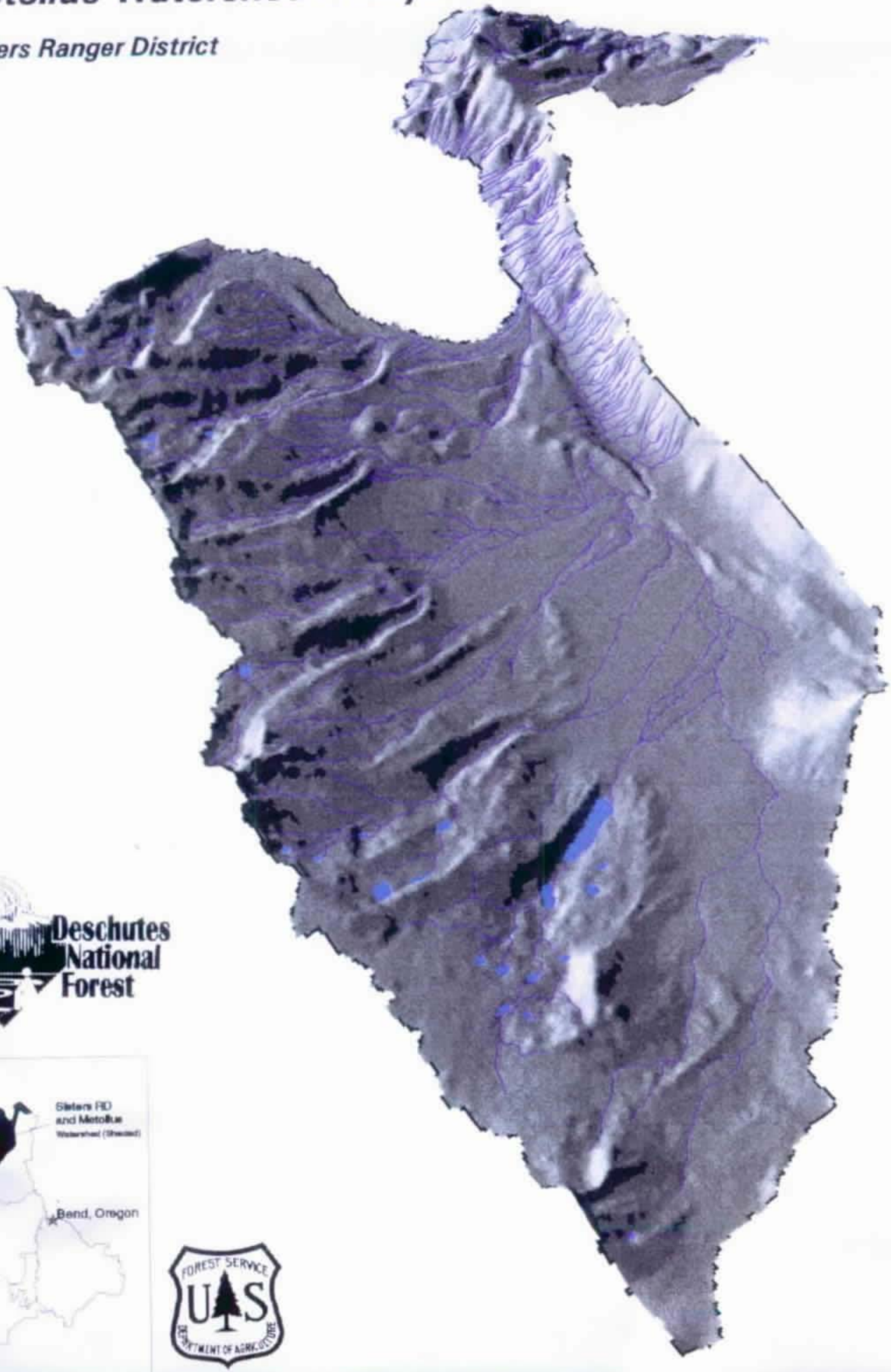
Metolius Watershed Analysis

Sisters Ranger District



Deschutes National Forest

FOREST SERVICE
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DEPARTMENT OF AGRICULTURE

United States Department of Agriculture | Forest Service | Deschutes National Forest | Sisters Ranger District
Post Office Box 249
Sisters, OR 97759

File Code: 1920/2520

Date: January 19, 1996

Dear Reader:

Attached is the first version of the Metolius Watershed Analysis. The 1994 Record of Decision (ROD) for the Northwest Forest Plan, which amended the Deschutes Land and Resource Management Plan of 1990, requires a watershed analysis in Key Watersheds. The Metolius drainage is one of seven Key Watersheds designated by the ROD on the Deschutes National Forest. The required analysis of these watersheds is to guide smaller and larger scale planning and must be completed before new management activities take place in the watershed.

The Metolius Watershed Analysis, which covers 149,000 acres, is a landscape level (larger than a project, smaller than a Forest) analysis. This document provides information on the dominant physical, biological, and social features and processes of the watershed.

The Metolius Watershed Analysis' purpose is to provide an understanding of the watershed that is essential to guide subsequent project planning and decision making. It is not a decision document, a planning document that will undergo future NEPA review, or a regulatory prescription document. Recommendations made in the analysis are general in nature, and any site-specific recommendations will undergo further analysis at the project level.

The Metolius Watershed Analysis Team assembled the best information available to them. As they synthesized this information, we all gained understanding of the complexity and magnitude of the watershed relationships. We also became aware of the existing gaps in data, information, and linkages. As new information becomes available, or as conditions and issues change, management recommendations will incorporate this new information.

If you have further questions, please call either of the Metolius Watershed Analysis Co-Team Leaders: Rod Bonacker, District Planner, at 541-549-7729, or Alice Carlton, Watershed Analysis Coordinator, at 541-383-5538.

Sincerely,

Karen Shimamoto

KAREN SHIMAMOTO
District Ranger

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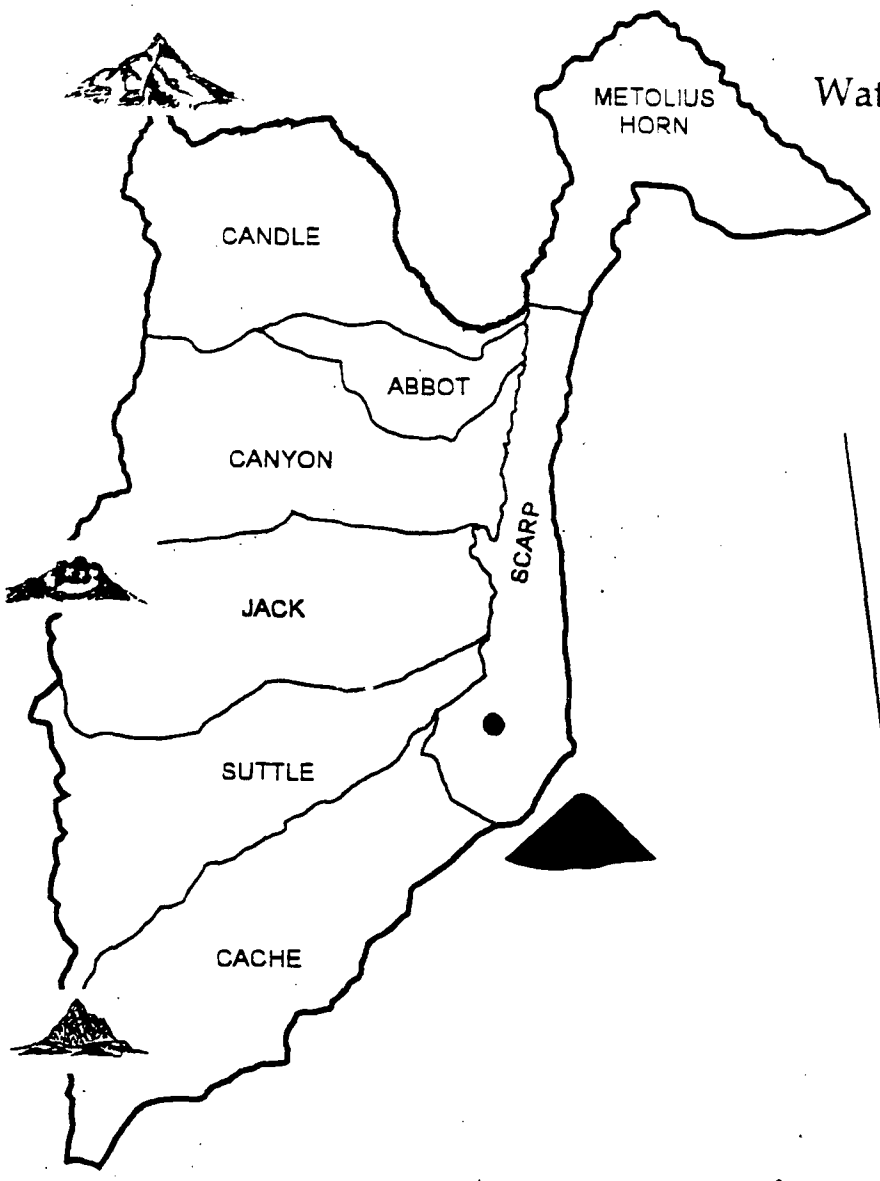
Area Map of the Metolius Watershed Analysis Area with the State of Oregon



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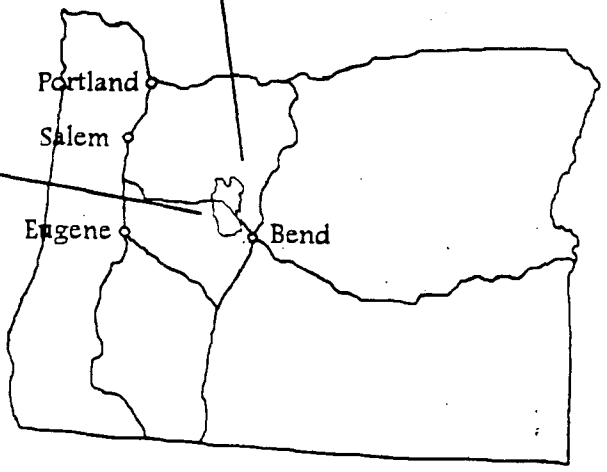

State of Oregon

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Special thanks to those not mentioned here who also assisted and gave their support throughout the analysis.

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Executive Summary

What is Watershed Analysis?

The Record of Decision (ROD) for the Northwest Forest Plan was signed on April 13, 1994, amending the Deschutes National Forest Land and Resource Management Plan. This includes the Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl (FEIS, 4/94). The ROD requires a watershed analysis in Key Watersheds be completed before new management activities take place and to guide provincial and project planning. Key Watersheds have been identified by building on previous work of the Scientific Panel on Late-Successional Forest Ecosystems and the Scientific Analysis Team.

The Metolius Watershed Analysis is a landscape level plan to help guide provincial and project planning. The area of study lies within the Sisters Ranger District of the Deschutes National Forest. The Metolius drainage is one of seven Key Watersheds found on the Deschutes National Forest.

Purpose and Scope Statement

This watershed analysis outlines strategies to meet human needs, while sustaining viable ecosystems and biodiversity. Broad landscape goals, guidelines, and opportunities are recommended, as well as means to meet aquatic conservation objectives and appropriate Riparian Reserve boundaries. It is not suitable for assessing species viability. It is also not suitable for making site specific decisions which require project level analysis. The scope of the watershed analysis does not include project planning or decisions.

The boundaries of the Metolius Late-Successional Reserve (LSR) are largely consistent with the Metolius Watershed boundary. Approximately 10,658 acres of the LSR are outside the area. A Late-Successional Reserve assessment has been conducted to meet the standards in the NW Forest Plan. It addresses specific issues for management of late-successional habitats within the Metolius basin. Information and data analysis from this watershed analysis were used as guidance in the development of the Metolius LSR assessment.

How to Use This Document

This analysis will be updated and revised when substantial new issues come forth, when important new information becomes available, or when significant changes in watershed condition occur.

The Metolius Watershed Analysis was completed using the Watershed Evaluation and Analysis for Viable Ecosystems, (WEAVE) 1993. This document is organized to facilitate use by the various audiences, and for the various purposes of watershed analysis. The following table will help crosswalk those familiar with the six-step Federal Guide process:

Orientation and Context Setting

The Physical Domain

The Context of the Watershed

The Metolius Watershed, situated on the eastern flank of the Cascade Mountains, displays many characteristics of a transition zone (from the moist west side to the drier east side of Oregon). The total size of the watershed includes 280,336 acres. It is the largest on the Sisters Ranger District and drains 195,000 acres within the District. **Approximately 149,000 acres are sesignated as the key Watershed covered by this analysis**. Its main feature is the Metolius River, the largest spring fed river in the Region and a major tributary of the Deschutes River. The Metolius River joins the Deschutes River approximately 100 miles above the confluence of the Deschutes and Columbia Rivers.

Climate

In the Cascade mountains, winter can bring up to 500 inches of snow per year. Precipitation ranges from 10-50 inches. Temperatures range as low as -30° F in the winter to 80° F in the summer. Freezing temperatures can be expected any month of the year; and the growing season is limited.

Geologic Origins

The landforms of the watershed are a product of early Cascade volcanism modified later by at least three periods of glaciation. During the ice age, ice carved big, deep canyons especially through Jefferson Creek, Canyon Creek, First Creek, Blue and Suttle Lakes. Beginning about 12 million years ago, the geologic products of the Cascades flowed eastward into what is now the Deschutes Valley. Many of these rocks are part of the Deschutes Formation - a complex layercake of basalts, andesites, tuffs, sands, and gravel that stretch from Sisters and Redmond northward to Madras. The flows emanated from a north-south belt of volcanoes now buried beneath the basalts of the High Cascades. Their remnants can be found in Green Ridge and Squaw Back Ridge north of Sisters.

Two million years ago, major north-south fault systems created the river valley and a trough-like garben known today as the Metolius Basin.

This steep sided basin contains a variety of geologic features from green valley floors to vertical-walled volcanic canyons and igneous intrusions. The lower Metolius River flows between steep ridges. Where the valley opens up the river emptys into Lake Billy Chinook Reservoir.

Soil Formation

Soil in the Metolius basin has developed from a variety of parent materials including volcanic rock, ash, cinder, glacial till, glacial outwash, and alluvial deposits. The greatest differences in soils in the watershed are related to the types of parent materials from which they were formed.

The Metolius Watershed is part of three ecological subsections: Upper Cascades, Lower Cascades, and Green Ridge. Soil in the Upper Cascade subsection is more cobbly and stoney formed by glacial activity. Soils in the Lower Cascade subsection developed in outwash deposits resulting in less cobbles and stones than the soils in the higher elevation to the east. Green Ridge subsection consists of residual soils that have formed in a variety of geologic materials including basalts, andesites, tuffs and breccias. These soils have had little or no volcanic ejecta influence and have weathered into finer soil textures.

Hydrologic Characteristics

The Metolius Watershed contains 110 miles of permanent streams, 324 miles of intermittent streams, 42 lakes and 121 ponds.

The Metolius River originates from springs at the base of Black Butte. The tributaries originate from snow melt in the Cascades or from groundwater springs that rise in the fractured basalt and alluvial gravels. The groundwater contribution of the tributaries is particularly important in maintaining flow stability and water temperatures below 50 F in the river. Low alkalinity and high clarity are typical throughout the year.

The Metolius River is designated as a Wild and Scenic River with water quality as one of the Outstandingly Remarkable Values.

The Biological Domain

Vegetation

The Metolius Watershed lies in a transition zone which creates a diversity of habitats and vegetation. Many plant species typical of the west-side of the Cascades are found here, including Pacific yew, dogwood, honeysuckle, and oceanspray.

Forested lands in the watershed comprise 94% of the landscape. A wide variety of coniferous forest types inhabit the area from low elevation ponderosa pine through high elevation subalpine fir which climax to mountain hemlock, subalpine fir, whitebark pine, silver fir, Douglas-fir, ponderosa pine, lodgepole pine, white/grand fir, and Engelmann spruce. Non-forest areas including grasslands, lava flows, lakes, and riparian areas are uncommon, comprising less than 6% of the watershed.

Peck's penstemon is a unique plant species, centered in the watershed. This rare wildflower is endemic to the Sisters Ranger District. More than half of the known global population of Peck's penstemon is found in the watershed. The watershed is also the only known site in Oregon for water lobelia, an aquatic flowering plant, and for a rare truffle (Elaphomyces anthracinus). The watershed contains known sites for 17 "Survey and Manage" species identified in the NW Forest Plan as requiring special management consideration. Most of these species are rare fungi and nitrogen fixing lichens.

Of increasing concern within the watershed are aggressive noxious weeds. The watershed is still relatively weed free, but populations have shown a marked increase and are spreading along roads and trails.

Terrestrial and Riparian Wildlife

The diverse habitats found within the watershed area provide potential habitat for about 300 terrestrial and riparian associated wildlife species. These include sensitive, candidate, and Federally listed species such as the American marten, northern spotted owl, bald eagle, goshawk, and peregrine falcons. There are significant amounts of edge habitats. Late-Successional interior habitats are highly fragmented and poorly connected. Riparian habitats make up only 2% of the watershed but contribute significantly to habitat and species diversity.

Aquatic Species

The cold spring-fed streams of the watershed provide unique stable habitats for aquatic species. Fish, amphibians, invertebrates, and aquatic plants species are wildely diverse, and have adapted to the special habitats that occur in the watershed.

A variety of fish including native rainbow trout, bull trout, mountain whitefish, longnose dace, bridgelip suckers, largescale suckers, and three species of sculpins are present. Anadromous forms of native sockeye salmon were probably eliminated from the watershed by 1940, by small dams on Lake Creek. Spring chinook were eliminated from the watershed by 1968, due to inadequate juvenile passage at Round Butte Dam. Brown trout, brook trout and kokanee have been introduced to the system. Hatchery rainbows are stocked each year in the upper Metolius River.

Aquatic habitat has been reduced in the Metolius River due to the removal of instream wood and the loss of large trees in the riparian areas. Some interaction has been found between indigenous and hatchery rainbow trout. Bull trout numbers were severely reduced but are recovering with protection from angling harvest. Spawning habitat quality is a concern in the tributary streams. Brook and bull trout occur together in certain streams and the potential for competition and interbreeding is being monitored. Introduced fish may interact and compete with amphibious invertebrate species in high lakes that originally were absent of fish. Further study of this question is needed.

Species uniquely adapted to the cold and stable habitats of the watershed are bull trout, the Cascade Apatania caddisfly, the plant water lobelia, rare liverworts and tailed frogs. These species may be candidates for further monitoring.

The Social Domain

People

Prehistoric use of the Metolius Watershed extends back 7,000 to 10,000 years. The first recorded description of the river dates from the early 1800's. The area was then rapidly settled. Travel was mostly up and down the stream and river drainages with seasonal settlements at lakes and stream confluences. Much of the watershed was used for grazing cattle and sheep from the 1860's into the 1920's. Significant events in the history of the watershed include:

- Warm Springs Reservation establishment in 1855,
- Santiam Wagon Road in the 1860's,
- The establishment of Camp Sherman in the 1890's, and
- The completion of Hwy. 20 over Santiam Pass in 1938.

Today, recreation opportunities within the watershed contribute to the local economies of Camp Sherman and Sisters.

Values and Uses

The Metolius Watershed has been important to people for hundreds of years for its recreational opportunities, scenery, food resources, and commodities. This area was traditionally used by Native Americans for hunting, fishing, and gathering. The Confederated Tribes of Warm Springs have expressed an interest in maintaining native plant communities that have resources associated with treaty rights. These resources include plant foods and raw plant materials of cultural significance.

The river, streams, and lakes continue to be a major attraction for visitors. Popular recreational activities include a range of water sports, sightseeing by car, biking, hiking, and horse use.

Early timber harvest in the watershed was primarily selective for trees of declining health. Harvest areas were limited by the capabilities of machinery and access. The 1970's mark the transition toward clearcutting in mixed conifer forests and partial cut treatments in ponderosa pine.

Firewood harvest is important to local citizens. Mushroom picking is a fast growing activity. Cones, plants for landscaping, poles, boughs, and decorative wood are also utilized. Cinder material sources have been developed on 4 of the 13 cinder sites within the watershed. Gravel is used by federal and state agencies for road construction.

Land Management

The Sisters Ranger District of the Deschutes National Forest manages 94% of the watershed, under varied and complex management guidelines from the Deschutes Land and Resource Management Plan, as amended by NW Forest Plan. Private lands make up 6% of the area and include lands managed for timber production, resorts, individual homes and commercial businesses. Most of the watershed is within Jefferson County with a portion of the southern end in Deschutes County.

Key Issues

- **Issue #1 - Physical Domain**: Soil disturbing activities are adversely affecting vegetation growth, infiltration rates, runoff rates and amounts, and sediment delivery processes.
- **Issue #2 - Biological Domain**: High stand densities, changes in species composition, and fragmentation result from altered disturbance regimes and resource extraction. These changes have led to vegetation compositions and configurations that are unsustainable and place habitat and species at risk. In riparian areas, vegetation loss can increase stream erosion and water temperature; and reduce stream cover, and leaf and wood input.
- **Issue #3 - Social Domain**: This watershed has been and continues to be an important place for people. People in adjacent and distant communities assign abstract and utilitarian values to various places and components within this watershed. Human uses and their associated pressures and conflicts with natural resources can be expected to continue into the future and to pose management challenges.

Landscape Areas of the Metolius Watershed

The analysis team divided the watershed into Landscape Areas. Landscape Areas were initially determined by social patterns. Trends were then defined for each preliminary Landscape Area. Through synthesis and integration of these trends, areas were combined and refined creating the final Landscape Areas described below (see map 1).

Landscape Area 1 Wilderness

This area includes portions of two congressionally designated wilderness areas. The area is comprised of high elevation forested types which for the large part have not been affected by forest management practices, including fire exclusion. Some areas of the wilderness have been heavily impacted by recreational use, most have not. Except for areas of high use, these are pristine environments.

Landscape Area 2 Central Basin

The most outstanding feature of this Landscape Area is the mainstream of the Metolius River, and the effect it has from a social perspective on adjacent areas. Lower Jack Creek, Canyon Creek, Candle and Jefferson Creek are significant bull trout habitat. Recreation use is heavy, as are demands for other social uses. The year round community of Camp Sherman is found here. A mix of forest types are represented from pure ponderosa stands, ponderosa/mixed conifer, to mixed conifer stands. Road densities are heavy,

and old growth habitats have been highly fragmented. Fire exclusion has made a marked difference in the way this forested landscape looks today.

Landscape Area 3 Highway 20 Corridor

Just as the Metolius River dominates the Central Basin, Highway 20 is the focal point of this area. The scenic character of large trees from this scenic highway has been largely lost in the past few years due to insect epidemics. There are also many riparian areas. The corridor is important not just for access but also for wildlife movement and genetic exchange between west-side and east-side species.

Landscape Area 4 Meadow Lake Basin

A mid elevation, subalpine lake basin. The area burned in 1964, and was left open and accessible to recreational use. The popularity of the area for dispersed camping and off-road vehicle travel, in combination with the unique riparian, aquatic and special plant habitats has resulted in conflicts. As use increases in the area so do the incidences of conflict.

Landscape Area 5 Black Butte

Black Butte is a unique landmark in Central Oregon and the focal point for many Central Oregon views. It has Native American cultural significance, as well as historic significance because of nearly a century of use as a fire lookout. Trails lead recreationists to the top of the Butte for spectacular views of the surrounding landscape.

Landscape Area 6 Cache

This is an area of contrast. Checkerboard ownership is the most dominant feature of this Landscape Area. Much of this area has been affected by timber harvest and fire exclusion and insect and disease damage. Cache Mountain is the most significant landmark with little surface water or other attractions for recreationists. This area includes the Cache Mountain Research Natural Area..

Landscape Area 7 Suttle Lake

This is a popular recreation area and important for bald eagle management. A combination of selective harvest, fire exclusion and insects and disease have caused large trees to decline in numbers and vigor. This decline is affecting visual quality and long term bald eagle habitat viability. The health of riparian and aquatic ecosystems are also declining in this highly used area. Suttle Lake and Blue Lake form the core, while Link and Lake Creek provide connections to other Landscape Areas.

Landscape Area 8 Upper Tributaries

This is a mixed conifer forest type and the center of the northern spotted owl habitat. This area has significance to the Central Basin because of the many streams that feed the Metolius and help maintain its high water quality. This area has been heavily affected by timber harvest and fire exclusion. The results are highly fragmented stands at risk of loss due to fire or insect and disease. Insect epidemics have already resulted in heavy mortality. Road networks crisscross the landscape.

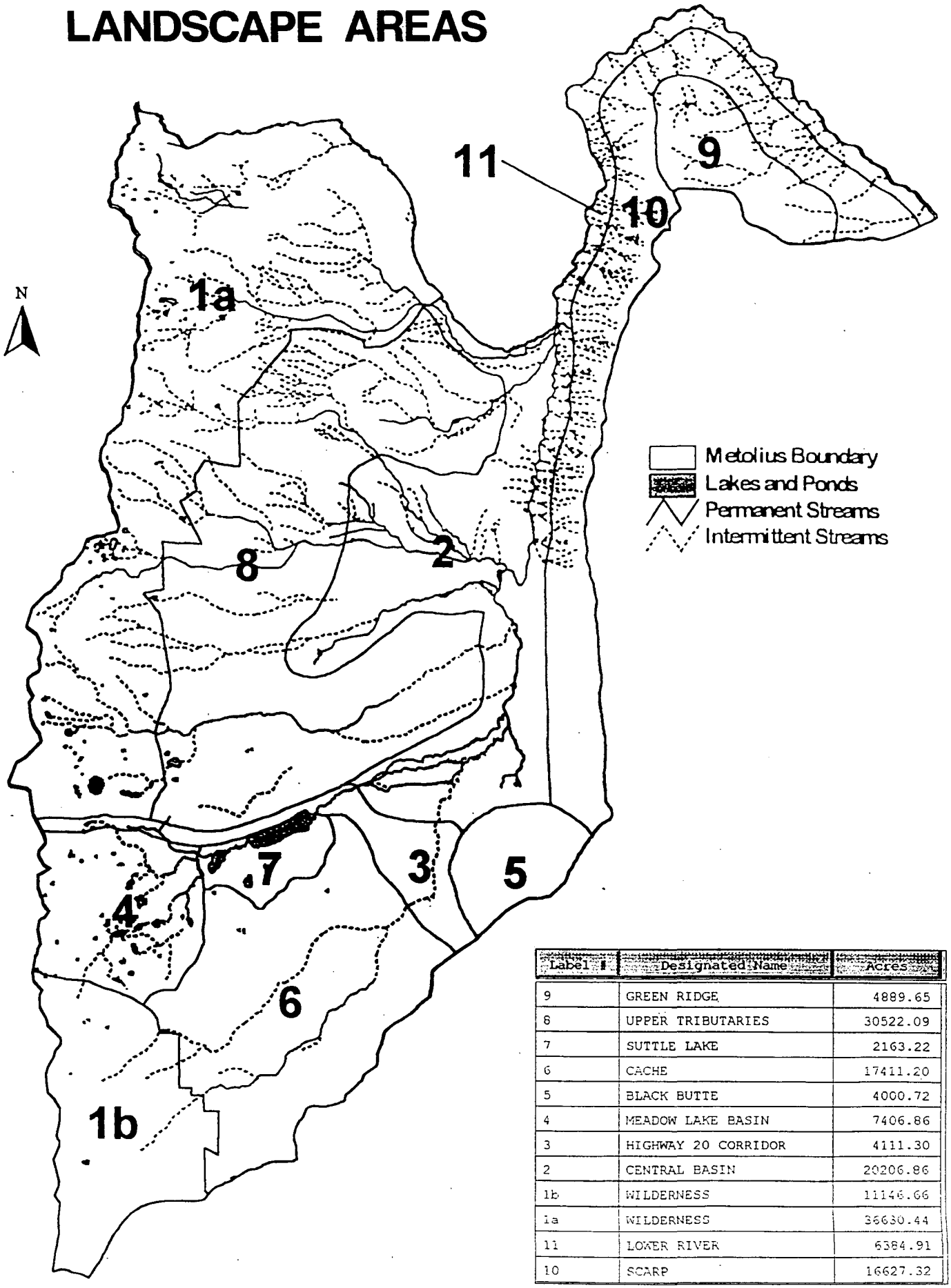
Landscape Area 9 Green Ridge

This area on top of Green Ridge is characterized by unique old soils, and intensive vegetation harvest which began in the 1950's. However, notable remnants of old growth forest still exist.

Landscape Area 10 Scarp

A steep slope to the west with old and erodible soils, the eastern watershed boundary lies on the top of Green Ridge. Old growth forested stands have been affected by fire exclusion, timber harvest, and road density. This ridge forms the easternmost extension of the ancient Cascade Range and contains many isolated "west-side" plant associations.

LANDSCAPE AREAS



Label	Designated Name	Acres
9	GREEN RIDGE	4889.65
8	UPPER TRIBUTARIES	30522.09
7	SUTTLE LAKE	2163.22
6	CACHE	17411.20
5	BLACK BUTTE	4000.72
4	MEADOW LAKE BASIN	7406.86
3	HIGHWAY 20 CORRIDOR	4111.30
2	CENTRAL BASIN	20206.86
1b	WILDERNESS	11146.66
1a	WILDERNESS	36630.44
11	LOWER RIVER	6384.91
10	SCARP	16627.32

Landscape Area 11 Lower River

A stretch of the Metolius that is the least affected by management practices and human use because of limited access. It provides important habitat for bald eagles, osprey and other species. The beauty of this area is defined by the riparian-influenced zone.

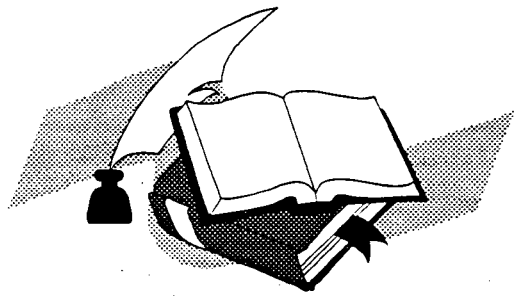


Table 3: Priority Landscape Areas.

Landscape Areas					
High Priority	8--Upper Tributaries	2--Central Basin	7--Suttle Lake		
Medium Priority	3--Highway 20 Corridor	4--Meadow Lake Basin	6--Cache		
Low Priority	1--Wilderness	5--Black Butte	9--Green Ridge	10--Scarp	1--Lower River

Landscape Goals

Landscape Area 1 Wilderness

Maintain a primitive setting and uncrowded recreation experience. Maintain the function of riparian areas. Reduce potential impacts of human use on wildlife and alpine habitats. Restore impacted high use areas. Develop user education to emphasize stewardship

Landscape Area 2 Central Basin

Restore, maintain, and protect high soil and water quality and maintain function of riparian areas. Provide healthy forests dominated by large ponderosa pine. Provide for fuels reduction in urban interface. Provide well connected late-successional ponderosa pine habitats. Protect habitat for bald eagles, bull trout, rainbow trout, osprey, Pecks penstemon and other associated species. Maintain healthy riparian areas while providing for diverse recreation opportunities. Maintain the low key rustic character of facilities.

Landscape Area 3 Highway 20 Corridor

Restore and maintain the visual character of the corridor viewshed. Promote healthy large trees, park-like stands and visual diversity. Restore highway-related hydrologic impacts. Maintain the integrity of the Suttle Bald Eagle Management Area. Provide adequate riparian protection and forest cover to maintain effective wildlife travel routes across Highway 20 and avoid creating conditions that increase the potential for vehicle-wildlife conflicts.

Landscape Area 4 Meadow Lake Basin

Provide well connected late-successional habitats and protect remnant late-successional habitats. Maintain water and riparian quality, and habitat for summering elk, eagles and osprey. Promote semi-primitive motorized recreational experience and reduce off-highway vehicle conflicts. Restore riparian habitats deteriorated by heavy human use.

Landscape Area 5 Black Butte

Maintain a healthy pine-dominated mixed conifer forest that provides well connected late-successional habitats and maintains the scenic integrity of the landmark. Maintain efficient fire detection capabilities. Maintain semi-primitive recreational opportunities, and reconcile conflicts between the setting and the increasing human use.

Landscape Area 6 Cache

Maintain a healthy mixed conifer forest that provides well connected late-successional habitats and provides opportunities for sustainable forest products. Provide effective big game transitional and winter range. Preserve the integrity of the Santiam Wagon Road, and the Cache Creek Toll Station.

Landscape Area 7 Suttle Lake

Provide high quality developed recreation opportunities, while maintaining water and riparian habitat quality, fishery productivity, and habitat for sensitive wildlife species. Maintain healthy mixed conifer stands that promote large trees for bald eagles and provide well connected late-successional habitats. Reduce conflicts between recreation uses and wildlife habitats.

Landscape Area 8 Upper Tributaries

Restore and maintain healthy mixed conifer forests. Maintain well-connected late-successional habitats while providing sustainable forest products. Restore soil and water quality and maintain the function of riparian areas. Restore riparian areas that show signs of vegetation loss and deterioration.

Landscape Area 9 Green Ridge

Restore and maintain healthy mixed conifer and ponderosa pine late-successional habitat. Provide effective big game summer range. Maintain the integrity of Castle Rock and the surrounding landscape as a potential peregrine falcon nest site.

Landscape Area 10 Scarp

Maintain the scenic quality of the ridge. Maintain healthy pine and mixed conifer forests by allowing natural processes and disturbances to continue. Provide well connected late-successional habitats.

Landscape Area 11 Lower River

Reserve this area for the present and future benefit of riparian-dependent species by allowing the continuation of natural processes. Maintain riparian and instream habitats within the historic range of variability. Maintain healthy mixed conifer stands with large trees for bald eagles and osprey. Provide semi-primitive, non-motorized recreation activities along the river and improve existing developed campgrounds. Provide effective big game winter range.

Critical Restoration Opportunities

Restoration opportunities were developed to reverse or interrupt the path of trends that are counter to Landscape Area goals; or to address the existing effects of trends. Many of the opportunities have been brought forward from previous analyses, such as Jack and Suttle PREWEAVES.

Rehabilitate Aquatic/Riparian Systems (LA 1, 2, 4, 7, 8, 11).

Rehabilitate heavily used alpine lake campsites and trails, (i.e., Head of Jack Creek). Assess the potential effects of road-stream intersects. Restore instream wood. Revegetate riparian areas in campgrounds. Maintain Metolius trail. Manage dispersed camping.

Restore Fish Passage (LA 2, 8, 11).

Restore fish passage in the Lake/Link Creek System, Lake Billy Chinook, Candle Creek.

Integrate Vegetation Management (LA 2, 3, 4, 5, 6, 7, 8, 9, 11).

Reduce stand densities. Maintain big trees. Facilitate reintroduction of fire. Provide habitat protection and enhancement for species of concern. Reduce fire risk and develop fuelbreaks. Develop vegetation management plans for campgrounds. Implement Bald Eagle Management Strategy. Regenerate with larch, cedar and western white pine where appropriate. Propagate native plants. Reduce fragmentation and improve habitat connectivity.

Reintroduce Fire (LA 1, 2, 3, 4, 6, 7, 8, 9, 10, 11).

Implement Fire Management Plans for the wilderness, and the upper and lower Metolius River. Use prescribed fire to benefit species which have evolved with fire (ponderosa pine, larch, huckleberry, Peck's penstemon, mountain lady slipper, candystick). Restore meadows. Reduce fire risk. Restore fire as a natural disturbance factor. Implement urban interface protection.

Protect Species of Concern (All LAs).

Assess known sites of plant and wildlife species of concern. Monitor past management treatments to learn more about disturbance ecology. Restore and protect habitat.

Implement Access Strategies (LA 1, 2, 3, 4, 5, 6, 7, 8, 9, 11).

Assess and plan wilderness trails to include user impacts, road closures and obliteration, culvert repair and removals, road/stream intersects, and weed control. Assess OHV use to determine needs for rehabilitation and possible controls.

Protect and Restore Soils (All LAs).

Use subsoiling and other treatments to restore compacted soils. Determine long term transportation and access needs to predict cumulative effects on soils.

Protect Heritage Resources (All LAs).

Implement Heritage Resource Management Plans for significant sites. Evaluate sites in developed locations. Use partnerships to restore historical CCC structures. Protect Santiam Wagon Road and Cache Creek Toll Station. Enhance cultural use plant management (i.e., huckleberries).

Enhance Recreational Experience (All LAs).

Restore visual quality and damaged areas. Maintain desired character and opportunities. Promote stewardship.

Aquatic Conservation Strategy

The NW Forest Plan outlines the Aquatic Conservation Strategy (ACS) to restore and maintain the ecological health of watersheds and aquatic ecosystems.

For the Metolius Watershed, Riparian Reserve widths were established based on local empirical data. Standard Riparian Reserve widths were established at twice the potential tree height for fish bearing streams, lakes and ponds, or 320 feet from either side of the edge of the active channel. Single tree heights were used to establish Riparian Reserve widths of 160 feet for wetlands, created ponds, reservoirs and intermittent streams.

Riparian Reserve widths may be adjusted during project planning to include special features like floodplains, riparian vegetation, inner gorge or terrace, terrestrial wildlife habitat connectivity, big game calving and fawning, unstable areas, and aggregations of special features or adjacent Riparian Reserves.

Special considerations for recreation sites, aquatic resources, vegetation, soil, habitat connectivity and special habitats have been developed as additional guidelines for the watershed in addition to those presented in the NW Forest Plan.

Data Gaps/Limitations of Analysis

Aquatic

- The direct link between road borne sediments and fish, insect and amphibian habitat are not well described. Measurements of sediment discharged from roads and identifying the roads with the highest risk will help in targeting road realignment, maintenance, closure or obliteration.

Vegetation

- Develop a more site specific upper limit Stand Density Index (SDI) by using plant association SDIs, calculated from healthy stands. More accurate stocking limits by plant association and productivity group would allow managers to determine when stands might be moving into potentially risky conditions.

Soils

- Better define large woody debris levels for different plant associations and the role it plays in long-term soil productivity by establishing baseline research soil carbon studies.

Wildlife

- Generally, spotted owl literature is specific to west-side spotted owl conditions, and there is a lack of east-side spotted owl information. The eastern Cascade Province is considered "high risk" because of the fire-dependent plant associations, yet spotted owl viability is dependent on these same associations. Specific information about spotted owl use in east-side systems is needed to address forest health and species viability concerns.
- An assessment is needed of habitat conditions and effects to terrestrial species under natural fire frequencies in ponderosa pine and mixed conifer stands. This information will help answer questions about managing habitat to mimic natural fire regimes

Recreation

- Map user-created trails and assess their impacts.
- Inventory types and extent of day use and overnight dispersed use in the watershed.
- Identify problem areas along trails to direct maintenance activities.
- Low elevation air photos are needed for redesign of developed campgrounds.

Priority Monitoring Recommendations

Aquatic

- In the Metolius River area, ground water sampling should be coordinated to assess if groundwater quality has been affected by drainfields.
- Continue monitoring bull trout and brook trout populations.

Soils

- Evaluate management impacts on long-term soil productivity by comparing similar sites that have had different management activities.

Wildlife

- Monitor the impacts of vegetation management activities on spotted owl habitat selection in the Matrix. This information will be the basis for habitat manipulation in Late-Successional Reserves.

Species of Concern

- Continue study of soil invertebrates associated with N. Shackle subsoiling project (5 years, and 10 years).

Recreation

- Monitor use levels and types of use in dispersed camping areas near water.
- Assess the possible association of heavy use around high lakes with fish stocking.

Metolius Watershed Assessment

Overview and Key Issues/Questions

The team identified issues and synthesized them into Key Issues for each domain. The key questions associated with each issue are intended to focus the analysis and identify the information necessary to respond to the issue with recommendations. Sometimes, a question is answered in the domain analysis; sometitmes the answer is the identification of a trend. Finally, some questions were not answered because of data gaps which are noted at the end of this document. Page numbers indicate where in the document the question is answered.

Issue #1 - Physical Domain: Roads and other soil disturbing activities affect vegetation growth, infiltration rates, runoff rates and amounts, and sediment delivery processes.

- How have nutrient cycling processes changed? include microbial processes.
- How has the ecology of soil been altered?
- How has the long-term productivity of the land been affected by land management activities and changes to disturbance processes? Where and to what degree? (pg 23)
- Have land use patterns significantly changed hydrologic regimes (flow quantity or timing)? (pg 25, 26, 27)
- Where is sedimentation of the aquatic systems occurring? What is the affect on aquatic habitat quality? Are sedimentation regimes (input and transport) significantly changed from natural/geologic rates? (pg 26)
- Is septic effluent degrading water quality? (pg 28)

Issue #2 - Biological Domain: High stand densities, changes in species composition, and fragmentation resulting from altered disturbance regimes and resource extraction have led to vegetation compositions and configurations that are unsustainable and place habitat and species at risk. In riparian areas, vegetation loss can increase stream erosion, water temperature; and reduce stream cover, and leaf and wood input.

A) **What mix of forested stand densities, structure and species composition could be reasonably sustained (horizontally and vertically) throughout the landscape?**

- **What is the historic and existing distribution, density, size/structure, and species (grasses, shrubs and trees) composition of forested and riparian associations within the watershed? (pg 38, 39, 40, 41, 77)**
- **What are the historic disturbance processes? Identify scale and intensity. What would the vegetative landscape look like under historic disturbance regimes? (pg 42, 43, 47, 55-57, 61-62, 65-67, 71-72, 74, 78-81)**
- What is the vegetative potential (as described by plant association groups including riparian) for the watershed? (pg 56, 61, 64, 70, 74, 76-77)
- Historically and more recently, what activities, natural processes, and alterations to disturbance regimes have created the current vegetative conditions (including riparian)? (pg 39, 45, 46, 59)
- Have changes in the pattern and structure of riparian vegetation significantly affected stream temperature or reduced stream cover and debris input? Where and how much? (pg 29, 30)

B) What species have potential for significant changes to population trends based on habitat availability and capability?

- What were historic fish population levels and habitat? How do current populations compare to historic populations and habitat capabilities? (pg 111-114)
- What species are threatened, endangered, sensitive, declining or missing? Why? What do we know about their population trends? What are their critical habitats? (pg 85-95,97-110)
- Are there unique or sensitive habitats at risk? How does this affect fish and wildlife species? What role do historic disturbances play in maintaining wildlife habitats? How has fire exclusion impacted habitats? (pg 58, 63, 68, 72, 74, 77, 81, 84)
- How have forest management activities (timber harvest, livestock grazing, special uses, road densities) affected fish and wildlife populations and habitat? (pg 58, 63, 68, 72, 74, 77, 81, 84)
- How are habitats connected inside and outside the watershed? How wide should riparian reserves be to provide connectivity and to maintain ecological process? How are species of concern affected by habitat connectivity or lack of connectivity (how species move within and through the landscape)? (pg 106-110, 150-154)
- What non-native plant, fish, and wildlife species occur in the watershed? How have these been affected by current vegetative conditions? What effects do they have on native species? (pg 95-97, 110-111, 114-115)

C) Are there management activities which could maintain or enhance ecosystem sustainability?

- Is there a critical area of uplands associated with riparian reserve areas? If adjacent uplands are burned in catastrophic wildfire what restoration activities should be triggered and when?
- What are the trade-offs of actively managing for sustainable conditions vs. allowing current conditions to proceed? (pg 44, 59)
- What would be the effect on fish and wildlife populations? Which species would increase? which would decrease? (pg 180)
- What are the impacts on vegetation, water quality, and fish and wildlife of reintroducing fire at historic frequencies and scale? (pg 180)

Issue #3 - Social Domain: This watershed has been and continues to be an important place for people. Residents in the Metolius as well as people in adjacent and distant communities assign abstract and utilitarian values to various places and components within this watershed. Human uses and their associated pressures and conflicts with natural resources can be expected to continue into the future and to pose management challenges.

- What communities utilize this watershed? What and where are their current and historic patterns of use, travel, and development? (pg 119, 126, 131-132)
- What forces have contributed to the development of the landscape and land use patterns in the watershed? How do the landscape and land use patterns effect human use and activities? (pg 119, 121, 122-123)
- What types of human uses and activities are the most incompatible with biological and physical resource values in the watershed? Where do they occur? Where are these uses and activities more compatible? (pg 126-130)
- How do human uses and activities within the watershed relate to the larger vicinity? (pg 130-131)
- How should fire be managed throughout the watershed? What is the relationship between areas of high fire risk and other social values?

Physical Domain

Soil and Geology Summary

The Metolius Watershed is part of three ecological subsections (broad areas characterized by similar topography, soils, and climate): Upper Cascades, Lower Cascades, and Green Ridge. The Upper Cascades subsection includes the volcanic upper slopes of the Cascade Range where glaciers have left a major imprint on the shape of the land and its soils. Ground moraines and deeply eroded volcanic peaks dominate the upper regions, and deep glacial valleys with associated end and lateral moraines dominate the lower regions. The Lower Cascades subsection includes the Cascade Range below the furthest extent of glaciers. The land is dominated by gently sloping plains of glacial outwash and by hills and ridges of lava that rise above the outwash plains.

The Green Ridge subsection in the Metolius Watershed includes a major, west-facing fault scarp that rises 2000 feet above the Metolius River. At the south end of the scarp is Black Butte, a prominent, steep-sided volcanic cone that rises 3400 feet above the Head of the Metolius River. The Metolius River flows around the north end of Green Ridge in a rugged, 900-foot-deep canyon.

Landscape Area numbers 1 and 4 are located within the Upper ecological Cascade subsection. Landscape Area numbers 2, 6, 7 and 8 are located within the Lower Cascade subsection. Landscape Area numbers 5, 9, 10 and 11 are located within the Green Ridge ecological subsection.

The physical domain of the Metolius Watershed is characterized by:

- A rugged landscape created by volcanism and glaciation
- Deep valleys, tall peaks and steep to gentle slopes
- Soils derived from volcanic ash, lava, glacial till, and glacial outwash
- Precipitation ranging from about 20 to 100 inches annually
- Mountain regions dominated by winter snow
- Lower elevation regions dominated by winter rain
- Warm, dry summers
- Spring-fed streams
- Elevations ranging from 2000 to 10,497 feet

The Geologic Foundation

The Metolius Watershed is part of the volcanic Cascade Range of Oregon. In the Metolius Watershed virtually all landforms, rocks, and soil are the product of volcanism, glaciation, and major earth movements.

The oldest rocks in the Watershed are nine million years old and belong to the andesitic Castle Rock volcano at the north end of Green Ridge. During the period from seven to five million years ago, a different Cascade Range grew vigorously in the area of the present crest. The lava, tuffs, and ash from this old mountain range spread in vast aprons to the West and East. The Castle Rock volcano was nearly buried, as well as the land in the Deschutes Basin from Bend to Madras. Green Ridge is made of these deposits. From five to four million years ago, the crest of the Cascades from Green Ridge to Tombstone Pass sank leaving a giant trough a mile or more deep called the Cascade graben. The steep, west face of Green Ridge is the east edge of the graben and a major fault scarp.

The Cascade graben has been filling with volcanoes ever since it formed. Most are overlapping shield volcanoes much like those around Belknap Crater on McKenzie Pass. Hundreds, perhaps thousands, of these

basaltic shield volcanoes have constructed the present Cascade crest and slopes. The center is usually a cinder cone, the slopes are lava flows, and the downwind slopes and land beyond are covered with sheets of cindery ash. Perched on the crest are Mt. Washington and Three Fingered Jack, the eroded remnants of basaltic cones that once looked similar to Black Butte. Mt. Jefferson has been a major volcanic center for 2.5 million years. It has erupted a wide range of rocks including lava, domes, and ash of basaltic to rhyolitic composition. Except for the Mt. Jefferson area and Black Butte, the landscape from the Metolius River to the Cascade crest is less than about 500,000 years old. Black Butte, a basaltic cone of lava, cinders, and ash, last erupted about one million years ago. Sitting in the rain shadow of the Cascades it has escaped intense erosion.

The Cascades of Central Oregon have endured eight Ice Ages. However, there is direct evidence for only 3 (450,000 years, 150,000 years, and 25,000 years ago). Each has produced a major, continuous ice sheet in the Cascades from Mt. Jefferson to South Sister and well beyond. At the heads of deep valleys in the Metolius Watershed the ice was up to 2000 feet thick. Glaciers extended miles down these valleys to roughly the 3200 foot elevation. Extensive ridges of moraines mark the location of the sides and ends of glaciers during the Ice Ages. Below this elevation, lands have been buried under large fans of sand and gravel from glacial outwash. Glaciers did not affect Green Ridge or Black Butte.

Since the last Ice Age, volcanoes have continued to erupt on or near the Cascade crest. About 7400 years ago, eruptions in the Forked Butte area produced cinder cones, ash sheets, and lava that flowed down the deep glacial valleys of Jefferson and Cabot Creeks. Later, about 4,300 years ago, the eruption of Sand Mountain (a group of cinder cones 5 miles southwest of Santiam Pass) produced a wind-carried deposit of basaltic ash as far as Black Butte. Soon after, about 3,700 years ago, an explosive eruption created a large hole now filled by Blue Lake. This eruption buried the middle area of the Sand Mountain deposit.

The generally porous and permeable volcanic and glacial rocks of the Metolius Watershed strongly affect how the land handles water. Large amounts of melting snow and rainfall infiltrate the ground and percolate downward to perched aquifers and the regional aquifer. This groundwater emerges from a host of springs within the Watershed to feed most streams and some lakes. A great deal of groundwater continues to flow eastward to feed large springs on the Deschutes and Crooked Rivers and to supply water for wells in the Middle Deschutes Basin Some surface runoff persists into the summer and fall, but most runoff occurs only when precipitation or snowmelt rates exceed infiltration rates or when the ground is frozen.

Climate

The climate of the Metolius Watershed is primarily characterized by a major precipitation gradient from West to East. Along the Cascade crest, average annual precipitation is about 100 inches. Just nine miles to the East, precipitation decreases to about 30 inches. Immediately east of the Metolius Watershed, annual precipitation decreases to less than 15 inches.

About two-thirds of the annual precipitation falls between October and March. Winter storms bring heavy snowfalls to the Cascades. At lower elevations the storms bring more rain than snow. A secondary peak of precipitation occurs in May and June due to thunderstorms and upper level low pressure systems.

January nighttime temperatures average about 20 degrees F throughout the watershed while July daytime temperatures rise into the 80s and 90s. Daytime humidity is generally low in the summer and fall. Winters are long and relatively cold with considerable cloudiness. Occasionally, arctic air from Canada flows through the area and causes temperatures to drop to well below zero degrees. Summer days are usually warm with cool nights and low rainfall. Moist, subtropical air often brings thunderstorms and localized heavy rains.

Rarely, great storms pass through the area such as the damaging storm of December 22, 1964. Considerable flooding and wind-toppled trees were widespread. More frequently, however, storms with warm, strong winds accompanied by heavy downpours of rain pass through the area every decade or so. These "rain-on-snow" events can cause serious flooding when the snowpack melts rapidly. (Table 1, Weather Data Summary).

Table 1: Summary weather data from three locations in or near the Metolius Watershed.

	Santiam Junction* (1961-85)	Camp Sherman* (1984-93)	Sisters* (1961-94)
Average January Maximum-Mean-Minimum Temperatures (oF)	34-27-21	45-32-19	41-31-21
Average July Maximum-Mean-Minimum Temperatures (oF)	73-58-43	92-68-44	84-63-41
Annual Precipitation (Inches)	86.7	29.8	14.1
Average January Precipitation (Inches)	14.2	4.5	2.6
Average July Precipitation (Inches)	1.4	0.6	0.4

(*Climate data for Santiam Junction from records supplied by Ray Hatton, Bend, Oregon; for Camp Sherman from records of the late Jim Ellingboe, resident of Camp Sherman, supplied by Hatton; and for Sisters from Hatton's 1994 book Sisters Country Weather and Climate.)

The Soil Resource

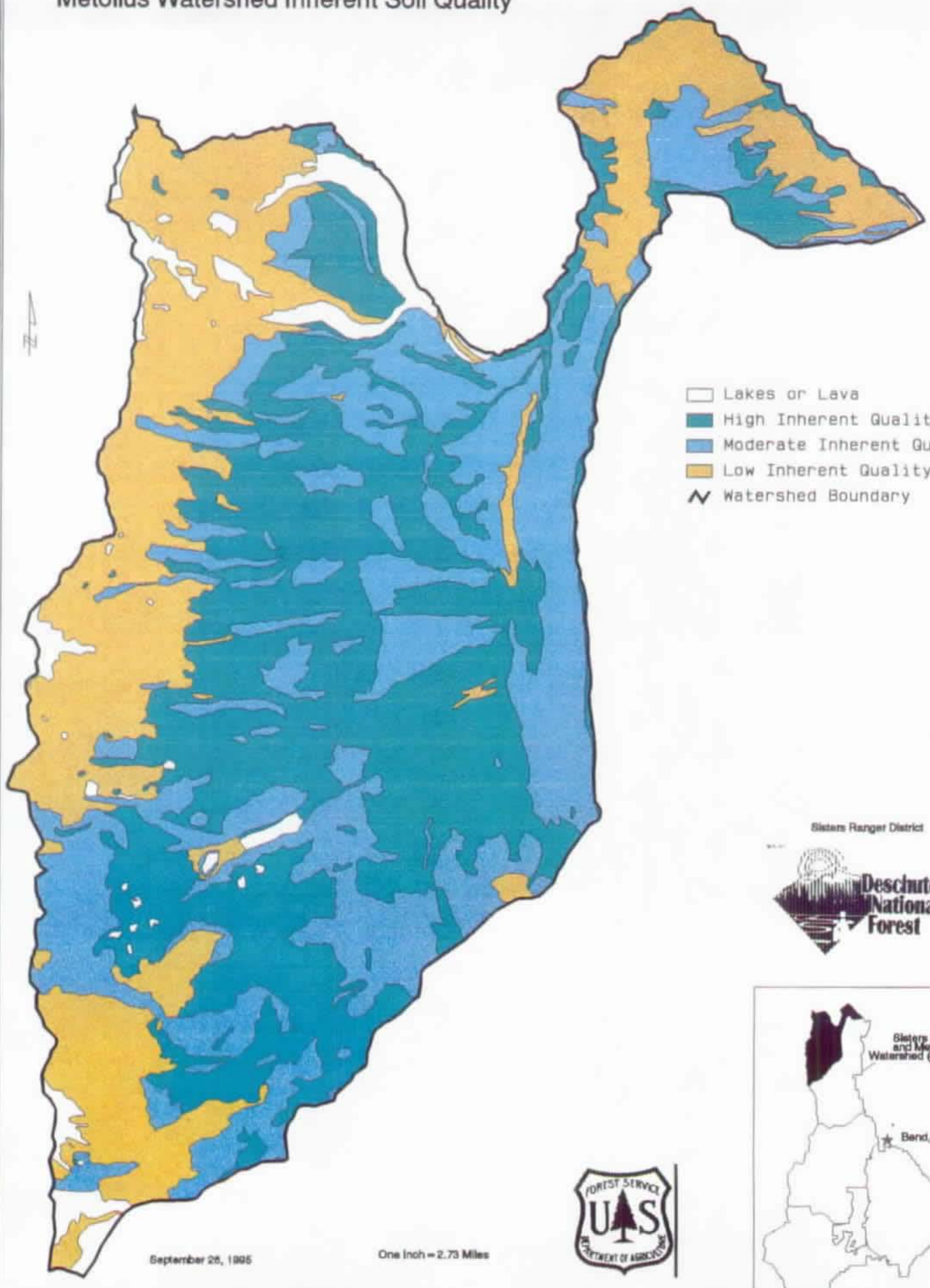
Combinations of geology, climate, vegetation and other organisms, topography and time determine the kind of soil that will develop on a given site. Soils in the Metolius Basin have developed from volcanic ash or cinders, volcanic bedrock without additions of ash, and glacier-related deposits of till, outwash, and lake sediments. An assessment of inherent soil quality is based on a combination of site index, soil characteristics (such as soil depth, organic matter content, water holding capacity and rock fragment content), and climatic influences, which characterize soil moisture and temperature regimes. (Table 2 and Map 3, Inherent Soil Quality).

Table 2: Inherent soil quality.

% OF WATERSHED	INHERENT SOIL QUALITY
39	HIGH
32	MODERATE
29	LOW

Areas with less organic matter content in the soil are prone to reduced productivity due to erosion or displacement of the critical surface soil layer. Areas of rocky soil and higher organic matter content are less sensitive. Due to their inherent porosity, these soils are normally not prone to erosion except along steep slopes. However, management induced changes to infiltration rates can establish conditions that will make these soils prone to surface soil erosion. Mass wasting in the form of landslides, debris torrents and slumps is not a significant concern in this watershed. Rock and snow avalanches have occurred only rarely on the steep glacially scoured slopes in the north portions of the wilderness area.

