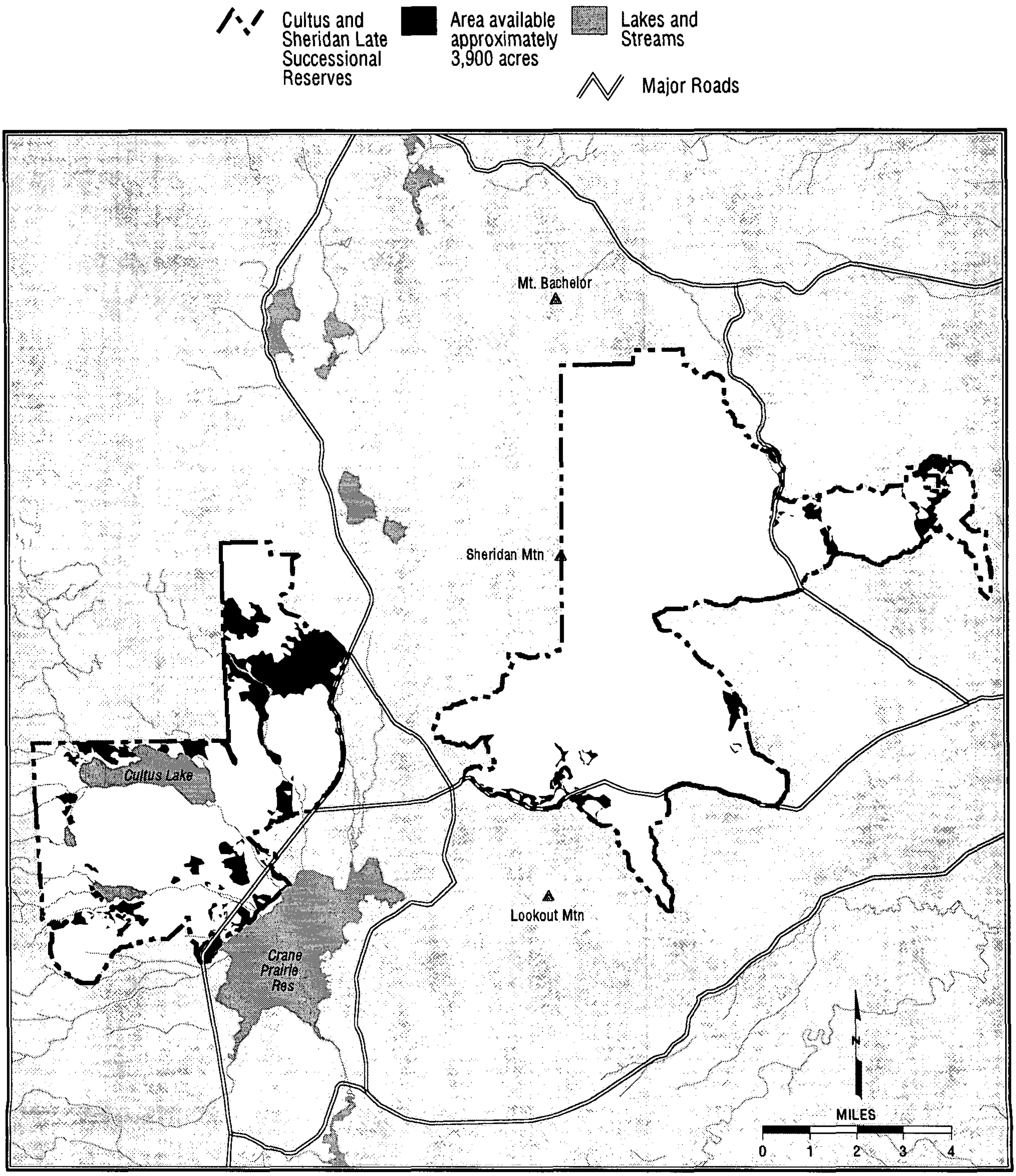
Within all thinning scenarios, additional post sale activities may be prescribed. Reforestation of armillaria root rot pockets with more resistant species may occur. Pre-commercial thinnings may be used to clean up the residual understory and reduce stocking levels to desired conditions.

FUELS REDUCTION

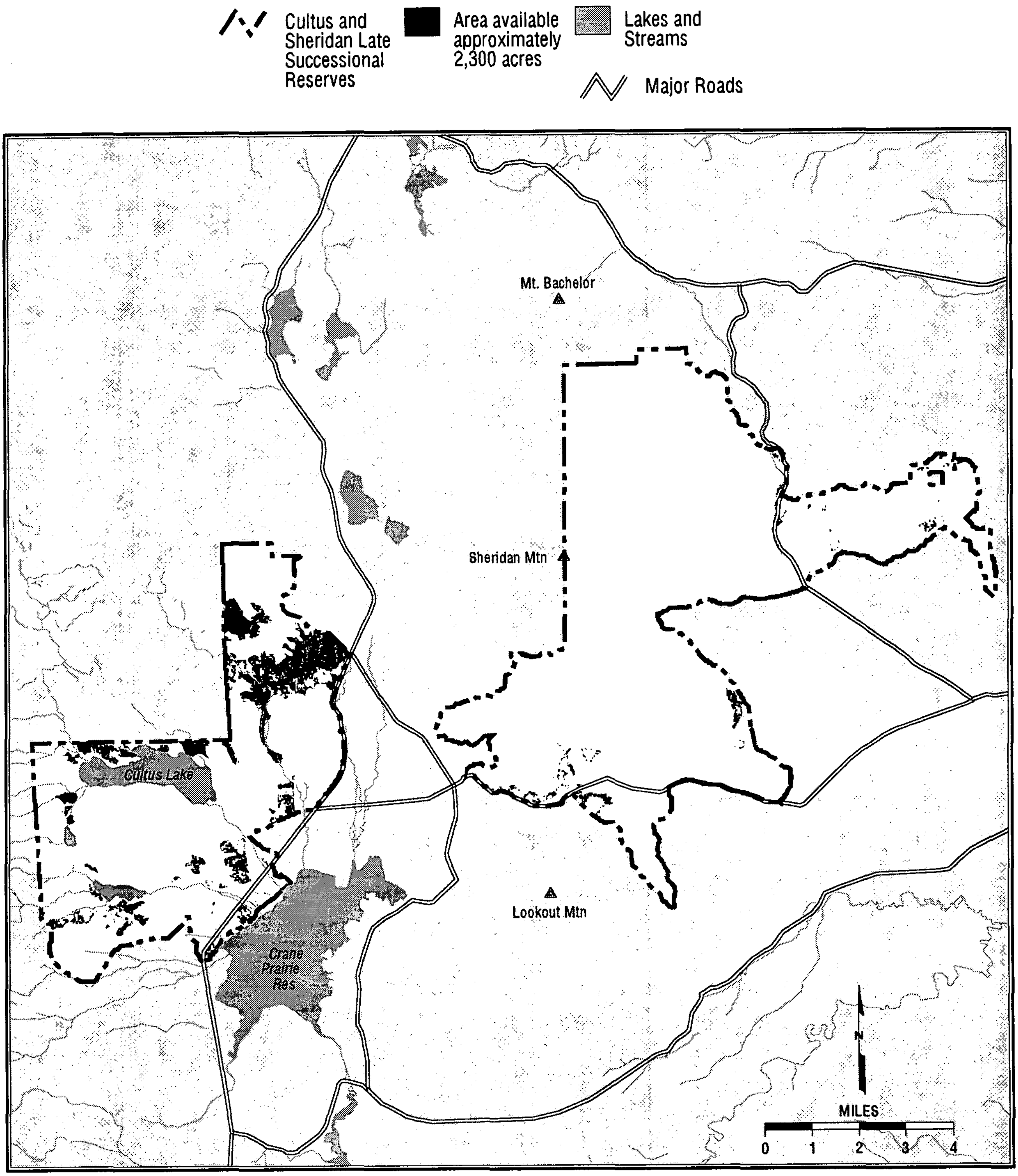
Underburning is useful for reducing the fuel beds and stocking levels in stands where fire adapted species dominate or where only disturbances that simulate natural processes are permitted. Generally, this treatment would be used in conjunction with other treatments as appropriate and/or used to simulate a more natural fire regime.

If coarse woody materials are above threshold levels of the desired condition, manual or mechanical cleanup may be utilized to reduce the risk of large-scale fire. Typically, cleanup would target dead and down wood less than three inches in diameter. This could be implemented in unharvested and harvested stands.

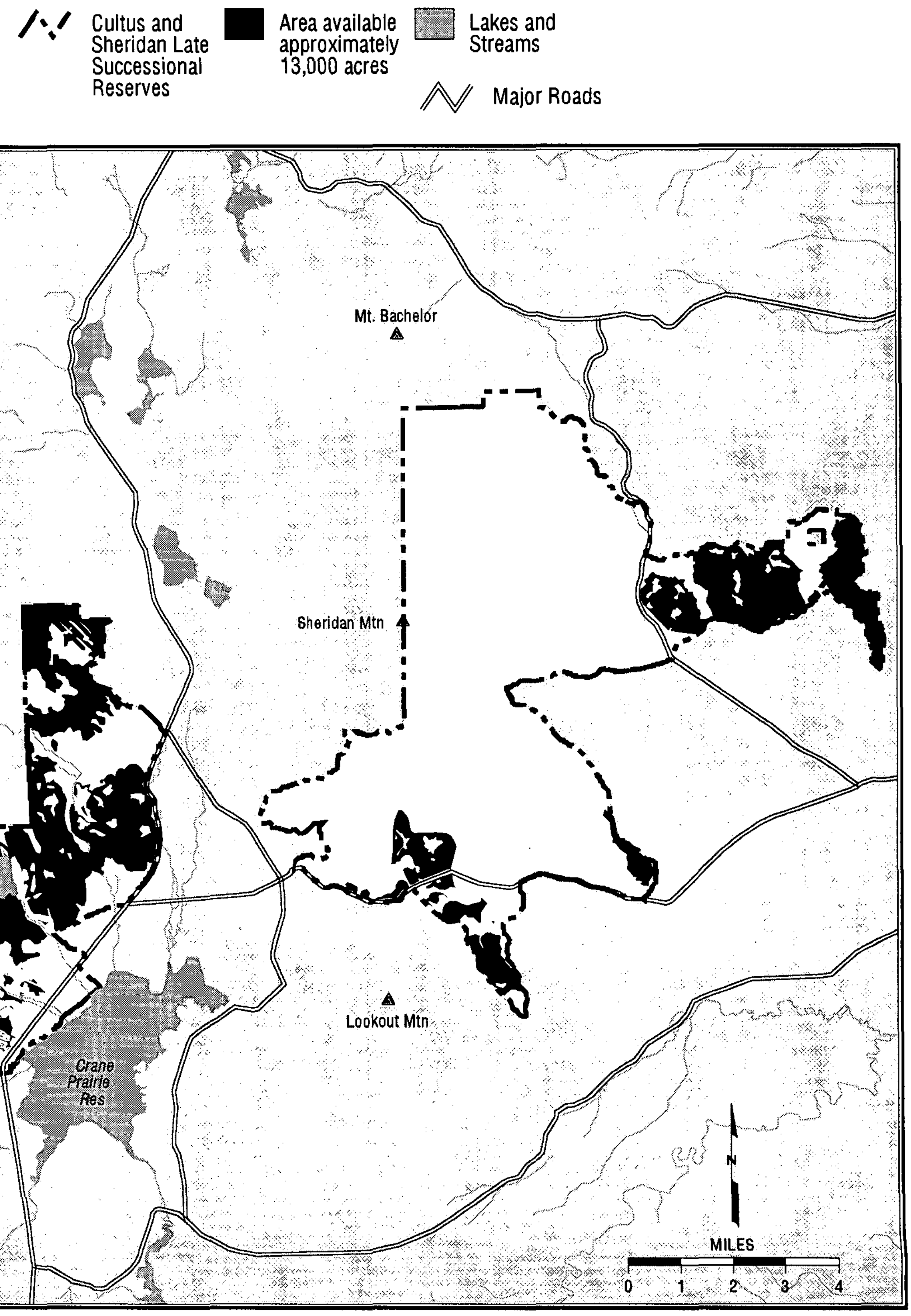
MAP 20 -- PROTECTION STRATEGY
LODGEPOLE PINE SALVAGE AND REFORESTATION
LPP outside harvest units
Cultus and Sheridan Late-Successional Reserves



MAP 21 -- PROTECTION STRATEGY
LODGEPOLE PINE FUELS REDUCTION
LPP with high or extreme crownfire risk
Cultus and Sheridan Late-Successional Reserves



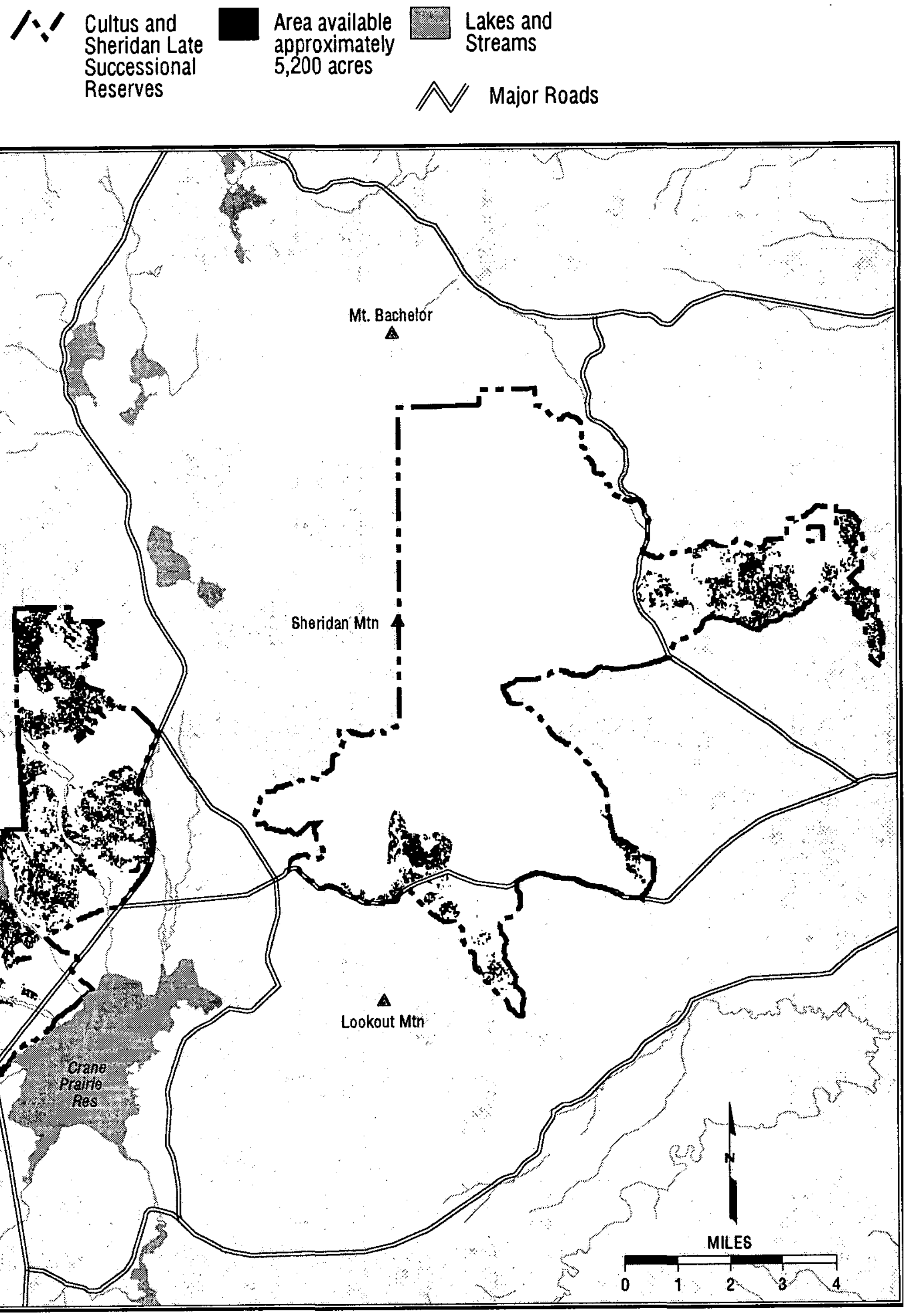
MAP 22 -- PROTECTION STRATEGY
MIXED CONIFER TREE CULTURING AND THINNING
Mixed Conifer outside harvest units
Cultus and Sheridan Late-Successional Reserves



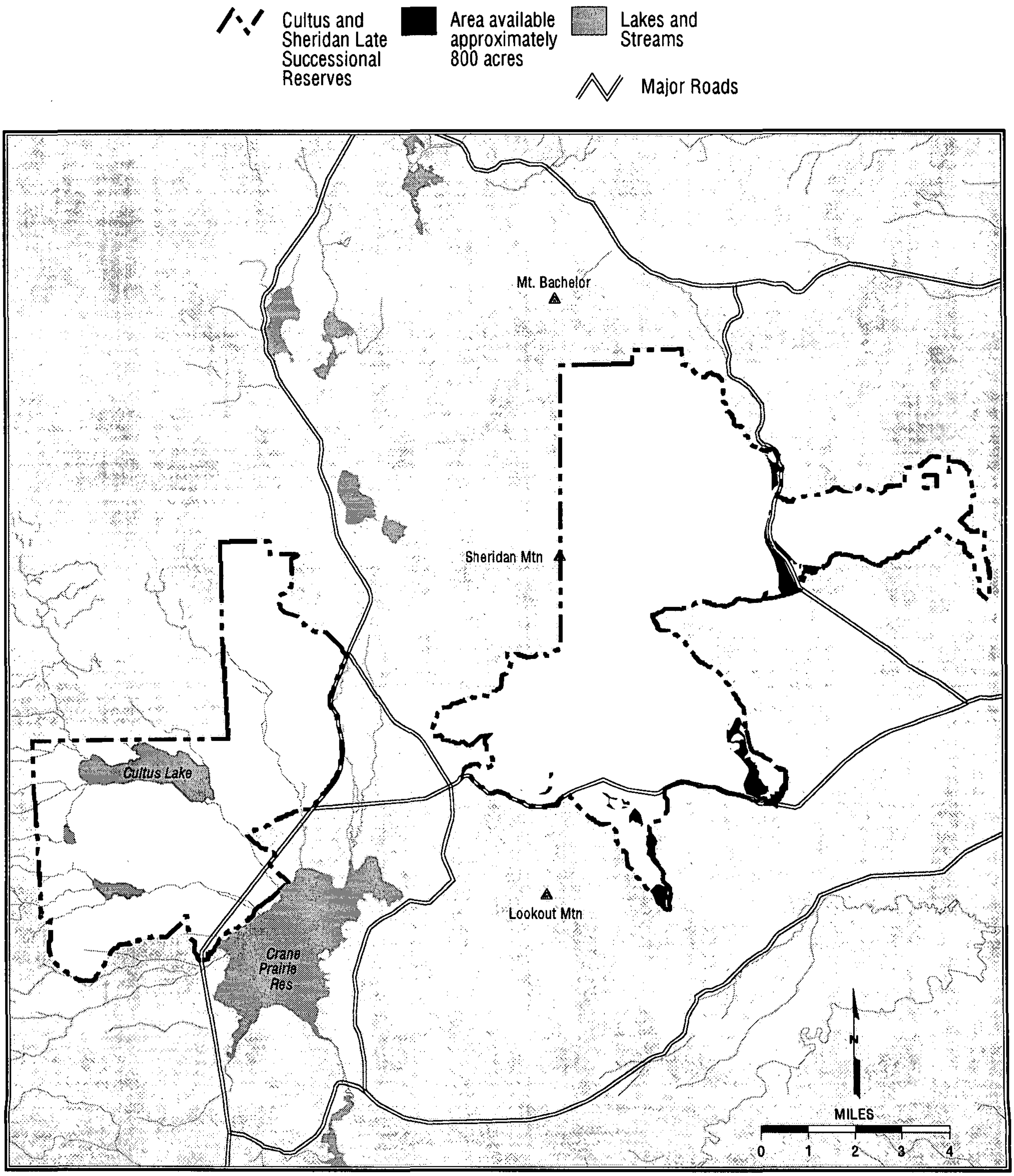
MAP 23 -- PROTECTION STRATEGY
MIXED CONIFER FUELS REDUCTION

Mixed Conifer PAGs with high or extreme crownfire risk

Cultus and Sheridan Late-Successional Reserves



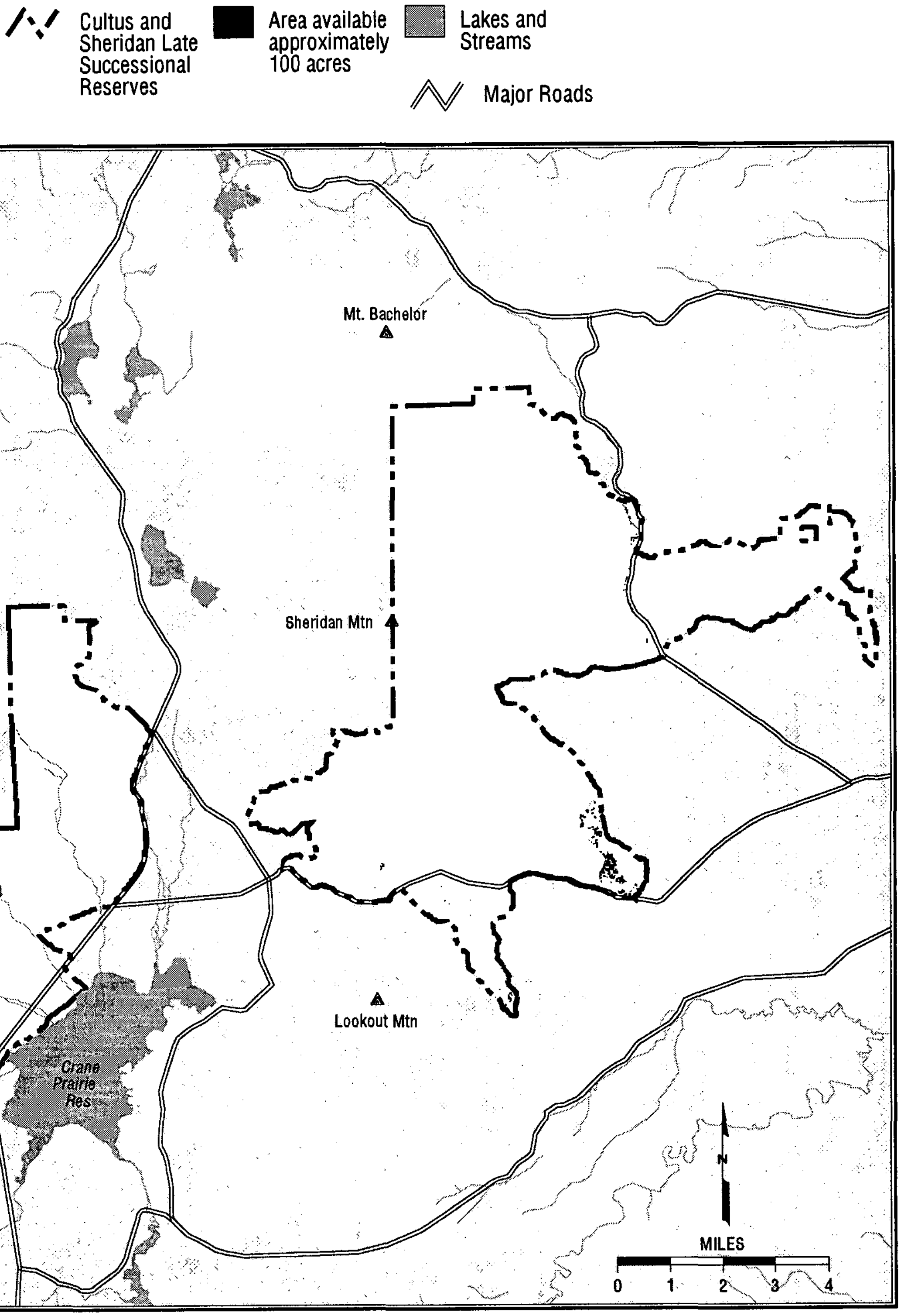
MAP 24 -- PROTECTION STRATEGY
PONDEROSA PINE TREE CULTURING AND THINNING
Ponderosa Pine outside harvest units
Cultus and Sheridan Late-Successional Reserves



MAP 25 -- PROTECTION STRATEGY
PONDEROSA PINE FUELS REDUCTION

Ponderosa Pine with high or extreme crownfire risk

Cultus and Sheridan Late-Successional Reserves



IV. C. 3. LSOG ENHANCEMENT STRATEGY

The other principal objective for silvicultural treatments listed in the NWFP is the enhancement of late-successional old growth habitats. One of the primary concerns is the acceleration and development of old growth forest characteristics. This includes snags, logs on the forest floor, large trees, and canopy gaps that enable establishment of multiple tree layers and a diversity of plant and wildlife species. The following table lists are the enhancement strategies that may be implemented to meet these objectives. Activites in MSA I, Forested Lavas, will be deferred until the on-going research is completed. Enhancement strategies as described would be used as the objectives when implementing protection strategies as described in section IV.C.2. The spatial location, the intensity, and feasibility of these strategies on a particular piece of ground and a better understanding of how these systems function is critical before implementation.

TABLE IV-7—LSOG ENHANCEMENT STRATEGIES FOR THE MSAS

	MSA									
ENHANCEMENT STRATEGIES	A MH	B MCW	C MCD	D LPW	E LPD	F UNI	G RNA	H PS	I FL	J PPW/D
LSOG Habitat Acceleration (Map 26)	-	X	X	X	X	-	-	-	X	X
NRF Cycling (Map 27)	-	X	X	X NO	X NO	-	-	-	X	X
Bald Eagle Tree Culturing (Map 28)	X	X	X	-	-	-	-	-	-	-
Small Canopy Openings (Map28)	X	X	X	-	-	-	-	-	-	-
Prescribed Fire (Map 29)	-	-	X	-	-	-	-	-	X	X
Precommercial Thinning (Map 30)	-	X	X	X	X	-	-	X	X	X
Diversity Plantings (Map 31)	X	X	X	X	-	-	-	-	X	-
Meadow Restoration (Maps 32 & 33)	-	-	-	-	-	X	X	-	-	-

LATE-SUCCESSIONAL OLD GROWTH HABITAT ACCELERATION

Definitions of late-successional habitat and dispersal habitat have been developed for each PAG in terms of tree size, species composition, and stand structure in Table IV-1. In stands that have yet to reach these characteristics, precommercial or commercial thinnings may be implemented to accelerate development. Prescriptions would feature within stand variable densities to speed stand differentiation. These treatments could be applied to any MSA except A, F, G and H.

NRF HABITAT CYCLING

The intent of this prescription is to cycle NRF habitat through time and space across the landscape. Rotations and manipulation of vegetation would be done to maintain at any given time the desired amounts of the 4 vegetative stages within the LSRs. This manipulation in some cases would move existing suitable habitat conditions to younger, simpler successional stages in terms of size structure, canopy cover, species composition and other attributes. The end result would be a stand that still meets suitable habitat as defined in Table IV-1 yet residual densities would be lower. In other cases, where the vegetative condition is such that stand manipulation would have negative impacts, passive management would be allowed and the stand would continue on its successional path and evolve naturally. This treatment would be applicable to all MSAs except A, F, G and H.

TREE CULTURING FOR EAGLE HABITAT
Tree culturing may be used to modify the size and structure of potential nest trees for bald eagles so lateral branches develop that are capable of supporting nests in the future. The treatment consists of removing all competing trees for a distance around large ponderosa pine and Douglas-fir so that lateral branches are not shaded by competing vegetation. This treatment would be applicable only in the portions of MSAs A, B, and C that are designated as Bald Eagle Management Areas in the LRMP.

SMALL CANOPY OPENINGS
The creation of small canopy openings may be appropriate in Bald Eagle Management Areas. Harvest may be necessary to open up areas for seedlings to develop in places where succession to shade tolerant conifers have eliminated the opportunity to regenerate young ponderosa pine and Douglas-fir. This would also create canopy gaps for diversification, differentiation of the stands, encourage understory development, etc. Planting may need to be done after an opening is created to regenerate the desired tree species. This treatment would be of small scale and be confined to Bald Eagle Management Areas where an absence of age classes for potential nest trees is a concern. The size of the opening would be determined through site specific analysis based on the existing stand characteristics. This treatment is only applicable to the portions of MSAs A, B and C that are designated as Bald Eagle Management Areas in the LRMP.

PRESCRIBED FIRE
Prescribed fire can be appropriately used to re-introduce historic fire regimes to revitalize shrub understories, reverse understory succession to a grass/forb stage, and/or to create canopy gaps to improve avian foraging opportunities. These treatments may be appropriate to use in MSAs C, I and J. At a future date prescribed fire may be used in MSA G when the RNA becomes officially designated and a management plan developed and approved.

PRECOMMERCIAL THINNING
Precommercial thinning would be done within stands that are in the regeneration stage. This kind of thinning would help display stand differentiation early in the tree life cycle and help move the stands toward late-successional characteristics. This treatment though, may not be the preferred method of choice in the traditional sense of the word. Precommercial thinnings prescribed would be of variable spacing and densities and designed with the LSR objectives in mind. This type of treatment could be prescribed for any MSA except A, F and G.

DIVERSITY PLANTINGS
Species diversity can be enhanced through underplantings to retain a desired mix of vegetation on the landscape. Douglas-fir may be planted in selected areas recognizing though that this species has proven difficult to regenerate on the District. Prescriptions to plant this species would need to be site specific to increase survival success. This treatment may be done within MSAs B and C. Within MSA D, planting of Engelmann spruce may be used to increase stand diversity as well, with site specific prescriptions. These treatments may occur subsequent to thinnings or salvaging, or they may occur independent of other activities.

The western white pine component of the late-successional forest is thought to be diminishing due to white pine blister rust. Opportunities exist to increase this species through planting genetically resistant seedlings. Site-specific analysis should be completed prior to initiating this treatment. This treatment would be most applicable in root rot pockets within MSA A and I.

MEADOW RESTORATION

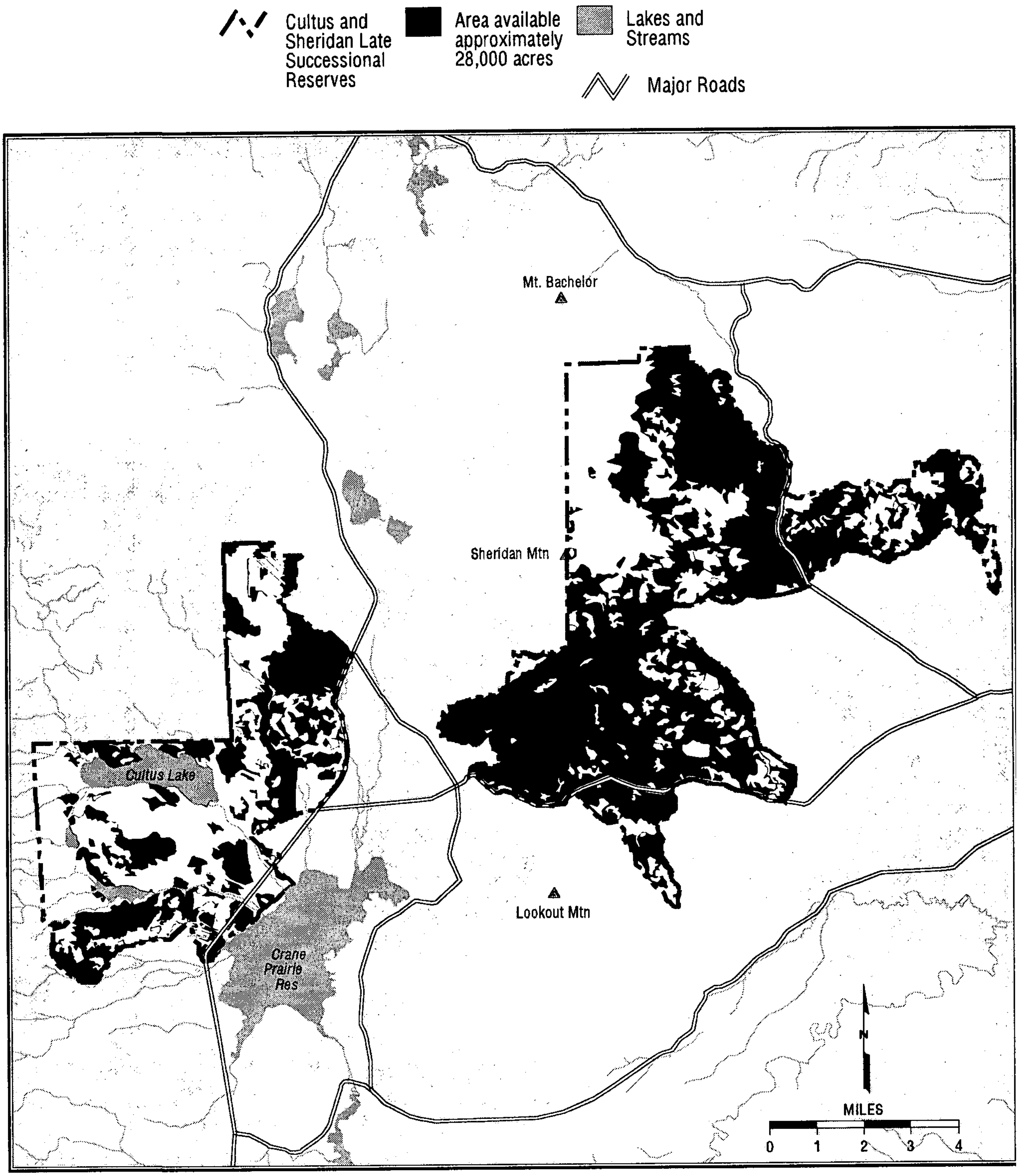
Meadows provide valuable habitats for a variety of species and edge habitat for great gray owls. Due to the suppression of fire meadow areas have been reduced in size by trees invading in from the edges. Removal of these trees from the meadow environment by cutting or burning may be beneficial. This treatment should only be used where it has been determined-through site specific analysis that conifer encroachment is due to past management practices, including fire suppression. This treatment would be used only in MSAs F and G.

Wet meadows provide one of the only habitats for willow. Either because of fire suppression or fluctuations in the hydrologic regime, the willow resource is decadent or absent. Restoration treatments aimed at stimulating sprouting of existing willow patches with fire or supplementing populations through planting are desirable enhancement treatments. These treatments would only be used in MSAs F and G. Prescribed fire is the only activity allowed in established RNAs. Prescribed fire treatments will be deferred within the proposed Many Lakes and Cultus River RNAs until these areas become officially designated and a management plan developed and approved.