Metolius Watershed Inherent Soil Quality



Sisters Ranger District

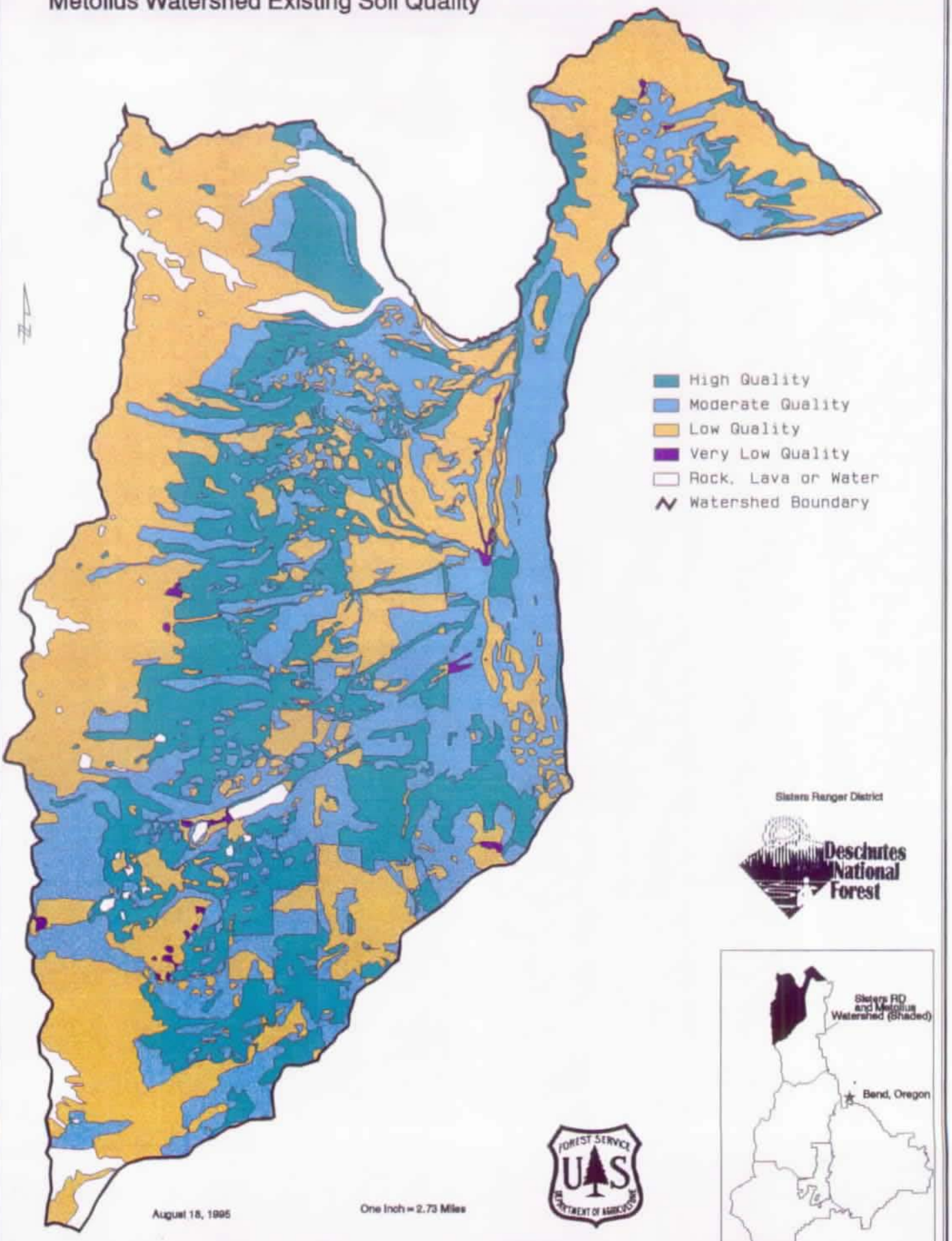
Deschutes National Forest

FOREST SERVICE
U.S.
DEPARTMENT OF AGRICULTURE

September 26, 1995

One Inch = 2.73 Miles

Metolius Watershed Existing Soil Quality



Soils - Existing Condition

Detrimental soil condition (Table 3) is a measure of:

- The amount of compaction that has increased the bulk densities of the soil over 20% above natural conditions.
- The amount of detrimental soil displacement
- The degree of soil combustion during burning
- Areas of significant erosion.

Table 3: Detrimental Soil Condition

SOIL CONDITION CLASS	% TOTAL WATERSHED	% WATERSHED OUTSIDE OF WILDERNESS
A (0 - 10% detrimental)	62	47
B (11 - 20% detrimental)	11	16
C (21 - 40% detrimental)	18	25
D (>40% detrimental)	9	13

The existing soil quality (Table 4 and Map 4) is determined by combining the inherent soil quality, the amount of activity that has occurred on the site that has the potential to degrade the soil quality, and the sensitivity of the soil at that site. The result of the assessment shows that management activities have degraded soil quality, mostly by soil compaction, with some significant soil displacement on old slashpiled areas.

Table 4: **Changes to Soil Quality Type**

INHERENT SOIL QUALITY	% WATERSHED	EXISTING SOIL QUALITY	% WATERSHED
HIGH	39%	HIGH	26%
MODERATE	32%	MODERATE	42%
LOW	29%	LOW	32%
		VERY LOW	.4%

Inherently high quality soils have undergone the greatest percent change due to management activities. They have been degraded to moderate quality (24%) and to low quality (9%). The next significant change has been by converting moderate quality soil to low quality soil (30%). Some low quality soils have been degraded to very low quality due to management impacts (1%). Overall, throughout the watershed, 23% of the land base has had some change in the quality of the soil resource. These conditions warrant a focused restoration program to restore these areas and return sites to their most productive state.

Compaction disrupts several soil processes. Most directly it affects impacts water cycling by inhibiting the infiltration of water; however, it also increases the runoff potential, thereby accelerating the processes of soil erosion. Compaction and erosion both can change the soil moisture storage capacity of the soil.

Compaction restricts root growth that reduces the physical ability of roots and associated mycorrhizae to penetrate the soil profile in order to uptake water and nutrients, and transport it to the tree. Compaction also influences nutrient cycling by creating an environment that has a reduced ability to support soil biotic communities due to increased water stress, reduced aeration, and physical barriers.

The Water Resource

Hydrologic Characteristics

The headwaters of the Metolius Watershed originate in the Upper Cascade subsection. As streams flow to the east over the glaciated landscape they change from small rivulets of snow pack meltwater, to steep gradient cascades. Near the lower half of this subsection streams flow through deep glacial valleys. Small lakes and ponds formed by terminal glacial moraines also occur in the higher elevations, generally above 4,500 feet (Map 5 -Streams and subwatershed).

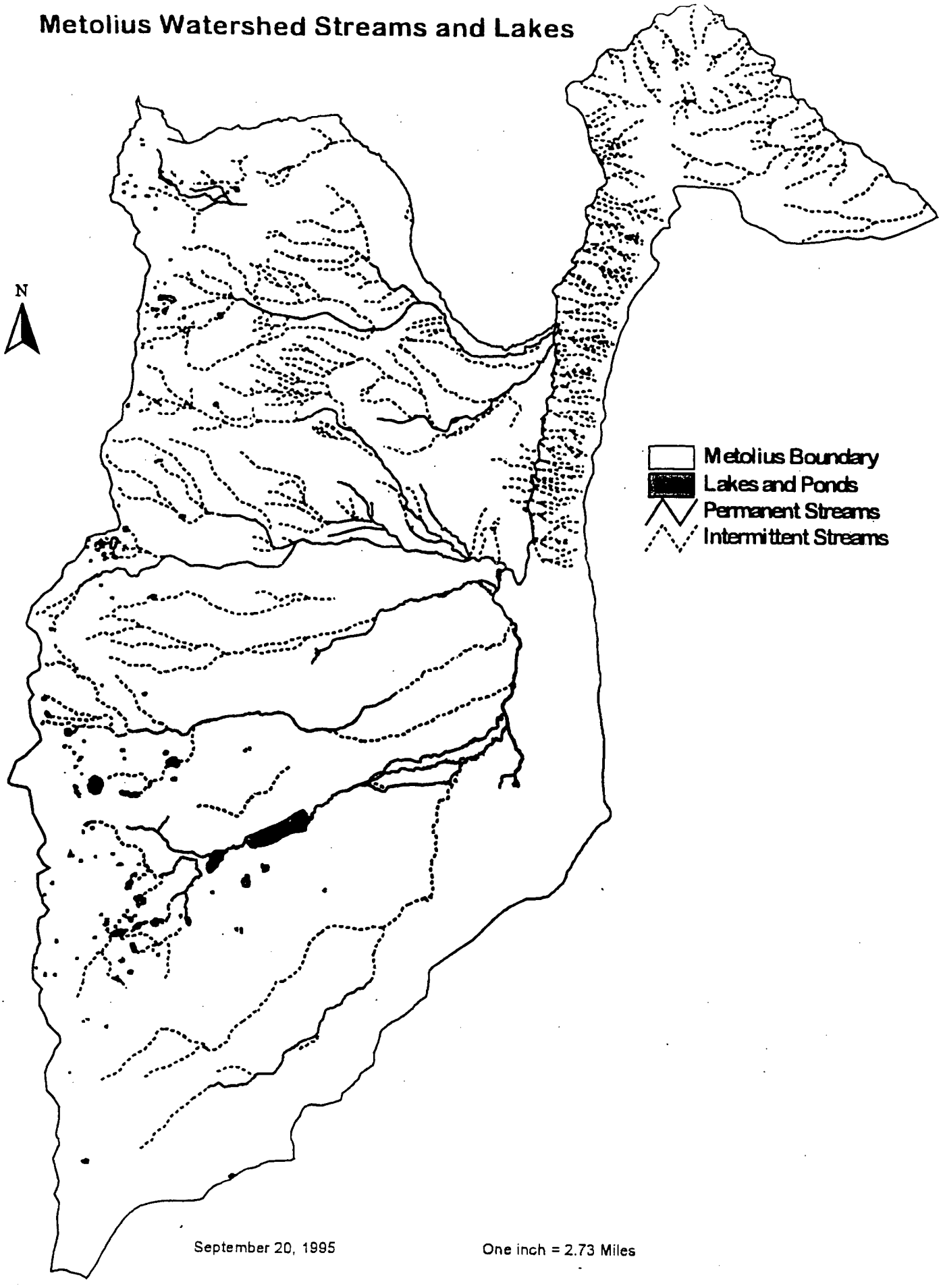
Streams continue to flow east into the Lower Cascade Subsection. This is below the furthest extent of early glaciers, and stream morphology changes. The glacial outwash landscape is less sloping, thus lowering stream gradient and causing many streams to meander until they reach the Metolius River. Throughout the course of the streams, groundwater inputs influence flows, water quality and the aquatic life found in the streams.

East of the Metolius River is the Green Ridge Subsection. Most of the streams are ephemeral and flow for a short distance down the steep escarpment. Most of these streams carry water only during storm events. The amounts of stream miles in most subwatersheds are dominated by intermittent streams (Table 5)

Table 5: Miles of stream by class within the study subwatersheds. Stream miles generated for 1:24,000 scale based GIS.

Subwatershed	Permanent with Fish	Permanent without Fish	Intermittent
Abbot	6.1	–	20.9
Cache	4.7	–	18.6
Candle	20.6	–	52.8
Canyon	29.3	0.9	58.4
Horn	8.7	–	81.3
Jack/First	13.5	1.5	41.4
Scarp	3.6	–	36.1
Suttle/Lake	19.7	1.7	14.7
Total	106.2	4.1	324.2

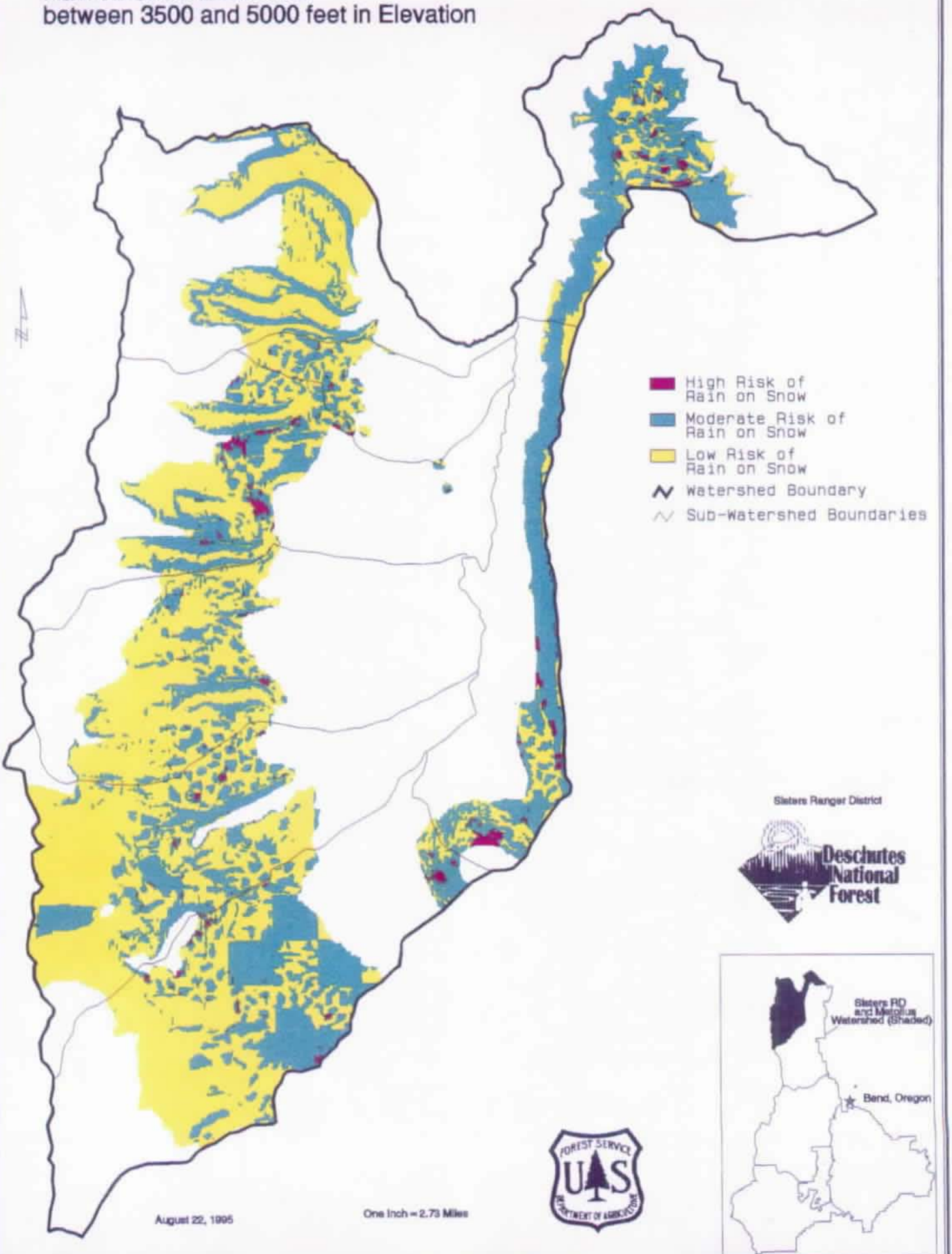
Metolius Watershed Streams and Lakes



September 20, 1995

One inch = 2.73 Miles

Rain on Snow Event Risk between 3500 and 5000 feet in Elevation



Aquatic Systems

Sedimentation /Erosion

Roads may create new drainage channels that can speed runoff and carry fine sediment to natural stream channels. Density of roads in the watershed exceeds Forest Plan objectives for all subwatersheds except in Candle and Horn (Table 6). **With wilderness areas included, the Jack/First, Canyon, Abbot, Suttle and Cache subwatersheds contained 3.4 to 6.7 miles of road per square mile. If the wilderness is not considered, the managed portions of the watersheds have much higher road densities in the Jack/First and Canyon watersheds.** Abbot Creek drainage is mostly outside the wilderness and therefore roads will have a much more direct effect on the stream.

Table 6: Road Densities for subwatersheds under study. Data from Sisters Ranger District GIS data base, 1995.

Subwatershed	*Subwatershed Area (mile 2)*	*Subwatershed Miles of Road*	*Road Density Including Wilderness*	*Road Density Excluding Wilderness*
Candle	30.3	13.5	0.4	5.1
Jack/First	37.9	174.3	4.6	6.4
Canyon	35.0	119.3	3.4	5.2
Abbot	9.4	63.2	6.7	6.8
Suttle/Lake	27.2	159.8	4.9	6.8
Horn	25.6	58.3	2.3	–
Scarp	21.6	112.1	5.2	–
Cache	40.3	194.8	4.8	7.0

Road crossings over creeks can be direct sources of runoff and sediments from road ditches. The more crossings, the more opportunities for artificially channelized storm flow bring fine sediments into the stream channel raising the fine sediment load above historic levels. **Subwatersheds found to have more than one crossing per mile are Suttle/Lake, Abbot, Cache, Canyon, Scarp and Horn (Table 7). Some road crossings and culverts are failing and causing scour and sedimentation in streams in the Blue Lake area.** Some areas have local concentrations of road crossings but this measure can be used to rank risk of sedimentation and help assess the need for road realignment, redesign, or closure.

Roads can result in moderate to high risks of sediment in watersheds even in areas of fairly permeable soils if they are compactible. Abbot Butte has finer textured soils that result in a moderate risk of runoff. The area above Blue Lake in the Suttle/Lake watershed is another example. Areas of moderate to high risk of runoff due to compaction and slope occur in 41% of the elevation band prone to rain on snow events (Map 6). Other areas of similar slope and compaction may still be at risk from summer thunderstorms during dry soil conditions. Runoff due to hydrophobic soil conditions during these events can move fine sediment from roads rapidly.

Table 7: Number of road crossings per mile of streams for permanent and intermittent flow within the Metolius watershed.

Subwatershed	Number of road crossings		Crossing per mile of stream	
	permanent	intermittent	permanent	intermittent
Abbot	5	54	0.8	2.6
Cache	5	28	1.1	1.5
Candle	1	19	0.1	0.4
Canyon	19	92	0.6	1.6
Horn	0	93	0	1.1
Jack/First	8	42	0.5	1.0
Suttle/Lake	23	28	1.1	1.9
Scarp	9	80	2.5	2.2

Roads have become part of the stream network in the Roaring Creek, Abbot Creek, Brush Creek and Jack Creek drainage. In many areas, roads are located in the riparian area along the streams and these roads can transport sediment directly to streams during storms directly. **The density of roads in the riparian area is 3.4 miles of road per square mile of riparian zone and 5.4 miles per square mile within the interim riparian reserve.** Riparian roads also interrupt the band of riparian vegetation and provide access within 100 feet of the streams.

Fine sediment reduces the open spaces in gravel and reduces the quality of habitat for aquatic invertebrates (embeddedness). **Invertebrate habitat may be limited by sediment in Roaring Creek, Jack Creek and Abbot Creek. Moderate to high levels of fine sediment were detected in these streams and the invertebrate sampling showed moderate representation of sediment-tolerant invertebrates (Mangum 1988, Wisseman 1992).** Embeddedness is well correlated with sediment intolerant stoneflies and mayflies in the streams sampled.

Salmonid spawning habitat has been rated fair quality in Jack and Roaring Creek due to the high percentage of fine sediment in gravel areas (Table 19, Soil, Geology, Hydrology Appendix). This fine material can reduce trout survival by reducing the amount of oxygen flowing through the gravel where eggs are deposited and by trapping the emerging fry in the gravel.

Monitoring of fine sediment in the streams of the Metolius Watershed has been conducted since 1988. Early analysis of McNiel core samples showed little change from 1988 to 1991. Only Roaring Creek showed a trend toward less fine sediment from 1988 to 1992 (Riehle 1993).

Another technique used to monitor fine sediment was assessed in this analysis. Sediment traps placed in spawning locations and retrieved the following year has been used since 1990, to monitor trends in fine sediment as described by Riehle (1993) and Wesche and others (1986). Using a test of confidence intervals of the difference to compare two means and using t-tests, **significant increases in fine sediment less than 3.35mm were detected in spawning areas of Abbot Creek, Brush Creek, First Creek and South Fork Lake Creek ($P<0.05$). Abbot Creek also showed an increase in fines less that 0.85mm.** Follow-up sampling of Brush Creek using McNiel core samples showed no significant change from 1989 to 1993. Jefferson Creek

was the only stream that showed a significant decrease in fine sediment since 1990, based on the sediment traps.

There is no threshold or number that indicates the significance of sediment levels. However, situations where sediment is increasing above baseline or historic levels should be cause for concern. Although this is preliminary data and longer term trends should be reviewed to assess year to year variations, this analysis does raise a concern for the quality of aquatic habitats for fish, amphibians and invertebrates. The results of this monitoring also show that the streams with increased sediment were those streams not used by bull trout for spawning. The results of this monitoring can be used to direct restoration efforts in watersheds with high fine sediment risk.

Changes in Flow Regimes

Changes in flow quantity and timing

The hydrograph of Lake Creek plotted with monthly means from 1970 to 1991, showed increases in stream flow in December, continuing until the peak flow in May. Jefferson Creek showed high, average, monthly flows primarily in June with the spring snowmelt. The Metolius generally has a flat hydrograph with a slight increase in flow during the winter (Riehle 1993). In these streams, summer low flows are moderated by the groundwater sources in the watershed.

Timber management has focused on selective cutting in the ponderosa pine timber type and clearcutting in the mixed conifer. Openings can concentrate snow and runoff into small headwater streams and can increase channelized runoff on road networks. The percentage of mixed conifer stands in seedling/sapling size classes has increased from 1% in 1953, to 10-16% in 1991. This increase in openings results primarily from small clearcut patches that have been harvested since the 1970's. These openings can concentrate snow deposition and runoff in small headwater streams and can increase channelized runoff along road networks.

Stream gauging at the Suttle Lake outlet on Lake Creek, Jefferson Creek and the Metolius River provides little evidence of an altered flow regime when peak flows were assessed (Riehle 1993). These stations are low in the system and alterations of peak flow would be suspected in the headwaters, and lower ordered streams. Gauging of peak annual flows in smaller streams in the watershed from 1983 to the present has been fairly inconclusive (Table 20, Soils, Geology, Hydrology Appendix). The data presented show no trend of discharge per square mile within the watersheds. These data are not sensitive to showing changes in flow due to the lack of reference watersheds (MacDonald and Wissmar 1991). The closest reference watershed measured is the Candle Creek station with only 0.4 miles of road per square mile. Differences in the watershed character make direct comparisons to heavily roaded drainages difficult, and the absence of long term data makes this analysis inconclusive. **Other indicators of stream stability, such as bankful width to depth ratio's, overhanging vegetation and streambanks, similar wetted width and bankful widths, and high wood densities suggest that most Metolius tributaries have fairly unaltered flow regimes during bankful** events. First Creek and Upper Canyon Creek show channel characteristics that are not as stable as most Metolius streams and warrant further monitoring for peak flow.

Changes in water quality

Nutrients and Bacteria

The Metolius River generally has good water quality. Water testing has shown low dissolved solids, low alkalinity and low conductivity. The dilute water of the Metolius and its tributaries is characteristic of many Cascade streams. The State Department of Environmental Quality has a long term monitoring station on the Metolius at Bridge 99. Data has been collected in many other stations and tributaries. Data collected by the Confederated Tribes in 1993 showed similar results.

The Metolius River has a level of orthophosphorous that has been measured to be higher than the recommended DEQ maximum of 0.05 mg/l (DEQ data from 1977-1987). While nitrogen is generally within State standards, the higher levels of phosphorous suggest the system is nitrogen limited. The higher concentration of phosphorous may be related to the young volcanic character of the watershed and the groundwater interaction with the volcanic material.

In general, the tributaries have much more dilute water than the Metolius River. The tributaries have fairly low conductivity and low nutrients. Water clarity is excellent and generally below one NTU during base flows (Riehle 1993). Lake Creek turbidity increases in the summer due to the influence of surface water from Suttle Lake.

Algal blooms and water chemistry of Suttle Lake and Blue Lake have been studied intermittently since 1940.

These studies suggest that the bloom of Suttle Lake may be trending toward a more nutrient rich condition (Aquatic Analysts 1990). Intense algal blooms can increase pH to 8.4 or more, above US Forest Service Guidelines for swimming areas. Increasing the nutrient load in Suttle Lake can alter the oxygen, pH and water clarity in Suttle Lake, Lake Creek and the Metolius River. A study of the algal bloom of Suttle Lake was initiated in 1995 by the Sisters Ranger District to describe the algal character of the lake and to assess if the water quality is changing. With recent improvements to a day-use site toilet and to a resort septic system, improvement in the water quality of Suttle Lake is expected. This study will serve as baseline data for future monitoring of water quality in Suttle Lake.

Bacteria has been monitored in the Metolius system by DEQ and the Sisters Ranger District. The effects of

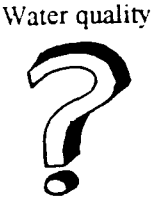
the surrounding development on the water quality of Lake Creek and the Metolius River have been a concern for over 60 years. In the early 1970's, new proposals for housing development near Lake Creek prompted surface water testing for total and fecal coliform bacteria, by the Sisters Ranger District. **A review of the data from that period together with the DEQ and Confederated Tribes data indicates that bacteria levels have not exceeded State standards.**

Groundwater

The watershed receives its highest precipitation along the Cascade crest with precipitation decreasing to the east. The highly permeable volcanic ash soils allow water to infiltrate into a complex network of fractures in the underlying basalt flows. The volcanic and glacial history of the Metolius watershed has created a complex network of underlying basalt flows and glacial and fluvial deposits. These underground aquifers connect to the surface as springs most frequently along the transition between the glacial and the alluvial outwash areas, along surface lava flows and along the Metolius River.

Flow rates of springs vary little throughout the year, suggesting slow release from large sources of underground water. Below 3,200 foot elevation, groundwater can be found at depths of 50 feet or less throughout the year. The Metolius River represents the minimum elevation that ground water is likely to be encountered in the basin.

Water quality testing of the Metolius River in the 1970's, showed some trends related to groundwater. **Fecal**



coliform bacteria rose in July and August and at times of rain but stayed within state standards. The highest levels appeared to be concentrated at the mouths of Link Creek and Lake Creek but were dissipated as the water moved downstream. There were higher levels of fecal bacteria between Allingham Bridge and Gorge Campground. In 1991, testing of wells along the recreation residences in this area found six groundwater wells that tested positive with fecal coliform bacteria. Since then, wells have been drilled into a lower aquifer but the source of this pollution has not been identified. Groundwater testing may be warranted to identify the extent of shallow ground water contamination. Possible sources may include domestic waste water drain fields and the Allingham Dump Station.

Stream Temperature

Stream temperatures in the tributaries of the Metolius River are low due to the influence of cold water springs (Table 8). Bull trout are dependent on these colder stream reaches for spawning and the first two years of rearing. Cold water reaches may be the refuge that allowed the bull trout population to survive. The lower reaches of Canyon Creek and Abbot Creek have colder water because of the low temperatures in their source springs, and the middle reaches of Brush Creek interact with cooler subterranean flows - these reaches all provide bull trout rearing habitat. Bull trout spawning is linked only to streams with maximum August temperatures less than 10 C.

Stream temperatures have been monitored since 1988, and no significant change in stream temperatures have been found that can not be attributed to the drought (Riehle 1993; Table 8). Several clearcuts along all streams have reduced shade and threaten the cold water quality of these streams. **Although recent cutting near streams has had little effect on stream temperature in reaches monitored, additional cutting near the stream should be carefully assessed to ensure water temperatures remain low (Riehle 1993).**

High stream temperatures in summer months result from the surface water of Suttle Lake draining into Lake Creek (Riehle 1993). These high water temperatures may cause trout to seek thermal refuges by concentrating in groundwater seeps or moving downstream into the Metolius River. Although part of the natural character of the watershed, these high stream temperatures should not be increased by removal of streamside vegetation.

Table 8: 1994 Monthly maximum, minimum and mean temperature (C) for streams monitored in the Metolius watershed.

Stream Station	June			July			August		
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
Abbot Creek lower 12 rd *	6	11	8	6	10	8	5	11	8
Candle Creek 500 rd	5	8	6	6	8	7	6	7	6
Candle Creek 1290 rd	5	7	6	5	7	6	5	7	6
Canyon Creek 12 rd	4	10	7	5	10	8	4	9	7
Canyon Creek 1420 rd	4	11	7	5	11	8	5	10	7
Jack Creek 1420 rd	3	11	7	4	11	8	4	10	7
Jefferson Creek 1290 rd	4	9	7	6	9	8	6	8	7
Metolius River Bridge 99	6	10	8	6	10	8	6	10	8
Roaring Creek 1260 rd	4	8	6	5	8	6	5	8	6
S. Fork Lake Creek 090 rd	10	21	15	14	24	19	13	21	17

* =1993 data available only, which may have been an unusually cloudy, wet year.

Changes in quantity and distribution of large wood

Instream wood in the Metolius River has had a long history of manipulation. In the 1930's, wood was removed from the Metolius River to facilitate floating logs down to a mill on the Deschutes River. Photos of the Riverside area taken in 1924-26 show many large logs in the river. The CCC camp at Riverside was reported to have cleaned the river of wood in the Camp Sherman area as one of their public works projects. Salvage logging in the 1930's and 1940's after a large blowdown in 1931 may have removed newly fallen wood from the river. A 1938 account of two individuals floating the Metolius River reported over 20 portages from Canyon Creek to the Deschutes River. In a discussion on clearing the river for a log drive, one company reported that all of the obstructions were above Street Creek. These reports suggest that the frequency of wood jams in the Metolius above Street Creek was about one full spanning jam per mile in the 1930's. In 1995, there were no jams requiring portages on the Metolius below Canyon Creek.

In the Lower Metolius River, the amount of instream wood is recovering since the 1950's. The number of trees in the river below Bridge 99 that can be counted from air photos has increased from 11 in 1951, to 86 trees in 1993. The number of log jams increased from 0 to 16 during the same time period (CTWS data). **The increase of instream wood is slow and is not near the natural density of wood found in the 1930's.** This recovery rate is expected to continue as trees fall into the river from natural processes such as blowdown, flood scour and natural mortality. **The manipulation of wood in the river for opening passage for boating may have an effect on the retention of wood in the system and the formation of wood jams.** Although the Forest Service does not remove the wood, logs have been rearranged in the upper river to provide safe passage of boats. **Full spanning jams have not been allowed to develop below Camp Sherman.** The river below Bridge 99 is not managed for safe passage by the Forest Service but has been opened unofficially in the past by cutting trees that have fallen across the river.

Wood densities in the tributaries are moderate to high compared to many Cascade streams (Table 9). The smaller the stream the higher the expected instream wood. This trend is supported in the data collected in the survey (Table 10). Instream wood is less frequent in lower reaches of the tributaries possibly due to salvage or stream clean out. Local residents report removal of wood after the 1964 flood for erosion control. **The ponderosa pine and larch stands grow at lower densities than mixed conifer areas and may contribute to lower instream wood densities. In many cases instream wood sizes reflect the current dominance of small tree size classes in riparian forests.**

Compared to densities in unaltered grand fir sites in the John Day and Malheur watersheds, Metolius tributaries have much more wood. Fire frequencies are similar in the Metolius basin but fires may be more intense in the Blue Mountains, resulting in less down wood in riparian areas. The Metolius River was the only river with less instream wood than the Blue Mountain study, partly due to the size of the river and possibly the history of wood removal. All Metolius tributaries exceed PACFISH Riparian Management Objectives of greater than 20 pieces of wood, greater than 12 inch's diameter, and 35 feet long.

Table 9: Summary of wood densities in streams of the Metolius Watershed by reach type and forest type. Data from the upper John Day and Malheur River drainage in unaltered mixed conifer stands presented for comparisons (Cordova 1995).

Forest Type	Rosgen Channel Type	Instream Wood per Mile		
		Large >20in dia mean range	Small <12in dia mean range	Brush 20-12in dia mean range
Metolius Basin				
Mixed Conifer	A	38 (10-85)	119 (77-181)	110 (71-141)
	B	22 (8-49)	126 (20-486)	88 (13-184)
	C	18 (3-35)	161 (44-262)	246 (104-486)
Ponderosa Pine	C	20 (3-32)	83 (25-127)	76 (38-163)
John Day/Malheur *(a) basins-unaltered				
Grand fir	A	16	30	62
Climax	B	37	34	115
	C	42	46	144
PACFISH RMO	all	20 *(b)		

*a- from Cordova 1995

*b- includes all wood >12 inches dia, >35ft long

Changes in Stream Structure

The low bankfull width to depth ratios suggests a fairly stable flow regime and good streambank stability. All streams except the head spring reaches met the PACFISH RMO for bankful width to depth ratios less than 10. The headwater reaches of Jack Creek, Brush Creek, Roaring Creek and the Metolius River may have a wider shape due to the influence of the stable flow and proximity to the spring.

All streams surveyed had relatively low frequency of pool habitats. Pool frequency in unaltered upper John Day and Malheur drainage streams were 2-3 times higher than Metolius tributaries (Cordova 1995). The PACFISH (RMO) for pool frequency is based on the wetted width of the stream. For streams 10 to 25 feet in width, the goal of 96 to 47 pools per mile is set (USDA 1994). Most Metolius tributaries have pool frequencies between 1-27 pools per mile. Only high gradient reaches of Bear Valley Creek and Canyon Creek had pool densities that approach the PACFISH objectives.

Side channels are important habitats in the tributaries of the Metolius because they provide important rearing habitat for juvenile bull trout and other aquatic life (Goetz 1994). Side channels are most abundant in stream reaches that are low gradient, have high wood densities and are groundwater influenced. Reaches that provide important side channel rearing habitat are Roaring Creek, lower Candle Creek, middle Canyon Creek and upper Jack Creek.

Cover for fish is most abundant in the form of overhanging vegetation, undercut banks and aquatic vegetation (Riehle 1993). Wood material, even fine wood accumulations, are frequently used by juvenile bull trout for cover (Goetz 1994). Riparian vegetation along these stable streams often grows to overhang the stream because the active channel and wetted channel are often similar. Aquatic mosses in groundwater-influenced reaches provides cover, even in winter months. Fine wood is allowed to accumulate and create complex habitats along stream margins. These features are important juvenile bull trout habitats.

Table 10: Habitat measurements from the stream survey of stream understudy. Information was collected according to USFS, Region 6 protocol and Smart program output. Canyon Creek, Roaring Creek and the first reaches of Jefferson Creek and Jack Creek were generated prior to the Smart program.

Stream	Reach	Bankfull width/depth ratio	% side channels	Pools		Logs per mile			
				% Pools	Pools per mile	Large	Small	Total	Brush
Abbot	1	8	5	7	6	19	65	69	153
	2	7	<1	<1	<1	21	112	153	286
Bear Valley	1	3	5	20	55	29	77	71	177
	2	9	<1	6	–	–	–	–	–
Brush	1	4	1	3	4	3	44	104	151
	3	22	<1	<1	<1	10	131	208	348
	4	3	<1	2	5	10	94	98	202
Candle	1	–	16	3	11	–	–	–	–
	2	–	5	5	22	–	–	–	–
Canyon	1	6	5	30	21	19	78	42	141
	2	9	13	18	22	22	262	186	470
	3	6	<1	1	3	85	160	136	318
	4	6	2	43	42	21	486	184	754
	5	7	3	6	11	13	181	106	320
First	1	dry	–	–	<1	–	–	–	–
	2	5	2	40	27	28	49	99	176
	3	9	<1	13	22	52	81	141	275
Jack	1	22	13	8	19	27	41	121	189
	2	30	3	<1	<1	35	205	486	725
Jefferson	1	9	1	12	7	–	–	–	–
	2	9	1	12	6	49	149	78	277
Lake	S Fork	6	3	16	17	21	123	95	240
	N Fork	7	0	10	16	32	127	163	322
	M Fork	6	2	1	1	25	80	49	136
	Main	8	6	3	1	10	26	49	85
Metolius	1	32	<1	5	2	20	20	13	54
	2	4	1	3	1	8	8	37	75
	3	5	<1	3	2	3	3	38	65
Roaring	1	57	11	3	8	11	69	190	270
	2	21	11	1	6	11	66	105	182

Biological Domain

Vegetation Summary

The Metolius Watershed Analysis area is located in the High Cascades Province and on the edge of the High Lava Plains Province, on the eastern slope of the Cascade mountains (Franklin and Dyrness, 1973). Forested lands in this area include associations climax to mountain hemlock, subalpine fir, whitebark pine, silver fir, Douglas-fir, ponderosa pine, lodgepole pine, white/grand fir, and Engelmann spruce. Vegetation on the Deschutes National Forest varies in response to several environmental gradients, including a precipitation gradient, from the Cascades eastward to the desert-forest ecotone, an edaphic gradient in the Mazama pumice deposits, north and east from Crater Lake, and microclimate gradients associated with local changes in topography (Volland, 1985). At least 34 forested plant associations occur in the non-wilderness portions of this watershed analysis area, not including riparian plant associations.

Knowledge of the vegetative structure, composition , and density in the analysis area is a critical factor in evaluating the historic and existing physical, biological, and social processes occurring in this area. The quality of most of the processes is directly related to the structure, composition, and density of the vegetation where those processes take place. Vegetative structure, composition and density are a function of climate, topography, disturbance events, succession, seed supplies, newly introduced species, time, social values and economics. Climate and topography remain fairly constant over time compared with the other processes mentioned. Disturbance events include insect attacks, disease infestations, wind storms, fire, and management and recreational activities of people. Human activities are influenced by social values and economic needs and desires.

There are four major vegetation trends that apply to all Landscape Areas in the watershed.

1. Stand densities that are higher than site potential can support putting all sizes of trees at risk
2. Mortality of larger trees, insect and disease damage, and catastrophic fire risk are all increasing
3. Species composition has been shifting from early to late seral species
4. Outside of the wilderness in unmanaged stands, stand structure has been shifting from larger tree sizes to smaller tree sizes, and from single or two canopy-layers to multi-canopy-layers.

Aquatic/Riparian Summary

Riparian vegetation covers approximately 2.1% of the Metolius Watershed. In general, plant associations fall into three zones: the stream margin (emergent), flood plain, and transition zone to terrestrial vegetation. Common riparian associations in the tributaries start with alder/spirea or alder/snow berry that transitions to ponderosa pine/snowberry on the outer edge of the riparian vegetation. As the forest canopy closes in the mixed conifer stands, riparian plant associations move to alder/snowberry and alder/bank association. Alder/Spring associations are common on the high ground water and spring sites. Engelmann spruce and white fir/beadlily become dominant in the upper mixed conifer areas. The white fir/beadlily tends to be dominated by vine maple in the upper elevations near passes. Wilderness riparian areas were not inventoried.

The Metolius has extensive ponderosa pine/snowberry areas in the Camp Sherman area. Hawthorn occurs in openings near the river and the lower portions of the upper tributaries. Small fruit bulrush (big leaf sedge) is a common stream margin association along the water edge and islands of Lake Creek and the upper Metolius River. Although undescribed, the islands of the upper Metolius River are rich in a unique association of riparian species and may be the result of the stable flow character of the river.

Wildlife Appendix, Table 1 provides a list of species associated with riparian habitats. At least 282 species are known or suspected to occur in riparian habitats of the watershed. These riparian habitats are a relatively small portion of the watershed but contribute significantly to habitat and wildlife species diversity.

The riparian areas and associated uplands are important connectivity corridors between late-successional interior habitats in this fragmented landscape. This is especially true in the ponderosa pine and mixed conifer PAGs. The riparian corridors in the watershed vary in size and length. Many of the corridors are associated with larger blocks of forested habitat, and others are simply narrow stream buffers less than 200 feet wide. Riparian corridors less than 800 feet wide are considered all edge habitat and are not as effective as corridors for interior wildlife species.

Species like the American marten, fisher and wolverine are known to use riparian corridors for denning, foraging and as movement pathways. Many amphibian species (e.g., Cascade Frog) require riparian habitats and the associated adjacent uplands for dispersal and linkages between adjacent populations. Goshawks, spotted owls and other raptor species are using riparian areas for nesting and foraging because of a relatively high amount of potential prey species.

Amphibians are closely associated with riparian habitats. So little is known about amphibian populations that it is difficult to estimate the impacts of past activities or current population levels.

Fire Summary

Fire is a natural process that has shaped the landscape of the Metolius Watershed. Fire suppression and the effects of fire exclusion have also played a role in shaping the current landscape patterns.

A total of 18 large fires totaling 25,027 acres (17% of the watershed) have occurred in the Metolius Watershed since 1908. Fires ranged in size from 114 acres (1960 Round Lake Fire) to 3,917 acres (1945 Minto Pass Fire). The average fire size is 1,390 acres.

Large fires within the Metolius Watershed generally burn from west to east or down the Metolius River. This is due to the influence of afternoon (diurnal) down slope or down canyon winds. The highest concentration of large fires within the watershed can be found in the Metolius Horn subwatershed. This subwatershed is steep and inaccessible and composed of primarily Ponderosa Pine Plant associations. The Minto Pass Fire, the largest fire in the watershed, occurred in mixed conifer plant associations of the Canyon subwatershed.

There is an average of 17 fires per year in the watershed, ranging from 0.75 fires per year in the Abbot subwatershed to 3.0 fires per year in the Suttle subwatershed.

Of the 200 fire starts, 106 (53%) were lightning caused while 87 (44%) were human caused. Seven fires (3%) do not have sufficient information to determine cause. Lightning caused fires range from 80% in the Candle subwatershed to 33% in the Abbot subwatershed.

Fuel loadings in ponderosa pine range generally from 5% to 15 tons per acre, while mixed conifer ranges from 15 to 45 tons per acre depending upon harvest activities, and stand conditions. The regeneration units within mixed conifer generally have lower fuel loadings than the adjacent untreated stands (5-15 T/A). The fuel loadings in the high elevation forests range from two or three tons per acre in the grass meadows to greater than 30 tons per acre in decadent hemlock stands where there are large quantities of down hemlock logs.

Insects And Disease Summary

The roles of insects and diseases as disturbance agents in the forest are very closely tied to vegetation patterns. Factors such as species composition, size, structure, and density of forest stands are all very important in determining which agents are likely to be present in the forested environment, their abundance, and how profound their effect is likely to be on that vegetation. By their actions, forest insects and diseases sometimes alter the vegetative patterns that provided them with suitable habitat, and set the stage for new processes to occur.

Tree growth and vigor, as influenced by site conditions, also play a very important part in determining when and where insect and disease organisms will be operating in the forest.

The primary insects and diseases in the analysis area are dwarf mistletoe in the fir, pine and larch, fir engraver, mountain pine beetle, western pine beetle, tip moth, Ips pini, armallaria, annosus root rot, gall rust, commandra rust, white pine blister rust, Indian paint fungus, pecky cedar rot, brown cubical butt rot, Douglas-fir bark beetle, tussock moth, and residual populations of the western spruce budworm. There is also some blackstain in the area. This has been a favorite area for conducting regional insect and disease courses because of the variety and intensities of insect pests present in the dense mixed conifer stands.

Terrestrial Summary

A total of 349 wildlife species are known or suspected to occur in the Metolius Watershed during the year. A list of species found in each Plant Association Group (PAG) and the structural stage(s) that they utilize for breeding, foraging and/or resting habitat is in the Wildlife Appendix.

Focal wildlife species include: PETS species identified as Federally threatened, endangered or Category 2; and selected species. The selected species are those species listed as State Sensitive because they are likely to become threatened or endangered (Oregon's Sensitive Species Rule - OAR 635-100-140). These species represent a variety of other species found in similar habitats within the watershed.

The quality and quantity of wildlife habitats within the watershed are diverse. Wildlife habitats are provided in ponderosa pine, mixed conifer (dry and wet), lodgepole pine and high elevation mountain hemlock and riparian PAGs. Within these PAGs are meadows and other unique and special wildlife habitats. There are a variety of seral stages and forest structures associated with each PAG group. In general, the watershed landscape has changed from a fairly homogeneous, landscape composed primarily of medium and large trees to a heterogeneous landscape with numerous small, early and mid-seral patches. There are now significant amounts of edge habitat with high edge contrast. Late-successional interior habitats are highly fragmented and poorly connected.

Human Use Summary

Access for recreation and commercial activities have had substantial impact to vegetation within the watershed. Roads cover most of the areas except the wilderness. There are currently 895 miles of roads within the watershed, with most of the roads being gravel. Roads have diverted runoff resulting in some areas getting more water than others, which may have an effect on vegetation species, and can disrupt seed dispersal for some plants. Roads have disturbed underground flow regimes causing springs to come to the surface in road cuts forming new wet areas. Other roads have required substantial amounts of fill material, forming loss of large areas of vegetated. The number of miles of road surface has replaced substantial amounts of vegetative ground cover. In addition to constructed roads there are roads caused by forest users repeatedly traveling over certain areas. Plant roots (especially trees) can be detrimentally affected by traffic over them; by being covered by roadway (which reduces the availability of nutrients and water to the root system); and by having the roots damaged by road cuts. Road can also be pathways that assist in the distribution of noxious weed seed.

Recreation activities have greatly influenced vegetation from the high alpine areas to the lowest elevation areas. Within the wilderness meadow areas, lakeshores, and streamsides have lost vegetation trampling or pitching of tents. Trails, either intentionally constructed or user developed, have resulted in water being channeled during periods of runoff resulting in soil loss and deposition that damages vegetation.

Dispersed and developed camping have also resulted in vegetation loss in and around popular camping areas. The compacted soils in these camping areas can have a detrimental effect on nutrient cycling along with the loss of litter burned. The compacted soils may also assist disease and insects affecting trees because trees that are stressed are naturally more susceptible.

Other recreation impacts to vegetation include: trampling around trails and popular fishing spots; careless hacking on trees and shrubs; non-native plant seeds introduced to meadow areas by horses and vehicles; replacement of natural vegetation with non-native plants on recreation residence tracts and private lands;

non-native plants dispersed downstream by the river; and the removal of hazard trees reducing natural snag habitat in all developed recreation sites.

Harvest units cover 25,166 acres. Regeneration units cover 14,331 acres. There are still large trees in some of the units. Timber stand improvement acres cover 6,910 acres, mostly in pole size or small size trees. Partial cut areas mapped in 1953 cover 36,355 acres.

Vegetation/Habitat

Size and Structure

The most striking change in the watershed is the transition from large unfragmented areas dominated by medium and large-sized trees to smaller areas dominated by small-sized trees. There has also been an increase in seedlings, saplings and pole-sized trees (Maps 7 and 8, 1953 and 1991 Size and Structure).

The following tables introduce the format for comparison of historic variability described in each PAG. The historic range of variability was not estimated for the entire watershed, since HRV of each PAG is more meaningful and useful.

Table 11: Comparison of Vegetation Classes in 1953 and 1991

1953 AND 1991 SIZE CLASS COMPARISON				
SIZE CLASS	1953 PHOTOS		1991 PHOTOS	
	ACRES	PERCENT	ACRES	PERCENT
NON-FOREST GRASS / FORB /SHRUB	14,653	10%	10,051	7%
SEED / SAP * 0-4.9"	686	0%	14,195	9%
POLE TREE 5-8.9"	2,785	2%	13,584	9%
SMALL TREE 9-20.9"	36,060	24%	92,309	62%
MEDIUM / LARGE TREE 21"+	94,976	64%	19,021	13%

Table 12: Historical Variability

Metolius Watershed Total Acres = 149,160			
		Species Composition	
Size/Structure Class	Year or Time Frame	Pioneer Mixed & Climax	
		Acres	Percent
Non-Forest & Grass/Forb/ Shrub	1991 1953	10051 14653	7 10
Seed/Sapling 0-4.9"	1991 1953	14195 686	9 0
Pole 5-8.9"	1991 1953	13584 2785	9 2
Small 9-20.9"	1991 1953	92309 36060	62 24
Medium/Large 21"+	1991 1953	19021 94976	13 64
TOTALS	1991 1953	27036 27036	100 100

Canopy Cover

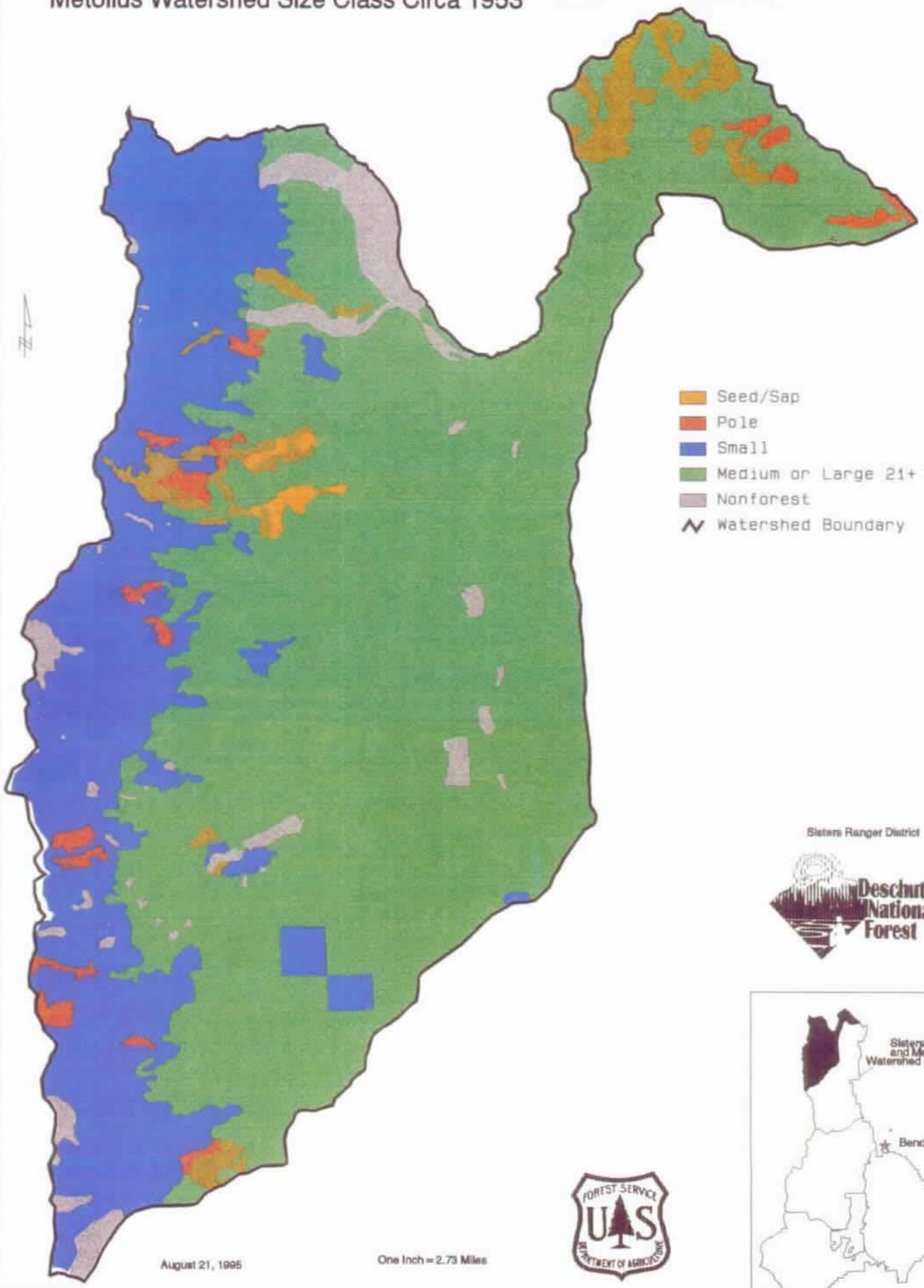
Canopy cover has decreased in mixed conifer areas in the last ten years because of the spruce budworm infestation. We don't have historical records of canopy cover, but we can estimate that with lower densities maintained by frequent underburns in much of the watershed, historical canopy cover was lower. **Except in some of the budworm defoliated areas, canopy cover in current natural stands exceeds historical canopy cover levels.** The thinned and regenerated stands are more representative of the lower canopy cover found historically in areas with frequent underburns, or in areas following stand replacement fires.

Table 13 below shows an estimate of canopy cover in the watershed taken from 1991 aerial photos.

Table 13: Canopy Cover by PAG

1991 CANOPY COVER BY PAG - ACRES AND PERCENT OF PAG									
PAG	CANOPY COVER								
	0 - 10	%	11 - 40	%	41 - 70	%	71 - 100	%	Total
MCD	7,997	17%	13,821	29%	21,025	44%	4,741	10%	47,581
MCW	5,474	14%	8,570	22%	20,663	53%	4,030	10%	38,735
PP	3,018	11%	11,597	43%	12,352	46%	69	0%	27,033
HIGH	2,502	13%	5,222	26%	8,084	41%	4,006	20%	19,813
LP	599	7%	3,767	47%	3,581	44%	154	2%	8,101
RIP	613	19%	664	21%	1,687	53%	221	7%	3,181

Metolius Watershed Size Class Circa 1953



Sisters Ranger District

Deschutes National Forest

August 21, 1995

One Inch = 2.73 Miles

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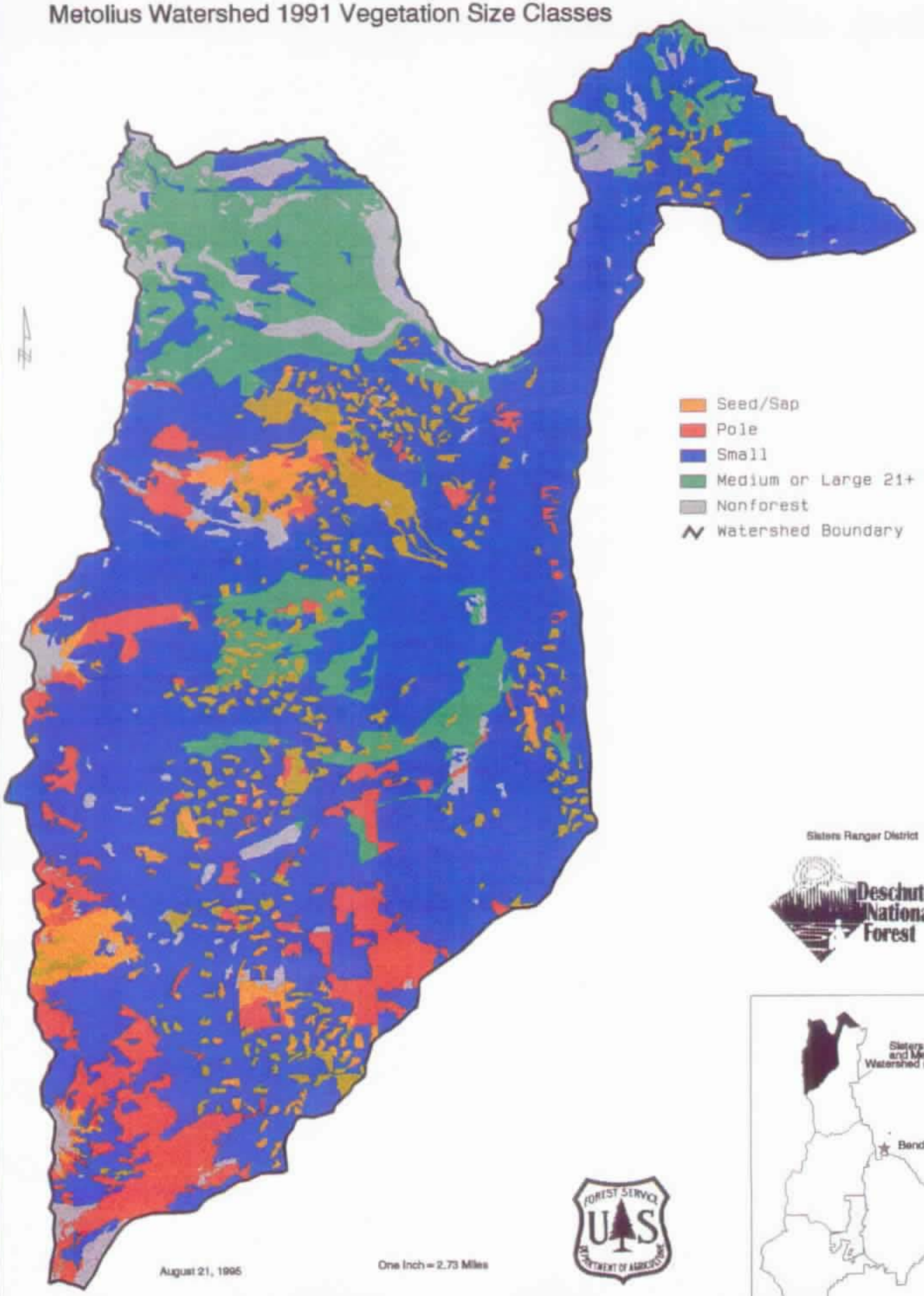
Metolius Watershed 1991 Vegetation Size Classes



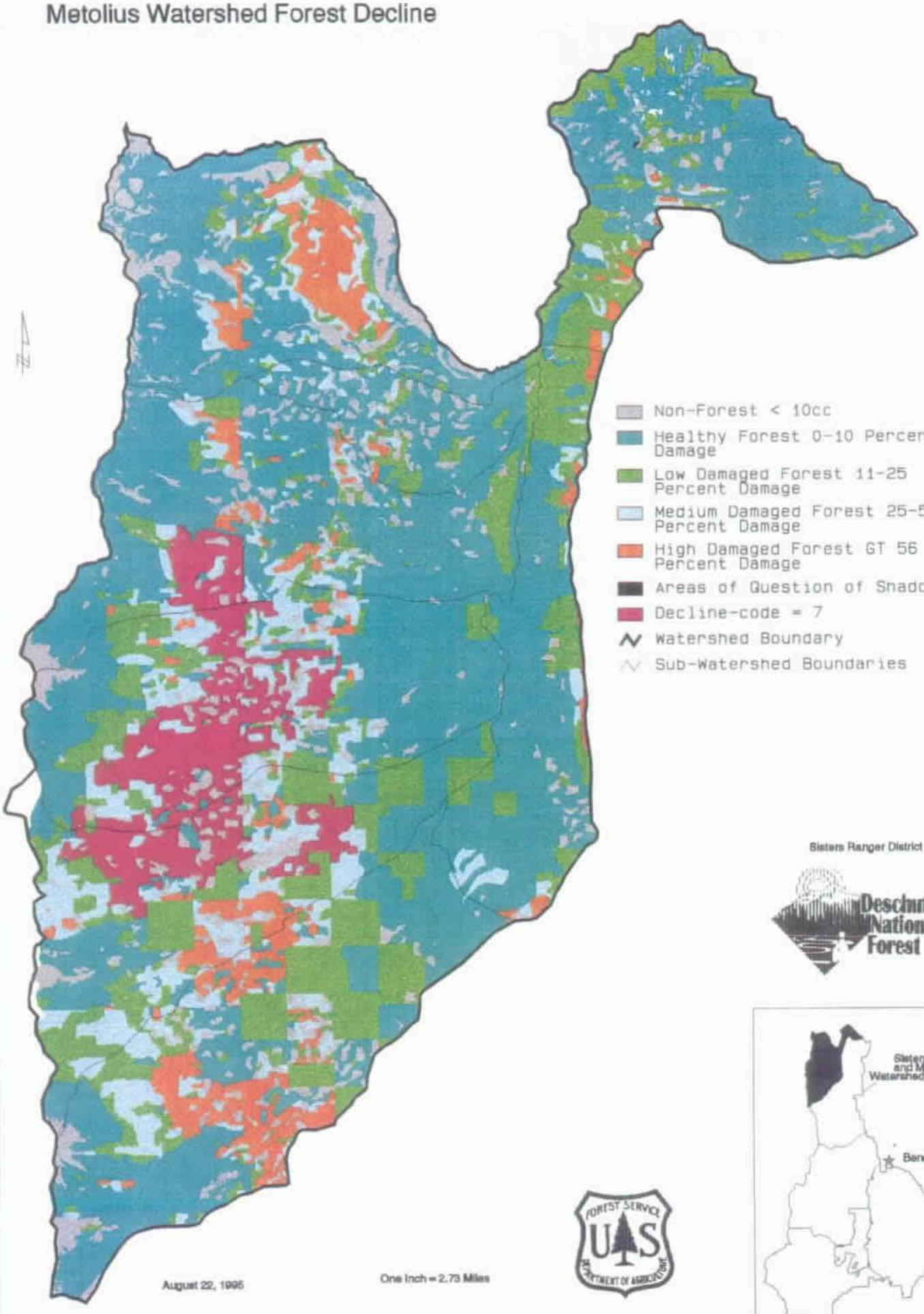
Sisters Ranger District

Deschutes National Forest

August 21, 1995

One Inch = 2.73 Miles

Metolius Watershed Forest Decline



Sisters Ranger District

Deschutes National Forest

August 22, 1995

One Inch = 2.73 Miles

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Tree Density And Mortality

The overstory and understory densities were estimated from 1991 aerial photo data, and calculated from 1995, entomology tree mortality plots and from stand exam data. **Even with the high mortality that has occurred in the mixed conifer areas, many acres still exceed sustainable density levels of live trees. Estimates indicate that at least 50% of the forested acres in the watershed exceed sustainable densities.** A very visible and current example of the consequences of trying to maintain densities above sustainable levels is the amount of mortality in the mixed conifer areas (Map 9, Forest Decline).

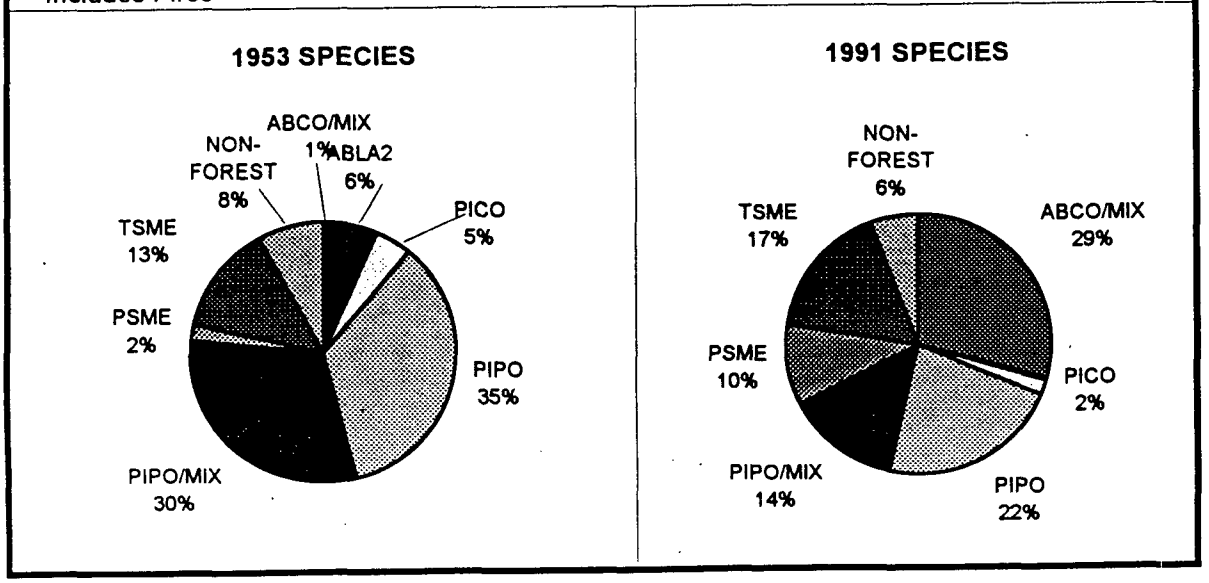
The estimated volume of dead standing timber in the analysis area was determined by calculating the board foot volume of salvagable dead trees from stand exam data in all the areas identified as "medium or high decline" from the 1995 forest decline mapping, excluding wilderness areas of high decline. The total volume of dead trees in the analysis, outside the wilderness areas, exceeds half a billion board feet.

Species Composition

A comparison between current overstory species and the 1953 overstory species is shown in Table 14 and Maps 10 and 11, 1953 and 1991 Species.

Table 14: Primary Overstory Species

PRIMARY OVERSTORY SPECIES					
SPECIES NAME	SPECIES	1953		1991	
		Acres	%	Acres	%
White Fir / Mix	ABCO/MIX	1,022	1%	43,258	29%
Subalpine Fir	ABLA2	8,805	6%	574	0%
Lodgepole Pole	PICO	6,706	5%	2,814	2%
Ponderosa Pine	PIPO	52,252	35%	32,828	22%
Ponderosa Mix	PIPO/MIX	45,091	30%	20,834	14%
Douglas Fir	PSME	3,146	2%	14,970	10%
Mountain Hemlock	TSME	19,826	13%	24,542	17%
Non-Forest	NON-FOREST	11,728***	8%	8,805	6%
* All Ponderosa lumped					
** Counts some Ponderosa plantations					
***Includes Fires					



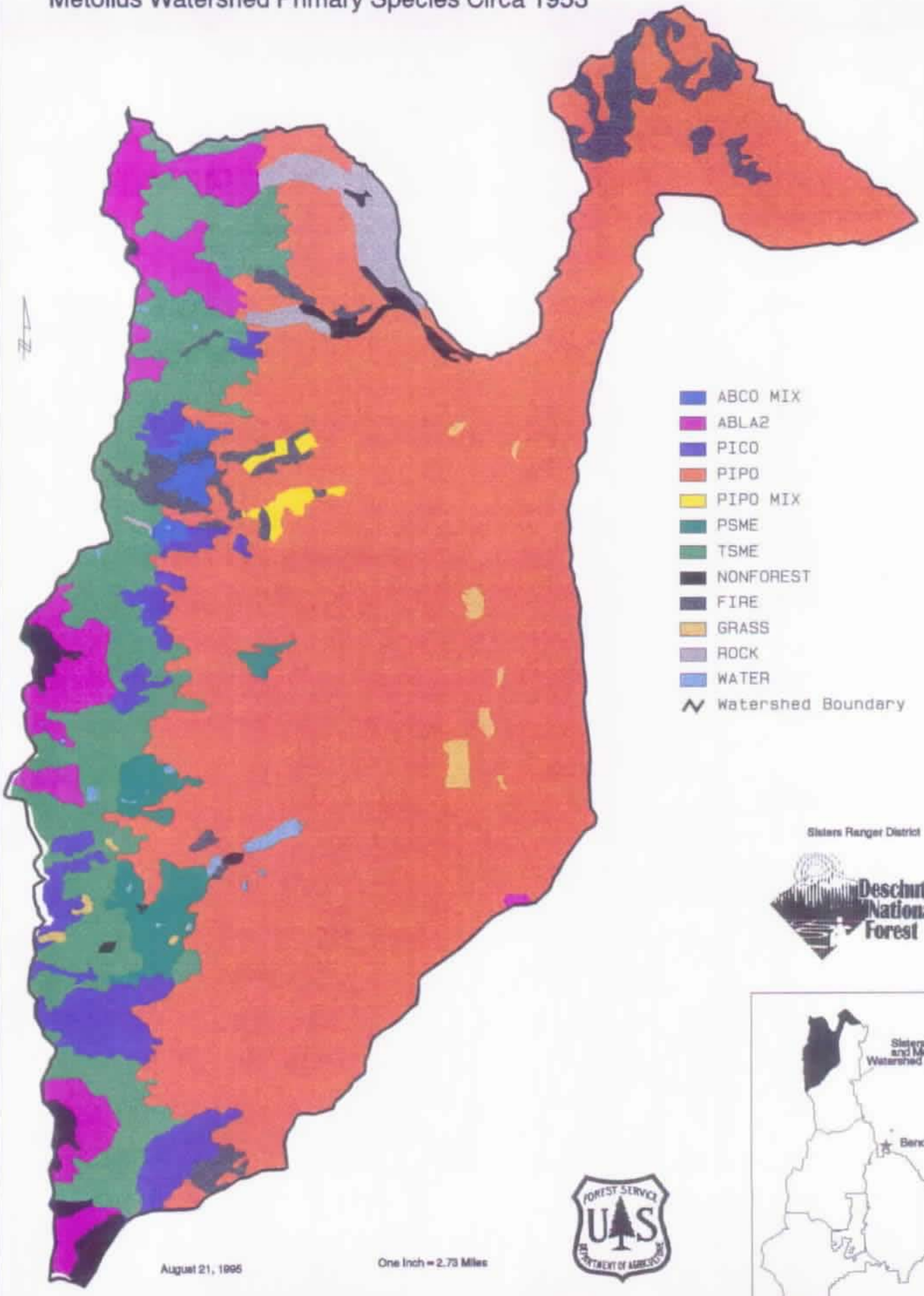
The dramatic changes are the decrease in acres of ponderosa pine and ponderosa pine mix and the increase in white fir mix and Douglas-fir.

Some tree species found in this area are not common or present on the rest of the forest. There are vigorous cottonwood stands in riparian areas. Western red cedar grows in Canyon Creek. Western Hemlock can be found growing in some of the higher areas. Yew is found in the mixed conifer areas.

Landscape Patch Conditions

A comparison of historic and current habitat conditions was completed using FRAGSTATS, 1953 Aerial Photo data, 1991 Aerial photo data, Forest Decline Layer, 1991 Mortality plots, and various wildlife habitat

Metolius Watershed Primary Species Circa 1953



Sisters Ranger District

Deschutes National Forest

August 21, 1996

One Inch = 2.73 Miles

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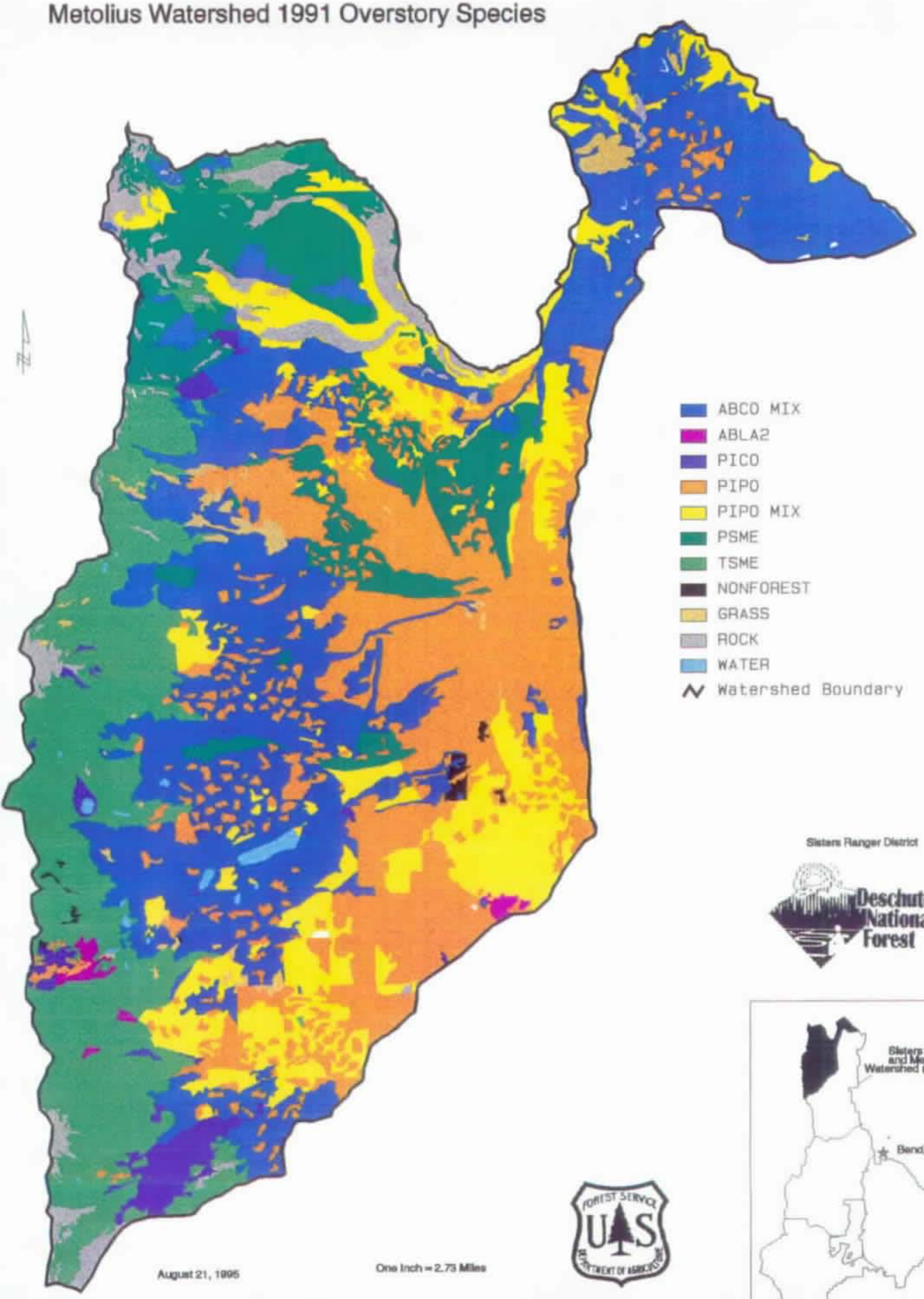
Metolius Watershed 1991 Overstory Species



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surveys. FRAGSTATS is a spatial pattern analysis program for quantifying landscape structure. The program was used on the Metolius Watershed primarily to define patch type parameters, edge and interior habitat conditions.

Prior to 1953

In general, the landscape was dominated by large unfragmented patches of ponderosa pine-dominated habitats and high elevation mountain hemlock habitats.

The ponderosa pine (18% of landscape) and dry mixed conifer (32% of landscape) areas were primarily a large patch of medium/large tree (21 inch dbh+) ponderosa pine habitats with open canopies of 1-2 stories. The vertical structure of these stands was probably less complex than today because of frequent low-moderate intensity fires. **Wildlife species like the northern goshawk and white-headed woodpecker benefited from these conditions and probably reached high population levels.**

Mixed conifer (26% of landscape) provided a majority of the multi-storied, high canopied patches, but this habitat condition was probably limited in the watershed. Species associated with late-successional mixed conifer habitats (e.g., northern spotted owl and pileated woodpecker) that were vertically complex, multi-storied and high canopied may have been less abundant on the landscape.

The second largest patch type was in high elevation mountain hemlock. The mountain hemlock was fairly contiguous in nature, except where disturbance factors (i.e., fire) created smaller patches of early seral grass/forb habitats or dense stands of pole and small tree habitats of lodgepole pine and mountain hemlock.

Early seral patches and edge habitats were a small percentage of the landscape. The early seral patches, however, were much larger in size because they were created by occasional stand-replacement fires. **Early seral wildlife species were probably less abundant than today.**

Snags and down woody debris densities were probably lower than today because of the frequent low-moderate intensity fires, and the absence of logging debris.

1953 Condition

The habitat conditions were probably similar to those described on the Pre-1953 condition, except that years of fire exclusion had increased the amount of mixed species, high canopied habitat. **The ponderosa pine and dry mixed conifer areas were dominated by large unfragmented patches (62% of the watershed) of open, medium-large ponderosa pine trees. High elevation mountain hemlock was the next largest habitat patch (18% of the landscape).**

The ponderosa pine patches were few in number (8 landscape patches), but were large in size (mean patch size 12,000 acres with a patch size standard deviation of 30,000 acres). There were 21 patches of smaller sized ponderosa pine habitats interspersed (5% of the landscape) throughout this larger, medium/large tree habitat. The largest medium/large tree habitat patch encompassed 59% of the watershed. **These patches were composed of open, 1-2 storied ponderosa pine habitats.** The vertical structure of these stands was probably less complex than today because of frequent low-moderate intensity fires. **Wildlife species like the northern goshawk and white-headed woodpecker, benefited from these conditions and probably reached high population levels. The amount of multi-storied, high canopied habitat in wet mixed conifer increased from pre-1953 conditions providing additional habitat for species associated with late-successional mixed conifer habitats (e.g., northern spotted owl and pileated woodpecker).**

The mountain hemlock patches (27,000 acres in 4 patches on the landscape) was fairly contiguous in nature, except where disturbance factors (i.e., fire) created smaller patches of early seral grass/forb habitats or dense stands of pole and small tree habitats of lodgepole pine and mountain hemlock. The largest mountain hemlock patch encompassed 16% of the landscape.

Early seral seed/sap habitats were relatively large in size (mean patch size of 500 acres), were few in number (13 patches), and encompassed only about 5% of the landscape. These habitats were primarily the result of fires.

1991 Condition

Landscape conditions changed drastically from 1953 to 1991. The landscape has many more landscape patches of varying sizes and structural stages, and is heavily fragmented. The large unfragmented ponderosa pine forests and dry mixed conifer areas were reduced to less than 1% of the landscape.

The most common (40% of the watershed) landscape patch type in the ponderosa pine and dry mixed conifer areas is now small sized (9-21 inch dbh) ponderosa pine and mixed conifer habitats with open canopies. There are approximately 167 habitat patches with the largest patch encompassing less than 1% of the landscape.

However, the largest landscape patch is the pole and small sized lodgepole pine and mountain hemlock located in the Wilderness and Santiam Pass (18% of the watershed). This patch type, while not the most common (based on acres), is the largest patch type (largest patch encompasses 9% of the landscape) within the watershed. The small sized ponderosa pine and mixed conifer with closed canopies is the third most common patch type in the watershed (>40% canopy closure, 11% of the watershed).

The most common habitat patches are early seral seed/sap habitats. They have increased significantly since 1953. These habitats are relatively small in size (mean patch size of 40 acres), are scattered across the landscape (350 patches), and encompass about 20% of the landscape. This change in habitat composition is primarily due to timber harvest practices.

Several results of timber harvest are increased miles of edge, higher edge contrast and a reduction in the size of late-successional interior habitats or Core Area Habitats.

The estimated total miles of edge increased from 600 miles in 1953, to 7000 miles in 1991. A majority (63%) of this edge resulted from the creation of seed/sap habitats. In addition, the effect of edge ("edge effect") on the landscape is significantly higher because of the increased number of patches, and the greater contrast between seed/sap patches and other patch types.

The increase in early/ middle seral patches and edge have probably resulted in higher population levels for species such as mountain bluebirds, white-crowned sparrows, mule deer and Roosevelt elk.

While interior habitats were not a concern in the pre 1953 landscape, they are an important consideration today. **The medium to large ponderosa pine stands with less than 40% canopy closure habitat that dominated the 1953 landscape, is now reduced to 21 small interior habitats.** In general, both mixed conifer and ponderosa pine areas contain late-successional interior habitats that are small (<800 acres) and widely dispersed across the watershed.

Range Of Historical Variability

A main assumption regarding Watershed Ecosystem Management is that ecosystem elements have natural ranges of variability, and that when conditions are kept within those ranges, structure and composition of vegetation tend to be more predictable and sustainable over time. In their report "Restoring Eastside Ecosystem in the Blue Mountains," the panel noted, "A key concept of SES (Sustaining Ecological Systems) is that when systems are 'pushed' outside the bounds of natural variability there is substantial risk that biological diversity and ecological function will not be maintained, and therefore, ecological systems will not be naturally sustained." It therefore can be important for managers to be able to estimate the natural range of variability in the components of ecosystems. Natural variability can be highly subjective ("natural when?") so managers may more readily be able to determine "historic" variability to use as a baseline. The vegetation management opportunities developed for the watershed are based on moving landscape vegetative conditions

and disturbance patterns toward a balance within the historic range of variability. Historic vegetation is defined as what we believe existed prior to the significant human influence of the early 1900's.

The historical ranges of variability for vegetation for this analysis were derived from vegetation information mapped from the late 1800's; from 1953 maps of vegetation that developed with fire exclusion excluded and risk cutting, from information on past disturbance events; successional pathways; current stand ages; and ranges of variability already calculated for the Ochoco National Forest and for the Odell Watershed on the Deschutes National Forest; and from discussions among ecologists, silviculturists, fire managers, entomologists and pathologists.

Area Ecologist Bill Hopkins offers this definition of Forest Health: "Forest health is a function (f) of desirable biological diversity as related to stand (forest) structure, composition and density, and growing at a rate that renders the stand (forest) largely immune to epidemic attacks from disease and insects.

For Deschutes National Forest mixed conifer, ponderosa pine, lodgepole pine and Douglas-fir plant association groups, an effort has been made to describe species composition and structure, maximum densities, and historical fire periodicity focusing on stand-level considerations. Landscape level considerations, particularly involving structure and composition over the landscape, are considered by noting where the current conditions are outside the range of historical variability, and are integrated into the goals and opportunities for this watershed.

The Blue Mountains Forest Health Report (1991) referred to biodiversity, saying that: "Landscape diversity is promoted when patchiness of vegetation, size of patches, and the juxtaposition of the patches promote a diverse mosaic. By provision of a variety of communities exhibiting different seral stages and age classes across the landscape, the health of that vegetation and its associated fauna is promoted".

It is possible to have conditions that are temporarily outside the range of historical variability, such as the denser spotted owl habitat on the east side of the Cascades in the dry mixed conifer. Because of limited moisture, these habitats cannot be maintained over time without some density reduction. These sites can provide short-term habitat before disturbances bring densities and species composition back toward more historic levels. This is currently happening in many areas of the Metolius due to insect and disease infestations. The risk is very high for losing much of this remaining "nonhistoric habitat" to large catastrophic fires.

Sustainable Conditions

Descriptions of sustainable stand size and structure, species, and densities in the following sections are based on the concept of moving the conditions in the watershed back toward the historic range of variability.

For both lodgepole pine and ponderosa pine plant associations, lodgepole pine and ponderosa pine are the primary species, both at seral stages and climax stages. For mixed conifer associations, determining species composition for long-term healthy conditions is more difficult. For most of these associations ponderosa pine makes up the major seral tree species. Maintenance of early seral species in mixed conifer sites are recommended in the Deschutes Forest Plan for biological and social reasons (p. 4-47). Maintenance of stands at slightly higher densities than identified by Cochran (1994) is possible, but there would be a greater risk of losing the largest ponderosa pine and Douglas-fir trees. Tree growth would be slower, making all trees more susceptible to insects and diseases.

Maintaining stand densities at manageable levels is essential for promoting forest health and maintaining or creating large tree character and habitats in dry areas. In the draft report being developed on the Deschutes National Forest for sustainable healthy density levels, Stand Density Index (SDI) is being used to describe a range of stand densities that are likely to result in healthy forest conditions. Of particular importance is the maximum "healthy" limit, that density above which forest health conditions and large tree health are likely to deteriorate.

Excessive numbers of trees or vigorous brush species in the understory, even though they don't contribute to the total basal area, do compete for moisture, and can lower the vigor of larger trees in the stand, even if basal areas are below critical levels. In these areas, where an objective is to keep healthy large trees over time, the understories need to be thinned to reduce competition for moisture. These treatments may also decrease the risk of catastrophic crown fires.

Insects and Disease

The western spruce budworm was very active in this watershed in the late 1980's and early 1990's. Noticeable defoliation occurred on firs and Douglas-fir between 1986 and 1992. In those cases where defoliation was light (the central portion of the watershed), the affected trees recovered and now show minimal effects of the prolonged budworm outbreak. **Further west and into the foothills of the Cascades, the effects of defoliation were more profound. Many trees sustained moderate to severe topkill while others were killed, either by the budworm defoliation, or in combination with the high levels of Armillaria root disease, which is pervasive throughout the mixed conifer PAGs.** Prolonged drought may accelerate the effects of insects and disease.

In addition, the budworm outbreak set the stage for secondary bark beetles such as the Douglas-fir beetle and fir engraver which attacked and killed trees weakened by defoliation and by the complex of other factors which are operating in that area. The populations of these bark beetles have followed a typical pattern in that their effects have become more pronounced once the defoliator outbreak subsided. Even today, Douglas-firs and true firs continue to be killed two to three years after the budworm population has collapsed. **In the case of the Douglas-fir bark beetle, the largest trees are being removed from affected stands, and the insect is causing substantial changes in species composition where Douglas-fir was once an important component.** Particularly high populations of Douglas-fir beetle were recently noted along the Road 1235 from Canyon Creek to Bear Valley.

The combined effects of western spruce budworm, Armillaria root disease, and other agents such as bark beetles have produced substantial tree mortality in the western portion of the watershed. In order to estimate the level of this recent tree mortality, we examined data from some of the Continuous Forest Inventory plots within the watershed. Seven inventory plots lie within the western portion of the area between First Creek and Brush Creek (dominated by mixed conifer plant associations) and all were surveyed most recently in 1994. Thus, the figures for live basal area are probably fairly reliable as an indicator of current vegetative condition since they take into account some of the most recent tree mortality that has occurred.

Although the levels of tree mortality are quite variable among the seven CFI plots, the average dead basal area for all of them is 31 square feet per acre. Mortality is evenly divided between trees greater than 13 inch dbh and those less than 13 inch dbh. The average live basal area for the seven plots is 122.7 square feet per acre, half of which is contained in trees greater than 13 inch dbh. **This overall average of about 20% mortality is far less than was expected, given the duration and intensity of the spruce budworm outbreak. It is important to point out, however, that much of the "live" basal area probably contains trees with significant amounts of top-kill and poor vigor. It can also be expected that additional trees will continue to die in the near future, primarily due to the high levels of Armillaria root disease throughout the area and to the bark beetles, which are also still active.**

Another source of information can be used to describe the recent mortality caused by the complex of western spruce budworm, Armillaria root disease, and bark beetles in the western portion of the watershed. In June and July of 1995, sixty-one variable radius plots were established in four subunits of the area that was analyzed in 1992, for suppression of the western spruce budworm. These subunits are all west of Forest Road 12 and extend north to south from Abbot Butte to Cache Creek. Tree mortality was quite variable on these plots. All trees died in some areas, while other areas showed very little effect from the recent outbreak. As an average for the four subunits that include Abbot, Jack Lake, Round Lake, and Santiam Pass, about 38% of the basal area was killed during the spruce budworm outbreak. The live basal area remaining on these plots averages slightly over 200 square feet per acre.

Insect and Disease, Expectations for the Future

The combinations of site characteristics, growing conditions, and vegetative patterns often allow us to predict changes that are likely to occur due to the actions of insects and diseases. By the same token, a recent history of insect and disease infestations would also imply that certain vegetative patterns were present on the landscape when these disturbance agents were at work. For example, the extremely high levels of western spruce budworm across the westside of the watershed in the late 1980's reflected high stocking levels of white fir in fire-climax ponderosa pine sites. Similarly, high incidence of Armillaria root disease in many mixed conifer sites reflects highly stocked stands combined with a cutting history that has produced many large stumps to be colonized by the fungus.

In spite of the spruce budworm outbreak of recent years, the residual stand densities are still fairly high in some of the previously infested areas. This suggests that changes may continue to occur in these stands, most likely from Armillaria root disease and from secondary attack by bark beetles. Since the inoculum load from Armillaria is extremely high throughout the moist habitats, it is likely that tree mortality will continue to occur, with or without vegetative treatments.

Those stands that are currently stocked above the carrying capacity for the site (in all vegetative series) will continue to experience mortality from the bark beetle species, which are prominent in this region. Some general risk rating and predictions for bark beetles can be based on the available stand exam information for the Forest. The pre-WEAVE document for this area identified appropriate stocking levels beyond which tree mortality begins to occur in the various plant associations, expressed in terms of stand density index (SDI) (Cochran et al 1994). These stocking levels should serve as useful guides for predicting the likelihood that pines and other trees can be maintained over time in the absence of treatment, either silviculturally or by use of prescribed fire to manage stand densities. The ratio of existing stocking to recommended stocking would serve as a useful index for identifying stands with a high likelihood of experiencing changes due to bark beetles and other agents. Stands where current densities are well below the recommended stocking levels are much less likely to experience tree mortality than those stands where stocking is above the recommended level.

Some general statements can be made for the future, based on current vegetation information that we have for the Metolius River Watershed:

1. In 1953, the dominant tree species in this watershed was ponderosa pine; 40 years later the dominant species are white fir and Douglas-fir. These latter two species are far more vulnerable to a host of organisms and as such, stands dominated by white fir and Douglas-fir are likely to be more unstable and will be more subject to dramatic change than pure ponderosa pine stands.

2. The most prevalent size/structure condition in the watershed appears to be one where small trees (11-21 inch dbh) comprise the overstory, and occur in a multi-storied condition with the remaining trees being either slightly smaller or slightly larger, but generally secondary in abundance to these small trees. Since stand densities are generally high, these stands are likely to experience changes from density-dependent agents such as root disease, drought, and assorted bark beetles.

Fire As A Disturbance Process

Fire is a natural process that has played a role in shaping the landscape of the Metolius Watershed. Fire suppression and the effects of fire exclusion have also played a role in shaping the current landscape patterns.

"Fire changes ecosystem, community, and population structure either by selectively favoring certain species or creating conditions for new species to invade. It usually favors early successional species but sometimes can 'accelerate' succession to favor late successional species." (Agee, 1993).

A fire regime is a generalized description of the role fire plays in an ecosystem or plant communities. Systems for describing fire regimes may be based on the characteristics of the fire, the dominant or potential vegetation of the ecosystem or the fire severity. For this analysis, the fire regime will be described primarily by dominant or potential vegetation within the watershed. The fire regime identifies potential fire effects and historic size, frequency and intensity of fires within vegetation. Early reports, such as Frederick Coville's 1898 report on "Forest Growth and Sheep Grazing in the Cascade Mountains of Oregon" indicates that **forest composition was quite different a century ago, and so were fire regimes.** He described the general forest types as "the yellow pine forests, and the heavy west slope forests." Regarding the yellow pine forests, he wrote "the principal species is the yellow pine, Pinus ponderosa. The individual trees usually stand well apart, and there is plenty of sunshine between them". He recognized the role of fire, **"the scant grass and underbrush do not make a destructive burn, while the bark of the yellow pines is so thick and so nearly devoid of resin that only under exceptional circumstances is a mature tree killed.** The saplings, however, up to an age of fifteen or twenty years are readily killed by fire." He seemed to recognize the mixed conifer zone, "at their upper elevations the yellow pine forests are denser, and often contain a considerable amount of Douglas spruce (Pseudotsuga macronata) and California white fir (now treated as a form of Abies concolor)" and the different role of fire in this zone **"in the higher elevations of the yellow pine zone, where there is a large admixture of white fir and Douglas spruce the underbrush is thicker, a forest fire is often extremely destructive to the timber, and is followed by a very dense growth of shrubs."** Simon, in his study of fire history of the eastern portion of the Mt. Jefferson wilderness (1991), noted increasingly longer fire return intervals at higher elevation vegetation zones.

Large Fire History

The fires occurring in the Metolius Watershed from 1908 to 1994 are included in Fire Appendix, Tables 1-4. Large fires, for this analysis, are described as fires greater than 100 acres. The sources of information about these fires are also included in the Appendix.

The Abbot Creek fire and the Warm Springs Fire of 1938 are not included in this number. The Abbot Creek fire has no information about size or date of origin. It was described in the Sisters Fire Atlas (1950-1961) but no additional information was found. The Warm Springs Fire of 1938, has a reported size and date of origin but it cannot be verified through any information source other than "a newspaper report" described by McCauley.

There is a wide range of acres burned in each subwatershed. There have been no large fires in the Jack/First subwatershed while 49% of the Scarp subwatershed has burned in the same time period. Metolius Horn has 7,925 acres burned.

The number of acres burned by large fires, by decade, range from zero acres in 1950-1959 and 1970-1979 to 6,682 acres in 1940-1949. This is an average of 2,634 acres burned in each decade. No clear trend for acres burned by decade can be seen.

Fire Occurrence

Within the Metolius Watershed between 1982 and 1994, there have been 200 fires that required suppression action for a fire occurrence rate of 1.3 fires per 1,000 acres. Within each subwatershed, fire starts range from nine in Abbot to 36 in Suttle. (Fire Appendix, Tables 5-10)

Although the percentage of human caused fires is the highest in the Abbot subwatershed (67%), this subwatershed has the lowest number of fire starts within the entire Metolius Watershed. Candle and Metolius Horn subwatersheds have the highest percentage of lightning caused fires. These subwatersheds do not have a high amount of human use.

The Suttle subwatershed has the highest number of fires per year, as well as a large amount of human use. Fires in the Suttle subwatershed are 50% lightning caused, 47% human caused and 3% of unknown cause (probably human caused). This area seems to be a hotspot for both human and lightning caused fires.

Eighty-three percent of the fires in the Metolius Watershed are size class A (1/4 acre or less). Sixty percent of all fires in the watershed occur during July and August. This decreases significantly to 13% in June and 14% in September.

Fuel Loading

Information about fuel loadings within this watershed is old and not accurate for specific questions about tons per acre of fuel by size classes. Based on timber sales fuels inventories completed in the late 1980's, relative estimates can be made. No fuel loading information has been collected in the wilderness.

Fire and Fuel Trends

1. Most important conclusion- Firefighter and public safety hazards increase as fire intensities across the watershed continue to increase. Firefighters spend an increased amount of their time suppressing high intensity wildfires.
2. The expected fire intensities for all fires within the watershed have increased due to increases in fuel loading and ladder fuels.
3. The fire return intervals in the entire watershed have increased, except in the high elevation forest.
4. The ability to protect riparian zones decrease as fire intensities increase.
5. As fire intensities increase, there has been and will continue to be an increase in money spent for fire suppression.
6. As fuel loadings and fire intensities increase, the amount of smoke produced by wildfires will correspondingly increase.
7. In ponderosa pine, the fire regime has changed from one of frequent, low intensity fires to one of more infrequent, moderate to high intensity fires. There has been a significant decrease in the number of low intensity fires that occur in the ponderosa pine.
8. The high elevation forests, except the lodgepole pine PAG, are near the "natural" end of their fire cycle and stand replacement events are probable.
9. The regeneration units have lower fuel loadings than the surrounding untreated stands.
10. There is no trend to show a decrease in acres burned in large fires in the last 87 years.
11. As the human use of the watershed increases, the potential for fire starts increases
12. There has been an increase in wildland/urban interface associated with increasing use and development in the Metolius Basin and Camp Sherman. Wildland/urban interface is one of the most hazardous fire suppression situations.
13. As the wildland/urban interface increases, the need for cooperation with adjacent fire protection agencies increases. There is a potential need to develop an evacuation plan for the urban interface that includes the campgrounds, housing developments and Camp Sherman.
14. There is an important and continuing need for effective fire detection in this watershed.

Plant Association Groups

Introduction

This section contains an introduction to the vegetation in the watershed, and discussion and analysis of potential natural vegetation, disturbance events that have influenced vegetation, and current and historic size, structure, canopy cover, species, and habitat pattern and conditions across the landscape for the whole analysis area. A discussion of the range of variability and sustainable conditions in the watershed sets the stage for more specific discussions in the following sections on current and historic vegetation conditions and trends in each PAG.

Table 15: Acres and percentage of each plant association group (PAG) by Landscape Area.

PAG SUMMARY BY LANDSCAPE AREA

LANDSCAPE AREA	LA #	TOTAL	MCD		MCW		PP		HIGH		LP		RIP	
		Acres	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
WILDERNESS	1	42,775	291	1%	15,077	35%			5,225	12%	3,753	9%	67	0%
CENTRAL BASIN	2	19,844	5,566	28%	3,095	16%	9,147	46%					1,830	9%
HIGHWAY 20 CORIDOR	3	3,988	1,680	42%	134	3%	1,867	47%			218	5%	73	2%
MEADOW LAKE BASIN	4	7,018	307	4%	3,046	43%					3,466	49%	91	
BLACK BUTTE	5	3,427	2,127	62%	934	27%	366	11%						
CACHE	6	16,279	8,837	54%	3,949	24%	2,743	17%			666	4%	83	1%
SUTTLE LAKE	7	2,163	1,687	78%	113	5%							46	2%
UPPER TRIBUTARIES	8	30,521	19,100	63%	8,332	27%	2,315	8%	14	0%			709	2%
GREEN RIDGE	9	4,528	1,521	34%	1,767	39%	1,208	27%					33	1%
SCARP	10	14,833	5,979	40%	1,686	11%	7,115	48%					33	0%
LOWER RIVER	11	3,597	483	13%	586	16%	2,273	63%					178	5%

Table 16: Acres and percentage of each PAG by subwatershed.

PAG SUMMARY BY SUB-WATERSHED

WATERSHED NAME	MCD		MCW		PP		HIGH		LP		RIP	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
ABBOT	4,900	82%	888	15%		0%	2	0%		0%	200	3%
CACHE	8,314	32%	7,350	28%	4,908	19%	1,419	5%	3,067	12%	86	0%
CANDLE	1,185	6%	6,943	36%	23	0%	8,059	42%		0%	251	1%
CANYON	7,322	33%	6,277	28%	2,184	10%	5,338	24%		0%	916	4%
JACK	8,228	34%	7,060	29%	3,965	16%	3,998	17%	2	0%	568	2%
METOLIUS	2,746	17%	3,536	22%	9,741	60%		0%		0%	258	2%
SCARP	7,424	54%	1,383	10%	4,767	34%		0%		0%	248	2%
SUTTLE	7,465	36%	5,272	25%	1,448	7%	487	2%	5,034	24%	656	3%

Potential Natural Vegetation

The field mapping of the potential natural vegetation (PNV) to the plant association level in these eight sub-watersheds was based on field observations by silviculturists, soils scientists, ecologists, and stand exam experts to determine the divisions between plant associations. The major plant associations' acres in the Watershed (>1200 acres) are shown below in Table 17.

Table 17: Area of Major Plant Associations in the Metolius Watershed.

Major Plant Associations	Acres
CWC211	###
CWS112	7,591
CDS613	5,611
CDS612	4,975
CWC212	4,691
CPS211	4,475
CPS217	4,421
CDS614	3,876
CLM411	3,773
CWC213	3,360
CWH111	3,155
RIPARIAN	2,679
CPS312	1,725
CPS213	1,587
CPS314	1,242

The original maps and photos used to produce Steve Simon's 1991, report, "The Fire History of the Jefferson Wilderness Area East of the Cascade Crest" were used to identify the vegetation series in the wilderness. Parts of the Metolius Horn, Mt. Washington Wilderness, and private lands that were not mapped for plant associations were classified to the series level, using the plant association data in the Soil Resource Inventory, aerial photo interpretation, and spot field checking.

PAG Formation

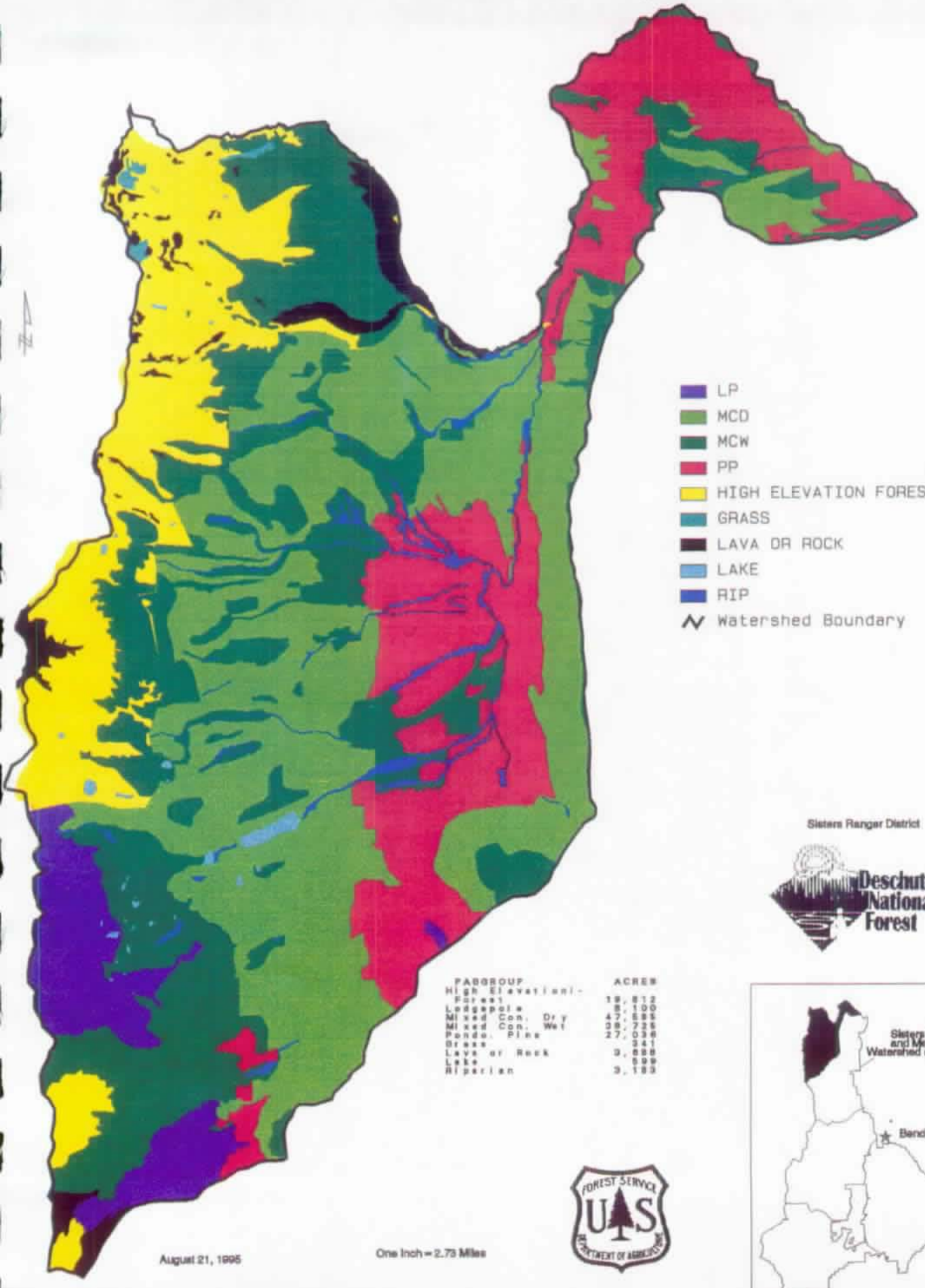
Mapped plant associations were grouped by their climax species, site potential, and moisture similarities into Plant Association Groups (PAGs). These different PAGs respond in different ways to disturbance events and provide different habitats characteristics for wildlife species. Grouping plant associations simplifies prediction, comparison, and analysis of potential disturbance patterns and the resulting successional pathways, species composition, habitat conditions, and vegetation size, structure, density, and species composition over time in different areas of the forest. (Table 18)

Table 18: Plant Association groups in the Metolius Watershed

PLANT ASSOCIATION GROUP (PAG)	COMMON ABBREVIATION	LUMPED PAGS FOR ANALYSIS	ACRES	PERCENT
Mixed Conifer Drier	MCD	MCD	47,585	32
Mixed Conifer Wetter	MCW	MCW	38,725	26
Ponderosa Pine Drier	PPD	PP	17,725	12
Ponderosa Pine Wetter	PPW	PP	9,311	6
Mountain Hemlock	MH OR TSME	HIGH ELEV FOREST	14,398	10
Lodgepole Pine	LP OR PICO	LP	8,100	5
Rock or Lava	ROCK	SPECIAL	3,688	3
Subalpine Fir/Hemlock	ABLA2	HIGH ELEV FOREST	3,451	2
Riparian	RIP	RIP	3,183	2
Silver Fir	ABAM	HIGH ELEV FOREST	1,837	1
Water	WATER OR LAKE	AQUATIC	599	<.4
Grass	GRASS	SPECIAL HABITATS	341	<.2
Whitebark Pine	PIAL	HIGH ELEV FOREST	126	<.1
Juniper Woodland	JW	SPECIAL HABITATS	71	<.1

These groups were then further combined into drier mixed conifer, wetter mixed conifer, ponderosa pine, high elevation forest, lodgepole pine, special habitats, riparian and aquatic "lumped" PAGs for information sharing and analysis, as shown on below in Table 19 and on Map 12, Plant Association Groups.

Metolius Watershed Combined Plant Association Groups



Sisters Ranger District

Deschutes National Forest

PASSGROUP	ACRES
High Elevation/- Forest	18,812
Lodgepole	8,100
Mixed Con. Dry	47,585
Mixed Con. Wet	38,735
Ponde. Pine	27,036
Grass	341
Lava or Rock	3,888
Lake	599
Riparian	3,183

August 21, 1995

One Inch = 2.73 Miles

FOREST SERVICE
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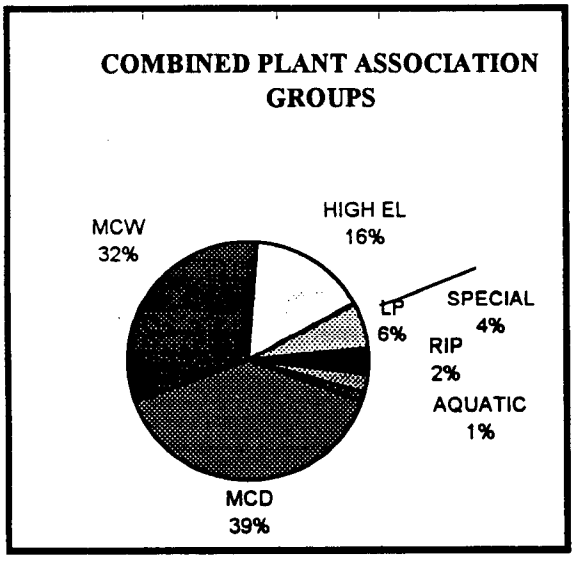
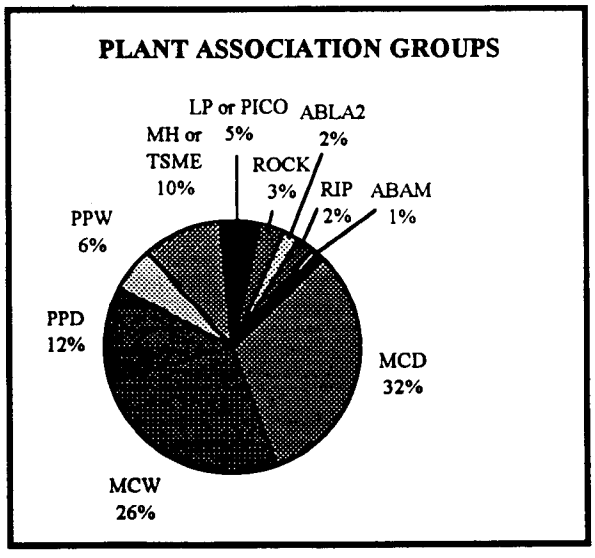
Table 19:Lumped Plant Association Groups in Metolius Watershed

LUMPED PLANT ASSOCIATION GROUPS	ABBREVIATION	ACRES	PERCENT
Mixed Conifer Drier	MCD	47,585	32
Mixed Conifer Wetter	MCW	38,725	26
Ponderosa Pine	PP	27,036	18
High Elevation Forest	HIGH EL	19,812	13
Lodgepole Pine	LP	8,100	5
Special Habitats	SPECIAL	4,100	3
Riparian	RIP	3,183	2
Aquatic	AQUATIC	599	1





These "combined" plant association groups reflect differences in response to disturbances such as fire. The climax species would be the dominant species with little or no disturbance, and in most cases except in ponderosa pine and lodgepole pine PAGs, other species would dominate after a disturbance event.

Plant associations vary due to a combination of environmental conditions. Elevation, precipitation, soils, and aspect seem to be major influences. The elevation ranges from 1920 feet in the Metolius Horn subwatershed, along the Metolius River, to 7841 at the top of Three Fingered Jack in the wilderness. The very top of Mt. Washington is currently mapped as draining into the subwatershed south of Cache. This area receives approximately 90-100 inches of precipitation annually in the far western portion (Cascade Crest) and the mean precipitation decreases to approximately 10-15 inches in the eastern portion.

The higher elevations with the coldest and wettest sites are Mountain Hemlock, Silver Fir, Subalpine Fir, and Whitebark Pine Series, combined into the High Elevation Forest Plant Association Group, (13% of the watershed). In the Mountain Hemlock series, lodgepole pine is the major seral species, common in areas which have had fires in the past 100 years. Areas which have not experienced fires in the past 100 years are dominated by mountain hemlock or silver fir, the bulk of which is on the steeper slopes within the wilderness. In the wilderness areas where they are found, the subalpine fir and whitebark pine series occur at the highest elevations with tree climax species.

The majority of the watershed is mixed conifer, both the Douglas-fir/White fir series and the Grand Fir/White Fir series. The most productive of these sites are in the moist areas. A number of mixed conifer plant associations make up these series but the dominant climax species are grand fir/white fir and Douglas-fir. In these series ponderosa pine, incense cedar, larch, and Douglas-fir may all be seral species, but throughout much of the area they are now subordinate to the true firs. A significant development over the last eight to ten years has been the defoliation of the fir by large numbers of western spruce budworm, and more recently, the tussock moth larvae. Some years have been more severe than others but the result of this prolonged infestation has been a noticeable decline in the vigor of the fir with many dead tops, an average of 40% of the standing basal area dead, and some isolated areas with fir mortality as high as 90%. Approximately 26% of this area is the wetter mixed conifer types, and 32% of the area is the drier mixed conifer plant association types. Altogether the Mixed Conifer plant association groups make up 58% of the area.

The ponderosa pine plant associations are found mostly in the eastern part of the area, just west of Green Ridge, where the land is flatter, and also in the northern part near the Metolius River, where many slopes exceed 30%, and ponderosa, although currently mapped as climax, is also mixed with Douglas-fir. The weather in these areas is warmer and drier than the rest of the watershed. Ponderosa pine is the dominant species but fir is increasing in the western, higher, and/or wetter areas due to adjacent seed sources and fire excusion. The wetter ponderosa pine associations are found in approximately 6% of the area, and the drier ponderosa pine associations are found in 12% of the area, for a total of 18% ponderosa pine plant associations.

The high elevation TSME (Mountain Hemlock), ABAM (Silver Fir), ABLA2 (Subalpine Fir), and PIAL (Whitebark Pine) series are found in approximately 13% of the analysis area, and are combined as High Elevation Forest for the analysis.

The Lodgepole Pine plant associations are found in some of the colder high elevation areas with poor cold air drainage, and in lower elevation frost pockets. These plant associations make up 5% of the area.

Riparian areas, as identified by the plant association mapping effort described above, comprise approximately 2% of the area. Rock and other special habitats make up 3%. The remaining 1% is water.

Current, Historic Conditions And Trends By PAG

The PAG summaries for Mixed Conifer Dry, Mixed Conifer Wet, Ponderosa Pine, High Elevation, and Lodgepole in the following sections include discussion and analysis of current and historic vegetation conditions, Size and Structure, species composition and density, disturbances, and trends.

MIXED CONIFER DRIER PAG 47,585 Acres 32% of Total Watershed

These plant associations are found on the slopes of the Cascades and on Green Ridge, with moderate to high productivity and a mean annual precipitation of 35 to 75 inches. Current vegetation consists of true firs, ponderosa pine, Douglas-fir, larch, incense cedar, and lodgepole pine.

Table 20: Current and Historic Size and Structure.

Mixed Conifer Drier Total Acres = 47,585									
		Species Composition							
Size/Structure Class	Year or Time Frame	Pioneer(P)		Mixed(M)		Climax©		Totals	
		Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
Grass/Forb/ Shrub	1991 1953 Historic Change	675 930 476-3331	1 2 1-7					675 930	1 2
Seed/Sapling 0-4.9"	1991 1953 Historic Change	7109 419 952-7138	15 1* 2-15	74* 0* 476-4759	0* 0* 1-10	265 0 0-476	0 0 0-1	7448 419	16 1
Pole 5-8.9"	1991 1953 Historic Change	1197 50 2307-9993 -(1200-8796)	3* 0* 5-21 -(2-18)	1056 41* 952-7138	2 0* 2-15	629 63 476-1903	1 0* 1-4	2882 154	6 0
Small 9-20.9"	1991 1953 Historic Change	8721 1270 5710-19034	18 3* 12-40	16861* 1150 2855-14276 +(14006-2585)	35* 2* 6-30 +(29-5)	7516 348 1428-2379 +(6088-5137)	16* 1* 3-5 +(13-11)	33098 2768	70 6
Medium/Large 21"+	1991 1953 Historic Change	136 21903 7138-19986 -(7002-19850)	0* 46* 15-42 -(15-42)	1553 21319 2379-13324 -(826-11771)	3* 45* 5-28 -(2-25)	1696 14 1428-2379	4 0* 3-5	3385 43236	7 91
TOTALS	1991 1953.	17838 24572	38 52	19544 22510	41 47	10106 425	21 1		

The areas dominated by medium and large pioneer and mixed size classes have decreased below the Historical Range of Variability (HRV). These same classes exceed HRV in 1953.

The small mixed and climax size classes has increased from 1993 to 1995 and exceed HRV.

The pole pioneer size class has decreased below HRV.

The opportunity exists to move toward HRV by thinning smaller size classes, growing smaller trees into larger size classes, and maintaining existing live larger size classes. Removing dead trees to protect existing medium / large size classes from being burned by a catastrophic fire would also move this PAG toward HRV.

Mixed Conifer Dry (MCD) Species Composition And Density

The Mixed Conifer Dry PAG includes Moderate and Lower Productivity CW Series plant associations, including CW-S1-12, CW-C2-11, CW-C2-13, CW-S1-15, and CW-H1-11. *Historically, mature stands were primarily composed of early seral species.* Ponderosa pine was the major species present, with minor amounts of lodgepole pine, Douglas-fir, western white pine, white fir and western larch. On a landscape scale, Ponderosa pine should be maintained or reintroduced for diversity of future stands.

Surveyor's notes from 1870 describe lots of yellow pine (ponderosa pine) and fir overstories, as well as western larch, and cedar overstories. Larch was noted fairly often in the surveyor's notes (there was a dense western larch thicket over a mile long) but is missing or scarce now. There is an opportunity to re-introduce larch into stands where mistletoe is common in ponderosa pine or Douglas-fir. Hardly any of the understories in the lower elevations were described as dense. In some areas laurel, manzanita, bunchgrass and/or pinegrass were common. The entire area was described as forested with contiguous stands. One of the surveyors noted sizes and species of the largest trees that fell on his survey lines. In the western part of this PAG, he mentioned pines 40 inches and firs 40-70 inches, although most trees noted were 10-30 inches.