MAP 26 -- ENHANCEMENT STRATEGY LATE-SUCCESSIONAL OLD GROWTH ACCELERATION

PAGs MC, PP, and LP not overstocked and not harvested

Cultus and Sheridan Late-Successional Reserves



MAP 27 -- ENHANCEMENT STRATEGY CURRENT NESTING, ROOSTING, AND FORAGING HABITAT CYCLING

NRF Habitat

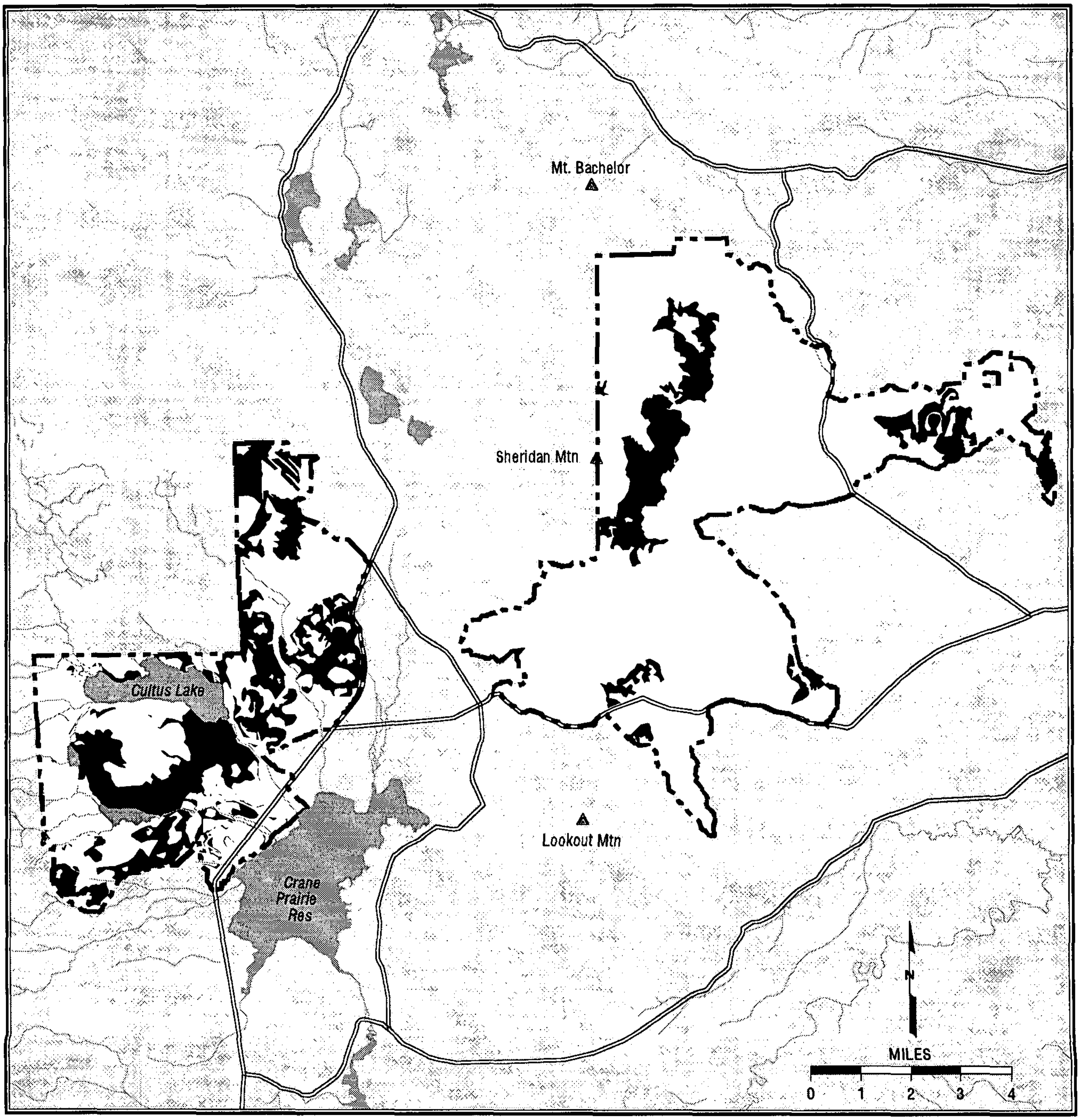
Cultus and Sheridan Late-Successional Reserves

Cultus and Sheridan Late Successional Reserves

Area available approximately 9,000 acres

Lakes and Streams

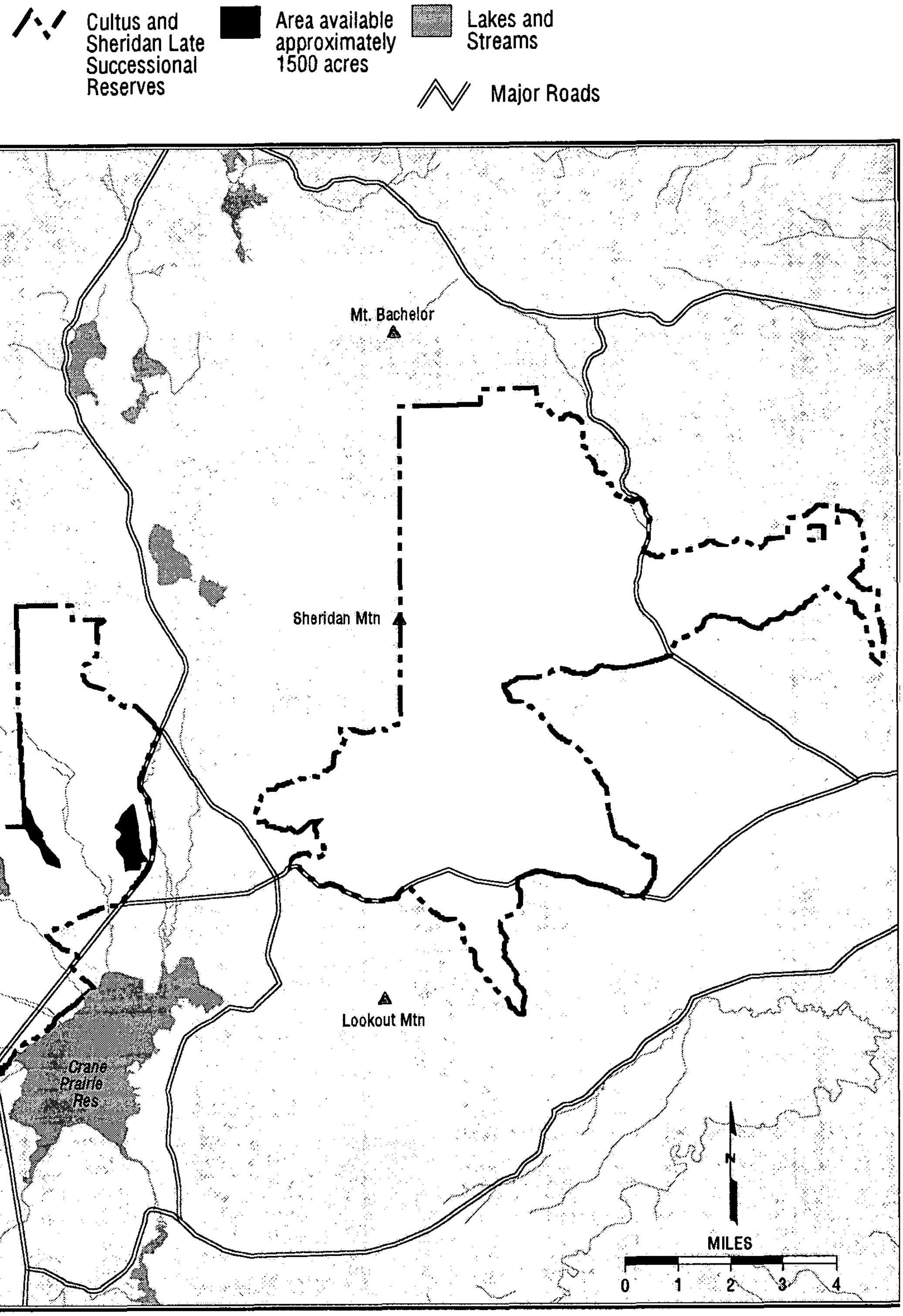
Major Roads



MAP 28 -- ENHANCEMENT STRATEGY TREE CULTURING AND SMALL CANOPY OPENINGS FOR EAGLE HABITAT

Eagle Management Areas from the Forest Plan in MH and MC PAGs

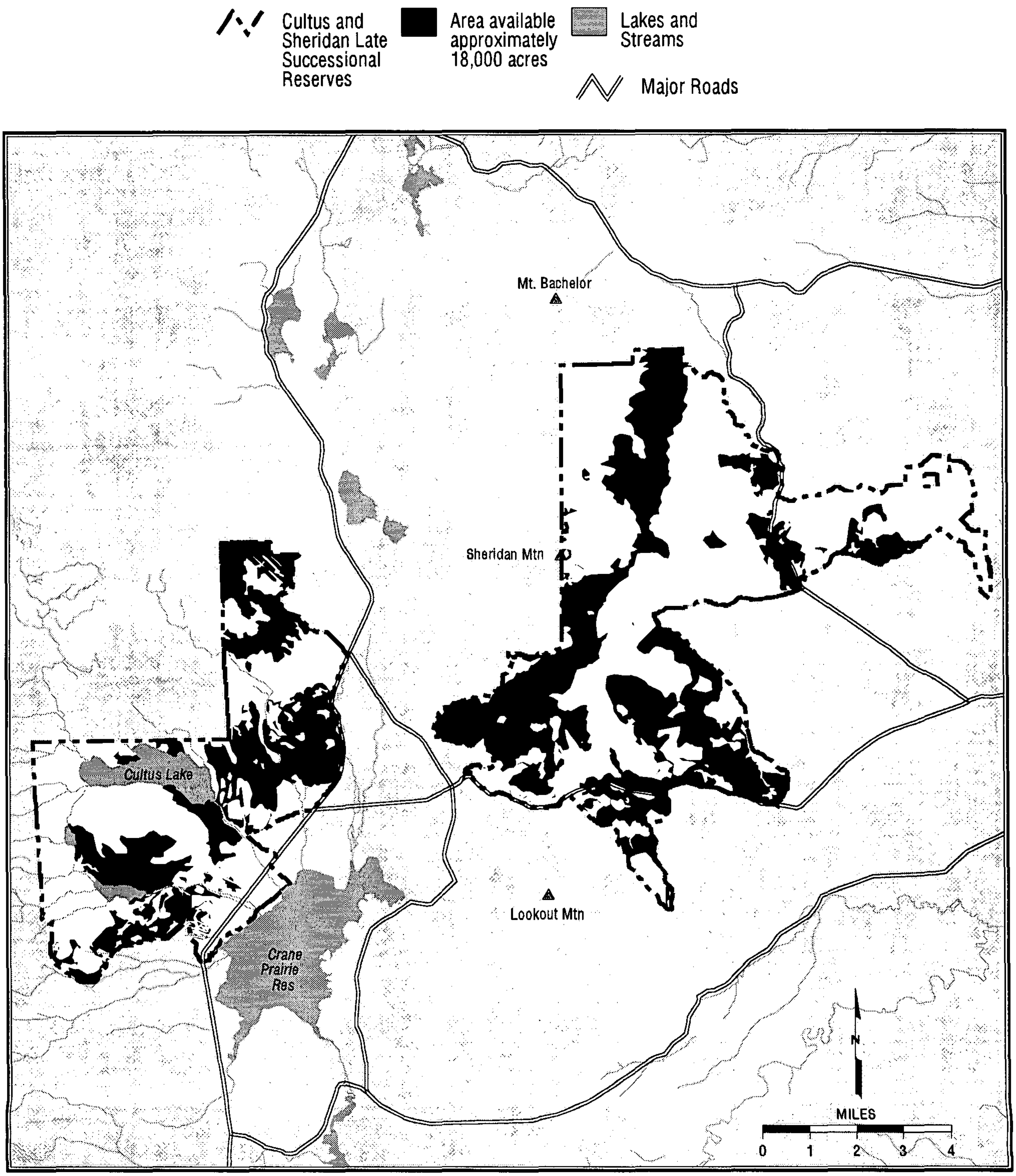
Cultus and Sheridan Late-Successional Reserves



MAP 29 -- ENHANCEMENT STRATEGY PRESCRIBED FIRE

PAGs MCD, PPW, and PPD outside harvest units

Cultus and Sheridan Late-Successional Reserves



MAP 30 -- ENHANCEMENT STRATEGY PRE-COMMERCIAL THINNING

PAGs MC, PP, and LP in HCC, HFR, or HCR units

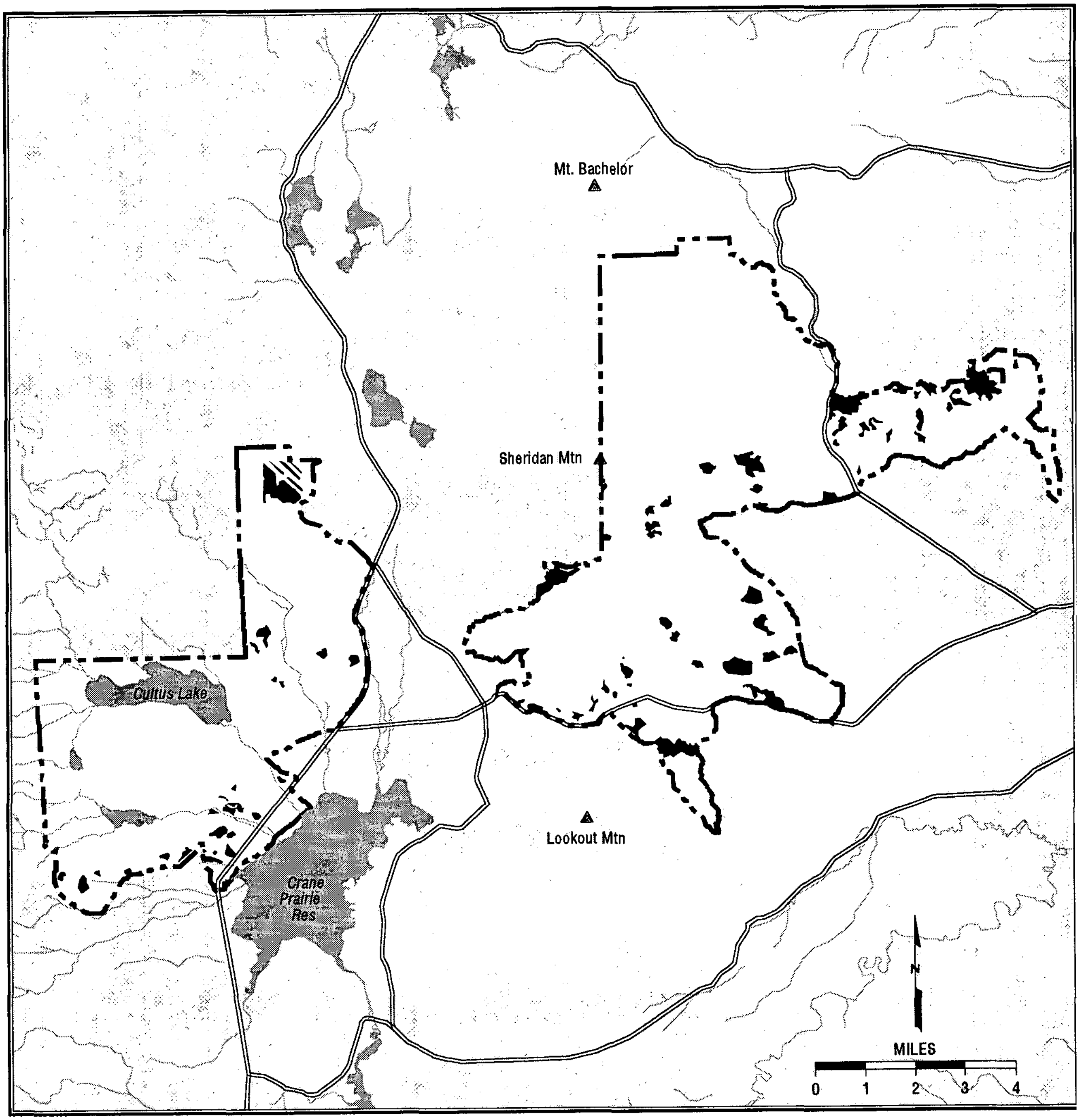
Cultus and Sheridan Late-Successional Reserves

Cultus and Sheridan Late Successional Reserves

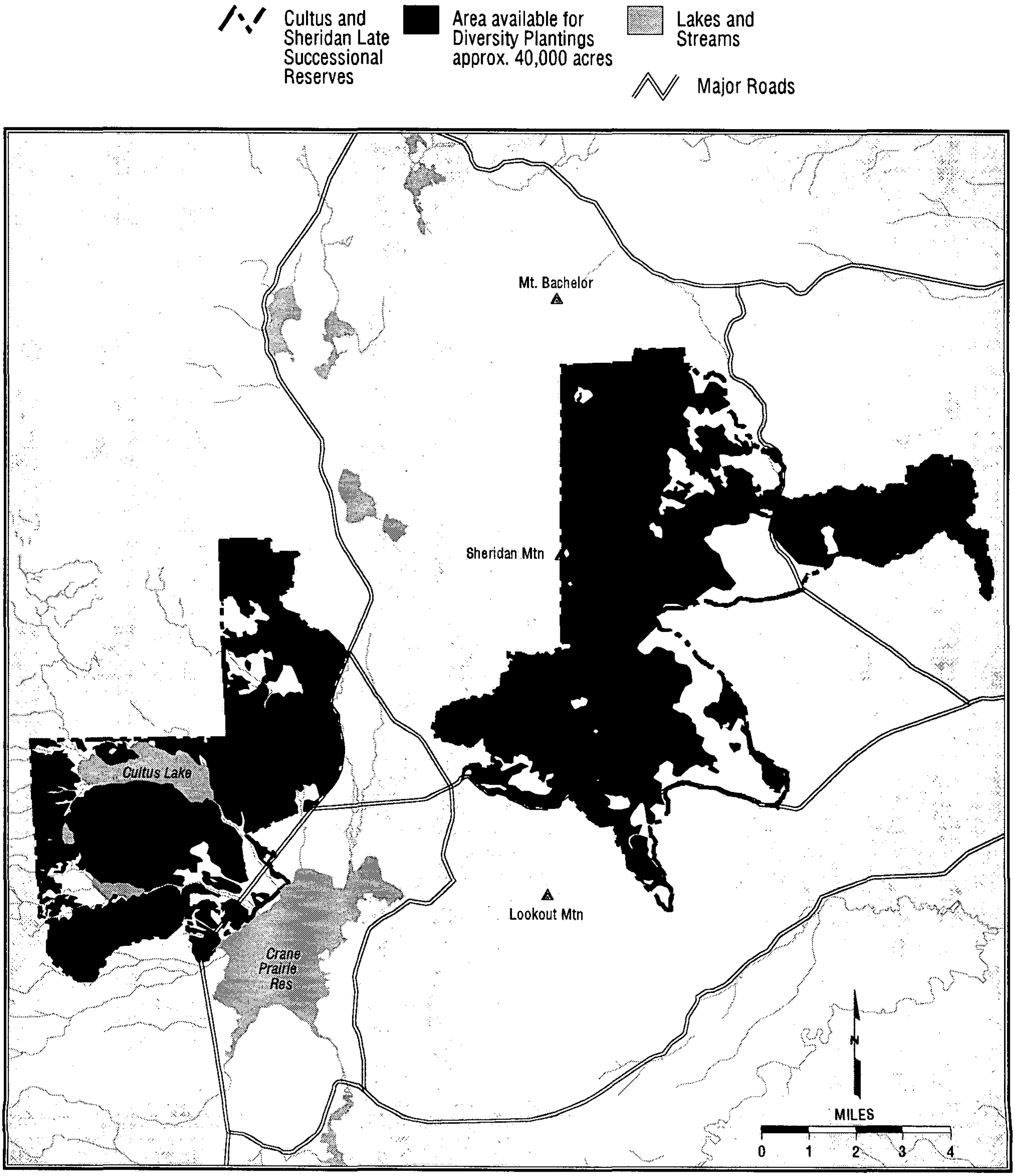
Area available approximately 2,000 acres

Lakes and Streams

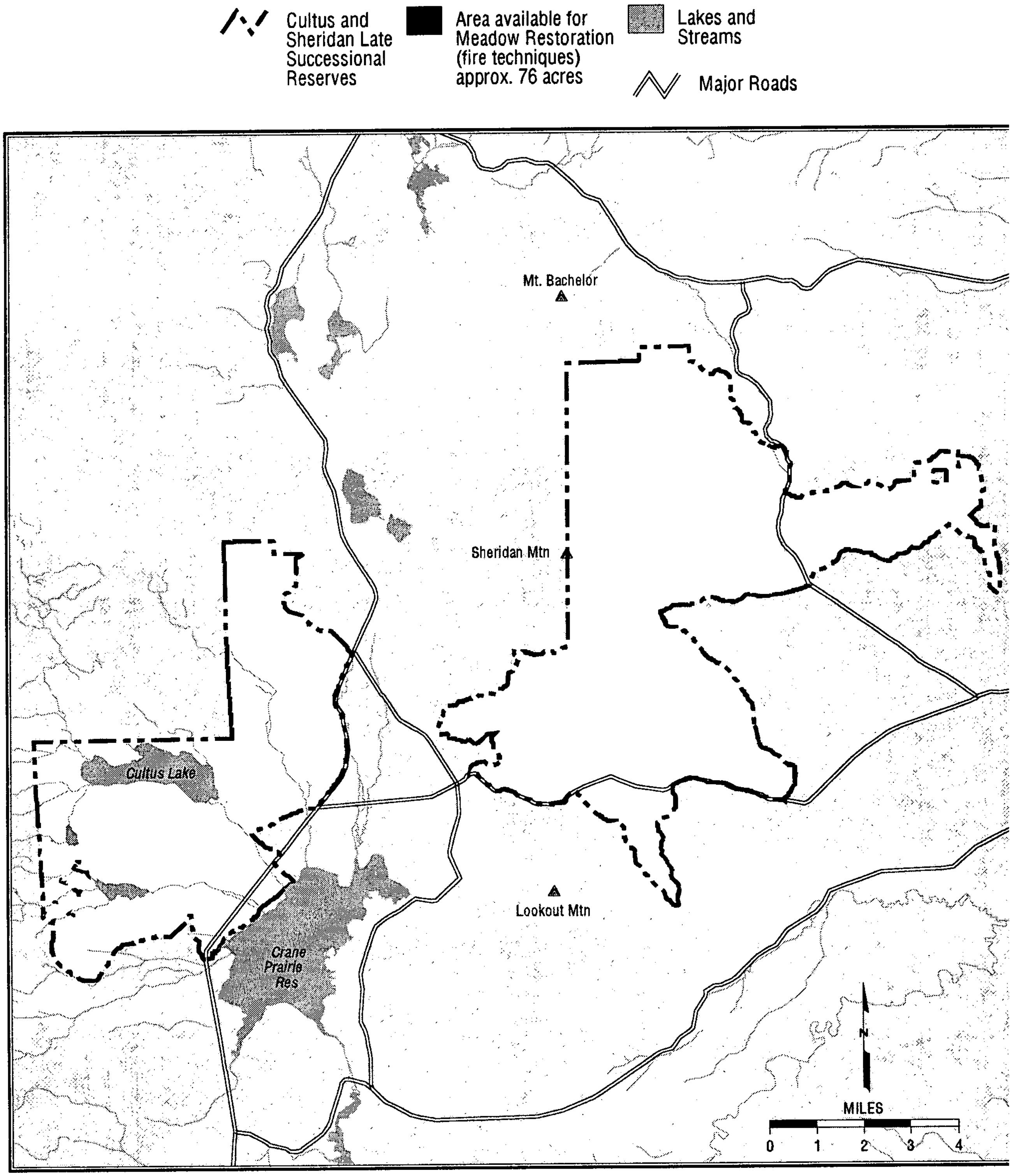
Major Roads



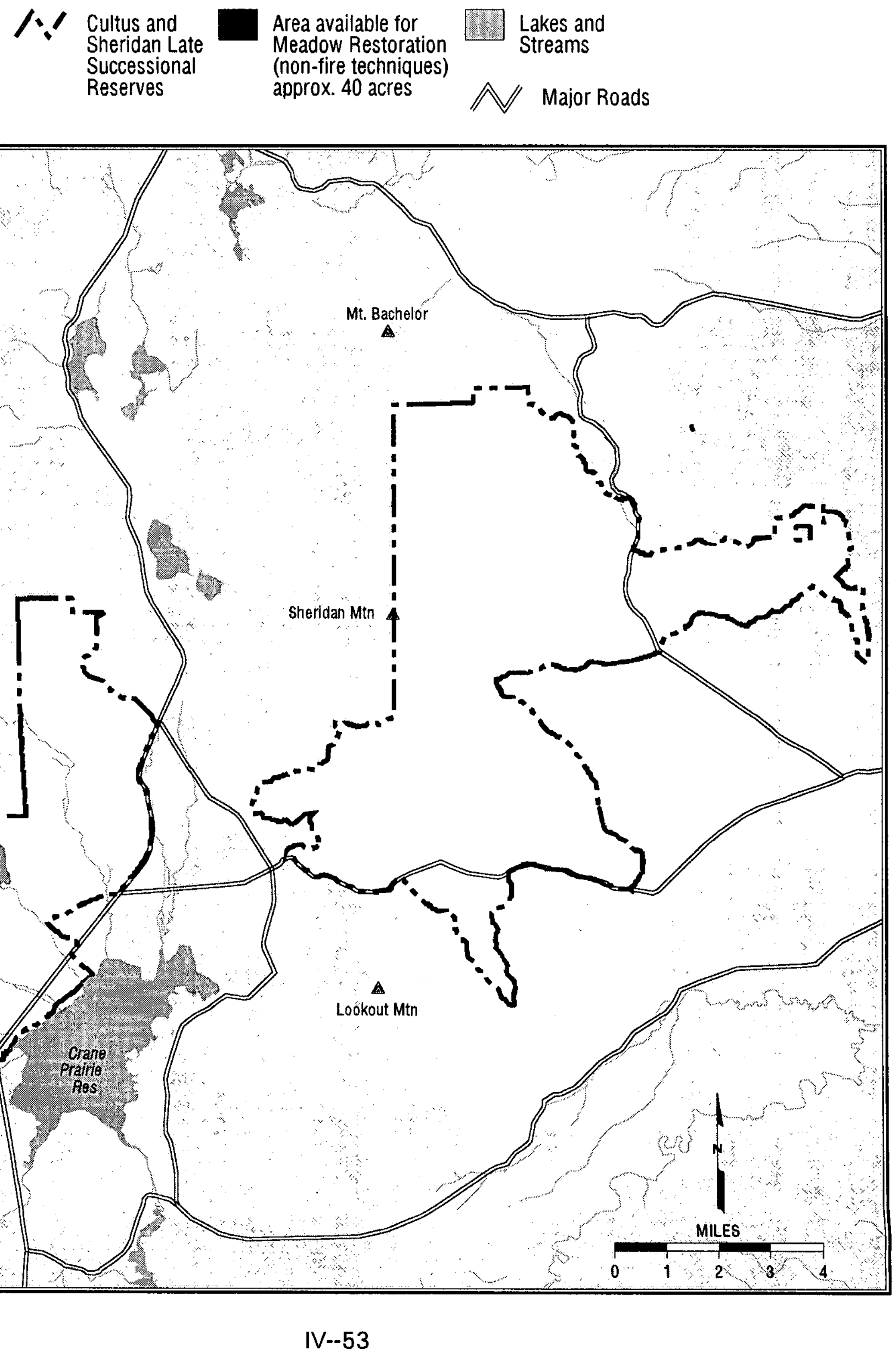
MAP 31 -- ENHANCEMENT STRATEGY
DIVERSITY PLANTINGS
Mountain Hemlock, Mixed Conifer, and Lodgepole Wet PAGs
Cultus and Sheridan Late-Successional Reserves



MAP 32 -- ENHANCEMENT STRATEGY
MEADOW RESTORATION USING FIRE
Meadows in Research Natural Areas
Cultus and Sheridan Late-Successional Reserves



MAP 33 -- ENHANCEMENT STRATEGY
MEADOW RESTORATION BY NON-FIRE TECHNIQUES
Meadows in the Unique PAG
Cultus and Sheridan Late-Successional Reserves



IV. C. 4. GENERAL LSOG STRATEGIES APPLICABLE TO ALL MSAs

The following list of recommendations are common to all Management Strategy Areas. These recommendations help meet or exceed management objectives across the LSR landscape and are applicable as needed. Site-specific analysis will determine appropriate use and implementation.

SNAGS AND COARSE WOODY MATERIAL

Desirable levels of snags are displayed on Table IV-1 for each PAG. When these levels are not present or are unlikely to be reached through natural processes, snag creation may be used to reach the desired condition. The intent is to produce snags when stands are adequately stocked and moving towards the desired condition and snag levels are below what is desired. A variety of treatments targeting large diameter trees of a variety of species could be done. These treatments include innoculation (Parks 1995), low intensity burning (Everett 1993), top blasting, and chainsaw topping. These treatments may be used in the short or long term as needed and determined through site specific analysis.

Desirable levels of coarse woody material that provide habitat without creating excessive fire hazard are displayed in Table IV-1 and 2 by PAG. When these levels are absent or not likely to be recruited through natural processes, coarse woody material enhancement may be used. Enhancement may be attained by falling overstory trees or snags or by dispersing existing unutilized decks over the treatment area. This condition is most likely to occur in plantations where coarse woody material removals through fuels reduction and reforestation treatments may have been excessive in the past.

MANAGEMENT OF DEAD WOOD IN FORESTED AREAS NOT NEEDING TREATMENT

Active snag or down wood creation is not recommended unless there are other objectives for entering a stand. Allow natural mortality to occur to provide snags and future down woody debris. Protect existing snags by managing firewood cutting and road access.

MANAGEMENT OF DEAD WOOD IN FORESTED AREAS NEEDING TREATMENT

All treated stands should comply with the desired condition guidelines as outlined in Table IV-1. Some additional recommendations are listed here:

- Retain dead wood that represents the species composition of the original stand.
- Retain material among the largest available on the site to meet dead wood requirements.
- Retain adequate green tree replacements to provide future dead wood at levels specified in Table IV-1.
- If snags that meet the size criteria described above must be felled during harvest operations, they should be left on site as coarse woody material.
- If trees are being felled to meet risk reduction safety objectives, whole trees that are among the largest felled should be left on site at levels specified in Table IV-1 for suitable habitat. No live trees should be felled with the sole objective of meeting down woody material requirements i.e., trees that need to be felled to meet desired basal areas should be left on site rather than falling additional trees for down wood and taking the stand lower than target basal areas.
- Where available prior to harvest, five lodgepole snags per acre among the largest available on the site will be retained to provide foraging habitat for black-backed woodpeckers and other insectivorous birds.

MANAGEMENT OF DEAD WOOD IN EXISTING TREATED AREAS (I.E. CLEARCUTS)

Manage regenerated areas such that natural mortality will occur to create the desired dead wood components over time. In the first few decades this will be accomplished by leaving 15-

30% of a precommercial thinning unit untreated. In subsequent decades this will be accomplished by varying thinning densities in treated units.

Seek opportunities to redistribute 'jackpot' coarse woody material from adjacent stands and/or cull decks in existing regenerated areas.

HAZARD TREE REMOVAL

Hazard tree removal, to ensure public safety, may be implemented. This treatment will remove dead trees and may remove some green trees that meet the definition of hazard trees in FPM-TP039-92 (Harvey and Hessburg 1992). Hazard tree removal should be documented prior to implementation.

ASPEN MANAGEMENT

Aspen is known to be disappearing due to fire suppression. One small stand of aspen exists on Cultus Mountain, which will be evaluated to determine appropriate management actions.

FIRE SUPPRESSION

Due to the build-up of unnatural fuel loadings, high values associated with the LSRs, and the high risk of large scale wildfires, all fire will be suppressed at this time. However, the long-term goal is to re-introduce fires, eventually allowing them to play a role in maintaining fire adapted ecosystems. All management activities should work towards achieving this long term goal. Further details are found in the LSR Fire Management Plan.

PUBLIC AWARENESS

We need to continue to develop public awareness through meetings and contacts in the field to disseminate information concerning the danger of wildfires, ecosystem damage in sensitive areas through recreation use, and many other topics of concern to forest managers. User groups may be enlisted to support behaviors that have less of an impact on the ground. Restrictions may be considered on the timing and location of certain high use impact activities.

ROADS

Lands in which timber harvest has occurred are heavily roaded and road densities exceed desired levels described in the LRMP. The NWFP, Standards and Guidelines on page B-19, state that "The amount of existing system and nonsystem roads within Key Watersheds should be reduced through decommissioning of roads. Road closures with gates or barriers do not qualify as decommissioning or a reduction in road mileage. If funding is insufficient to implement reductions, there will be no net increase in the amount of roads in Key Watersheds." The ROD on page C-7 states that "...outside roadless areas - reduce existing system and nonsystem road mileage. If funding is insufficient to implement reductions, there will be no net increase in the amount of roads in Key Watersheds." Roads should be closed by obliteration to reduce fragmentation and put roaded land back into vegetative production. High priority obliterations include roads those causing disturbance to riparian and aquatic ecosystems and roads that increase the level of human activity in sensitive wildlife areas. Lower priority obliterations may be considered when more than one route to service an areas exists.

The Cultus Subwatershed is classified as a Key Watershed and encompasses most of the roadless area around Cultus Mountain. The NWFP Standards and Guidelines on page B-19 state that no new roads will be constructed in inventoried roadless areas in Key Watersheds.

Within areas that have not been managed for timber production, the road density is very low to non-existent. Portions of three Rare II Inventoried Roadless areas are found within the LSRs.

Other roadless areas within the LSRs and outside of Key Watersheds may be considered for development if roading is necessary to economically treat stands to meet LSR objectives. Recognizing that roads cause conflicts with wildlife, recreation users, aquatic species, are corridors for noxious weeds, etc., sound resource management based on clear concise objectives will be particularly critical when considering entering these roadless areas. A plan should incorporate all necessary activities to meet the LSR objectives and reduce the need for multiple re-entries. Roads created should be obliterated after treatment and rehabilitation should occur at the same time.

CINDER AND GRAVEL PITS
Of the eight existing pits located within the LSRs, five are formally closed. These five sites need to be rehabilitated so forest vegetation may be returned to the site. The remaining open pits may remain operating to service the existing developments. Restrictions on the season of use may be considered depending on their proximity to nest sites of LSOG species. Development of new sources or expansion of existing pits need to consider the effects on maintaining and enhancing late-successional old growth forests through site-specific NEPA documents.

SPECIAL FOREST PRODUCTS
Minor levels of Christmas tree cutting, bough cutting, private firewood gathering, and mushroom harvesting are thought to currently occur within the LSRs. These activities are generally inappropriate within the LSRs. These activities may conflict with the development of LSOG habitat in the future. Specifically, mushroom harvesting is currently being done, but the ecology of fungi and the role they may play in ensuring the stability of the ecosystem is unknown. The intensity of mushroom activity, increased use of the area, soil compaction and disturbance are uses not consistent with the LSR objectives. Until research has been conducted to confirm that effects from mushroom harvesting are inconsequential to late-successional forest development, mushroom collection should be prohibited.

AQUATIC CONSERVATION STRATEGY
Additional treatments may be applicable within the LSRs that seek to restore the proper function of the watershed or to improve the aquatic resources. The Cascade Lakes Watershed Analysis discusses and displays these types of treatments. The highest priority treatments that were identified in watershed analysis include restoration of compacted soils in riparian and upland areas as well as controlling recreation use through campground and trail design and maintenance. Efforts to change recreation behavior through public information or law enforcement are considered as well.

IV. D. SUMMARY OF MANAGEMENT STRATEGY AREAS (MSA)

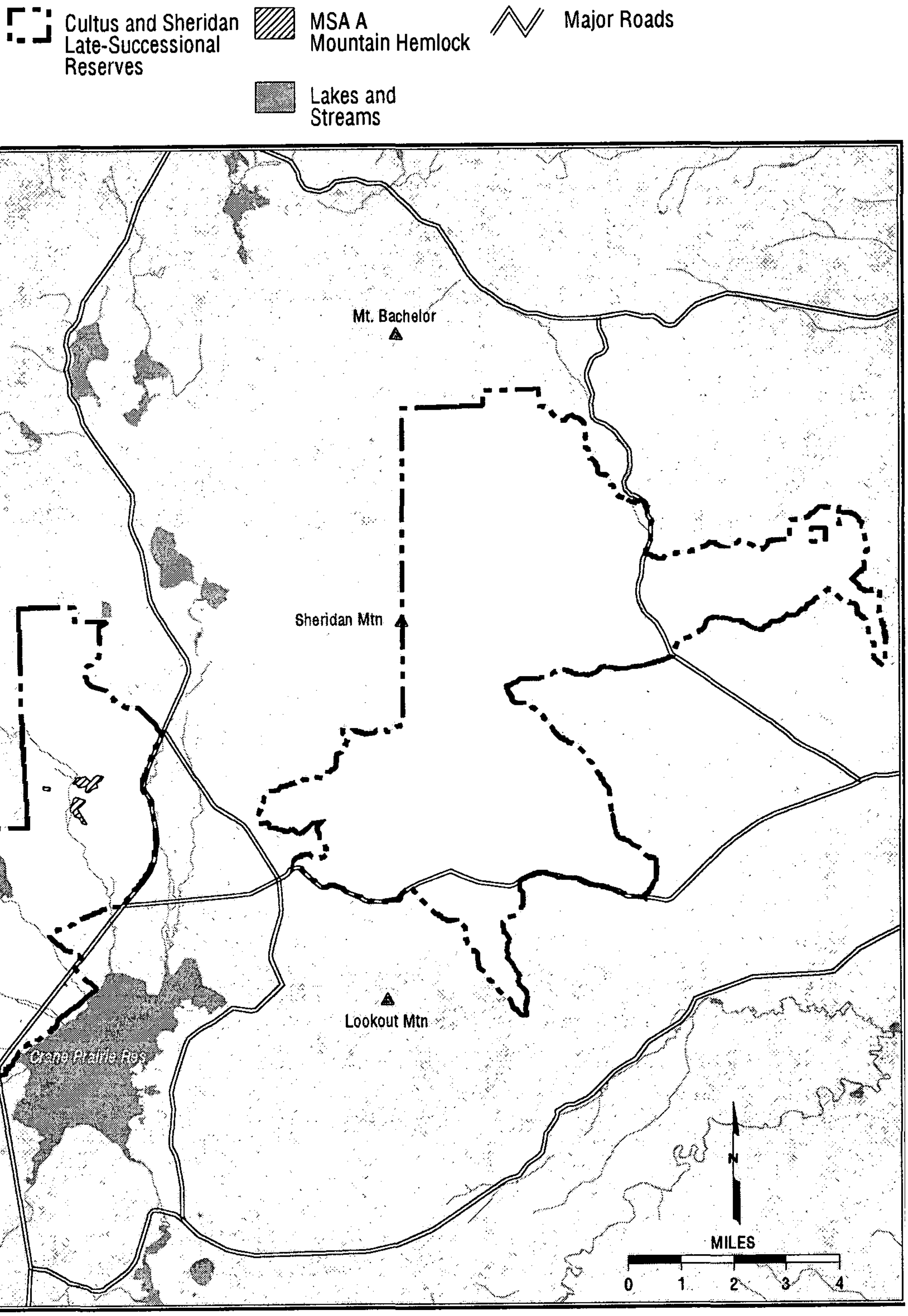
IV. D. 1. INTRODUCTION

Ten MSAs were defined for the Cultus and Sheridan LSRs. The following information provides summaries of the MSAs developed for this assessment. Each MSA summary sheet includes: plant association, total acres, elevation range, LRMP allocations, wildlife indicator species, botanical species, acres of existing LSOG, insect and disease risk, fire risk, fire hazard, access, protection treatments, and enhancement treatments.

- MSA A - Mountain hemlock PAG: 2,070 acres, 5%
- MSA B - Mixed Conifer Wet PAG: 4,560 acres, 9%
- MSA C - Mixed Conifer Dry PAG: 9,490 acres, 19%
- MSA D - Lodgepole Pine Wet PAG: 3,890 acres, 8%
- MSA E - Lodgepole Pine Dry PAG: 950 acres, 2%
- MSA F - Unique PAG: 1,410 acres, 3%
- MSA G - Research Natural Areas: 1,160 acres, 2%
- MSA H - Public Safety (All PAGs): 1,100 acres, 2%
- MSA I - Forested Lavas (All PAGs): 23,470, 48%
- MSA J - Ponderosa Pine Wet and Dry: 930 acres, 2%

MAP 34 -- MANAGEMENT STRATEGY AREAS
A - MOUNTAIN HEMLOCK

Cultus and Sheridan Late-Successional Reserves



MANAGEMENT STRATEGY AREA A

MOUNTAIN HEMLOCK (MH)

SUMMARY

Plant Associations Represented: CM-S1-11, CM-G2, CM-G3, CL-S3-11, CL-S4-12, CR-S1-11.

Total Acres: Cultus LSR - 2,070, Sheridan LSR - 0.

Elevation Range: Cultus LSR - 4,700 - 6,800 ft, Sheridan LSR - 0.

More Restrictive DES LRMP Allocations: Rare II Roadless (not official LRPM allocation).

Wildlife Indicator Species: American Marten, Boreal Owl.

Botanical Species: None.

Existing LSOG Acres: Cultus - 910, Sheridan - 0.

Insect and Disease Risk: None.

Fire Risk: Moderate.

Fire Hazard: Low.

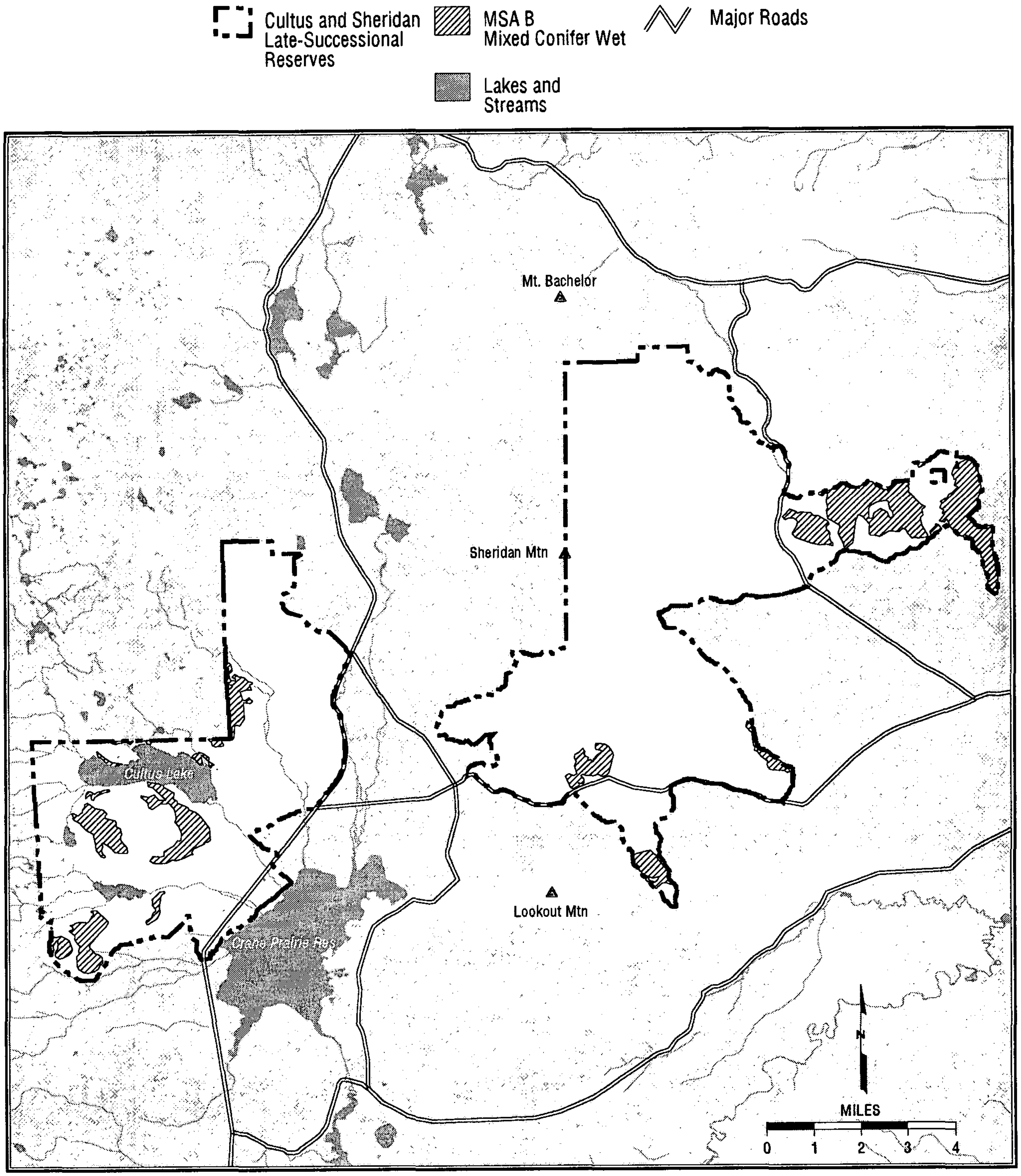
Access: Unroaded.

Protection Treatments: (See Table IV-6) None.

Enhancement Treatments: (See Table IV-7) Bald Eagle Tree Culturing, Small Canopy Openings, Diversity Plantings.

MAP 35 -- MANAGEMENT STRATEGY AREAS B - MIXED CONIFER WET

Cultus and Sheridan Late-Successional Reserves



MANAGEMENT STRATEGY AREA B

MIXED CONIFER WET (MCW)

SUMMARY

Plant Associations Represented: CW-S1-13, CW-S9-11, CD-S6-13, CD-S6-14, CR-S1-11.

Total Acres: Cultus LSR - 1,745, Sheridan LSR - 2,815.

Elevation Range: Cultus LSR - 4,800 - 5,800 ft, Sheridan LSR - 4,700 - 5,500 ft.

More Restrictive DES LRMP Allocations: Old Growth, Rare II Roadless (not official LRMP allocation).

Wildlife Indicator Species: Northern Spotted Owl, Pileated Woodpecker.

Botanical Species: Allotropa virgata, Mimulus jepsonii, Castilleja chlorotica.

Existing LSOG Acres: Cultus - 840, Sheridan - 220.

Insect and Disease Risk: High.

Fire Risk: Moderate.

Fire Hazard: Moderate.

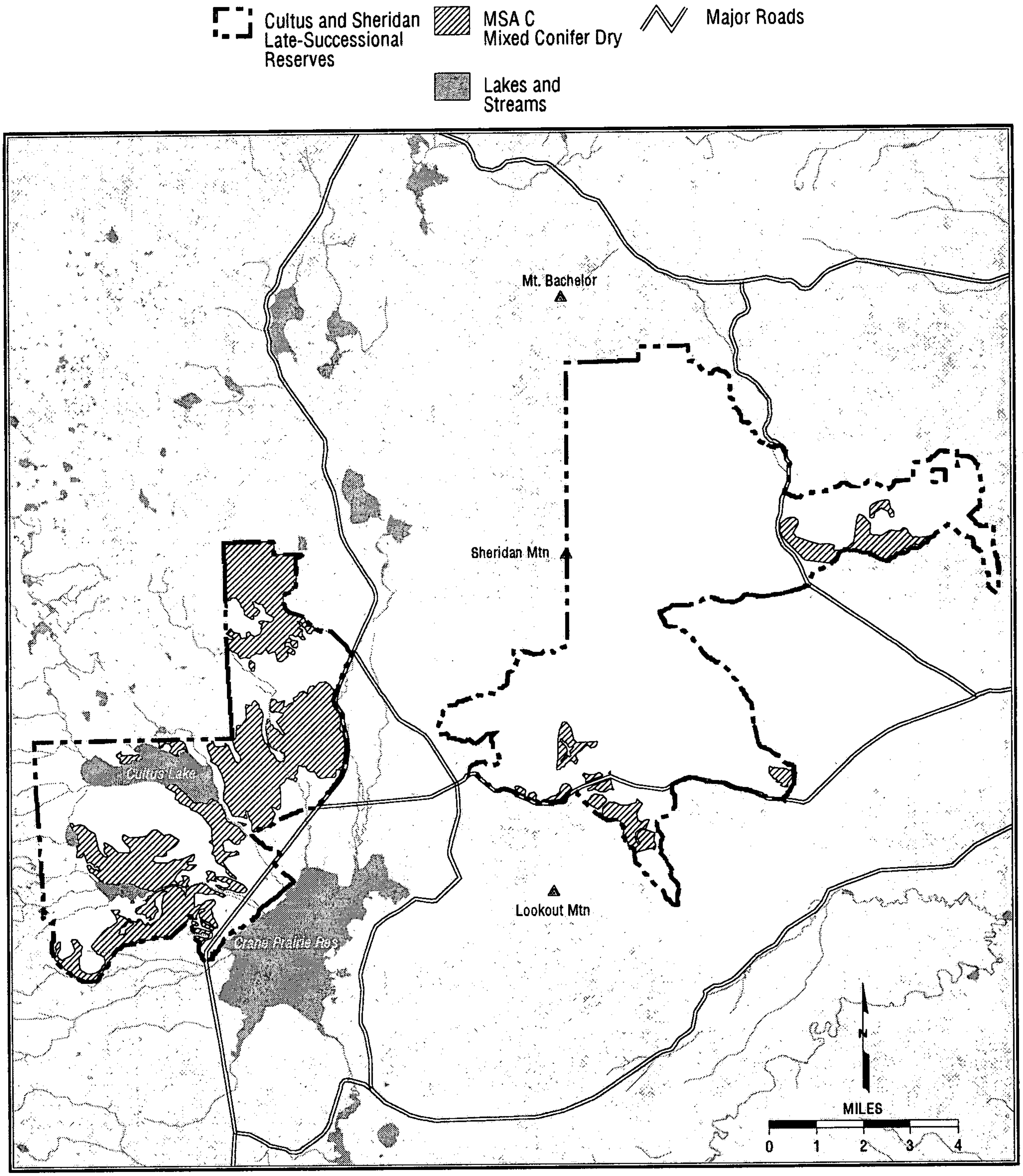
Access: Roaded and Unroaded.

Protection Treatments: (See Table IV-6) Tree Culturing, Thinning, Fuels Reduction.

Enhancement Treatments: (See Table IV-7) LSOG Habitat Acceleration, NRF Cycling, Small Canopy Openings, Precommercial Thinnings, Diversity Plantings.

MAP 36 -- MANAGEMENT STRATEGY AREAS
C - MIXED CONIFER DRY

Cultus and Sheridan Late-Successional Reserves



MANAGEMENT STRATEGY AREA C

MIXED CONIFER DRY (MCD)

SUMMARY

Plant Associations Represented: CW-S1-12, CW-S1-15, CW-C2-11, CW-C2-13, CR-S1-11, CL-S3-11, CW-H1-11.

Total Acres: Cultus LSR - 7,825, Sheridan LSR - 1,665.

Elevation Range: Cultus LSR - 4,500 - 6,000 ft, Sheridan LSR - 4,700 - 5,500 ft.

More Restrictive DES LRMP Allocations: Old Growth, Rare II Roadless (not official LRMP allocation).

Wildlife Indicator Species: Pileated Woodpecker, Great Gray Owl, Northern Goshawk, Bald Eagle, Flammulated Owl, Black-Backed Woodpecker.

Botanical Species: Allotropa virgata, Mimulus jepsonni, Castilleja chlorotica.

Existing LSOG Acres: Cultus - 2,760, Sheridan - 120.

Insect and Disease Risk: High.

Fire Risk: Moderate.

Fire Hazard: High.

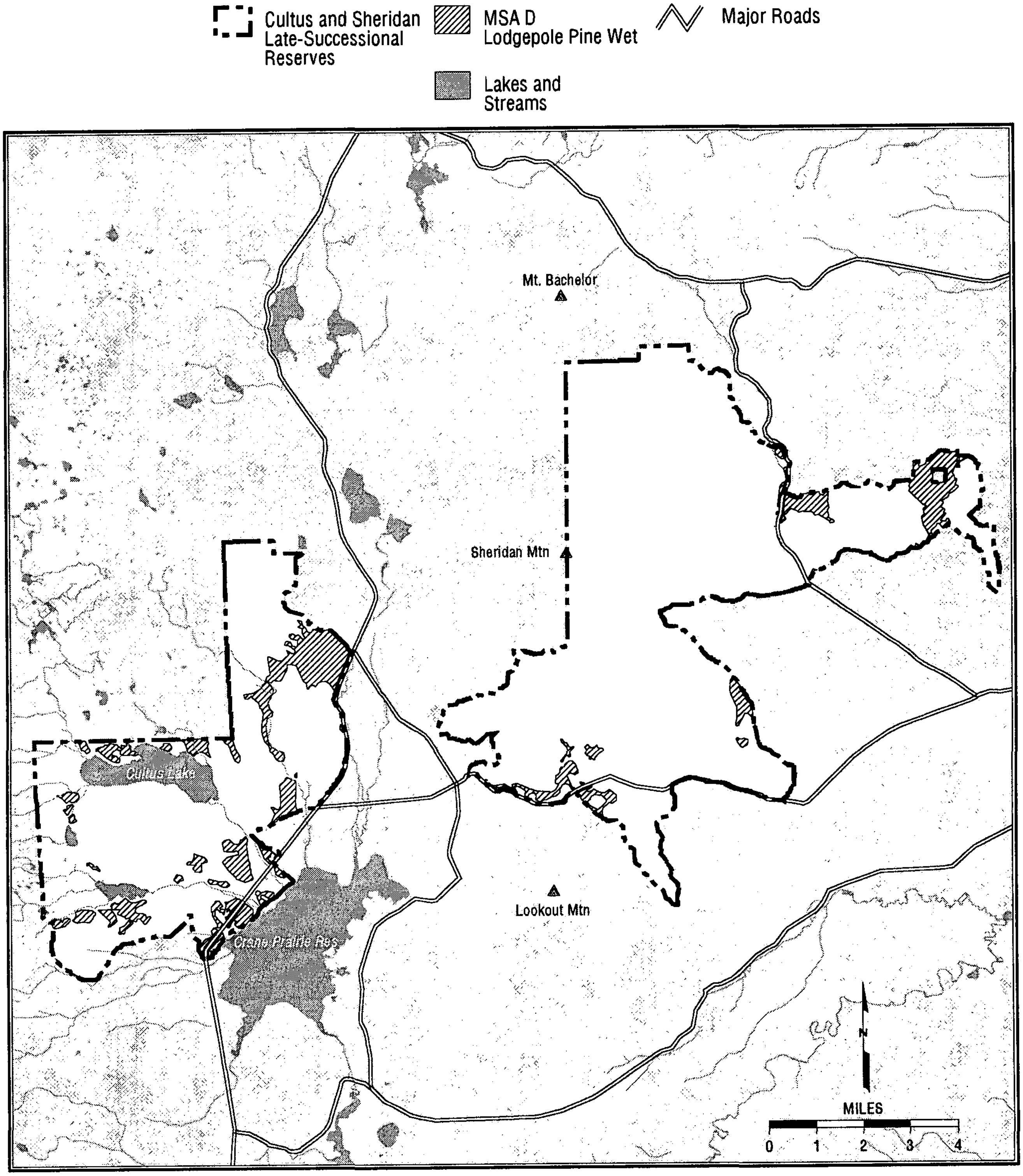
Access: Roaded.

Protection Treatments: (See Table IV-6) Tree Culturing, Thinning, Fuels Reduction.

Enhancement Treatments: (See Table IV-7) LSOG Habitat Acceleration, NRF Cycling, Bald Eagle Tree Culturing, Prescribed Fire, Precommercial Thinning, Diversity Plantings.

MAP 37 -- MANAGEMENT STRATEGY AREAS
D - LODGEPOLE PINE WET

Cultus and Sheridan Late-Successional Reserves



MANAGEMENT STRATEGY AREA D

LODGEPOLE PINE WET (LPW)

SUMMARY

Plant Associations Represented: CL-G4-11, CL-G4-12, CL-M3-11, CL-S2-12.

Total Acres: Cultus LSR - 2,465, Sheridan LSR - 1,425.

Elevation Range: Cultus LSR - 4,400 - 4,900 ft, Sheridan LSR - 4,800 - 5,100 ft.

More Restrictive DES LRMP Allocations: Old Growth, Rare II Roadless (not official LRMP allocation).

Wildlife Indicator Species: Black-Backed Woodpecker, Great Gray Owl, Northern Goshawk.

Botanical Species: Mimulus jepsonni, Castilleja chlorotica.

Existing LSOG Acres: Cultus - 160, Sheridan - 10.

Insect and Disease Risk: Low.

Fire Risk: High.

Fire Hazard: Extreme.

Access: Unroaded and Roaded.

Protection Treatments: (See Table IV-6) Salvage, Reforestation, Fuels Reduction.

Enhancement Treatments: (See Table IV-7) LSOG Habitat Acceleration, NRF Cycling, Precommercial Thinning, Diversity Plantings.

MAP 38 -- MANAGEMENT STRATEGY AREAS
E - LODGEPOLE PINE DRY

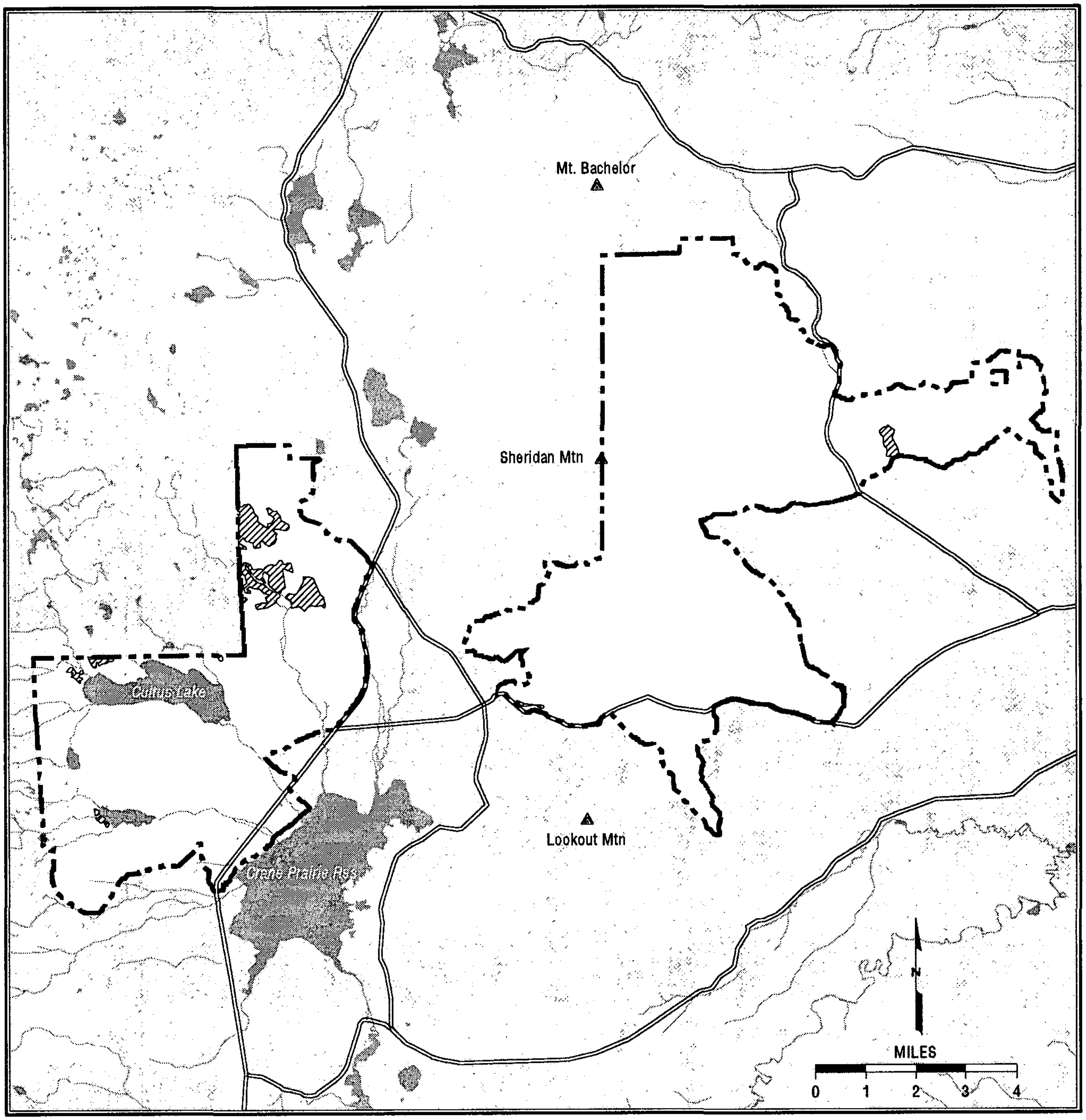
Cultus and Sheridan Late-Successional Reserves

Cultus and Sheridan Late-Successional Reserves

MSA E Lodgepole Pine Dry

Major Roads

Lakes and Streams



MANAGEMENT STRATEGY AREA E

LODGEPOLE PINE DRY (LPD)

SUMMARY

Plant Associations Represented: CL-S2-11, Cl-S3-11, CL-S9-11, CL-G4-13, CL-G3-11.

Total Acres: Cultus LSR - 850, Sheridan LSR - 100.

Elevation Range: Cultus LSR - 4,700 - 5,200 ft, Sheridan LSR - 4,800 - 4,900 ft.

More Restrictive DES LRMP Allocations: Rare II Roadless (not official LRMP allocation).

Wildlife Indicator Species: Black-Backed Woodpecker, Great Gray Owl, Northern Goshawk.

Botanical Species: Mimulus jepsonni, Castilleja chlorotica.

Existing LSOG Acres: Cultus - 90, Sheridan - < 10.

Insect and Disease Risk: Low.

Fire Risk: High.

Fire Hazard: Extreme.

Access: Roaded.

Protection Treatments: (See Table IV-6) Salvage, Reforestation, Fuels Reduction.

Enhancement Treatments: (See Table IV-7) LSOG Habitat Acceleration, NRF Cycling, Precommercial Thinning.

MAP 39 -- MANAGEMENT STRATEGY AREAS
F - UNIQUE HABITATS

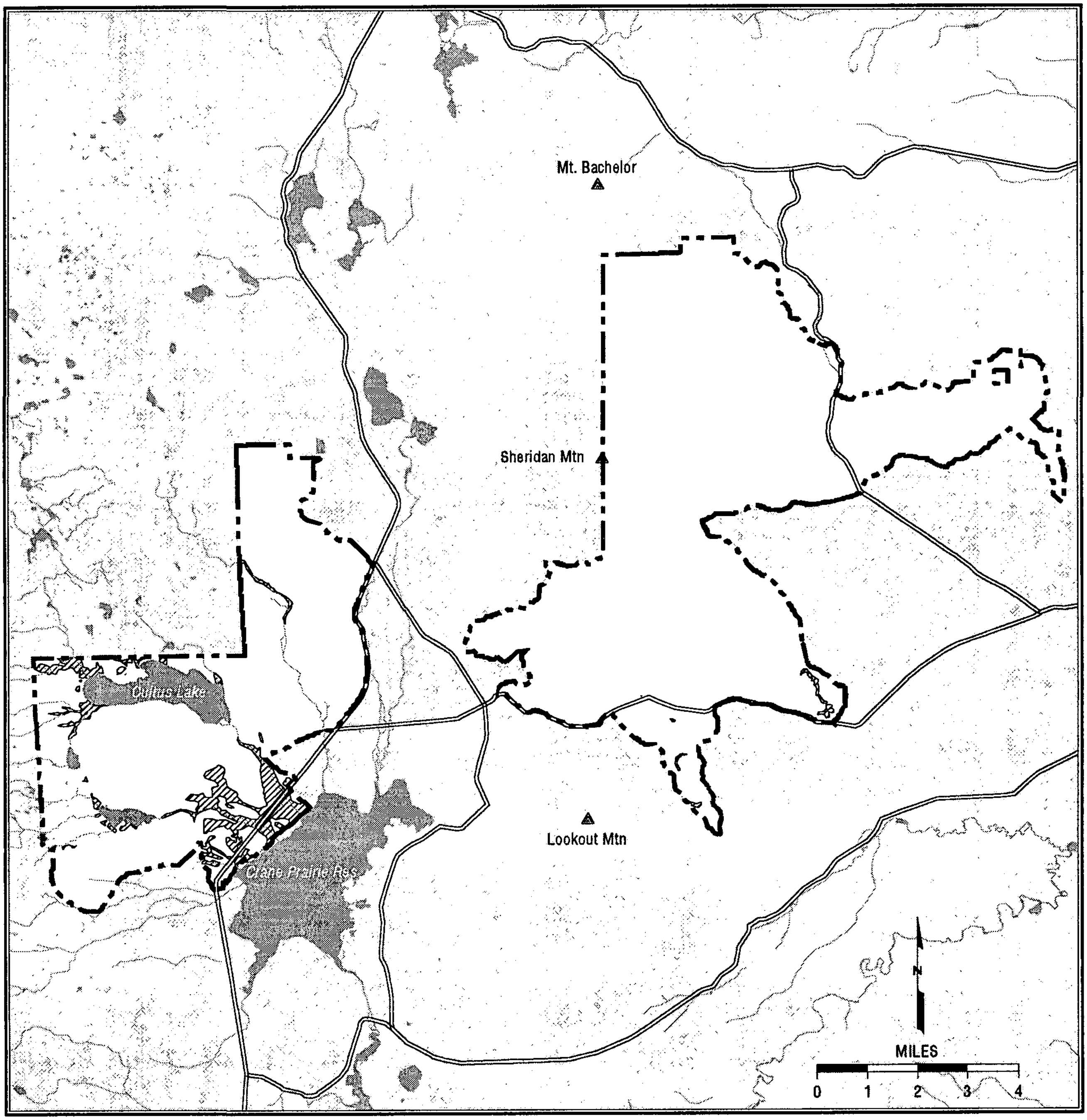
Cultus and Sheridan Late-Successional Reserves

Cultus and Sheridan Late-Successional Reserves

MSA F Unique Habitats

Major Roads

Lakes and Streams



MANAGEMENT STRATEGY AREA F

UNIQUE HABITATS (UNI)

SUMMARY

Plant Association Groups Represented: Engelmann Spruce, Aspen, Meadow & Shrub, Rock Outcrops & Cinder.

Total Acres: Cultus LSR - 1,335, Sheridan LSR - 75.

Elevation Range: Cultus LSR - 4,400 - 5,000 ft, Sheridan LSR - 4,800 - 5,200.

More Restrictive DES LRMP Allocations: Old Growth, Scenic Views.

Wildlife Indicator Species: None.

Botanical Species: None.

Existing LSOG Acres: Cultus - 790, Sheridan - 0.

Insect and Disease Risk: None.

Fire Risk: Low.

Fire Hazard: Low.

Access: Mostly Unroaded.

Protection Treatments: (See Table IV-6) None.

Enhancement Treatments: (See Table IV-7) Meadow Restoration.

MAP 40 -- MANAGEMENT STRATEGY AREAS
G - RESEARCH NATURAL AREAS

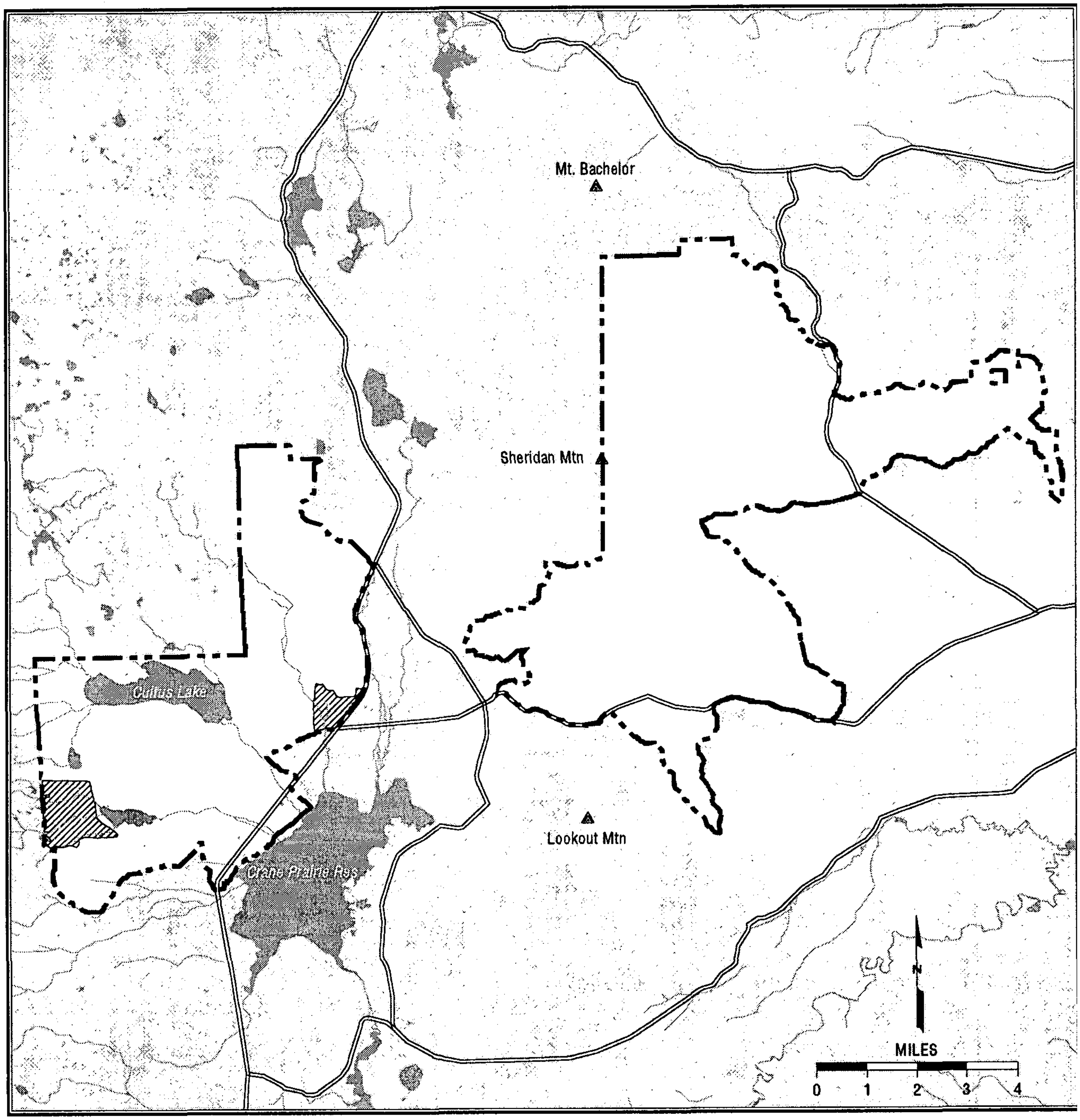
Cultus and Sheridan Late-Successional Reserves

Cultus and Sheridan Late-Successional Reserves

MSA G Research Natural Areas

Lakes and Streams

Major Roads



MANAGEMENT STRATEGY AREA G

RESEARCH NATURAL AREAS (RNA)

SUMMARY

Plant Association Groups Represented: Englemann Spruce, Mountain Hemlock, Lodgepole Pine Wet & Dry.

Total Acres: Cultus LSR - 1,160, Sheridan LSR - 0.

Elevation Range: Cultus LSR - 4,400 - 5,000, Sheridan LSR - 0.

More Restrictive DES LRMP Allocations: RNA.

Wildlife Indicator Species: Varies by PAG.

Botanical Species: Mimulus jepsonni.

Existing LSOG Acres: Cultus - 450, Sheridan - 0.

Insect and Disease Risk: Moderate.

Fire Risk: Low.

Fire Hazard: High.

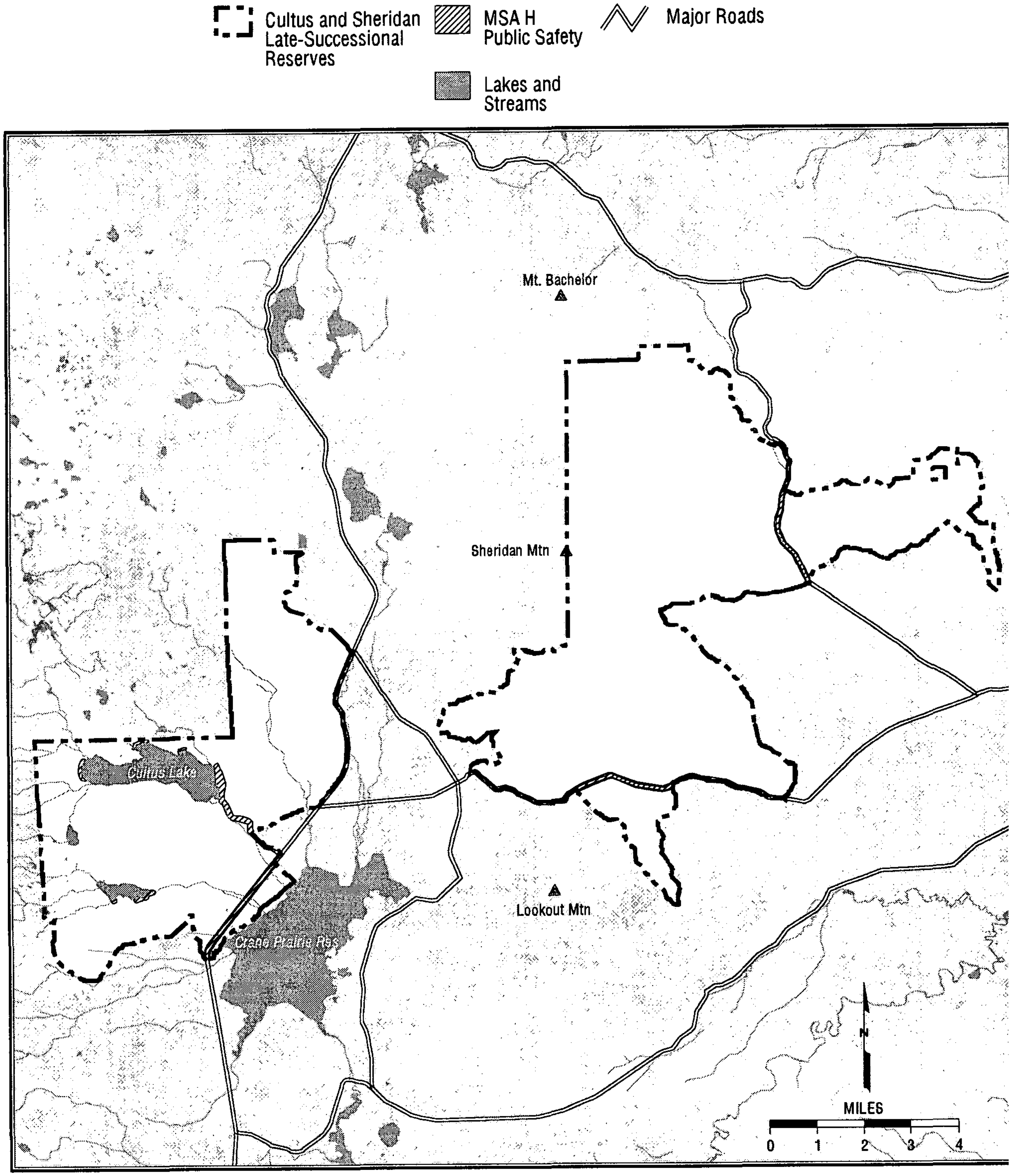
Access: Roaded and Unroaded.

Protection Treatments: (See Table IV-6) None.

Enhancement Treatments: (See Table IV-7) Prescribed Fire, Meadow Restoration.

MAP 41 -- MANAGEMENT STRATEGY AREAS
H - PUBLIC SAFETY

Cultus and Sheridan Late-Successional Reserves



MANAGEMENT STRATEGY AREA H

PUBLIC SAFETY (PS)

SUMMARY

Plant Association Groups Represented: All.

Total Acres: Cultus LSR - 540, Sheridan LSR - 560.

Elevation Range: Cultus LSR - 4,500 - 4,700, Sheridan LSR - 4,500 - 4,900.

More Restrictive DES LRMP Allocations: Old Growth, Scenic Views.

Wildlife Indicator Species: Varies by PAG.

Botanical Species: Centaurea maculosa, Centaurea diffusa.

Existing LSOG Acres: Cultus - 170, Sheridan - > 10.

Insect and Disease Risk: Low.

Fire Risk: High.

Fire Hazard: Low.

Access: Roaded.

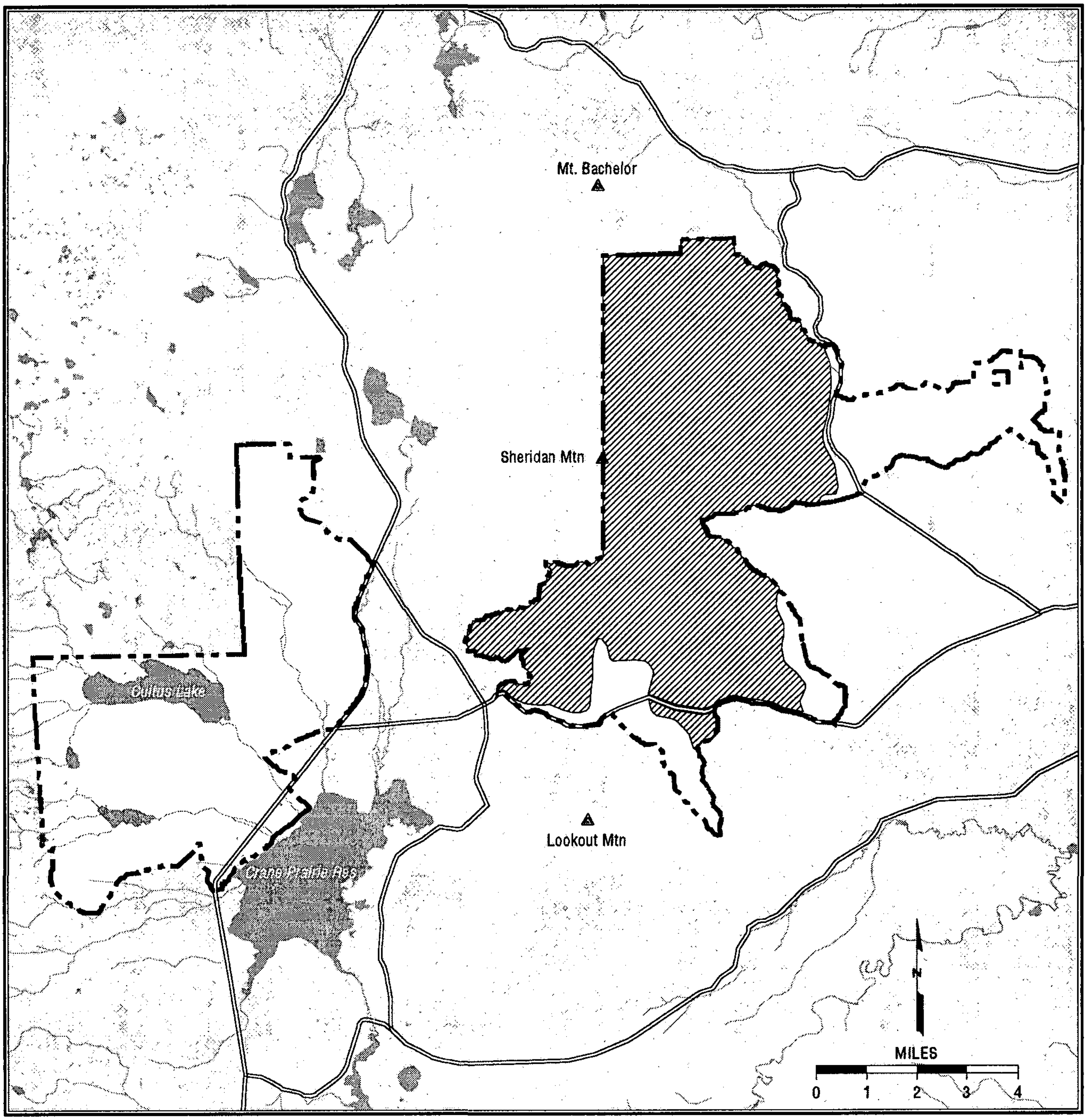
Protection Treatments: (See Table IV-6) Hazard Tree Removal, Fuels Reduction.

Enhancement Treatments: (See Table IV-7) Precommercial thinnings.

MAP 42 -- MANAGEMENT STRATEGY AREAS
I - FORESTED LAVAS

Cultus and Sheridan Late-Successional Reserves

Cultus and Sheridan Late-Successional Reserves
MSA I Forested Lavas
Major Roads
Lakes and Streams



MANAGEMENT STRATEGY AREA I

FORESTED LAVAS (FL)

SUMMARY

Plant Association Groups Represented: Mountain Hemlock, Mixed Conifer Wet & Dry, Ponderosa Pine Wet & Dry, Lodgepole Pine Wet & Dry.

Total Acres: Cultus LSR - 0, Sheridan LSR - 23,470.

Elevation Range: Cultus LSR - 0, Sheridan LSR - 4,600 - 6,800.

More Restrictive DES LRMP Allocations: Old Growth, Rare II Roadless (not official LRMP allocation).

Wildlife Indicator Species: Varies by PAG.

Botanical Species: None.

Existing LSOG Acres: Cultus - 0, Sheridan - 1,890.

Insect and Disease Risk: Low to High.

Fire Risk: Moderate.

Fire Hazard: Moderate.

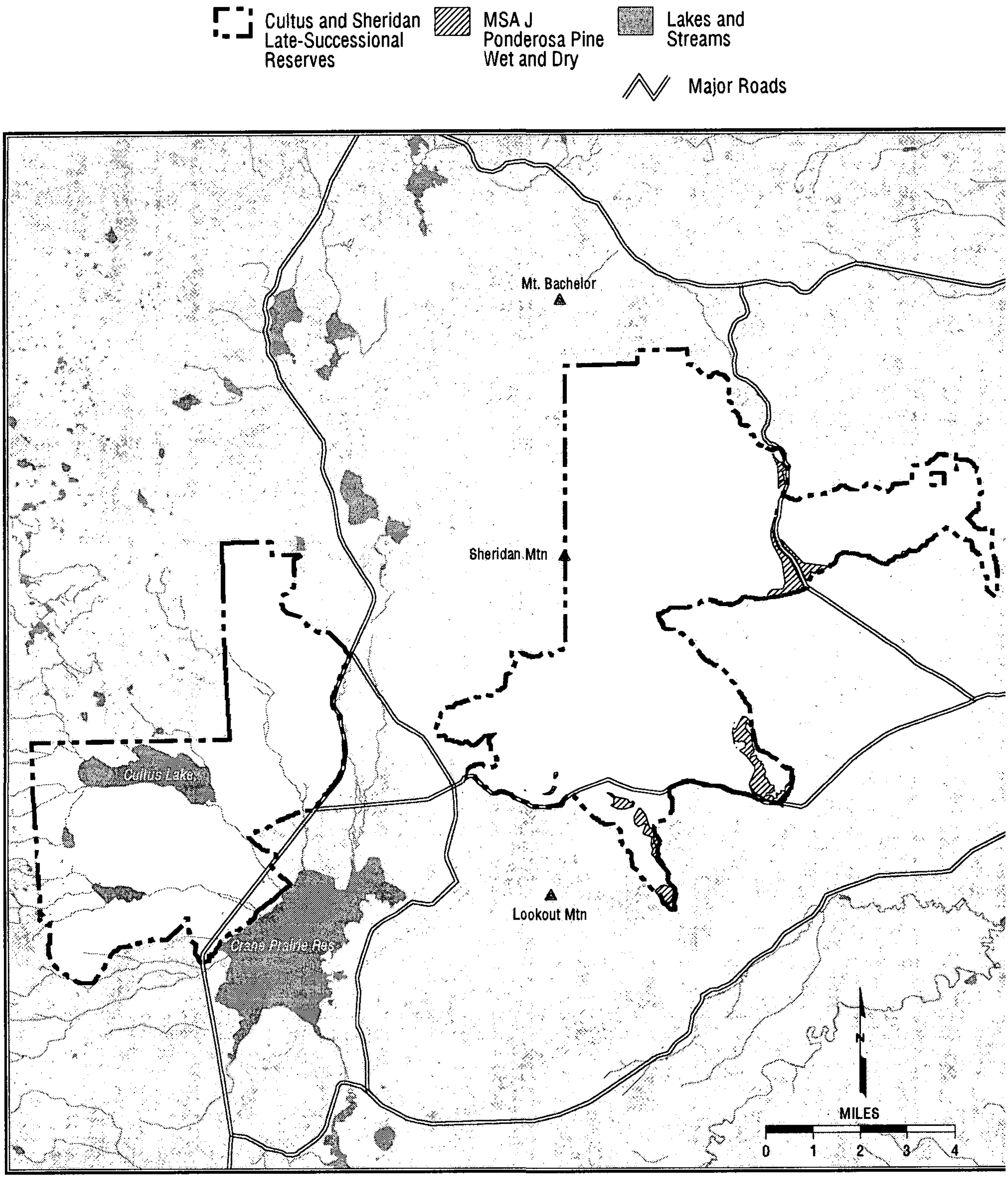
Access: Mostly Roaded.

Protection Treatments: (See Table IV-6) None.

Enhancement Treatments: (See Table IV-7) LSOG Habitat Acceleration, NRF Cycling, Prescribed Fire, Precommercial Thinnings, Diversity Plantings (treatments are deferred until research project is completed).

MAP 43 -- MANAGEMENT STRATEGY AREAS
J - PONDEROSA PINE WET AND DRY

Cultus and Sheridan Late-Successional Reserves



MANAGEMENT STRATEGY AREA J

PONDEROSA PINE WET AND DRY (PPW & PPD)

SUMMARY

Plant Associations Represented: CP-S3-11, CP-S3-14, CP-S2-13, CP-S2-14, CP-S3-12.

Total Acres: Cultus LSR - 0, Sheridan LSR - 930.

Elevation Range: Cultus LSR - 0, Sheridan LSR - 4,500 - 4,800.