The current vegetation types have shifted from open, park-like stands of ponderosa pine and Douglas-fir to dense stands of white fir. Much of the largest ponderosa pine and Douglas-fir has been removed. To keep species within a healthy range of variability, white fir should compose less than 20% of tree stocking on the site (personal communication, H. Maffei). Age is a consideration, too. Filip and Schmitt (1990) cite Aho (1977) stated that grand fir has little defect when less than 100 years old, and has considerable decay after age 150. "Second generation" true fir may experience insect and disease problems at earlier ages, due to the increased level of pathogens introduced from first generation firs (personal communication, H. Maffei). Minor amounts of true firs can help to meet various resource objectives, such as presence of soft snags for cavity excavators, hiding cover, foraging, nesting, roosting habitat, etc. while minimizing potential for stand-level and landscape-level forest health problems, but large amounts outside the range of historical variability cannot be sustained over time.

MCD Disturbances And Processes

Fire

"The most complex set of forest types in the Pacific Northwest includes those called mixed-conifer or mixed-evergreen forests.... They differ in their specific mix of species, their fire regime, and the successional patterns likely after disturbance.... Ponderosa pine as a seral species and Douglas-fir as a seral or climax species can be found in each type, although not at every site" (Agee, 1993).

Agee (1992) believes that historically, the mixed conifer forests show the most frequent fire activity of all Eastside forests, **although cooler, wetter sites (mixed conifer, wet) have longer fire return intervals. Frequent fires in drier plant associations of these PAGs are likely due to higher productivity, when compared to the ponderosa pine associations.** After a fire, the fine dead fuels needed to carry another fire are more rapidly replaced in the mixed conifer associations.

Fire return intervals were estimated by Bork (1985) at 9 to 25 years while Hopkins (1995) estimates them to be 30 to 50 years in the lower elevations (1500 to 4000 feet) and 50 to 80 years in the higher elevations (4000 to 5000 feet). McNeil and Zobel (1980) found an increasing fire-return interval with elevation. The average fire return interval was 9 to 42 years along an elevation gradient. Fire return intervals in mixed conifer are quite variable and a specific fire regime for the entire area is difficult to determine.

Hopkins (1995) estimates the average fire size for low intensity fires ranged from 50 to 100 acres and that stand replacement fires were 200 to 500 acres in size.

Historical fire intensities and frequencies ranged from frequent, low intensity fires to infrequent, high intensity fires. This would be considered a moderate severity fire regime with low, moderate and high intensity fires all common. Most mixed conifer plant associations were more open in appearance than they are today and were dominated by ponderosa pine. "Frequent, low intensity fires kept such sites open so that they were less likely to burn intensely even under severe fire weather." (Agee, 1993) As these low intensity fires burned they removed understory ladder fuels and consumed debris on the forest floor. Fires that occurred after an extended fire-free period would generally have been more intense and consumed more trees and forest floor debris (fuels) while creating patches or openings where 70 to 80% of the overstory trees were killed by the fire. These opening would vary in size based on the weather, fuel and vegetation conditions on the site at the time of the fire. Approximately 58% of the Metolius Watershed falls within this disturbance regime.

There has been a large increase in insects and disease due to the increase in stand densities and the lack of frequent low intensity fires. In many areas the stand densities have recently been reduced by mortality from defoliators, increasing the fuel loadings, and leaving behind low vigor and top-killed trees.

Insects and Disease

Typically, the stands in this PAG are two-storied or multi-storied with ponderosa pine in the overstory and white fir in the understory. **Key disturbance agents include Armillaria root disease, western spruce budworm, fir engraver, western pine beetle, and western dwarf mistletoe.** The first three affect primarily the true fir component and the latter two occur on ponderosa pine. Since stand densities tend to be very high in these settings, **the role of Armillaria root disease becomes extremely important in setting a threshold for maximum stand densities that can be maintained on a site. Western pine beetle is a very important agent in removing the larger overstory ponderosa pines** once stand densities are beyond a sustainable level.

1. Where the vegetation of fire-adapted ecosystems has been altered by fire exclusion, certain organisms such as Armillaria root disease, all of the dwarf mistletoes in seral species, western spruce budworm, fir engraver, and western pine beetle are much more important now than they were historically in terms of their effects on stand dynamics. This statement applies throughout the two Ponderosa Pine PAGs and to the Dry Mixed Conifer PAG.

2. On Dry Mixed Conifer sites, the degree of instability of current vegetative conditions is directly related to the abundance of the true fir component. Those stands deriving their "late old structure" character from the fir component are not likely to continue providing it in the long run. All of the biotic agents which utilize white fir as a host have more significance now than they did in the past because their host now occupies a greater portion of the area than it did historically.

Another significant disturbance in the last 100 years has been harvesting. Many regeneration harvests have been implemented to reduce the impacts from dwarf mistletoe and reduce the probability of western pine beetle spruce budworm and tussock moth outbreaks.

Species of Concern

A key characteristic of both Mixed Conifer PAGs is their fragmented nature. **The species found in both mixed conifer PAGs are closely tied to late successional habitats which are limited because of past harvest.**

Twelve rare species are found in these two PAGs, several of which have a known association with fire, such as Candy Stick. Under historical fire regimes a complicated interaction of low, moderate, and high severity fires in these forest type created a variable landscape patchwork that is believed to have been the most diverse of all eastside landscapes. Excluding fire from these forests is believed to have been the single greatest detriment to landscape and habitat diversity on the eastside (Hessburg et al. 1994). Many of these species may be adapted to fire. However, the lichens, Lobaria, Nephroma, or Pseudocyphellaria which are found in association with disjunct coastal species, may be as sensitive to fire as their associate, Pacific yew. The shrub form of Pacific yew commonly found in these PAGs is speculated to survive light fires because its self-created moist microclimate makes it more fire resistant (DEIS, Pacific Yew 1993). It is likely under historic fire regimes this same phenomena created a mosaic of fire effects and allowed many moist sites species to escape severe fire effects.

Database queries found an additional 80 Survey and Manage species have some probability of occurrence in these PAG.

Wildlife Focal Species

Focal Species: Northern Goshawk, Northern spotted owl, white-headed woodpecker, Williamson's sapsucker, pileated woodpecker and marten.

The landscape is more heterogenous with many small habitat patches and more edge effect. Forest

landscape has changed from the large patches of ponderosa pine dominated habitat to smaller fragmented patches with mixed and climax species composition. Smaller tree sizes are more prevalent. Late-successional habitat structure is more complex (more canopy cover and multi-storied) where it occurs because of the suppression of fire. Tree mortality from insect and disease has reduced the habitat quality of some late-successional forests. **Focal species populations are probably lower than under historic conditions because of habitat fragmentation and less large tree habitat.**

Trends

- Increase in insects and disease due to increased stand ages and densities.
- Decrease in number of large ponderosa pine and Douglas-fir.
- Increase in probability of stand replacement/high intensity wildfires due to increase in stand age and density.
- The understory tree species have changed from primarily ponderosa pine to true firs.
- Stand densities, especially understory densities, have increased significantly.
- Single-story, open, park-like stands have become less common, and multi-story stands have become more common.
- There has been a significant increase in mortality of white fir and Douglas-fir.
- Decrease in medium and large size classes of pioneer and mixed tree species and increase in small size class of mixed and climax species.
- Decrease in pole-sized pioneer species.

- In the mixed conifer; the fire regime has changed from one of frequent low, moderate and high intensity fires to one of primarily high intensity fires. There has been a significant reduction in the amount of low and moderate intensity fires in this fire regime.
- The mixed conifer has had the largest increase of fuel loadings in the watershed due to mortality and the high quality sites that produce greater amounts of vegetation than other sites.
- Protection of the riparian zones in the mixed conifer is the most difficult due to the adjacent high fuel loadings, narrower riparian zone effects and steeper canyon walls.
- The most severe consequences of a stand replacement fire are expected in the mixed conifer zone. These effects could be seen on soils, riparian vegetation, and streams.
- The mixed conifer zone will require mechanical vegetation treatments prior to the use of prescribed fire for reducing ladder fuels and fuel loadings

Two significant changes within this PAG are likely to lead to increased activity by several insect and disease disturbance agents. The most important is the strong shift toward the climax species (white fir) over many acres previously occupied by seral ponderosa pine. White fir is host to an extensive list of organisms, many of which are capable of removing it from a stand. **The second important change is in the structure of stands within this PAG. In 1953, most of the area in this Plant Association Group was dominated by medium to large trees. Currently stands are denser with fewer large trees. These high-density stands cannot be sustained in their present condition for long periods of time, and will continue to be altered until densities are reduced to the carrying capacity of the site.**

MIXED CONIFER WETTER (MCW) PAG 38,725 Acres 26% of Total Watershed

These plant associations occur on the slopes of the Cascades with a mean annual precipitation of 35 to 75 inches. The productivity is generally higher than in the Mixed Conifer Dry (MCD) PAG. Current vegetation consists of true firs, ponderosa pine, Douglas-fir, larch, incense cedar, and lodgepole pine. Spruce can be found in the wetter areas, as well as riparian areas.

Table 21: Mixed Conifer Wet Current and Historic Size and Structure

Mixed Conifer Wetter Total Acres = 38,725									
		Species Composition							
Size/Structure Class	Year or Time Frame	Pioneer(P)		Mixed(M)		Climax©		Totals	
		Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
Grass/Forb/ Shrub	1991 1953 Historic Change	705 1897 0-7745	2 5 0-20					705 1897	2 5
Seed/Sapling 0-4.9"	1991 1953 Historic Change	3355 266 1162-7745	9 1* 3-20	296 0 0-9681	1 0 0-25	100 0 0-3485	0 0 0-9	3751 266	10 1
Pole 5-8.9"	1991 1953 Historic Change	390 158 387-4260	1 0* 1-11	1107 354 1936-11618 -(829-10511)	3* 1* 5-30 -(2-27)	1488 247* 387-3873	4 1 1-10	2985 759	8 2
Small 9-20.9"	1991 1953 Historic Change	1429 462 387-4260	4 1 1-11	10176 2996* 3873-12392	26 8* 10-32	11196 7130 775-5422 +(10421-5774)	29* 18* 2-14 +(27-15)	22801 10588	59 27
Medium/Large 21"+	1991 1953 Historic Change	911 7190 387-4260	2 19* 1-11	5867 15474 3098-10843	15 40* 8-28	822 1163 775-5422	2 3 2-14	7600 23827	19 62
TOTALS	1991 1953	6790 9973	18 26	17446 18824	45 49	13606 8540	35 22		

The small-sized climax species have increased from their Historic Range of Variability, and the pole-sized mixed species have decreased below the Historic Range of Variability.

- The medium and large pioneer and mixed species exceeded HRV in 1953, but are now more in balance with landscape HRV.

MCW Species Composition And Density

The Mixed Conifer Wet PAG includes the CD Series and the most productive sites in the CW series.

The most productive CW plant associations in this PAG include CW-C2-12, and CW-S1-13. Historically, mature stands in this series were primarily composed of early seral species mixed with climax species. Ponderosa pine was the major species present, with some lodgepole pine, Douglas-fir, western white pine, white fir, and western larch. Species composition included white fir regeneration, with mature trees usually making up 30% or less of the total stocking. On a landscape scale, stands currently exist outside this range, being largely composed of mature and immature white fir or Douglas-fir.

Surveyor's notes from 1870 describe lots of heavy yellow pine (ponderosa pine) and fir overstories, as well as western larch, cedar, and spruce overstories. They described dense understories of pine, fir, willow, and chinkapin in some areas. The entire area was described as forested with contiguous stands.

White fir should probably compose less than 30% of tree stocking on the site (personal communication, H. Maffei). Age is a consideration, too. Filip and Schmitt (1990) cite Aho (1977) stated that grand fir has little defect when less than 100 years old, and has considerable decay after age 150. "Second generation" true fir may experience insect and disease problems at earlier ages, due to the increased level of pathogens introduced from first generation firs (personal communication, H. Maffei). Minor amounts of true firs can help to meet various resource objectives, such as presence of soft snags for cavity excavators, hiding cover, foraging, nesting, roosting habitat, etc. while minimizing potential for stand-level forest health problems, but major amounts are outside the range of historical variability, and cannot be sustained over time.

The CD Series plant associations in the PAG include CD-S6-12, CD-S6-13, and CD-S6-14. These associations are climax to Douglas-fir and white fir. The major seral species is ponderosa pine, with western larch also present in CD-S6-12, and as a minor associate in CD-S6-14. Historically these associations, contained small amounts of Engelmann spruce, incense cedar, and pacific silver fir. White fir and Douglas-fir were present, but made up less than 30% of the stands. On a landscape scale, stands currently exist outside this range, being partially or largely composed of mature white fir or Douglas-fir.

MCW Disturbances And Processes

Fire

This area has a historic fire return interval of 9-80 years. In the wet mixed conifer PAG, which historically had a moderate severity fire regime, the proportion of low intensity fires has declined (Agee, 1992). Small, low intensity fires have been effectively controlled. The only fires capable of having a landscape impact are those burning under severe fire weather where initial attack by fire suppression forces has failed. **High intensity fires are now the dominate severity level.** This can be attributed to fuel buildup and ladder fuels that enable ground fires to move into the canopy and increase fire intensities. "This represents a shift from a complex historic moderate fire severity regime to one of high fire severity" (Agee, 1992). Overall, the current fire regime is the same as dexcribed for the Dry Mixed Conifer PAG.

Insects and Diseases

Due to the diversity of species, sizes, and structures of trees, the forest stands in this PAG are affected by an abundance of insect and disease agents.

The white fir component is exposed to a number of root diseases including annosus root disease (Heterobasidion annosum), Armillaria root disease (Armillaria ostoyae), and laminated root rot (Phellinus weirii). Although each of the root diseases reduces tree growth and produces mortality, they all have unique properties which must be taken into consideration in managing their effects.

Armillaria root disease, by far the most important of the three root diseases in the Metolius Watershed, is an organism which is greatly benefited by tree stress and by certain harvesting practices. Factors such as high stand densities, drought, soil compaction, and harvesting of large trees all contribute to increased levels of Armillaria on a site. The most vulnerable tree species are the true firs and Douglas-fir, but ponderosa pine will also be infected and killed on occasion. After the infected trees die (and when stumps are created through harvesting), the fungal inoculum of Armillaria builds up in the dead host material and is viable for over two decades as an infection source for new root, which come into contact with it.

The S-strain of Heterobasidion annosum is another disease which is aggravated by harvesting practices. When large fir stumps are created they are quickly colonized by spores of H. annosum, which later grow throughout the stump and provide an infection source to any roots coming in contact with the inoculated stump.

Laminated root rot is also present in this PAG but is less significant than in the higher elevations where it affects mountain hemlock.

Indian paint fungus (Echinodontium tinctorium) is an important source of decay in larger true firs. The decay spreads very rapidly in trees after they are wounded. Although this fungus is not a direct mortality agent, the decay which it produces can sometimes lead to failure and breakage of the bole. The decay fungus is most significant and abundant in those areas where firs have been suppressed in the understory for some time.

Other important disturbance agents on white fir in this PAG include defoliating insects (primarily western spruce budworm, Choristoneura occidentalis) and the fir engraver (Scolytus ventralis) which often kills firs which have been exposed to stress by these other agents or by drought. The western spruce budworm consumes new foliage and after several years of defoliation, causes top-kill and sometimes death of host trees. The defoliator outbreaks sometimes persist in an area for six or seven years, during which time the accumulated effects on a host stand can be very significant.

Douglas-firs in this PAG are exposed to the same defoliating insects as the true firs (primarily western spruce budworm) and to several of the root diseases as well. The most significant disturbance agents on Douglas-fir are dwarf mistletoe (Arceuthobium douglasii), the Douglas-fir bark beetle, Dendroctonus pseudotsugae, and Armillaria root disease. Many of the stands dominated by large trees are heavily infected with mistletoe (especially in the Cache Mountain area). These trees are infecting the smaller Douglas-firs and will inhibit the development of the understory within infection centers. Armillaria root disease is killing Douglas-fir trees in particularly dense stands and in areas where the western spruce budworm was active in recent years. Similarly, the Douglas-fir beetle is removing the largest trees from stands where these other agents are present, or where other stresses such as drought and soil compaction have occurred.

Some important insects in the pine component include the mountain pine beetle (Dendroctonus ponderosae) in lodgepole pine and the western pine beetle (D. brevicomis) in larger ponderosa pines. When lodgepole pine stands attain an age of 100 years, they are quickly altered by the mountain pine beetle which thins them from above, removing the largest trees from the stand. The western pine beetle is similarly attracted to the largest ponderosa pines in a stand and kills them once they begin to lose their competitive advantage in dense stands or when they are under other forms of stress.

Dwarf mistletoes are also very important in these pine hosts (A. americanum - lodgepole pine dwarf mistletoe; A. campylopodum - western dwarf mistletoe). Both of these diseases, if present in the overstory, will limit the development of the understory and will eventually kill the infected trees.

Western larch is exposed to very few insect or disease disturbance agents in this watershed. The most significant of these agents is larch dwarf mistletoe (A. laricis), which has infected a high proportion of the trees in the watershed. The dwarf mistletoe is eventually lethal to its host and thus causes western larch to be removed from the stand.

With the exception of some of the root diseases, these disturbance agents are fairly host-specific and as such, their presence in a stand has a very important influence on how plant succession develops. Over time, susceptible hosts will be removed from the stand and will be replaced by those which are resistant. With the exception of the mistletoes, most of these agents exert a stronger influence on stands with high densities.

Focal Species by PAG

Focal Species: Northern Goshawk, Northern spotted owl, Wolverine, Fisher, Pine Marten, and pileated woodpecker.

Similar to dry mixed conifer PAG, the landscape is more heterogenous with many small habitat patches and more edge effect. Late-successional habitats are heavily fragmented and poorly connected. Tree mortality from insect and disease has reduced the habitat quality of some late-successional forests. **The focal species population levels are probably lower than historic levels because of the conversion of the large tree habitat to small tree stands and the fragmented habitat conditions. Their distribution in the watershed has been limited by the location, size and connectivity of late-successional habitats.**

Trends

- Increase in insects and disease due to increased stand ages and densities
- Decrease in number of large ponderosa pine and Douglas-fir.
- Increase in probability of stand replacement/high intensity wildfires due to increase in stand age and density.
- The understory tree species have changed from primarily ponderosa pine to true firs.
- There has been a significant increase in stand densities.
- There has been a significant increase in mortality of white fir and Douglas-fir.
- Increase in acres dominated by small-sized climax species.
- Decrease in the acres dominated by pole-sized mixed species.

PONDEROSA PINE PAG (PP) 27,036 Acres 18% of Total Watershed

This PAG has some slopes, but the pure ponderosa pine areas are mostly fairly flat. It is located in much of the eastern portion of the Metolius Watershed, and includes fairly productive ponderosa pine sites. Annual precipitation ranges from 15 to 40 inches.

Table 22: Current and Historic Size and Structure

Ponderosa Pine Total Acres = 27,036			
		Species Composition	
Size/Structure Class	Year or Time Frame	Pioneer Mixed & Climax	
		Acres	Percent
Grass/Forb/ Shrub	1991 1953 Historic Change	670 2683 1352-8111 -(682-7441)	3* 10 5-30 -(2-27)
Seed/Sapling 0-4.9"	1991 1953 Historic Change	871 0 811-5678	3 0* 3-21
Pole 5-8.9"	1991 1953 Historic Change	1919 596 811-5678	7 2* 3-21
Small 9-20.9"	1991 1953 Historic Change	21376 32 5407-13518 +(15969-7858)	79* 0* 20-50 +(59-29)
Medium/Large 21"+	1991 1953 Historic Change	1865 23720 8111-18925 -(6246-17060)	7* 88* 30-70 -(23-63)
TOTALS	1991 1953	27036 27036	100 100

The medium / large size classes and the grass / forb / shrub size classes have decreased below HRV. The seed / sapling size class is on the lower end of HRV.

The small size classes have increased above HRV.

PP Species Composition And Density

The PP PAG includes the High, Moderate and Lower Productivity Sites in the CP Series. In the CP-S2-17, CP-S2-13, CP-S2-16, CP-S1-11, and CP-S1-12 associations. Ponderosa pine was and is the main seral and climax species, growing in small, even-age groups. Minor amounts of western juniper and sometimes Douglas-fir are present particularly on ecotones.

In the CP-S2-12, CP-S2-11, and CP-S3-12 associations, ponderosa pine and lodgepole pine are seral. Lodgepole dominates with disturbance and on colder sites. Historically, stands are composed of mature ponderosa pine and ponderosa pine regeneration, in relatively even-age groups, with minor amounts of lodgepole pine and possibly Douglas-fir present, and juniper on ecotones.

Historic surveyor's information describes the stands in this area as large even-aged stands of pure ponderosa pine, many with grass understories. Some fir, probably Douglas-fir, is mentioned. There are many references to "best bunchgrass." Most of the understories, if present, are not "dense", and include "sweet laurel" or "greasewood."

Within the Metolius River Watershed, some of the vegetative series have experienced minimal departures from the "natural balance", while others have been altered quite dramatically through past management activities and are outside the historic range of variation. For example, forested vegetation at the high elevations that occurs within the mountain hemlock series has probably been altered minimally by human activity. In contrast, the dry mixed conifer plant associations, considered to be fire-climax ponderosa pine, have experienced the most extreme degree of change due to a combination of harvesting practices and the exclusion of natural fires. Large acreages of these plant associations are now dominated by white fir, a very unstable species on these dry sites. This latter group of plant associations, together with some portions of moist mixed conifer and the two ponderosa pine groups are the most likely to experience dramatic changes in the future due to insect and disease disturbance agents.

PP Disturbances And Processes

Fire

"The area covered by individual fires in ponderosa pine forests was probably large, because continuous fine fuel was available on the forest floor: long-needled pine litter and extensive cured grass in the understory" (Agee, 1992). The fire return interval for ponderosa pine forests on the Warm Springs Indian Reservation is 11 to 16 years (Weaver, 1959). In 1985, Bork found an average fire return interval of 16 years on sites near Cabin Lake and Pringle Falls on the Deschutes National Forest. **Bill Hopkins, Area 4 Ecologist, estimates fire return intervals of 8 to 12 years for low intensity fires and 150 years for stand replacement fires. Hopkins estimates that the low intensity fire sizes ranged from one-half acre to five or ten acres and that the stand replacement fires were approximately 150 acres in size (Hopkins, 1995).** Approximately 18% of the Metolius Watershed falls within this disturbance regime.

Historically, fires were of low intensity, rarely scorching the crowns of the mature trees. This can be inferred from the pattern of scarring found on residual trees and from early accounts of wildfires in this forest type. 'Ordinarily, a fire in yellow-pine woods is comparatively easy to check. Its advance under usual conditions may be stopped by a patrolman on a fire line a foot or so wide, either with or without backfiring. The open character of the woods makes the construction of fire lines relatively easy, and in many cases horses may be used to plow them' (Munger, 1917).

"Frequent underburns killed most of the small understory trees which colonized the sites during brief fire-free intervals, maintaining an open, park-like appearance." (Agee, 1992) These open and park-like stands had substantial grass and forb cover. (Wickman, 1992) Frequent, light burning allowed bunchgrasses and most forbs to recover rapidly, so the herbaceous vegetation dominated the understory. The natural landscape pattern was a seemingly unbroken parkland of widely spaced tree clumps and continuous herbaceous understory (Agee, 1992). "The stable patch dynamics were largely a result of frequent, low intensity fire. Disruption of this pattern occurred as small scales when trees in patches became senescent or when mistletoe infested trees torched. Of all the Eastside forest vegetation types, the Pinus Ponderosa type was the most stable in landscape pattern." (Agee, 1992).

To maintain the grass understory indicated in the historical records, frequent, low intensity fires would have been necessary. Fires were probably large, 5 to 500+ acres, due to no suppression and the build-up

of fine fuels (needles) that occur in ponderosa pine stands. The surveyor's notes from the 1870's do not mention fire, so the fire intensity must have been very low. Removal of "high risk" ponderosa pine, and other types of partial cutting harvests have been another source of disturbance in this area during the past 50 years.

Fuels were rarely at high levels because the frequent fires consumed forest floor fuels and pruned residual trees. Fine fuels were produced by needlefall or understory vegetation (Agee, 1993). "In presettlement stands, downed logs were probably clumped at the same scale as the live tree components from which they were created, as such clumps contributed to local increases in fire behavior. It is doubtful that logs remained long on the forest floor to provide wildlife habitat, rooting media for seedlings, or sites for nitrogen fixation by microorganisms, as they were probably consumed by the next several frequent fires on the site" (Agee, 1993).

Fire now has the potential of being the major disturbance in this area, as the vegetation has changed in the last 120 years. There is a higher percentage of small to medium sized ponderosa pine with a heavy brush component which has developed because of fire exclusion. Fires are generally carried by the brush component and the small diameter trees. Flame lengths of 4 to 12 feet could be expected during typical summer conditions.

"The dynamic process leading to stand replacing fire events in ponderosa pine is complex. It is often facilitated by some other event such as insect mortality, diseases, wind events, drought, or by natural fire exclusion allowing time for ladder fuels to accumulate to the extent necessary to either sustain a crown fire over a large area or to generate sufficient intensity and duration to reach inside a bark temperatures capable of killing a normally fire resistant mature tree" (WEAVE, 1994).

In ponderosa pine forests, where the historic fire-return interval was 8 to 12 years for low intensity fires and 150 years for stand replacement fires, fire exclusion has increased the fire return interval and increased the expected fire intensities. "The landscape development pattern of clumped groups of even-aged trees was interrupted by fire protection (Morrow 1985), allowing regeneration to survive not just in openings but under mature clumps. A wide-spread, fire-protection age of ponderosa pine trees has colonized across the landscape. This colonization has created dog-hair thickets of pine trees in many areas. This dense understory has created stress on the older trees. Where once-frequent surface fires were carried through pine stands by needle litter and grass, they are now carried by needle and branch fuels. The vertical continuity of fuelbeds is also higher than historically, which allows surface fires to develop into understory or crown fires under less severe weather conditions. At the same time that average fire intensity, due to fuel buildup, is increasing, average fire tolerance of stands has dramatically decreased as a function of overstocking and stagnation" (Agee, 1992). The fire regime has been converted from a frequent, low severity fire regime to one of less frequent, moderate to high severity.

Insects and Diseases

The occurrence of insects is relatively low. There are endemic levels of western pine beetle and mountain pine beetle. Due to fire exclusion, dwarf mistletoe has had a significant influence on vegetation and motivated much of the harvesting that has occurred. Windthrow occurs occasionally but has produced no significant changes in vegetation.

In both the Wet and Dry Ponderosa Pine PAGs, the stand densities are generally higher than they were historically. As such, those agents which respond to the stresses imposed by inter-tree competition (mountain pine beetle, western pine beetle) have become potentially more significant than they were in the past. In the 1930's, western pine beetles were considered to be at "outbreak levels" when they killed 100 trees per half-section (0.3 trees per acre per year). Normal, or "endemic levels" of mortality were considered to be 0.6 trees per acre per year. **In certain areas in central Oregon, western pine beetle has recently demonstrated the ability to kill trees at much higher levels than were ever reported historically when stand densities were lower.** In these areas, over 50% of the trees in some stands were killed within a three-year period.

Since 1953, there has been a strong shift from large trees to smaller trees as the dominant overstory vegetation. As this shift occurred through risk-cutting of low-vigor trees and the selective harvesting of large trees in general, the role of the western pine beetle became less important during the 1960's and 1970's. Now as stand densities continue to increase, the western pine beetle will probably become an important thinning agent in the near future. The degree of thinning resulting from bark beetle attack could be far greater than the rather subtle reductions in stand densities which occurred during beetle outbreaks in the 1930's. In those times when stand densities were far lower, an outbreak of western pine beetle would reduce the stocking by one third over a two-decade period.

Where the vegetation of fire-adapted ecosystems has been altered by fire exclusion, certain organisms such as Armillaria root disease, all of the dwarf mistletoes in seral species, western spruce budworm, fir engraver, and western pine beetle are much more important now than they were historically in terms of their effects on stand dynamics.

Moist site ponderosa pine: Some key disturbance agents in this PAG include the western pine beetle, mountain pine beetle, and western dwarf mistletoe. The western pine beetle is normally associated with old-growth or large-diameter ponderosa pine, but can also infest younger trees of the same species when these are growing under crowded conditions. The mountain pine beetle is more commonly associated with second-growth stands and begins to thin them once trees are about 70-80 years old. This thinning effect can take on many forms; at times the larger second-growth trees are removed and on other occasions the beetles will kill the smaller trees. Most commonly, the mountain pine beetles kills trees in groups (sometimes as many as 30-50 trees in a group), and creates holes in the stand.

Western dwarf mistletoe is important in this setting since stands are made up entirely of the host species and the parasite can spread readily from one infected tree to another. In the absence of a stand-cleansing fire, these infection centers can become very large over time.

Fairly unique to the Metolius Watershed is the rust fungus Cronartium comandrae which causes comandra blister rust. This disease produces a progressive dieback in the tops of infected trees. The dead top is impregnated with resin which enables the wood to remain intact for a long time after the death of the top. A year of severe infection occurred in the 1940's and the effects are still visible today in the form of spiketops in the larger ponderosa pines in the Metolius basin.

Dry site ponderosa pine: The key agents of change include the mountain pine beetle, western pine beetle, western dwarf mistletoe, and annosus root disease. Density-related disturbance agents such as the bark beetles begin to express themselves at lower stand densities than on moister pine sites, where carrying capacities are higher. Since growth rates are not as high as they would be on better sites, the effects of dwarf mistletoe are also more severe on the pine host. Infected trees are less likely to attain the growth rate which allows then to outgrow mistletoe infections. Accordingly, infections spread more rapidly through stands where this parasite is present.

In the Dry Ponderosa Pine component, agents such as dwarf mistletoe and annosus root disease are more important now than they were in the past. Where fires have been excluded, mistletoe infection centers have been allowed to prosper and continue to infect the developing trees. By creating stumps on a fairly large scale, the selective harvest of large ponderosa pines has increased the importance of annosus root disease which can infect and kill large as well as small ponderosa pines.

Species of Concern

The Ponderosa Pine PAG contains the most important habitat for Peck's penstemon and has critical connections to upslope wet and dry mixed conifer PAGs through streams, drainages and overland flow which aid in penstemon seed dispersal and germination success.

Peck's penstemon, Tall Agoseris, and Mountain Lady Slipper have all been affected by the exclusion of fire in this PAG and would benefit from the reintroduction of low intensity fires. Little is known about the habitat requirements of the rare truffle, Elaphomyces. However, because of its close association with old growth pine forests, and underground habit, it is almost certainly well adapted for the periodic fire common to this PAG, if not dependent on it. The two rare lichens found in this PAG are both associated with riparian areas and would have probably escaped most effects of natural fire regimes. Caution may be warranted for reintroduction of fire into these riparian areas to avoid altering moist microclimates.

Database queries found an additional 40 Survey and Manage species have some probability of occurrence in this PAG, as well as two sensitive plants.

Focal Species

Focal Species: Northern Goshawk, White-headed Woodpecker and Northern Bald Eagle.

Stand structure has changed from the large patches of more open large tree habitat to smaller patches of denser habitats with smaller trees. Late-successional habitat is limited and poorly connected. **Focal species populations are probably lower than under historic conditions, except bald eagle. The distribution of these species is dictated by location of medium/large tree habitat.** Many of these species are also associated with the Dry and Wet Mixed Conifer PAGs

Trends

- Historic fires were much larger, due to no suppression actions, and of lower intensity due to higher frequencies and lighter fuel loadings.
- Stand densities, especially understory densities, have increased.
- Single-story, open, park-like stands have become less common, and multi-story stands have become more common.
- Many grass understories have been replaced by brush or tree understories.
- Stands of large, even-aged ponderosa pine have developed spotty understories of ponderosa pine, and in some areas, white fir or Douglas-fir, due to exclusion of wildfires and presence of nearby seed sources.
- There has been an increase in fuel loadings and brush component due to fire exclusion.
- There are fewer large and medium-sized trees (>21") and more small sized trees (9"-20.9").
- There has been a decrease in grass / forb / shrub openings.
- As fire intensities increase, the percentage of large ponderosa pine trees killed by wildfire increases. The use of prescribed fire to reduce fuel loadings and ladder fuels will be most successful in the ponderosa pine.
- As stand densities increase, western pine beetles will become an increasigly more active thinning agent.

HIGH ELEVATION MOUNTAIN HEMLOCK PAG (HEL)

19,812 Acres 13% Total Watershed

This vegetation type is found mostly in the wilderness. It includes the upper forested slopes of the Cascades. These are mid or lower productivity sites due to their higher elevations and rocky soils. Vegetation consists primarily of lodgepole, hemlock, subalpine fir, silver fir, and whitebark pine. The plant associations in this area are in the mountain hemlock, silver fir, sub-alpine fir, and whitebark pine series.

Table 23: Current and Historic Size and Structure

High Elevation Forest Total Acres = 19,812							
		Species Composition					
Size/Structure Class	Year or Time Frame	Pioneer(P)		Mixed (M) and Climax©		Totals	
		Acres	Percent	Acres	Percent	Acres	Percent
Grass/Forb/ Shrub	1991 1953 Historic Change	150 916 0-991	1 4 0-5			150 916	1 4
Seed/Sapling 0-4.9"	1991 1953 Historic Change	167 0 0-991	1 0 0-5	331 0 0-594	2 0 0-3	498 0	3 0
Pole 5-8.9"	1991 1953 Historic Change	29 21 0-991	0 0 0-5	2084 353 0-5944	10 2 0-30	2113 374	10 2
Small 9-20.9"	1991 1953 Historic Change	82 11 0-594	0 0 0-3	9843 16805 991-9906	50 85* 5-50	9925 16816	50 85
Medium/Large 21"+	1991 1953 Historic Change			5786 957 991-3962 +(4795-1824)	29* 5 5-20 +(24-9)	5786 957	29 5
TOTALS	1991 1953	428 948	2 4	18044 18115	91 92		

The acres of medium / large size climax species exceed the HRV, and the acres of small size are at the upper end of the HRV.

High EL Species Composition And Density

Historic vegetation is very similar to current vegetation. With natural succession and lack of fire, seral lodgepole has decreased, and the climax species have increased in size and density. Many of the hemlock stands were and are very dense. The surveyor's notes mention heavy fir, hemlock, spruce, and pine on the east side of the wilderness. **The understories were and are now often dense.** The higher moisture levels can support and sustain higher vegetation densities. At higher elevations, similar to today, the whitebark

pine and subalpine fir stands were open and park-like. The high elevation forest of the Metolius Watershed is characterized by mountain hemlock as a major component of the overstory vegetation. Subalpine fir, pacific silver fir, white bark pine and lodgepole pine are all found in the overstory and understory. The Lodgepole PAG is the early successional stage of the high elevation forest, due to fire or other major disturbance patterns.

High EL Disturbances And Processes

Fire

Within the Metolius Watershed, the high elevation forest has the coolest temperatures, the shortest growing season, and the longest fire-return intervals. **Hopkins (1995) estimates fire-return intervals of 100 to 300 years with fire sizes of 5 to 10 acres.** Regeneration in this forest type occurs after stand replacement fires that may be 50 to 100 acres in size.

Lightning is the most common fire cause. Fire occurrence was, and continues to be, infrequent with moderate to high fire intensities once they do start. The 1953 vegetation maps show locations of high elevation fires at that time. The fire return intervals were long (100 to 300 years). There was no evidence of fire in this area when the surveyors moved through in 1870, although most of this area was not surveyed.

Approximately 18% of the Metolius Watershed falls within this disturbance regime.

"The changes of the last century have been least significant, of all the elevation zones, in the Eastside high elevation forests.... Although a fire exclusion policy has been in effect for almost a century, the naturally long fire return intervals have resulted in little noticeable change in these ecosystems at the stand level. At the landscape level, the absence of fire has probably resulted in a slight shift towards later seral communities and away from earlier seral communities" (Agee, 1992).

Fire is the primary large-scale disturbance in the high elevation forest. Most other disturbances operate at the tree or small stand scale. **Due to the lack of fire resistance of the major tree species in these forests, most fires are stand replacement fires.** The estimation of fire intensity in high elevation forests is complicated by the erratic, often weather-driven nature of these fires (Agee, 1993). Crown fires can occur when foliar moistures are low and may be aided by lichen draped within the canopy.

"All subalpine plant associations will burn, but not under all conditions. In the Tsuga mertensiana zone, closed or parkland forest has the highest probability of burning, because of the dead fuel loads that can be desiccated during east wind events and the presence of flammable lichens in crowns low to the ground (Agee and Smith, 1994)." Fire has been an important factor in the creation of subalpine meadows (Kuramoto and Bliss, 1970). "Subalpine forests exist in a marginal environment for tree establishment and growth, so a fire disturbance that kills most or all of a stand can create almost permanent meadows or open parklands that persist for decades to centuries." (Agee, 1993) "Drier subalpine meadows, such as those dominated by Festuca spp., have burned frequently ... (Kuramoto and Bliss, 1970). Little is known about fire effects and fire-return intervals in wet subalpine meadows.

"Subalpine fires tend to be erratic and unpredictable. Although they are infrequent in most Pacific Northwest subalpine forests, fires have been important in shaping the landscapes we see today. Many subalpine meadows bordering forest were created by fire, ..." The fire suppression period during the twentieth century so far has not had much impact on landscape structure in subalpine zones because of the fairly long fire-return intervals" (Agee, 1993).

Insects and Disease

Mountain hemlock: The key agent of disturbance in this PAG is laminated root rot caused by the fungus Phellinus weirii. Wherever large openings occur in the late-successional canopy of mountain hemlock, the laminated root rot is the most likely causal agent. These openings expand in radius at the rate of approximately one linear foot per year, and each year the trees on the edges of the openings become infected. Openings in the stand are colonized by species which are resistant to the root disease (western white pine and lodgepole pine), and by mountain hemlock which will probably not attain a large size in the root disease pocket. The western white pine in turn is affected by an introduced pathogen, white pine blister rust, caused by the fungus Cronartium ribicola. Intensity of this exotic disease is quite variable, and depends on the suitability of environmental conditions for species of Ribes, the alternate host for white pine blister rust. White pine blister rust has also killed some whitebark pine.

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.

Species of Concern

The Mountain Hemlock PAG is not botanically well known. Two important Survey and Manage fungi sites occur associated with wilderness lakes and are at risk from increasing recreational use.

Three sensitive plants and four Survey and Manage species have a moderate to high probability of occurrence. Database queries found an additional forty four Survey and Manage species have some probability of occurrence in this PAG.

Wildlife Focal Species

Focal Species: Wolverine, Fisher, American Marten and Black-backed woodpecker

This PAG is a small portion (5%) of the watershed and is located in the higher elevations associated with mountain hemlock plant associations. Small and pole size trees have dominated this PAG since the early 1900's. At this point in time the pole sized habitat are dominating this PAG, while in 1953, this PAG was dominated by the small tree habitat. **The focal species population levels have probably not changed as a result of these habitat changes, except possible the black-backed woodpecker populations which are associated with the larger (medium and small) tree sizes.**

Trends

- The stands have increased in age. The trees have become older, larger, and more dense.
- The woody debris found on the forest floor has increased. As the stand ages increase, tree mortality within the stands increases, and more trees fall to the ground. This increases the amount of woody debris (fuel loading) on the ground, and this has the potential to increase wildfire intensity in these stands.
- The occurrence and extent of root rots have increased.
- Spruce budworm mortality has recently increased in the true firs, and some whitebark pine has been killed by mountain pine beetles or white pine blister rust.

LODGEPOLE PINE PAG (LP)

8,100 Acres
5% of Total Watershed

This vegetation type is found mostly at higher elevations in this area. There is also a very small patch of lodgepole on the southeastern side of the Watershed Analysis area. The areas where lodgepole pine is climax tend to have poor cold air drainage, or soil or moisture conditions that other species don't tolerate as well.

LP Size And Structure

Table 24: Lodgepole Pine Current and Historic Size and Structure

Lodgepole Pine Total Acres = 8,100			
		Species Composition	
Size/Structure Class	Year or Time Frame	Pioneer Mixed & Climax	
		Acres	Percent
Grass/Forb/ Shrub	1991 1953 Historic Change	115 650 0-4860	1 8 0-60
Seed/Sapling 0-4.9"	1991 1953 Historic Change	1357 0 0-4860	17 0 0-60
Pole 5-8.9"	1991 1953 Historic Change	3616 871 810-6480	45 11 10-80
Small 9-20.9"	1991 1953 Historic Change	2912 5823 810-6480	36 72 0-80
Medium/Large 21"+	1991 1953 Historic Change	0 510 0-162	0 6* 0-2
TOTALS	1991 1953	8100 8100	100 100

There is a wide range of historical conditions in this PAG, because of the boom and bust cycles of fire and insects in these plant associations. Because of this, none of the size classes are shown as outside HRV.

LP Species Composition And Density

The CL High Productivity Sites in this watershed include CL-M4-11 and CL-G4-12 plant associations. Historically, mature stands were composed mainly of lodgepole pine, with minor amounts of subalpine fir, mountain hemlock, or white pine present at higher elevations. Lodgepole pine associations are relatively simple in structure. Most are relatively even-age, even-sized stands.

The CL Moderately Productive sites include the CL-S9-11 plant association. Historically, mature stands were mainly composed of lodgepole pine, with minor amounts of ponderosa pine and white fir present. The moderately productive lodgepole plant associations also are composed of relatively even-sized, even-age lodgepole pine. Scattered mature ponderosa pine is often present near edges with ponderosa pine associations.

LP Disturbances And Processes

Fire

Fire and mountain pine beetle are the major disturbance factors in this PAG. Lightning is the most common cause of fires in the higher elevations. Lodgepole pine is usually present at these elevations as a persistent early seral pioneer of areas where climax hemlock and/or fir have been removed by fire or other disturbance. Typically these stands persist in locations of poor soils or cold air pockets that other species cannot tolerate, and become, essentially, the climax species. **The normal fire regime is a high intensity, stand replacement fire associated with dry late summer conditions, high winds, and lightning. The fire return interval is 100-150 years; on the outside edge of the range, pine beetles often intervene and cause extensive mortality, followed by stand replacement fire.** After a pine beetle attack or in older stands with lots of large dry wood on the ground, even low intensity fires can cause extensive mortality as fire creeps from log to log and damages roots or tree boles. Patch sizes are usually small - 10 to 100 acres. Lodgepole regenerates easily on these burned sites, and the cycle begins anew. At lower elevations, ponderosa pine or true firs may slowly intrude into these even-aged lodgepole stands due to moderating changes to micro site or climate. Lower intensity fires may favor these species and allow further development, but usually they are lost in the next high intensity fire.

Insects and Diseases

The most important disturbance agent in this series is the mountain pine beetle. Once stands have attained their "old growth" character at age 100-120, they are dramatically altered by the bark beetle which may kill virtually all of the larger trees within a three-to-four year period. Dwarf mistletoe is an important agent which affects the stand dynamics of lodgepole pine by affecting growth and inducing mortality.

Species of Concern

The Lodgepole Pine PAG is relatively rare in the watershed and appears to have no known associations with species of concern. However, few surveys have been completed and six Survey and Manage species have a high probability of occurrence in this association.

Focal Species

Focal Species: Wolverine, fisher, American marten and black-backed woodpecker.

The Lodgepole PAG is a lightly fragmented patch of high elevation habitat associated with the Wilderness. The habitats are in late-successional stages of development and are subject to a large-scale stand replacement disturbance that could significantly change the habitat composition of this PAG. The PAG is composed of small and large (>21" dbh) tree habitat. Historically there was more small tree habitat because of the presence of fire. **The focal species distribution and population levels have not changed because of the changes in habitat structure within this PAG.** The concerns about Wolverine, fisher and marten are primarily a result of the fragmentation and human disturbances in the higher elevation mixed conifer PAGs.

Trends

- The stands are increasing in density.

Riparian and Aquatic Systems

Table 25: Current and Historic Size and Structure.

Riparian Total Acres = 3,183									
		Species Composition							
Size/Structure Class	Year or Time Frame	Pioneer(P)		Mixed(M)		Climax©		Totals	
		Acre	Percent	Acres	Percent	Acres	Percent	Acres	Percent
Grass/Forb/ Shrub	1991	184	6					184	6
	1953	298	9					298	9
Seed/Sapling 0-4.9"	1991	270	8					270	8
	1953	1	0					1	0
Pole 5-8.9"	1991	28	1	31	1	10	0	69	2
	1953	2	0	29	1	0	0	31	1
Small 9-20.9"	1991	450	14	791	25	956	30	2197	69
	1953	3	0	17	1	13	0	33	1
Medium/Large 21"+	1991	116	4	254	8	15	0	385	12
	1953	1527	48	1161	37	38	1	2726	86
TOTALS	1991	1048	33	1076	34	981	30		
	1953	1831	57	1207	39	51	1		

Historic Condition of Riparian Vegetation

The area of riparian habitat has probably not changed much from historic conditions. The quality of riparian habitats, however, has probably changed over the decades. In the late 1800's and early 1900's sheep grazing, and to a lesser degree, cattle grazing were common in the watershed. Large herds of sheep and cattle grazed and reduced the complexity of many riparian habitats. The extent of these changes in riparian habitat conditions is not known. When cattle and sheep left the watershed in the mid-1900's, the riparian habitat affected by the grazing mostly recovered. **More recently, timber harvest activities and recreational uses have impacted many of the riparian habitats in the watershed. There are locations where riparian habitat deterioration is evident, but generally riparian habitats are in good condition.**

Historically, in unlogged old growth forests more trees were available to fall into streams, lakes and wetlands, creating important habitats for Survey and Manage species such as lichens, liverworts, and mosses. Trees falling into stable spring fed streams and rivers in the watershed slowly developed into floating island habitats, supporting first forb and graminoid plant associations and eventually shrubs. These islands were cover for aquatic wildlife, especially fish, amphiphians and birds and provided structural diversity in riparian areas for many other species.

Focal Species

Focal Species: Wolverine, Fisher, American marten, northern goshawk, cascade frog, tailed frog and spotted frog.

This PAG is limited in size, but contributes significantly to habitat and species diversity. **Generally the amount of riparian habitat has not changed, but the amount of large tree habitat associated with these riparian areas has decreased. As result the effectiveness of these riparian areas as late-successional corridors has been reduced.** This is especially true where this PAG overlaps with the ponderosa pine and mixed conifer PAGs. Human use has increased in riparian areas causing habitat deterioration at some heavily used sites. **The extent of these impacts on wildlife species is not known, but negative impacts to amphibian species are possible.**

Riparian Vegetation Size and Structure

Riparian vegetation can be much more diverse than terrestrial vegetation in both species and structure.

The successional classes of riparian vegetation in the watershed for 1953 show a dominance (37%) of riparian acres in medium/large sized mixed species. In 1991, the dominant successional class was small climax species (30%). Small sized mixed species class was also well represented in 1991 (25%). This trend is primarily the result of the increase of white/grand fir with the exclusion of wildfire, shifting most mixed conifer stands toward white fir dominated, pole and small sized stands. The true firs are a climax species in the absence of fire.

In 1953, the protion of the watershed dominated by larger trees was especially evident in the riparian area. The proportion of the riparian area with medium/large sized trees has declined from 86% in 1953 to 12% in 1991. Prior to 1953, the historic conditions of riparian stands may have been more weighted toward large sized trees before selective logging, thinning the larger trees from riparian areas. More early seral patches may have existed prior to 1953 due to the influence of irregular patches of wildfire of varying intensity. **Of the area within 100 feet of streams within the watershed in 1991, approximately 50% of the area is comprised of small sized trees, 9 to 20.9 inches in diameter. In 1991, trees > 20.9 inch dbh were less than 15% of the total within 100 feet of streams. This downward trend in tree sizes will result in fewer large trees available to fall into streams and provide large woody debris. At present, wood recruitment is dominated by small or pole sized trees.**

Crown closure within 100 feet of streams was moderate to high in 1991. Moderate crown closure was defined as 56 to 70% closure and high was defined as 71% or greater closure. If we use crown closure as an indicator of the cover over narrow streams, stream shade appears to be adequate. This assessment is generally supported by the low percentage of pole, seed/sapling and grass sizes and by the stream temperature data. Summer shade has been measured on Roaring Creek, Canyon Creek and Abbot Creek and ranged from 41 to 71% for recently logged areas and 56 to 77% in control areas. Historic shade may be within the range of the control sites. Shade is adequate if riparian areas are not opened by logging or blowdown caused by logging.

The width of riparian vegetation was estimated by stream surveyors from 1989 through 1992. Of the streams sampled, several streams had riparian associations that extended beyond 300ft from the stream, including Lake Creek, Canyon Creek, Brush Creek, First Creek and the Metolius River. Some stream reaches had riparian vegetation that was confined to within 200 ft of the stream.

Riparian Disturbance Processes

Riparian areas are subject to a variety of disturbance agents, some unique to the streamside or lakeside ecotone. Natural agents of disturbance within riparian areas include floods, wildfire, wind and insects/disease. These factors influence the species composition, structure and function of the riparian area. Changes in the size and frequency of these events can alter the function of the riparian area.

Floods

Floods can influence the riparian vegetation by scouring the flood prone area and creating unvegetated sites for establishment of early invader plants. Floods also rearrange instream wood in the channel and create accumulations or jams that develop pools and complex habitats for bull trout and other aquatic species. Jams that form can also cause side channels to develop that flow through the riparian vegetation and create diverse soil moistures that add to the vegetative diversity along streams. Large floods may come every 50 to 100 years but can have a great influence on the species composition, age structure and pattern of vegetation type that remain along the stream for many years following an event. In the Metolius basin, these large events that affect flood plains are more infrequent, but are an important factor shaping the vegetative communities. Streams most shaped by floods are First Creek, Canyon Creek, Brush Creek and Lake Creek.

Wind

Wind can also affect riparian areas by blowing down trees or groups of trees. Riparian areas may be more susceptible to blowdown due to high soil moisture or saturated soil. Trees in these areas have shallow roots when the water table is near the surface. Spruce are generally a shallow rooted species that are common on many of the mixed conifer streams reaches. The wet soil and the shallow roots make riparian trees vulnerable to windthrow. Blowdown trees shape the stream by creating jams, side channels and pools. Blowdown can also reduce stream shade if it occurs in pockets. Many of the blowdown in riparian areas still have their roots attached, upturning soil and creating a depression in the floodplain. The depressions can create unique microhabitats for amphibians and other riparian associates. If streambank blowdown is widespread, the upturned roots can increase bank disturbance and introduce fine sediments into potential fish spawning areas (e.g. Roaring Creek).

The frequency of wind storms in the last 100 years has been investigated and may have been a significant agent of disturbance in the Metolius Watershed. The events presented cite the nearest recorded reports of high wind events that were more regional storms from the reports. In some cases a large storm reported in Portland was not reported in Bend, but some influence on the Metolius Watershed is inferred. Large wind storms are documented for 1880, 1900, 1931, 1962 and 1994. Large wind storms lasted up to three days and occurred at a frequency of roughly 30 years. Lighter intensity storms occur at a frequency of approximately 5-10 years.

The two greatest impacts to riparian, wetland, and lake habitats have been timber harvest and recreation. Harvest of old growth within riparian areas removed many potential infalls and altered riparian microclimates, thus increasing desiccation stress in the litter, soil, and boundary layer by allowing more sun and wind to reach the forest floor. Increased exposure of the forest floor to heavy rains allows erosion of organic layers and results in a net drain of nutrients from the system (Olsen 1992). Heavy equipment on wet soils has caused compaction and damaged fragile understory environments. Recreational impacts range from trampling and subsequent loss of riparian vegetation to removal of wood infalls to provide safe boating passage. Removal of instream wood and fewer potential infalls have resulted in less floating island habitats, particularly in the Metolius River.

Fire

Fire generally has two types of impacts on riparian zones: direct and indirect. Direct impacts are those associated with burning within the riparian zone. Indirect impacts are those associated with burning at another location on the landscape, which affects sediment transport, biomass creation or removal of water quantity and quality as it moves through the riparian zone.

In general, wildfires tend to burn at lower intensity in riparian areas due to their high moisture regimes. Some cases such as the Dinkelman fire in Washington have shown examples of the headwater riparian areas burning at high intensities due to the effect of steep canyons funneling winds and radiating heat (Agee, 1992). Agee (1988) predicted different effects based on stream width. Beschta (1990) rated the risk of fire affecting water resources as highly variable, depending on topography, fuel, moisture regimes, microclimates and conditions prior to the fire.

With the wide range of variables that determine fire effects in riparian areas only a general discussion of risks, based on general weather conditions, can be developed for the Metolius Watershed. These risks will be relative within the watershed.

Along the Metolius River, the risk of catastrophic effects from wildfire is low. The Metoius River is a large stream with generally healthy, well established riparian vegetation. Historic large fires have burned down the Metolius River or have started near the river and moved up to the top of Green Ridge. Because of its large size and influence on adjacent vegetation, fires would generally be of low intensity in this riparian area. Fuel moistures would generally be higher than the surrounding slopes and the large trees would survive light underburning while small patches may be created where a few shrubs or deciduous trees were consumed. **Fire effects from a fire along the Metolius River would, under most normal circumstances, be minimal. Few, if any, large trees would be killed and only small patches along the river would be created.**

Along the outwash of the Metolius Basin, in the ponderosa pine PAGs and the mixed conifer PAGs to the north, the risk of catastrophic effects from wildfires is moderate. The lowlands are prevailing flat and the streams meander through the area, with fairly large flood plains. The slow movement and wide channels allow wide bands of riparian vegetation to establish. Fuel moistures in this vegetation is usually higher than the surrounding vegetation. When a fire moves into the riparian area, it's intensity usually decreases. With the increased fuel loadings and ladder fuels that have occurred from fire exclusion, the fire intensity will not decrease as much as it would have historically. The topography surrounding the streams is relatively flat so the "chimney effect" that can be created along steep, narrow streams is not a concern here. The flat topography helps reduce the risks of high intensity fires.

Along the steep channels in the glaciated areas, the risk of catastrophic effects from wildfires is moderate or high. The stream channels in this portion of the watershed, are more narrow and the canyon sides are steeper than found in the basin lowlands. The band of riparian vegetation adjacent to the streams would be narrower than in the lowlands because the streams are generally smaller and flood plains are more narrow. This would reduce the effect of water and vegetation on fuel moistures. Riparian area fuel moistures here would generally be less than fuel moistures in the lowlands riparian areas. The fuel loadings would be higher here because of the increased precipitation and ability of these sites to support vegetation. Heavier fuel loadings, smaller widths of riparian area vegetation, heavier fuel loadings in the upslope stands, lower fuel moistures in the riparian area, steeper canyon sides and a natural fire regime of moderate intensity fires (in the mixed conifer PAGs) indicate the risks of destructive effects in these riparian areas are higher.

The most severe consequences of a stand replacement fire are expected in the mixed conifer zone. These effects could be seen on soils, riparian vegetation, and streams. The ability to protect riparian zones decrease as fire intensities increase. Protection of the riparian zones in the mixed conifer is the most difficult due to the adjacent high fuel loadings, narrower riparian zone effects and steeper canyon walls.

Insects and Disease

The agents at work in riparian areas are the same insects and diseases mentioned for the moist mixed conifer and ponderosa pine PAGs.

Human Impacts

Several areas along the streams have been disturbed by heavy recreational use including dispersed and developed camp sites, roads and trails. These areas can be small isolated interruptions of the riparian vegetation along the stream and have little impact if they stand alone. However, when these areas are frequent and connect together, they can begin to reduce riparian habitat quality and increase streambank erosion and sedimentation, especially at Jack Creek and Canyon Creek. Other impacts to riparian areas were noted around the Link Lakes Basin lakes and along Lake Creek. New accesses are being created by users each year and campsites are becoming devegetated after long term use. Pulling some of these sites back from the streams and limiting access within riparian areas is needed to control this trend.

The developed recreation sites that have deteriorated from long term use include the Head of Jack Creek, Jack Creek Campground, Canyon Creek Campground, Candle Creek Campground, Camp Sherman Campground and many other Metolius River campgrounds. Redesign and limitations on foot and vehicle traffic will improve these areas and restore the vegetation that can help filter sediments and increase infiltration of rain and snow.

Recreation use along the lake shore of Suttle Lake has caused instability of the shoreline and slope between the lake and campsites. The soil of Suttle Lake area is comprised of loose cinder and without roots, erosion occurs. As a result, the sites affected by trampling have eroded into the lake, undermining trees. The largest sites are in Blue Bay, South Shore and Link Creek campgrounds. Some eroded areas exist along the north shore, but to a lesser degree. The erosion along the south shore may contribute sediment toward the outlet at Lake Creek, which could adversely impact the creek and the Metolius River.

Roads, either from logging or recreation, have changed riparian areas by compacting the soil, segmenting riparian corridors and increasing sedimentation and erosion. Within the interim stream Riparian Reserve widths, road densities are 3.4 miles of road per square mile. This figure includes wilderness and would be much higher for reserves if only those outside of wilderness were considered. Road density within riparian vegetation and riparian soils is 5.4 miles of road per square mile of riparian vegetation, with wilderness included. This amount is approximately twice the Forest Plan objective. These roads occupy sites of the richest vegetative diversity, and modifying or closing riparian roads are a high priority to reduce the effect on streams and riparian dependent species.