More Restrictive DES LRMP Allocations: Old Growth.

Wildlife Indicator Species: Flammulated Owl, White-Headed Woodpecker, Bald Eagle, Northern Goshawk.

Botanical Species: Castilleja chlorotica.

Existing LSOG Acres: Cultus - 0., Sheridan - 20.

Insect and Disease Risk: Low.

Fire Risk: Moderate.

Fire Hazard: Moderate.

Access: Roaded.

Protection Treatments: (See Table IV-6) Tree Culturing, Thinning, Fuels Reduction.

Enhancement Treatments: (See Table IV-7) LSOG Habitat Acceleration, NRF Cycling, Prescribed Fire, Precommercial Thinning.

CHAPTER V: MONITORING, INVENTORY AND RESEARCH

V. MONITORING, INVENTORY AND RESEARCH

In the development of this LSR assessment, gaps in scientific knowledge and in data necessary for management were encountered. Meeting the data gaps through research and inventory will improve the management of the Late-successional Reserves in future. In addition, proposed treatments need to be monitored to ensure that the actual effects are similar to the predicted effects. This information will provide the data that can improve the efficacy of prescriptions applied in the future, which meets the NWFP ROD direction for adaptive management. Summaries of these needs are as follows:

V. A. MONITORING (IMPLEMENTATION AND EFFECTIVENESS)

1. Monitor the effects of prescribed and wildfire in all fuels profiles and vegetation to gain a better understanding of fire effects on the composition and structure of vegetation.
2. Monitor success of risk reduction treatments to restore stand resilience to insect, disease and wildfire.
3. Monitor indicator wildlife species within each PAG to determine treatment effectiveness in maintaining and enhancing late-successional habitat.
4. Monitor the efficacy of plantation treatments designed to accelerate development of late-successional habitat, including plantings and precommercial thinnings of plantations.
5. Monitor disturbance (recreation, roads, boats, etc.,) in bald eagle, osprey, and sandhill crane habitats to identify future needs and the effectiveness of mitigation actions.
6. Monitor the adequacy of recommended levels of snags and coarse woody material.

V. B. INVENTORY (DATA GAPS)

1. Utilize stand examination to collect site specific data on stand density, insect and disease infestation, and quantities of snags and down wood.
2. Inventory populations of amphibians and aquatic invertebrates in riparian areas to establish baseline data.
3. Inventory disturbed areas for the presence of noxious weeds.
4. Inventory neo-tropical migrant birds using the Breeding Bird Survey.
5. Inventory for the presence of sensitive animals and plants and Survey and Manage Species listed in the ROD as Category 2 or 3, using established protocol.
6. Inventory the presence, absence, and extent of non-native wildlife populations within the LSRs.
7. Inventory and map site suitability types within Forested Lavas to further refine this Management Strategy Area.

V. C. RESEARCH (VALIDATION MONITORING)

1. Conduct research on the effects of fire and fire exclusion on vegetation and other functions within wet lodgepole pine communities to supplement Hopkin's and Agee's findings in the Cultus RNA.
2. Conduct research for the development of a General Technical Report similar to "Fire Ecology of Forest Habitat Types of Central Idaho" that is applicable to Central Oregon.

3. Conduct research on the role of understory plant communities and organic matter in creating and maintaining ecosystem productivity in the Research Natural Areas.
4. Conduct research into a variety of methods to analyze the pattern of landscape patches and determine the best modeling approach for wildlife habitat requirements.
5. Complete the research project currently initiated with the Pacific Northwest Research Station and Oregon State University to characterize the growth potential and the susceptibilities of the Forested Lavas.
6. Conduct research to define the habitat needs of survey and manage arthropods.
7. Conduct research to determine if created LSOG habitat is attracting and sustaining desired wildlife species.

CHAPTER VI: FIRE MANAGEMENT PLAN

A. INTRODUCTION

B. FUEL HAZARD AND RISK ANALYSIS

C. HAZARD AND RISK REDUCTION STRATEGIES

D. FIRE SUPPRESSION

E. REINTRODUCTION OF FIRE

F. FIRE MANAGEMENT STRATEGY AREAS

VI. FIRE MANAGEMENT PLAN

VI. A. INTRODUCTION

The Record Of Decision (ROD) for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl (April 1994) and US Fish and Wildlife Service (USFWS) Final Draft Northern Spotted Owl Recovery Plan (December 1992) identified considerable risk to late-successional habitat from large-scale disturbances, such as fire and/or insect and disease outbreaks, in the Late-Successional Reserves of the Oregon Eastern Cascades Physiographic Province (ROD pages B-7, B-8 and C-12). Fire management planning is a critical part of Late-Successional Reserve Assessments. This planning effort is especially significant in LSRs located east of the Cascade Mountains where fire historically has played a role in influencing vegetation and successional states across the landscape (ROD page C-11). Large scale disturbance events have eliminated old growth stands, late-successional habitat, and future late-successional habitat conditions on thousands of acres in the Pacific Northwest. The alteration or elimination of fire as a natural process in fire-developed ecosystems has created conditions where entire sub-watersheds are at risk.

Fire management planning, as identified in Appendix B-8 of the Final Environmental Impact Statement on Management of Habitat for Late-Succession and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl (1994), includes activities such as fire suppression, wildfire hazard reduction and the use of prescribed fire.

Fire management planning and activities will be conducted in a manner compatible with the goals and objectives for the Cultus and Sheridan LSRs. The goals for fire management for the Cultus and Sheridan LSRs are:

1. Maintain current and move towards sustainable late-successional habitats in the Cultus and Sheridan LSRs.
2. Reduce the existing high risk (by reducing ground fuels) of late-successional habitat loss from large, high intensity wildfires.
3. Reintroduce fire into fire-adapted ecosystems.

The objectives for the Cultus and Sheridan Late-Successional Reserves Fire Management Plan are:

1. Assess current hazard and risks.
2. Recommend fire hazard reduction operations that will reduce the potential for landscape scale, high intensity wildfires while meeting desired amounts of the four vegetative stages for each PAG.
3. Develop risk reduction or preventive strategies for the LSRs
4. Implement fire suppression strategies that protect human life and property while sustaining late-successional habitats and protecting other resource values.
5. Recommend actions that will expedite the reintroduction of fire into fire-adapted ecosystems.

The ROD directs fire managers to "utilize minimum impact suppression methods" with emphasis on "maintaining late successional habitat." Fire suppression strategies should strike a balance between resource considerations, potential resource losses, public and firefighter safety and suppression cost. Aggressive control strategies may be appropriate in areas of Proposed, Threatened, Endangered or Sensitive species habitat, in order to protect that habitat. Consultation with the US Fish and Wildlife Service will be initiated when this is the case.

This Fire Management Plan identifies Fire Management Strategy Areas (FMSAs) but does not include specific treatment areas. Additional analysis will be required for all site-specific activities and before prescribed fire can be utilized within the LSRs.

VI. B. FUEL HAZARD AND RISK ANALYSIS

A fuel hazard and risk analysis were completed for the Cultus/Sheridan LSRs and used for identification of the FMSAs. This was a landscape level analysis based on the prevention assessment completed in December 1995 by Karla Ksenzulak, Prevention Specialist, Bend-Ft Rock Ranger District. The ratings of Low, Moderate and High were based upon the relative conditions within the LSRs and the area that connects the two.

Information used for this analysis included:

- Fuel loadings. Fuel loading information was gathered through fuels inventories using the photo series (GTR PNW 105), along with satellite imagery data from 1988.
- Fire occurrence information from 1970 to 1994.
- Personal knowledge of district employees who have extensive knowledge of the Bend/Ft. Rock Ranger District fire behavior and suppression efforts in recent years.

This analysis identifies elements of fuel hazard, risk and value, and assigns a rating for each in a pre-designated area.

FUEL HAZARD RATING

Hazard is best defined as the "potential to burn". Key hazard elements are fuels and topography. Fuels conditions such as fine fuel loadings, continuity and arrangement define specific areas for potential crown fire, fire size and resistance to suppression efforts.

The fuel hazard rating was based upon fuel loadings by size class, fuel stratification, current stand conditions and the percentage of mortality in the stands. Depending upon several factors (ie. crown density, time since death, root rots and insects), lodgepole pine snags in the high mortality areas will usually fall to the ground in the next 6 to 10 years, adding significantly to current ground fuel loadings. Snags of other larger diameter species may remain standing for much longer periods of time.

FIRE RISK RATING

Risk is defined as the "potential to ignite". Historically, ignitions have been either human caused or natural ignitions. Lightning fires can not be assessed as a "manageable" element of risk because lightning ignitions are random, uncontrollable events. Human uses or activities which have the potential to result in a wildfire ignition are controllable or manageable events. Industrial operations, recreational activities, and urban development represent manageable risk.

Between 1970 and 1994, the Cultus Mt. LSR has had 98 fire starts that required suppression actions. Of those starts, 45% were human caused and 55% were caused by lightning. The LSRs average 5 fires per year. In the same period of time the area encompassed by the Sheridan LSR had 132 fire ignitions. 38% of those were human caused and 62% lightning caused. The LSRs have a relatively moderate fire occurrence for both human and lightning caused fires.

VALUE RATING

Value is defined as the "potential for loss". Values are assigned to any area where losses from wildfires are unacceptable. Losses from wildfires include resource losses where late successional characteristics are jeopardized or where connective links between blocks of late seral habitat may be severed. Other potential wildfire losses are property damages, human lives, and suppression and rehabilitation costs.

VI. C. HAZARD AND RISK REDUCTION STRATEGIES

As a result of the fuel hazard, risk and value ratings identified for the LSRs, the following strategies were identified to reduce the manageable risk of fire starts.

CULTUS LSR

Increase patrols with prevention units, engines and recreation technicians due to increasing recreation use and the fuel hazards. Increase signing using the new Industrial Fire Precaution Level, (IFPL), format. Fire inspections of all Resorts, special use summer homes, lookouts and radio sites, will be done with a check list to be developed in conjunction with the City of Bend structure inspection guidelines. Fire inspections for all timber sales will be done with follow-ups and monitoring in conjunction with the fire danger levels. Meet with concessionaires and crews to develop good communications and exchange of information about specific dangers and hazards.

SHERIDAN LSR

Increased patrol and signing can be done in the Outback Trail area from Edison Butte to Lava Lakes. Monitoring of special use functions and special public use restrictions depending on fire danger level. New IFPL signs will be posted on each end of the 45 Road. All timber sales will be inspected for compliance to fire requirements.

RECOMMENTATION

Enact a special public use fire restriction for site specific areas depending on hazards. Restrictions should include no smoking, campfires in designated areas, road closures and special area closures

VI. D. FIRE SUPPRESSION

The suppression of wildland fires is both dangerous and very costly. Wildland fires are unexpected events that can become emergencies in which firefighters compete with the powers of nature to minimize threats to life, property and resources. Despite our preeminent efforts, combinations of heavy fuel buildups, severe burning conditions, and depleted resources make escaped fires inevitable.

Unfortunately, our past success is impacting our present abilities. Ninety years of fire exclusion in forest ecosystems has resulted in entire landscapes that are at extremely high risk for intense fires to occur. Already we are seeing a trend within the Cascade Lakes Watershed of an increase in fire size and intensity. This trend is reflected in data on fires across much of the western United States. This trend combined with increasing complexity of natural resource issues has complicated suppression strategies and safety.

Fire management decisions will be driven by the concepts of minimizing loss at the least cost. Loss not only includes resources values that are lost as a result of fire effects, but losses that can be incurred by suppression tactics. Fire managers and resource advisors must work closely together to find the fine line between these two potential effects on resources.

All fire management suppression decisions and activities are based upon the principle that the safety of the public and wildland firefighters will, under all circumstances, be given the highest priority during wildfire suppression operations. The principle of containing a wildfire as quickly as possible, and therefore keeping it to its smallest size, will result in fewer resources being involved. This minimizes exposure to the hazards that are inherent in all wildfire.

The Deschutes National Forest Land and Resource Management Plan (1990) requires that all wildfires receive an immediate and appropriate suppression response, that are commensurate with values at risk. Additional considerations during multiple ignition situations will be suppression priorities, based on "relative" values at risk. This means that property may not always be given priority over resources (Refer to the Federal and Wildland Fire Management, Policy Review, Final

Report, Preparedness and Suppression, USDA and USDI, December 1995). Criteria established for suppression was based upon the above Report. Historically it has been: 1) human life, 2) property, and 3) resource values. Human life remains the number one priority. The second priority of property over natural resource values was changed. The second suppression priority will be based on the relative value of property or resources when fire fighting resources are scarce or limited. This gives a Fire Manager the flexibility to determine if a summer cabin warrants more efforts and resources than a Bald Eagle Management Area. This also makes the Fire Manager much more dependent on the Resource Advisor in order to make the most informed decisions.

In Riparian Reserves, the use of chemical retardants or foams should be carefully considered, except where there is an immediate threat to human life. Both chemical retardants and foams are toxic to aquatic life and thus in general are not applicable measures to be used. Consultation with a Resource Advisor knowledgeable in aquatic ecology should occur.

VI. E. REINTRODUCTION OF FIRE

The use of management ignited fire should be given strong consideration in the project analysis phase of any proposed actions within the LSRs. This is appropriate in all the plant association groups if the objectives are ecological in nature, that is where the full range of fire effects are acceptable. If the objectives are related to hazard reduction through the consumption of fuels, it is only appropriate in the ponderosa pine and dry mixed conifer groups. The effects of prescribed fire in the lodgepole pine, wet mixed conifer and mountain hemlock plant associations may conflict with other resource objectives where retention of structure is important.

Prescribed natural fire programs, usually ecologically sound and desirable, can carry high risk. These risks become inherent in stands where fire exclusion, and insect and disease problems have resulted in enormous ground and crown fuel loads. Risks are inherent where drought conditions pre-dispose the kind of fire that is natural in terms of the ecological process. When burning conditions develop in these stands, moderate to high intensity fires of long duration are common. The opportunity to manage fire spread is the inverse of the size of the fire perimeter. Add into this the risk involved with public safety, detrimental effects on ecosystems and habitats and the opportunity window shrinks even more.

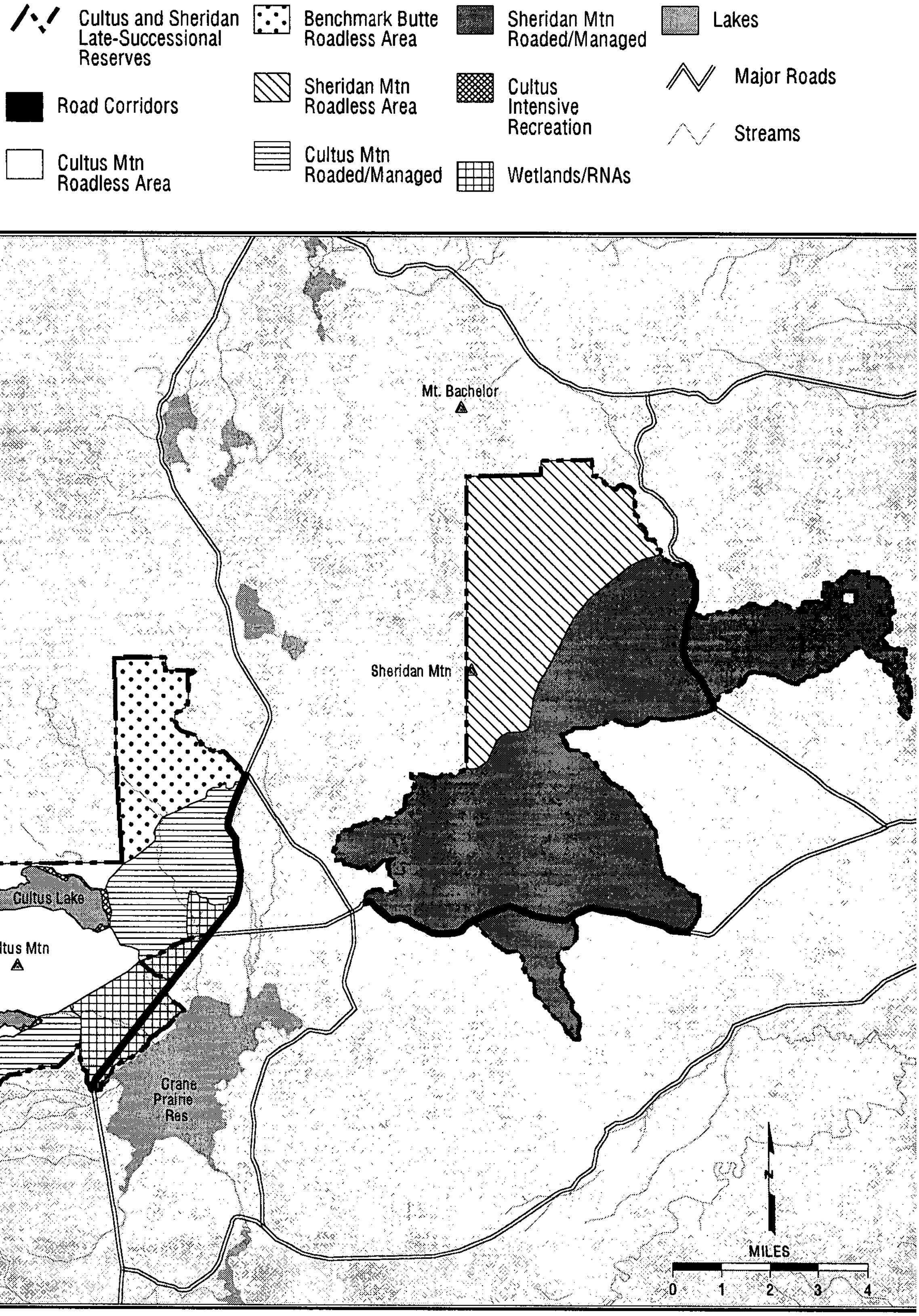
Lightning is the most common ignition source, however, it results in "manageable" fires within the LSRs only on very rare occasions. Additionally, waiting for natural ignitions in the right place at the right time, mitigates risk levels, but will also increase flammability potential over time.

Management ignited fires allow for a much wider use of fire and enable managers to significantly reduce uncertainty and associated risk. Management ignitions are not risk free, but until less hazardous fuel conditions are established, they should be given serious consideration. Management ignitions can also be used to reduce the risk of wilderness prescribed natural fires breeching the wilderness boundaries, therefore increasing the potential for a successful program.

VI. F. FIRE MANAGEMENT STRATEGY AREAS

Criteria for identification of the FMSAs include; 1 roadless areas, 2) recreation areas, 3) roaded/managed, 4) primary highway corridors and 5) wetland/research natural areas. This criteria was based upon the elements of, hazard, risk, values, and objectives of the LSRs. FMSAs are geographically different than the management strategy areas (MSAs) identified in the LSR assessment and thus are different although they may overlap. Fire Suppression strategies, and hazard and risk reduction recommendations were developed for each FMSA. These will guide the development of treatements desgined to word toward protecting, enhancing and sustaining late-successional habitats. The FMSAs were used to develop protection priority treatments within the LSR MSAs.

MAP 44 -- FIRE MANAGEMENT STRATEGY AREAS
Cultus and Sheridan Late-Successional Reserves



VI. F. 1. FIRE MANAGEMENT STRATEGY AREA I — CORRIDORS

The major recreation/scenic corridors are Cascade Lakes Highway, Forest Road 46, Forest Road 45 and Forest Road 42. These are paved and heavily traveled access roads. Traffic speeds are usually 40 - 50 miles per hour. Fires burning along or near these areas may require road closures or intensive traffic control measures. Public safety, firefighter safety, and preservation of scenic resources delineate this area.

VI. F. 2. FIRE MANAGEMENT STRATEGY AREA II — CULTUS ROADLESS AREA

The lodgepole pine flats that wrap around Cultus Mountain and Cultus Lake are best characterized by very high ground fuel loadings and high to extreme fire hazard. Mountain pine beetle infestations within these stands, and subsequent mortality, have heavily impacted this area for the past six years. Fuel loadings generally range from 15 to 25 tons per acre in stands where stand mortality is less than 20 percent. In stands where mortality is greater than 20 percent, fuel loads range from 30 - 120 tons per acre. Slope supplies an additional effect to fire behavior. The horizontal and vertical stratification of these dead fuels and the presence of significant amounts of fine fuels and dead aerial fuels, make these stands highly susceptible to large crown fire events. This susceptibility is slowly reduced as stands fall completely apart and significant openings are created in the canopy. The resulting high ground fuel loadings will still represent a significant hazard due to potential fire intensity and related resistance to control until the overstory becomes re-established and significant decay of dead material has occurred. These openings are rapidly being regenerated with a crop of new lodgepole pine seedlings.

VI. F. 3. FIRE MANAGEMENT STRATEGY AREA III — BENCHMARK BUTTE ROADLESS AREA

This area is north of Benchmark Butte and follows the boundary of the Three Sisters Wilderness. The northern half of this area is dominated by mountain hemlock and subalpine fir stands. The rest of the area has stands of lodgepole pine and mixed conifer with mountain hemlock and ponderosa pine showing up as a minor component. Fuel loadings are light to moderate. The southern half of the area possesses the same stand condition and fuel traits as the Cultus Mt. roadless area. Access for fire suppression is poor.

VI. F. 4. FIRE MANAGEMENT STRATEGY AREA IV — SHERIDAN ROADLESS AREA

Bounded by Sheridan mountain on the west and the southeast flanks of Mt. Bachelor on the north, this area is used primarily for winter recreation. Mixed conifer and mountain hemlock stands dominate the overstory, with lodgepole pine regeneration in numerous root rot pockets. Fuel model 8 is most common with pockets of fuel, National Forest Fire Laboratory (NFFL) fuel model 10 where laminated root rot is active, and model 6 in openings created by the latter. Very poor vehicular access has resulted in most fires historically being staffed by smoke jumpers.

VI. F. 5. FIRE MANAGEMENT STRATEGY AREA V — CULTUS ROADED/MANAGED

This area includes all the roaded areas within the Cultus LSR where timber harvest activity has taken place in the past. Benchmark Butte, the area west of Benchmark Butte and the area immediately south of Cultus mountain are included. Access by engines is good and fuels are light to moderate. An important feature of managed areas are discontinuous fuel beds and fragmented canopies. Lodgepole pine, ponderosa pine and mixed conifer stands with varying amounts of mortality dominate. Fuels vary greatly from a light model 8 to a heavy model 10.

VI. F. 6. FIRE MANAGEMENT STRATEGY AREA VI — SHERIDAN ROADED/MANAGED

This area covers over 50% of the Sheridan LSR and is dominated by mixed conifer and ponderosa pine stands. The lodgepole component of these stands is being attacked and killed by mountain pine beetle which is adding significant amounts of debris to the dead fuel bed. Unfragmented areas are model 8 in transition to model 10. Fragmented areas are characterized by fuel model 2 in transition to fuel model 6. Access for fire suppression is good in most of the area.

VI. F. 7. FIRE MANAGEMENT STRATEGY AREA VII — CULTUS INTENSIVE RECREATION AREAS

The area around Cultus Lake Resort, north of Cultus Lake, north of Little Cultus Lake and at the junction of the 4630 and 4635 roads are included. Cultus Lake sees the greatest number of recreationists and is nationally known for its fishing, water sports, pure water and beauty. Stands consist of mixed conifer, spruce, lodgepole pine and ponderosa pine. Fuel model 10, + 30 tons best represents this area. Large, fast moving fires would pose a serious threat to property and life. Egress could be compromised quickly during a catastrophic fire event. Nearly all of Cultus Lake is accessible only by boat or foot.

VI. F. 8. FIRE MANAGEMENT STRATEGY AREA VIII — CULTUS AND MANY LAKES RNAS, AND OTHER WETLANDS

This area was delineated because of a proposed Research Natural Areas and wetland between Crane Prairie and Cultus Lake. The Cultus RNA is at the south base of Benchmark Butte where the Cultus River emerges from the lava. Both areas are dominated by dense stands of lodgepole pine with heavy mortality from pine beetles. Engelmann spruce and white fir are replacing the lodgepole pine as the dominant species in the frost prone areas. Fuels are the same as those found in the Cultus roadless FMSA II. The Many Lakes RNA is in the southwest section of the Cultus LSR dominanted by meadows, mountain hemlock and lodgepole pine. The need to protect these fragile riparian flora and fauna, and water quality is an important component of this area.

MAP 45 -- FIRE MANAGEMENT STRATEGY AREA I
Corridors

Cultus and Sheridan Late-Successional Reserves

Cultus and Sheridan Late-Successional Reserves

Three Sisters Wilderness

Cascade Lakes Scenic Byway

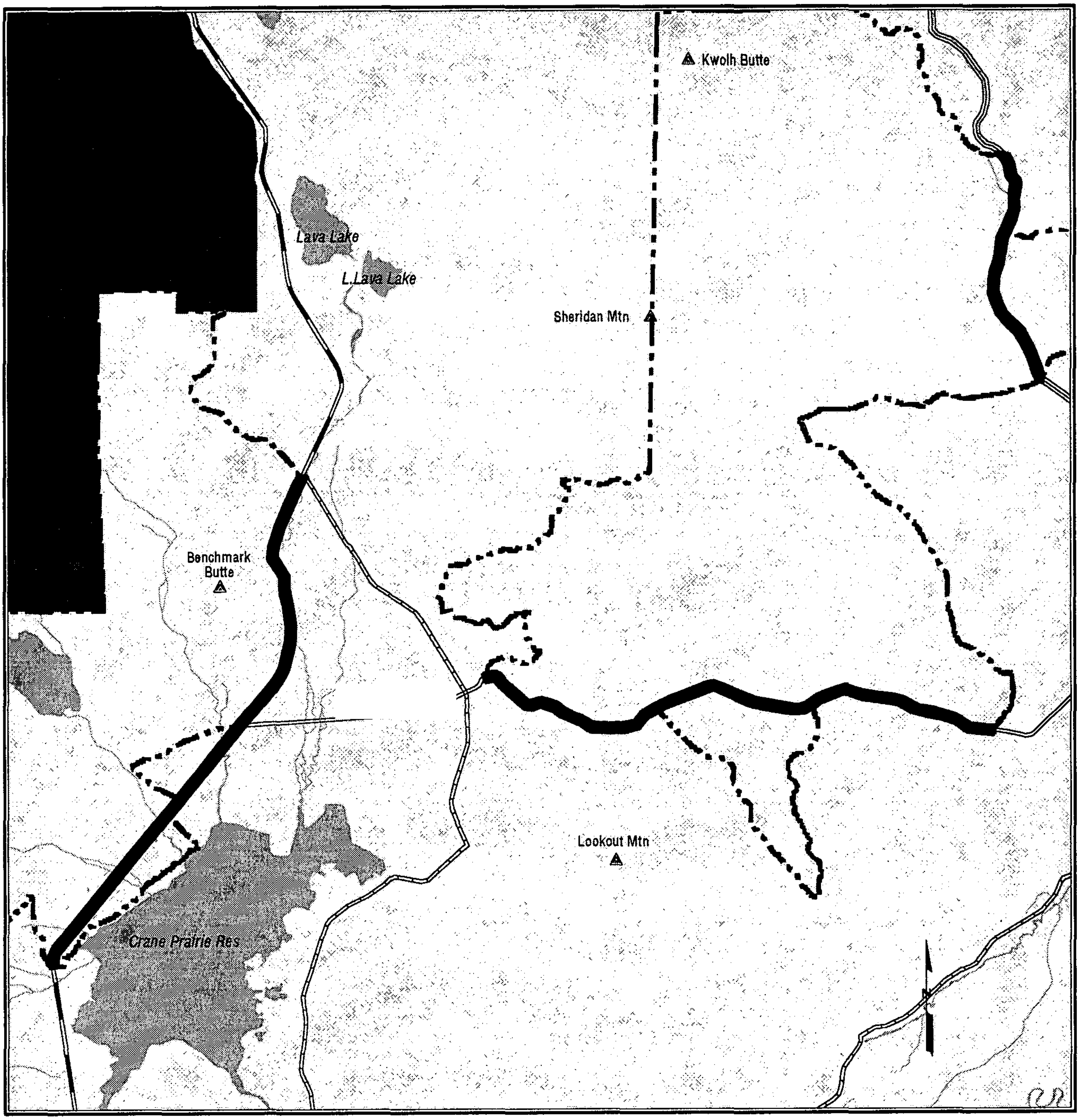
Forest Road 40

Corridor Areas

Lakes and Streams

Forest Road 45

Forest Roads 42 and 4270



FMSA I: CORRIDORS

TOTAL ACRES
1,410.

ELEVATION RANGE
4,330' - 4,700'

PLANT ASSOC. GROUPS (PAGS)
LPW, LPD, MCW,MCD.

NEAREST LANDMARK
Forest Roads 42, 45, 46.

SPECIAL CONCERNS
Heavy traffic moving at highway speeds.

FUEL HAZARD RATING
Moderate for all Forest roads except along portions of Forest Road 46 where high levels of mortality in exist in the lodgepole pine stands. Generally, fuels have been managed and fuel bed continuity has been broken into blocks. Extreme fire behavior potential is high.

FIRE RISK RATING
Moderate.

VALUE RATING
High. Scenic resource.

RECOMMENDED FUEL TREATMENT
Handpile and burn down, woody material < 3". Mechanical removal of > 3" material to a level consistent with LMP standards.

ACCESS
Good. Quick response time from engines stationed at Fall River Guard Station (GS) and Deschutes Bridge GS.

SUPPRESSION STANDARDS AND GUIDELINES
Forest Plan standard is for immediate suppression, minimizing impacts on scenic resource.

FIRE MANAGEMENT CONSIDERATIONS
Suppression activities in these areas will involve traffic control or road closures to insure firefighter and public safety is not compromised.

TYPICAL FUELS

MAP 46 -- FIRE MANAGEMENT STRATEGY AREA II
Cultus Roadless Area

Cultus Late-Successional Reserve

Cultus Late Successional Reserve

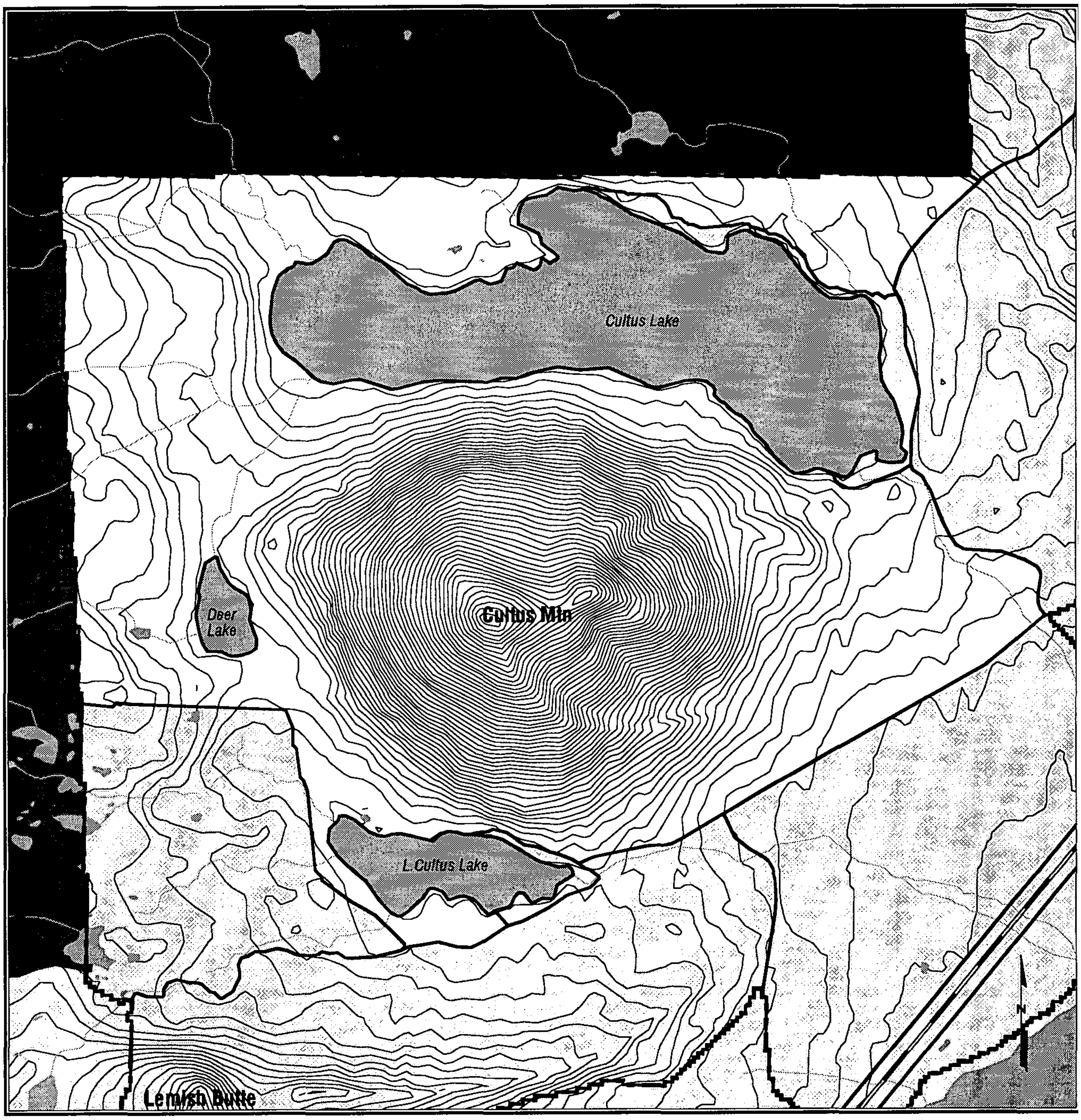
Cultus Roadless Area

Three Sisters Wilderness

Lakes and Streams

40 foot contours

Cascade Lakes Scenic Byway



FMSA II: CULTUS ROADLESS AREA

TOTAL ACRES
5,650.

ELEVATION RANGE
4,700' - 5,000'.

PLANT ASSOC. GROUPS (PAGS)
LPW, MH, MCD

NEAREST LANDMARK
N and W of Cultus Mt.

SPECIAL CONCERNS
West Cultus Campground, Deer Lake.

FUEL HAZARD RATING
Extreme. High level of stand mortality in LP. Extreme fire behavior potential is high.

FIRE RISK RATING
High.

VALUE RATING
Low. Low density, non-motorized recreation. Dead and dying stands.

RECOMMENDED FUEL TREATMENT
Within large continuous areas of dead LP, create smaller blocks of 20-40 acres in size to break up continuous heavy fuel loads. Within the blocks remove 80% - 90% of standing dead and dead and down material. Thin healthy LP stands to achieve a canopy closure < 30%. Within the dry mixed conifer types thin green understory and remove 80-90% of standing dead and down woody material >3". Prescribe burn on a 20-30 year rotation. Treatments must be consistent with LSR objectives and must meet desired LSOG habitat conditions.

ACCESS
Poor. Limited trail access. Boat access along Cultus Lake & Little Cultus Lake. District Ranger has key to the gate to access West Cultus CG.

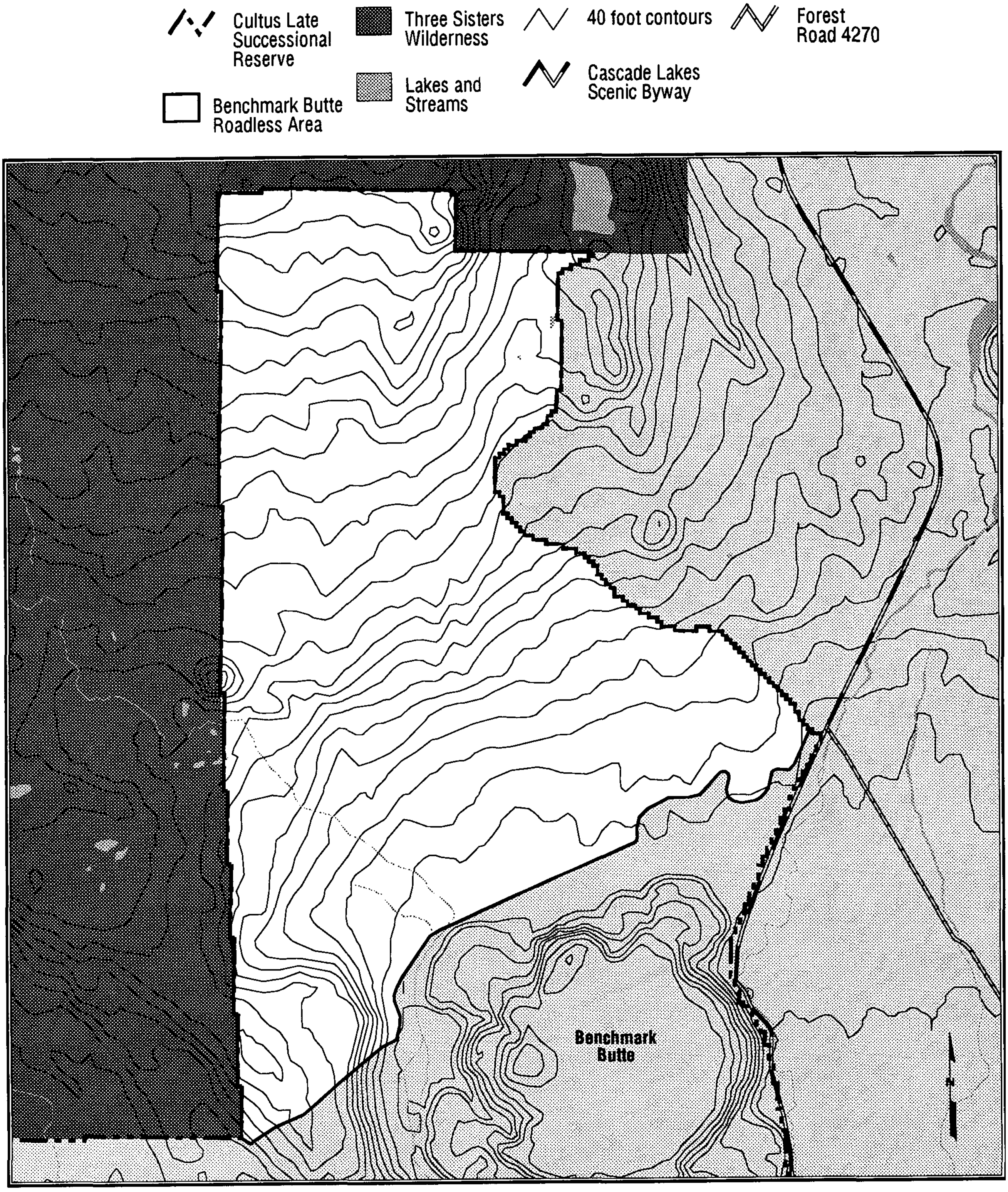
SUPPRESSION STANDARDS AND GUIDELINES
Minimum Impact Suppression Tactics (MIST) is appropriate.

FIRE MANAGEMENT CONSIDERATIONS
This area will have an extreme fuel hazard until the stands fall over, (4-10 years). After that, high ground fuel loads will exist for another 40 - 50 years.

TYPICAL FUELS

MAP 47 --FIRE MANAGEMENT STRATEGY AREA III
Benchmark Butte Roadless Area

Cultus Late-Successional Reserve



FMSA III: BENCHMARK BUTTE ROADLESS AREA

TOTAL ACRES
3,710.

ELEVATION RANGE
4,700' - 5,700.

PLANT ASSOC. GROUPS (PAGS)
LPW, MH, MCD.

NEAREST LANDMARK
N of Benchmark Butte.

SPECIAL CONCERNS
None.

FUEL HAZARD RATING
Low to moderate. Some stand mortality in LP and Mixed conifer stands. Fire behavior potential is high under severe burning conditions only.

FIRE RISK RATING
Moderate.

VALUE RATING
Low. Low density summer recreation. Low density winter non-motorized recreation.

RECOMMENDED FUEL TREATMENT
Within large continuous areas of dead LP, create smaller blocks of 20-40 acres in size to break up continuous heavy fuel loads. Within the blocks remove 80% of standing dead and dead and down material. Thin healthy LP stands to achieve a canopy closure < 30%. Within the dry mixed conifer types thin green understory and remove 80-90% of standing dead and down woody material >3". Prescribe burn on a 20-30 year rotation. Treatments must be consistent with LSR objectives and must meet desired LSOG habitat conditions.

Other stands: none.

ACCESS
Poor. Trail access only.

SUPPRESSION STANDARDS AND GUIDELINES
MIST is appropriate.