Logging that disturbs the riparian area can affect stream conditions in several ways. Roads created in riparian areas can channelize water, increase scour, and deliver increased amounts of fine sediment to spawning areas in the streams (see above discussion on sedimentation). Openings created in the forest in the riparian area can cause trees to blowdown along the stream, increasing sun light that reaches the stream bed and increasing the water temperature. Blowdown can also cause bank disturbance in and along the stream bank reducing undercut banks and releasing fine sediment into fish spawning areas. Blowdown can also reduce the long term recruitment of large wood to the stream in stands that would have grown larger if left undisturbed.

When the effect of creating openings near Roaring Creek, Abbot Creek and Canyon Creek was examined, the size of the opening along the direction of prevailing storm wind was a significant factor related to the amount of blowdown trees that resulted (USFS, appendix). The width of the buffer between the stream and the opening was another factor related to blowdown and stream shade. Trees in narrow buffers may have been in wetter soils and became unstable after the opening was created. Openings greater than 450 feet appeared to increase blowdown along streams and buffer widths of less than 200 feet had more blowdown (USFS, appendix). Bank disturbance, described as areas of bare soil along the stream bank, was higher in buffered areas along logged openings than in uncut stream sections. Blowdown had little

effect on shade as most of the blowdown covered the stream and shaded the water. As the branches break off the blowdown trees, the effect on shade may become greater.

Grazing effects on riparian vegetation may have been more significant from the late 1860's through the 1930's. Heavy sheep and cattle grazing may have influenced plant communities by favoring grass species and reducing palatable shrubs such as willow, aspen and snowberry. Although willow remains scarce and may always have been, snowberry is wide spread. The effects of sheep grazing may be completely masked now. Light sheep grazing occurred until 1993, but has been discontinued. One horse pasture is permitted on the lower North Fork Lake Creek but has only minimal local effects.

Species of Concern

A Regional Forester's Challenge Grant study used pitfall trapping to inventory forest floor invertebrates in riparian areas and associated forest uplands. No distinct riparian ground fauna was found in the pilot study. However, species diversity was higher in forest riparian areas than in dry forest sites.

Focal Species

The following focal amphibian species are known or suspected to occur in the watershed.

Cascade Frog

This species is a Oregon State Sensitive Species in the critical category because populations appear to be declining.

The densities of Cascade frogs in these watershed is unknown, but the wet meadows, edges of ponds, marshy edges and small streams are all considered potential habitat. Cascade frogs have been observed in Canyon Creek, Suttle and First Creek subwatersheds. The presence of down woody material, litter, horizontal grass and shrub cover, and high levels of tree canopy are important to maintain micro habitats preferred by this species.

TREND: Unknown in watershed, but downward at the State level.

Tailed Frog

This species is a Oregon State Sensitive Species in the critical category because populations appear to be declining.

There are no formal surveys, and very little information regarding this species. There are two verified sightings, both in the Canyon Creek subwatershed and there is potential habitat in most major tributaries of the watershed.

Tailed frogs prefer cold fast-flowing permanent streams in forested areas similar to the major tributaries of the Metolius. Adults spend the days under rocks or debris and emerge at night to feed on insects and other invertebrates. This species has been found foraging as far as 75 feet from water. Overall, tailed frogs have exacting habitat requirements, including the lowest known temperature requirements, and one of the narrowest temperature tolerances of any of the world's frogs. These cold temperature requirements are primarily associated with high levels of canopy cover and cool micro-climates found in mature and late-successional habitats.

Habitat alterations that cause siltation, increase water temperatures, and lower humidity will eliminate this species from impacted areas.

Current population densities and acres of potential habitat from historic conditions to current conditions is not known.

TREND: Unknown in watershed, but downward at the State level.

Spotted Frog

This species is a federally listed category 2 species.

No formal surveys have been conducted, and there are no known sightings within the watershed. This species occupies marshy pond or lake edges, or algae-covered overflow pools of streams. However, it is not likely to be found in wet meadows that dry up during the summer, and unlike the Tailed frog it is more likely to be found in slow moving streams. The small ponds and wetlands within the watershed are all considered potential habitat. The presence of down woody material, litter, horizontal grass and shrub cover is important to maintain micro habitats preferred by this species.

The changes in population densities and acres of potential habitat from historic conditions to current conditions is not known. The marshy ponds needed by this species were probably never abundant in the watershed. It is likely that this species does not occur in the watershed, or only in isolated populations in unique wetland habitats.

TREND: Unknown in watershed, but downward at the State level.

Trends in Aquatic/Riparian

TREND #12 LU 2,7,11 There is a reduced density of wood in streams and in riparian areas. Rating: Red Flag. Reason for Rating: The absence of wood on the shore and in the water reduces aquatic habitat quality and complexity. Wood in streams provides cover for juvenile and adult fish and invertebrates. Instream wood also can sort stream gravel for spawning habitat and can create side channels and special habitats like side channels, log jams, pools and backwaters. Insects, amphibians and other invertebrates depend on this habitat for viability. Large logs along the lake shore also stabilize the banks and protect tham from wave-related erosion. This trend is red for the Metolius River in Landscape Units 2 and 11 because of continued limitations of log jam development by clearing passage for recreational boaters. This trend is yellow flag in areas other than the Metolius River.

TREND 13 LU 2,7,11 Native inland fish populations are isolated and anadromous populations are lost due to large and small dams. Rating: Yellow Flag. Reason for Rating: Spring Chinook and sockeye salmon once abundant in the Metolius and Lake Creek, have been eliminated from the watershed. These fish have immeasurable spirtitual and economic value to the people of the northwest. Bull trout and perhaps rainbow trout were once able to interact with the lower Deschutes populations but are no longer connected. Round Butte Dam and small dams on Lake Creek have isolated populations and contributed to the region wide loss of populations and connectivity of remaining populations.

TREND #14 LU 1,2,4,5,7,8 Stock of non-native fish and the potential interaction may result in increased competition with native aquatic species, especially native rainbow trout in the Metolius River and amphibians in high lakes and streams. Rating: Yellow Flag. Reason for rating: Native trout in the Metolius River have been rated as depressed by ODFW and some interaction has been shown between hatchery rainbow trout and native rainbow. Fishing for wild trout is increasingly popular and ODFW manages a catch and release only for wild fish in the Metolius River. Interaction with stocked fish is a concern but the population is strong enough to recover. In small tributaries and high lakes, introduced fish increasingly compete with native amphibians and bull trout, especially by brook trout. Bull trout numbers are stable or increasing. Amphibians in small streams and lakes have small and isolated habitats and loss of all or a portion of the population may increase risk to population viability.

TREND 15: LU 2,8,11 Bull trout population in the watershed is increasing from recently low numbers. Rating: Green Flag. Reason for Rating: Bull trout spawning counts have increased since 1986 in a recovery from over fishing, predator control programs and other factors. This trend is one that is being encouraged by all interested agencies and we would like to see continue. This population is the only fishery on bull trout that remains open in the state of Oregon.

Unique and Special Habitats

Special habitats are areas which sustain unusual and/or particularly rich biological diversity. These habitats have a high probability of supporting rare species. All non-forest and riparian habitats are often treated as special habitats because they encompass such a small percentage of the land base in forested regions but have a disproportionate value in the conservation of biological diversity.

The texture and pattern of biodiversity can be examined at many different scales, ranging from global to microscopic. At the landscape scale the coarse scale of PAG patterns miss unusual small scale habitats such as small non-forested habitats, or riparian seeps. At a even finer scale certain structural features within habitats such as hard snags or root wads provide habitat for rare species of fungi, bryophytes, lichens and invertebrates about which we know very little.

The following PAGs are special habitats that may contain unusual or particularly rich biological diversity represented by sensitive plant species, amphibians or reptiles, lepidoptera and other invertebrates, fungi and other survey and manage species.

Grassland

No known species of concern are found in this PAG, however, there have been limited surveys. Three sensitive plants have moderate to high probability of occurrence. These habitats are vulnerable to trampling from recreational activities and have a higher risk of weed introduction related to horse use.

Lava or Rock

Larsens Collomia, a state watch list plant, is known to occur in this PAG. Limited surveys exist and seven other sensitive plant species have a low to moderate probability of occurrence. These habitats are naturally very harsh. Species which occur here are probably adapted to recover from some disturbances, such as periodic rockfall. Highly moveable substrates may be at risk from mountaineering descents.

Lake or Riparian

Riparian areas compose only two percent of the watershed but contain a disproportionate amount of plant diversity and rare species. These special habitats are at risk from recreational use. This is discussed in the aquatic section.

Juniper woodland

This PAG is very rare in the watershed and composes less than 0.1% of the total acres. However this plant association is extremely common and widespread to the east. This particular sliver of juniper woodland has no known or suspected rare associates. Risks associated with this PAG are low.

Sensitive Plants

The first part of this portion of the analysis is a brief summary of current knowledge about the historic and current plant species of concern known or suspected to occur within the Metolius Watershed. The second part is an analysis of habitat and population conditions specific to each PAG.

Sensitive plant species are those listed in the Regional Foresters Sensitive Plant List. Watch List species are identified by the Oregon Heritage Data Base. Survey and Manage species are identified in the NW Forest Plan. Species of concern known to occur in the Metolius Watershed are listed in Table 26. Species suspected to occur are listed in Table 27.

Terrestrial/Plant Species of Concern

Peck's penstemon

Historic Condition

The historical distribution and abundance of Peck's penstemon is unknown. Several large habitat areas on private lands, which are housing developments or golf courses (Metolius Meadows, Black Butte Ranch), retain traces of the plants. It can be assumed these habitat areas supported larger populations of Peck's penstemon, which are now lost.

The plant was described from a 1931 collection, nine miles northwest of Sisters. Earliest survey records for the plant are from Pogson 1979, when populations were found to be coincident with the Lake Creek Timber sale. A study of the effects of harvest on the plants was set up in 1980, by Moldenke. The plots were relocated and read in 1993, by Ingersol. The plant has also been the subject of a Ph.D. Thesis (Field, 1985), a Draft Species Management Guide (Vrilakas and Kagan 1989), a Species Conservation Strategy (O'Neil, 1992) and an Undergraduate Thesis analyzing genetic variation by gel electrophoresis (King 1993).

Current Condition

Peck's penstemon is endemic to an area of approximately 325 square miles centered around Black Butte on the Sisters Ranger District. Most known populations are on National Forest Lands and 37 of the 83 known populations containing 142,961 of 222,353 plants or 64% of the global population is within the Metolius Watershed. Half of the "protected populations" identified by the Species Conservation Strategy as crucial to long term species survival are found in this watershed.

The plant displays a patchy distribution, with greatest concentrations found at lower ends of watersheds on level ground with relatively high water retention. Larsen Soil Type 8 is often an indicator for the plant.

Geomorphologic maps show most population areas are coincident with areas of young outwash, young till or floodplain. Field (1985) found the center of the range of PEPE overlies a disjunct quaternary alluvium, or an area of glacier deposit formed at the end of the Pleistocene. This geomorphologic type holds more water than the surrounding areas of andesite and basalt. PEPE is found primarily on sandy loams, loamy sands, and occasionally pumiceous loamy sands, which formed from tills deposited in valley bottoms. These soils are finer textured and retain higher moisture contents through the season.

The Species Conservation Strategy for PEPE identified 25 populations that should be managed for the benefit of PEPE to ensure long term viability of the species. Twelve of these are within the watershed.

The Species Conservation Strategy recommends is that no permanent habitat loss is allowed in these sites and that loss of individual plants due to active resource management not exceed 0.2% in populations greater than

2000 individuals and 0 in populations less than 2000 individuals. The Strategy found that populations are underrepresented in the Abbott Creek, Canyon Creek, and Jack/First Creek area and recommends high probability habitat in these watersheds be mapped and surveyed.

All other 25 populations within the watersheds are termed "managed." These are to be managed for the enhancement of PEPE habitat with existing or experimental forest management tools suspected to be of benefit to the species. Loss of more than 20% of a population that exceeds 500 individuals is not recommended. Losses of individuals less than 500 plants should not exceed 10%. Permanent loss of habitat is not recommended.

The PEPE Conservation Strategy identifies the five most important abiotic and biotic variables involved in the plant's viability:

1. abundant moisture,
2. light (required for flowering),
3. abundant pollinators,
4. periodic fire,
5. flooding (seed dispersal).

Management Treatment studies have shown that the plant benefits from low intensity prescribed fire.

Severe ground disturbance, including timber harvest activities which uproot plants, can destroy populations. Pogson (1979) observed populations in otherwise contiguous habitat ending at private land boundaries where the soil was severely disturbed. If the seed bank is depressed from canopy closure before harvest, or conditions are too dry for successful germination, the population is in particular danger of being lost.

In the Lake Creek Monitoring Study, the effects of timber harvest on Peck's penstemon were studied. Plots established in 1980, were read in 1993, (Because harvest was delayed in some units, over a decade, some sites were sampled only 3-4 years after harvest). Ingersoll (1993) found the abundance of PEPE declined significantly at all harvest sites between 1980 and 1992. No seedlings were found at any site and juveniles were rare, although flowering stems increased. The conclusions state:

> " Despite Field's characterization of PEPE as an early seral species well-suited to colonizing open sites, this study provides no evidence that timber harvest, by reducing overstory cover and creating open microsites, stimulates expansion of populations. Detrimental effects of soil disturbance or altered hydrology resulting from timber harvest may outweigh any benefits of reduced overstory cover on growth and recruitment of PEPE. Timber harvest dramatically influenced vegetation at all sites, more through its effects on soil than through overstory removal."

Several populations outside the watershed are being lost through proposed land exchanges or altered by adjacent mining. Permanent habitat loss is of concern because of the finite amount of habitat for this endemic species. All populations near the town of Sisters are included in proposed land exchanges in the recent past and will most likely be exchanged at some point in the future. These populations are on the southern and eastern edges of the plants range and may contain important ecotypic variation. The Metolius Watershed, the heart of the population, is mostly in federal ownership, and remains the most important watershed for the survival of the species. This watershed may become even more important in the future as development, land exchanges, and population growth affect populations on the urban interface.

Tall Agoseris

Historic Condition

The historical distribution and abundance of tall agoseris is unknown. Several historic sitings have not been relocated; however, positive identification is difficult because the sizes of achenes and beaks of mature seeds of related species are more variable and overlapping than available descriptions and technical keys indicate.

Since the plant is strongly associated with meadow habitats in forested settings, the exclusion of fire, which has reduced meadow areas and affected habitat conditions, may have reduced available habitat.

Current Condition

The plant is a Pacific Northwest endemic known from only six state records, including two unverified sitings near Meadow Lake and Allingham Meadow. The Mt. Hood National Forest has three populations totaling 187 plants. Two verified populations on Green Ridge are less than 50 plants. Suitable meadow habitats are rare in the watershed and affected by fire exclusion.

Larsen's Collomia (Watch List)

Historic Condition

The historical distribution and abundance of Larsen's collomia is unknown.

Current Condition

Larsen's collomia is considered rare throughout its range. It grows on talus slopes on the high peaks of the Cascades from Washington to California on extremely harsh sites, low in nutrients, subject to environmental extremes, on unstable substrate. Disturbance by hikers could disrupt the talus substrate and destroy plants.

Candy Stick (Allotropa virgata)

Historic Condition

The historical distribution and abundance of Candy Stick is unknown.

Current Condition

The plant has highly isolated populations and is rare throughout its range. One population has been documented in the watershed consisting of only three current years stems and 12 stems from last year in a isolated remnant of closed canopy old growth hemlock/ Douglas fir forest. Similar remnants of suitable habitat exist throughout the watershed; however, the plants episodic flowering habitats may make it difficult to detect. The exclusion of fire, fragmentation of older stands, and effects to the plant's obligate mychorrhizal fungi through soil compaction has affected suitable habitat. Continued suppression of fire and soil disturbance are detrimental to the species.

Mountain Lady Slipper (Cypripedium monatum)

Historic Condition

The historical distribution and abundance of Mountain Lady Slipper is unknown. Periodic fire appears to be very important. The population is noted to be in severe decline on the west side where fire frequencies are longer. The population is persisting on the east side in burned areas.

Current Condition

One known site of 26 stems is documented from 1991, when it was protected during slash treatments in a logged unit. The population was found in a dry mixed conifer forest 120 feet from a stream. Two other unverified sitings reported that the plant was located along the Metolius River trail and lower Metolius River Road 1499.

Fungi/ Rare False Truffle - Alpova alexsmithii

Historic Condition

Alpova alexsmithii is believed to have always been rare due to its natural history.

Current Condition

One known site exists within the watershed and is listed as a **type locality** in Appendix J2 of the NW Forest Plan that should be protected by mitigation. The known site is located around a heavily used wilderness lake. The lake and riparian area are heavily impacted by horses and camping. Upland forest areas where the truffles occur are less impacted.

Fungi/Rare Truffle- Elaphomyces anthracinus

Historic Condition

Elaphomyces anthracinus has been reported as widely distributed but rare since its discovery in Italy in 1832. Only 50 collections are known. The only known site within the range of the northern spotted owl is within this watershed. The harvest of mature ponderosa pine is believed to have reduced available habitat.

Current Condition

The known site is in a campground along the Metolius River, which in past years was impacted by unrestricted traffic flow and recreational vehicles. The site has since been closed to vehicles and is walk-in camping only. Additional habitat exists within the area.

Fungi/Rare Bolete- Gastroboletus ruber

Historic Condition

Gastroboletus ruber is another rare endemic, which is known from only 16 collections.

Current Condition

The known site within the watershed is associated with three wilderness lakes that receive heavy recreational use by hikers and horses. Appendix J2 of the NW Forest Plan recommends that this site be protected by mitigation.

Fungi/Chanterelle- Gomphus floccosus

Historic Condition

This chanterelle is classified as edible but not recommended due to toxic compounds, which may affect the liver. It was observed at a site within the watershed growing in association with edible/choice chanterelles (Cantharellus sp.) during the 1960's and 1970's.

Current Condition

Much of the habitat where this mycorrhizal chanterelle was observed was harvested in the 1980's and has since been affected by spruce budworm epidemics. It has not been recently found.

Fungi/Uncommon gilled mushroom- Hygrophorus caeruleus

Historic Condition

Hygrophorus caeruleus is believed to have always been rare due to its natural history and restricted range.

Current Condition

Much of its habitat of low elevation montane has been harvested and modified soil conditions may have affected this ectomycorrhizal species. The species was found within the watershed this year by an expert truffling group. The site is near areas which have experienced extensive timber harvest.

Pin Lichen- Calicium sp.

Historic Condition

Pin lichens are closely associated with late-successional and old growth forests and require sheltered microsites with complex canopy structure and leaning tree boles. Much of their habitat has been removed or altered.

Current Condition

One known site exists within the watershed in a steep unharvested drainage off Green Ridge. Similar habitat in the area is likely to support additional populations.

Riparian Plant Species of Concern

There are nine rare species known to occur in riparian areas of the watershed. Another five species have low to high probabilities of occurrence. Database queries found twenty-four species with some probability of occurrence. These species are found in association with hardwoods or coastal disjunct species such as Pacific yew, which in this east side watershed are restricted mostly to riparian areas, drainages, high water table areas, or floodplains. Therefore, in this watershed these species have a strong riparian association.

Known Occurrence

Water Lobelia

Historic Condition

The historical distribution and abundance of water lobelia is unknown. However, the earliest local record of the plant is from an herbarium collection from the 1930's, "growing in the Metolius River". This population could not be relocated and in 1990, the plant was listed as extirpated form Oregon. A large population of 100,000 plants was found in 1992, in a lake within the watershed.

Current Condition

The plant's range is listed as interruptedly circumboreal. Observations of the known population note the plant is associated with clean, gravelly like substrate and does not occur in areas covered with fine woody debri or sediment, or in areas of heavy foot traffic by swimmers. The lake it occurs in is very clean and cold. Other potential habitat areas, including lakes, streams, and wet meadows exist in the watershed and have not been surveyed.

Bryophyte/ Liverwort- Tritomaria exsectiformis

Historic Condition

This liverwort was first found near a headsprings in the watershed in 1977.

Current Condition

The area has experienced heavy recreational use and trampling of sensitive streamside habitats where the liverwort is found on saturated rotting wood. This site is one of two known in Oregon.

Riparian Lichen- Collema sp.

Historic Condition

The presence of hardwoods and high humidity within riparian areas is critical for this species. Harvest within and next to riparian areas has modified and dried microclimates. Fragmentation within riparian habitats has probably affected their capability to disperse to suitable adjacent habitats, since they are known to be dispersal limited.

Current Condition

One known site exists within the watershed in association with cottonwoods flooded by beaver activity in First Creek. The First Creek drainage has experienced extensive regeneration harvests, which has modified microclimates near the creek.

Nitrogen fixing Lichens- Nephroma helveticum

Nephroma resupinatum

Pseudocyphellaria anomala

Pseudocyphellaria anthrapsis

Historic Condition

These lichens are in the same group as Lobaria pulmonaria, with similiar affinities for pockets of old-growth with disjunct coastal species such as Pacific yew. See discussion #10 above on Lobaria pulmonaria.

Current Condition

Nephroma helveticum is known from one site near Cabot Creek.

Nephroma resupinatum is known from three sites near Jack, First and Cabot Creeks.

Pseudocyphellaria anomala is known from the same four sites as Lobaria pulmonaria.

Pseudocyphellaria anthrapsis is known from one site near Cabot Creek. See above discussion.

Rare Nitrogen fixing Lichen- Lobaria halli

Historic Condition

This lichen does not usually colonize stands until they are greater than 200 years old and need an open, multi-layered canopy to ameliorate microclimate. It is also closely associated with riparian areas and hardwoods. Fragmentation and modification of these habitats have probably affected their capability for dispersal capabilities to suitable adjacent habitats, since they are known to be dispersal limited.

Current Condition

Two known sites exist within the watershed near First Creek and an intermittent drainage of Green Ridge. Much of the suitable habitat near First Creek has been lost. Similar habitat in the Green Ridge drainage area is likely to support additional populations.

Nitrogen fixing Lichen- Lobaria pulmonaria

Historic Condition

This lichen is known only occasionally east of the Cascades in pockets of old-growth forests in populations of coastal disjunct species such as flowering dogwood and Pacific yew. Much of the suitable habitat has been harvested. However, because of this watersheds proximity to the west side and the many populations of yew and other typically west side species, other old-growth remnants in the Metolius Watershed are high probability habitat.

Current Condition

This species was found at four widely scattered plots in the watershed, in a variety of PAGs, all associated with perennial or intermittent streams. This indicates Lobaria pulmonaria has a high probability of occurrence in old growth remnants near drainages in this watershed.

Table 26: The following Species of Concern are found within the watershed.

Species	Common Name	Type	Status	Occurrence	Plant Assoc. Group
Penstemon peckii	Peck's Penstemon	Vascular Plant	Sensitive	**SISTERS ENDEMIC***	PP, MCW, MCD
Lobelia dortmanna	Water Lobelia	Vasular Plant	Sensitive	**ONLY KNOWN SITE IN OREGON***	Lake, river, stream
Agoseris elata	Tall Agoseris	Vascular Plant	Sensitive	PNW endemic	PP
Collomia debilis larsenii	Larsens Collomia	Vascular Plant	Watch List	Cascades WA to CA	Lava/Rock
Allotropa virgata	Candystick	Vascular Plant	S &M/ 1,2	North America	MCD, (MCW,LP?)
Cypripedium montanum	Mountain Lady Slipper	Vascular Plant	S & M/1,2	Range of PFP	MCD, PP
Alpova alexsmithii		Rare False Truffle/ Fungi	S &M/1,3	Cascade endemic	High elevation forest, TSME
Elaphomyces anthracinus		Rare Truffle/Fungi	S &M/1,3	**ONLY KNOWN SITE IN PFP RANGE***	PP
Gastroboletus ruber		Rare Bolete/Fungi	S & M/1,3	Cascadeendemic	High elevation forest
Gomphus floccosus		Chanterelle/Fungi	S &M/3	Regional	MCD
Hygrophorus caeruleus		Uncommon gilled Mushroom/ Fungi	S & M/1,3	PNW endemic	MCW, (MCD?)
Hydnothryna, Trappe#787,792 Martellia, Trappe #5903		Rare Undescribed False Truffles	S & M/1,3	rare local endemics	High elevation forest
Calicium sp		Pin Lichen	S & M/4	N. Europe, PNW	PP
Collema sp		Riparian Lichen	S & M/4	North & South America	MCW, (Riparian?)
Lobaria halli		Rare nitrogen fixing Lichen	S & M/ 1&3	North America	PP, MCW, (MCD?)
Lobaria pulmonaria		Nitrogen fixing Lichen	S & M/ 4	PNW	MCD, (MCW ?)
Nephroma helveticum		Nitrogen fixing Lichen	S & M/4	PNW?	MCD, (MCW?)
Nephroma resupinatum		Nitrogen fixing Lichen	S & M/4	PNW?	MCD,MCW
Pseudocyphellaria anomala		Rare nitrogen fixing lichen	S & M/ 4	PNW endemic?	MCD, MCW
Pseudocyphellaria anthrapsis		Nitrogen fixing Lichen	S & M/4	PNW?	MCD, (MCW?)
Tritomaria exsectiformis		Bryophyte/ Liverwort	S &M/1,2	**1 0f 2 KNOWN SITES IN OR**	Riparian

Table 27: Species of Concern that have the potential to occur within the watershed.

Species	Common name	Type	Status	Probability of Occurrence	Plant Assoc Group
Artemisia ludoviciana estesii	Estes' Artemisia	Vascular Plant	Sensitive	low / Central OR endemic	Riparian
Arnica viscosa	Shasta Arnica	Vascular Plant	Sensitive	moderate/ Regional endemic	Lava, High elevation forest
Aster gormanii	Gorman's Aster	Vascular Plant	Sensitive	moderate/ OR endemic	Lava
Botrychium pumicola	Pumice Grapefern	Vascular Plant	Sensitive	moderate/ Central OR endemic	Lava, High elevation forest
Calamagrostis breweri	Brewer's Reedgrass	Vascular Plant	Sensitive	moderate/ Regional endemic	Grassland
Calochortus longebarbatus longebarbatus	Long-bearded Mariposa	Vascular Plant	Sensitive	low / Regional endemic	PP
Campanula scabrella	Rough Harebell	Vascular Plant	Sensitive	moderate/ PNW endemic	Lava/Rock
Carex livida	Pale Sedge	Vascular Plant	Sensitive	moderate/ circumboreal	Riparian
Castilleja chlorotica	Green-tinged Paintbrush	Vascular Plant	Sensitive	low/ Central OR endemic	PP, LP
Cymopteris nivalis	Snowline Cymopteris	Vascular Plant	Sensitive	moderate/ North Great Basin	Lava/Rock
Draba aureola	Golden Alpine Draba	Vascular Plant	Sensitive	moderate/ Regional endemic	Lava/Rock
Gentiana newberryi	Newberry's Gentian	Vascular Plant	Sensitive	high/ Regional endemic	Grassland
Hieracium bolanderi	Bolander's Hawkweed	Vascular Plant	Sensitive	low/ Regional endemic	Lava, High elevation Forest
Lycopodium complanatum	Ground Cedar	Vascular Plant	Sensitive	low/ circumboreal	Riparian
Ophioglossum vulgatum	Adder's Tongue	Vascular Plant	Sensitive	low /circumboreal	Grassland, riparian
Gastroboletus subalpinus		Bolete/ Fungi	S &M/ 1,3	high/Known on Deschutes/ Regional endemic	LP, High elevation Forest
Nivatogastrium nubigenum		False truffle/ Fungi	S &M/ 1,3	high/Known on Sisters District/ OR & ID	LP, High elevation Forest
Rhizopogon flavofibrillosus		Rare false truffle/ Fungi	S &M/ 1,3	high/Known on Sisters District/ Regional endemic	LP, High elevation Forest
Rhizopogon truncatus		False truffle/ Fungi	S &M/3	high/Known on Deschutes/ N Am	High elevation Forest
Elaphomyces subviscidus		Rare truffle/Fungi	S &M/1,3	high/Known on Sisters District/ Cascades & AZ	LP,
Hydrothyria venosa		Aquatic lichen	S &M /1,3	high/Known on Deschutes/ N.Am	Riparian

NOTE: This table lists only S &M species known to occur on the Deschutes National Forest.

Species Of Concern By Landscape Area

Survey and Manage Sensitive Plants

Plant distribution in the watershed is linked by habitat continuity, and seed dispersal patterns caused by wind, water, and wildlife. Peck's penstemon appears to be closely linked with patterns of hydrology, since the plant is often found associated with intermittent channels, or high water table areas.

Landscape Area 1 - Wilderness; has had few surveys, but high probability habitat exists for both TES plant and Survey and Manage species. Two known Survey and Manage fungi sites surround wilderness lakes. Increasing recreational impacts to subalpine meadows and riparian areas are of greatest concern.

Landscape Area 2 - Central Basin; is the epicenter of the global population of Peck's penstemon. Four subwatersheds (Cache Creek, Lake Creek, Jack-First Creek, and Canyon Creek) converge in a 5 mile stretch along the upper Metolius River floodplain. Because of the opportunities for mixing of seeds from these four subwatersheds, this may be an especially important area for genetic exchange (O'Neil, 1992). The western part of this area has many small populations of Peck's penstemon, which appear to have been fragmented by past harvest.

The only known site (within the range of the spotted owl) of a rare truffle is found associated with an old growth pine stand along the Metolius River. Similar habitat is widespread in the area and undiscovered populations of the truffle are likely. Limited surveys have yielded a diversity of Survey and Manage species including three nitrogen fixing lichens, two vascular plants, an uncommon gilled mushroom, and a rare liverwort. There is a high probability these rare species could be more widespread here.

Landscape Area 3 - Highway 20 Corridor; follows an ecotone of moisture and elevation and passes through pine and mixed conifer forests to moderate elevation blueberry bogs, small wetlands, and intermittent streams, which contain potential habitat for rare plant species. Rapidly expanding noxious weed populations are found along the highway corridor where they can be spread by vehicles into adjacent areas.

Landscape Area 4 - Meadow Lake Basin; contains a mix of habitats supporting a diversity of plant species, including many lakes and meadows. Intact mixed conifer growth stands and a large uninventoried wetland are found in the proposed Cache Research Natural Area. Off-road vehicles and dispersed camping are damaging lakeside areas.

Landscape Area 5 - Black Butte; transitions from open pine forests to subalpine grassland slopes. No rare vascular plants are known from this area; however, high probability habitat for Survey and Manage fungi and lichens exists. Recreational impacts on the trails and summit of Black Butte are of concern.

Landscape Area 6 - Cache; contains large populations of Peck's penstemon closely associated with the intermittent channels of Cache and Dry Creeks. The populations have been fragmented by logging practices which used these channels as skid trails, and are affected by drought and mining of alluvial gravels.

Landscape Area 7 - Suttle Lake; has been extensively surveyed for rare vascular plant species. It contains the only known site in Oregon of water lobelia, in a lake at risk of sedimentation from private land logging and recreational impacts to riparian areas. Noxious weeds are common on roadsides and in old timber harvest units.

Landscape Area 8 - Upper Tributaries; limited surveys have yielded the most Survey and Manage lichen species within any landscape area. There is a high probability that rare lichens could be more widespread here in remaining old growth habitats.

This is the second most important landscape unit for Peck's penstemon because of several large populations in high water table areas. PEPE populations in the Abbott/Candle Creek area may also be isolated from rest and genetically unique.

Landscape Area 9 - Green Ridge; has had virtually no vascular plant surveys and contains potential habitat for Survey and Manage species in limited areas of remaining late-successional habitats. These old growth remnants are particularly important to protect as refugia, which may harbor old growth fungi and lichens.

Landscape Area 10 - Scarp; limited lichen surveys have identified four Survey and Manage nitrogen fixing lichens. Additional habitat for these species is likely to occur.

Landscape Area 11 - Lower River; is unsurveyed but has potential habitat for many rare species.

Terrestrial Non-Native Plants and Noxious Weeds

Historic Condition

Noxious weeds and other non-native plants have been introduced from other countries both intentionally and inadvertently during international trade of goods and livestock. Natural biological controls which existed in the weed's native country were not present in the United States and populations could expand unchecked. Once introduced to this country, weeds were spread by animals, vehicles and numerous other vectors.

Current Condition

The following noxious weed species are known to occur in the watershed (see riparian section for riparian specific non-natives).

- Diffuse Knapweed
- Spotted Knapweed
- Dalmation Toadflax
- Tansy Ragwort
- Scotch Broom
- St Johnswort
- Canada Thistle
- Bull Thistle

Seventeen of 31 known sites in the Sisters Ranger District are in this watershed (55%).

There are many other non-native plants which are not officially classified as "noxious" present and are increasing in the watershed. Some such as dandelions or mullein are considered relatively benign but others also affect the quality and quantity of habitat and wildlife forage.

Cheatgrass is widespread in areas which have had soil disturbance, particularly old timber sale units, landings and skidtrails. Cheatgrass is of particular concern because when dried and cured in the late summer and fall it is a highly flammable fine fuel which increases fire hazard. Other non-native grasses such as crested wheatgrass were widely applied to timber sale landings as wildlife forage and persist, displacing native grasses. Bulbous bluegrass (Poa bulbosa) is a non-native grass that appears to be rapidly increasing in disturbed areas of the watershed. It is reproductively aggressive and non-palatable.

How have these been affected by current vegetative conditions?

- Past activities, including past timber harvest activities have introduced noxious weeds or created conditions such as disturbed soils which enhance weed habitat.

- Six sites (35%) are associated with roadsides (Rd 14, 1419, 1216, 1220, Hwy. 20).
- Five sites (29%) are associated with old timber sale units (All Tansy Ragwort). Six sites (35%) are associated with recreation sites particularly horse camps and other trails.
- Disturbed sites, trails, and roadsides are vulnerable to infestations. Movement is linked to transportation systems. Introduction by vehicle tires, equipment tread, contaminated hay, road equipment, muddy shoes with imbedded seed, animal hooves, and fur.
- Many weed species (Dalmation toadflax, diffuse knapweed, spotted knapweed) are intolerant of shade. Diffuse knapweed and spotted knapweed are also intolerant of flooding or excess moisture. Drought may enhance their habitat conditions.

What effects do these have on native species?

These plants are highly competitive with native plants and can reduce biological diversity in native plant communities. The most aggressive and rapidly increasing noxious weeds in the watershed are the knapweeds.

Native plant species and their associated mycorrhizal and invertebrate counterparts are being displaced, resulting in a direct loss of biological diversity, as well as indirect effects to wildlife species. Many noxious weeds are non-palatable, poisonous or less nutritious than native species.

What non-native insects occur in the watershed?

Insects, which are natural predators of noxious weed species, have been imported as biological control agents. Biocontrol agents for Tansy Ragwort (Cinnabar moth) and Knapweeds (Urophora fly) are present due to past introductions or natural spread.

What effects do these have on native species?

Cinnabar moth is fairly nonspecific and could attack native Senecios. Of particular concern is th potential for spread onto the riparian forb Arrowleaf groundsel (Senecio triangularis). However, the Cinnabar moth reproduces poorly in this climate and is unlikely to cause a serious impact.

Trends

Noxious weeds and other non-native plants are increasing in the watershed. The increasing use of mechanized harvest equipment and subsoiling equipment to mitigate harvest soil compaction have the potential to infect new areas and lower the quality and quantity of native and rare plant habitat and disrupt relationships within the ecosystem. Prevention is considered the most effective and in the long term, least expensive control tactic. Effective prevention strategies will require understanding and cooperation from the public and managing agencies.

Riparian Non-Native Plants and Noxious Weeds

Because of their moist microclimate, riparian areas in this east side watershed harbor weed species which are more typically found on the west side. Scattered scotch broom are found along the Metolius River and near other streams, but are rare outside these moist areas. Reed Canarygrass has not been documented to occur in this watershed but is found in other riparian areas of the forest and most riparian areas in this watershed remain unsurveyed. These non-native plants are particularly aggressive and displace native plants and their mycorrhizal and invertebrate counterparts, as well as more palatable or nutritious wildlife forage species.

In the Camp Sherman area non-native ornamentals have escaped from summer homes along the Metolius River and spread downstream into riparian areas and vegetated islands. Ribbon grass is found widely and replaces bigleaf sedge and small-fruit bulrush associations on active channel shelves. Yellow iris are also

found in scattered locations and have the potential to displace the diversity of native streamside wildflowers. These non-native plants may play similar roles as their native counterparts in streamside stabilization but may not support the same plant-insect interactions. In a natural sequence bulrush/sedge associations are replaced by other sedges and nitrogen fixing alders. How non-natives affect these riparian successional patterns is unknown.

Wildlife

Terrestrial Threatened and Endangered Species

The following is a summary of the status and habitat conditions of wildlife species that are known or suspected to occur in the watershed. These species represent a variety of other species with similar habitat needs.

Peregrine Falcon

The peregrine falcon is a federally listed endangered species. There are several unconfirmed peregrine sightings in the Green Ridge area outside the watershed. There are no current or historic nest sites in the watershed. Castle Rock is the one known potential nest site in the watershed. The Green Ridge Scarp is considered an important migration area for raptors including the peregrine falcon.

The Castle Rock site is surveyed periodically by helicopter for peregrine falcon activities. Fall raptor migration surveys from Green Ridge lookout are conducted annually and will document any peregrine falcons migrating through the watershed.

The watershed does provide good foraging habitat for peregrine falcons. The diverse landscape and habitats associated with the Metolius River provide habitat for a variety of prey species.

There is high potential habitat north of the watershed on the Reservation fo the Confederated Tribes of Warm Springs (CTWS). The whitewater cliffs are considered ideal habitat for nesting peregrine falcons; however, these sites are not currently active.

TREND: Neutral. There is limited habitat in the watershed, so there is little contribution to overall species viability. If Castle Rock does become occupied, then this site will contribute to the recovery of the species.

Bald Eagle

While the bald eagle has been removed from the Threatened and Endangered Species List through parts of its range, it is still a federally threatened species within the High Cascades Recovery Zone that includes the Metolius Watershed.

Three known bald eagle nest sites occur within the watershed: The Lower Metolius and Suttle Lake sites have been monitored since 1971; the Wizard site in the upper Metolius River was located in 1995. There is a fall/winter roost site on the lower Metolius River near Monty Campground. In addition to these eagle sites, there are nests just outside the watershed at Box Canyon (Warm Springs Reservation) and associated with Lake Billy Chinook.

Wildlife surveys at Lake Billy Chinook are conducted by Portland General Electric. Winter surveys (November-April) indicate the bald eagle use of Lake Billy Chinook have increased. During the 1990-91 surveys, the peak eagle count was 126 bald eagles; in 1991-92 peak eagle count was 35 eagles; during the 1992-93 surveys peak eagle count was 41 eagles; peak count in 1993-94 was 137 eagles; and the peak count in 1994-95 was over 215 eagles.

The Metolius River and Lake Billy Chinook provide ideal habitat for bald eagles. These two water bodies provide season-long forage and the adjacent riparian and uplands provide suitable nesting, perching and roosting habitat.

Historically, bald eagles foraged on the anadromous fish that moved up the Metolius River from the Deschutes River. The numbers of bald eagles utilizing this forage resource is not known; however, it is likely that during fish spawning, bald eagle use was common, especially in the upper river where calmer waters prevailed.

In 1963, the Round Butte Dam was completed and Lake Billy Chinook was formed. The impact of the dam on bald eagle populations is not clear. The lake probably improved the forage base for eagles by providing habitat for waterfowl, increasing fish availability, and providing a season-long forage resource. By the middle 1970's, kokanee salmon runs (currently an important seasonal foraging resource) were established in Lake Billy Chinock and the Metolius River. They are an important food source for resident and migrating eagles from September to October.

The bald eagle nest site at Suttle Lake has been productive since the early 1970's. Eagles have been observed at Suttle Lake, Dark Lake, Scout Lake, in the Meadow Lakes basin, and at Square and Long Lakes in the Wilderness. It is likely that these eagle observations represent home range use of the Suttle bald eagles.

The existing recreation use at Suttle Lake and in the associated forests do not appear to be disturbing these eagles. However, the threshold at which the recreational use of Suttle Lake begins to disturb the eagles and affect the productivity of the nest site is not known. Increased recreational use of the Suttle Lake area could potentially disturb eagle activities and reduce the productivity of the nest site.

TREND: Stable in the watershed, but recovery goals still not met in the Recovery Zone. All known nest sites are essential to recovery goals.

Northern Spotted Owl

The northern spotted owl is a federally threatened species. The entire watershed is within the range of the northern spotted owl. There are two US Fish and Wildlife Service Critical Habitat units within the watershed.

There are 17 known spotted owl nest sites associated with the watershed. These sites have not been monitored on an annual basis, so productivity is not well established. Table 28 displays the number of spotted owl pairs located in each subwatershed of the Metolius Watershed, in relation to the estimated acres of nesting, roosting and foraging habitat (NRF):

Metolius Watershed Northern Spotted Owl

Management Status

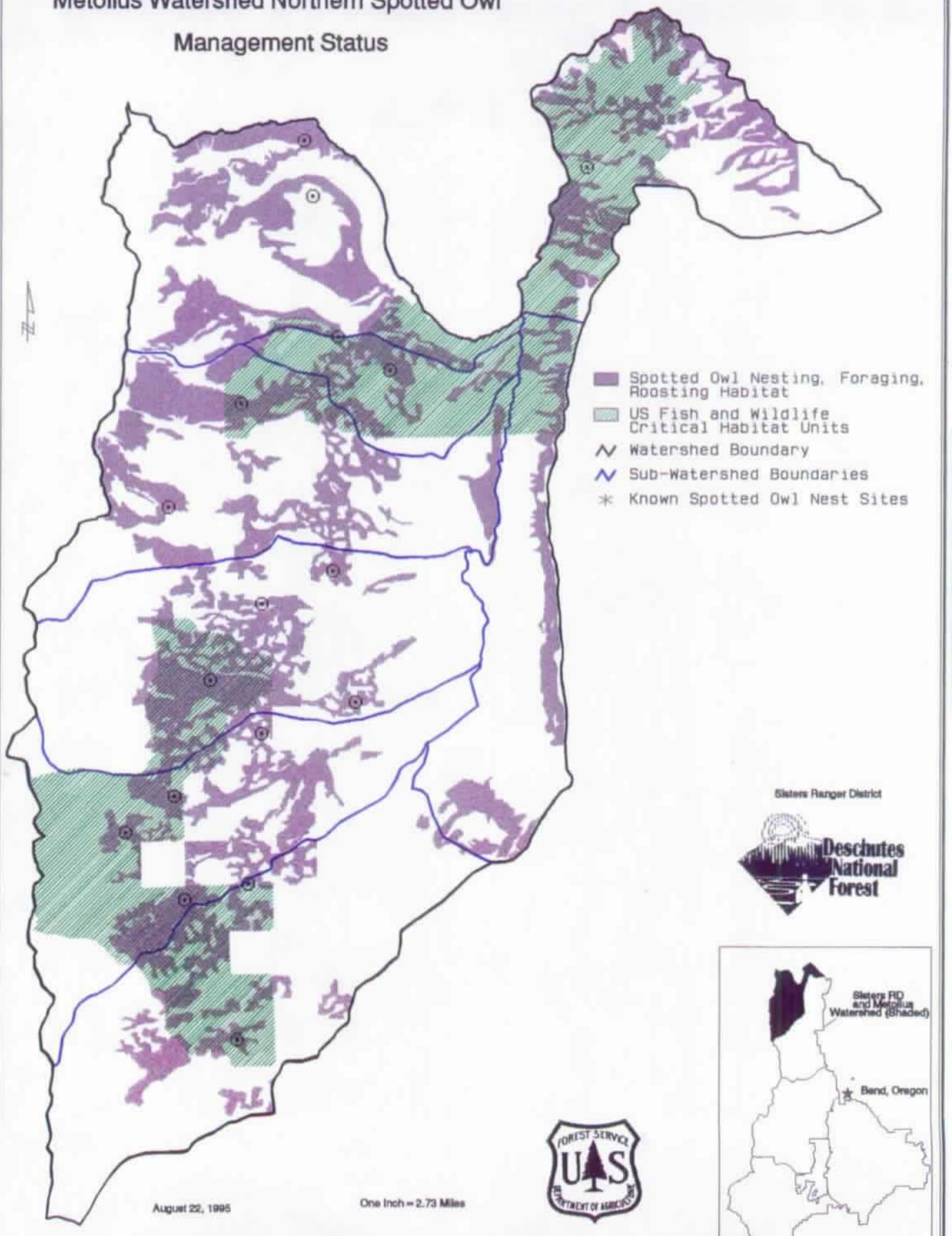


Table 28: Known number (1992) of Spotted Owl Pairs and Acres of Nesting, Roosting and Foraging Habitat Associated with Subwatersheds of the Metolius Watershed.

Subwatershed	No. of Known Owl Pairs	Acres NRF
Candle	2	6,900
Abbot	2	1700
Canyon	2	7800
Jack	4	6200
Suttle	4	5200
Cache	2	4100
Scarp	0	3,000
Horn	1	5,200

The 17 pairs of spotted owls are estimated to need a minimum of 20,000 acres of suitable spotted owl habitat (1,180 acres of suitable habitat/pair within a 3,000 acre home range). There are an estimated 34,700 acres of suitable habitat or NFR habitat in the watershed (Map 13). Considering the amount and configuration of suitable habitat in the watershed, it is likely that spotted owls are probably nesting, roosting and foraging in habitat that may not meet many standard suitable spotted owl definitions (multi-storied stands of old growth with high canopy closure (>80%).

Mike Gerdes, Forest Wildlife Biologist conducted vegetative sampling at various nest sites across the Deschutes National Forest, including three sites within the watershed. The nest sites occur in a variety of structural conditions. The canopy cover at these three nest sites ranged from 33% to 92% canopy cover. The following minimum habitat conditions were present at these known spotted owl nest sites: mixed conifer, multi-storied stands with at least 60% canopy cover, and 40 contiguous acres; at least 8 trees per acre greater than or equal to 2 inch dbh; at least 82 trees per acre in the understory less than or equal to 2 inch dbh.

The insect and disease outbreaks in spotted owl habitat are a concern related to habitat availability. The impacts (effects on movement, vulnerability to predation, foraging success, fledgling and juvenile mortality, home range size, etc.) of the insect and disease tree mortality on spotted owl populations has not been studied.

Several changes to suitable spotted owl habitat have occurred:

Increased densities of snags and down woody material. Possible Affect: Higher levels of spotted owl prey, and possibly successful spotted owl reproduction where limited habitat may occur.

There are 4,500 acres of identified suitable habitat (based on 1992 aerial photo interpretation and field checking) that have been heavily damaged by spruce budworm defoliation. There are 5,300 acres of suitable habitat that received a high level of mortality (>75% tree mortality). While many of the heavily damaged areas have recovered, and there is little change to live tree canopy, the areas with high tree mortality have reduced live tree canopy closure and multi-storied structure of suitable spotted owl habitat. Possible Affect: Not clear, but possible effect is a loss of suitable spotted owl habitat, reproducing spotted owl pairs and eventually reduced species viability.

In 1995, a spotted owl administrative study was developed by Mike Gerdes. Four pairs of spotted owl were located, and the radio telemeters were attached to the four males. In addition, the four females and two juveniles were banded. The spotted owl nest sites involved are: Canyon Creek, Spring Creek, Upper Canyon

Creek and Bear Valley. The objective of the study is to determine relationships between northern spotted owl habitat selection and use, and silvicultural treatments targeted to address maintenance and enhancement of late-successional habitat characteristics and forest health concerns.

The role frequent low-moderate intensity fires (within the dry mixed conifer and ponderosa pine PAGs) played in the structure and configuration of suitable spotted owl habitat in east-side cascade ecosystems is not clear. If suitable habitat was less available historically because of frequent fires, then a common conclusion is that spotted owl densities were probably lower than they are today. However, the Metolius Watershed has probably always provided suitable spotted owl habitat, especially in wet mixed conifer PAGs and north facing slopes in dry mixed conifer PAGs. Spotted owls may have been using habitat with slightly less structure than today's standards; and spotted owl densities may have always been relatively high.

There are two US Fish and Wildlife Service (USFWS) Critical Habitat Units (O-44 and 0-45) in the watershed designated for recovery of the spotted owl. CHU 0-44 is approximately 22,000 acres in size and 0-45 is approximately 9,800 acre in size. All activities proposed within these areas must consider impacts to northern spotted owl and require consultation with the USFWS.

Spotted owl activities on the Confederated Tribes of Warm Springs Reservation (CTWS) are monitored. While juvenile dispersal has not been documented between the CTWS and the Metolius Watershed, it is highly probable, as is adult movement. One spotted owl pair has nested on both the Metolius Watershed and CTWS near Jefferson Creek.

TREND: Unknown, but species persistence within the watershed may be at risk due to habitat fragmentation and reductions in the amount and quality of suitable spotted owl habitat due to insects and disease. The potential for catastrophic wildfire increases the risk of habitat loss and downward population trend.

California Wolverine

The wolverine is a federal candidate species (Category 2). There have been no formal surveys and there are no recent sightings of wolverine. The two documented wolverine sightings in the watershed are prior to 1980; one on Highway 20 north of Suttle Lake and another in the Santiam Pass area. It is doubtful that the watershed supports any resident wolverines. This assumption is based on: 1) No recent sightings even though there is high human use in this area, 2) there is limited unfragmented, primitive, isolated habitat or alpine areas, and 3) there are 23 records of wolverine in Oregon from 1981 to 1992, compared to 57 records from 1913 to 1980.

Prior to timber harvest activities, the wolverine may have been found throughout the watershed, though probably always rare and uncommon. Currently, the high elevation mixed conifer and mountain hemlock PAGs have the highest potential for wolverine occurrence because of the large unfragmented nature of this area. Wolverine use of the areas may include individuals migrating or dispersing through the cascades from northern Washington to northern California, but resident wolverines are unlikely.

If wolverines are using the wilderness, then increased human use could potentially displace wolverines in high use areas.

TREND: Unknown, but probably downward from historic levels. The watershed probably never supported high population numbers. Any wolverines using the watershed are important contributions to species viability. The recent timber harvest activities have reduced the amount of suitable wolverine habitat.

Northern Goshawk

The goshawk is listed as a State Sensitive Species due to conversion of mature and late-successional habitats to younger, even-aged stands. This species is also listed as a federal category 2 species (C2) and is proposed for listing on the Region 6 Regional Foresters Sensitive Species list.

Goshawk population densities are not known. Though there have been no formal surveys for goshawk except in the Jack Canyon area, nine known goshawk territories have been identified. It is likely formal goshawk surveys in suitable habitat would reveal additional sites.

Mature and late-successional habitats in the ponderosa pine, and mixed conifer PAGs are considered potential nesting habitat for this species. All other seral stages are considered potential foraging areas. A preference was shown for moist areas on north slopes, often near water. Single nest territories may have two-four nest stands. The nest areas are usually the stands with the highest density of large trees, high tree canopy cover and high basal areas. The post-fledgling area (450 acres) and foraging areas (5,400 acres) are a mosaic of vegetation structural stages.

The amount of suitable goshawk habitat in the watershed was probably higher historically than it is today. The large patches of mature and old-growth ponderosa pine habitats that covered 60% of the watershed were ideal habitat for goshawks. In recent decades, timber harvest practices have reduced the amount of suitable habitat, and probably the number of goshawks nesting in the watershed.

TREND: Unknown, but probably downward due to recent activities. Habitat fragmentation from timber harvest, and the potential for catastrophic wildfire increases the risk of habitat loss.

Fisher

The fisher is a federal candidate species Category 2 (C2). Similar to the wolverine, large unfragmented mixed conifer and mountain hemlock forests provided suitable habitat. There have been several recent (October 1994) fisher sightings in the Green Lakes area of the Three Sisters Wilderness areas immediately adjacent to the watershed. Population levels have probably always been relatively low and widely distributed. Fishers currently using the watershed are likely to be found in the high elevation mountain hemlock PAG.

Timber harvest practices have probably eliminated fisher from many parts of the watershed where historically they may have been found. Fragmented forest conditions in mixed conifer PAGs severely limit or eliminate potential fisher use.

Trapping has had a major impact on fisher populations. Fisher population levels were probably higher prior to the 1900's, when other human activities were less apparent. Fisher trapping in Oregon was closed in 1937.

TREND: Unknown, but probably downward from historic levels. The watershed probably never supported high population numbers. The recent timber harvest activities have reduced the amount of suitable fisher habitat, and probably the numbers of fishers.

Townsend's Big-eared Bat

The big-eared bat is a federal candidate species Category 2 (C2). It occurs in numerous PAGs, using caves, building, mines and bridge undersides for nursery and hibernation purposes.

There have been no formal surveys for the big-eared bat. Without habitat surveys the amount of potential habitat remains a mystery. Little is known about the historic occurrence of this species. There is one known day roost site, and there is potential habitat for nursery sites and hibernaculm. Many of these potential sites are unidentified at this time, but are known to occur in the watershed. The nearest known hibernaculum is three miles to the south at Skylight cave.

Bats cannot tolerate people at hibernaculum and nursery sites. Population declines are occurring where sites have been disturbed, but where caves have been protected populations remain stable or increased. Recreational use and vandalism at caves are a problem.

TREND: Unknown, because of limited information on potential nursery and hibernaculum sites.

Terrestrial Wildlife Species of Concern

Black-backed Woodpecker

The black-backed woodpecker is considered a sensitive species in the critical category by the Oregon Department of Fish and Wildlife due to loss of snags and the conversion of mature lodgepole pine stands to younger stands.

Black-backed sightings have been documented in the lodgepole pine and mixed conifer habitats of the watershed. A black-backed study conducted in the Deschutes National Forest showed habitat selection of mature and overmature lodgepole pine stands, against younger stands and logged areas. Ponderosa pine, lodgepole pine and western larch were used in northeastern Oregon. The mature lodgepole pine or mixed conifer with lodgepole pine habitats found in the mixed conifer PAG (higher elevations) and the high elevation mountain hemlock PAG are ideal habitat for this woodpecker species. However, this species may be found throughout all mixed conifer and ponderosa pine PAGs as well. The snag management objective to provide 100% population potential for this species is 0.12 conifer snags per acre in forest habitat. These snags must be at least 17 inches dbh or greater and a hard decay class.

The preferred lodgepole pine habitats used by this woodpecker were probably never abundant in the watershed. As a result black-backed population densities were probably relatively low and limited in distribution.

TREND: Unknown, but may be stable or increasing as a result of tree mortality in mixed conifer PAG.

White-headed Woodpecker

The white-headed woodpecker is considered a sensitive species in the critical category by the Oregon Department of Fish and Wildlife due to loss of snags and the conversion of mature ponderosa pine stands to younger stands. This species is also identified in the NW Forest Plan (Appendix J2) as needing special mitigation provisions.

The white-headed woodpecker has been observed within the mixed conifer and ponderosa pine PAGs. The remaining areas with high densities of large diameter ponderosa pine are currently occupied by woodpeckers. The presence of large diameter ponderosa pine may be essential as foraging areas for this species. For this species a snag level of 0.6 conifer snags per acre are required to maintain 100% population levels in forested habitats. These snags must be at least 15 inches dbh or greater and in soft decay stages.

The actual population densities are not known. This species was probably more abundant historically than it is today. The selection harvest and clearcutting of mature ponderosa pine within the ponderosa pine and mixed conifer PAGs have reduced the amount of suitable habitat for this species. The role that low-moderate intensity fires played in maintaining snag densities within the ponderosa pine and mixed conifer PAGs is unclear. When compared to current conditions, it is likely that snag levels were much higher under natural fire regimes, than under suppressed fire conditions with intensive timber harvest.

TREND: Unknown, but is probably downward from historic levels due to forest fragmentation and loss of medium and large tree ponderosa pine habitats.

Pileated Woodpecker

The pileated woodpecker is considered a sensitive species in the critical category by the Oregon Department of Fish and Wildlife due to loss of snags and the fragmentation of late-successional mixed conifer habitats.

There has been numerous sighting of pileated woodpeckers in the mixed conifer PAGs. This species has probably benefited from the recent tree mortality associated with the spruce budworm epidemic. There are large tracts of mixed conifer forest that supports high levels of snags and down logs. This species forages mainly by excavating into wood and scaling or chipping bark. A preference for large diameter logs and trees

is related to insect abundance. Nest tree dbh was found to range from 16 inch to 30 inch or greater. For this species a snag level of 0.6 per acre is required to maintain 100% population levels in forested habitats. These snags must be at least 25 inches dbh or greater and in hard decay class.

Pileated woodpeckers have probably always been rare in the watershed, and population densities may have been highest in wet mixed conifer PAG and the upper elevations of the dry mixed conifer PAG. Timber harvest activities have probably reduced population levels in recent decades due to loss of late-successional habitats. The mixed conifer PAG is heavily fragmented, therefore, the remaining mature and late-successional habitats in this association are critical for pileated nesting and foraging.

TREND: Unknown. Individuals may be benefiting from insect and disease tree mortality, but individuals may be at risk due to habitat fragmentation and reductions in the amount and quality of late-successional mixed conifer habitat due to insects and disease outbreaks. The potential for catastrophic wildfire increases the risk of habitat loss.