FIRE MANAGEMENT CONSIDERATIONS
Historically, most fires in this area were very small and staffed by 2-3 smoke jumpers. Fires detected with in ½ mile of a trail could be staffed by a handcrew if there is no imminent potential for an escape.

TYPICAL FUELS

MAP 48 -- FIRE MANAGEMENT STRATEGY AREA IV
Sheridan Roadless Area

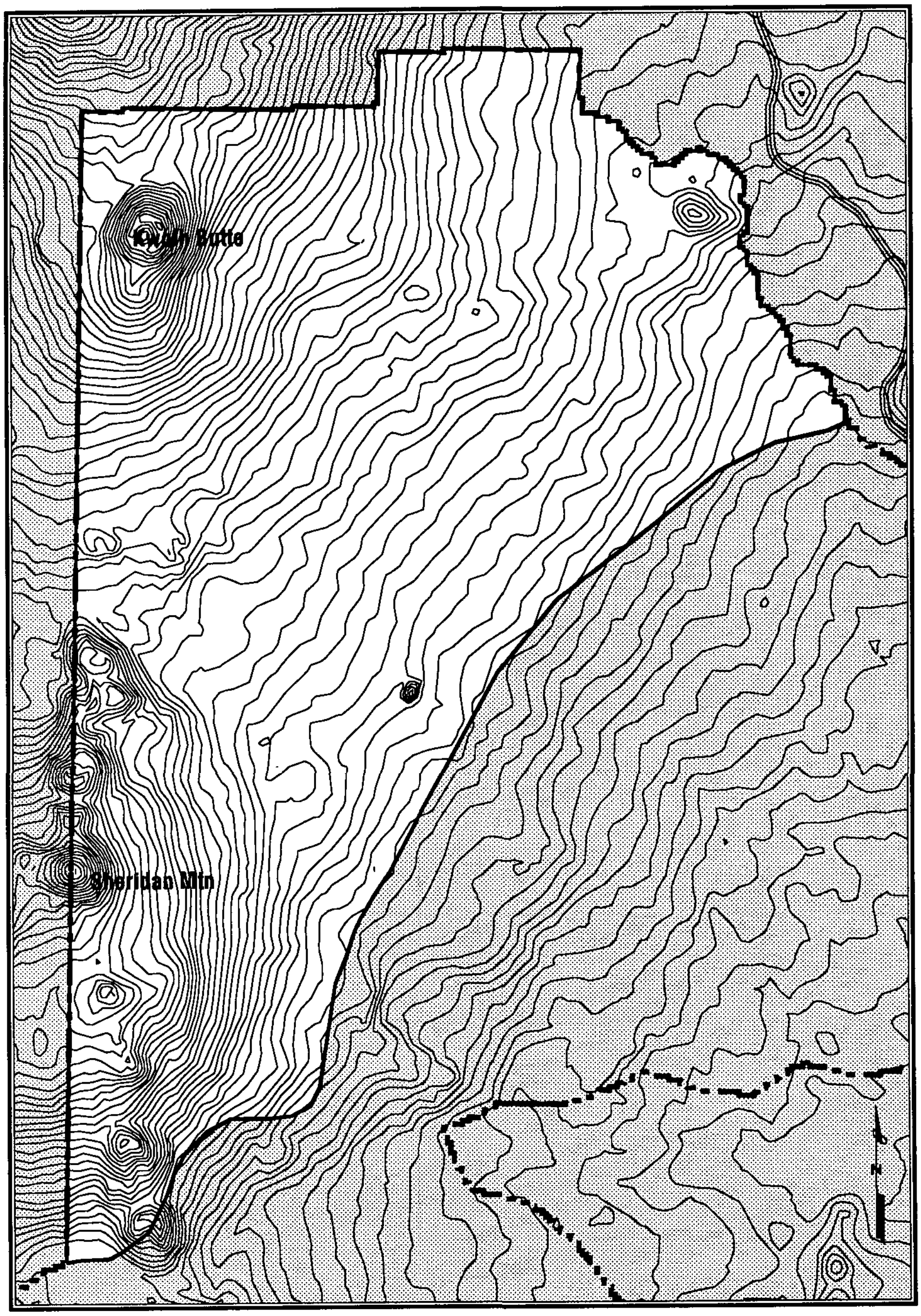
Sheridan Late-Successional Reserve

Sheridan Late Successional Reserve

Sheridan Mountain Roadless Area

Forest Road 45

40 foot contours



FMSA IV: SHERIDAN ROADLESS AREA

TOTAL ACRES
8,540.

ELEVATION RANGE
5,600' - 7,300'.

PLANT ASSOC. GROUPS (PAGS)
MCW, MH.

NEAREST LANDMARK
Sheridan Mountain, Kwolh Butte.

SPECIAL CONCERNS
Sheridan Mt Ski Shelter.

FUEL HAZARD RATING
Low. High elevation stands where fuel loading is relatively low and fuel moistures are relatively high.

FIRE RISK RATING
Low.

VALUE RATING
Low.

RECOMMENDED FUEL TREATMENT
None.

ACCESS
Poor. Mostly cross country walk-in, due to limited trail access .

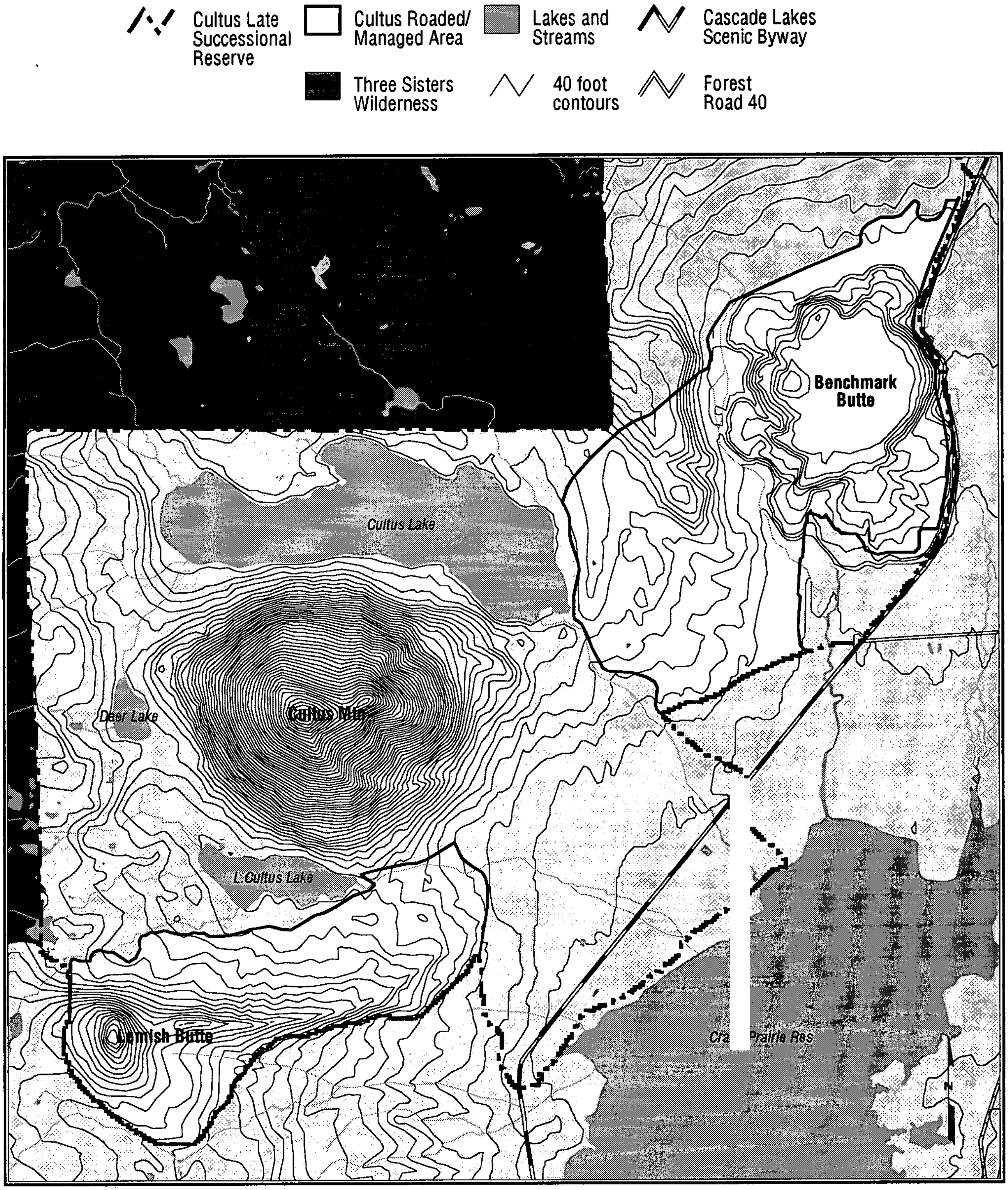
SUPPRESSION STANDARDS AND GUIDELINES
Forest Plan Standard is to prevent losses of large acreage to wildfire. MIST is appropriate.

FIRE MANAGEMENT CONSIDERATIONS
There is no evidence that large fires occurred in this area in the last 90 years. Nearly all fires are lightning caused and often remain in tree tops or snags. Many fires are ignited when significant snow is still present, which should lead managers to consider a Fire Situation Analysis prior to committing resources.

TYPICAL FUELS

MAP 49 -- FIRE MANAGEMENT STRATEGY AREA V
Cultus Roaded/Managed Area

Cultus Late-Successional Reserve



FMSA V: CULTUS ROADED/MANAGED

TOTAL ACRES
5,310.

ELEVATION RANGE
4,700' - 5,000'.

PLANT ASSOC. GROUPS (PAGS)
LPW, MCW, MCD.

NEAREST LANDMARK
S and W of Benchmark Butte,
S and W of Cultus Mt., Benchmark Butte.

SPECIAL CONCERNS
None.

FUEL HAZARD RATING
Moderate to High. High level of stand mortality in LP. Management activities have fragmented crown fuels and ground fuels. Extreme fire behavior potential is high in unmanaged stands.

FIRE RISK RATING
Moderate.

VALUE RATING
Moderate.

RECOMMENDED FUEL TREATMENT
Within large continuous areas of dead LP, create smaller blocks of 20-40 acres in size to break up continuous heavy fuel loads. Within the blocks remove 80% of standing dead and dead and down material. Thin healthy LP stands to achieve a canopy closure < 30%. Within the dry mixed conifer types thin green understory and remove 80-90% of standing dead and down woody material >3". Prescribe burn on a 20-30 year rotation. Treatments must be consistent with LSR objectives and must meet desired LSOG habitat conditions.

ACCESS
Fair. Many roads are gated or not maintained.

SUPPRESSION STANDARDS AND GUIDELINES
Utilize suppression tactics that are commensurate with timber resources at risk.

FIRE MANAGEMENT CONSIDERATIONS
Handcrew should be considered due to somewhat limited vehicle access and high percentage of non-dozer ground. Fires in this area have not typically been difficult to control at less than one acre with initial attack resources.

TYPICAL FUELS

MAP 50 -- FIRE MANAGEMENT STRATEGY AREA VI

Sheridan Roaded/Managed Area

Sheridan Late-Successional Reserve

Sheridan Late Successional Reserve

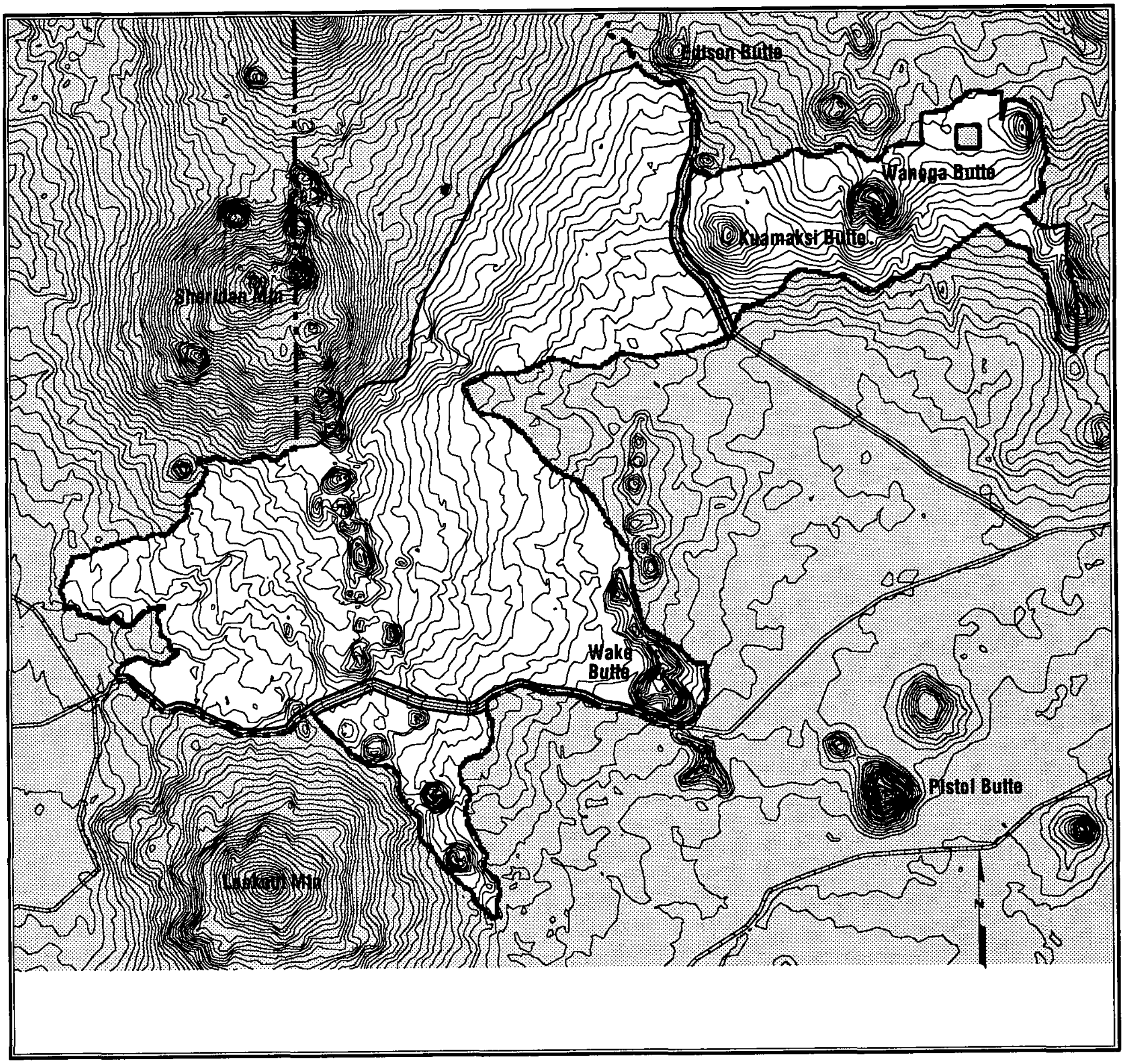
Sheridan Roaded/ Managed Area

40 foot contours

Forest Road 45

Forest Road 40

Forest Road 42 and 4270



FMSA VI: SHERIDAN ROADED/MANAGED

TOTAL ACRES
21,900.

ELEVATION RANGE
4,700' - 5,800'.

PLANT ASSOC. GROUPS (PAGS)
LPW, MCW, MCD, PPW.

NEAREST LANDMARK
Sheridan Mountain.

SPECIAL CONCERNS
Road 40 and 45. Private land west of Pistus Butte.

FUEL HAZARD RATING
Low to moderate. High level of management activity has significantly reduced ground fuels and fragmented crown fuels. Managed stands older than 10 years have significant levels of flammable shrubs present in the understory.

FIRE RISK RATING
Moderate.

VALUE RATING
Low. Motorized winter recreation.

RECOMMENDED FUEL TREATMENT
Within large continuous areas of dead LP, create smaller blocks of 20-40 acres in size to break up continuous heavy fuel loads. Within the blocks remove 80% of standing dead and dead and down material. Thin healthy LP stands to achieve a canopy closure < 30%. Within the dry mixed conifer and ponderosa pine types thin green understory and remove 80-90% of standing dead and down woody material >3". Prescribe burn on a 20-30 year rotation. Prescribe burn ponderosa pine to control shrubs on a 6-10 year rotation. Treatments must be consistent with LSR objectives and must meet desired LSOG habitat conditions.

ACCESS
Good. Drive to access in most areas. Some roads have been poorly maintained.

SUPPRESSION STANDARDS AND GUIDELINES
Considerable capital investment has been made in managed areas. Fire suppression strategies should minimize acres burned in consideration of resource values, present and future. Engine and dozer attacks are typical.

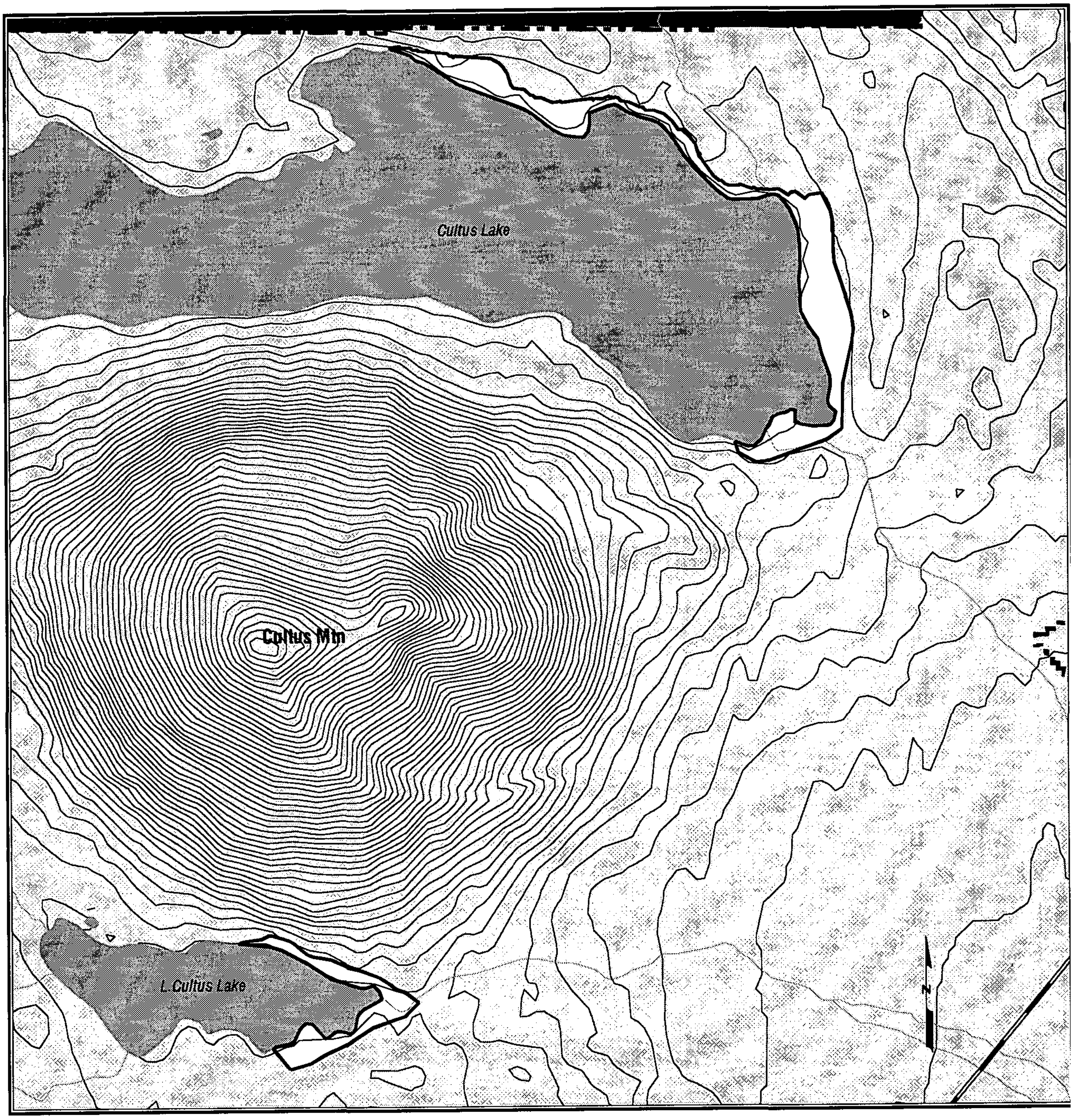
FIRE MANAGEMENT CONSIDERATIONS
This area is well roaded and working off roads, i.e. burnout, should be considered. Fires are typically small, due to quick response time and relatively sparse ground fuels. Larger fires should be very manageable. Open canopy conditions and stand fragmentation significantly increases the effectiveness of retardant used in conjunction with ground resources.

TYPICAL FUELS

MAP 51 -- FIRE MANAGEMENT STRATEGY AREA VII
Cultus Intensive Recreation Areas

Cultus Late-Successional Reserve

Cultus Late Successional Reserve
Cultus Intensive Recreation Areas
Three Sisters Wilderness
Lakes and Streams
40 foot contours
Cascade Lakes Scenic Byway



FMSA VII: CULTUS INTENSIVE RECREATION AREAS

TOTAL ACRES
150

ELEVATION RANGE
4,700' - 4,800'

PLANT ASSOC. GROUPS (PAGS)
LPW, MCD.

NEAREST LANDMARK
Cultus Lake, Little Cultus Lake.

SPECIAL CONCERNS
Little Cultus Campground, Cultus Lake Resort, and Campground.

FUEL HAZARD RATING
Low. Dead trees and ground fuels have been reduced over time to lower the risk to the public.

FIRE RISK RATING
Moderate.

VALUE RATING
High. Cultus Lake Resort and campground. West Cultus campground. Lake shore

RECOMMENDED FUEL TREATMENT
Within large continuous areas of dead LP, create smaller blocks of 20-40 acres in size to break up continuous heavy fuel loads. Within the blocks remove 80% - 90% of standing dead and dead and down material. Thin healthy LP stands to achieve a canopy closure < 30%. Within the dry mixed conifer types thin green understory, remove excess regeneration, and remove 80-90% of standing dead and down woody material >3". Prescribe burn conifer stands on a 20-30 year rotation. Treatments must be consistent with LSR objectives and must meet desired LSOG habitat conditions.

ACCESS
Good. Although could be compromised by vehicles evacuating the area.

SUPPRESSION STANDARDS AND GUIDELINES
Forest Plan standards are for aggressive control measure. Use of dozer line only when fire intensity precludes hand line construction.

FIRE MANAGEMENT CONSIDERATIONS
Ingress and egress should be considered prior to committing resources. Pre-plan for evacuations. La Pine Rural Fire Department should be dispatched to provide structure protection at the Resort.

TYPICAL FUELS

MAP 52 -- FIRE MANAGEMENT STRATEGY AREA VIII
Wetlands and Research Natural Areas

Cultus Late-Successional Reserve

Cultus Late Successional Reserve

Wetlands/Research Natural Areas

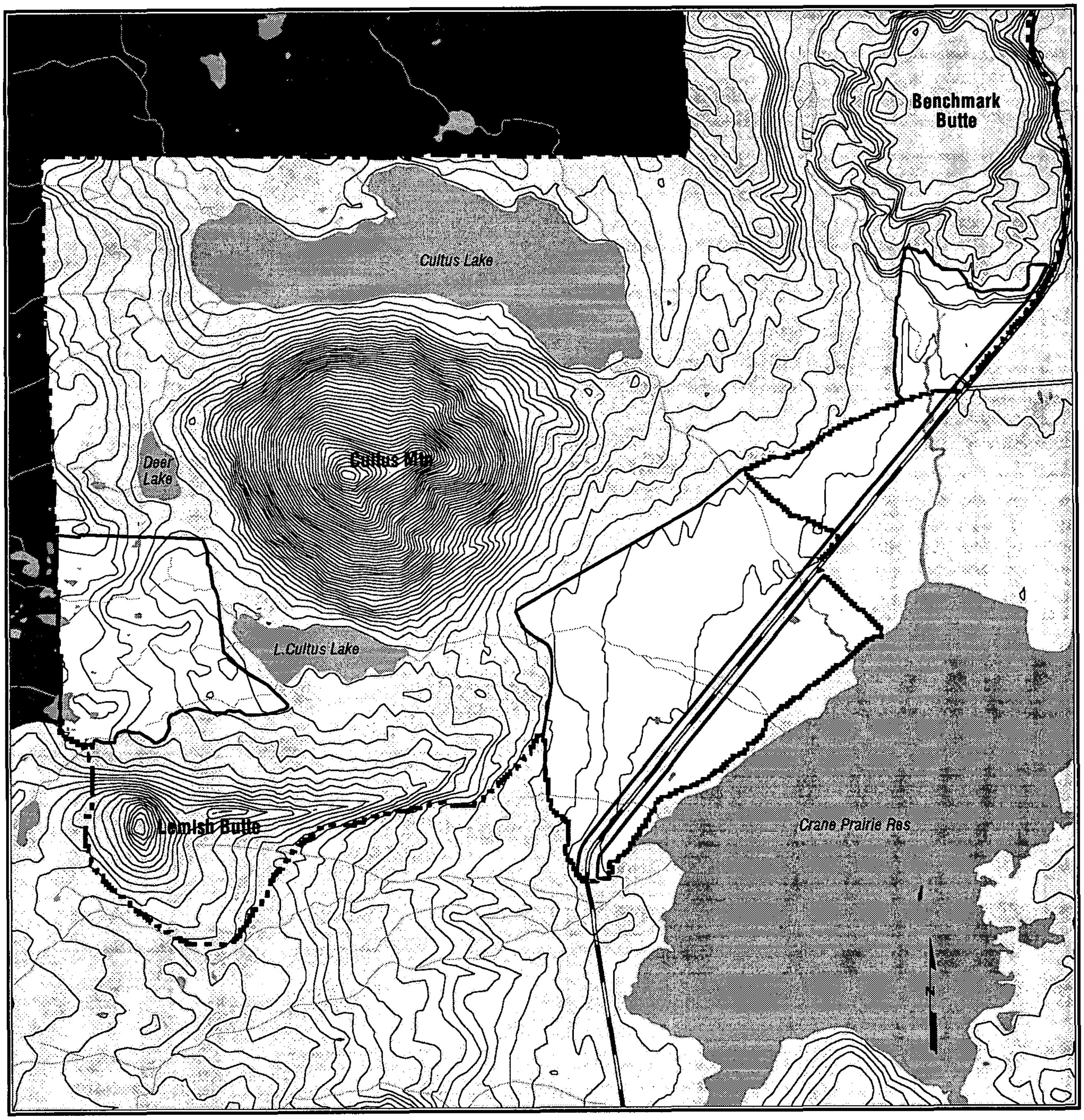
Lakes and Streams

Cascade Lakes Scenic Byway

Three Sisters Wilderness

40 foot contours

Forest Road 40



FMSA VIII: CULTUS AND MANY LAKES RNAS, AND OTHER WETLANDS

TOTAL ACRES
3,160.

ELEVATION RANGE
4,700' - 5,000'.

PLANT ASSOC. GROUPS (PAGS)
LPW, MH.

NEAREST LANDMARK
Cultus River-base of Benchmark Butte;
SE of Cultus Mt and directly W of Little Cultus Lake.

SPECIAL CONCERNS
T& E Plants. Fragile systems.

FUEL HAZARD RATING
Extreme: High level of stand mortality in LP. Extreme fire behavior potential is high.

FIRE RISK RATING
Low.

VALUE RATING
High. Research Natural Areas and unique wetland habitats.

RECOMMENDED FUEL TREATMENT
None.

ACCESS
Poor. Trail access, some road access.

SUPPRESSION STANDARDS AND GUIDELINES
Aggressive containment using MIST is appropriate. High impact methods will be used only to minimize large losses. Mop-up with water only, or natural burnout is preferred.

FIRE MANAGEMENT CONSIDERATIONS
Much of this area will have an extreme fuel hazard until the stands fall over, (4-10 years). After that, high ground fuel loads will exist for another 40 - 50 years. Live and dead fuel moistures are normally high. The greatest threat would be from a large fire burning into these areas.

TYPICAL FUELS

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PROCESS PAPERS

GIS/ARC/GRID LAYER FOR NFFL FUEL MODELS

DETERMINING CROWN FIRE SUSCEPTIBILITY FROM PMR DATA

FORESTED LAVAS IN THE WEST ZONE OF THE BEND/FT. ROCK RANGER DISTRICT

PLANT ASSOCIATION GROUPINGS FOR THE CULTUS AND SHERIDAN LSR ASSESSMENT

MODEL AND LOGIC TRACK FOR ANALYZING COMPLEXITY

DEVELOPMENT OF SUITABLE HABITAT CONDITIONS FOR INDICATOR SPECIES, SDI VALUES AND SUMMARY TABLES

SNAG AND DOWN LOG MODEL

DESIRED LATE-SUCCESSIONAL RESERVE CONDITION

GIS/ARC/Grid Layer for NFFL Fuel Models

Deschutes National Forest

Chuck Vickery, Fuels Specialist and Randy Gray, GIS Specialists

Bend/Ft. Rock Ranger District

Deschutes N.F.

Spring 1996

Intent

To track the process utilized in fuel model mapping for GIS on the Deschutes National Forest.

Goal

To develop a fuel model layer within GIS that can be used as a visual analysis tool or imported into the "Farsite" spread model for deterministic fire behavior modeling. (This map can be used for display purposes, but that is not the intent).

In order to map existing and potential fuels across large landscapes, without expending a large amount of time and money, a process was needed where as existing remote sensing data the forest purchased from Pacific Meridian Resources could be used. A group of fire/fuels specialist, silviculturalists and GIS data specialist met and came up with a process that would convert existing data layers derived from satellite imagery into a fuel model layer.

Concepts

- A matrix using "if", "and", "then" logic blocks was developed.
- The existing layers that could potentially be used were: species, slope, aspect, elevation, canopy closure and size/structure. Some of these were directly or indirectly related, so to avoid redundancy the species, canopy closure and size/structure layers were used.
- The fuel layer must be a pixel map base on 25 square meter pixels.
- Species groups will be used as opposed to more specific species descriptions.-Assumptions were based on knowledge and experience of the silviculturalist and the fuels specialist.
- Assumptions were based on knowledge and experience of the silviculturist and fuels specialist.
- This would not take activity fuels into account.
- The 1988 data will be used.
- Harvest activities were not considered. The matrix considered fuels as they change during natural succession including burned areas. Areas where equipment has disturbed the site will follow a different successional path. It would be very difficult to attempt to make an assumption about a given area that has been harvested, because the satellite image gives no information about the area other than it was disturbed.

The Process

The matrix was developed starting with the species group codes. Only the codes that represented vegetated areas were considered. Twenty-one species groups are addressed in the matrix.

The next block was canopy closure. From a fuel model stand point, canopy closure is either relatively open or relatively closed. An open canopy would allow a greater amount of sunlight and moisture to reach the forest floor. Additionally, there was probably a reason the canopy is open such as mortality in the stand. A more closed canopy would shade the forest floor and change the species of the understory vegetation and therefore the fuels. We decided to split the canopy block into sub-blocks: 1) >55% closure and 2) <55% closure.

The next block was size/structure data. We grouped these codes into young/old and single/multi-storied. Assumptions were that older stands had more litter or mortality and younger stands had a grass/forb/shrub component, lighter litter layer, and more needle cast.

Finally, given species, canopy and size/structure we postulated on the most likely ground fuel model. These were coded 1-13 representing the 13 NFFL fuel models.

This matrix was given to a GIS analyst and using Arc Macro Language (AML) a macro was written that converts the codes into a digital fuel layer.

The layer will be updated to reflect change due to fire, disease, blowdown, etc. when the change detection work is done or updated imagery becomes available.

One of the questions that was posed frequently to use was why we were not using the forest stand inventories that had fuel load data. The reasons for this were: 1) We use fuel models to describe fire behavior potentials and characteristics. Discerning fuels models strictly from down woody inventories is risky as only the three timber models could be considered and fine fuels were not inventoried, 2) Inventories represent a condition that exist at a particular time. The stands would have to be reinventoried in order to update the fuel layer. Whereas the use of PMR data requires only an update image that the macro can be applied to.

Spp Group	Canopy	Size - Structure	Fuel Model	Assumptions
26 P Pine	15,18,20	10-12	8	Young PP stands are fuels deficient
26 P Pine	15,18,20	>13	6	Shrubs develop in open PP stands as stands mature
26 P Pine	23,24	10-12	2	Grass develops in shaded, young PP stands
26 P Pine	23,24	>13	9	Needles become the significant component of the fuel bed.
27 PPine/Larch	15,18,20	all	9	Grass and needles generally drive the fire. Stands are mid to late seral (absence of disturbance).
27 PPine/Larch	23,24	all	8	Shade situation fire spread best characterized by model 8.
28 PPine/Mix Conifer	15,18,20	10-12	2	
28 PPine/Mix Conifer	15,18,20	>13	6	Shrubs begin to show up as stands develop.
28 PPine/Mix Conifer	23,24	10-16	8	Shaded needles and some grass
28 PPine/Mix Conifer	23,24	>16	10	As stands develop (firs die and goes down).
29 PPine/DF				all same as 28
22 Lodgepole	15,18,20	10	8	Saplings
22 Lodgepole	15	11	11	Thinned Stands
22 Lodgepole	18,20	11	8	Unthinned
22 Lodgepole	15,18,20	12,20,21	6	Shrubs come in as fuels breaks

Spp Group	Canopy	Size - Structure	Fuel Model	Assumptions
				down.
22 Lodgepole	23,24	10-11	8	Assumptions in close canopy represents unmanaged stands.
22 Lodgepole	23,24	>12	10	Dead and down load increases as stand develops.
22 Lodgepole	15,18,20	>21	11	Open stand that is collapsing.
23 LP/Mix Conifer	all	all	8	Smolders or crowns, no in between.
24 LP/PP	15,18,20	all	9	Some shrubs, but generally needle and litter.
24 LP/PP	23,24	10-12	8	Healthy stand.
24 LP/PP	23,24	>13	10	Dying stand, down woody significant.
34 <25% any species	all	all	6	Exposed fuels, mostly shrubs.
16 Juniper	15	all	1	Grass with scattered shrubs.
16 Juniper	18	all	6	Shrubs are the dominate carrier of the fire.
6 Ag Land	NA	NA	3	Dense, high agricultural grasses, with a cheatgrass component.
5 Shrublands	NA	NA	6	Old, decadent shrubs.
4 Grass	NA	NA	2	Davis Lake may better be rep'ed as a model 3.
32,33 All Hemlock	All	All	8	Pockets of model ten, but mostly model 8 due to

Spp Group	Canopy	Size - Structure	Fuel Model	Assumptions
				site.
7,19 Silver fir and Mix conifer	All	All	8	Pockets model 10, but site is high elevation and not highly productive.
25 Spruce	All	All	1	Generally riparian grass.
8 Silver, white, Douglas fir	All	All	8	High elevation
20 Hardwoods	All	All	8	Found in riparian sites.
21, 9, 10, 31 Douglas fir, white fir/mix conifer	All	All	10	Generally a model 10, some model 8, but litter loading reach 10 levels quickly as stands develop and understory regen is thinned naturally. Very old stands, where litter has decayed are rep'ed by model 8.

DETERMINING CROWN FIRE SUSCEPTIBILITY
BASED ON PMR DATA

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Deschutes N.F.
Spring 1996

The increasing occurrence of high energy, crown fire events on the Deschutes National Forest, and the assessment of watershed and late-successional reserves, has underscored the need to evaluate and quantify the potential for crown fire across forest landscapes.

The ability to identify and rank the relative susceptibility of a timber stand to crown fire disturbance would greatly aid fire specialists in analyzing the expected ecological effect and extent of future fires. As an agent of ecological disturbance in timber stands, crown fire far exceeds surface fire or understory fire in magnitude (Agee 1993). Fire Specialists supporting landscape scale analysis for late-successional and riparian reserve areas and watershed restoration projects need tools to evaluate crown fire potential and to display the changes in crown fire susceptibility resulting from natural processes such as insect and pathogen attack or from human manipulation of stand structure, vegetation, and down woody material.

A determination of the relative susceptibility of an area to crown fire should be based on well documented criteria such as those addressed in the publication INT-438, Predicting Behavior and Size of Crown Fires in the Northern Rocky Mountains (Rothermel 1991). In this publication, eight criteria are described as being "favorable conditions for a crown fire."

The Final Report on Federal Wildland Fire Management Policy and Program Review, published in December 1996, directs resource managers to assess "values at risk" when determining suppression strategies. These values may be life, property or natural resources, such as late-successional habitats. The fire behavior characteristics of crown fires threaten all of these, often simultaneously. Knowing where those highly susceptible stands conditions exist is of paramount importance to resource managers who the public expects to preserve these values.

A determination of the relative susceptibility of an area to crown fire should be based on well documented criteria such as those addressed in the publication INT-438, Predicting Behavior and Size of Crown Fires in the Northern Rocky Mountains (Rothermel 1991). In this publication, eight criteria are described as being "favorable conditions for a crown fire":

- Dry Fuel
- Low Relative Humidity
- High Temperature
- Heavy Surface Fuel Accumulations
- Reproduction and Other Ladder Fuels
- Slope
- Winds
- Instability
- Continuous Forest Canopy

Of these elements, the ones that are relatively static over a period of time and can be represented on a map are: surface fuels, canopy closure, and stand structure. Surface fuels were represented by the 13 NFFL fire behavior models as fuels inventories have not been completed for the entire forest and would have to be redone for updated information. The fuel model map based on Pacific Meridian Resources satellite imagery (ISAT) was used to represent surface fuels. ISAT data was also used to characterize canopy closure, species and stand structure.

Using the criteria of fire behavior fuel model and canopy fuel loading, a matrix can be developed by fire behavior experts that ranks timber stand susceptibility to crown fire in relation to other stands with different characteristics. Stands that can expect to support independent crown fire episodes under average worst case weather conditions are labeled as "extreme". Stands that will support active crown fire under the same weather conditions are labeled as "high". Stands that will only support passive crown fire are labeled as "moderate" and stands where only incidental torching is possible are labeled as "low".

Canopy fuel loading can be determined from a number of silviculture data sources, specifically, information on size structure, canopy closure and species group. Much of this information can be acquired from professionally interpreted satellite imagery. Data tables are also available to assist in developing assumptions for "if/then" statements to convert existing stand data to generate a crown fuel loading layer. These tables commonly use species, tree size and tree spacing as inputs to estimate canopy fuel load in tons per acre.

The combination of surface fuel loads with sufficient potential energy to ignite crown fuels, as well as the species, age and structure of the stand can result in an adjective rating of susceptibility to sustain crown fire. The crown fuel load is based on density and species and is assumed to be the fine fuels or needles and > 1/4" material in the crowns (Rothermel 1991).

The rating and the assumptions for each are defined and listed below:

> ***Null*** *- Little if any overstory present or canopy closure is < 20% or surface fuel model is 1. Previously harvested area, old burns, meadows, shrub fields, and unforested areas.*
>
> ***Low*** *- Fire is generally an intense ground fire with some incidental torching where fuels are concentrated. < 50% of the crowns are effected. Assumptions: Canopy closure is < 56% or there is a fuels model 2 in the understory or it is a single story ponderosa pine stand > 21" dbh.*
>
> ***Moderate*** *- Passive crowning can be expected in patches of trees. Short duration, crowning runs occur. <70% of the crowns are effected. Assumptions: Canopy closure is >56% < 71% and it is a single storied stand or it is or it is a mixed conifer/lodgepole pine stand or fuels models 6/10/11 represent the surface fuels.*
>
> ***High*** *- Active crown fire being sustained by a intense ground fire. >90% of the crowns are effected. Assumptions: Canopy closure is >56% < 71% and it is a multi-storied stand and fuels models 6/10/9+30tons/11 represent the surface fuels.*
>
> ***Extreme*** *- Fire is burning through the crowns independent of ground fire which may be lagging far behind or is burning through light surface fuels at times. Assumptions: Canopy closure is >71% and it is a multi-storied or single-storied stand and surface fuels are 6/9/10/11/12.*

The matrix does not consider the probability that sufficient surface fire intensity and low crown foliar moisture content would be present at the time of ignition. It is assumed that the necessary environmental conditions are present to precipitate crown fire.

The matrix does not consider element of fire spread such as slope, dead fuel moisture, and weather.

Canopy Closure	Size Structure	Species Group	Fuel Model	Susceptibility	Assumptions (See above)
24	10-32	>6 <25	6,9,10,11	Extreme	
24	20-32	26,27	6,9,10,11	Extreme	
23	20-32	>6	6,10,11,	High	
23	10-19	7,8,9,10, 14, 19,20,21,22 23,24,25,31 32,33	6,10,11	Moderate	
<23	>4	>6	2,6,8,9,10,11	Low	
24	10-19	26,27	2,6,8,9,10,11	High	
<23			2	Low	
23	14-19	26	2,6,8,9,10,11	Low	
23	10-12	31-33	8	Low	
23	11-12	26,27	2,6,9	High	
23	10	26,27	6,8,9	Low	
<9				Null	
	<4			Null	
		<6		Null	
			1	Null	
24	10-32	7-33	8	Moderate	
23	20-32	26,27	9	Moderate	
23	10-19	7,8,9,10,14, 19,20,2122, 23,24,25, 26,27,28,29, 31, 32,33	2, 8	Low	
24	10-32	10-33	10,11	High	
23	20-32	>6	8	Moderate	
23	10-12	31-33	10	Moderate	

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Rothermel, Richard C. 1991. Predicting Behavior and Size of Crown Fires in the Northern Rocky Mountains. Research Paper INT - 438. USDA Forest Service Intermountain Research Station.

FORESTED LAVAS IN THE WEST ZONE OF THE BEND/FT. ROCK RANGER DISTRICT

BACKGROUND INFORMATION AND RATIONALE FOR MSA DESIGNATION

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Bend/Ft. Rock Ranger District

Deschutes N.F.

15 July 1996

INTRODUCTION

The term "forested lava" refers to areas where forests are growing on lava flows which, over geologic time, have acquired varying amounts and volume of soil. The lavas often have little or no visible surface soil, but soil exists in cracks, depressions, and open spaces among rocks. The general impression of walking through a forest growing on forested lavas is that the trees and vegetation are growing out of rocks, not soil (Biglor et al. 1991).

Within the Sheridan LSR (Late-successional Reserve), forested lavas comprise approximately 23,460 acres of land (76% of the LSR). These lavas are part of an extensive field of lava flows and cinder cones called the Mount Bachelor Volcanic Chain. Geologists from the U. S. Geological Survey mapped this area in the late 1980's and published their work in 1992. Refer to map on next page.

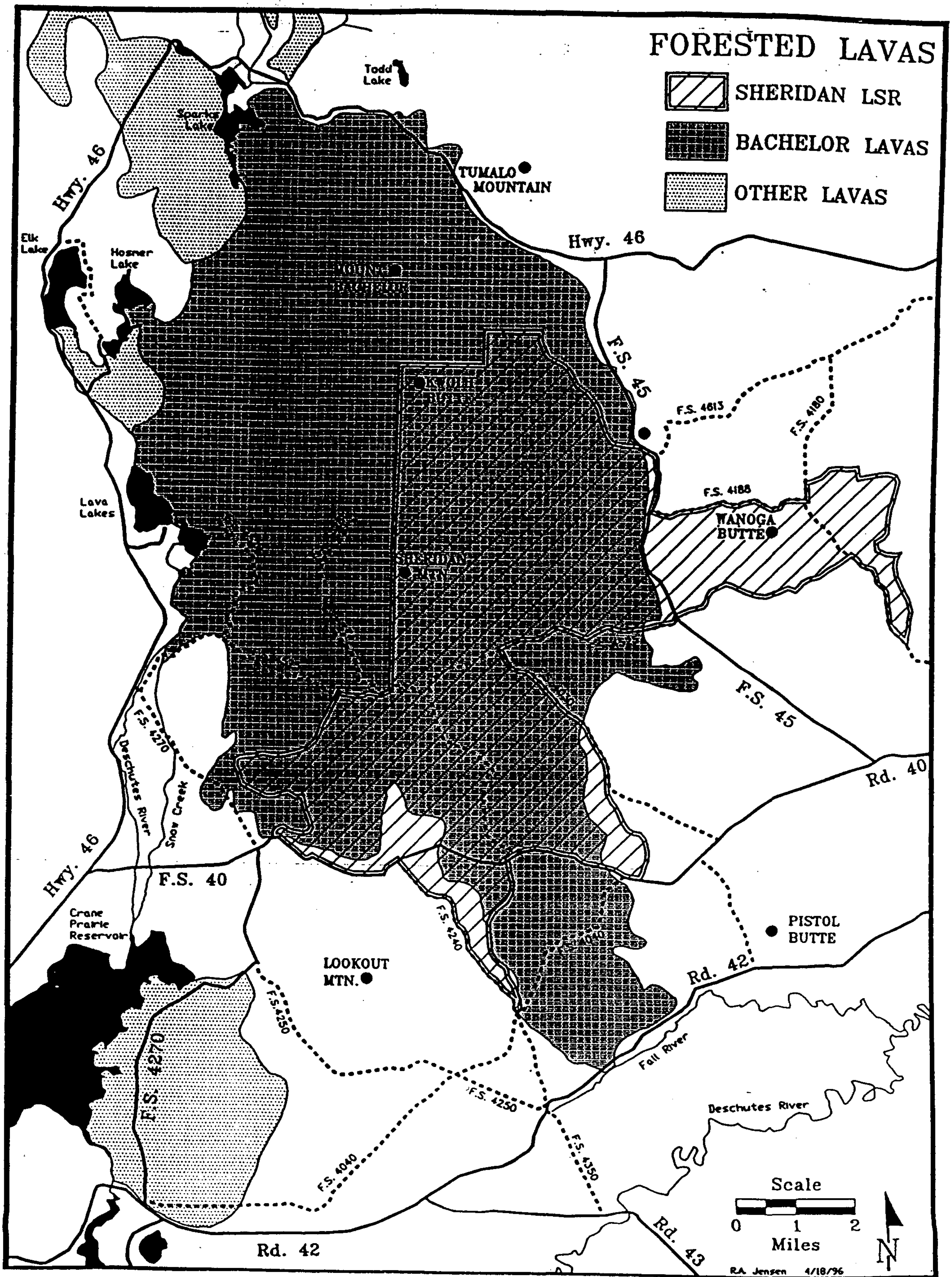
A Forested Lava Management Strategy Area (MSA) was developed as part of the Cultus and Sheridan LSR analysis and is located entirely within the Sheridan LSR. This MSA was established due to our current lack of understanding of ecological processes. These processes may be significantly different than nearby forested areas where ecological processes are better understood. The following discussion provides some history, information, observations, and comments by professional colleagues concerning the forested lava area.

GEOLOGY AND SOILS

The forested lavas are "young" in geologic terms. Lavas of the Mount Bachelor Volcanic Chain erupted near the end the last Ice Age and are approximately 15,000 years old. These lava flows drastically altered the drainage of the area. New lakes, streams, and springs formed. About 7700 years ago, 1 to 1.5 feet of white ash fell on the entire forested lava area during the catastrophic eruption of Mount Mazama. The ash partially filled openings among rocks and depressions. In many places, Mazama ash is the only soil. Ash deposits from Rock Mesa (2100 years old) may also be found, but these deposits are thinner and less extensive than the Mazama ash.

Two general types of lava flows make up the lava of forested lava. The first, called a rubble flow, has a hard, solid core surrounded on all sides by loose, rubbly material ranging in size from large rocks to soil size particles. It was produced by shearing and fracturing of the top of the lava when it was flowing. Core drilling has found that the rubble is usually 5 to 20 feet thick (Larry Chitwood, personal communication 1996). This material is often crushed and used as aggregate for roads.

In rubble flows, a tree seed may fall on one of three different microsites. It may fall on a site where soil is extensive and near the surface. The seed may germinate and grow. At a second site, the seed may fall into a deep crack or space between rocks. It may germinate, but darkness does


FORESTED LAVAS
SHERIDAN LSR
BACHELOR LAVAS
OTHER LAVAS
Todd Lake
Sparks Lake
TUMALO MOUNTAIN
Hwy. 46
Elk Lake
Hosmer Lake
F.S. 45
F.S. 4613
F.S. 4180
F.S. 4188
WANOGA BUTTE
Lava Lakes
F.S. 45
Rd. 40
F.S. 4270
Deschutes River
Snow Creek
Hwy. 46
F.S. 40
Crane Prairie Reservoir
LOOKOUT MTN.
F.S. 4240
PISTOL BUTTE
Rd. 42
F.S. 4250
Fall River
F.S. 4270
F.S. 4250
Deschutes River
F.S. 4040
F.S. 4350
Scale
0 1 2
Miles
N
Rd. 43
Rd. 42
R.A. Jensen 4/18/96

not allow photosynthesis to take place. The seedling does not survive. At a third site, soil cannot be seen at the surface but is among the rocks only a short distance below the surface. This situation has the potential for germination and growth. However, the growth rate may be very slow until exploratory roots find other pockets of soil.

The other general type of lava flow found within the forested lava area is the "inflated lava." These flows have resulted from impressive swelling or inflation. Larry Chitwood, Geologist for the Deschutes National Forest, describes this process in his paper, "Inflated Basaltic Lava - Examples of Processes and Landforms From Central and Southeast Oregon" (1994). He describes them in the following way:

> *"Flow fronts, which initially advance rapidly, slow down as the lava fans out. Eventually, flow advance ceases when the strength and viscosity of a developing crust cannot be overcome by internal hydraulic pressures. But molten lava continues to flow into the system. The result is inflation. The surface crust rises, tilts, and cracks in complicated patterns."*

The cracks and depressions within this type of flow become locations for soils to accumulate. Vegetation is found mostly within these soil-filled (often referred to) "flower pots." Terry Brock, a former Deschutes NF Soil Scientist, noted in his Soil Note #4, 1988, that:

> *"We have just begun to understand that the trees that have established in the lavas have a different rooting character than do those in non-lava areas. On the broken lava areas, we see that most of the roots are concentrated in the cracks between lava chunks...some fine roots have been seen in the roofs of caves more than 15 feet below the surface. ...Trees may establish in small pockets that have filled with sand and organic soil by wind erosion. These resemble flower pots and they may only be able to support a single species of plants. What would result is total occupation of the rooting volume and would not allow an entire plant community to become established."*

Chitwood estimates that 70% of the forested lavas are of the rubble flow type and 30% the inflated flow type (Larry Chitwood, personal communication 1996).

Cinder cones and their aprons of cinders and ash often occur within areas of forested lavas. For example, eruptions at Sheridan Mountain produced large fields of lava to the east and west, but cinders and ash were also produced at the higher elevations. Up to several feet cover a portion of these lava flows.

ECOLOGICAL PROCESSES

Not much is currently known or understood about the ecological processes occurring on these forested lavas. Even though the forests growing on forested lavas may look similar to those growing on non-lava areas, ecological processes may in fact be very different. For example, Dave Perry, an Ecological Scientist with Oregon State University and the Cascade Center for Ecosystem Management, suggests that trees growing on forested lavas are not water limited; therefore, thinning (to reduce competition and stand densities) may not be beneficial (Larry Chitwood, personal communication 1996). Past silviculturists on the Bend Ranger District, Deschutes National Forest, have found that trees growing on forested lavas are not water stressed and continue to exhibit good growth rates through the growing season.

Stand structure and densities vary in the forests of forested lavas as compared to those on non-lava areas. An analysis of stand exam information from forested lava areas vs non-forested lava areas was completed in 1991 by the Director of the Sunriver Nature Center, David Danley. His interpretations indicate that the forested lavas have significantly less trees per acre and that these trees are older than the trees on similar non-lava sites. This trend seems to disappear in the larger diameter size classes. He also makes the interpretation that even though the climax plant associations and biomass may be end point similar, the establishment systems for these sites are very different.

Unusually large and colorful mycorrhizal mats have been found within the forested lavas by Dr. Ching-Yan Li, PNW Lab, Corvallis. These mats may be much more abundant in forested lava areas than in non-lava areas. Some questions are then raised.

- *What ecological function do these mats serve?*
- *Are these mats the link between vegetation, moisture, and ultimately survival and growth?*
- *What would happen if these mats were disturbed through management activities?*
- *Do frequent ground fires play an ecological role in association with these mats?*
- *What function do stumps play?*
- *Are old stump sites the only sites for seedlings to germinate?*
- *Do the stumps contribute to underground decay and mycorrhizal ecology of the soil?*

Artificial regeneration efforts in some forested lavas have failed after repeated attempts whereas in other areas regeneration efforts have been successful. Natural regeneration time frames seem to be much greater on forested lavas than on forests with little visible lava. This suggests that regeneration and establishment of trees takes longer on forested lavas as compared to non-lava areas. It also suggests that regeneration space is limited within the forested lavas.

More questions are then raised:

- *Do mycorrhize play a critical role in regeneration?*
- *Once vegetation becomes established, can it be enhanced by management practices to reach a desired condition more quickly?*
- *Can desired vegetative conditions be sustained over time or will they deteriorate more quickly?*
- *How resilient are these forests to change?*

A research study was initiated between the Pacific Northwest Research Station and Oregon State University in the early 1990's to try and answer some of the above mentioned questions. Preliminary findings of this research indicate that the michorrizal mats are causing a chemical reaction that may be the key reason why the ponderosa pine trees can become established and grow on sites where we would not expect them to live (Andy Youndblood, Bend Silviculture Lab Director, personal communication 1996). Specific management implications of these initial findings are not know at this time. The study will try to answer those questions and provide recommendations for management activities that would be appropriate for the various lava conditions within the forested lava area.

The Deschutes National Forest has just completed a two year vegetation mapping project across the Forest that identified and mapped individual plant associations and is verified to the 90+% confidence level. This mapping though, makes no distinction between areas of forested lavas and non-lava areas. Gladys Biglor, a former district silviculturist, worked with Leonard Volland, retired plant ecologist and author of "Plant Associations on the Central Oregon Pumice Zone", on these forested lava areas. Volland agreed that these areas should have been distinguished by their own plant association due to the lava flows and regeneration potentials (Gladys Biglor, personal communication 1996).

CONCLUSIONS

What the above discussion this suggests is that the forested lavas are very unique. Their ecological processes are not currently understood, and care must be taken when prescribing any type of management activity. Consequently, the forested lavas have been designated as an MSA specific to the Sheridan LSR. This MSA will not be further subdivided at this time as the significance of differences are not well known or understood. The intent though in the future, if and when these differences are identified and are able to be mapped, the MSA would be further subdivided. A most likely subdivision would be by the different lave flow types. These refinements would also display management activity recommendations specific to that type of lava flow.

For this LSR assessment, it is recommended that all priority 1 treatments that may be applicable to other areas with the same vegetation, be deferred into priority 2 treatments within the forested lava MSA until further inventory and analysis is available to display the differences in lava types. Then, at this point, appropriate treatments may be prescribed and implemented.

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PLANT ASSOCIATION GROUPINGS
FOR THE CULTUS AND SHERIDAN LSR ASSESSMENT

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The following documents the rationale and process used for analyzing vegetation within the Cultus and Sheridan LSRs.

Plant associations are classified using the 'potential natural vegetation' concept. "This is the "biotic community that would become established if all successional sequences were completed without interference by humans under present environmental conditions" (FSM 2060.5) (R6 Ecol. Tech. Paper 289-87). Classification is based on the potential vegetation that would occupy the site in the absence of fire. Productivity is used to 'validate' the concept that associations do indicate a set of specific environmental conditions. Associations that do not meet the confidence intervals established need to be classified into new associations which have less variability in production. If plant associations are to be used as a site indicator, then productivity must be part of the classification.

A document titled the Watershed Evaluation and Analysis for Viable Ecosystems (WEAVE), was published by the Deschutes National Forest in 1994 that provides direction and clarification for watershed analysis on the Forest. Included within this document are the guidelines and rationale for grouping plant associations. These groupings were developed by lumping specific plant associations by plant series, such as lodgepole pine, mixed conifer, etc., and then further subdivided these series into wet and dry classifications based on productivity class. The resulting plant association groups (PAGs) have been used in numerous analysis's throughout the Deschutes National Forest.

In January 1996, a letter to Deschutes National Forest District Rangers was circulated which described the results of the Forest wide plant association mapping project and associated highly stocked acre map. This was a large scale project, requiring 2 years to complete, that delineated the forest vegetation types by plant association as well as defining high stocking for these groups in terms of basal area and trees per acre.

A meeting of the forest silviculturists on Thursday, February 22, 1996 discussed this mapping project and the use of the products. Everyone agreed that this product would be the base vegetative mapping for current and future projects, with discretion allowed for changes based on site specific conditions, within individual project areas. A process was set up for determining additional changes across the forested landscape on an as need basis.

Revisions to the guide 'Plant Associations of the Central Oregon Pumice Zone', were promoted by this forest wide mapping project. The final revisions to the guide should be completed by the end of 1996 by the Area Ecologist. Specific to the Deschutes National Forest, the Forest Silviculturist and Area Ecologist reviewed the changes and interpretations and then further refined Appendix C - Plant Association Groups and Data Source for Vegetative Information, of the WEAVE Guide. To the best of our ability, these changes were incorporated into the Cultus and Sheridan LSR analysis and are documented here. We recognize that further refinement may occur in the future.

Minor modifications were made for the Cultus and Sheridan LSR analysis to fill in the blanks where new plant association codes still needed development and to represent potential site specific vegetative conditions (keeping in mind the PAGs are based on potential vegetation the site could support). The landscape updates for individual polygons was made based on recommendations by the Area Ecologist, comparisons to 1959 aerial photo mapping and 1991 aerial photo interpretation and to a minor extent 1988 ISAT vegetation mapping.

Specific to the Cultus and Sheridan LSR analysis the breakdowns of plant associations by PAG are as follows:

Mountain Hemlock PAG includes: CL-S4-12+, CR-S1-11, CM-S1-11, CL-S3-11#, CM-G2, CM-G3.*

Wet Mixed Conifer PAG includes: CD-S6-14, CW-S1-13, CD-S6-13, CR-S1-11, CW-S9-11.*

Dry Mixed Conifer PAG includes: CL-S3-11, CW-C2-11, CW-H1-11, CW-S1-12, CW-S1-15, CR-S1-11, CW-C2-13.*

Wet Ponderosa Pine PAG includes: CP-S3-11, CP-S3-14.

Dry Ponderosa Pine PAG includes: CP S2-13, CP-S2-15, CP-S3-12.

Wet Lodgepole Pine PAG includes: CL-G4-12, CL-G4-11, CL-M3-11, CL-S2-12.

Dry Lodgepole Pine PAG includes: CL-G4-13, CL-S2-11, CL-S3-11#, CL-S9-11, CL-G3-11.

Unique includes: Engelmann spruce bottomlands, aspen, moist meadows, riparian, rock, and cinder.

Documentation of adjustments to forest vegetative mapping specific to this project are:

1)(+) CL-S4-12 was lumped into the mountain hemlock PAG due to the high regeneration potential of mountain hemlock associated with this plant association. (Current thinking as per Bill Hopkins, area ecologist, is that almost 25% of the Deschutes landscapes exist in ecotones or transitions. To tell if you are in a transition, use the 5 TPA rule: if you see 5 oddball trees or stumps per acre, call the association that of the oddball trees.)

2)(*) CR-S1-11, veg code 72, was originally noted as mixed conifer but after reconn of 1959 aerial photography mapping and high elevation infra-red photo interpretation, I determined that this plant association fit better into the mountain hemlock zone in some instances and in others it fit best with the wet or dry mixed conifer groups. The area north of Benchmark butte was lumped into the mixed conifer zone and the areas west-southwest of Little Cultus lake was lumped into the mountain hemlock zone for this analysis.

3)(#) CL-S3-11 is found as; small pockets of lodgepole pine in association with root rot pockets in the mountain hemlock zone, as pockets of regenerating harvest units surrounded by mixed conifer plant associations, and as pockets in proximity to other lodgepole stands. Where these pockets were situated on the landscape and at what elevation were the determining factors as to which PAG the pockets were lumped in with. High elevation LP in association with mountain hemlock was lumped into the mountain hemlock PAG. Lower elevation LP was lumped into dry mixed conifer and dry lodgepole pine PAGs.

The vegetation within the LSRs was also defined into climatic climax and fire climax groupings. Climatic climax plant associations include all the mixed conifer wet PAG, plant association CW-C2-11 of the mixed conifer dry PAG and all of the ponderosa pine wet PAGs. This split is based on productivity of the individual plant associations. Fire climax plant associations include all of the mixed conifer dry PAG except CW-C2-11 and all of the ponderosa pine dry PAG. The main qualifier to this is that if a plant association defined as fire climax is found on a north facing slope where moisture is usually greater, then that plant association would also be considered as climatic climax. Since this analysis is looking at the landscape level, these splits by slope position were not further defined. Site specific analysis at the project level should describe further refinement. Ponderosa pine wet and dry PAGs represent a small amount of acreage within the Sheridan LSR. Therefore, these two PAGs were not delineated further by climatic and fire climax vegetation.

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MODEL AND LOGIC TRACK FOR ANALYZING COMPLEXITY

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Summer 1996

The purpose of this document is to describe the process that was used to analyze the complexity involved in developing management opportunities within the Cascade Lakes Environmental Analysis area. The complexity of developing management opportunities is great due things such as direction in the Northwest Forest Plan, direction in the Deschutes LRMP, the CHU designation overlaying the Cultus LSR area and many more. The associated process and table will outline this items in more detail.

The Cultus LSR area was used as the prototype for this process to determine if the process was feasible and logical. This process and results were then presented to the Cascade Lakes IDT and they agreed it should be used for the entire EA area. Some tweaking was then done by IDT members to further refine the rating guide and then the procedure was then completed for the EA area.

<u>Step one</u>: Step on is to show the Forest Plan Management Allocations and the direction the Plan provides as to treatments, guidance, etc. Refer to the Cultus Mt. LSR Wildlife/Vegetation Opportunity Table. Activities that are allowed as per Plan S & G's and other guidance will be check marked. **This does not indicate what we may or may not propose to actually do on the ground.** This is just to display what we think the range of our options are given current direction. Within each allocation, it is also noted additional allocations contained within, which gives the reader an idea of the overlapping direction and starts to display the complexity of the situation. Some of this overlapping direction may be more limiting than the Forest Plan S&Gs. Therefore, all overlapping layers need to be displayed for more clarity and to show the complexity of the area. A narrative associated with each allocation is displayed in Step 2. Assumptions made during the step one phase are as follows:

1) Thinnings equal all thinning opportunities such a commercial thins, thinning from below, thinning to reduce risk to insects attacks, etc.

2) Dead tree enhancement as defined in the LSRA will occur across all areas as needed where levels are not or will not be met. Therefore this was not displayed as an individual treatment opportunity.

3) Pruning will occur after regeneration harvest activities and is therefore not displayed as an individual treatment opportunity.

4) Late Habitat Acceleration equates to existing harvest activities where habitat may be accelerated and is different from tree culturing in that regard.

5) Tree culturing equates to eagle management areas and to overstocked areas as per the Forest overstocking map.

6) Catastrophic events and treatments associated with catastrophic events are not discussed in this process. The Forest Plan gives direction on what treatments are/are not allowed and this will guide opportunities in such an event.

7) PCT is usually done in the early seral stage, but in some instances may show up under mid seral stage.

8) Thinning is usually done in the mid to late seral stage, but in some instances may show up under early seral stage.

9) The ROD (NWFP) speaks to the spotted owl, CHU designation by USFW also speak to the spotted owl. We assumed the ROD will supersede all other direction for the spotted owl, unless other standards and guidelines/direction are more restrictive.

Keep in mind this step does not determine what management opportunities actually exist on an individual piece of ground. Existing ground truthed vegetative conditions will be the final determinants as to feasible opportunities and these will be displayed in step 3.

Step two: The is the narrative form of the guidance/limitations associated with the overlapping plans and associated standards and guidelines. This will include information on CHU's, Tier 2 Key Watersheds, Rare II areas, Riparian Reserves, Key Elk areas and Scenic Views. These allocations overlap the Forest Plan Management Allocations and in some instances one piece of ground may have 3-5 overlapping layers. The Forest Plan allocations are also listed below with limitations attached if known. The number of overlaps and limitations/constraints may preclude any management treatment opportunity as an example. Reference Cultus Mt. LSR Wildlife/Vegetation Opportunity Table.

CHU - Critical Habitat Unit - A land designation provided by the USFW to provide protection of habitat under the Endangered Species Act, which stipulates that the areas containing those physical and biological attributes that are essential to a species conservation may require special management considerations or protection. This land designation requires consultation on management activities that may affect the attributes listed below, but are not limited to the following primary constituent elements:

1) Space for individual and population growth, and for normal behavior;

2) Food, water, or other nutritional or physiological requirements;

3) Cover and shelter;

4) Sites for breeding, reproduction, rearing of offspring, and;

5) Habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of a species.

Tier 2 Key Watersheds - The Cultus sub-watershed is designated as a tier 2 watershed which may not contain at-risk fish stocks, but is an important source of high quality water (ROD B-19).

There is no guidance in the Cascade Lakes Watershed Analysis that speaks directly to the Cultus sub-watershed in terms its status as a tier 2 sub-watershed. Nor does it provide guidance on management activities, restoration activities or other acceptable opportunities specific to the Cultus sub-watershed.

The amount of existing system and non-system roads within key watersheds should be reduced through decommissioning of roads (ROD B-19). Road closures with gates or barriers do not qualify as decommissioning or a reduction in road mileage. If funding is insufficient to implement reductions, there will be no NET increase in the amount of roads in key watersheds.

Roadless areas within key watersheds -To protect the remaining high quality habitats, no new roads will be constructed in inventoried roadless areas in key watersheds (ROD B-19). This will includes a portion of the Three Sisters Roadless Area # 6192 that is within the tier 2 Cultus sub-watershed within the Cultus LSR.

- ROD summary of Aquatic Conservation strategy for key watersheds (ROD B-19): (2 additional points are discussed, but are not listed as they speak to watershed analysis needing to be completed prior to management activities, which it is.) Tier 2 key watersheds were selected as sources of high quality water and may not contain at-risk fish stock.

- No new roads will be built in roadless areas in key watersheds.
- Reduce existing system and nonsystem road mileage outside roadless areas (see above).
- Key watersheds are the highest priority for watershed restoration.

Roadless Rare II Areas - There are pieces of 2 Rare II Inventoried areas within the Cultus LSR; Three Sisters #6192 and Charlton # 6107. A portion of the Three Sisters roadless area is also within the Cultus tier 2 key watershed and was discussed in the previous section.

The Three Sisters roadless area is classified in the Forest Plan as 50% visual management and 50% protection management, semiprimitive. The Charlton roadless area is classified as dispersed recreation, primitive. The Plan seems to be vague on what these classifications mean but does provide some consequences of the designations of semiprimitive and primitive (PLAN Appendix C-93). It states that areas managed for primitive or semiprimitive recreation will eventually reach the climax plant succession stage. In areas designated for scenic quality carefully designed vegetative manipulation, including time harvest, can be used to enhance or maintain the areas visual quality.

There are 2 additional issues relating roadless areas within the Cultus LSR. The first comes from IRT which relates that the NWFP S & G's say no roads can be built within a key watershed, as mention already (Cultus sub-watershed). IRT would not consider walking a track machine into a roadless area to do pre-bunching for helicopter pick up as a road - the interpretation by Mollie is that this means one machine one time, in and out. Temporary roads for logging are considered a road according to IRT.

The next issue is one of NEPA sufficiency. We have been given no direction other than to say that if we may have a significant effect on the roadless character by doing something then we may have to do an EIS. We need to look at the NEPA sufficiency language. Mollie's interpretation of this and her call on the question of significance is the consideration of the impacts we would have on visual quality, how noticeable would the stumps be, would we have an effect on wildlife by entering the roadless areas, would we have defacto access just by going in with a track machine, etc.

Riparian Reserves - The Riparian Reserves designated in the Cascade Lakes Watershed Analysis, Aquatic Conservation Strategy within the Cultus LSR include portions of the Crane Riparian Reserve and the Many Lakes Riparian Reserve. The Aquatic Conservation Strategy discusses these riparian reserve areas in a little more detail. The ACS provides direction for riparian widths equivalent to the greatest distance reported in the Northwest Forest Plan. Minimum slope distances being 300 feet from lakes and fish-bearing streams; 150 feet from permanently flowing nonfish-bearing streams or edge of riparian vegetation on wetlands greater than 1 acre; 100 feet from intermittent streams or edge of wetlands less than 1 acre. Another piece of pertinent direction as designated by the Watershed Analysis is that there will be not net increase in roads within the riparian reserves.

Standards and guideline within the ROD state as a general rule that the riparian reserves prohibit or regulate activities in the riparian reserves that retard or prevent attainment of the Aquatic Conservation Strategy objectives. For portions of the riparian reserves that are located within key watersheds, S & G's for key watersheds (ROD C-7) and the ACS (ROD B-9) as well as S & G's for riparian reserves listed beginning on page C-31 of the ROD will apply. Riparian Reserve standards and guidelines are listed beginning on page C-31 of the ROD, since the list is long, it will not be repeated here. A few important points from the S & G's as they relate to vegetative treatments are listed here but be sure to reference the entire list for full resource understanding:

- Prohibit timber harvesting, including fuelwood cutting, in riparian reserves, except as described: 1) where catastrophic events such as fire, flooding, volcanic, wind, or insect damage result in degraded riparian conditions, allow salvage and fuelwood cutting if required to attain the ACS objectives.

- Salvage trees only when watershed analysis determines that present and future coarse woody debris needs are met and other ACS objectives are not adversely affected.

- Apply silviculture practices for riparian reserves to control stocking, reestablish and manage stands and acquire desired vegetation characteristics needed to attain ACS objective.

Key Elk Areas - Refer to the Forest Plan Wildlife S & G's for information on what is acceptable within key elk areas, pg 4-42-51.

Scenic River - The headwaters of the Deschutes River are designated as 'Scenic'. Refer to the Forest Plan S & G's, MA-17, pg 4-155. In addition to the Forest Plan, the Resource Assessment completed in 19XX provides direction and guidance for management treatments within the scenic boundary of the river.

Scenic Views - Refer to the Forest Plan S & G's, MA-9, pg 4-121 for information regarding management activities that will be allowed within the Scenic viewshed. The areas classed as scenic within the LSR have a designation of fore-ground and middle-ground.

Forest Plan Allocations:

Old Growth - MA-15, pg 4-150. Restricted by Forest Plan S & G's. No prescribed fire allowed in lodgepole pine old growth areas.

RNA - MA-2, pg 4-92; ROD, pg C-11. Restrictions within the Forest Plan and ROD. No timber harvest allowed, no control of insect and disease outbreaks allowed, no harvest allowed even if catastrophic events occur. Prescribed fire allowed only as specified to meet natural research areas goals.

Bald Eagle - MA-3, pg 4-94; ROD, pg C-11. Timber harvest allowed only if it meets bald eagle objectives. District Bald Eagle Plan has to be completed prior to activities being planned within Bald Eagle Management Areas. Forest Plan and ESA Recovery Plan are most restrictive documents. ROD exempts approved recovery plans from LSR S & G's.

Osprey - MA-5, pg 4-100. Forest Plan S & G's.

Wild & Scenic - MA-17, pg 4-155. The Deschutes River is classified as Scenic, Forest Plan S & G's apply.

Intensive Recreation - MA-11, pg 4-135. Forest Plan S & G's. No programmed harvest allowed, but can do treatments for other reasons. Refer to Forest Health S & G's also.

Dispersed Recreation - MA-12, pg 4-140. Forest Plan S & G's. No programmed harvest allowed except for salvage. Refer to Forest Health S & G's.

Step Three: Next, opportunity areas were drawn on an overlay (with all the other overlapping layers attached) and a ranked according to the criteria outlined in the Rating by Opportunity Area Table. Refer to overlay map and to the Rating by Opportunity Area Table. This table displays the items used to rank each opportunity area: Biological agents of insect and disease risk and crown fire susceptibility risk; Economics based on access, logging systems, and product value; Management Constraints as defined in the Management Constraints Criteria Table, and the Probability of Success ranking which is the probability of being able to implement a plan and define project areas based on the complexity of the areas. A raking sheet was used for each opportunity area identified. Additional issues or note were recorded on these sheets for reference. Refer to Ranking Guide that is attached to the Rating by Opportunity Area Table. As a reminder, this determination is only to be used for the wildlife/vegetation portion of this process. An additional overlay of other resource opportunities such as social opportunities, and more in depth fire/fuels opportunities will further refine the ranking of the wildlife/vegetation opportunity areas. Rankings are subject to change also if field verification does not support the initial ranking.

The Probability of Success ranking will provide the IDT and managers with a good overview of what is feasible to accomplish on the ground given the timelines we are under. This will help the managers to direct the IDT to areas to focus on for this analysis. This process will also provide a logical, systematic process for determining the future focus of work and begin the scheduling of an outyear program for this area. For example, a low probability of success ranking due to constraints such as Roadless areas, may want to be scheduled for 2 years out for completion, because of the real possibility of having to do an EIS. Other areas with a high ranking, would be more easy to complete analysis and field work and could be scheduled for the current year.

Probability of Success Ranking System: Each opportunity areas receives a probability of success ranking. This ranking system is as follows and can also be found on the Rating Guide Table. A ranking of **L** means that there is a low probability of success that work will be able to be accomplished within the timelines given due to the high complexity of the area, the extensive ground verification and field reconn needed and/or the high risk of doing treatments in a particular area. A ranking of **M** means that there is a moderate probability of success that work will be able to be accomplished within the timelines given due to the moderate complexity of the areas, moderate amount of ground verification and field reconn needed and/or the moderate risk of doing treatments in a particular area. A ranking of **H** means that there is a high probability of success that work will be able to be accomplished within the timelines given due to low complexity of the area, small amount of ground verification and field reconn needed and/or the low risk of doing treatments in a particular area. (A ranking of **NA** means No Action will be undertaken as no opportunities are feasible at this time. This ranking was not used due to the following assumptions listed below, that ended up rendering this ranking a moot point at this time.)

1) No opportunities were proposed within RNA's, Unique Veg areas, Forested Lava areas, Red Plague and Landing EA area, and within areas of known Shasta Red Fir vegetation.

2) No opportunities were proposed for Riparian areas except on the south side of Benchmark Butte. Opportunity areas are proposed adjacent to riparian areas and noted on the rationale sheets.

3) No opportunities were proposed where habitat seemed minimal or where existing habitat was needed for wildlife connectivity.

4) Proposed opportunity areas focused on where preventative treatments could be done and then rated according to the rating process as outlined.

5) Any opportunity that fell within a RARE II Roadless designation was given an automatic management constraint of H = difficult constraints, complexity is extreme.

6) Any opportunity that fell within the CHU or LSR was given an automatic management constraint of M = moderate constraints and complexity but can be met through careful design.

7) The Insect and Disease Risk Rating was based on the Forest wide High Stocking Mapping that was just completed this winter. This map shows areas rated above a certain basal area figure that correspond to an SDI value that indicate overstocking. Anything rated as overstocked was assumed to be imminently susceptible to insects and diseases and was ranked as H. Moderate ranking was given to areas not showing up as highly stocked on the map. Areas of Low risk consisted mainly of areas of dead lodgepole pine and was determined through ground knowledge and aerial photo interpretation.

The products from this rating process are: 1

1) Maps that designate areas as low, moderate, or high probability success areas.

2) A rating table for each area (not enclosed).

3) A summary table that displays the overall rating by opportunity area identified.

4) A summary table that displays acres and approximate volume estimates by the ranking of low, moderate and high probability of success.

5) A summary table that displays by opportunity area the probability of success, the timber type, the acreage and volume estimates.

The final outcome, based on timelines and the probability of success rankings, is the proposed action.

Step four: This step is left to the manager and line officer. Their charge will be to determine where to focus the work of the IDT for the project area given all of the above information, opportunities, limitations, constraints, etc. in light of the tight timelines this project is under. If management direction changes, then this process sets the stage for determining new opportunities based on the new direction and guidelines.

Management Constraints
Criteria

Allocation	Low	Moderate	High
CHU			Meet the 5 primary elements
LSR	Habitat status in: preliminary, transitional or exceeds 20% above suitable.	≤ 20% above suitable	below suitable
Spotted Owl Activity Sites	NRF habitat outside 1.2 mile radius	between .7 and 1.2 mile radius	.7 or less mile radius
RARE II			Change character of designation, no roads.
Riparian Reserves		Meets ACS and NO net increase of roads	
Key Elk Habitat		Meets FP S&G's	
Wild & Scenic River		Protects/Restores or Enhances Outstanding Remarkable Values.	
Scenic Views		Meets Visual Quality Standards.	
Old Growth		Perpetuate/enhance old growth characteristics	
RNA			Natural Processes
Bald Eagle		Bald Eagle Management Plan is completed and is met.	
Osprey	Large Tree Structure development.		
Intensive Recreation	Meets FP S&G's		
Dispersed Recreation	Meets FP S&G's		
Winter Recreation	Meets FP S&G's		
Special Interest	Preserve & manage for education, research, and to protect their unique character.		

Rating Guide

Biological Agents

Insect/Disease[1]

L - Low risk of insect and disease or already dead.
M - Moderate risk of insect and disease.
H - Area is imminently susceptible of insect and disease.

Crown Fire Susceptibility[2]

L - Low rating
M - Moderate rating
H - High or Extreme rating

Economics

Access

L - No roads
M - Moderate road density
H - High road density

Logging Systems

L - Easy design of logging systems and inexpensive to operate.
M - Some difficulty in design of logging systems and moderately expensive to operate.
H - Complex design of logging systems and costly to operate.

Product Value

L - Chippable material.
M - Small dimension green trees or standing dead.
H - Large dimension green trees.

Management Constraints (See table on following page)

L - Few constraints, can be met through design.
M - Moderate constraints and complexity but can be met through careful design.
H - Difficult constraints, complexity is extreme.

Probability for Success

L - High complexity, needs extensive ground work or high risk probability.
M - Moderate complexity, ground work or risk.
H - Low complexity, ground work or risk.
NA - No Action, no opportunities feasible at this time.

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[1] Risk is rated from today forward. Example, areas of dead lodgepole that have had Mountain Pine Beetle mortality would be rated Low.

[2] If you have areas that are a combination of crown susceptibility ratings take the one that is the greatest acreage.

Rating by Opportunity Area

(What is it going to take!)

	Biological Agents		Economics				
Opportunity Area	Insect & Disease Risk	Crown Fire Susceptibility Risk	Access	Logging Systems	Product Value	Management Area Constraints	Probability for Success
1Example	M	H	L	H	M	H	L
2Example	L	H	M	L	L	M	M
3Example	H	M	H	M	H	H	M
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DEVELOPMENT OF SUITABLE HABITAT CONDITIONS FOR INDICATOR SPECIES, SDI VALUES AND SUMMARY TABLE

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Summer 1996

This paper documents the process and logic track the Wildlife Biologists and the Silviculturist used to determine the suitable habitat (vegetative) condition for indicator species within the Cultus and Sheridan LSR's, the associated SDI values, and the comparison Summary Table.

Wildlife indicator species were designated early in the LSR process as per LSR direction from the ROD and the Deschutes NF LSR oversight paper. An extensive search of the literature, research projects and papers was conducted by the wildlife biologist to detail habitat conditions that the LSR indicator species were using either as nesting, roosting, or foraging. The data collected through this search lends itself to be displayed in a table format (See Suitable Habitat Condition by PAG Table). (**NOTE:** The table illustrates habitat that is neither minimal or optimal but was found as suitable for reproductive success.) The table is structured based on PAG and then further subdivided by structural group within each PAG. Within each structural group, trees per acre (TPA), basal area (BA) and stand density index (SDI) values were calculated. This gives an initial look at the suitable structure by PAG.

Next, this TPA by structural group by PAG was further refined based on local forest level monitor plot data collected for the northern spotted owl and northern goshawk. The wildlife biologists also spent an additional 2 days in the field conducting sample plots of representative stands that best met the habitat needs of some of the other LSR indicator species. The suitable habitat condition table was then further refined based on this additional information and best professional knowledge by looking at the appropriate plant associations for the range of tree species and tied this to the LSR indicator species needs for those plant associations.

Besides TPA and SDI, a need for BA as a descriptor was identified to provide a better picture of the habitat described. Basal area for the suitable habitat condition are calculated by individual structural/size group within each PAG by applying the following formula:

$$BA = Dg^2 * .005454 * TPA$$

Where Dg equals the average diameter of the individual structural group (example: sapling group is 1" to 4.9" dbh, average diameter used was 3" dbh), and TPA equals the trees per acre by size group.