Williamson's Sapsucker

The Williamson's sapsucker is considered a sensitive species in the critical category by the Oregon Department of Fish and Wildlife due to loss of snags and the fragmentation of late-successional mixed conifer and ponderosa pine habitats.

The Williamson's sapsucker habitat is found mainly in the mature and late-successional mixed conifer and ponderosa pine PAGs at 3,500 to 6,500 foot elevation. They can also be found in lodgepole pine-fir areas. This sapsucker is a poor excavator and requires live or recently dead trees with advanced wood decay, such as occurs in mature and late-successional stands of fir (Abies spp.). The retention of large diameter trees with heart rot is important to maintain this sapsucker species. For this species a snag level of 0.33 per acre is required to maintain 100% population levels in forested habitats. These must be at least 17 inches dbh or greater and in hard decay class.

This sapsucker has probably always been rare in the watershed, and population densities may have been highest in mixed conifer PAGs. Timber harvest activities have probably reduced population levels in recent decades due to loss of late-successional habitats. The mixed conifer PAG is heavily fragmented, therefore, the remaining mature and late-successional habitats in this association are critical for nesting and foraging.

TREND: Unknown. Individuals may be benefiting from insect and disease tree mortality, but individuals may be at risk due to habitat fragmentation and reductions in the amount and quality of late-successional mixed conifer habitat due to insects and disease. The potential for catastrophic wildfire increases the risk of habitat loss.

Marten

The marten is considered a sensitive species in the critical category by the Oregon Department of Fish and Wildlife due to loss and fragmentation of late-successional mixed conifer habitats.

There have been no formal surveys for pine martens in the watershed, but they have been observed in various locations within the wilderness. It is likely that this species can be found throughout the watershed (especially in the wilderness) in mature and late-successional mixed conifer, lodgepole pine and high elevation mountain hemlock PAGs at elevations ranging from 5,000' to timberline. Martens prefer extensive stands of relatively dense forests containing abundant down woody material as habitat for prey. Moist forests and areas near streams are important to marten, due to an abundance of important prey species on these sites. Prey species include: squirrels, chipmunks, woodrats, rabbits, voles, birds and insects.

The insect and disease condition in this watershed have resulted in down log levels that create prime denning and foraging habitat. In addition to down logs, martens use snags for denning and nursery sites.

The highest densities of marten are probably found in the upper 1/3 of the watershed, including the wilderness areas.

TREND: Unknown. Population densities were probably higher in the past than today, because of less fragmentation. The fragmentation of mixed conifer PAGs have probably influenced the distribution and densities of martens in these areas.

Osprey

There are numerous osprey observations along the Metolius River, several sightings in the First Creek drainage, and two known osprey nest sites associated with the smaller lakes west of Suttle Lake. Portland General Electric conducts a comprehensive osprey survey each summer along the Metolius River. The surveys have revealed a osprey nest site count of 38, and a peak of 14 active nests.

This species feeds entirely on fish and is moderately associated with mature and late-successional habitats. However, other successional stages that provide large diameter snags and green trees near water will also provide habitat for this species.

Ospreys are a seasonal resident of the watershed. They arrive in the spring, breed, raise young, and then migrate to the south in the winter.

Osprey have always been present along the Metolius River. Round Butte Dam and Lake Billy Chinook have resulted in an increase in osprey population numbers, primarily because of increased foraging area and fish availability.

TREND: Upward and stable. Population levels have increased as a result of Round Butte Dam and Lake Billy Chinook.

Big Game

The watershed is primarily summer range for deer (black-tails, mule deer and possibly hybrids) and Roosevelt elk. Mule deer are fairly common, but elk are found in relatively small herds in isolated areas. Roosevelt elk populations have increased in recent years, while mule deer numbers are stable. The Oregon Department of Fish and Wildlife increased the elk management objective for the Metolius unit from 100 to 200 animals. The management objective for mule deer remains at 6,000.

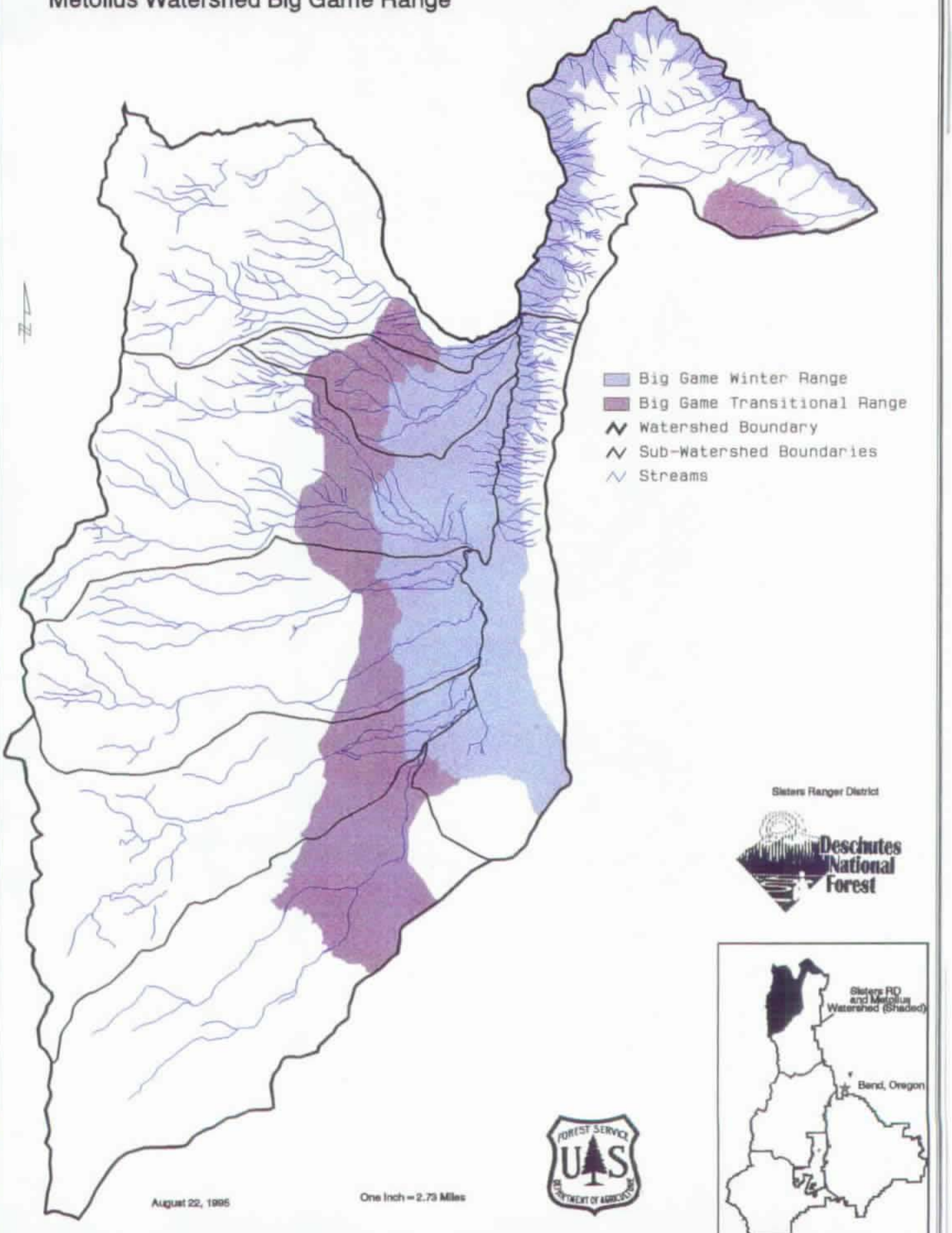
The lower elevations are considered transitional and winter range for both species (Map 14). Deer and elk migrate elevationally from summer to winter ranges. Deer and elk migrate from the Cache and Suttle subwatershed into the Metolius basin. Migration generally moves northeast towards the Metolius Winter Range through the lower Metolius canyon and the saddle between Green Ridge and Black Butte. The Metolius River basin, the lower elevations of Green Ridge and the Crooked River National Grassland are all part of the Metolius Winter Range.

In years when snow fall is light, many deer and elk will stay in the lower elevations. In heavy snow years, most deer and elk move out of the Metolius basin to the Crooked River National Grassland and private lands, and north to the Warm Springs Reservation. Mule deer and elk movements between the Metolius basin and Warm Springs Reservation occur throughout the year.

Based on elk telemetry information from winters of 1989-90, and interviews with wildlife biologists from Oregon Department of Fish and Wildlife and Confederated Tribes of Warm Springs, the Key Elk Area identified in the 1990 LRMP should be expanded to encompass an area from Wizard Fall Fish Hatchery to Lake Billy Chinook, and the lowland pine country from Lake Creek to Cold Springs to Jefferson Creek, to better reflect the area of actual use.

TREND: Roosevelt elk populations have increased. Mule deer levels have increased from historic levels and remain stable. The increase in early seral habitats and edge have contributed to these population increases.

Metolius Watershed Big Game Range



Neotropical Birds

Decline of Neotropical migratory bird (NMB) populations are of growing concern throughout the world. Certain species have been decreasing in abundance throughout their range for prolonged periods. Examples of declining populations include Olive-sided Flycatcher, Ruby-crowned kinglet, and Macgillivary's warbler.

There is a Breeding Bird Survey Route that starts at Jack Lake, proceeds to Roaring Creek, to Cold Springs, to Lower Bridge and then terminates at the Horn of the Metolius. This route has been surveyed since 1966. A total of 87 species of birds, and 44 NTB have been observed since 1966. Some of the NTB present include: willow flycatcher, dusky flycatcher, olive-sided flycatcher, Hermit thrush, Western wood pee-wee, orange-crowned warbler, Western tanager, Cassins finch, sharp-shinned hawk, cooper's hawk, Vaux's swift, Western bluebird, mountain bluebird, cedar waxwing, solitary vireo, Nashville warbler, and brown-headed cowbird.

The changes in NMB populations within the watershed are unknown. Species requiring early and middle seral conditions have probably increased in number, while species needing mature and late-seral conditions have probably decreased.

Snag densities, interior habitats, habitat connectivity, exotic birds and old-growth habitats are all areas of concern when considering NMB.

TREND: Unknown, but is probably upward for early and middle seral species, and downward for many late-successional species.

Terrestrial Species Associated with Snags & Down Logs

Snags and Down Logs

In general, snag densities are highest in the mixed conifer and lodgepole pine PAGs and lowest in the ponderosa pine PAGs. Snag densities vary on a stand by stand basis, but are usually low in old even-aged harvest units and burned areas. In the ponderosa pine habitats, there are an average of approximately 1.2 per acre (range 0 to 2 per acre); and in the mixed conifer they average 11 per acre (range 0-35 per acre). The number of snags in mixed conifer habitats have increased in the past two years because of insect and disease. The lodgepole pine and mountain hemlock PAGs are estimated to have snag densities >5 per acres.

In ponderosa pine PAGs, the snags are distributed in small patches across the landscape. Snags are primarily 20"+ dbh and hard. The intermediate (12-20" dbh) snags sizes are limiting in these habitats. In mixed conifer and mountain hemlock PAGs, snags are more evenly distributed because of the insect and disease. Snags are primarily 10-20 inch dbh class, and Douglas fir snags in the >20 inch dbh class can be found throughout the mixed conifer. In mixed conifer many of the snags are soft white fir. The lodgepole pine snags are generally 8-12 inch dbh and are hard.

Down log densities are similar to snag densities. They are highest in the mixed conifer, mountain hemlock and lodgepole pine PAGs (14 to 37 per acre, except in clearcuts), and lowest in the ponderosa pine PAG (0 to 15 per acre). Tree mortality from insects and disease is a significant contributor of down logs. The logging debris from past timber activities contributes large amounts of woody debris to most managed stands.

In ponderosa pine, dry and wet mixed conifer PAGs, snag and down log levels were probably lower in the past than today because of natural fire frequencies. In the lodgepole pine and high elevation mountain hemlock PAGs, snag and down log densities may be similar to historic conditions.

TREND: Increases in snag and down log densities in mixed conifer PAGs, therefore, upward population trends for dependent species are possible, but not confirmed. Snag and down log densities vary on a stand by stand basis, and are low in ponderosa pine PAG. In the ponderosa pine PAG downward population trends are possible.

Species of Concern by Landscape Area

The wildlife use of the Metolius Watershed is linked to adjacent watersheds; is linked between sub-watersheds within the Metolius Watershed; and is linked within Landscape Areas (LA). Larger terrestrial wildlife species (e.g., mule deer, Roosevelt elk, spotted owl, bald eagle, wolverine, etc.) move freely between LAs, and in many cases this movement occurs on a daily basis. On the other hand, smaller terrestrial species (i.e., ground squirrels, some neotropical birds and reptiles, etc.), may live their entire lives within a vary small home range.

Landscape Area 1 - Wilderness

Species of Concern	Reason
Wolverine	Limited knowledge, increased human use
Fisher	Limit knowledge, increased human use
American marten	Limited knowledge, increased human use
Cascade frog	Limited knowledge, increased human use
Tailed frog	Limited knowledge, increased human use

Landscape Area 1 is primarily high elevation mountain hemlock habitat, with a small amount of wet mixed conifer. The habitat is generally unfragmented and late-seral forest except for natural meadows, talus slopes, lava flows, and some areas of high tree mortality associated with the spruce budworm epidemic. This unfragmented condition is rare for the watershed, and provides important linkage between adjacent areas (LA 8 and 4) and adjacent watersheds. All of the mixed conifer PAGs within this LA are associated with known spotted owl pairs. This LA is most likely to support wolverine and/or fishers.

There is limited information about wolverine, fisher, marten, cascade frog and tailed frog use of the area. There may be some localized displacement of wildlife species because of concentrated human use near wetlands and streams, and along designated trails and trail heads.

Landscape Area 2 - Central Basin

Species of Concern	Reason
Northern spotted owl	Habitat fragmentation
Pileated woodpecker	Habitat fragmentation
White-headed woodpecker	Loss of snags and medium/large ponderosa pine
Williamson's sapsucker	Snag and habitat loss
Northern goshawk	Habitat fragmentation
Cascade frog	Limited knowledge, increased human use
Tailed frog	Limited knowledge, increased human use
Spotted frog	Limited knowledge, increased human use
Northern bald eagle	Known & potential nest sites, increased human use
Townsend's big-eared bat	Limited knowledge, increased human use
Big game	Winter range

Landscape Area 2 is primarily ponderosa pine PAG, but contains a significant amount of dry and wet mixed PAG in LA 8. Past timber harvest activities have significantly fragmented habitats in this LA. The remaining ponderosa pine and mixed conifer late-successional habitats in the LA are small is size and poorly connected. In addition, many of these late-successional habitats, because of high tree densities, are at risk from catastrophic fire and insects and diseases.

The potential for human disturbances on wildlife is visible in this LA. There is an increase in human use, including an increase in the types of use. Many of these uses are associated with riparian habitats. Increased human use combined with limited knowledge about the location and densities of amphibians and Townsend's big-eared bat is reason for concern.

The Metolius Winter Range for mule deer and key elk area occur within this LA. Increased human use, especially in spring and winter, could displace and/or stress wintering big game.

Also of concern are the potential impacts of increased human use on known and potential osprey and bald eagle nest sites.

Landscape Area 3 - Highway 20 Corridor

Species of Concern	Reason
Northern spotted owl	Highway is a potential barrier to north-south movement
Cascade frog	Limited knowledge, Known sites at Link Creek and other riparianareas
Tailed frog	Same
Northern bald eagle	Highway adjacent to perch site

Landscape Area 3 Hwy. 20 corridor is composed primarily of ponderosa pine and mixed conifer PAGs. This LA contains suitable spotted owl habitat and includes portion of the Suttle Bald Eagle Management Area (1990 LRMP).

The maintenance of adequate suitable owl habitat to provide for dispersal across the highway corridor is a consideration, especially since one nest site is within the corridor and several spotted owl nest sites are immediately adjacent.

The large tree habitat between Suttle Lake and Highway 20 is commonly used by bald eagle for roosting and perching. The integrity of this area would be compromised by highway widening projects or other activities that would infringe on the Bald Eagle Management Area (BEMA).

There is one known occurrence of tailed frog in Link Creek and several sightings of cascade frog immediately adjacent to the LA, but there is limited knowledge about available habitat, species distribution and species abundance within the LA. Without this knowledge all activities in the LA that may impact riparian or wetland habitats are of concern.

Avoiding activities that increase the risk of vehicle-wildlife mortality is important.

Landscape Area 4 - Meadow Lakes Basin

Species of Concern	Reason
Northern spotted owl	Habitat Fragmentation
Pileated woodpecker	Habitat Fragmentation
Northern Goshawk	Habitat Fragmentation
Black-backed woodpecker	Limited habitat
Cascade Frog	Limited knowledge
Tailed Frog	Limited knowledge and abunda potential habitat
Spotted Frog	Limited knowledge
Northern Bald Eagle	Bald Eagle perching and foragin
Wolverine	Limited knowledge and increase human use
Fisher	Limited Knowledge and increas human use
Roosevelt Elk	Key summering Area

Landscape Area 4 is a unique wildlife habitat area because of the numerous small lakes and ponds. Past wildfires, timber harvest and tree mortality from insects and disease have significantly altered the landscape within this LA.

The LA is dominated by early seral habitats. Late-successional habitat has been reduced to poorly connected remnants and has been severely impacted by the spruce budworm. Snags and down woody material created by spruce budworn tree mortality have created a catastrophic wildfire risk that places forested wildlife habitats at risk. Wildfire risk combined with highly fragmented conditions place limited late-successional habitat and associated species at risk.

There is limited knowledge about wolverine, marten and fisher in the LA; however, it is probable that the LA is an important habitat link between the wilderness. Increased human use in the area and highly fragmented conditions may be disturbing movement of the mustelids between wilderness areas.

Bald eagles are commonly seen foraging and perching around the larger lakes. The deteriorated forest conditions from insect and disease are limiting long term nest site potential. The increased human use of the area could result disturbances to eagle activities. The area northwest of Island Lake has been identified as an important in elk summering area. The area may become a less effective summer range if human use, particularly off-road vehicle uses are maintained or increased.

The unique riparian habitats associated with lakes and ponds receive intense recreational use resulting in areas of deteriorating riparian habitat condition. There is one known occurrence of tailed frog in Link Creek and several sightings of cascade frog, but there is limited knowledge about available habitat, species distribution and species abundance. Without this knowledge all activities in the LA that may impact riparian or wetland habitats are of concern.

Landscape Area 5 - Black Butte

Species of Concern	Reason
Northern spotted owl	Maintain habitat
White-headed woodpecker	Loss of snags and medium/large ponderosa pine

A majority of Landscape Area 5 is steep and unroaded. Wildlife use is not well known because of these conditions. The LA does provide a significant amount of middle and late-seral habitats. Especially important are the mature and old-growth ponderosa pine forest around the base of the butte, and the multi-storied mixed conifer habitats on the northern aspect. These forests are fairly contiguous on the lower butte providing well-connected large tree habitat for wildlife species moving around this topographical barrier.

Human activities are concentrated on the Black Butte Trail. Impacts to wildlife are relatively few except for some occasional encounters along the trail.

The maintenance of large tree habitat in this LA is important for white-headed woodpecker foraging and nesting, and spotted owl dispersal.

Landscape Area 6 - Cache

Species of Concern	Reason
Northern spotted owl	Habitat fragmentation, maintain habitat
Pileated woodpecker	Habitat fragmentation, dispersal habitat
White-headed woodpecker	Habitat fragmentation, loss of snags
Black-backed woodpecker	Snag and habitat loss
Williamson's sapsucker	Snag and habitat loss
Northern goshawk	Fragmented habitats

Landscape Area 6 contains private lands that have been intensively managed for timber production. The result is large areas of early seral habitats and loss of snags. While these conditions have benefited early seral wildlife species, species requiring older seral stages for dispersal, nesting, foraging or roosting have been negatively impacted.

The ownership pattern in this LA and the projected intensive timber harvest objectives on private lands increase the concern and the need to manage Forest Service System Lands with snag densities, and late-successional habitat as a consideration.

Landscape Area 7 - Suttle Lake

Species of Concern	Reason
Cascade frog	Limited knowledge, increased human use
Tailed frog	Limited knowledge, increased human use
Spotted frog	Limited knowledge, increased human use
Northern bald eagle	Long term nest tree, increased human use

Landscape Area 7 is the primary habitat area for a known pair of nesting bald eagles. The increase in true firs in the understory has placed large diameter trees at risk, and has reduced the natural regeneration of ponderosa pine and Douglas-fir. Both these factors are reducing bald eagle management options. Enhancing bald eagle habitat may result in negative impacts to spotted owls, pileated woodpeckers and northern goshawks.

Recreation use at Suttle Lake and associated forests does not appear to be disturbing these eagles. However, the threshold at which the recreational use of Suttle Lake, begins to disturb the eagles and affect the productivity of the nest site is not clear. Therefore, all activities within the LA must consider impacts to bald eagles.

There are known occurrence of tailed and cascade frog in the lakes and streams above Suttle Lake, but there is limited knowledge about available habitat, species distribution and species abundance. Without this knowledge all activities in the LA that may impact riparian or wetland habitats are of concern.

Landscape Area 8 - Upper Tributaries

Species of Concern	Reason
Northern spotted owl	Habitat fragmentation
Pileated woodpecker	Habitat fragmentation
Black-backed woodpecker	Limited habitat
White-headed woodpecker	Loss of medium/large ponderosa pine
Williamson's sapsucker	Habitat loss
Northern goshawk	Habitat fragmentation
Cascade frog	Limited knowledge, increased human use
Tailed frog	Limited knowledge, increased human use
Spotted frog	Limited knowledge, increased human use
Big game	Winter range

Landscape Area 8 is primarily dry and wet mixed PAG. Past timber harvest activities have significantly fragmented habitats in this LA. The remaining mixed conifer late-successional habitats are small in size and poorly connected. In addition, many of these late-successional habitats, because of high tree densities, are at risk from catastrophic fire and insects and diseases. This LA currently contains the highest densities of spotted owl in the watershed. Since suitable habitat is already fragmented and poorly connected, any additional habitat loss could affect species viability.

Primary cavity nesters are probably benefiting from high snag and down log densities, but habitat fragmentation and loss of specific habitat structure may result in downward population trends.

There are known occurrence of tailed and cascade frog in Canyon and First Creek drainages, but there is limited knowledge about available habitat, species distribution and species abundance within the LA. Without this knowledge all activities in the LA that may impact riparian or wetland habitats are of concern.

Mule deer winter range and a key elk area for winter ranger occur within this LA. Increased human use, especially in spring and winter, could displace and/or stress wintering big game.

Landscape Area 9 - Green Ridge

Species of Concern	Reason
Pileated woodpecker	Habitat fragmentation
Northern goshawk	Habitat fragmentation
Williamson's sapsucker	Snag and habitat loss
White-headed woodpecker	Loss of snags and medium/large ponderosa
Roosevelt elk	High road densities in summer range

Landscape Area 9 is primarily dry and wet mixed PAG. Past timber harvest activities have significantly fragmented habitats in this LA. The remaining mixed conifer late-successional habitats are small is size and poorly connected. In addition, many of these late-successional habitats, because of high tree densities, are at risk from catastrophic fire and insects and diseases. There are no known spotted owl sites, but the area is considered Late-Successional Reserve. Since late-successional habitat is already fragmented and poorly connected, any additional habitat loss could effect late-successional wildlife species.

Primary cavity nesters are probably benefiting from high snag and down log densities, but habitat fragmentation and loss of specific habitat structure may result in downward population trends.

The area supports a small herd (estimated at 10-20) of summering Roosevelt elk. The current road densities reduce the habitat effectiveness of the area for elk. In addition portions of the area are allocated as Wildlife Primitive area. A reduction in road densities is consistent with this allocation.

Landscape Area 10 - Scarp

Species of Concern	Reason
None	Steep and isolated

Landscape Area 10 is steep and inaccessible by vehicles. Wildlife use area generally undisturbed by human activities, but are vulnerable to catastrophic wildfires that could reduce the amount of mature and late-successional habitat used by northern goshawk and spotted owls. Generally natural disturbances are considered compatible with the area.

The Metolius Horn portion of the LA is part of a Critical Habitat Unit identified by the US Fish and Wildlife Service for recovery of the northern spotted owl. All activities within this portion of the LA need to consider impacts to the owl.

Landscape Area 11 - Lower River

Species of Concern	Reason
Northern spotted owl	Known nest site
Northern goshawk	Known nest site
Northern bald eagle	Known nest site, Monty campground
Osprey	High density of nest sites, increased human uses

Landscape Area 11 (Lower River) includes the Metolius River and associated riparian and upland habitats. This LA supports a high number of osprey nest sites (41 total) and several bald eagle nest sites. The large tree character (snags and live trees) associated with the river provide ideal habitat for these two species. These large trees are placed at risk as tree densities increase, and wildfire and insect and disease infestations become more likely.

The Metolius Wild and Scenic Plan would create a more primitive lower river condition by closing the lower river road and seasonally restricting the use of Monty campground. These management activities would greatly increase the habitat effectiveness of this LA.

Terrestrial Wildlife Non-Native Species

Turkey

Rio Grand and Merriam turkeys introduced into the watershed in 1961 (17 Merriam's) and 1987 (26 Rio Grandes). Two other releases were conducted outside the watershed in the Fly Creek area: 1984 (23 Merriam's), and 1985 (7 Merriam's).

Turkey populations are scattered in low numbers (probably less than 50 birds) throughout the watershed, and use is limited to the summer. Occasional sightings of individual birds or small flocks (2-5 birds) are reported. Habitat conditions in the watershed are not ideal for this species. They prefer more open landscapes commonly found east of the watershed on the eastern slopes of Green Ridge.

The turkey population levels are so low that there are no competition conflicts with other gallinaceous birds.

Brown-headed cowbird

The cowbird is found in many habitats throughout the watershed. This species parasitizes many other species. The result is lowered reproductive success for many neotropical birds. The extent and depth this threat is not known.

Of special concern is the impact of fragmentation on native species that are associated with late-successional habitats. Studies have shown that fragmentation of forested habitats, and the creation of edge habitat has contributed to the expanding range of the cowbird. In addition, fragmented habitats increase cowbird parasitism of bird species associated with late-successional habitats.

Barred Owl

There is one known sighting of barred owl in the watershed. There are reported sighting west of the watershed on the Mckenzie Ranger District, three sightings south of the watershed on the Bend Ranger District, and a number of sightings in the northwest corner of the Warm Springs Reservation.

Habitat fragmentation throughout the Western United States has allowed the barred owl to spread its range east of the rockies to the cascades. The barred owl, a close relative of the spotted owl, appears to be better adapted to fragmented late-successional habitats than the northern spotted owl. Barred owls out-compete spotted owls for suitable habitat where limited habitat exists. The highly fragmented conditions of the mixed conifer PAGs places the spotted owl viability at risk if barred owls move into the watershed.

Bull Frog

There are no known bull frog sightings in the watershed. They are known to occur at Tule Lakes (adjacent to Deschutes River) on the Warm Springs Reservation. There is a low probability that the frog could move up the Deschutes River into Lake Billy Chinook and eventually the Metolius River. However, this expansion into the watershed may be limited by the cold-water conditions in the Metolius River.

Bullfrogs can prey on native amphibians, significantly reducing their population levels.

European Starling

The European starling is common throughout the watershed. It is an aggressive cavity nesting species, which is know to displace native cavity nesting species, especially bluebirds. The extent of the starling impacts on native birds is unknown, but probable. Where snag densities are low starlings can displace native cavity nesting birds and can reduce the population densities of these native species.

Aquatic/Riparian Threatened, Endangered and Sensitive Species

See Focal Species, Page 81-82

Fish Historic Condition

Historic records show spring chinook, sockeye salmon, rainbow trout, bull trout, mountain whitefish, longnosed dace, bridgelip sucker and sculpins are native to the Metolius Watershed.

Spring chinook used Spring Creek, Heising Spring, lower Lake Creek and the upper Metolius for spawning and rearing. As early as the late 1800s intensive fishing at the mouth of the Deschutes River may have reduced the chinook run in the Metolius River (Nehlsen 1995). Runs of several hundred fish were reported in the 1940's. Spring chinook hatchery stock were planted in the late 1940's and 1950's from the Metolius hatchery built on Spring Creek in the hopes of rebuilding the runs (Wallis 1960). From 1948 to 1958, chinook runs counted at the Metolius hatchery rack varied from 580 to 89 adults (Wallis 1960). Runs after 1953 were less than 100 fish until fish were no longer passed at Round Butte Dam in 1967. Round Butte Dam on the Deschutes River was completed in 1964. After several years of passing adults, the run declined due to inadequate juvenile passage and the adults were taken for hatchery production starting in 1967.

Sockeye historically used Link Creek for spawning and Suttle Lake for rearing, (Suttle is one of two lake systems in Oregon that supported historic sockeye runs). The native run of sockeye in Suttle Lake and Link Creek were reported extinct by 1940, probably due to low dams on Lake Creek (Frey 1942), especially at the outlet of Suttle Lake (Nehlsen 1995). Sockeye hatchery stock were planted in the late 1940's and 1950's in the hope of rebuilding the runs (Wallis 1960) but the effort was unsuccessful. Counts of adult sockeye at the Pelton trap from 1955 to 1962 varied from 30 to 332 adults. The sockeye hatchery program was not continued and the return of native fish ranged from 7 to 35 from 1957-1959 (Nehlsen 1995). No effort to continue the sockeye run was attempted after Round Butte Dam was constructed.

Bull trout spawn in Jack Creek, Canyon Creek, Candle Creek, Jefferson Creek, Heising Spring and Roaring Creek. Streams used for rearing include Brush Creek and unnamed tributaries to Roaring Creek and Canyon Creek. Bull trout may have used the lower Deschutes for rearing before construction of Round Butte Dam but have adapted a lake residence life history. For many years, bull trout were thought of little value and were trapped and killed to reduce predation on more favored game fish such as salmon and trout. At the present, the population is faring well in Lake Billy Chinook, as evidenced by state record bull trout caught in Lake Billy Chinook that weighed over 23 pounds. Since 1986, redd counts in the tributaries have increased from 27 to over 300 redds in 1994.

Bull trout were originally reported to spawn in Link Creek and Abbot Creek but are no longer found to spawn in these waters. Bull trout have not been reported in Suttle Lake since 1950's or 1960's, possibly due to their vulnerability to angling or passage limitations along Lake Creek. Kokanee and brown trout are found in Suttle at the present. Two reports have identified Abbot Creek as originally supporting bull trout as late as the 1940's. Few bull trout are found in Abbot Creek today and those found there possibly move up from the Metolius to feed. The stream now supports an abundant population of small brook trout and rainbow trout.

Historically, rainbow trout of the Metolius River were once part of the Deschutes River Rainbow Trout complex. Access to the Deschutes River, Crooked River and Squaw Creek was open prior to the creation of Lake Billy Chinook and Round Butte Dam. The extent to which rainbow trout intermix between these areas is unknown but access to the lower Deschutes no longer exists.

Hatchery rainbow trout have been stocked in the Metolius River since the 1920's. Although comparison of population levels is limited, the present population of rainbow trout has been rated as depressed by ODFW Upper Deschutes Basin Plan.

Fish Existing Conditions

The dam on Blue Lake is a barrier to fish movement into Link Creek and Suttle Lake. Some rearing of sockeye and bull trout occured in Blue Lake prior to the dam construction. The Blue Lake dam would require major alterations for fish passage. The low head dam on Suttle Lake could be easily modified to increase fish passage. Lake Creek Lodge has a dam on the pond that may be a barrier to fish moving up Lake Creek at certain times of year.

Rainbow trout are found throughout the system and are the target fish for most anglers in the Metolius River. The Metolius River has been studied in recent years for both habitat quality and the status of rainbow trout populations. Habitat surveys by both ODFW and the Sisters Ranger District have showen low cover and low wood in the upper Metolius River (Fies and Robart 1988, Riehle 1993).

There has been some evidence that the Metolius River wild rainbow trout has characteristics intermediate between Deschutes wild stock and hatchery stocks (Fies and Robarts 1988). More recent field surveys have shown that some genetic mixing of wild and hatchery rainbow trout occurred in the spawning areas and some evidence of depressed numbers of wild fish in sections where hatchery fish were stocked (Hemmingsen and Buchanan 1993). Stocking has been changed to reduce this mixing in the upper river. The effect this change in stocking has had on the lower river or the extent of spawning that occurs in the lower river or tributaries is not well known.

The dam on Jack Creek at Road 1230 is low and has an adequate pool below to allow passage of some fish above. Concentration of spawning below the dam suggests that the dam is a partial barrier to upstream migration. With the population increasing, better distribution of spawning may become more important as competition for juvenile rearing habitat increases. A small, unscreened irrigation diversion exists on Canyon Creek and attracts juvenile bull trout during their downstream movements. These fish are lost when the ditches are shut off at the end of the irrigation season.

The high lakes are stocked with brook trout, rainbow trout and cutthroat trout. Brook trout are not stocked in lakes with outlets that connect to the tributaries of the Metolius River to avoid introducing brook trout into bull trout habitat. In some case, brook trout have been shown to compete with bull trout when they occur

together. The risk of interbreeding in the Metolius River system is low due to the large size of the lake reared bull trout and the small size of the resident brook trout.

Introduced resident fish in the system include cutthroat trout, brown trout, brook trout and hatchery rainbow trout. Spawning populations of brook trout have become established in First Creek, Canyon Creek and Abbot Creek. Brown trout have become established in the Metolius River and Lake Creek but do not use the other tributaries. Hatchery rainbow trout are stocked in the Metolius River but do not range into the tributaries.

Aquatic invertebrate communities have been rated in good to excellent condition in the tributaries and in the Metolius River (Mangum 1988, Mangum 1991, Wisseman 1991, Wisseman 1992, Vinson 1995). Taxa richness is high and the relative abundance of intolerant taxa are well represented. North Fork Lake Creek did show signs of high levels of sediment tolerant taxa but this stream was reported to have been intermittent prior to changes for irrigation. Other streams showed some sign of sediment tolerant taxa but high diversity of clean water taxa. Some fine sediment level may natually limit riffle invertebrate communities. The Metolius River at Lake Creek showed indicators of organic enrichment but the cause of this has not been identified. This site is above the mouth of Lake Creek.

A caddisfly, Apatania tavala, a listed USFS Sensitive Species, has been found in Roaring Creek and the Metolius River. The habitat for this species is small to fourth order shaded streams with moderate velocities and gravel to cobble substrates. Some known sites are spring-fed and have extensive debris jams and mossy stream bottoms. Suitable habitat has been identified in Candle Creek, Jefferson Creek, Jack Creek, Heising Spring, Spring Creek,Canyon Creek and Abbot Creek. This species is found in many drainages in the Cascades but at low abundance (Wisseman per. comm.).

Non-Native Fish

Introduced resident fish in the system include brown trout, brook trout and hatchery rainbow trout and kokanee. There has been increasing concern for the effects of introduced fish on the native fish, amphibians and invertebrates.

The effects of introduced fish or native fish may be important through behavioral interactions, interbreeding or introductions of disease. Introductions of fish that may have resulted in interbreeding include kokanee in Suttle Lake and Lake Billy Chinook. Some sampling of the genetic character of the kokanee has been conducted in Suttle Lake but the results were not available for this report.

Research on the possible interbreeding of hatchery rainbow trout has suggested some mixing during spawning season in the upper Metolius River (Hemmingson 1993). Stronger evidence for spacial interactions between hatchery and wild rainbow has been presented for the upper Metolius River (Hemmingson 1993). The pending ODFW Basin Plan for the Upper Deschutes Basin makes preliminary recommendations to discontinue stocking of hatchery rainbow trout in the Metolius River (Chip Dale, per. comm). Hatchery rainbow trout are also stocked in Blue Lake; the effect on native fish is unknown but suspected to be slight.

Brown trout have become established in Suttle Lake where bull trout were native but are no longer found. Possible interactions on habitat use both in the lake and in Link Creek may occur if bull trout were reestablished. Link Creek, the inlet and only spawning habitat, is limited to one half mile and some super-imposition of brown trout redds over bull trout redds may occur. Low numbers of brown trout occur in Lake Creek and the Metolius River. Their role in these habitats has not been studied.

Brook trout introduced to the Metolius system have become established in First Creek, Canyon Creek, Brush Creek and Abbot Creek. Overlap with bull trout habitat occurs in Brush Creek, Canyon Creek and possibly Abbot Creek. Historical reports of anglers catching bull trout in Abbot Creek raise questions about whether habitat changes or the introduction of brook trout were important in the possible loss of bull trout in that stream. Brook trout have similar temperature and habitat use and have been reported to interbreed with bull trout in small resident populations. The presence of brook trout is being monitored annually by the Sisters Ranger District.

Brook trout and rainbow trout populations introduced to high lake and small streams may have altered habitat conditions for native aquatic species other than fish. The introduction of fish to waters previously fishless may alter the amphibian and invertebrate community. Predation of fish on frogs and salamanders could reduce or eliminate certain species from certain waters. Zooplankton can be related to fish presence/absence in some cases. The introduction of disease such as the fungus sapolegnia may kill developing amphibian embryos and larvae.

More research is needed to determine the biological effects of stocking fish in previously fishless lakes. Dark Lake is of the few lakes in the area at middle elevation that has not had a recent fish stocking program. This provides a unique opportunity for comparative studies of the effects of stocking on endemic aquatic wildlife. The wilderness lakes of Koko and the unnamed lake to the north (North Koko Lake) are a pair of adjacent lakes similar in size but represent a stocked and unstocked lake comparison. Although the fishless North Koko lake is smaller, it does have an abundance of Northwestern salamanders where the rainbow trout stocked Koko Lake had none. Phantom midge densities were high in the fishless lake. More wide spread work is being conducted to assess the effects of fish stocking on wilderness lakes, by the USFS with the cooperation with ODFW, and to assess the size and presence of some zooplankton.

Social Domain

Summary

The Metolius Watershed is a very popular and diverse area. The area was traditionally used by Native Americans for hunting, fishing, and gathering. The Confederated Tribes of the Warm Springs Reservation have expressed an interest in maintaining the native plant communities in the watershed, which provide resources guaranteed by treaty rights. These resources include plant foods and materials of cultural significance to the Tribes. Early explorers traveled through the area following natural drainages, but it wasn't until the early 1900's that the area was finally "discovered". Tall pines, water rushing to the surface in large springs, along with great fishing, drew people to the Metolius River and its tributaries. The river may have been the original draw, but soon other areas within the Basin began attracting more people.

As new roads and trails were constructed more areas became easily accessible. The Metolius Watershed includes landmarks such as Black Butte, Green Ridge, Metolius Horn, Mt. Washington, Three Fingered Jack, and Mt. Jefferson. From the higher alpine meadow and lakes of the Wilderness to the lower reaches of the Metolius River, the impacts of human use have taken a toll on the landscape.

Within the watershed are broad classifications of vegetation that correspond roughly to elevation bands. These classifications can be used to discuss the scenic condition and landscape character patterns within the watershed.

Commodities associated with the Metolius Watershed include recreation, extraction of gravel, cinders, and clay, timber harvest, grazing, geothermal, as well as collecting special forest products (firewood, cones, boughs, poles, decorative wood, mushrooms and transplanting trees, shrubs, and herbaceous plants).

Heritage

Historic Condition

Prehistoric use of the Metolius Watershed extends back at least 7,000 years and possibly as much as 10,000 years. There is currently no information about changes in travel routes or settlement patterns during prehistory. Travel was mostly up and down the stream and river drainages with seasonal settlements at major rivers, lakes, and confluence of streams. A secondary settlement area was along the glacial outwash plains at the edge of the mountains. This area provided diverse environments and resources.

What cultural groups occupied this area is not fully understood. **It is likely that bands of Columbia Plateau, Mollala and Northern Paiute utilized the resources of this watershed at different times in prehistory, and in some cases concurrently.** This watershed was not any group's exclusive territory, nor was it occupied year round. There is unrealized research potential in many of the sites in the area. A few of the sites around lakes have the potential for underwater archaeology studies as well.

Significant events in the history include the establishment of the Warm Springs Reservation in 1855, the Santiam Wagon Road in the 1860's, the beginning of the Forest Reserve in 1893, the beginning of Camp Sherman in the 1890's, the expansion of Forest Service lands in the 1920's and 30's, and the completion of Hwy. 20 over Santiam Pass in 1938. Much of the watershed was used for grazing cattle and sheep from the 1860's into the 1930's. **Development began with road construction and houses along the Metolius River and slowly expanded westward into higher elevations as trails and roads were built for recreation and timber harvest.**

Prehistoric Sites

Currently, prehistoric resources consist mostly of open air lithic scatters, some rock shelters or shallow caves, and reports of scattered pictographs. Most of the known resources are on Forest Service land, with little information from tribal land and almost no information from private land. Management by the Forest Service consists primarily of avoiding any new disturbance of these resources. Efforts continue slowly to determine the nature, extent, and significance of located resources. After almost 20 years of conducting surveys for prehistoric sites, the Forest Service is recently putting more emphasis on managing the resources that are known.

Historic Sites

Historic structures include summer homes, water wheels, picnic shelters, fire lookouts, a guard station, and recreation facilities. Other historic resources that remain include roads and trails, and debris left behind when buildings were destroyed or removed. Some present uses of heritage resources include picnic shelters in campgrounds, Black Butte lookout structures, and summer homes.

Landscape Area Conditions

Landscape Area 2 (Metolius River) Within this LA, historic structures are not being maintained or rehabilitated until they are in a condition that warrants demolition or heavy modification that usually detracts from the historic value. All structures continue to be utilized by the public and only one has had any degree of rehabilitation work done for it. Prehistoric sites at developed locations continue to deteriorate from ongoing use and

occasional site development or modification. Very little data has been recovered from most of these prehistoric sites besides their location on the ground.

Landscape Area 5 (Black Butte) Within this LA, some historic structures are not being maintained or rehabilitated until they are in a condition that warrants demolition or heavy modification that usually detracts from the historic value. Some structures have deteriorated to the point that they are abandoned.

Landscape Area 7 (Suttle Lake) Within this LA, historic structures are not being maintained or rehabilitated until they are in a condition that warrants demolition or heavy modification that usually detracts from the historic value. Other structures have been removed outright and given to another forest. Prehistoric sites at developed locations from ongoing use and occasional site development or modification. These sites have had a moderate amount of data recovered and some information is known about the distribution and density of artifacts.

Cultural Use Plants

Historic Condition

Native Americans may have managed some important gathering areas with the use of periodic fire. The use of fire by Native Americans to maintain open huckleberry habitats and increase berry production by pruning existing plants has been documented in other areas.

Existing Condition

Plant surveys have identified many species of plants which have cultural significance. Most of these species are common species of shrubs, trees and forbs that can be found in many places on the Sisters District.

The most significant cultural food plant found within the watershed are huckleberries. The exclusion of fire and closing of forest canopies has reduced huckleberry habitat. Potential habitat for one culturally significant species, Blue Camas, may exist along the Lower Metolius River in seasonally wet meadows.

Landscape Area Conditions

Landscape Area 1 (Wilderness) Huckleberry habitats occur in this area on subalpine slopes.

Landscape Area 3 (Hwy. 20 Corridor) Several roadside wetlands are dominated by western bog blueberry plant associations, which may be significant cultural food plants.

Landscape Area 4 (Meadow Lake Basin) Huckleberry habitats occur in open woodlands.

Landscape Area 6 (Cache) Huckleberry habitats occur in open woodlands.

Landscape Area 11 (Lower River) Potential habitat for cultural food plants such as Blue Camas may occur.

Landscape Area 5 (Black Butte) Traditional food gathering area

Land Ownership and Administration

Historic Condition

Land ownership patterns have remained stable for the last 50 years. The Warm Spring Reservation Treaty of 1855 defined the first land boundary. This established the ownership and management of the northern end of the watershed. **In 1893, the Cascade Forest Reserve was formed which included most of the west half of the Metolius Watershed.** Also, in the 1890's, much of the private land along the Metolius River was established as homesteads. **The Santiam Wagon Road was constructed using a land grant, which resulted in a checkerboard pattern of private and Forest Service lands along the southern edge of the watershed by the early 1900's.** Around the Horn of the Metolius, most of the area was privately held timber lands until the 1920's and 30's. During this time the Forest Service acquired much of this land and extended the boundary of the National Forest east onto Green Ridge. **Since about 1940, land ownership changes have been few and consisted mostly of exchanges between private timber companies and the Forest Service.**

Existing Condition

Management direction for the watershed is varied and complex. Forest Service lands within the watershed fall under about 20 different management areas and five different NW Forest Plan designations. Private lands include lands managed for timber production, resorts, individual homes, and commercial business. Most of the watershed is in Jefferson County, with the southern portion in Deschutes County.

Table 29: Land ownership.

Land Allocations	Acreage	Percent Land Base
Forest	140,504	94.4%
Private	8,375	5.6%
Wilderness	42,291	28.4% of entire watershed or 30.1% of FS land within the watershed

Scenic Condition/Landscape Character

Historic Condition

With the exception of some of the high alpine areas in the Wilderness, most of the watershed is forested. The ponderosa pine plant associations once appeared predominantly open and park- like with grassy forest floors forming much of the understory. Small sunny openings typically contained clusters of young pines. The orange trunks of the large pines formed the dominant visual component characterizing this forest type. From a distance the forest canopy appeared course-grained and somewhat uniform. Small openings resulting from either fires, disease or insect damage were typical.

Mixed conifer plant associations are more visually diverse than the ponderosa pine forest areas. Different species of trees collaborate to form a variety of textures and shades of green in the forested canopy. Up close these forests appeared to have multiple heights and ages of vegetation. Large orange-trunked ponderosa were still a common visual component in these areas joined by the large gray trunks of other species. From a distance the canopy appeared dense with a variety of textural and color diversity. Natural disturbance agents such as fires, insects and disease caused some openings in the canopy.

The higher elevation plant associations such as hemlock and subalpine fir appear shorter and stouter than the lower elevation species. In response to climatic shifts the vegetation at the higher elevation bends and conforms to the wind. Grassy meadows and high alpine lakes combine to form pristine settings with expansive views across the forested land below. Rugged, rocky peaks, usually covered in white, form the uppermost edges of the watershed.

Bands of brighter colored, dense riparian vegetation flow throughout the watershed. Originating in either the high alpine areas or at one of the many springs in the lower mixed conifer forests, the riparian vegetation follows numerous creek corridors down to and along the Metolius River.

Existing Condition

The Metolius Watershed is an area of high scenic quality and value. **Fire exclusion, management activities, insects and disease, recreation use, and new development have all contributed to the existing scenic condition and landscape character within the watershed.**

Fire exclusion has contributed to the ponderosa pine plant associations becoming more dense with understory vegetation growing up and blocking views into and through the forest. Sunny openings are no longer as common and many of the large orange- barked pines are no longer visible. The canopy has become less coarse and it is difficult to distinguish individual large trees when viewed from a distance. Past harvest activities in this forest type were typically partial cut treatments, reducing the amount of large pines in the forests and causing a textural change in the canopy. In general trees are smaller, large trees are not as visible, and many areas have dense understory vegetation.

In mixed conifer plant associations fire exclusion has also allowed forests to grow denser. White fir has become a dominant feature of the understory and middlestory vegetation. **Also, the spruce budworm has been contributing to the change in the landscape character.** Portions of the forest appear dead or dying because of the recent defoliation of the dense white fir stands. The dead trees contribute an overall gray cast to the forest with the intensity of the impact ranging from a slight gray cast in a predominately dark green forest, to areas that appear mostly dead. Past harvest activities in this forest type have affected the scenic condition. **Harvest treatments have typically been clearcuts and thus many treated stands are readily evident both up close and from a distance.** The forest canopy throughout the mixed conifer areas appears patchy with obvious openings. Up close, the treated regeneration stands appear green and vigorous with young, even-aged ponderosa pine growing in them.

Riparian areas are popular places to recreate. **Concentrated dispersed recreation use along the tributaries, around some of the lakes, and around the Head of Jack Creek has contributed to soil compaction, trampling of vegetation, bank erosion, and degraded scenic quality.** Developed campgrounds, summer home tracts (giving a distinctly rural feel), and private lands with concentrations of rural homes and resorts add to the human dominated visual influence.

In the higher elevation areas, mostly in the wilderness, changes from fire exclusion are less obvious or not evident at all. Treatment activities have not occurred and the setting appears predominately natural and undeveloped. The primary changes in the scenic condition stem from recreation use. Around popular lakes, in some riparian areas, and along trails, soil compaction and trampling of the vegetation has become more obvious, as the amount of people in the wilderness has increased.

With the exception of the wilderness, road access exists throughout much of the watershed and thus affects how the watershed appears, as well as how much of the

watershed is visible from up close. The types of uses and viewing durations vary across the watershed and can be more easily described by Landscape Area (Also see Recreation).

Landscape Area Conditions

Landscape Area 1 (Wilderness) includes two Wilderness areas. Many of these areas are unforested and allow for views out across the landscape. Access is by foot or on horse only. Scenery is intended to complement a remote, primitive recreation experience.

Landscape Area 2 & 7 (Central Basin & Suttle Lake) include some of the main (and historic) access routes to Suttle Lake and the Metolius River. Most of the developed recreation use is concentrated in these areas along the Metolius River and around Suttle Lake. Substantial views of the surrounding landscape are available from these developed campgrounds. Because of the long history of use, expectations for retaining the distinctive character of these places is high. Dispersed recreation is concentrated along some of the creek tributaries.

Landscape Area 3 (Hwy. 20 Corridor) includes the Metolius-Santiam Pass Scenic Byway. Crossing the entire watershed, this Byway carries travelers across the Cascades through a variety of landscape types. The route passes primarily through mixed conifer forest from the summit down past Suttle Lake. Recently some of the dead standing trees along the road were removed and the area immediately adjacent to the road appears less dense. Below the lake and around the base of Black Butte the Byway passes through ponderosa pine communities. Scenic viewing from this road is promoted through the Byway program and use of the highway corridor has increased substantially in the recent past (see Travel And Access).

Landscape Area 4 (Meadow Lake Basin) includes the Meadow Lake and

Cache Lake areas. Viewing occurs in conjunction with dispersed recreational activities. Also, much of this area is viewed from the Mt. Washington viewpoint on the Scenic Byway. Road 2076 running north/south through this LA is in a Scenic Views Management allocation.

Landscape Area 5 (Black Butte) Black Butte is the dominant, dark form visible from countless locations in Central and Eastern Oregon. At the summit of the butte is a well established recreational viewpoint and an active fire lookout. Some past harvest activities are visible on the butte and a large fire scar opens up the canopy along the top edge of the butte on the north side.

Landscape Areas 6 & 9 (Cache & Green Ridge) include relatively flat land primarily unseen from established scenic routes. One exception to this is Cache Mountain. It is a high point in the area and a scenic views management allocation. The Santiam Wagon Road passes through LA 6 (and the lower edge of LA 4). This historic travel route is not

currently managed for scenic quality. Harvest activities are visible throughout many portions of these Landscape Areas.

Landscape Area 8 (Upper Tributaries) includes numerous small ridges and drainages. The undulating terrain creates natural screening of some of the lower portions of these drainages. From a distance, this area is primarily viewed from the top of Black Butte, along Green Ridge, from the Scenic Byway, and from the Wilderness. Up close this area is typically used and/or seen by people collecting special forest products (firewood, collecting mushrooms, etc.) or by people en route to the Wilderness trailheads. Currently the routes to the wilderness trailheads are managed for a higher level of scenic quality than the surrounding forest. Harvest activities are evident in many locations in the surrounding forest. Dispersed camping occurs along some of the tributaries.

Landscape Area 10 (Scarp) includes the sloping face of Green Ridge. Originating at the north edge of Black Butte this landform is visible from numerous highpoints and vistas to the west as well as from the top of Black Butte. There are currently some visible clearcuts on the northern portion of the ridge. Where this LA wraps around the Metolius Horn, it becomes visible from locations to the north and east.

Landscape Area 11 (Lower River) includes the lower portion of the Wild and Scenic River corridor along the Metolius River. This area is primarily viewed from the river; however, there are also developed camp sites at the western and eastern ends of the Landscape Area.

Recreation

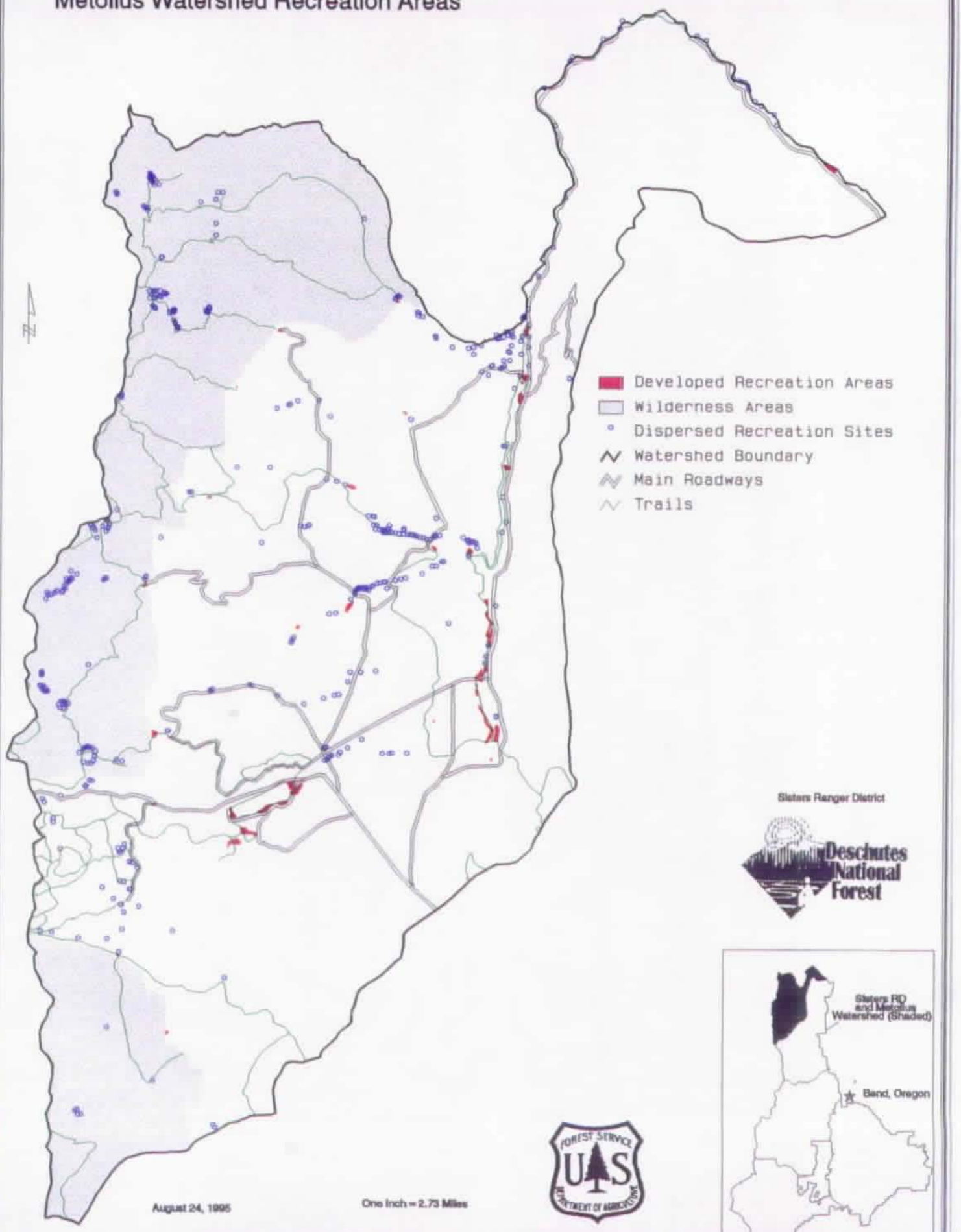
Historic Condition

Early recreation focused on the Metolius River and some of its tributaries. There is little information on the early history of campgrounds, but most were constructed by Civilian Conservation Corp. crews during the 1930's. There are still signs of their handiwork: picnic shelters at Cinder Beach on Suttle Lake, Camp Sherman Campground, Pine Rest Campground, and Pioneer Ford Campground. In some campgrounds there are still dates cemented in rock barriers from this period.

Early access was difficult with native surface roads providing access to the Metolius Basin. Visitors to the area in the 1930's remember pioneering roads into some of the areas that are now campgrounds.

Fishing has always been a strong draw along the Metolius River with sizable stringers of large fish common. Fishing also drew people to Suttle Lake. Before the dam was put in at the mouth of Suttle Lake, followed by the dams on the Deschutes River, there were runs of sockeye salmon that provided a fishing opportunity in Suttle Lake. The high wilderness lakes were devoid of fish until locals began hauling fish with pack stock.

Metolius Watershed Recreation Areas



Main access over the Cascades was provided by the McKenzie Highway until the Santiam Pass Highway was improved. Most of the Metolius Basin was not roaded, and much of the early access was provided by horseback. Access to the Head of Jack Creek was provided by narrow roads accessible by horse and buggy.

Some of the early popular activities were trapping, fishing, hunting (for food and pleasure), mountain climbing and hiking (early climbs to Mount Jefferson frequently took over a week because of the long walk-in), and horseback riding (as the main means of transportation). Certainly there used to be considerably more solitude, less structure, and more of a wilderness experience available.

People who camped in campgrounds during this early period generally stayed longer since it was a lot more of a challenge to get to the campgrounds. Regulations were pretty well unheard of because there was not the pressure for campsites that there is today.

During the 1910's and 1020's, the Camp Sherman area became increasingly more popular. This was the period when summer homes in the National Forests grew in popularity. The first summer home permit was issued in 1916, and today there are 108 summer homes along the Metolius River. It was during this period that Camp Sherman got its name, from the Sherman County wheat farmers who came to the Metolius following the harvests.

The Metolius River area was not the only popular recreation area within the watershed. Suttle Lake has also been a popular destination of campers since the 1920's. Suttle Lake Resort was a major destination resort, dating back to the 1920's. Cinder Beach was developed by the Civilian Conservation Corp. in the 1930's. It included flush toilets, a picnic shelter, swimming beach, and bath house.

The Meadow Lakes area has always had some minor use, but it wasn't until the Air Strip fire in 1967 more roaded access became available following the salvage logging.

Existing Condition

Winter recreation activities are confined to higher elevations along the Highway 20 corridor, although some trails are signed in the Metolius Basin for skiing. Nordic skiing and snowmobiling are the primary winter activities taking place in the Basin, some snowshoeing and dog sledding also takes place. Summer recreation activities include pleasure driving, hiking, camping, bicycling (mountain and road), boating (including water skiing and trolling), fishing, horseback riding, hunting, sailboarding, OHV use, wildlife viewing, picnicking, sailing, canoeing, whitewater rafting and kayaking, and climbing.

The Metolius River is nationally known as a premium fly fishing stream. Private resorts rarely have to advertise as families have regularly returned for several generations. The Mount Jefferson Wilderness area is one of the jewels in the National Wilderness system. Most of the well known areas lie on the west side of the Cascade crest, but places like Canyon Creek Meadows draw people as soon as the flower "bloom" is on.

Outfitter/guide operations have been limited to some outfitter/guide operations permitted along the Metolius Windigo trail and within the Mount Jefferson Wilderness. The District has decided to not allow any fishing outfitter/guiding until the Metolius Wild and Scenic River planning has been completed (the plan would analyze the environmental impacts of allowing guiding on the river, and whether it is acceptable to permit guiding based on the potential impacts).

Impacts to riparian areas are common due to the popularity of the area and the attractiveness of camping next to water (Map 15). Dispersed camping occurs within 100 feet of all streams and lakes where access allows people to drive their vehicles close to the water; or in Wilderness where people have pitched their camp too close to lakes or streams. This has resulted in areas bare of vegetation, bank degradation, compaction and siltation. Trails in and out of the Wilderness show signs of heavy use. Where trails go through wet areas, frequently two or more trails develop as people try to avoid damp spots. In the spring, and during heavy rains, these trails frequently serve as stream channels as water is diverted into them, causing erosion channels. Stream crossings, especially on horse trails, can develop serious siltation problems.

There is a minimum level of accessibility for physically challenged visitors to recreation sites in the Basin. A few accessible toilets, an accessible fish viewing platform, and an accessible trail to the Head of the Metolius are the only existing facilities.

Most of the users in the watershed, based on marketing studies at Suttle Lake and user surveys from the Head of Jack Creek and Black Butte, come to the area from the Willamette Valley from an area between Eugene and Portland (this group appears to make up 60 to 70% of the use).

Landscape Area Conditions

Landscape Area 1 (Wilderness) This area is designated Wilderness, including part of the Mount Jefferson and Mount Washington Wilderness areas. The section of the Mount Washington Wilderness gets relatively low levels of use compared to other areas. At George Lake, no trails are shown on maps, but there are three user-created trails that come in from various locations. The trail from Dugout Lake is heavily eroded, and because it was user created, it is poorly aligned, causing water to channel down the trail creating more erosion. Use in this section of the Wilderness is primarily by people passing through on the Pacific Crest National Scenic Trail, and day use (overnight use is concentrated at George Lake).

In the Mount Jefferson Wilderness, overnight use is down (Hall and Selby, 1995), but day use is up considerably. Use figures for the Jefferson Lake and Jack Lake trailheads show an increase in use of over 40% between 1981 and 1991, but this increase primarily is from day use. Destinations in the Wilderness are generally associated with water. Areas showing high levels of use and corresponding site deterioration are Square Lake, Carl and

Cabot Lake, Table Lake (primarily horse use), and Canyon Creek Meadows. The trail into Canyon Creek Meadows exceeds 3000 visits a year, with 85% of that being day use; Cabot Lake shows over 1200 visits a year, with 61% being day use; and the Santiam Pass Trailhead (which includes Square Lake) includes over 3000 visits a year, of which 62% of the visits are day use. On the Sisters Ranger District portion of the Mount Jefferson Wilderness, 72% of the use is day use and 28% of the use is overnight use.

Resource concerns within the Wilderness are: trails that go through (instead of around) wet meadow areas; trail short cutting resulting in erosion; camping too close to lakes or streams; and camping in or on the edge of meadows. Because of the short growing season it doesn't take much camping on a particular site before the site becomes compacted. Most water bodies within Wilderness are known or suspected of being contaminated with giardia.

Primary activities within the Wilderness include hiking, fishing, mountain climbing, photography, camping, horseback riding, and hunting.

Landscape Area 2 (Central Basin) This is the Metolius River Corridor above Bridge 99. It includes the lower portions of the main tributaries of the Metolius River, and part of the Wild and Scenic River corridor. Included is a concentrated use area between Jack Creek and Brush Creek. Most of the use along this area is associated with developed and dispersed (outside developed sites) camping, hiking, nature study, wildlife viewing, rafting and kayaking, fly fishing, photography, bicycling (both road and trail), driving for pleasure, and horseback riding.

Use is increasing, especially for activities associated with day use. Overnight use has leveled off or decreased slightly in the last 20 years, although there is some indication that dispersed camping use is increasing slightly, at least on peak holiday weekends (primarily concentrated on Memorial Weekend). In the last 20 years overnight use in the 13 campgrounds have gone from 80,700 visitor days in 1974, to 73,730 visitor days in 1982, to 69,253 visitor days in 1994. In the three developed day use areas use has gone from 64,000 visits in 1974 to 56,300 visits in 1982, to 214,400 visits in 1994. The fish viewing platform did not exist in 1974 and 1982, but if the figures from this facility are not included there were still 137,600 visits to the two facilities in existence in 1974 and 1982 (a 225% increase in use in 20 years).

Most recreation use is associated with the Metolius River or its tributaries. Developed campgrounds cover 50 acres along the Metolius River, and its tributaries and day use facilities take up five acres. Also within this LA are 108 summer homes, private residences, private resorts, and a store operated under permit to the Forest Service. These facilities all have an impact on the character of the Basin.

The only official trails are the Metolius River trail, the Metolius-Windigo trail, the Head of Jack Creek trail, and the trail to the Head of the Metolius; there are numerous user created

trails too. Where the Metolius-Windigo, and various user trails, cross tributaries, erosion and sedimentation problems are showing up. Along the Metolius River and the Head of Jack Creek trail there are areas of bank erosion. Erosion along the Metolius River trail is caused by fisherman using the edge of the river or where they enter the river.

In addition to the problems listed above, there are problems with dispersed sites being too close to the river and tributaries. A loss in riparian vegetation is resulting, and thus an increase in sedimentation. Other associated problems with dispersed camping are user created roads in dispersed areas, human waste, potential for human caused fire starts, and loss of down woody material.

Landscape Area 3 (Hwy. 20 Corridor) The Highway 20 corridor (McKenzie Pass - Santiam Pass Scenic Byway) is the State's busiest route across the Cascade Mountains. This use continues to increase. Within the corridor are Corbett Snopark, Cinder Beach Day Use area, Suttle Lake information station, Metolius Basin information station, and the Mount Washington Viewpoint. Recreation use along this corridor is often associated with travel to other areas outside the corridor.

Cinder Beach area is different. Originally constructed by the Civilian Conservation Corp, the Cinder Beach area gets a mix of use, from the visitor who pulls off the highway for a rest and possibly a bite to eat; to the visitor who comes specifically to this area for a substantial picnic lunch/dinner, fishing, boating, or windsurfing. The beach area is mostly cinders and appears to be highly resistant to erosion. Use is relatively light at Cinder Beach and at the other recreation facilities within this LA. Activities includes: swimming, fishing, sailboarding, picnicking, photography, skiing, snowmobiling, and driving for pleasure.

Landscape Area 4 (Meadow Lake Basin) The Meadow Lake Basin is becoming a popular recreation destination for people looking for a roaded recreation experience that is largely unregulated. Numerous lakes are scattered throughout the Basin, and all that are easily accessible have roads to them (and usually dispersed campsites). **Most campsites are closer than 100 feet to the lakes, resulting in riparian vegetation impacts, and some erosion. Numerous user created trails have developed in the area. These trails are used by OHV users, horseback riders, mountain bicyclists, and some hikers, resulting in some compaction, erosion, and loss of vegetation. Some of the larger lakes are fished, and because of their small sizes and fairly shallow depths they are also used for swimming. There has been no known water quality testing done on these lakes. There are no toilets in and around any of the lakes. The soils and vegetation in this area are particularly sensitive and are being affected by unmanaged OHV use; to what extent is unclear since little monitoring and enforcement occurs in this area.**

During the winter months this area is used by snowmobilers and cross country skiers. Numerous trails traverse the area with the amount of use dependent on snow levels.

Some of the motorized winter and summer (OHV) use is encroaching on the Wilderness, this is an growing management concern.

Landscape Area 5 (Black Butte) The Black Butte LA gets very specific social pressures. There is some mountain bike activity on roads converted to trails, and some unauthorized trail bike use lower on the mountain, but the main focus of people is on the trail to the top of Black Butte. The trail use frequently exceeds 40 to 60 people per day on weekends during the summer. Overall the trail is in pretty good shape until you reach the top of the Butte. **Past use has created a myriad of trails across the top of the Butte. The 6400+ foot elevation of Black Butte is characterized by a sensitive, sub-alpine environment that is easily impacted by the indiscriminate trampling of human feet.** There is some horseback riding to the top of the butte, but use is light, with no substantial impacts at this time. Other activities on the Butte include photographers, fire lookout enthusiasts, and those interested in nature study. Use continues to increase as the surrounding community of resorts and permanent residents grows. The high visibility, and ease of access compounds the popularity of the Butte. Sanitation has been a problem in the past, but the portable toilet provided at the trail head seems to have alleviated some of the problems.

The Deschutes Forest Plan directs that the "Metolius Special Interest Management Area (including the top of Black Butte) will provide the recreation activity, setting and experience opportunities of the Recreation Opportunity Spectrum Category of semi-primitive nonmotorized." In many situations the experience offered at the top of Black Butte is outside this category for: social encounters (supposed to be 6 to 15 parties a day), number and type of physical structures, and the type of interpretation signing (represented by the old interpretive signs). The Forest Plan should be reassessed to define a suitable goal.

Landscape Area 6 (Cache) is well roaded with scattered parcels of private land. There is not a lot of public use in this area. There is some OHV and equestrian use, and in the fall the area gets some hunting pressure. There is likely to be some difficulty maintaining road closures in this area.

Landscape Area 7 (Suttle Lake) The Suttle Lake area includes Suttle Lake, Blue Lake, Scout Lake, and Dark Lake. The area gets some of the heaviest public use in the Metolius Watershed. There are four campgrounds, two day use areas, three resorts on public land, and two resorts on private land. At Suttle Lake high densities of people partaking in a number of activities makes the area seem highly developed. Uses in the Suttle Lake area include: swimming, picnicking, fishing, water skiing, camping, mountain bicycling, hiking, jet skiing, sailboarding, and boating.

Suttle Lake is the only lake in the area where higher boat speeds are allowed. **High speed boat activity results in wave action (also caused by the wind) that erodes the banks along the lake. This, along with the hiking, mountain bicycling, and boat mooring on the shore has resulted in**

deterioration of the lake shoreline. Other factors causing erosion are user trails down steep banks, and poor drainage patterns off of roadways in the campgrounds. Recently watershed restoration projects in the Suttle Lake area contributed to rehabilitation of the lake edge and the banks.

Recreation use data for 1975, count 9,500 recreation visitor days (rvd's) in Blue Bay Campground; 13,600 rvd's in South Shore; and 18,000 rvd's in Link Creek. In 1993, the figures were 6,803 rvd's in Blue Bay; 14,687 rvd's in South Shore, and 13,373 rvd's in Link Creek campground. As in other places in the watershed overnight use is down slightly, but day use has increased significantly. There are conflicts that occasionally arise between fisherman and water skiers; between sailboarders and water skiers; between sailboarders and fisherman; between swimmers and water skiers; and between mountain bicyclists and hikers, and between jet skiers and other water users.

Resorts add to the use on Suttle Lake. The Suttle Lake Resort and Suttle Lake Methodist Youth Camp are on or adjacent to the lake on Forest Service land, but their use is concentrated at the lake. Camp Davidson is located on private land adjacent to Suttle Lake, and their use also is oriented toward the lake. Within the campgrounds at Suttle Lake heavy recreation use over time has resulted in the loss of ground vegetation and vegetative screening between campsites.

The spruce budworm outbreak stressed many of the trees resulting in renewal of high numbers of hazard trees in the last two years. **This loss of overstory trees has meant some increase in ground vegetation within the campgrounds, but there are still large bare areas that are in need of some vegetation rehabilitation. Compacted soils are also a concern.**

Suttle Lake has large algae blooms that turn the lake a pea green color. The cause of these blooms is not known, but they appear to be getting worse.

Other lakes in the LA are smaller and do not get the diverse types of use that Suttle Lake does. Blue Lake is mostly on private land and its deep waters and deep blue color make it a popular destination. Dark Lake is surrounded by Camp Tamarack, a resort under permit to the Forest Service. Scout Lake is a shallow, small lake that is used primarily for swimming. Scout Lake occasionally experiences high levels of fecal coliform during periods of warm weather and low water levels.

Landscape Area 8 (Upper Tributaries) This area includes the upper reaches of the tributaries and Round Lake and Jack Lake. The small campground at Round Lake has been closed for two years because of hazard trees. There is significant erosion occurring along the road through the campground down to the primitive boat launch area (numerous roots are exposed). There could be a problem of uncontrolled vehicle access to the area once the trees are removed and the gate removed. The high cost of rehabilitation and redesign may prohibit reopening the site as a developed campground. At Jack Lake the lake shore gets a lot of impact from hikers, day users and horses. The water level in this

lake can drop substantially through the summer exposing its wet shoreline to trampling. There are isolated dispersed campsites on a number of the tributaries, but access to the creeks is usually difficult (preventing the concentrations of campsites found on the lower stretches of the creeks) because of the deep draws where most creeks are located. There is some OHV use in this area, especially north of Jack Creek.

Use in this area include: dispersed camping, fishing, hunting, mushroom hunting, OHV use, wildlife viewing, firewood cutting, and hiking.

Landscape Area 9 (Green Ridge) This area at the end of Green Ridge gets very little use by the public. There is some hunting in the area. This area does include the Castle/Cathedral Rocks Special Interest Area, which is part of the Metolius Special Management Area. This area is to be managed as semi-primitive non-motorized, and part of it is in roaded modified.

Landscape Area 10 (Scarp) The Green Ridge area is steep and mostly unroaded. Road 1480 provides access between the upper Metolius Basin and Lake Billy Chinook. The road also provides some of the most dramatic views of the Metolius drainage and the Cascade Range to the west. The only social activities occurring in any regularity are photography and driving for pleasure. There is some grouse and deer hunting.

Landscape Area 11 (Lower River) The Lower Metolius Basin is only accessible by Road 1499 on the east side, and the road into Candle Creek on the west side. Upstream from Lake Billy Chinook, the area is accessed via County Road 64. There is considerable dispersed camping occurring, with many of the campsites and access roads well within 100 feet of the river's edge. Lower Bridge, Candle Creek and Monty Campground are the three campgrounds within the LA. Lower Bridge Campground is a fee campground, and both Candle Creek and Monty Campgrounds are rustic non-fee sites.

Recreation uses on the lower river include camping, hiking, fishing, hunting, OHV use (although technically not legal, it is occurring), rafting and kayaking, horseback riding, and mountain biking. Dispersed camping is heaviest early in the season on holiday weekends, and occasionally includes large groups. Launch areas for boating the lower river are at Bridge 99, and the takeout is just above Monty Campground.

Because of access problems in the lower river fire danger, especially above Monty Campground, is a concern. **Other identified problems associated with recreation are: uncontrolled roading resulting in erosion and vegetation loss; bank erosion resulting from hiking and angling access; loss of instream woody material; litter; wildlife harassment; crowding; and erosion from roads.**

Outdoor Experiences

A questionnaire given to a cross-section of visitors in order to gain a better understanding about public use and concerns associated with the Metolius Watershed. Questionnaires also were distributed internally and in newspapers. The following is a summary reflecting the general character of the comments received.

Overview: There are diverse groups of people that use the Metolius Watershed: Wilderness backpackers and visitors from out of state (or country) staying at one of the resorts; hikers in the Wilderness and OHV users; mushroom pickers, firewood gatherers and timber harvesters; fly-fishers and summer home owners on the Metolius; RV campers at Suttle Lake and tent campers in the Meadow Lakes Basin.

There is an overriding concern that more people, more cars, and more home construction are having a detrimental impact on the Basin. The overall message from people is, "keep the Basin as natural as possible", or "return the area to a more natural environment", where fire is used to manage the environment and maintain the "park-like stands of trees", "the big trees". "Keep the small community feel" was another message frequently heard, especially by those who live, or have lived in the Metolius Basin.

Vegetation: People are worried about the loss of "ancient trees" and "old growth ponderosa pine. There are more created openings (by timber harvest), the understory is denser, and there are more dead trees. Some people suggested: "More prescribed burning"; introduce natural fire; manage timber with emphasis on forest health; and open up stands of ponderosa pine.

Wildlife, Fisheries, and Water Quality: Concerns were raised over "more pollution", "fishing is getting poorer", "steambanks are breaking down", and "there are more elk" and "fewer deer". People want to see the "riparian area protected", "additional stream enhancement", and a "better managed fishery". It is important to protect the "water quality" and the "native fish need to be saved".

Recreation/Visitation: People are seeing more visitors to the Basin, "there are more types of use", and there "is more firewood and mushroom gathering occurring". "Further use of the area must be guided with restraint and firmness...". There should be more management of people, and "more information provided to the visitor" so they better understand the challenges of the Metolius ecosystem. People like the camping experience along the river, but some are also concerned about the impacts of this human pressure on the river. There are a number of people who like the "undeveloped campgrounds" along the river, and want that experience protected.

Several people addressed summer homes, but there was a difference of opinion, some said "get rid of the summer permits/structures" and other people wanted to maintain the homes because they were an integral part "of the character of the Metolius Basin".

Travel/Access

Historic Condition

Many of the roads of today follow the trails of yesterday. General Land Office (GLO) maps from the 1860's and 70's, which coincide with the homesteading of the earliest white settlers through the early 1900's often refer to "Indian Trails" with a general location depicted on their plats. Those maps can often be compared to the same routes used by today's roads. The GLO maps are about the only representation of those early travel routes that are available today. There was an easily understood progression from one type of travelway to another based on the predominate travel mode, from trail to wagon road to horseless carriage.

A few of those trails are not represented by routes or traffic flows today. For example there are trails coming off of the Cascade Summit in several areas running northeast that are labeled "Trail to Warm Springs". Probably because of closing off the Warm Springs Reservation to outside travel these trails have dimmed and disappeared.

Several trails converge at the base of Black Butte (on the west side) before turning north to the Metolius or south towards Sisters. This undoubtedly resulted from using Black Butte as an landmark point for cross country travel.

From the earliest settler days there were attempts to access the Metolius and Central Oregon area from Linn and Benton Counties through a low spot west of the Metolius. There was also a desire to travel to Eastern Oregon and Idaho through this area. Originally known as Wiley's Trail, this low spot through the Cascade Mountains later became the Santiam Pass. The current location of the highway through this pass was called "Hogg Pass," while at that time the name Santiam Pass refereed to the route of the Santiam Toll Road about three miles south of Hogg Rock. One of the early attempts to formally address the need for transportation over that route was a wagon road project in about 1865. An 1897 GLO map labels the roadway through here as the "Willamette Valley and Cascade Mountain Road". This route passed south of Suttle Lake and Cache Mountain, to the base of Black Butte and on to Camp Polk. The Linn Road Company received alternate sections of land through this area as compensation for its work on this road. The checkerboard land ownership pattern we see in this area today is a remnant of that land grant system. This and other roads in the area were replaced by construction of Hwy. 20 in the present location in the 1930's.

Existing Condition

Highway 20 is the busiest highway pass in the Oregon Cascades. Most of the traffic passing through the area is going between the middle and southern Willamette Valley and Central Oregon and points beyond. An estimated 20 to 25% of the traffic turns off between Sisters and the pass

summit, including traffic into Black Butte Ranch, Camp Sherman, and the Suttle Lake Recreation Area. The rest (300-400 vehicles per day) is probably dispersed forest recreation traffic.

Traffic classification in the late 1970's and early 1980's found that even on traditional timber haul roads such as Forest Road 12 the traffic (vehicle numbers) was predominately recreation users (typically 85 to 100%.)

There are generally two types of recreation travel. 1) Those using the road to access another site and continue their travel in another mode such as on foot, bicycle, or horseback (from trailheads) or boat (from boat ramps) and/or other access along the river or several lakes, or 2) those driving for pleasure, in which case they will tend to travel a looping route to present themselves with new scenery rather than back track past the views that they have already seen.

Commercial Use

Historic Condition

Early timber harvest was primarily risk cutting, and treatments were focused on declining trees. Harvest areas were determined and/or limited by the capabilities of the machinery (which typically could not access areas with greater than 30% slope), as well as access routes, roads and railroads. A majority of the local roads were built between 1940 and 1970. The 1970's mark the transition from risk cutting towards silvicultural prescriptions. Clearcutting became common in mixed conifer forests and partial cut treatments in ponderosa pine. Machinery evolved allowing access into steeper terrain. Much of what appears harvested, was treated by prescription in the 1970's and 1980's. Harvest activities slowed down substantially in the early 1990's.

All cinder pits in the watershed were opened between 1953 and 1972, and were used primarily as sources for road surfacing material for timber access roads. Two gravel pits (Metolius Junction, Cache Creek) were established prior to 1943, along Highway 20 and were used for base and surfacing material when the highway was built. Dry Creek Pit (on private land) was opened between 1943 and 1953, and was probably used in the construction of the Brooks-Scanlon logging railroad grade (Jensen 1995). The Black Butte Pit was opened in 1970, and the adjacent Diamond Pit (on private land) probably opened at about the same time. There is a small area on Green Ridge where minor amounts of clay were extracted sometime between 1953 and 1972.

Leasing for geothermal exploration first became available on federal land in 1974, accompanied by a flood of lease applications. Many leases were issued between 1982 and 1987, at which point they began to drop off. Geothermal exploration holes have been drilled on Santiam Pass, at Blue Lake, above Bridge 99, near Abbott Butte, and on the slope of Green Ridge (Chitwood 1995).

Commodity Resources

With the exception of the steep scarp of Green Ridge and the Wilderness areas, timber harvest activities have taken place throughout much of the watershed. Recently however, there have been limited harvest activities. The availability of poles(generally associated with harvest treatment areas) has been limited due to the decrease in harvesting.

Firewood is the largest component of the special forest products program on the district. Currently, there is one designated cutting area (West Metolius) within the watershed. Mushroom picking (both commercial and personal use) is a fast growing activity. In 1990, there were 20-30 commercial mushroom permits (on the district), compared with 300-400 permits in 1995. Picking occurs from April to June and Morells and Bolectes are the most common types. Little is known about where or how many people are picking mushrooms. Cones, personal use transplanting, commercial transplanting, poles, boughs, and decorative wood are the other active components of the special forest products program. In addition to these, there are many new requests for other products which are not currently included under the special forest products program (Heath 1995).

There are a total of thirteen cinder cones and material sources have been developed on four of them. Of these four sources, one is active, one is inactive, and two are closed. Shilling Cinder Pit is a large, active pit. Most of its past use was associated with road development in the Metolius Basin. Today it is the community source (small local users) for the Metolius Basin and is occasionally used for small road projects. It is the major cinder source in the watershed. Approximately 100,000 cubic yards have been taken from this site. Cache Cinder Pit is an inactive pit from which approximately 10-20,000 cubic yards have been removed (Jensen 1995). Round Lake Cinder Pit (closed) is relatively small and is now substantially overgrown with vegetation and difficult to locate. Suttle Cone Cinder Pit (closed) is a small source located high up on a cone in a highly visible area. A total of approximately 1,000 cubic yards were taken from this source sometime prior to 1972, and has not been used since. Additional use would likely be highly visible.

Material sources associated with gravels occur primarily in conjunction with glacial outwash deposits. Good quality gravel deposits are not a common geologic feature on the Deschutes National Forest. Therefore, gravel sources managed by the Deschutes National Forest are not open to the public, they are reserved for use by federal, state, and county agencies. There are five gravel pits within the watershed, two are on private land. Of the ones on Forest Service land, two are closed and one is open. Metolius Junction Gravel Pit (closed) and Cache Creek Gravel Pit (closed) were created during the construction of Highway 20. They have not been rehabilitated and there has been material dumping and storage in the pit areas. Black Butte Gravel Pit (active) was created in 1970, and is currently being used. A average of more than 10,000 cubic yards per year is removed and the pit has a potential life span of about another 50 years. Diamond Gravel Pit is on private land, just north of and adjacent to Black Butte Gravel Pit. Dry Creek Gravel Pit is

on private land and is located northwest of Diamond in the same section. Additional good quality gravel prospects have been identified in the several areas of the watershed.

Hard rock material sources are not common on the Deschutes National Forest. These are managed under the same guidelines as gravel sources. There are no hard rock sources within the watershed but several prospects have been identified. There is a hard rock source on the Willamette National Forest at Hogg Rock on the Santiam Pass just west of the watershed. The nearest Deschutes National Forest hard rock quarry (Sullivan Quarry) is located on Green Ridge east of the watershed. The material at this site is nearly exhausted and an EA. has been completed for a new quarry (East Sullivan Quarry) one mile further east.

Clay is not commonly found within the watershed, district, or forest. There are two small areas of clay-like material north of Black Butte on Green Ridge. Both of these areas are associated with vernal pools and represent an uncommon aquatic habitat. Outside of the watershed the east is an active clay pit, Edgar Lake. The entire clay source is estimated to amount to approximately 100,000 cubic yards. This amount of material could potentially be entirely depleted with one large project.

Within the Metolius Watershed the area from the Cascade crest on the western edge over to the Metolius River could be considered to have moderate potential for geothermal energy (relative to the rest of Central Oregon). From the Metolius River, eastward, the potential drops to low (Chitwood 1995). There are lands near Suttle Lake with existing geothermal leases. Also, in an area described roughly as a northwest band across LA 8, north of ThreeFingered Jack, there are numerous geothermal lease applications.

Other commercial uses consists primarily of the activities associated with the recreation resorts at Camp Sherman and Suttle Lake. The resorts are an integral part of the Central Oregon economy.

Utilities

Historic Condition

Powerlines were constructed to the resorts and summer homes in the Camp Sherman area many years ago. On 1915 maps, telephone lines ran from guard stations and lookout towers on the Warm Springs Reservation to the Allen Ranch. Telephone lines connected Forest Service lookouts, guard and ranger stations throughout the area. Irrigation ditches carried water from the east slope of the Cascades via Jack Creek and Lake Creek ditches to fields in the Metolius Basin.

Existing Condition

Many types of utilities are under Special Use Authorization within the watershed. The Deschutes Land and Resource Management Plan has standards which address utilizing existing corridors to capacity and grouping utilities within corridors to minimize the area committed to utilities.

One of the few windows in Oregon that exists to tie utilities east and west is located in Landscape Area 3, the Santiam Highway Corridor. Since congressionally designated Wilderness Areas flank the Cascade Mountain Range for most of Oregon, the few areas of non-Wilderness (south Crescent Lake area, Highway 58 and Highway 20 are the only ones centrally located in the State) become valuable for utilities and other facilities.

In 1993-1994, the Pacific Gas Transmission Company studied the Santiam Pass as an alternative for natural gas transmission from the major North/South transmission lines east of the Cascades to serve the Willamette Valley. This area was dropped from complete study due to the presence of interim protection measures for late successional habitats in the Northern Spotted Owl Recovery Plan. However, this corridor still remains important to utility transmission east and west in the State.

Trends

Heritage Trends

The Forest is in the process of developing a Heritage Preservation Plan that will prioritize preservation treatment and management of classes and specific types of archaeological sites. Data from all sites that have been recorded are stored in computer databases in the Forest GIS locations. There will likely be future inventory, monitoring, archaeological testing and data analysis on sites within this watershed. Sensitive sites, such as at Suttle Lake Resort and Camp Sherman, will require protection to prevent vandalism and destruction. Other sensitive sites such as the Black Butte structures, will need rehabilitation, maintenance, and interpretation to the public.

Trends for prehistoric sites are mostly slow deterioration of prehistoric sites that are present in existing developed locations such as campgrounds and the Camp Sherman area. Few and scattered efforts have been made to mitigate or stop impacts to these sites.

Trends for historic resources within the watershed include backlog maintenance for most historic structures with replacement or heavy modification being favored over maintenance or rehabilitation. Historic travel routes are largely modernized and retain little historic character. Overall, historic resources within the watershed are slowly disappearing. There has been a well established historic use of recreational sites and a desire to preserve and protect important cultural sites and unique recreation experiences.

Scenic Condition/Landscape Trends

Trends affecting scenic quality within the watershed include: past and current management activities, continuing and increasing recreation use, and natural disturbance cycles (insects, disease, and wildfires). Trends vary by Landscape Areas. The dominant trends affecting scenic quality for each Landscape Area are described below:

Landscape Area 1 (Wilderness)

- Continuing overnight use and increasing recreation day use (crowding, trampling of vegetation, compaction of soils). Management concern for managing to allow naturally occurring fires.

Landscape Area 2 (Central Basin)

- Continuing overnight use and increasing recreation day use (crowding, traffic congestion, trampling of vegetation, compaction of soils, impacts on facilities, new development).

- The effects of fire exclusion and past harvest practices in ponderosa pine and mixed conifer vegetation communities (dense stands, fewer large trees visible, graying of mixed conifer stands, risk of wildfire).

- Recreation use along riparian corridors and at the Head of Jack Creek (soil compaction, bank erosion, trampling riparian vegetation, hazard tree management).

- Decrease in large trees from past harvest activities (fewer large trees visible, road development).

Landscape Area 3 (Hwy. 20 Corridor)

- Increasing traffic on highway and increasing recreation day use (crowding, traffic congestion, increasing expectations for scenic quality, impacts on facility development).

- The effects of fire exclusion in ponderosa pine and mixed conifer vegetation communities (hazard tree management, dense stands, fewer large trees visible, graying of mixed conifer stands, risk of wildfire).

- Visibility of insect and disease mortality in the foreground forest.

Landscape Area 4 (Meadow Lake Basin)

- Continuing overnight use and increasing recreation day use(crowding, trampling of vegetation, compaction of soils, impacts on trails).

- The effects of fire exclusion in mixed conifer vegetation communities (dense stands, fewer large trees visible, graying of mixed conifer stands, risk of wildfire).

- Recreation use along lakes edges (soil compaction, bank erosion, trampling riparian vegetation).

Landscape Area 5 (Black Butte)

- Increasing recreation day use at the summit (crowding, trampling of vegetation, compaction of soils, impacts on facilities), and the inconsistency with the semi-primitive nonmotorized ROS objective.

- The effects of fire exclusion in mixed conifer vegetation communities (dense stands, fewer large trees visible, graying of mixed conifer stands, risk of wildfire).

- Visibility of past harvest activities and proximity to Scenic Byway.

Landscape Area 6 (Cache)

- The effects of fire exclusion in ponderosa pine and mixed conifer vegetation communities (dense stands, fewer large trees visible, graying of mixed conifer stands, risk of wildfire).

- Visibility of past harvest activities (breaks in the forested canopy, road development).

- Visibility of insect and disease mortality.

Landscape Area 7 (Suttle Lake)

- Continuing overnight use and increasing recreation day use (crowding, traffic congestion, trampling of vegetation, compaction of soils, impacts on facilities).

- The effects of fire exclusion in mixed conifer vegetation communities (dense stands, fewer large trees visible, graying of mixed conifer stands, risk of wildfire).

- Visibility of insect and disease mortality.

- Recreation use along the edge of the lakes (soil compaction, bank erosion, trampling riparian vegetation).

- Loss of water quality from increase in algae blooms on Suttle Lake.

Landscape Area 8 (Upper Tributaries)

- Increasing use at the wilderness trailheads (traffic through the area, impacts on facilities).

- The effects of fire exclusion in mixed conifer vegetation communities (dense stands, fewer large trees visible, graying of mixed conifer stands, risk of wildfire).

- Recreation use along riparian corridors (soil compaction, bank erosion, trampling riparian vegetation).

- Visibility of past harvest activities (fewer large trees visible, road development, breaks in the forested canopy).

- Visibility of insect and disease.

Landscape Area 9 (Green Ridge)

- The effects of fire exclusion in ponderosa pine and mixed conifer vegetation communities (dense stands, fewer large trees visible, graying of mixed conifer stands, risk of wildfire).

- Visibility of past harvest activities (road development, breaks in the forested canopy).

Landscape Area 10 (Scarp)

- Continuing overnight use and increasing recreation day use in surrounding areas (increased amount of visual sensitivity).

- The effects of fire exclusion in mixed conifer vegetation communities (dense stands, fewer large trees visible, graying of mixed conifer stands, risk of wildfire).

- Visibility of past harvest activities.

Landscape Area 11 (Lower River)

- Continuing overnight use (at the campground) along riparian corridors (soil compaction, bank erosion, trampling riparian vegetation).

- Continuing use along the wild and scenic river (high expectations for scenic quality).

Recreation Trends

Recreation use has a big impact in the watershed, and it is clear that these uses will continue, and in most cases actually increase. There maybe new uses that develop in the coming years that we have not even heard about, particularly day use. All we have to do is go back 25 years and who would have imagined the type of motor homes we now have using our campgrounds, or who would have predicted that bicycles would have evolved into mountain bikes, or that windsurfing would be a major activity up at Suttle Lake.

In this section we will treat the trends by activity since many of the activities occur in several LAs and there is not much difference in trends by Landscape Area.

The following recreation trends are extrapolated from the Recreation Demand Information Statewide Recreational Need for Central Oregon (SCORP). Categories are added when the SCORP chart did not cover all of the recreational activities occurring in the Basin. Remarks are added based on personal observation, and comments from the public and employees in recreation.

Recreational Activity Demand

Freshwater Fishing - The category as listed in SCORP refers to bank fishing which is not fully applicable to the Metolius Watershed, so we have adjusted slightly. The Metolius River is a world class fly fishing stream open year round that draws people from around the US and the world. Flyfishing is allowed only above Bridge 99, open fishing for a ¼ mile stretch below Bridge 99, and fly or lure fishing with barbless hook below this point. The projected increase for the category in SCORP for Central Oregon is 60%, however it is hard to relate this to fly fishing since it is very different from general bank fishing. What is true however is that fly fishing is increasing and most of the use is above Bridge 99, and most of that use is above Gorge Campground. The riparian area is showing impacts from the fishing pressure, and the impacts are greatest during the wet seasons of the year. Although the increase of 60% might be high, it wouldn't be surprising to see a 30% increase in use. There may be some drop in use if the state stops stocking the river, but that drop in numbers will be offset by people who come to the river for the "wild trout" experience.

Lake fishing on at Suttle Lake is primarily trolling or still fishing from a boat. This use is heaviest during the opening day weekend of fishing season and has other peaks during the season dependent on fishing success levels. The size of the lake and the number of campgrounds limits the number of boats and anglers that can use the lake. We do not expect numbers of anglers to increase much on the lake.

In the Meadow Lakes area numerous small lakes get irregular fishing pressure. We do not expect fishing use to increase significantly in this area. This also applies in the wilderness lakes.

Boating - The SCORP survey only lists Boating in reference to lakes. On Suttle Lake the size of the lake limits any increases in numbers, and we don't expect any increases due to the size of the lake and limited number of campgrounds and day use areas around the lake. Waterskiing, fishing, and windsurfers seem to distribute themselves safety across the lake. A new concern is the addition of jet skis. Other lakes in the watershed are very small and the size again limits the number of boats on the lake, with no significant changes expected. There is nothing listed for rivers, yet there is boating on the Metolius primarily in rafts, kayaks, or white water canoes. There has probably been a slight increase in the number of boaters over the last five years, but it is unlikely that there will be any large increase in numbers because the river is a day use experience that requires a lengthy car shuttle to the take out area. The Wild and Scenic River plan will have an effect on boating on the river.

Nature, Wildlife Observation - The SCORP survey calls for an increase of 145% in Central Oregon. Nature and Wildlife observation is one of the reasons people come to the Metolius Watershed. Hiking the trails or just sitting in camp provide opportunities for nature observations whether it is the warbler in the riparian shrubs, the geese along the river, the osprey flying overhead fishing, or simply viewing the wildflowers. They are all popular activities and numbers of participants are increasing. There are frequently over 200 people a day visiting the Head of the Metolius River on weekends, and probably 30 to 50 people a day on weekends visiting the Head of Jack Creek (although this figure is harder to verify). A good part of the driving around is nature observation, as is the hiking in the Wilderness.

Hunting - In 1994, 2,200+ deer tags were issued for the Metolius. Tag numbers and hunting opportunities will fluctuate with game management objectives, but 1994, was probably lower than average due to high winter losses in 1992-93. Grouse, bear, and turkey are also hunted in this watershed. Hunters are the largest user group for dispersed campsites.

Outdoor Photography -With the scenery in the Metolius Basin people coming into the Basin will have a camera in hand. It is difficult to measure demand for this activity, but it is likely that it will continue to grow.

Day Hiking on Trails - The Metolius River trail continues to get heavy traffic. Projections for Central Oregon are that use will increase by 94%, and this could include the Metolius. There is currently no record of actual use on the trail, but certain segments get very heavy use. The loop trail between Wizard Falls Fish Hatchery and Bridge 99 is getting increasing use by anglers and hikers both. The trailhead at Lower Canyon Creek Campground usually contains five or more cars on weekends. The stretch between Gorge Campground and Camp Sherman gets very heavy use. The trail tread along the Metolius River trail is showing signs of deterioration, and where anglers enter the river from the trail there is frequently erosion.

The Head of Jack Creek and Head of Metolius Trails also receive significant and increasing foot traffic. The Head of Jack Creek will receive an assessment this summer to

determine ways to reduce the riparian vegetation damage that is occurring around the Headwaters. Day use hiking into the Wilderness is increasing and is having a significant impact on the trails and the amount of solitude offered users.

Camping Recreational Vehicle/Tent With Motorized Vehicle - It is difficult to differentiate these uses since people can camp at sites that are open to both types of use. Recreational vehicle needs are projected to increase approximately 64% and tent camping approximately 33%. Right now we seem to a stable level of use in the Basin by both groups. As the "baby boom" generation grows older we may see an increase in Recreational Vehicle use. Use in campgrounds seems relatively steady and it doesn't appear to be fluctuating much (most of the fluctuation probably attributed to weather). The campgrounds are generally full on weekends from the time school is out until Labor Day (and full on Memorial Weekend), but use drops off to an average of about 40% on weekdays. The Suttle Lake area gets similar types of use. We don't expect use levels to increase significantly for overnight camping.

Outside of developed campgrounds there is dispersed car camping occurring in moderate to significant amounts in LA 2, 4, 8, 9, and 11. This use is heaviest earliest in the summer season, with some other peaks during the rest of the summer, and then again during hunting season. Changes in use are going to depend somewhat on management strategies that effect dispersed camping in other areas. If things do not change we can continue to expect to see increases in use that have significant impacts on the environment along streams and lakes.

Overnight camping in Wilderness has declined since the peak of the 1970's, and use is expected to stay at about the same level as current.

Camping Organized Group - There are no organized group camps other than the Redmond Saddle Club site that is operated under special use permit. There is a need to identify suitable sites within campgrounds that can accommodate larger groups. Especially on holiday weekends large groups will frequently squeeze into campsites that are inadequate for accommodating their needs.

Cross country Skiing - This activity is highly dependent on snow. Skiing is an incidental activity because of the unreliable snow in all but the higher reaches around Santiam Pass. There is significant skiing occurring in the Santiam Pass area of LA 4, and this use seems to have stabilized, with weather and snow conditions controlling levels of use. We do not see any significant change in skier numbers.

Bicycle Riding On-Road - Use is projected to increase 114% in Central Oregon by the year 2000. While use will increase in the Metolius Watershed, bicycle riding is strongly correlated to use levels in the campgrounds and resorts. This use is not expected to increase at levels that exceed 100%. Since trail riding is strongly limited much of the use ends up on roads, especially Roads 14 and 1490 (through Camp Sherman and by most of the campgrounds along the Metolius River).

Bicycle Riding Off-Road - The number of trails open to bicycles is currently limited. There are some opportunities for riding on roads that have been converted to trails, and this could increase as more roads are closed. Most of the bicycles coming into the Basin are mountain bikes, so any access to trails, or closed roads, would be sought after by people bringing mountain bikes. The trend for most of the bikes to be mountain bikes will continue. Projections are for this type of use to increase 40%, but I see this use increasing at a higher level (certainly the last few years have seen use of mountain bikes increase more than 40%, although most of this use is currently on existing roads it could easily shift if trails or more closed roads are added to the system).

Horseback Riding - Use seems to be increasing. There are limited numbers of trails open to horses, and the Sheep Springs and Redmond Saddle Club are the only two facilities set up for horse camping. What we are seeing is heavy numbers of horse campers dispersed camping on some of the tributaries to the Metolius River (currently most of the use is occurring along Canyon Creek). The only trail currently open to horse use is the Metolius-Windigo trail and the Wilderness access trails, but there is a lot of riding occurring on dirt and gravel roads and on closed roads or user developed trails. Projections are for this use to increase 19%, but current results show the use increasing at higher levels (probably closer to 40 to 60%).

Picnicking - Projections are for this use to increase about 40%. What we are seeing though day use numbers seem to be increasing at levels higher than 40%. Not all of the day users are looking for a place to picnic, but places for picnicking are limited and poorly advertised. With more space it is likely that picnicking would increase beyond 40%.

Sightseeing - Resorts, rapidly growing neighboring communities and the camping public within the Basin are swelling the number of sightseers. Projections are for this group to increase 44%, but observation leads one to believe that numbers in this category are higher. There is more and more use on roads that were hardly traveled in the past, and more and more people asking about what is available. A better figure might be closer to 60 to 80%.

Bus Touring - The watershed is currently receiving very little bus tour activity. School bus tours visit the fish hatchery, fish viewing station, and Head of the Metolius. Since actual bus tour operations would require a special use permit, it is unlikely that use will increase significantly.

Off-Road/On Road ATV (OHV) Vehicle Driving - The areas that get significant amounts of OHV use have been effected heavily. This is particularly true of LA 4 and 11. There is also some significant use in LA 8. Use levels seem to be increasing in LA 4, and staying about the same in LA 8 and 11. Use levels will continue in this trend unless management actions change.

Travel Access Trends

Significant increases in population both in the Willamette Valley and Central Oregon will cause increases in traffic on Highway 20, as well as increased demand for developed and dispersed recreational opportunities accessed by forest roads and trails.

Commodity Trends

Trends in timber harvest have been closely tied with harvest technology, access, markets, forest health, the availability of dead material for salvage, and forest management policies. Today, ecosystem management strategies combined with the current forest health conditions are key players affecting management decisions. Recently the NW Forest Plan allocated 50% of the watershed as Late Successional Reserve, 29% is congressionally withdrawn from programmed harvest, 14% is in Matrix, and 2% is administratively withdrawn from programmed harvest (5% is other ownership).

Firewood continues as the largest component of the special forest products program. Mushroom picking (both for commercial and personal use) appears to be increasing rapidly as a popular activity. Demand continues to increase for poles, boughs and cones. Decorative wood and requests for transplanting materials appear to be relatively stable. Demands for boughs, poles, and commercial transplant materials are not consistently met.

The demand for cinders has decreased as crushed gravel and hardrock has become a more common surfacing material for major roads. Currently, there appears to be more supply than demand and this is likely to continue. In selected areas cinders will continue to be the road surfacing material of choice.

The demand for crushed gravel and hardrock increased in the early 1980's as they became more commonly used as road surfacing materials. The supply of gravel within or adjacent to the watershed appears to be meeting the demand for road surfacing materials in the area. This can be expected to continue as long as the restriction of private use of the gravel pits and quarries remain.

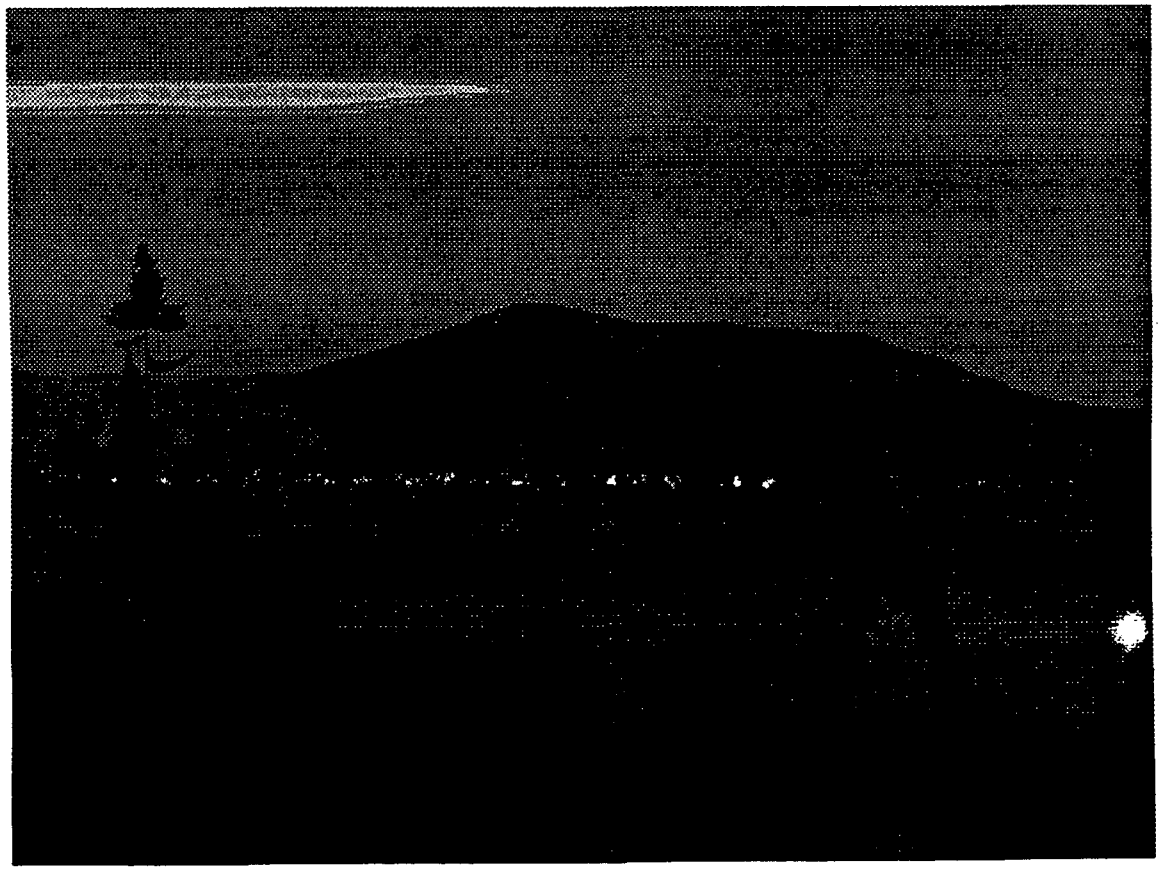
Clay is typically used for lining ponds (farm and golf courses), and irrigation ditches. The demand for clay has been steady and fluctuates relative to these types of projects. If development in the area increases, demand for clay is likely to increase accordingly. The clay source in the watershed is very limited, it would not take much to deplete the entire supply.

There is potentially a great deal of geothermal energy in the Cascades; however, much of the area has not been evaluated. Newberry Caldera and the Tumalo Highlands are considered to have the highest potential in the area. The outcome of drilling (still unknown) at these two areas can be expected to be an important determinant in accessing future geothermal activities in Central Oregon.

The number of resorts and often commercial recreation activities are expected to remain about the same.

Utilities Trends

As population and use of the area continues to grow, increased power demands may necessitate more or bigger powerlines, and other utilities such as telephone lines.



Metolius Watershed

Landscape Goals, Recommendations and Opportunities (Phase E)

Integrated Goals Recommended for All Landscape Areas

Habitat Restoration and Vegetation Management

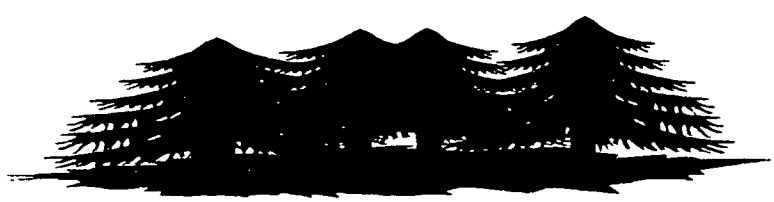
(1) Aim for a balance of vegetation within each Plant Association Group consistent with the historic natural range of variability. This includes consideration of size, structure, species composition, arrangement, distribution and amount. *These are a desired condition, not static, and will change over time.*

(2) Restore late-successional conditions in LSR's, typical of Eastern Oregon Cascade Province when succession of vegetation occurred under natural fire regimes. Provide late-successional habitat so that the Late-Successional Reserves play an effective role in meeting the goals for which they were established.

(3) Reduce potential for habitat loss due to stand replacement wildfires. Protect this habitat from loss due to large-scale fires, insect and disease epidemics and major human impacts so that late-successional ecosystems and biodiversity are maintained.

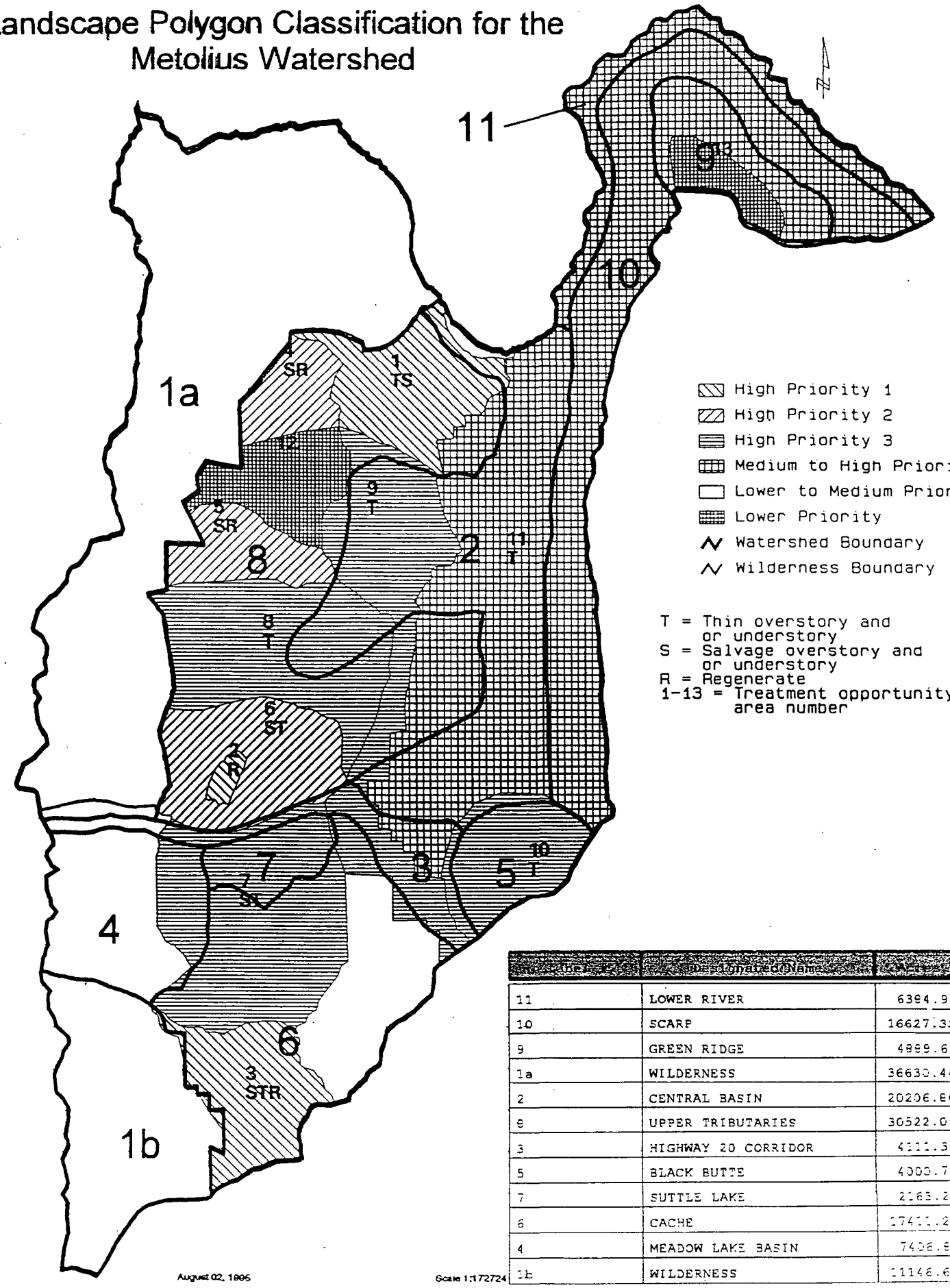
(4) Generate commercial yields of wood as a result of implementing vegetation management opportunities to meet Goals (1), (2) and (3).

(5) Use prescribed fire when possible, either in conjunction with other silvicultural treatments such as thinning, or alone, to achieve Goals (1), (2) and (3). This benefits many species which have evolved with periodic fire.



Vegetation Treatment Priorities

Landscape Polygon Classification for the Metolius Watershed



[illegible]	Designated Name	Acres
11	LOWER RIVER	6394.91
10	SCARP	16627.32
9	GREEN RIDGE	4889.65
1a	WILDERNESS	36630.44
2	CENTRAL BASIN	20206.86
8	UPPER TRIBUTARIES	30522.09
3	HIGHWAY 20 CORRIDOR	4111.30
5	BLACK BUTTE	4000.72
7	SUTTLE LAKE	2163.22
6	CACHE	17411.20
4	MEADOW LAKE BASIN	7406.86
1b	WILDERNESS	11146.66

Recommendations Common to All Landscape Areas

(1) In the ponderosa pine and mixed conifer Plant Association Groups of the Metolius Watershed, reduce stand densities to promote the development of late-successional and old-growth habitats over time, to reduce the loss of large tree habitat, and to prevent large-scale disturbances by fire or insect and disease that would destroy or limit these habitats.

A. In stands with high tree densities and a desired large, medium or small live tree component, reduce the risk of losing these larger trees to insects and diseases or large-scale fires by mechanical and hand thinning and/or prescribed burning the understory and mid-level canopies.

B. In plantations and other stands composed primarily of smaller size classes, promote the development of late-successional, large tree, and old-growth characteristics over time by, pruning, release and/or prescribed fire.

C. Maintain or enhance the large tree character along scenic travelways.

(2) In the dry and wet mixed conifer PAGS, salvage dead and dying material to prevent negative effects to late-successional and large tree habitats (i.e., lower the risk of large-scale fire) and to promote the development late-successional habitats within HRV.

A. In high mortality stands, where natural regeneration of early seral species is unlikely, regeneration treatments can be used to promote regeneration of earlier seral species (i.e., Douglas-fir, ponderosa pine and western larch) where they are lacking. Regeneration units should consider patch sizes and textures created under natural disturbance regimes.

B. Regenerate with larch, cedar, or rust resistant western white pine where these species occur or were present in the past, especially where mistletoe, insects or diseases will prevent other species from reaching medium/large size classes.

C. Large scale salvage (i.e. fire salvage) should proceed with a conservative and careful approach to avoid eliminating future management options and to avoid unnecessary impacts to other resources (i.e., soils). Temporal scales of ecosystem evolution and the value of natural recovery processes should be recognized prior to large-scale salvage, and balanced with the desire to protect still existing late-successional habitat from large high intensity fires and insect and disease caused mortality.

D. Retain some patches of high mortality stands throughout these PAGS to provide habitat for wildlife species.

E. In high mortality areas where there are still some live trees with desirable larger tree habitat structure, remove some of the dead and dying trees to lower the risk of large-scale fires that would eliminate or negatively affect the remaining late-successional and large tree habitats.