It was determined that Stand Density Index (SDI) would be the best measure to use for comparison purposes between the suitable habitat condition, existing condition, and what an individual plant association could support on a sustained basis. SDI values were developed specifically for the Deschutes National Forest Plant Associations by Joanna Booser and Jim White, 1996.

Stand Density Index (SDI) for the suitable habitat condition are calculated by individual structural/size group within each PAG using the formula:

$$SDI = (TPA) * (Dg/10)^{1.77}$$

where TPA equals the trees per acre by size group, Dg equals the average diameter of the individual structural group (example: sapling group is 1" to 4.9" dbh, average diameter used was 3" dbh), and the slope intercept (1.77 in the above formula) equals the slope intercepts developed by Cochran in his paper, PNW-RN 513, April 1994, Table 1. The slope intercept (1.77) would vary by vegetative species (Cochran 1994). Individual size groups were then summed to determine the suitable SDI value for the entire PAG. **Note:** Average stand diameter as compared to individual structural group diameter was not used as this value gives a very high SDI value that is not indicative of the actual density the area.

Within the PAG, indicators refer to wildlife species determined to represent late-successional habitats within the plant association group (ex. American marten = AM).

Where canopy cover is illustrated by an average it is defined by a percentage range that can go no lower than 10% of the stated average, but can be managed up to 100% canopy cover. Within the Total Mean and the various size classes, TPA, BA and SDI unless otherwise stated per size class can range $\pm$ 20% of the mean to allow for natural variability.

Special features identify habitat needs that would be used when managing the PAG for the identified indicator species. The key tree species are not inclusive of the tree species that would be found or dominant on site. Rather these species were identified due to their importance as a habitat component for LSOG wildlife species. The plant association and actual site, along with the indicator species needs, would dictate the percentage levels of each tree species and in which size class they would be managed.

Individual structural group TPA's were also summed to reflect the total TPA of the suitable habitat condition.

Next, the suitable habitat condition by TPA and SDI, the plant association group SDI values, and the existing condition SDI values are displayed in the Summary Table within the Desired Late-Successional Reserve Condition paper. The existing condition SDI values were derived from two data sources; the first from walk through stands exams completed in the Sheridan LSR in the fall of 1995; the second from old formal stand exams completed in 1987 in the Cultus LSR area. There are data gaps though within both data sets. For example, the 1995 walk through exams did not look at the high elevation hemlock and some of the higher elevation wet and dry mixed conifer areas. The exams only focused on what was easily accessible from roads within the area, due to time frames, weather conditions and safety constraints. The 1987 stand exams in the Cultus LSR do not provide full coverage for the entire LSR. As such, some of the current condition SDI values were estimated based on comparisons to existing data and best professional judgment.

SNAGS AND DOWN LOG MODEL

Carol Morehead, Wildlife Biologist and Chuck Vickery, Fuels Specialist
Bend-Ft. Rock Ranger District
Deschutes N. F.

Snags/Logs is represented as a total of tons/acre and cubic feet/acre. The levels are determined by the indicator species needs and acceptable fuel loading to prevent catastrophic fires. These levels were agreed to between the Fire Behavior Analyst and the Wildlife Biologist using the reference "Photo Series for Quantifying Natural Forest Residues in Common Vegetation Types of the Pacific Northwest, 1980". The goal is to provide for wildlife needs and be able to stop a wildfire under normal conditions. To determine the tons/acre and cubic feet/acre the Snaglog Model created on the Bend/Ft. Rock District is used. The model converts snags and logs by species, number, size, length to tons/acre and cubic feet/acre. Specific tree species dead weights (lbs/ft^3) are used in the volume formula to determine the tons/ac and ft^3/ac calculations. Examples of numbers of snags and logs are provided and calculated at 40% and 60% levels. That is, if forty percent was allocated in snags and sixty percent in logs then the reader could expect for MH - 6 snags > 21" dbh, 2 snags 15-21" dbh and 24 logs > 31" diameter and 33' long. Or if forty percent was allocated in logs and sixty percent in snags then the reader could expect for MH - 15 snags > 21" dbh, 3 snags 15-21" dbh, and 7 logs > 31" diameter and 33' long. These calculations vary due to size, height or length and tree species. Snags diameters varied from 11 to 35" dbh. and 53 to 114' tall depending on tree species and habitat structure characteristics. Logs sizes varied from 11 to 31" diameter at the large end and 15 to 50' in length depending on tree species and habitat structure characteristics. Refer to sample model run. The actual number of snags and logs is determined by site availability and existing conditions. Within the snags and logs to be managed a percentage level of recommended sizes are provided to meet the indicator species needs. If existing conditions do not meet prescribed levels, decision needs to be made by specialists and management whether snags and logs would be created to meet the prescribed levels.

SAMPLE MODEL RUN

Tree Species	Small End Diameter	Large End Diameter	Length	No. / Acre	Total Volume Cubic feet/Acre	Total Weight Tons/Acre	With Crowns
Ponderosa Pine							
Snag	3.00	20.00	90.00	6.00	602.29	6.77	8.94
Log	16.00	24.00	40.00	6.00	544.53	6.12	
True fir							
Snag	3.00	20.00	85.00	10.00	948.04	9.77	12.02
Log	14.00	16.00	20.00	20.00	493.04	5.08	
Douglas fir							
Snag	3.00	20.00	70.00	10.00	780.74	8.84	10.52
Log	14.00	16.00	20.00	15.00	369.78	4.19	
Lodgepole Pine							
Snag	3.00	12.00	55.00	15.00	344.22	3.87	4.41
Log	8.00	12.00	20.00	20.00	226.89	2.55	
Mt. Hemlock							
Snag	3.00	20.00	70.00	6.00	468.44	4.35	5.05
Log	15.00	16.00	16.00	15.00	314.80	2.92	
Incense Cedar							
Snag	3.00	20.00	70.00	2.04	159.27	1.57	1.82
Log	15.00	16.00	16.00	7.50	157.40	1.55	
Western Larch							
Snag	3.00	20.00	70.00	2.04	159.27	1.80	1.97
Log	15.00	16.00	16.00	7.50	157.40	1.78	

Assumptions:

1. Approximate tree weights - lbs/cubic foot:
   (Compiled by Mark E. Harmon, Dept. of Forest Science, Oregon State University)

Tree Species	Dead Weight*	Green Weight
Ponderosa Pine	22.48	26.88
True Fir	20.61	22.48
Lodgepole Pine	22.48	27.48
Douglas Fir	22.64	26.13
Mt. Hemlock	18.58	23.8
Incense Cedar	19.74	20.32
Western Larch	22.64	27.87

* Dead Weights for decay class I and II (average)
(Ponderosa pine = Sugar pine = Western White pine)

2. Formula for calculating volume (cubic feet):

   V = volume in cubic feet
   D = Large end diameter (inches)
   d = Small end diameter (inches)
   L = Length (feet)

$$V = 0.002727\,(D^2 + d^2)\,L$$

3. Fire hazard is considered to be 3" diameter or less, larger material contributes to fire intensity and duration. Treatment would focus on treating the small diameter fuels or where excessive amounts of larger diameter occurs.

4. Fuel loading by Weight and Volume:

Loading	Tons/Acre	Cubic feet/Acre
Heavy	> 25	> 1700
Moderate	12 - 24	800 - 1700
Low	< 12	< 800

(cubic feet/acre will vary depending on the weights used, 30 lbs was used here)

5. Snags and logs can be calculated by using a 1 inch taper for every 10 feet of length.

6. Limb and bole weights species from tip to 3" diameter (is approximated):
   32% for Ponderosa pine
   23% for True fir
   19% for Douglas fir
   14% for Lodgepole pine
   16% for Western Hemlock and Incense Cedar
   9% for Western Larch

   Based on interpolation of average total crown and tip weights from Table 1 GTR INT-37 Intermountain Lab.

7. Suggested Management of Snags and Down Logs by Plant Association Groups (PAGs)*

PAGs	Tons/Acre
Lodgepole Pine Dry	8 - 12
Lodgepole Pine Wet	12 - 24
Ponderosa Pine Dry	10 - 15
Ponderosa Pine Wet	12 - 24
Mixed Conifer Dry	12 - 24
Mixed Conifer Wet	25 - 35
Mt. Hemlock Dry	25 - 40

*Agreed levels between Fire and Wildlife Departments, with the aid of Photo Series for Quantifying Natural Forest Residues in Common Vegetation Types of the Pacific Northwest, 1980.

8. East of the owl line snag and log requirements:

Hard Snags/Acre

Tree Species	Tree Size (dbh)	No. / Acre
Ponderosa Pine	$> 20^2$	0.14
	$> 15^2$	2.11
Total		**2.25**
Lodgepole Pine	$>12^2$	0.59
	$>10^2$	1.21
Total		**1.80**
Mixed Conifer	$>20^2$	0.14
	$>15^2$	2.11
Total		**2.25**

Down Logs/Acre

Tree Species	Small End Diameter	Minimum Length	Logs/Acre	Total Linear Length/Acre
Ponderosa Pine	12^2	6'	3 - 6	20 -40
Lodgepole Pine	8^2	8'	15 - 20	120 - 160
Mixed Conifer	12^2	6'	15 - 20	100 - 140

9. West of the owl line (within Matrix) snag and log requirements:

Hard Snags/Acre

Tree Species	Tree Size (dbh)	No. / Acre
Ponderosa Pine	$10 - 15^{2}$	1.88
	$15 - > 20^{2}$	0.14
Total		**2.02**
Lodgepole Pine	$>10^{2}$	1.10
Total		**1.10**
Mixed Conifer	$10 - 15^{2}$	1.90
	$15 - > 20^{2}$	0.14
Total		**2.04**
White Fir	$10 - 15^{2}$	1.11
	$15 - > 20^{2}$"	0.14
Total		**1.25**

Down Logs/Acre

Minimum Diameter	Minimum Length	Logs/Acre	Total Linear Length/Acre
$> 16^{2}$	16'	7.5	120

DESIRED LATE SUCCESSIONAL RESERVE CONDITION

6/5/96

INTRODUCTION

According to the Northwest Forest Plan, the objective for Late Successional Reserves (LSRs) is to protect and maintain late successional and old growth habitats for the species dependent or are associated with them, including the northern spotted owl. However, the functional structural elements (snags/logs, canopy cover, canopy layers, size structure and any other special features) of this habitat have not been described. These descriptions have been left to individual Forests and ID teams to develop so that they could be appropriately site specific.

For many dry eastside plant associations, the very stand characteristics that define suitable habitat conditions for climatic climax late successional old growth dependent and associated species are often unsustainable. This is because these conditions have high susceptibility to epidemic insect attack and catastrophic wildfire. Thus, "protecting and maintaining" as much of this habitat as we can in the short term leads to not being able to maintain it in the long term. Since long term maintenance of late successional old growth habitat, distributed functionally across the landscape is essential for species viability, the dilemma of maintaining habitat conditions in the short term versus a continual supply of suitable habitat for the long term needs to be addressed.

The intent of the paper is to provide information in three topic areas to assist the Deschutes National Forest Late Successional Reserve Assessment teams while addressing the above issues in their analysis efforts:

> First, specific descriptions of structural elements which comprise suitable habitat (both in terms of fire climax and climatic climax) will be provided for late successional old growth dependent and associated species for plant association groups (PAGs) specific to the Deschutes NF. The intent of these descriptions for suitable habitat is to present a range of conditions that provide habitat for successful reproduction and dispersal of young. They are not meant to be minimum habitat conditions.
>
> Second, density levels and fuel profiles for suitable habitat conditions will be compared to density levels and fuel profiles required to sustain the stand (or landscape) over the long term. The degree of over lap between these two conditions will be clearly displayed.
>
> Third, where there is little or no overlap between suitable habitat and sustainable vegetative conditions, a process for, as well as a prototype of "desired apportioning of successional stages", by plant association group will be provided. This apportioning seems to assure, at least to the best of our ability to analyze it, a continued supply of late successional old growth habitat in our LSRs over time.

DEFINITION OF LATE SUCCESSIONAL HABITAT

If we are to manage the LSRs to protect and maintain late successional old growth forests, it is critical that we have a clear understanding of what the term "late successional old growth" means in terms of the vegetation on the Deschutes NF. In other words, what types of forest structures and associated characteristics are we labeling as suitable late successional old growth habitat? A clear definition of the desired condition will result in more effective communication and evaluation of our efforts.

In the frequent fire adapted forests of the east Cascades, we (the science team) propose that there are actually two types of late successional old growth forests: climatic climax forests and fire climax forests. These two states are very different both in terms of the species that use them and their relative sustainability. Thus, descriptions of specific key structural characteristics need to be provided for both types of conditions.

> Climatic climax forests develop in the absence of fire. These forests are characterized by dense stands dominated by climax species (true fir and Douglas-fir on mixed conifer sites), but early seral species may be dominate in the overstory for a period of time, until high densities of late seral species use most of the moisture and nutrients so the early seral species cannot survive. All size classes are usually present and understories are often very dense. This climax community takes a long time to develop, perhaps several hundred years, primarily because combinations of local weather, elevations, aspects, productivity and disturbance agents do not provide conditions for frequent community level disturbance and change. A series of low or moderate intensity fires can change these stands to a fire climax condition. However, the more typical loss of the climatic climax condition occurs with stand replacement fires, or when the stand is converted to a pole sized condition as the larger trees die and the dense stand conditions prevent growth of replacement large trees.
>
> Conversely, fire climax forests develop with frequent light to moderate intensity ground fires. These stands are characterized by open forests dominated by large trees of early seral species (most often ponderosa pine and Douglas-fir on the mixed conifer sites on the Deschutes NF). With the absence or suppression of fires, climax species (true fir) will increase on these sites and move them towards a climatic climax condition.

SUITABLE HABITAT BY PLANT ASSOCIATION GROUP

Methods: Individual Forest plant associations groups were identified. APPENDIX I provides an updated description and discussion of these plant association groups. The major PAG groups on the Forest consist of: Mountain Hemlock, Wet Mixed Conifer, Dry Mixed Conifer, Wet Ponderosa Pine, Dry Ponderosa Pine, Wet Lodgepole Pine, and Dry Lodgepole Pine. These descriptions can be modified in individual planning areas where other groupings make more sense for clarity of analysis.

Within select PAGs, the science team felt that there were two types of late successional old growth habitats: climatic climax and fire climax. All the PAGs were considered to have climatic climax conditions with 3 PAGs also having the fire climax condition: the dry mixed conifer, wet ponderosa pine and dry ponderosa pine PAGS. These three PAGs had frequent low intensity fires that maintained the late successional old growth fire climax habitat conditions historically.

The suitable late successional old growth habitat conditions for each plant association group were based on 10 selected mammalian and avian indicator species that utilize climatic climax and fire climax habitats. These species depend on or are associated with late and old structural characteristics for primary and secondary nesting, denning, roosting and foraging. Botanical species were not used as indicators due to insufficient data on late successional old growth habitat conditions. However, in the future, using plant indicators may add a dimension that is more closely tied to soil condition and mycorrhizal habitats. We started with approximately 118 wildlife species are dependent on or are associated with climatic climax and fire climax habitat conditions. Of these, only 40 species demonstrate selection for late successional old growth structural habitat and do not utilize earlier seral stages. Then through criteria determined through research, monitoring, and evaluation of habitat characteristics that provide essential habitat components for other late successional old growth dependent or associated species, we reduced the list of 40 species to 10 species.

We then translated key habitat features into measurable habitat characteristics. Structural characteristics that describe suitable late successional old growth habitat and that can be quantified include: snags/logs, canopy cover, canopy layers, trees per acre associated with a range of structural sizes, and special features. APPENDIX II describes the 10 indicator species structural habitat characteristics by individual plant association group. These characteristics were based on literature that best describes eastside biological habitat conditions and on Forest habitat research. Using the habitat characteristics identified for each indicator species, a suitable habitat condition table for each plant association group could be built.

TABLE I displays the suitable habitat conditions for each plant association group, using the Cultus/Sheridan LSR data as a prototype.

Results: Habitat characteristics identified for each indicator species by plant association group are displayed in TABLE I, using the Cultus/Sheridan LSR data as a prototype. It is VERY IMPORTANT to review this table carefully. This table displays a range of suitable habitat conditions. This DOES NOT mean that the low end of the range is what should be managed for. In some instances when desirable and sustainable conditions do not over lap, choosing the lower end of the range may be appropriate but it should not be used across the landscape. Landscape level considerations and site specific analysis will help make those determinations. The table will be used by each LSR Assessment team. **Site specifically, the LSR Assessment teams will need to modify the contents depending on the actual plant associations that are most common within each PAG.**

Climatic climax habitat featured numerous canopy layers, a high degree of snag and log accumulations, and high stand densities. Conversely, suitable fire climax habitat featured a range of single to multiple canopy layers, low amounts of snags and logs, and lower stand densities. In both of these late successional old growth types, the large trees component was a significant structural element. In fact, it was a critical structural element.

TABLE I: SUITABLE HABITAT CONDITIONS BY PLANT ASSOCIATION GROUP

Complied and Developed by Carol Morehead, Kim Johnson, Shelley Phillips, and Mike Gerdes

PAGs	Snags/Logs (Tons/Acre & Ft³/Acre)	Canopy Cover	Canopy Layers	Total Mean		Sapling 1.0 - 4.9"	Pole 5.0 - 8.9"	Small 1 9.0 - 14.9"	Small 2 15.0 - 20.9"	Med 1 21 - 24.9"	Med 2 25-31.9"	Large ≥32"	Special Features and Key Tree Species
MH (Climatic)	25 - 40 tons/ac. or 2700 - 4300 ft³/ac.	ave 70%	2 - 3	**TPA**	275	80	80	17	24	24	25	25	**AM** - Within PAG retain ≥ 50% of forest stand in mature/old growth for linkage, blocks of mature/old growth must be linked to provide connectivity.
Indicators: AM, BO	**Snag guides:** 85% > 21" dbh (examples: 6-15/ac), 15% 15-21" dbh (examples: 2-3/ac)			**BA**	433	4	21	13	42	69	107	177	**Tree Species:** PIMO - Blister rust ABMAS - Heartrot
	Log guides: 100% > 31" dia. and 33' long (examples: 7-24/ac)			**Stand SDI**	620	10	43	23	66	101	148	≥ 187	
MCW (Climatic)	25 - 35 tons/ac. or 2200 - 3100 ft³/ac.	> 70%	2 - 3	**TPA**	357	150	70	70	30	15	12	10	**PWP** - Roosts stands of white fir with > 4 TPA >20" live or dead.

PAGs	Snags/Logs (Tons/Acre & Ft³/Acre)	Canopy Cover	Canopy Layers	Total Mean		Sapling 1.0 - 4.9"	Pole 5.0 - 8.9"	Small 1 9.0 - 14.9"	Small 2 15.0 - 20.9"	Med 1 21 - 24.9"	Med 2 25 -31.9"	Large ≥ 32"	Special Features and Key Tree Species
Indicators: PWP, NSO	**Snag guides:** 60% 9-16" dbh (examples: 9-17/ac), 20% 16-25 dbh (examples: 1-2/ac) , 20% >25"dbh (examples: 1-2/ac)												**NSO** - ≥ 40% of white fir understory > 8" dbh.
				BA	270	7	19	55	53	14	51	71	**Tree Species:** PIPO and PSME - Large Tree component
	Log guides: 60% 16-25" dia. (examples: 7-16/ac), 40% >25" dia. (examples: 3-6/ac)			**Stand SDI**	476	18	37	97	85	66	74	≥ 78	LAOC, TSME, TABR - Species diversity
MCD (Climatic)	12 - 24 tons/ac. or 1100 - 2100 ft³/ac.	ave 50%	2 - 3	**TPA**	218	80	50	35	20	15	11	, 7	**PWP** - Roosts stands of white fir with > 4 TPA >20" live or dead. **GGO** - Young owlets require dense cover and/or leaning trees to escape predation.

PAGs	Snags/Logs (Tons/Acre & Ft³/Acre)	Canopy Cover	Canopy Layers	Total Mean		Sapling 1.0 - 4.9"	Pole 5.0 - 8.9"	Small 1 9.0 - 14.9"	Small 2 15.0 - 20.9"	Med 1 21 - 24.9"	Med 2 25 -31.9"	Large ≥32"	Special Features and Key Tree Species
													NG - Maintain a diversity of large trees scattered through the stands, especially near small breaks in the canopy.
Indicators: PWP, GGO, NG, BE, FO, BBWP	**Snag guides:** 70% 12-20" dbh (examples: 3-9/ac), 30% > 20" dbh (examples: .75-2/ac)			BA	218	4	13	27	35	43	47	49	**BE** - Insure large ponderosa pine and Douglas fir trees of the super canopy provide an open flight path from tree. Maintain large trees, especially snags along riparian edges that provide panoramic views and open exposure on at least one side. **BBWP** - Maintain trees with heart rot, gall rust cankers, trunk scars or mistletoe at just less than epidemic levels. Provide areas of dead or burned trees < 5 years old for foraging and roosting.
	Log guides: 100% > 15" dia. (examples: 5-14/ac)			Stand SDI	343	9	27	48	57	66	68	≥ 55	**Tree Species:** PIPO, PSME - Large tree component PILA, LAOC, CADE3, TABR, ABMAS - species

PAGs	Snags/Logs (Tons/Acre & Ft³/Acre)	Canopy Cover	Canopy Layers	Total Mean		Sapling 1.0 - 4.9"	Pole 5.0 - 8.9"	Small 1 9.0 - 14.9"	Small 2 15.0 - 20.9"	Med 1 21 - 24.9"	Med 2 25 -31.9"	Large ≥ 32"	Special Features and Key Tree Species
													diversity
MCD (Fire) Indicators: BE, WHWP, FO	**Snag guides:** BE 1-2 > 25" WHWP,FO 1-5 > 25"	30-50%	≥ 1	**TPA**	35+	0-80 ± 50%	0-50 ± 50%	0-35 ± 50%	10 ± 50%	7 ± 50%	11	7	
	Log guides: BE 1-2 > 25" WHWP,FO 1-5 > 25"			**BA**	144	10 total			18	20	47	49	
				Stand SDI	195+				28	31	68	68	
PPW (Climatic) Indicators: FO, WHWP	12 - 24 tons/ac. or 500 - 2200 ft³/ac.	> 40%	≥ 1	**TPA**	187	40	40	40	20	17	20	10	**WHWP** - Old growth should be maintain at > 37% over the PAG.
	Snag guides: 50% 18-28" dbh (examples: .5-			**BA**	285	2	11	31	35	49	86	71	**Tree Species:** PIPO - Large tree component

PAGs	Snags/Logs (Tons/Acre & Ft³/Acre)	Canopy Cover	Canopy Layers	Total Mean		Sapling 1.0 - 4.9"	Pole 5.0 - 8.9"	Small 1 9.0 - 14.9"	Small 2 15.0 - 20.9"	Med 1 21 - 24.9"	Med 2 25 -31.9"	Large ≥ 32"	Special Features and Key Tree Species
	3/ac) 50% > 28" dbh (examples: .25-1.5/ac)												PICO - species diversity
	Log guides: 100% > 20" dia. (examples: 1-9/ac)			Stand SDI	433	5	21	55	57	74	124	≥ 78	
PPW (Fire)	**Snag guides:** BE 1-2 > 25" WHWP,FO 1-5 > 25"	30 - 50%	≥ 1	**TPA**	35+	0-80 ± 50%	0-50 ± 50%	0-35 ± 50%	10 ± 50%	7 ± 50%	11		
Indicators: BE, WHWP, FO				**BA**	144	10 total			18	20	47	49	
	Log guides: BE 1-2 > 25" WHWP,FO 1-5 > 25"			**Stand SDI**	195+				28	31	68	68	
PPD (Climatic)	10-15 tons/ac. or 900 - 1300 ft³/ac.	ave 40%	≥ 1	**TPA**	180	40	40	40	20	15	15	10	**WHWP** - Old growth should be maintain at > 37% over the PAG.

PAGs	Snags/Logs (Tons/Acre & Ft³/Acre)	Canopy Cover	Canopy Layers	Total Mean		Sapling 1.0 - 4.9"	Pole 5.0 - 8.9"	Small 1 9.0 - 14.9"	Small 2 15.0 - 20.9"	Med 1 21 - 24.9"	Med 2 25 -31.9"	Large ≥ 32"	Special Features and Key Tree Species
Indicators: WHWP, NG	**Snag guides:** 15% 10-12"dbh (examples: 2.5-5/ac), 30% 12-20"dbh (examples: 1-2.5/ac), 25% 20-31"dbh (es. .25-.75/ac) 30% > 31" dbh (examples: .25-.5/ac)												
				BA	232	2	11	31	35	18	64	71	**NG** - Maintain a diversity of large trees scattered through the stands, especially near small breaks in the canopy.
	Log guides: 100% >20" dia. (examples: 7-15/ac)			**Stand SDI**	394	5	21	55	57	66	93	≥ 78	**Tree Species:** PIPO - Large tree component PICO - Species diversity
PPD (Fire)	**Snag guides:** BE 1-2 > 25" WHWP,FO 1-5 > 25"	30 -50%	≥ 1	**TPA**	35+	0-80 ± 50%	0-50 ± 50%	0-35 ± 50%	10 ± 50%	7 ± 50%	11 ± 50%	7 ± 50%	
Indicators: BE, WHWP,				**BA**	144	10 total			18	20	47	49	

PAGs	Snags/Logs (Tons/Acre & Ft³/Acre)	Canopy Cover	Canopy Layers	Total Mean		Sapling 1.0 - 4.9"	Pole 5.0 - 8.9"	Small 1 9.0 - 14.9"	Small 2 15.0 - 20.9"	Med 1 21 - 24.9"	Med 2 25 -31.9"	Large ≥ 32"	Special Features and Key Tree Species
FO	**Log guides:** BE 1-2 > 25" WHWP,FO 1-5 > 25"			**Stand SDI**	195+				28	31	68	68	

PAGs	Snags/Logs (Tons/Acre & Ft³/Acre)	Canopy Cover	Canopy Layers	Total Mean		Sapling 1.0 - 4.9"	Pole 5.0 - 8.9"	Small 1 9.0 - 14.9"	Small 2 15.0 - 20.9"	Med 1 21 - 24.9"	Med 2 25 -31.9"	Large ≥ 32"	Special Features and Key Tree Species
LPW (Climatic)	12 - 24 tons/ac. or 1000 - 2150 ft³/ac.	ave 60%	≥ 1	**TPA**	370	150	120	70	20	10			**BBWP** - Maintain trees with heart rot, gall rust cankers, trunk scars or mistletoe at just less than epidemic levels. Provide areas of dead or burned trees < 5 years old for foraging and roosting.
Indicators: BBWP, GGO, NG	**Snag guides:** 50% 11-20" dbh (examples: 3-8.5/ac) 50% > 20" dbh (examples: 1-3.5/ac) **Log guides:** 50% 11-15" dia.			**BA**	158	7	32	55	35	29			**GGO** - Young owlets require dense cover and/or leaning trees to escape predation. **NG** - Maintain a diversity of large trees scattered through the stands, especially near small breaks in the canopy.

PAGs	Snags/Logs (Tons/Acre & Ft³/Acre)	Canopy Cover	Canopy Layers	Total	Mean	Sapling 1.0 - 4.9"	Pole 5.0 - 8.9"	Small 1 9.0 - 14.9"	Small 2 15.0 - 20.9"	Med 1 21 - 24.9"	Med 2 25-31.9"	Large ≥ 32"	Special Features and Key Tree Species
	(examples: 13-43/ac) 50% > 15" dia. (examples: 6-19/ac)			**Stand SDI**	278	18	65	96	56	43			**Tree Species:** PIEN, PICO
LPD (Climatic) (High elevation Lodgepole pine plant associations including those adjacent to Mt. Hemlock)	8 - 12 tons/ac. or 700 - 1000 ft³/ac. **Snag guides:** 100% ≥ 11" dbh (examples: 13-27/ac)	ave 40%	≥ 1	**TPA**	360	150	170	40					**BBWP** - Maintain trees with heart rot, gall rust cankers, trunk scars or mistletoe at just less than epidemic levels. Provide areas of dead or burned trees < 5 years old for foraging and roosting.
				BA	83	7	45	31					
Indicators: BBWP	**Log guides:** 100% ≥ 11" dia. (examples: 34-72/ac)	(ave. 40%)	(≥ 1)	**Stand SDI**	164	18	91	55					**Tree Species:** PICO, ABMAS, PIAL, PIMO

PAGs	Snags/Logs (Tons/Acre & Ft³/Acre)	Canopy Cover	Canopy Layers	Total Mean		Sapling 1.0 - 4.9"	Pole 5.0 - 8.9"	Small 1 9.0 - 14.9"	Small 2 15.0 - 20.9"	Med 1 21 - 24.9"	Med 2 25 -31.9"	Large ≥ 32"	Special Features and Key Tree Species
LPD (Climatic)	8 - 12 tons/ac. or 700- 1000 ft³/ac.	ave 40%	≥ 1	**TPA**	353	150	120	70	13				**BBWP** - Maintain trees with heart rot, gall rust cankers, trunk scars or mistletoe at just less than epidemic levels. Provide areas of dead or burned trees < 5 years old for foraging and roosting. **GGO** - Young owlets require dense cover and/or leaning trees to escape predation.
(Lower elevations of Lodgepole pine plant associations)	**Snag guides:** 100% ≥ 11" dbh (examples: 13-27/ac)			**BA**	117	7	32	55	23				**NG** - Maintain a diversity of large trees scattered through the stands, especially near small breaks in the canopy
Indicators: BBWP, GGO, NG	**Log guides:** 100% ≥ 11" dia. (examples: 34-72/ac)			**Stand SDI**	214	18	64	96	36				**Tree Species:** PICO

PAGs	Snags/Logs (Tons/Acre & Ft³/Acre)	Canopy Cover	Canopy Layers	Total Mean		Sapling 1.0 - 4.9"	Pole 5.0 - 8.9"	Small 1 9.0 - 14.9"	Small 2 15.0 - 20.9"	Med 1 21 - 24.9"	Med 2 25 -31.9"	Large ≥32"	Special Features and Key Tree Species
Unique Habitats (Climatic)													
Engelmann Spruce	25 - 35 tons/ac. or 2700 - 3700 ft³/ac.	50 - 100%	2 - 3	**TPA**	275	100	70	40	25	15	15	10	**Tree Species:** PIEN, PICO
	Snag guides: 50% 15-20" dbh (examples: 5.5-11/ac) 50% > 20" dbh (examples: 2.5-5/ac)			**BA**	277	5	19	31	44	43	64	71	
	Log guides: 100% ≥ 15" dia. (examples: 21-43/ac)			**Stand SDI**	418	12	38	55	69	63	89	≥ 75	
Aspen	When regeneration is no longer occurring, manipulation would occur in a mosaic pattern throughtout stand.												
Meadows	When tree encroachment reaches a 30% loss of meadow when compared to 1959 photos, meadow restoration would occur.												
Willow Patches	When willow patches reach 80% decadence, treatment of 20% of the willows would occur. This would be random shrubs throughout the patch.												

TREE SPECIES FOR THE SUITABLE HABITAT CONDITION TABLE

Species code	Scientific Name	Common Name
ABMAS	*Abies magnifica var. shastensis*	Shasta Red Fir
CADE3	*Calocedrus decurrens*	Incense Cedar
LAOC	*Larix occidentalis*	Western Larch
PIAL	*Pinus albicaulis*	Whitebark Pine
PICO	*Pinus contorta*	Lodgepole Pine
PIEN	*Picea Engelmannii*	Engelmann Spruce
PILA	*Pinus lambertiana*	Sugar Pine
PIMO	*Pinus monticola*	Western White Pine
PIPO	*Pinus ponderosa*	Ponderosa Pine
PSME	*Pseudotsuga menzieii var. glauca*	Douglas Fir
TABR	*Taxus brevifolia*	Pacific Yew
TSME	*Tsuga mertensiana*	Mountain Hemlock

COMPARISON OF SUITABLE HABITAT WITH SUSTAINABILITY

Methods: For our purposes, we defined on site vegetation sustainability as a condition that:

> Is not likely to experience significant negative change in habitat quality as a result of epidemic insect or disease attack or catastrophic wildfire.

Suitable habitat (both climatic climax and fire climax) was compared with on site vegetative sustainability by individual plant association group. Stand density index and fuel profile descriptions were used as quantifiers of sustainability. These factors best determine the Deschutes NF vegetative conditions and best represent the risk of bark beetle epidemics and or extreme crown fire behavior. Bark beetle attack and high intensity wildfires were chosen as indicators since these disturbance agents are the most common cause of significant and unexpected large tree mortality (large trees are a critical element of both climatic climax and fire climax types, and also take the longest time to replace). Risk to bark beetle attack was measured using stand density index stocking guides developed by Cochran et al, 1994, for the Blue Mountains, together with adjustments and equations for plant associations groups found on the Deschutes NF but not included in Cochran's guide, (Booser et al. 1996). Fuel profiles were determined using the Morehead and Vickery model, equating tons per acre/cubic feet with wildlife habitat. Then photo series for quantifying forest residues (tons per acre) and the risk of catastrophic wildfire was displayed by plant association group.

Results: We found that suitable climatic climax habitat and densities required for on site vegetative sustainability did not overlap. For example, in mixed conifer dry, suitable climatic climax habitat is almost twice the upper management zone! Therefore, some process of cycling of the suitable habitat (habitat that is not vegetatively sustainable) and sustainable stand densities across the landscape overtime needs to be developed

TABLE II, compares suitable late successional old growth habitat (climatic climax and fire climax) conditions, with on site sustainable vegetative conditions and with existing LSR conditions by plant association groups. Suitable habitat conditions are displayed using trees per acre, the stand density index value, species composition and fuel loadings (snags and logs). These numbers are the summation of the values indicated on the suitable habitat condition table. On site sustainable vegetative conditions are defined by the Deschutes SDI values for the upper management zone (UMZ). "Sustainability" is defined by PAG and is a measure of a percent of stocking (SDI UMZ) that an individual plant association may be able to support. This SDI UMZ figure may be different than the SDI values shown in the first column for suitable habitat conditions. Remember, suitable habitat is based on species biological requirements, and sustainable forest conditions (DNF index) are based on what an individual plant association may be able to support overtime. These calculations of sustainability were intended to be a prototype since they were made using the specific vegetative conditions within the Cultus and Sheridan LSR. Existing Cultus and Sheridan LSR conditions in terms of density and fuel loading form the final column. Each LSR Assessment team will then need to adjust the range for suitable habitat based on adjustments to TABLE I and the range of sustainable forest conditions compatible with their unique mix of plant association within each PAG and the ranges in site quality of each plant association group.

It is important to note that TABLE II provides a rough comparison of suitable habitat versus sustainable forest conditions pertinent to the Cultus and Sheridan LSRs. The table does, however, represent the process we would like the LSR Assessment teams to use. **Thus, each LSR Assessment team will need to modify the columns based on individual plant associations that are most common within each PAG within their specific locations, as well as the site potential of those plant association groups.**

From these results, it appears that some process of cycling of the transient suitable habitat within the LSR overtime needs to be developed.

TABLE II: summary and comparison of conditions quantifiable between suitable habitat conditions, on site sustainable vegetative forest conditions and LSR existing conditions based on the best available data, using the Cultus/Sheridan LSR as a prototype.

PAG	SUITABLE HABITAT (1)			SUSTAINABLE (2)		EXISTING CONDITION (3)	
	TPA	DENSITY SDI	FUELS TONS/AC	DENSITY UMZ (SDI)	FUELS TONS/AC	SDI	TOTAL ACRES
MH	220-330	411-620	25-40	256	< 40		
climatic MCW	284-430	365-581	25-35	202	< 35		
climatic MCD	175-261	279-405	12-24	156	<24		
fire MCD	23-294	141-373	LOW	156	LOW		
climatic PPW	150-224	347-535	12-24	145	< 24		
fire PPW	23-294	141-373	LOW	145	LOW		
climatic PPD	144-216	313-472	10-15	102	< 15		
fire PPD	8-273	27-216	LOW	102	LOW		
LPW	296-444	222-353	12-24	161	< 24		
LPD	288-432	132-198	8-12	80	< 12		
mid - low elev LPD	282-424	172-259	8-12	161	< 12		

(1)Within the PAG, the plant association that was predominant within the LSRs is identified. This major plant association was used to identify which DNF indexes were used for the PAG. IF there are several major plant associations, a range of UMZ's could be used here. For subsequent site specific project analysis, the best site specific data available will be used for density prescriptions, keeping areas below the UMZ in order to sustain or create future suitable conditions, wherever possible, while still providing current, but perhaps unsustainable habitat as well, to meet current suitable late successional old growth habitat needs.

(2) Based on Cochran et al. 1994, Joanna Booser and Jim White developed the paper "Calculating Maximum Stand Density Indexes (SDI) for the Deschutes National Forest Plant Associations", 1996, that was used in determining the above table's values. Cochran advised using the lowest plant association values within the PAGs as the index. Again, the approach here was to use the UMZ of the major plant association (or major plant associations) in the PAG, which pushes management closer to the unsustainable level, but allows leaving more short term suitable habitat. The best available site specific density values will be used when managing specific stands overtime across the landscape, not the lumped PAG value used here for broadscale planning purposes.

UMZ - For most species, the upper management zone is defined as the density level at which a suppressed class of trees begins to develop (Cochran et al. 1994). This is the point at which sufficient competition is happening between trees to cause some trees to begin to slow down in growth, even to the point of death. The primary cause is that, on any given piece of ground, there are limits to the resources available for plant growth. These resources include light, water, nutrients, and growing space. When these limits are reached, loss of plant growth and/or mortality are common elements of the stand. These conditions can be ideal for certain late successional old growth plant and animal species. However, they are often providing the ideal habitat conditions only after there has been sufficient limitations of previous density levels that allowed a large tree component to develop. Historically, these limitations were provided in drier plant associations by frequent fire intervals which tended to limit development of understories and favored growth of the forest with overstory trees.

In ponderosa pine or lodgepole pine, the UMZ is calculated somewhat differently from the other species. This was recommended by Cochran et al. 1994, to show the level above which higher levels of large tree mortality are much more likely to occur. For these tree species, the UMZ correlates to a high risk threshold for markedly increased tree mortality due to many of the forest pests which are dependent on density and lower tree growth for epidemic levels to be reached. Other factors besides density, such as species composition, must be considered for the density independent forest pests such as the fir engraver beetles and spruce budworm. However, the use of UMZ in stands which are typically not hosts to density dependent pests is still recommended if the desire is to let small trees grow to large trees more quickly and safely especially where large trees are in short supply. This is because the presence of a suppressed class of trees would indicate average tree growth in the stand is beginning to slow down, perhaps significantly.

(3) SDI and Total Acres. Each site specific LSR Assessment team will need to determine their appropriate existing vegetative conditions.

CRITERIA USED TO CYCLE AND SUSTAIN DESIRED LATE SUCCESSIONAL OLD GROWTH CONDITIONS WITHIN THE LSRS

We believe that successful management of the Forest LSRs should result in the satisfaction of two criteria: 1) minimum critical thresholds should be maintained over the short term and 2) sustaining habitat above this threshold over the long term. This section reviews whether we can simultaneously satisfy both criteria at the same time.

Methods:

Critical Minimum Thresholds:

Minimum critical habitat thresholds for the northern spotted owl (climatic climax indicator species) have been set by the U.S. Fish and Wildlife Service, USDI, 1992. These thresholds were used in determining the amount and size/structure distribution of suitable late successional old growth habitat for the owl and other dependent and associated wildlife species within the LSR. The USFWS thresholds are a measure of suitable habitat within the owls home range radius. Calculations indicate that a **minimum** number of suitable climatic climax habitat acres for each LSR. The number of northern spotted owl pairs within the LSR were determined using the USDI Final Draft Recovery Plan for the Northern spotted Owl, December 1992. The minimum acres within each LSR are as follows: Davis LSR, 9,264 acres or 19 % of LSR; Metolius LSR, 10,422 acres or 14 % of LSR; and Cultus/ Sheridan LSR, 6948 acres, 13 % of LSR.

For fire climax species, like the northern bald eagle, there are no exact numbers that can be calculated. However, there are guidelines that do provide sideboards. For example, Bald Eagle Management Areas (DNF LRMP), and the US Fish and Wildlife Service recovery plan population density criteria provide specific management direction.

Historic Range of Variability was used as a frame of reference when addressing all species viability. A pivotal assumption in the use of HRV is that an element or process that is outside the range or natural variability cannot be sustained naturally (Caraher et al. 1992). Native species have adapted to the natural disturbance events of the Holocene (the past 10,000 years) environment and require those conditions for their survival (Swanson et al. 1993). Thus, through the watershed analysis process, we developed ranges of variability for our plant association groups.

Suitable habitat was examined from a spatial standpoint. Basically we were looking at quantity of , distribution and fragmentation of that habitat on a landscape level. This element was used to adjust critical habitat threshold levels above the minimum levels set by the USFWS and levels described by HRV. This was a very important element in the decision matrix since critical habitat must also be functionally distributed.

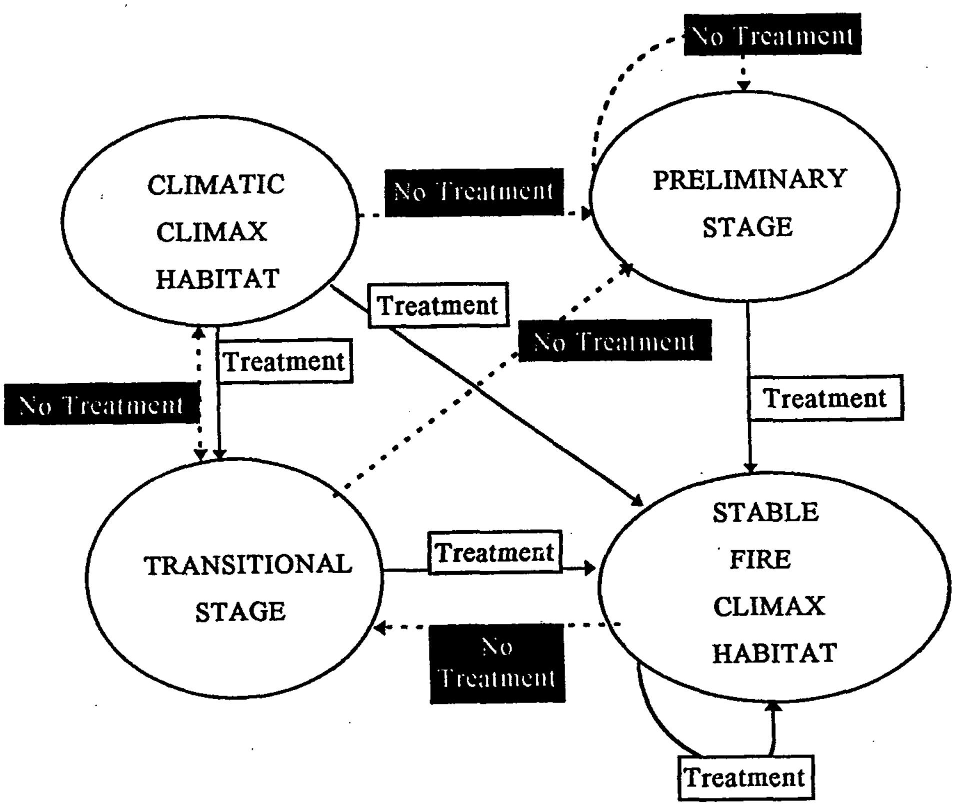
In summary, the above 4 elements were considered in and were used to develop estimated species thresholds. For example, in the mixed conifer wet plant association group, we first factored the USFWS habitat threshold for the northern spotted owl of 40 % suitable habitat within the owl's home range radius. By LSR this varies from 13 - 19 percent of the total LSR acreage, see above. We then estimated the distribution and amount of suitable habitat, without regard to land allocation, on a landscape level. This gave a picture of how suitable habitat was distributed on the Deschutes NF and adjoining Forests. Lastly using to the Historic Range of Variability, a range from 11-43 % was in either climatic climax or fire climax habitats. Thus, when these elements were factored together, along with an additional factor of how little the mixed conifer wet PAG made up of the LSR, we determined the percentage for the suitable habitat threshold.

Cycling Suitable Habitat:

In order estimate how much suitable habitat could be consistently sustained in the LSR overtime, we used two approaches. First we developed a conceptual flow model to visualize how we might approach cycling of late successional old growth habitat across the landscape, FIGURE I. In this model landscape vegetation was divided into four stages: 1) preliminary vegetation stage; 2) stable fire climax suitable habitat stage; 3) transition vegetation stage; and 4) climatic climax suitable habitat stage. Movement between the 4 vegetation stages, as a result of no management versus management (thinning to below the upper management zone) was also theorized. Rates of flow between the 4 vegetation stages were assumed based on general forest growth relationships and general forest pest behavior and impacts specific to central Oregon.

Second, we used the Historic Range of Variability to visualize how natural processes cycled the vegetation. The HRV numbers were taken from the watershed analysis for Odell and Metolius WA.

FIGURE IV-1. CONCEPTUAL FLOW MODEL OF CYCLING SUITABLE HABITAT IN RESPONSE TO TREATMENT OR NO TREATMENT



(1) Treatment consists of stocking control measures that result in on site stability and this promotes the growth and retention of large tree dominated forests.

The 4 vegetation stages are described in detail as follows:

<u>Preliminary vegetation</u>: Stands falling into this group, do not satisfy the requirements of either climatic climax or fire climax dependent or associated species. These stands encompass a wide range of structures and densities but share the common characteristic that large trees are not prevalent.

Management of these stands should emphasized growth into the late successional old growth condition as quickly as possible. Management activities in high risk stands could move them towards this group by thinning to lower susceptibility to bark beetles so existing trees can rapidly continue their development towards large trees. It may also take the form of a prescribe burn to remove hazardous levels of fuels. In the frequent fire adapted ecosystems, lack of management will result in cycling from other categories back to this category for many stands as a result of insect and disease attack and catastrophic wildfire.

Stable fire climax suitable habitat: Stands falling into this group of vegetation satisfy the requirements for suitable fire climax habitat and they are below the upper management zones. Without density management, or the re-introduction of fire, these stand types often progress into the unstable fire climax stage described below and may progress into unstable climatic climax suitable habitat. Continued density reduction through mechanical thinning or thinning by prescribed fire will maintain stands in this category.

Transitional vegetation: The condition that exists when stable fire climax vegetation transitions increases in density and becomes unstable fire climax but not yet suitable climatic climax. This condition is above the upper management zone but below the density levels or large tree sizes required to achieve the necessary structural attributes for climatic climax suitable habitat. Management in these stands should focus on developing the large tree component for climatic climax, developing the understory conditions needed for climatic climax when the large tree structure is already present, or density reduction to return the stand to suitable fire climax conditions.

Climatic climax suitable habitat: This group has the structural attributes necessary for climatic climax late successional old growth habitat, i.e. nesting, roosting and foraging habitat for the northern spotted owl. In most situations, this habitat cannot be managed both to retain these essential characteristics and be below the upper management zone. In some cases, however, it could be thinned, prior to some natural endemic advent, to a fire climax late successional old growth condition which is stable and could, in a relatively short period of time once again be suitable climatic climax. This action might be appropriate if there are disproportionately large amounts of climatic climax and small amounts of fire climax. Without treatment this vegetation group will revert to some variation of the preliminary vegetation stage or less likely to transitional vegetation.

Under active management and no management scenarios, it is very likely that the stand would not remain over time as climatic climax habitat. The difference would be that under active management the desired large tree structure could likely be retained over time; under no management it would likely not be retained.

Using one to several rotation cycles for each plant association group, we cycled structural stages through time, so there will be habitat on line to replace existing habitat when it no longer functions. Estimated growth, the use of the upper management zone (UMZ) to help determine levels of sustainability, and mortality rates were used to help determine realistic cycles. Suitable habitat decline will most likely be as a result of insect, and/or disease attack or wildfire.

TABLE III represents a visual display of the criteria, giving a quantitative representation to these criteria and size structure groups using percentages or a range of percentages.. Because the landscape was so fragmented and the amount of remaining suitable habitat was only found within the LSR, we found that spatial considerations were very important when determining suitable habitat thresholds. Concerns about the spatial distribution of habitat resulted in higher levels of habitat compared to the USFWS thresholds and historic levels. These concerns only applied to the mixed conifer plant association groups.

TABLE III EVALUATION CRITERIA, USING THE CULTUS/SHERIDAN LSR AS A PROTOTYPE.

	SUIT HAB. THRESHOLDS. % of Acres in ea size class				CYCLING (1) % of Acres in ea size class				HRV % of Acres in ea size class				
Size Structure	MCW	MCD	PPW/D	LPW/D	MCW	MCD	PPW/D	LPW/D	MCW	MCD	PPW/D	LPW/D	MH
Seed/Sap (2) 0-5"	-	*	*	25	6	7	5	25	0-40 0-25	0-40*	5-50	0-80 0-60	0-3
Pole (2) 5-9"	-	*	*	25	7	7	5	25	3-30* 23-80*	*	28-100*	10-80	0-40
Small (2) 9-21"	40	30*	40*	50	12	15	10	50	0-32* *	32-100*	*2-50	10-100 10-60	0-50
Medium (3) 21-32"	60*	60c/ 10f*	5c/55f*	-	25	38	20	-	11-43*	23-90*	20-70*	0+	5-20*
Late/Old (3) >32"	*	*	*	-	50	33	60	-	*	*	*	-	*

(1) Different rotation lengths were used for each plant association group. These rotation lengths (until regeneration is required) are as follows: MH, 600-1200 + years; MCW, 400 years; MCD 350 years; PPW/D, 500 years and LPPW/D, 100 years. The number of years within each structural group maybe calculated by multiplying the percent (as a decimal) in the table by the rotation length.

(2) These three size/structure classes represent the preliminary stage.

(3) These size/structure class represents either the stable fire climax habitat stage, transitional stage or the climatic climax habitat stage.

* - Percentage is shared between size structure classes, either up or down the size scale.

c - Climatic climax.

f - Fire climax.

Within the HRV column, note 2 sets of numbers. These represent figures from the Cascade Lakes and Odell Watershed Analysis.

Results: TABLE IV represents the integration of the above criteria to achieve a proposed distribution of vegetative conditions by plant association group across the landscape. Vegetation conditions are divided into 4 groups: 1) Preliminary vegetative conditions that are not large tree dominated. It recommended that these preliminary stage stands be managed below the upper management zone to hasten the development of large; 2) Suitable habitat -- fire climax; 3) Vegetative conditions that are above the upper management zone but are less than suitable habitat and is transitional stage in Figure I; and 4) Suitable habitat-- climatic climax. We propose that if the four conditions are well distributed in the displayed proportions across the LSR, that with management, a continual supply of suitable habitat can be maintained over the long term.

These percentages, since they are derived from integration of the species and tree growth data specific to each LSR, will vary somewhat based on the plant associations that make up the majority of each PAG, and the wildlife species that use these habitats.

TABLE IV: DESIRED AMOUNTS OF 4 TYPES OF VEGETATIVE CONDITIONS

PAG (1)	PRELIMINARY STAGE (2)	SUITABLE HABITAT % FIRE (3)	TRANSITIONAL STAGE (4)	SUITABLE HABITAT % CLIMATIC (5)
MH	15 (0-30)	NA	15 (0-30)	70 (40-70)
MCW	30 (20-40)	NA	10 (0-20)	60 (50-70)
MCD	25 (20-30)	10 (5-10)	25 (20-30)	40 (30-50)
PPW/D	20 (10-30)	55 (40-70)	20 (10-30)	5 (0-10)
PPW/D FORESTED LAVAS	20 (10-30)	5 (0-10)	20 (10-30)	55 (40-70)
LPW/D	40 (20-60)	NA	10 (0-20)	50 (30-70)

DESCRIPTION OF THE COLUMNS

(1) Plant Association Groups - are the combinations of plant associations, described by Volland, 1988, grouped according to productivity and growth potential. All plant association groups are the groupings defined by the science team meeting of February 22, 1996. Those groupings match the groupings in the WEAVE document with a few changes/exception as noted in the notes from the February 22 meeting. It should be noted that while PAGs work well as guidelines for landscape analysis, specific plant associations or individual stand measurements where available, must be used for site specific prescriptions to best meet long term habitat objectives

(2) vegetative conditions that are below the upper management zone, thus, sustainable. See figure I, this column relates to the preliminary stage. UMZ defines the point at which a suppressed class of trees begins to develop or high risk threshold of density related insect - indexed mortality for large pines is reached. In other words, the stand can maximize growth with little or no threat from insect attack. When prescribing management in these stands, consideration should be given to the conifer species and diameter mix desired to move these stands towards late successional old growth suitable habitat conditions.

(3) Suitable habitat -- fire climax conditions - as quantitatively described in TABLE I. See figure I, this column relates to the stable fire climax habitat stage.

(4) vegetative conditions that are above the upper management zone but are less than suitable habitat, describes a range of conditions between these two quantitative points. See figure I, this column relates to the transitional stage.

(5) Suitable habitat -- climatic climax conditions - as quantitatively described in TABLE I. See figure I, this column relates to the climatic climax stage.

It is important for readers to understand that the objective of all management within the LSRs, is to provide suitable late successional old growth habitat for the long term. Stands in column 5 (less than the UMZ) must be managed to provide big trees of long-lived species like ponderosa pine and Douglas fir in a short period of time. Wise management of these stands will set the stage for moving into column 4 (above the UMZ) where these stands should meet the large tree criteria of suitable habitat. Stands in column 4 should continue to be managed to encourage development of large tree structure to replace loss of habitat in column 1 over time.

The mixed conifer dry PAG generated the most discussion and discomfort with relative percentages generated for columns 2-4, both in terms of suitability and sustainability.

The minimum critical thresholds of suitable habitat were the base starting point in building the desired condition table for late successional old growth habitat conditions. **It is very important to note that the LSR should not be managed for the minimums but rather as optimal habitat for late successional old growth habitats for those dependent or associated species.**

Estimated time frames for how long those late successional old growth conditions might last and how long it would take to grow those conditions back from a regenerated stand were considered for various structural stages and the length of time in each of those stages.

In mixed conifer dry, it was estimated that it would take 250 to 350 years to grow late successional old growth conditions from a regenerated stand (if managed).

Depending upon the plant association group, it was estimated that the suitable habitat conditions would last in the mixed conifer wet PAGs approximately 60 years and within the mixed conifer dry PAGs approximately 30 years.

It was also determined that on a 300 year rotation, you could only have 1/6 (about 17%) of the land area in suitable habitat on a sustainable basis.

With management, stands in the mixed conifer PAGs could have the species mix kept to a fairly resistant mix for defoliators, and could allow manageable losses of bark-beetle susceptible trees. This might then let us get up to 40% of the PAG in a fairly sustainable suitable habitat connotation, with replacement stands coming along in the appropriate structural conditions.

SUMMARY

Several important conclusions may be drawn as a result of this paper. First, in order to effectively manage our LSRs, we must be able to define what the late successional old growth suitable habitat conditions are for both climatic climax and fire climax forests. The definition must make ecological sense, and must be measurable and practical on the ground. TABLE I provides the framework to fully describe suitable habitat conditions for the plant association groups on the Deschutes NF, based on the characteristics of the major plant associations within those groups. **Each LSR Assessment team will need to adjust the contents of TABLE I to**

fit the actual plant associations that are most common within their LSR, for each plant association group.

Second, most of our suitable climatic climax habitat conditions within our LSRs are often not sustainable for any period of time. Meeting suitable climatic climax habitat conditions for late successional old growth species and keeping the stands below the upper management zone are not compatible as clearly displayed in TABLE II.

Lastly, a strategy of rotating late successional old growth habitat through several vegetative structural stages and across the landscape through management seems to be appropriate. It also appears doable using the USFWS minimum thresholds and historic range of variability. However, it may not be achievable at this time due to quantity of -, distribution and fragmentation of the suitable mixed conifer late successional old growth habitats on a landscape level that currently exists within our LSRs. An aerial view of our landscape shows that almost all of our late successional old growth habitat is within our LSRs. Even inside our LSRs, the landscape is heavily fragmented. The balance of the landscape is also heavily fragmented with few residual stands of late successional old growth habitat.

Most of the plant association groups on the Forest and in general, eastside forests, are not able to provide large sustainable contiguous blocks of suitable northern spotted owl habitat, i.e. climatic climax habitat. Historically, on the Deschutes NF it is believed that owl habitat was limited to the wet mixed conifer and moist north aspect dry mixed conifer PAGs. The pattern of this habitat was in a mosaic distribution, intermixed with earlier seral stages. The number of owls on the Forest probably varied significantly through time depending on the amount of available habitat. Currently, the Deschutes NF has 34 owl pairs utilizing fragmented habitat, of which only a few are reproductively successful on an annual basis. This number may be the highest density of owls the Deschutes NF has yet experienced and may not be sustainable overtime. Never-the-less, this plan is designed to provide enough suitable habitat for all current owl pairs within the LSRs. The consequence of this strategy is that a large percentage of several PAGs are in an unstable condition which means that they are at high risk of epidemic insect and disease attack and catastrophic wildfire. In the short term this may not be a problem because there is an excess amount of habitat in the Transitional and Suitable Climatic Climax Habitat Stage (TABLE IV). Therefore, it will take several years of vegetative treatments just to get these PAGs down to the upper limits displayed in TABLE IV. In the long term, however, the Forest will need to evaluate the risks of maintaining large portions of the Forest in an unstable condition. This may result in a lowering of the percentages of various PAGs in the unstable categories. This, in turn, will result in a re-calculation of the number of northern spotted owls the Forest can support.

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Appendix I -- Plant Association Groups and Data Sources for Vegetative Information

Plant Association Groups	Plant-Associations		Eco-Class	Prod Class
Meadows	* MW	Wet Meadow	MW	7
	* MM	Moist (Hairgrass) Meadow	MM	7
	* MM	Moist (Bluegrass) Meadow	MM	7
	MD	Dry Meadow	MD	7
Xeric Shrublands	SD	Low sagebrush/Idaho fescue	S1	7
	SD	Big sagebrush/bunchgrass	S1	7
	SD	Big sagebrush/needlegrass	S1	7
	SD	Big sagebrush-bitterbrush/bunchgrass	S1	7
	SD	Buckwheat Flats	BF	7
	GB	Bluegrass Scabland	G1	7
Mesic/Wet Shrublands	* SW-22	Associations within forest zone or one topographic positions such as flood plains and canyons which accumulate subsurface moisture. Stands have either alder, willow, or spirea as dominant woody vegetation; could be forest lands if fire has been suppressed.	SW	
	* SW-11	Associations within riparian areas with standing or running water. Soils imperfectly drained through much of the growing season. Shrubs commonly alder, willows huckleberries or spirea.	SW	
Alpine Shrublands	SS-15-11	High elevation; above timberline; soils imperfectly drained early in the growing season or well drained.		
Subalpine/Alpine Meadows	MS-21	Associations dominated by sedges and occurring at high elevations; soils imperfectly drained-moist into summer		
Juniper Woodlands	CJ-S3-11	Juniper/bitterbrush/bunchgrass	J1	7
Ponderosa Dry	CP-S1-12	Ponderosa pine/bitterbrush-big sage/squirrel tail	PS	7
	CP-S2-17	Ponderosa pine/bitterbrush-manzanita/fescue	P3	6
	CP-S2-12	Ponderosa pine/bitterbrush/needlegrass	P5	6
	CP-S2-15	Ponderosa pine/bitterbrush/sedge	P1	6
	CP-S2-18	Ponderosa pine/bitterbrush/squirrel tail	PN	6
	CP-S3-12	Ponderosa pine/bitterbrush-snowbrush/sedge	P4	6
	CP-S2-13	Ponderosa pine/bitterbrush-manzanita/needlegrass	P2	6
	CP-S2-16	Ponderosa pine/bitterbrush/bluebunch wheatgrass	P8	6
	CP-S1-11	Ponderosa pine/bitterbrush-big sage/fescue	P8	6
	CP-S2-11	Ponderosa pine/bitterbrush/fescue	P1	6
	CP-S2-14	Ponderosa pine/bitterbrush-manzanita/sedge		6

Plant Association Groups	Plant-Associations		Eco-Class	Prod Class
Ponderson Wet	CP-S3-14	Ponderosa pine/bitterbrush-snowbrush/fescue	P3	6
	CP-S3-11	Ponderosa pine/bitterbrush-snowbrush/needlegrass	P7	6
	CP-G2-12	Ponderosa pine/sedge-fescue-peavine	PF	4
Lodgepole Dry	CL-G3-11	Lodgepole pine/needlegrass basins	L6	7
	CL-G4-13	Lodgepole pine/sedge-needlegrass basins	L6	7
	CL-S2-14	Lodgepole pine/bitterbrush/fescue	L3	6
	CL-S9-11	Lodgepole pine snowbrush-manzanita	P2	6
	CL-G3-14	Lodgepole pine/needlegrass-lupine	L7	6
	CL-S2-15	Lodgepole pine/gooseberry-bitterbrush/needlegrass	L5	6
	CL-S2-11	Lodgepole pine/bitterbrush/needlegrass	L5	6
	CL-S2-16	Lodgepole pine/bitterbrush (rhyolite)	L9	6
	CL-S1-12	Lodgepole pine/big sage (rhyolite)	L0	6
	CL-S1-11	Lodgepole pine/big sage/fescue	L	
	CL-G3-13	Lodgepole pine/needlegrass-lupine-linanthastrum	L7	6
	CL-S4-12	Lodgepole pine/grouse huckleberry	L8	5
	CL-S3-11	Lodgepole pine/pinemat manzanita	L6	7
Lodgepole Moist/Wet	CL-M4-11	Lodgepole pine/beargrass	M2	5
	CL-G4-12	Lodgepole pine/sedge-penstemon-lupine	M1	5
	CL-G4-11	Lodgepole pine/sedge-lupine	L8	5
	CL-M2-11	Lodgepole pine/bearberry	L2	6
	CL-S2-12	Lodgepole pine/bitterbrush/sedge	L4	5
	CL-S2-13	Lodgepole pine/bitterbrush/forb	L2	6
	CL-M1-11	Lodgepole pine/sedge-grass wetland	L1	5
	* CL-M1-12	Lodgepole pine/kentucky bluegrass		
	* CL-M1-13	Lodgepole pine/widefruit sedge		
	* CL-M1-15	Lodgepole pine/tufted hairgrass		
	* CL-M3-11	Lodgepole pine/grouse huckleberry/forb wetland	L1	5
	* CL-M3-12	Lodgepole pine/bog blueberry/widefruit sedge		
	* CL-M3-13	Lodgepole pine/Douglas spirea/forb		
	* CL-M3-14	Lodgepole pine/Douglas spirea/widefruit sedge		
	* CL-M9-11	Lodgepole pine-Engleman spruce/few flowered spikerush		
Mixed Conifer Dry	CR-S1-11	Mixed Conifer/Manzanita		
	CW-H1-11	CW/snowbrush-chinkapin	W2	6
	CW-S1-14	CW/snowbrush	W1	5
	CW-S1-12	CW/snowbrush-manzanita	W1	5
	CW-C2-11	CW/snowbrush-chinkapin/bracken fern	W3	5
	CW-C2-13	CW/snowbrush/sedge-bracken fern	W5	5
	CW-S1-15	CW/snowbrush/sedge	W6	5

Plant Association Groups	Plant-Associations		Eco-Class	Prod Class
Mixed Conifer Wet	CW-C2-12	CW/snowbrush-chinkapin/pinegrass	W3	5
	CW-S1-13	CW/manzanita-snowbrush/sedge-penstemon	W0	4
	CD-S6-13	CW/snowberryforb	W8	3
	CD-S6-12	CW/snowberry/twinflower flatlands	W9	4
	CD-S6-14	CW/snowberry/elk sedge	W7	4
	* CW-S9-11	Engelmann spruce bottom lands	E1	4
	* CW-F4-31	White fir/queencup beadlily		
	* CW-M2-22	Engelmann spruce/queencup beadlily		
	* CE-M3-11	Engelmann spruce/bog blueberry/forb		
	* CE-M3-12	Engelmann spruce/bog blueberry/widefruit sedge		
	* CE-M1-11	Engelmann spruce/widefruit sedge		
	* CE-M2-21	Engelmann spruce/common horsetail-twisted stalk		
Mountain Hemlock +	CM-S1-11	Mt. hemlock/grouse huckleberry	M1	5
Whitebark pine		Zones above Mt. Hemlock		
Riparian	HQ-S2-21	Quaking aspen/common snowberry/blue wildrye		
	HQ-M1-21	Quaking aspen/blue wildrye		
	HQ-M4-11	Quaking aspen-lodgepole pine/Douglas spirea/widefruit		

* Plant associations marked with * can be found adjacent to streams and can be included in the riparian plant association group for mapping ecological units.

DATA SOURCES FOR VEGETATIVE INFORMATION

a. **Data Sources for Potential Natural Vegetation (Plant Association Groups)**

1. Timber stand exam field verified plant associations
2. 1976 Soil Resource Inventory Ecoclass Map, 2"/mi. USGS Topographic Maps
3. Vegetation Resource Survey (Forest Timber Type Mapping from 1982)
   - Photo typing was completed on 1981 resource photos
   - TRI/GIS Database includes stratification codes on ecotype codes which correspond to the 4"/mi. GIS stand maps.
   - SO Timber Inventory has original 4"/mi, Orthophoto Stand Maps
4. Aerial Photo Interpretation
5. Ecology Plots, Inventory Plots, Managed Stand Survey Plots
6. Forest Ecomapping Contract (Available at the end of 1995)
7. Local Knowledge
8. 1908/1916 Timber Type Map located in 1908/1916 Fire Records.

b. **Data Sources for Current Vegetation**

1. Timber stand exam information -- Stand data base
2. PMR
3. Aerial Photo Interpretation (complete set of 1989 infra-red available).
4. Activity data and mapping since 1988 to update PMR
   - Stand database and IADB
   - Harvest Layer
   - Reforestation Layer
   - Timber Stand Improvement Layer
   - Fuels Layer
5. Fires since 1988 to update PMR
6. Forest Decline Layer

c. **Data Sources for Historical Vegetation Patterns**

1. Forest Ecologist, Bill Hopkins
2. Forest Fire Atlas Maps which date back to the early 1900's
3. Cadastral survey notes which date mid to late 1800's
4. Historic literature
5. Forest fire lookout panoramic photos taken in the 1930's
6. 1943 and 1959 aerial photos
7. Stand reconstruction field data

8. Fire History studies and analysis (see Appendix E).

APPENDIX II: HABITAT STRUCTURE CHARACTERISTICS FOR THE 10 INDICATOR SPECIES.

The table following summarizes described habitat structures for the various late successional old growth indicator species, together with research and Forest monitoring data that provide additional habitat descriptors. Ground cover (CWM, shrubs, grasses and forbs) is not discussed in the table though it is a critical element for the indicator species. All are predatory and rely on ground cover to support the prey base they live on to one degree or the other. Only logs, an element of CWM, will be described in the table. Note, that after each species an abbreviated identifier is shown (i.e., American Marten (AM)). Within the habitat structure the reader will notice (*) which separates different references. The habitat characteristics are then followed by a reference identifier code (i.e., A, B, AA, BB, etc.), which are listed after the tables.

HABITAT STRUCTURE CHARACTERISTICS SUMMARY SHEET FOR INDICATOR SPECIES

Compiled by Carol Morehead and Shelley Phillips

Species	PAGs	Snags	Logs	Canopy Cover	Canopy Layers	Tree Size/ Trees per Acre	Basal Area	Home Range	Special Features
American Marten (AM)	MH	*18/ac >31^2 dbh 13' tall (X), *class 2 & 3 (R) * 20-35/ac (A) *>20^2 dbh at rest sites >31^2 dbh at den sites (S)	*8-20/ac (H) *16/ac > 31^2 dia. and 33' long (X) *>20^2 dia. at rest sites >31^2 dia. at den sites Intermediate decay class (S)	*40-60% at rest and forage sites Avoids stands <30% (Y) *71% ave overall (w/roads), 83% ave in forested stands (R)	*2-3 (S)	*<u>Rest Sites</u> >20^{2}dbh - 50% >39^{2}dbh- 50% (S) *20-30^2 dbh (R) <u>Den Sites</u> *>31^2 dbh (S) *31-49^2 dbh (U)	*130-260 ft^2/ac (W), *126-252 ft^2/ac (U) *409-474 ft^2/ac (R)	Female *3.9 mi^2 (S), *.3-1.4 mi^2 (W), *1 mi^2 (A) Male * 6.7 mi^2 (S), *.6-3.2 mi^2 (W), *2-4 mi^2 (A) *1-2 mi^2 (U)	*w/in 1-5 mi^2 retain ≥50% of forest stand in mature/OG for linkage, blocks of mature/OG must be linked to provide connectivity (A) *Needs at least 160 acre blocks of suitable habitat (X)
Boreal Owl (BO)	MH	*2-3/ac > 15^2 dbh 1-7/ac >15^2 dbh at nest sites 2.4/ac >15^2 dbh at roost sites (Q)		*30-63% *<u>Roosting-</u> Winter-58% Summer-63% 44% average at roost sites 26-34% at nest sites (Q)	*2-3 (Q)	<u>Nest Sites</u> *23 (± 6) TPA, >15^2 dbh 1-9^2 dbh, 161± 66 TPA *<u>Roosts</u>: Winter 656 TPA, 1-9^2 dbh, 67 TPA, >9^2 dbh Summer 1060 TPA, 1-9^2 dbh 84 TPA, >9^2 dbh	*78 (± 14) ft^2/ac <u>Roosting-</u> Winter 113 ft^2/ac Summer 130 ft^2/ac (Q)	<u>Winter</u> *5.6 mi^2, <u>Summer</u> 4.5 mi^2 (Q)	

Species	PAGs	Snags	Logs	Canopy Cover	Canopy Layers	Tree Size/ Trees per Acre	Basal Area	Home Range	Special Features
						Combined 6 TPA, >15² (Q)			
Pileated Woodpecker (PWP)	MCW & MCD	* ≥3/ac >20² dbh (F) *Forage >12² dbh (U)	*Recommended 40/ac ≥ 15² dia. Mean density 117/ac ≥ 15² dia., long dead logs were preferred. (F)	* ≥ 60% (F)	*2-3 (U)	*28² dbh , roosts (G) *>8² dbh >20² dbh, roost >9² dbh, foraging >21² dbh, nest tree (U)		*1.6 mi²(F) *543 ac/pair (U)	*Roost stands of Grand fir >4/ac > 20² dbh live & dead (G)
Northern Spotted Owl (NSO)	MCW	*8/ac ≥ 16² dbh(L) * >5/ac (>25² dbh) >6/ac (16-25² dbh) 16/ac >25² dbh (N) *>16/ac (9-16² dbh) 12/ac >15² dbh (DD)	*15/ac ≥ 10² dia. (L) * >8/ac (16-25² dia.) >5/ac (>25² dia.) (N) *15/ac >15² dia. (DD)	*60-65% (L) *70-100% 63-67% (N) *75% (DD)	*2-3 (N)	*Overstory - ≥ 8 TPA, ≥ 21² dbh 2Layer - ≥ 82 TPA, ≤ 21² dbh (L) *70-90 TPA, 5-9² dbh 50-70 TPA, 9-16² dbh 20-30 TPA, 16-25² dbh 12-19 TPA ,> 25² dbh (N) * Overstory - 22 TPA ≥ 25² dbh 2Layer - 280 TPA (DD)	*180-210 ft²/ac (Range 135-350 ft²/ac) (N)		*>40% white fir understory > 8² dbh, Patch size, 40-200 acres of suitable habitat (L)
Bald Eagle (BE)	MCD			*Overstory <20% (Range 20-40%) 2 Layer -	*1-2 (T)	*Overstory - 8.5 TPA, >44² dbh (Range 1-30 TPA) 2Layer - 40		*10-15 mi² Distance between occupied nests .6-2 miles (AA)	*Nest tree has open flight path and panoramic view, Perching w/in 165' of H2O, typically in snags, tallest tree along shoreline w/panoramic view &

Species	PAGs	Snags	Logs	Canopy Cover	Canopy Layers	Tree Size/ Trees per Acre	Basal Area	Home Range	Special Features
				20-40% Overall - 20-40% (<70%) (T)		TPA ,20^{2} dbh (T)			open exposure on at least one side One or more alternate nests are common (AA)
Flammulated Owl (FO)	PPW MCD	* > 28^{2} dbh (H) * 22 $\pm$ 4.7^{2} dbh, 28 $\pm$ 5.7^{2} dbh (Q) *11.8 - 22.8^{2} dbh, nests in snags (U)		* <50% (O) *35-70% (Q)	* >1 Roosts >2 (Q)	*28^{2} dbh, nest trees 134 $\pm$ 59 TPA, 238 $\pm$ 182 TPA Roosts - 800 TPA (Q) *>19.6^{2} dbh (H) *7.8-19.6^{2} dbh surrounding stand (O)	*103 $\pm$ 84.6 ft^{2}/ac Roosts - 562 ft^{2}/ac (Q)	Male * 25 ac (U)	*Roost- select PP w/in MC stands, avoids pure PP (Q)
White-headed Woodpecker (WHWP)	PPW PPD	Nests * >31^{2} dbh (J) * > 18^{2} dbh (Range 9-39^{2} dbh), nests (U) *1/ac, 26^{2} dbh nests, (B) Roosts * >24^{2} dbh (J) *45/100 ac 10^{2} dbh, 82/100 ac 12^{2} dbh, 45/100 ac 20^{2} dbh (K) *Decay Class 2-4 (J)		* Nests < 26% (B) * 24%(mean) Roosts 44% (J)	* > 1 (B)	*Nest Areas ≤166 TPA (K) * Foraging > 20^{2} dbh (U) *10 TPA > 21^{2}dbh or 2 TPA > 31^{2} dbh >24^{2} dbh, forage nest ave. 26^{2} dbh, (range, 8-31^{2} dbh) (B) *Mean 31^{2} dbh, nest 24^{2} dbh, roost 29^{2} dbh, forage (J)	* ≥ 40 ft^{2}/ac lg trees Nest sites 15-22 ft^{2}/ac (J)	*.8-1.3 mi^{2} In contiguous stands, 524 ac (J) *1.7 mi^{2} (0.18-3mi^{2}) 261 ac in pure OG stands (B)	* Home ranges should contain > 37% OG (J) * Forages in live trees, secondarily use snags (B)

Species	PAGs	Snags	Logs	Canopy Cover	Canopy Layers	Tree Size/ Trees per Acre	Basal Area	Home Range	Special Features
Black-backed Woodpecker (BBWP)	LPW LPD MCD	* >11^2 dbh (U) *>60% MPP (V)		* <u>Nest</u> mean in uncut stands, 24% <u>Roost</u> mean >40% (V, P)		*Mean 11^2 dbh of nest trees; Mean 8^2 dbh stem size at nest sites (V,P) *Mean 14.6^2 dbh, nest (V) *Mean forage stands, 10^2 dbh; all trees used for foraging, 15^2 dbh; LPP used for foraging, 14^2 dbh; LPP used for roost trees, 11^2 dbh > 4^2 dbh, 503 TPA,(P)	*<u>Roost sites</u> Mean, 115 ft^2/ac <u>Forage Sites</u> mixed conifer, 363 ft^2/ac, mixed conifer dominated by LPP, 413 ft^2/ac; LPP 411 ft^2/ac <u>Nest sites</u> -LPP, 79-112 ft^2/ac; mixed conifer dominated by lpp, 136 ft^2/ac (P)	*1.5 mi^2 956 ac/pair (Y) *Mean 430 ac (I)	*Roosts in gall rust cankers, trunk scars, or mistletoe (U), * Nests in snags dead < 5 years old, Heart rot critical key factor in nest selection (V)
Great Gray Owl (GGO)	LPW LPD MCD		* >8^2 dia.w/in forage sites (E)	*<u>Foraging</u> 11-50% (U) *<u>Nesting</u> > 60% (range 52-99%) (Q) *11-59%, males at forage & roost sites (E,Q) *<u>Juveniles,</u> 50%, ≥60% (E)		*Mean stick nests, 23^2 dbh Mean broken top nests, 31^2 dbh (U,E) *Perch and forage trees, 10^2 dbh (E)		<u>Adults</u> *11.6 mi^2 (Q) *30 mi^2 (U), *26 mi^2 (D) <u>Juvenile</u> *60 mi^2 (U) *61 mi^2 (D)	*Owlets need dense cover or leaning trees (U) <u>Openings</u> *Nests w/in 0.2 mi of opening (U) *Size range 15-247 ac (C) *Plant height averages 8^2, grass dominated (E)

Species	PAGs	Snags	Logs	Canopy Cover	Canopy Layers	Tree Size/ Trees per Acre	Basal Area	Home Range	Special Features
Northern Goshawk (NG)	LPW LPD MCD	*25-75/ac, 8-10^2 dbh, pine forest type 5-15/ac, 7-12^2 dbh, pine/fir forest type 5-70/ac, 6-20^2 dbh, fir forest type (M)	*50-85/ac, 9-10^2 dbh, pine forest type 65-70/ac, 9-11^2 dbh, pine/fir forest type 40-190/ac, 5-9^2 dbh, fir forest type (M)	<u>Nesting</u> *44-85% (Z) *>40% (CC) *79%, good (I) *≥70% Recommend >90% (BB) *49-74%, pine forest type 71-91%, pine/fir forest type 70-94%, fir forest type (M)	> 1 (I)	*<u>Nest Stands</u> Mean dbh, 11^2 526 TPA (Z) *<u>Nest Area</u> Mean nest tree 12.4^2 dbh (range 7-20^2 dbh) Mean nest tree, 29^{2}dbh Mean nest area, 13^2 dbh 53.8 TPA (Z) *Ave on the east side, 14^2 dbh (BB) *Ave. stand size, 17^2 dbh (CC) *<u>Mixed Conifer</u> >25 TPA >20^2 dbh, good nesting habitat (I) *2.5-4.9^2 dbh, 86 TPA 4.9-8.9^2 dbh, 225 TPA 8.9-15.9^2 dbh, 192 TPA >15.9^2 dbh, 7 TPA (Z) *<u>Nest</u> <u>Pine type</u> 20-33^2 dbh;	*217 (range 148-283) ft^2/ac 221 ft^2/ac in nest areas (Z) *30-92 ft^2/ac, live trees (CC) *<u>Pine type</u> 152-179 ft^2/ac, live & dead, <u>Pine/Fir type</u> 116-181 ft^2/ac, live & dead, <u>Fir type</u> 143-262 ft^2/ac, live & dead, <u>Pine type</u> 1-4.9^2 dbh, 20-25 ft^2/ac; 5-8.9^2 dbh, 95-160 ft^2/ac; 9-14.9^2 dbh, 15-20 ft^2/ac; 15-20.9^2 dbh, 0-10 ft^2/ac; 21-24.9^2 dbh, 10-20 ft^2/ac; 25-31.9^{2}dbh, 5-10 ft^2/ac; 32^2+ dbh, 0-10 ft^2/ac <u>Pine/Fir type</u> 1-4.9^2 dbh, 25-35 ft^2/ac; 5-8.9^2 dbh, 30-	*6-15 mi^2 (BB,CC) *0.8 mi^2 if there is a lot of suitable habitat (BB)	*Nest tree is usually the largest w/in the stand and near small breaks in canopy (U) *Fully suitable stands contain 2 alternate nest stands within 0.6 miles of each other >20 acres (I)

Species	PAGs	Snags	Logs	Canopy Cover	Canopy Layers	Tree Size/ Trees per Acre	Basal Area	Home Range	Special Features
						Pine/Fir type 28-39^2 dbh; Fir type 19-39^2 dbh Pine type >11^2 dbh, 30-40 TPA; >20^2 dbh, 10-25; TPA Pine/Fir type >11^2 dbh 45-110 TPA, >20^2 dbh, 20-25 TPA, Fir type >11^2 dbh, 35-110 TPA, >20^2 dbh, 20-45 TPA(M)	95 ft^2/ac; 9-14.9^2 dbh, 55-105 ft^2/ac; 15-20.9^2 dbh, 10-35 ft^2/ac; 21-24.9^2 dbh, 0-10 ft^2/ac; 25-31.9^2 dbh, 5-10 ft^2/ac, 32^2+ dbh, 0-15 ft^2/ac Fir type 1-4.9^2 dbh, 5-45 ft^2/ac; 5-8.9^2 dbh, 25-70 ft^2/ac; 9-14.9^2 dbh, 5-115 ft^2/ac; 15-20.9^2 dbh, 5-40 ft^2/ac; 21-24.9^2 dbh, 5-20 ft^2/ac; 25-31.9^2 dbh, 5-25 ft^2/ac; 32^2+ dbh, 0-10 ft^2/ac (M)		

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