F. Large dead and dying trees provide remnant down log and snag components in younger stands. Consider retaining many or all large dead and dying trees, especially in size classes larger than 21 inch dbh in deficient areas to provide these remnant late-successional components. Balance this consideration with protecting habitat from large-scale fires.

G. Old growth remnants can act as refugia for rare survey and manage species. During future vegetation treatments, consider limiting machine entry to benefit known sites of old growth dependent fungi and lichen species and several known Survey and Manage Species with potential habitat in the area.

H. Special aquatic habitats are potential habitat for sensitive amphibian species and neotropical birds. Some of these habitats are at risk from recreational uses and may need special protection.

I. Implement an Integrated Weed Management Strategy across the watershed and District. Place a high priority on prevention measures.

J. Protect scenic quality and enhance landscape character within sensitive viewsheds.

Recreational Experience

(1) Maintain the character of the recreation experience within the Metolius Watershed. This is an area where people can come and have a peaceful, quiet recreation experience. Scenic beauty, majestic pines and large firs dominate the visual character of the area. The recreation experience in the Metolius Watershed has become an endearing resource, one that generations expect to be passed on to their children (and their children's children).

(2) People coming to recreate in the Metolius Watershed are primarily looking for a water based recreation experience. Where possible, respect those desires, and maintain the recreation opportunities associated with water.

(3) In all landscape areas it is important to understand the impact between recreation use and vegetative impacts. In all areas it is important that vegetative management planning associated with developed recreation sites (and in some areas of heavy dispersed recreation use) is completed.

Recreational Guidelines

Some control over use may be necessary to control the numbers, and types of use occurring in the Metolius Watershed if the recreation resource opportunities and experiences that are being sought are to be protected for future generations.

(1) There will be some areas where recreation use will be identified as conflicting with sensitive habitat, or identified as doing unacceptable resource damage. In those areas it may be necessary to close the area to recreation use, or restrict use. In the process of closing an area to recreation use (or restricting use) it is important to analyze the impact of this change on other areas, and before closing an area look at ways of alleviating the problem short of actually closing off an area to use.

(2) Site hardening, and interpretation (promoting land stewardship to the public) need to be the primary tools used in changing patterns of recreation use and behavior within the Metolius Watershed. However these techniques will not work in all cases, and site closures in some areas may be the only available and workable techniques.

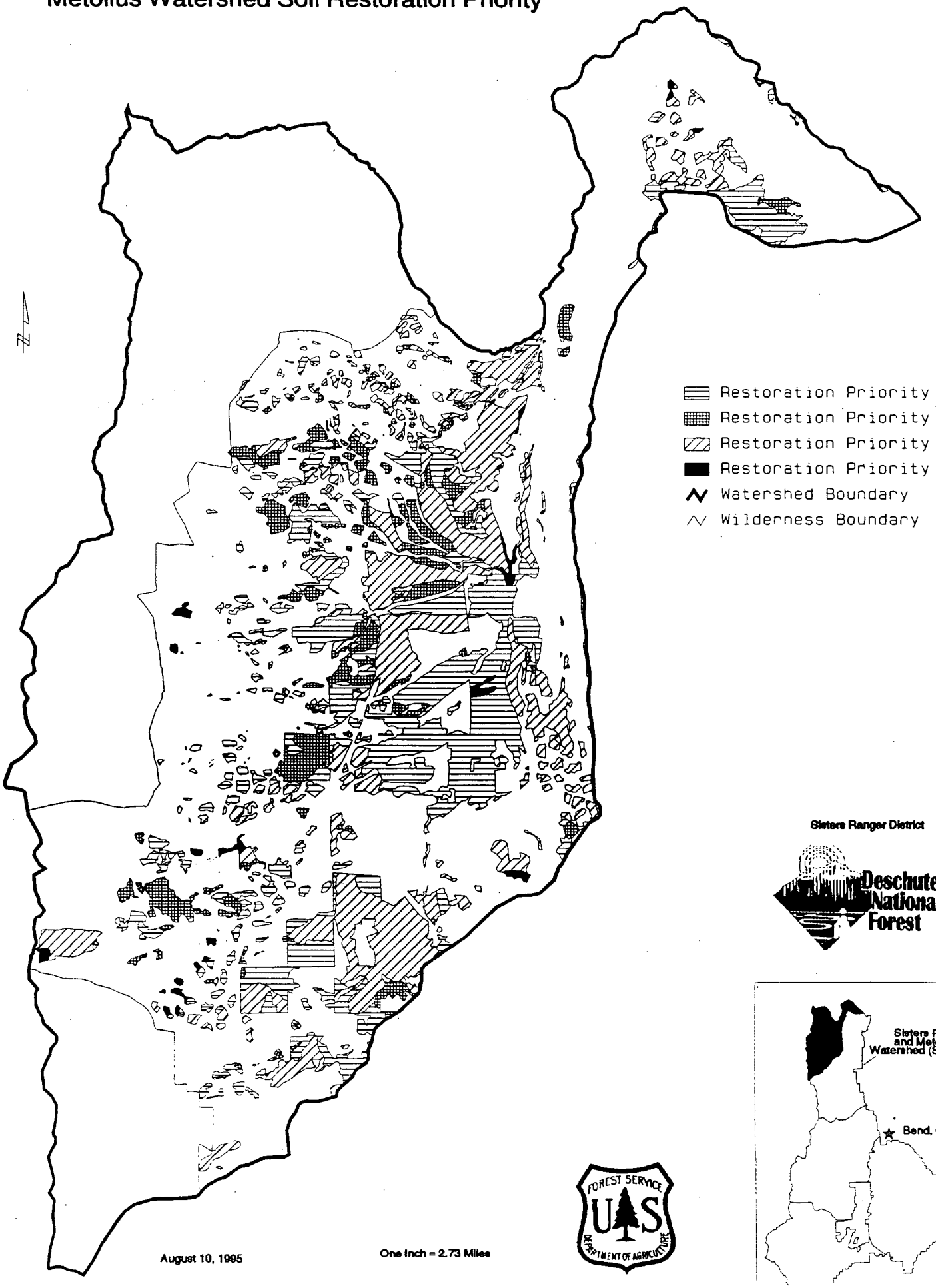
(3) Develop an interpretive strategy for prescribed fire.

(4) Develop and implement a monitoring system for incidental and commercial mushroom picking.

(5) Evaluate opportunities for rehabilitation of unused quarries and pits.

(6) Develop vegetation management strategies for all developed recreation sites.

Metolius Watershed Soil Restoration Priority



Sisters Ranger District

Deschutes National Forest

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August 10, 1995

One Inch = 2.73 Miles

Heritage Resources

(1) A prioritized list of Heritage Resource sites based on significance will aid in developing Heritage Resource Management Plans, the protect significant Heritage Resources, and aid in implementing other activities in the Watershed.

(2) Evaluate prehistoric sites in developed locations. Prioritize work at these locations based on resource significance and rate of destruction. Heritage Resource Management Plans can help to determine what steps are most appropriate for reducing resource destruction from site development

Soil Resources

(1) Develop a long term logging system in areas of ground based harvest to minimize the need for subsoiling.

(2) Subsoiling can be effective in areas that have been detrimentally compacted. Use subsoiling as a restoration measure for areas of ground based harvest to meet Soil Quality Standards.

(3) Identify areas of streamroad intersections where runoff has been concentrated and there is a high risk of sediment delivery to streams. Correct problem by modification of road drainage system. Road closure or road obliteration may be necessary in highly susceptible areas.

Aquatic Conservation Strategy

The Aquatic Conservation Strategy (ACS) as defined by the NW Forest Plan, was developed to "restore and maintain the ecological health of watersheds and aquatic ecosystems contained within them." The primary goals are to identify and maintain the natural disturbance regimes within watersheds, prevent further degradation of habitat, and restore habitats and processes. Management activities proposed for watersheds must meet the ACS objectives as specified in the NW Forest Plan (page B-11). Standards and guidelines have been established for **Riparian Reserves** in the NW Forest Plan (page C31-C38).

There are four components of the Aquatic Conservation Strategy: Riparian Reserves, Key Watersheds, Watershed Analysis and Watershed Restoration. Riparian Reserves have special standards and guidelines to direct activities along streams and other water bodies or potentially unstable areas. **Key Watersheds** serve as refugia of high quality habitat that are critical to at-risk stocks. **Watershed analysis** evaluates geomorphic and ecologic processes and provides basis for restoration and monitoring. Restoration is a long term program to restore watershed health and aquatic ecosystems. **Late-Successional Reserves** play a role as refugia of high quality stream habitat.

The Metolius Watershed was selected as a Key Watershed based on the presence of bull trout and its contribution to anadromous salmonid conservation. Water quality and its contribution to the Deschutes Basin is also an important feature of the watershed. Key Watersheds serve as refugia, which is the basis of most species conservation strategies. High quality habitat within the Key Watershed serves as an anchor for the recovery of depressed stocks. Watershed analysis is required prior to any long term management within the watershed and prior to any resource management in roadless areas. Key Watersheds are the highest priority of restoration.

An important role of watershed analysis is to analyize the interim Riparian Reserve widths and recommend appropriate reserve boundaries that address site specific conditions that are important to

achieving the Aquatic Conservation Strategy. Watershed analysis also sets priorities for restoration and monitoring strategies.

Riparian Reserves (Map 16)

The five basic categories of riparian reserves and their interim widths as outlined by the NW Forest Plan include:

- **Fish bearing streams**: From the edge of the active channel to the top of the inner gorge, edge of 100 year flood plain, edge of riparian vegetation, two site-potential tree lengths or 300 feet slope distance, whichever is greatest.
- **Lake and natural ponds** - Including the body of water to the outer edge of riparian vegetation, to the edge of seasonally saturated soil, or the extent of unstable or potentially unstable areas, or two site potential tree or 300 feet slope distance, whichever is greatest.
- **Permanent flowing non-fish bearing streams** - From the edge of active channel to top of the inner gorge, edge of 100 year flood plain, edge of riparian vegetation, one site-potential tree lengths or 150 feet slope distance, whichever is greatest.
- **Constructed ponds and reservoirs, and wetlands greater than 1 acre** - including the water body or wetland and the area to the edge of riparian vegetation, edge of seasonally saturated soil, edge of unstable areas, one site potential tree or 150 feet slope distance, whichever is greatest.
- **Seasonally flowing or intermittent streams, wetlands less than 1 acre and unstable or potentially unstable areas** - Includes the stream channel and edge of the inner gorge, edge of riparian vegetation, or one site potential tree height or 100 feet slope distance, whichever is greatest.

Refinement of Riparian Reserve Boundaries

Site Potential Tree Height

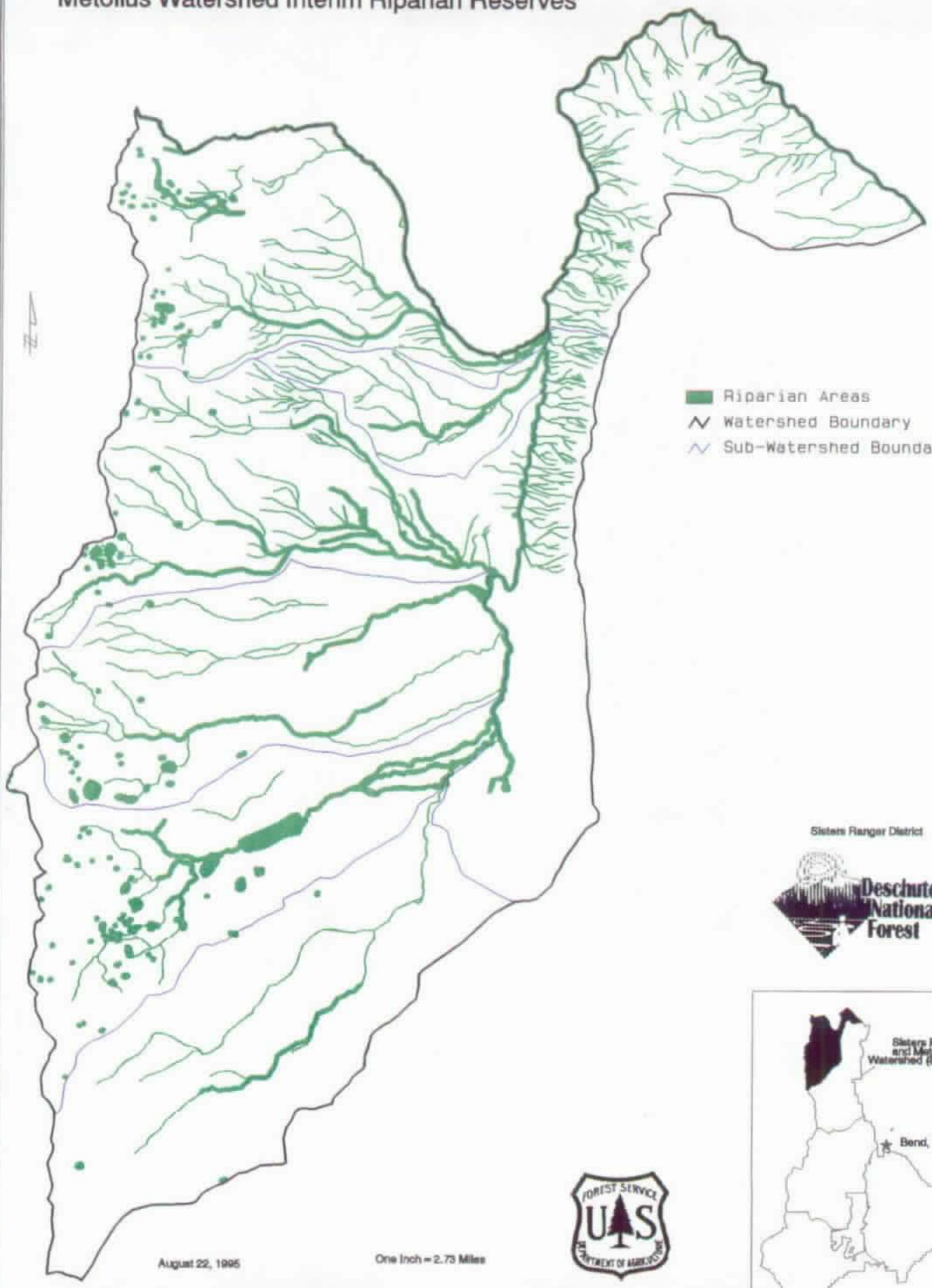
Using site index tables in Volland (1985), pine stands in the watershed averaged 120 feet for all sites at 200 years of age. Site potential in mixed conifer sites averaged 158 feet for Douglas-fir and white fir at 200 years. Riparian site potential tree height in the common associations was 150 feet for ponderosa pine and 146 feet for Douglas-fir.

These average site potential tree heights will be used to establish standard riparian reserve widths. For streams with fish and natural lakes, double the site potential of mixed conifer and riparian associations were used since the vast majority of fish bearing streams within these plant communities. Large wetlands and created water bodies are found near riparian or mixed conifer sites and potential tree heights for mixed conifer associations were used. Many intermittent streams have narrow bands of riparian vegetation within 100 feet of the stream channel. These areas are important for channel stability and filtering of sediments during high flow events. Many intermittent streams have been used as skid roads in the past and wood has been entirely cleaned out to provide open access. For the recovery of wood and the maintenance of streamside vegetation, interim widths for intermittent stream channels are recommended to be at 160 feet from the edge of the channel or equal to one site potential tree height for riparian and mixed conifer associations. Most intermittent streams occur in these zones. The following is a summary of Riparian Reserve standard widths based on site potential tree heights:

Permanent streams with fish, natural lakes and pond > 1 acre	320 feet
Wetlands > 1 acre, created ponds, reservoirs and permanent streams without fish	160 feet
Intermittent streams and ponds < 1 acre	160 feet

(The area of Riparian Reserve increases to 14% of the watershed)

Metolius Watershed Interim Riparian Reserves



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Special Features to Include in Riparian Reserves

Extensions to the standard reserve widths may be made to include special features important to protecting associated species and their habitats or considerations when designing Riparian Reserves. Theses special features are described as they are expected to be found in the Metolius Watershed and examples of known locations are given.

Flood Plains - In most cases, flood prone areas are narrow along stream margins and wetlands. However, several locations within the watershed have broad flood plains and an intricate network of flood prone channels. Examples of these areas include Lake Creek, Brush Creek and Abbot Creek. These and similar areas should be included in riparian reserves that include the flood prone surfaces.

Riparian Vegetation - Of the streams sampled, several have zones of riparian vegetation that exceed 320 feet from the active stream channel. These extensive riparian areas are found along Lake Creek, upper Canyon Creek, Bush Creek, First Creek and the Metolius River. Other streams that were not surveyed for riparian width but may have extensive riparian areas include Abbot Creek. These areas of extensive riparian vegetation should be included within the riparian reserve beyond the standard widths. The outer edge of riparian vegetation is defined by the outermost edge of the transitional riparian plant association or community using Kovalchik (1987).

Inner Gorge, Benches and Terraces - The NW Forest Plan define the extent of Riparian Reserves to include the top of the inner gorge. Examples of these features are usually basalt bedrock walls in which the stream is confined. These gorges are usually small and within the standard Riparian Reserve width but if not, the reserve width should be extended to the outer edge of the gorge. Other features that would require similar treatment are benches or terraces that may extend outside the riparian vegetation. The slopes should be included if they are abrupt and are easily eroded.

Terrestrial Wildlife Habitat Connectivity - Riparian Reserve widths should consider the contribution of these reserves to terrestrial wildlife species. A combination of 15% Reserve Areas and Riparian Reserves were provided in the NW Forest Plan Matrix allocation to maintain habitat connectivity. This strategy is probably most effective on west-side Cascade landscapes where stream densities and associated Riparian Reserves are relatively dense. As an example, interim riparian reserves covered 78% of the Siuslaw National Forest but only 4% of the Deschutes National Forest (11% of the Metolius Watershed). Eastside Cascade streams and wetlands occur in lower densities resulting in poor connectivity if standard Riparian Reserve widths are implemented. This is especially significant in the Metolius Watershed due to the highly fragmented forest conditions. In the Metolius, interum Riparian Reserves cover approximately 11% of the watershed.

When Riparian Reserves are needed to provided interior habitat connectivity, the reserve width should be at least 400 feet each side of stream edge or 800 feet total. Landscape openings can influence environmental conditions approximately 400 feet into the adjacent forest stand.

The following guidelines are provided so that Riparian Reserves can contribute to habitat connectivity in the Metolius Watershed.

1. Consider connecting riparian reserves with adjacent north facing slopes to protect the integrity of mesic habitat conditions commonly used by the northern goshawk, marten and other late-successional species. The reserves and north facing slopes combined can also provide interior habitat suitable for spotted owls.
2. Consider connecting Riparian Reserves to reproductive core areas or activity centers for northern spotted owl, northern goshawk or other wildlife species.
3. All the Metolius subwatersheds are highly fragmented, and the Jack/First, Cache, and Suttle/Lake subwatersheds have relatively low stream densities. To provide habitat connectivity consider expanding Riparian Reserve widths beyond the standards described in the NW Forest Plan. The following Riparian Reserve widths are appropriate in these subwatersheds: (1) minimum 400 feet

each side of the stream edge on permanent streams; and (2) minimum 250 feet each side of the stream edge on intermittent streams.

Big Game Calving and Fawning- When riparian areas are determined to be important as big game calving or fawning areas consider providing an area (including Riparian Reserve) 1000-2000 feet wide (Thomas, 1979, based recommendations for maximum distance to effective cover) or as needed to provide adequate cover and maintain the integrity of the area. Portions of the corridor may be treated to maintain or develop big game cover conditions.

Unstable areas -- The vast majority of the watershed is not prone to landslides or any type of slope failure. Highly or moderately erodible soils are present The most unstable soils in the watershed result from coarse ash, pumice or cinder. These areas are associated with the Blue Lake and Sand Mountain deposits. One slide has been documented east of Round Lake, within the Blue Lake deposit, that may have been associated with a road. Another area prone too dry ravel and slides is the Castle Rocks area. Slopes of greater than 30% within these deposits are prone to dry gravel and depositing sediment in stream channels, if disturbed. Where this loose soil is adjacent to streams or riparian reserves, the unstable slope should be included in the riparian reserve.

Aggregation of complexes -- Riparian reserves within close proximity of each other will be aggregated into simpler, larger complexes to eliminate narrow strips surrounded by riparian reserve. Other nearby areas that may be aggregated into standard riparian reserves include: meadows, seeps, rock outcrops and other unique and special habitats. Riparian reserves may be connected to nearby ponds and wet meadows where not normally connected by standard riparian reserves. Some areas already identified to be aggregated include the multiple channels of Lake Creek, Brush Creek, Abbot Creek and Roaring Creek springs.

Desired Condition For Riparian Reserves

The desired condition of riparian reserves is outlined in the NW Forest Plan Aquatic Conservation Strategy Objectives (B-11). These objectives serve as direction for management of Riparian Reserves. Other objectives of Riparian Reserves, are to provide for travel and dispersal corridors for many terrestrial animals and plants and provide for greater connectivity within the watershed.

Riparian Reserves should provide large wood, stable and vegetated streambanks and flood prone areas, stream shade, a vegetative filter for runoff from roads and a diversity of vegetative conditions to which associated species have been adapted. As an example, species such as bull trout may require stream shade to maintain could water for rearing juveniles. Bull trout are associated with cover provide in fine debris or large wood that form pools. Clean substrates with low fine sediment provide cover and quality spawning habitats. The Riparian Reserve widths are designed to provide conditions for wood recruitment, shade and protection from sediment introductions to streams.

The reserves are also designed to provide connectivity for species throughout the landscape. Down wood, canopy closure, vegetative species diversity and structural diversity and soil moistures are to be protected in the Riparian Reserves to provide a connection of these habitats throughout the landscape for associated species. A network of uninterrupted habitats along riparian reserves serve as connectors for species that have reduced mobility.

Recommendations for Watershed Specific Standards and Guidelines

The NW Forest Plan outlines standards and guidelines for the management of the Riparian Reserves. In addition to these guidelines, this analysis has identified objectives specific to the Metolius Watershed and the species which inhabit the Basin. The following objectives are offered as additional considerations to the NW Forest Plan guidelines (page C31-C38), and the Aquatic Conservation Strategy Objectives (B11). These additional watershed specific objectives are to be used in site specific analysis where they apply to attain the ACS objectives for the Metolius Watershed.

Recreation Sites

- Minimize new campground development within two site potential tree heights of lakes and streams to protect vegetative bark and shade cover, especially along the Metolius River and Suttle Lake.

Aquatic/Soil

- Avoid using ground base equipment to thin trees within Riparian Reserves to prevent any further compaction of soil and creation of runoff channels.
- Maintain stream temperature to meet habitat requirements of bull trout, tailed frog and other coldwater dependent species.
- Minimize or prevent future compaction of soils within the riparian reserve.
- Unneeded and poorly draining roads within Riparian Reserves should be rehabilitated or eliminated to reduce sediment delivery to streams.

Vegetation

- If vegetation manipulation is needed, only treat for sustaining late-successtional habitats and ACS objectives, treat only a portion of the reserve in each entry so that untreated refugia are maintained.
- Maintain large trees and snags over 21 inches in diameter to restore connected large tree habitats within the Riparian and Late-Successional Reserves, and provide a future source for large instream wood.

Special Habitats

- Preserve hardwoods, coastal distinctive species such as pacific yew, dogwood and others for their value as habitat for riparian survey and manage lichen species.
- Avoid fragmentation of riparian corridors that will isolate riparian associated species with limited dispersal capabilities (e.g., Survey and mange lichens).
- Identify and maintain moist microclimates that riparian associated vegetation can create. These microclimates can be fire resistant due to their moisture regime and may act as refugia for many species.
- Maintain uninterrupted flow regimes and channel integrity in intermittent streams to maintain dispersal opportunities for Pecks penstemon.
- Avoid siltation in lakes and streams in potential habitats of water lobelia and the survey and manage aquatic lichen Hydrothyria venosa.

Integrated Opportunities Recommended By Landscape Area

Landscape Area 1 - Wilderness

Green Flag

Goal: Maintain a primitive setting and uncrowded recreation experience. Diminish human influence on natural processes and allow natural processes to continue. Maintain function of riparian areas. Reduce potential impacts of human use on wildlife and alpine habitats. Restore impacted high use areas. User education emphasizes stewardship.

1) Alpine Lakes Restoration. Features: Wilderness Lakes, Special Riparian Habitats for Species of Concern (e.g., Rare Fungi), Recreational Experience.

Priority Lakes:

- Square
- Carl
- Cabot
- Table
- Shirley
- George
- Other high alpine lakes
- Canyon Creek Meadows
- Other associated areas

A) Rehabilitate overused campsites within 100 feet of lakes and waterways. Include rehabilitation of some wet meadow sites that have large areas devoid of vegetation.

B) Rehabilitate trails through wet areas, wet meadows, and over steep slopes that channel water, result in multiple trails, or are resulting in unacceptable resource damage. Examples would include the trail up from Dugout Lake to George Lake, and the Canyon Creek trail.

C) Identify areas and correct problems where wilderness trails are causing accelerated erosion due to improper alignment with slopes resulting in concentration of runoff.

D) Protect rare fungi species (S/M Category 1) Gastroboletus ruber and Alpova alexsmithii, Hydnotrya, and Martellia in known locations of the, Carl, Shirley, and Cabot Lake areas.

Management guidelines for Survey and Manage species are currently being developed by the Regional Ecosystem Office. In the interium, consider designating them as Mycological Special Interest Area. Sites should be surveyed to delineate the boundaries of habitat and population, and buffers be established to provide adequate protection of the populations. Monitor recreation impacts. Survey suitable habitat in the area for additional populations. Develop management guidelines to protect populations from adverse impacts. Develop and maintain interagency GIS layer and associated database for locations of rare or locally endemic taxa and type localities.

E) Continue to enhance interpretive/information systems. Wilderness education stewardship, where the responsibility of the preservation of the wilderness falls on the wilderness user.

F) Weed and native grass awareness training for wilderness guards. Focus on preventative recreation user trailheads. Message emphasizes using clean hay and washing equipment and stock before entry into the wilderness.

2) Wilderness Fire Plan: **Protection of Wilderness and special habitats for species of concern, fire, facilitates diminished human influence on natural processes.**

A) Develop a Wilderness Fire Plan for the Three Sisters, Mount Jefferson and Mount Washington Wildernesses.

B) Integrate opportunities to protect rare fungi species, Gastroboletus ruber and Alpova alexsmithii, Hydnotrya, and Martellia.

C) Integrate opportunities to enhance huckleberry habitats with fire.

There will be some risks associated with the small size of these wildernesses areas but this should be evaluated as part of the Wilderness Fire Plan. This area is not NOW outside it's historic range of variability, and a Wilderness Fire Plan should provide quidance to maintain the vegetation in this area within the historic range. The appropriate fire return intervals and fire intensities found in this area will need to be evaluated in the Wilderness Fire Plan. (Fires are generally small in size and intensity. On a long return cycle, the fires are large and of stand replacement intensities.)

3) Access Strategy Features: **Recreation experience, habitat enhancement.**

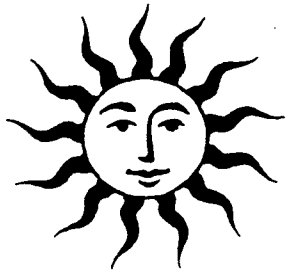
A) Wilderness trails assessment & plan.

B) Consider seasonal closure of Road 1237 while maintaining fire access (gate #1237) to provide semi-primitive non-motorized experience, and reduce conflicts with big game summer range.

C) Assess traffic impacts to subalpine and alpine areas and restrict access or rest damage areas. Implement a weed free or pelletized hay program..

4) Fish/Recreation Strategy

In coordination with Oregon Department Fish Wildlife, develop recommendations for stocking wilderness lakes. Lakes will be identified to be stocked, or not stocked based on criteria such as: suitability of lakes for fish rearing, wilderness opportunity zone (primitive, pristine, etc.) importance of the lake to other resources.



Landscape Area 2 - Central Basin

Red Flag

Goal(s): Restore, maintain, and protect high soil and water quality and maintain function of riparian areas. Provide healthy forests dominated by large ponderosa pine. Provide for fuels reduction in urban interface. Provide well connected late-successional habitats for associated fish, wildlife and plant species. Provide a balance between riparian resources and diverse recreational opportunities. Maintain the rustic character of facilities.

1) **Integrated Vegetation Management. Features:** **Habitat enhancement for species of concern, commodity production, firewood opportunities, reintroduction of fire, fire hazard reduction, variety of recreational experience, riparian and soil restoration.**

A) Maintenance of big trees. Maintain large tree character adjacent to Metolius River for bald eagles, osprey, old growth pine associated species, and scenic quality osprey and other .

B) Reintroduction of fire, including mechanical pretreatments.

In the uplands, outside of Riparian Reserve, thin understories and reduce brush to reduce the potential for high intensity wildfires. Treatment options should consider the use of prescribed fire and/or mechanical treatments. An analysis of potential effects on scenic quality will be essential. Public support for this proposal will be necessary due to the high public use of this area.

Restore fire by favoring the use of prescribed fire over mechanical treatments when possible to benefit rare and common species which have evolved with and benefit from fire, such as Peck's penstemon, Tall Agoseris, Mountain Lady Slipper. Plan and implement restoration for Allingham Meadow to benefit Peck's penstemon and Tall Agoseris, as well as to maintain important and limited meadow habitat. Prescribed fire will also improve forage conditions for big game.

C) Reduce Fire risk and develop fuelbreaks

In the urban interface areas (Camp Sherman, Metolius Meadows, Summer Home Tracts, etc.), evaluate the use of use mechanical treatments and/or prescribed fire to reduce the potential for wildfires in this area. Thin trees and reduce shrubs to develop fuelbreaks in the "urban interface" areas. These fuelbreaks should be designed to slow the rate of spread and intensities of a wildfire as it moves through the fuelbreak.

Develop and maintain fuelbreaks along the main north-south road system (Roads 12,14). The establishment of fuelbreaks should consider protection of late-successional habitats and scenic quality. Maintenance of these fuelbreaks is as important as developing them.. They will not remain useable through time, if not maintained. Mechanical treatments and prescribed fire can be used to maintain the fuelbreaks.

D) Native Plant Propagation

Native Plant propagation would begin a long term program to supply indigenous plant material for future restoration projects in the Metolius Basin. Currently, supplies of native plants are unreliable. Long term, ecosystem restoration depends on consistent availability of native plants adapted to the microclimates where they will be used. Collect and develop watershed specific riparian plant stock

for riparian restoration projects associated with river campgrounds and dispersed sites (Also see LA 4, 7, and 8).

E) Public education and interpretation is needed about the role of fire and the use of prescribed fire in a forested ecosystem. Many people come to the Metolius River because of the beauty and "naturalness". They would be a receptive audience for learning about the role of fire and the use of prescribed fire. There may be opportunities to develop support for the use of prescribed fire, as well as an understanding of the risks involved.

2) Riparian/Aquatic Restoration. Features: Fish passage restoration, Water

A) Head of Jack Creek Restoration

The interpretive trail at the Head of Jack Creek has led to heavy use, reduction of streamside vegetation, and compaction along the trail. A project to realign the road away from the spring, redesign the trail to protect and rest the streamside vegetation is needed. Bull Trout and the five Survey and Manage species are known to occur in the area. Develop interpretive information to sensitize visitors to the unique and fragile nature of the headsprings. Maintain the scenic character of the spring ecosystem.

B) Fish Passage Restoration

The dam at Lake Creek Lodge should be inspected and redesigned to allow fish passage. Improvement of this dam would rebuild the connection of the system and improve conditions for reintroduction. Downstream passage at Round Butte Dam is needed before sockeye or spring chinook could re-enter the system. Bull trout would also benefit from the improvements listed above. Other improvements to the Candle Creek Culvert at Road 1290 should be evaluated for the effect on bull trout passage. Bull trout passage over the irrigation dam at road 1230 could be improved and may improve the distribution of spawning and rearing upstream in Jack Creek. Candle Creek culvert should be reevaluated for bull trout passage (See also LA 7 and 8).

For spring Chinook, downstream passage for juveniles is restricted by Lake Billy Chinook and the feasibility of improving the situation is being studied bythe Confederated Tribes and P&E.

C) Soil Restoration - *Also see LA, 8, and 4*

Restore soil compaction in heavily logged areas by subsoiling where appropriate. North Shackle subsoiling project near First Creek is such a project. Subsoil high priority areas to reduce compaction especially considering areas that contribute to sedimentation.

D) Davis Creek Overflow Channel - *Also see LA 11, and 8*

The historic alteration of Davis Creek channel may funnel more flow to First Creek, and possibly destabilizing the First Creek Channel. An investigation should be conducted to determine the extent of this alteration and if the effects can be corrected.

E) Stream Fords - *Also see LA 8*

There are several fords on Canyon Creek, First Creek and Brush Creek that could be blocked to reduce the disturbance to these streams and disconnect the roads from the stream network.

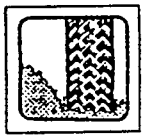
F) Instream Wood Restoration

Wood has been reduced in the Metolius River. Hazard tree removal and other vegetation management projects can supply large trees to put into the river. Target areas of the river where large trees are unavailable for natural infall.

G) Water Source Inventory and Rehabilitation

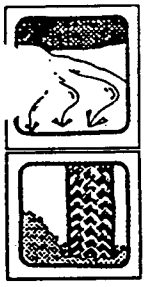
Identify water sources in the area that have been used for wildfire suppression. Identify potential locations for water sources. Review the current water sources to identify problems. If problems found, develop recommendations for treatment. These recommendations may include improvements to reduce impacts to resources, development of new water sources and removing of water sources that are not necessary or are not able to be improved to minimize resource impacts. Water draw locations need to be designated and stabilized at Jack Creek, Road 1230, Canyon Creek, Road 12, and Jefferson Creek at Road1290.

3) Recreation Strategy. Features : Recreation experience, habitat enhancement, soil and water quality.



A) Vegetation Management Strategies

Vegetation management strategies are needed for all of the campgrounds within the LA. Rehabilitate riparian areas within and adjacent to the campgrounds. Campgrounds such as Jack Creek, Lower Canyon, Candle Creek and many of the Metolius campgrounds have many trampled and bare areas along or near the streambanks. Maintenance and redesign of these facilities will help improve the vegetation cover and scenic character in these areas. Develop a vegetation management strategy for the Metolius-Windigo Trail.



B) Developed Campgrounds

Rehabilitate Jack Creek Campground to reduce the impact of roads in the campground on stream drainages, reduce compaction, and confine vehicles to certain areas. Complete the Head of Jack Creek trail project. Assess location and impacts of dispersed recreation campsites within 100 feet of streams, where damage to streams and riparian areas is occurring. Put in bridges along the Metolius/Windigo trail where unacceptable siltation is occurring. Assess the Metolius River trail for rehabilitation and/or rerouting where erosion and riparian impacts are unacceptable. Identify, map, and rehabilitate or close user created trails adjacent to streams that show unacceptable resource damage to the stream and riparian areas. Identify non-system trails within riparian areas and begin monitoring and rehabilitation.

C) Picnic Shelters

Continue the rehabilitation of the CCC picnic shelters along the Metolius. Utilize contract with Oregon Parks and Recreation to assist.

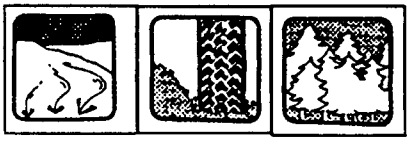
D) Partnerships

Partner with the Friends of the Metolius and State of Oregon to develop interpretive message/signing that will promote the interpretive message of stewardship of the Metolius River and what the public can do to help protect the watershed for future generations.

E) Special consideration and evaluation of the need to protect the rare truffle (S/M Category 1) Elaphomyces anthracinus in the Riverside Campground.

Management guidelines for Survey and Manage species are currently being developed by the Regional Ecosystem Office. In the interum, inventory area for populations and consider designating appropirate areas outside the developed campgrounds as a Mycological Special Interest Area. Initially designate 160 acres of similar habitat around the known location until ground survey can be conducted to determine the extent of the populations. Survey to delineate boundaries of habitat and population. Develop management guidelines to protect populations from adverse impacts.

Develop and maintain interagency GIS layer and associated database for locations for rare of locally endemic taxa and type localities.



F) Dispersed Camping Management - *See also LA 4, 8, and 11*

Many riparian areas are becoming overused as the demand for camping increases in the Metolius Basin. As more campers come and find campsites filled, new camps are created, increasing the roads along streams and the connection of the road network with the streams. Management of this problem could include closing some roads within 200 feet of streams and managing others for low density camping opportunities. Restriction of vehicle access and reducing streamside compaction should be included in the restoration of the areas. Rehabilitate the scenic quality of closed sites.

4) Access

A) Stream Crossings - *See Also LA 8*

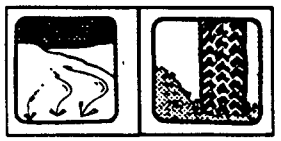
The eroded roadcut at Bridge 99 is causing gullies leading down to the river and depositing soil into the Metolius. Vegetating the slope and improving the road drainage is needed to reduce these sedimentation problems. Other sites where stream crossings cause sedimentation are Roaring Creek at Road 1260, Brush Creek at Road 12, and Candle Creek at Road 1290.

B) Metolius Trail Maintenance - *See also LA* 8

Several sites along the Metolius Windigo trail have increased streambank disturbance. Crossings and parallel trails along Canyon Creek and Roaring Creek could reduce the risk of sedimentation to these streams. Other trails that should receive heavy maintenance include the Metolius River trails. Maintain scenic quality along the trails.

C) Road Closures and Obliteration

Road Closures and obliteration would reduce sediment input and improve stream conditions. These include:



- Metolius Road 700
- Canyon Rd 400
- Canyon Rd 1420-200
- Roaring Creek north of Road 200
- Lower Abbot roads

5) Other

A) Big Game Transition and Winter Range

With Oregon Department of Fish and Wildlife, evaluate the need to expand the key elk area to include areas actually used by the elk herd. In transition and within ranges where road densities exceed 2.5 miles per square mile, evaluate the effects on deer and elk use patterns and habitat effectiveness. Consider seasonal or permanent closures where disturbance is affecting normal foraging area travel patterns. Maintain road closures within Big Game winter & transition ranges.

B) Fire Camps

Fire camp facilities are needed in the Metolius Basin - possibly utilizing already heavily impacted areas.

Landscape Area 3 - Highway 20 Corridor

Yellow Flag

Goal(s): Restore and maintain the visual character of the corridor viewshed. Promote healthy large trees, park-like stands and visual diversity. Restore highway-related hydrologic impacts. Maintain the integrity of the Suttle Bald Eagle Management Area. Provide adequate riparian and forest cover to maintain connectivity and travel corridors for wildlife crossing Hwy. 20, reducing the potential for vehicle wildlife conflicts.

1) Integrated Vegetation Management. Features: Scenic Byway maintenance and enhancement, highway safety, commodity production, firewood opportunities, reintroduction of fire, fire hazard reduction, recreational experience, riparian and soil restoration and habitat enhancement for species of concern.

A) Fuelbreak

A fuelbreak along the entire Highway 20 corridor will slow the rate of spread and intensities of a wildfire by reducing ladder fuels (understory vegetation) and the shrub component. The fuelbreak will also improve the vigor of the large overstory trees and it may increase their lifespan.

Maintenance of the fuelbreak is as important as developing it. It will not remain useable through time, if not maintained. Mechanical treatments and prescribed fire can be used to maintain the fuelbreak.

The establishment of fuelbreaks should consider protection of late-successional habitats.

B) Highway Safety

Thin stands adjacent to Highway 20 to improve views from the highway and reduce the potential for vehicle collisions with wildlife, while maintaining adequate cover to facilitate wildlife movement across the highway.

Vegetation management in BEMA south of Highway 20 will need to protect and enhance bald eagle habitat.

The forested stands around Corbett Snopark, and between Highway 20 and Suttle Lake are considered suitable spotted owl habitat. All activities within the corridor should consider the impacts to this threatened species.

C) Scenic Views

Develop and maintain a strategy for enhancing views and landscape character attributes, and maintaining scenic quality. Integrate interpretive opportunities with Scenic Byway objectives.

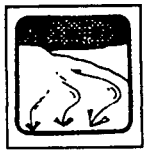
The Santiam Pass area may be an important wildlife movement corridor for many late-successional species. Late-successional habitat components should be maintained in the pass area.

D) Suttle Lake Resort Partnership

Developing a partnership with the Suttle Lake resort to develop and implement a vegetation

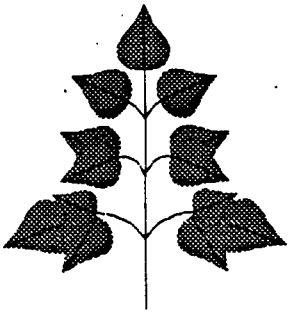
management plan for improving the health of the vegetation within the campground, and along Lake Creek.

2) Access Strategy. Features: Weed Control, Coordination with Oregon Department of Transportation.



A) An aggressive integrated noxious weed management program along Hwy. 20 will control rapidly expanding weed populations.

B) Work with the Oregon Department of Transportation on Highway 20 erosion areas, which are depositing cinders into wetlands and stream habitats



Landscape Area 4 - Meadow Lake Basin

Yellow Flag

Goals: Provide well connected late-successional habitats and protect remnant late-successional habitats. Maintain water and riparian quality, and habitat for summering elk, eagles , and osprey. Promote semiprimitive motorized recreational experience and reduce off-highway vehicles conflicts. Restore riparian habitats deteriorated by heavy human use. Maintain winter recreation opportunities.

1) Integrated Vegetation Management. Features: Fire risk reduction, BEMA, cultural use plant enhancement , habitat enhancement for species of concern.

A) Thinning

Determine if mechanical treatments or prescribed burning should be used to accomplish thinning and brush reduction. Fuels treatment options should consider prescribed fire and/or mechanical treatments. Public support for this proposal will be important due to the high use of this area.

B) Fuelbreaks

The establishment of fuelbreaks should consider protection of late-successional habitats.

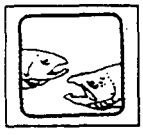
C) Bald Eagle Management Area (BEMA)

Consider areas associated with Link, Hand, Cache and Meadow Lakes as part of the Suttle BEMA and manage these stands to provide bald eagle roosting, nesting and perching sites. These lakes are currently being used by bald eagles for foraging.

D) Native Plant Propagation *See also LA 2,7, and 8*

Native Plant propagation would begin a long term program to supply indigenous plant material for future restoration projects in the Suttle Lake basin. Currently, supplies of native plants are unreliable. Long term, ecosystem restoration depends on consistent availability of native plants adapted to the microclimates where they will be used.

2) Aquatic/Water/Soil/Fish/Features: Watershed Protection from Sediment, Proposed Cache Research Natural Area, Fish and Amphibians Habitats.

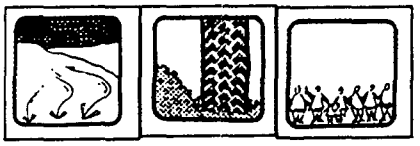


A) Fish Stocking

Coordinate with ODFW to access the effects of fish stocking in Cache RNA Lakes. Determine if stocking is consistent with RNA objectives.

3) Recreation/Features: Coordination with Willamette National Forest, Santiam Wagon Road, Confederated Tribes of Warm Springs, Cultural Plant Enhancement.

A) Dispersed Recreation



Develop a **dispersed recreation use plan** for the area; developing a management strategy for managing dispersed camping, and dispersed recreation use, including OHV use, horse use, and hiker and mountain bike use. Map roads and trails, and areas with resource damage associated with lakes and streams. Close roads, trails, and camping areas where unacceptable resource damage is occurring. Where needed rehabilitate these areas that have been closed, and develop an interpretive sign plan for signing the area, including the design of the signs.

B) Santiam Wagon Road

Consider how historic values of the Santiam Wagon Road can be protected and shared with the public. Coordinate with the Willamette National Forest. Develop vegetation management strategy for wagon Road corridor

C) Special Uses

Develop management strategy for Special Use activities.

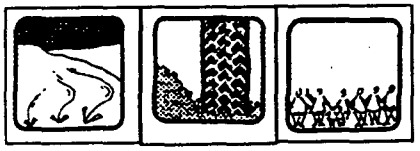
D) Huckleberry

Huckleberry Management opportunity.

4) Access strategy.

Manage as a semi-primitive motorized recreation area with an emphasis in non-motorized trails. Assess transportation system for unnecessary roads that could be converted to trails.

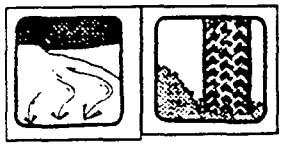
OHV



Close, obliterate and restore damaged areas adjacent to Torso Lake, Meadow Lake, Hand Lake, Cache Lake and other wetlands or lakes. Assess the sand dune areas for OHV impacts and work with the Willamette National Forest to control and limit access to these areas. Do not promote frequent high density motorized events in this area.

Eliminate summer OHV use north of Island Lake and Road 2076-500 to maintain summering elk area integrity. Eliminate OHV use associated with aquatic habitats, and manage other portions of landscape to minimize undesirable impacts of OHV's.

Road Closures



Work with the Road Management committee to close and obliterate unnecessary roads to open road densities of 2.5 miles of road per square mile or lower. Concentrate on reducing access to the proposed Cache Research Natural Area.

Landscape Area 5 - Black Butte

Green Flag

Goals: Maintain a healthy pine-dominated mixed conifer forest that provides well connected late successional habitats and maintains the scenic integrity of the landmark. Maintain efficient fire detection capabilities. Maintain semi-primitive recreational opportunities.

1) Integrated Vegetation Management

The use of prescribed fire will be very difficult in this area. The slopes are steep and the fuel loadings high. Mechanical treatments on the steep slopes and erosive soils are not possible with current technology (except helicopter treatments). The effects of prescribed fire use or wildfire will be very visible through much of Central Oregon. This area is not a high priority for treatment based on the difficulty of accomplishing the treatments, high visibility, and the need for maintaining scenic quality.

The north slope of the butte is known to provide habitat for spotted owls. This portion of the dry mixed conifer PAG should provide medium and large stand structure, including multi-storied, dense canopied stands of mixed climatic climax species.

The topographic saddle between Green Ridge and Black Butte is an important travel corridor for migrating big game. Maintain the integrity of this travel corridor by closing roads (if needed) or limiting access during the fall migration period, and maintaining adequate hiding, thermal and security cover.

2) Restoration, including Access strategy. Features: Semi-primitive Recreational Experience, Subalpine Habitat Restoration, Fire Lookout.

Continue the rehabilitation at the top of the Butte. The existing ROS classification of semi-primitive, non-motorized is not consistent with the developed setting of the summit, nor with the existing levels of use. It may not be possible to make the setting more primitive, but further development should be limited and designed to remain consistent with the existing character. Use patters can be altered in a number of ways, but user numbers may continue to increase. Review options for closing the existing road further down the Butte to make the trip to the top more challenging, and more consistent with the semi-primitive nonmotorized ROS classification in the Forest Plan. Review options for a one way trail to the top of the Butte and down another side to reduce the numbers of encounters. Review the needs for a permanent toilet facility at the trailhead.

Close and obliterate informal trails and cutoffs on the Black Butte Trail. Develop educational signing at the trailhead that emphasizes the fragile subalpine ecology and promotes stewardship.

3) Detection needs

Maintain Black Butte as a primary fire detection facility.

Landscape Area 6 - Cache

Yellow Flag

Goals: Maintain a healthy mixed conifer forest that provides well connected LS habitats and provides opportunities for sustainable forest products in the future. Provide effective big game transitional and winter range. Preserve the integrity of the Santiam Wagon Road, particularly the Cache Creek Toll Station.

1) Integrated Vegetation Management. Features:

Determine if mechanical treatments or prescribed burning should be used to accomplish thinning and brush reduction. Fuels treatment options should consider the use of prescribed fire and/or mechanical treatments. Thin understories and reduce brush components to reduce the potential for high intensity wildfires.

During project-level analysis, where open road densities exceed 2.5 miles per square mile, assess the effects on wildlife use patterns and habitat effectiveness. Close roads in the headwaters of Cache Creek to protect summering elk habitat.

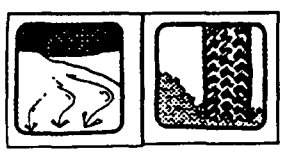
Implement prescribed fire to improve forage conditions for big game. Consider impacts of private land on landscape habitat conditions.

Provide early seral patches on private and Forest Service lands. The remaining area should be managed to provide large tree habitat.

Evaluate Cache Aspen Transplant Area for transplants and integrity of area.

2) Cache Mountain Detection or Communication Systems.

Is there anything that would improve this area from a detection or communications aspect?



3) Access Stragety

Close roads to reduce and maintain open road densities at 2.5 miles of road per square mile or lower.

4) Recreation

Consider how historic values of the Santiam Wagon Road can be protected and shared with the public. Coordinate with the Willamette National Forest. Develop vegetation management strategy for wagon Road corridor.

Landscape Area 7 - Suttle Lake

Red Flag

Goals: Provide high quality developed recreation opportunities while maintaining water and riparian habitat quality, fishery productivity, and habitat for sensitive wildlife species. Maintain healthy mixed conifer stands that promote large tree character for bald eagles and provide well connected late-successional habitats: work to reduce conflicts between recreation uses and wildlife habitats.

1) Integrated Management Strategy for Suttle Lake Basin Features: Combined BEMA Plan, Campground Vegetation Plans, Recreation Management Guidelines, Species of concern habitat restoration, Hazard Trees, Special Uses. *Also see LA 4.*

A. Bald Eagle and Recreation Management Guidelines

Develop integrated vegetation management strategies for all of the campgrounds and resorts associated with lakes and streams on National Forest land. Review recreation carrying capacity, recreation related impacts on lakes and streams, recreation use patterns, etc.

1. Vegetation treatments should maintain and sustain large tree conditions in BEMA.
2. Promote establishment of ponderosa pine and Douglas-fir
3. Guidelines for permitted special-use activities so that impacts to bald eagles are minimized.
4. Vegetation management to protect and enhance scenic quality in developed recreation sites and along travel routes.

Thin understories and reduce the brush components to reduce the potential for high intensity wildfires. Determine if mechanical treatments or prescribed burning should be used to accomplish thinning and brush reduction. Fuels treatment options should consider the use of prescribed fire and/or mechanical treatments. Public support for this proposal will be necessary due to the high public use of this area.

Bald eagle needs should be balanced with spotted owl needs, but within established bald eagle nest stands, bald eagle management should be emphasized.

Dark, Scout, Blue, Link, Hand, Cache and Meadow Lakes are in the Suttle BEMA.

Manage forested stands associated with these lakes to provide bald eagle roosting, nesting and perching sites. These lakes are currently being used by bald eagles for foraging.
Where open road densities exceed 2.5 miles per square mile, assess the effects on bald eagle use pattern in habitat effectiveness.

B. Native Plant Propagation

Begin a long term program to supply indigenous plant material for future restoration projects in the Suttle Lake basin. Currently, supplies of native plants are unreliable. Long term ecosystem restoration depends on consistent availability of native plants adapted to the microclimates where they will be used.

C. Water Lobelia Habitat Protection

Restore riparian areas in Camp Tamarack along Dark Lake to protect water lobelia from sediment. **This is a unique and significant site - the only known population in Oregon.** Include this area in vegetation project analysis for the Suttle Lake area and consider the effects of hazard tree removals and soil impacts at Camp Tamarack.

2) Riparian/Aquatic Restoration. Features: Fish Passage Restoration, Water.

A. Fish Passage Restoration -Lake/Link Creek System

The Dams at Suttle and Blue Lake outlets should be inspected and redesigned to allow fish passage. Improvement of these dams would rebuild the connection of the system and improve conditions for reintroduction of sockeye.

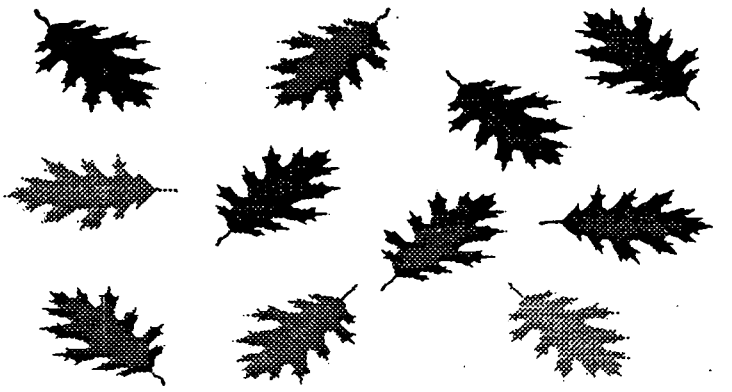
B. Water Source Inventory and Strategy.

Identify water sources in the area that have been used for wildfire suppression. Identify potential locations for water sources. Review the current water sources to identify problems. If problems found, develop recommendations for treatment. These recommendations may include improvements to reduce impacts to resources, development of new water sources and removing of water sources that are not necessary or are not able to be improved to minimize resource impacts.

3) Partnerships

Consider how Suttle Lake Resort could help manage and maintain historic structures at Cinder Beach Day Use Area.

Work with Camp Tamarack to develop a Vegetation Management Plan for the camp.



Landscape Area 8 - Upper Tributaries

Red Flag

Goals: Restore and maintain healthy mixed conifer forests. Maintain well-connected late-successional habitats while providing sustainable forest products. Maintain a recreation transition corridor. Restore soil and water quality and maintain the function of riparian areas. Protect riparian areas that show signs of vegetation loss and deterioration.

1) Integrated Vegetation Management. Features: Restoration of fire, Habitat enhancement for species of concern, commodity production, firewood opportunities fire risk reduction, recreational experience, riparian and soil restoration.

A. Reintroduction of fire, including mechanical pretreatments.

Thin understories and reduce brush components to reduce the potential for high intensity wildfires. Mechanical treatments or prescribed burning should be used to accomplish the thinning and brush reduction. In the mixed conifer plant associations, there is a high probability that mechanical treatments will be necessary before prescribed fire can be used for stand treatments. In the ponderosa pine associations, there are opportunities for using prescribed fire, without prior mechanical treatments, to thin the understories and reduce the shrub component. Public support for this proposal will not be as critical as in LA 2 (Metolius Basin-high recreation use).

Maintain linkage and scenic quality along access routes between Hwy. 20 and wilderness.

B. Fuelbreaks

Along the main north-south road systems (Road 12, 14), will slow the rate of spread and intensities of a wildfire and compliment the scenic quality objectives for these areas. Wildfires generally move from the west to east so these fuelbreaks would provide a spot to "take a stand". Maintenance of these fuelbreaks is as important as developing them. They will not remain useable through time, if not maintained. Mechanical treatments and prescribed fire can be used to maintain the fuelbreaks.

Develop long-term large scale logging systems to protect soils.

C. Species of Concern/ Habitat protection and enhancement

Look for opportunities to reintroduce fire to benefit species that have evolved with and benefit from fire such as Peck's penstemon and Candy Stick.

Map and assess the known site for Survey and Manage species Hygrophorus caeruleus. This is one of two sitings in the Northwest. Contact OSU herbarium for site information.

Map and Survey high probability habitat for Peck's penstemon in the subwatersheds of Abbott Creek, Canyon Creek, and Jack/First Creek and designate more protected populations in these underrepresented areas to insure long term viability of the species.

Bald eagle needs should be balanced with spotted owl needs, but within established bald eagle nest stands, bald eagle management should be emphasized.

2) Riparian/Aquatic Restoration Features: Fish Passage restoration, Water Habitat restoration for Species of Concern, Watershed improvements for soil and water, recreational experience.

A. Stream Fords

There are several fords on Canyon Creek, First Creek and Brush Creek that could be blocked to reduce the disturbance to these stream and disconnect the roads from the stream network.

B. Metolius Trail Maintenance

Develop a vegetation management strategy for the Metolius-Windgo trail corridor. Several sites along the Metolius-Windigo trail have increased streambank disturbance. Crossings and parallel trails along Canyon Creek and Roaring Creek could reduce the risk of sedimentation to these streams. The Metolius River trails should also receive heavy maintenance.

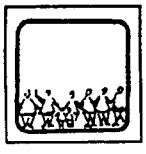
C. Water Source Inventory and strategy.

Identify water sources in the area that have been used for wildfire suppression. Identify potential locations for water sources. Review the current water sources to identify problems. If problems found, develop recommendations for treatment. These recommendations may include improvements to reduce impacts to resources, development of new water sources and removing of water sources that are not necessary or are not able to be improved to minimize resource impacts. Water draw locations need to be designated and stabilized at Jack Creek 1230 road, Canyon Creek Road 12 and Jefferson Road 1290.

3). Recreation

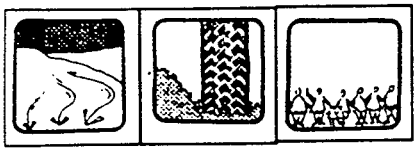
A. Round Lake Campground

Determine if Round Lake Campground is appropriate to maintain as a developed campground once hazard trees are removed. Rehabilitating the campground site, based on future use.



B. Jack Lake Trailhead Assessment and Redesign.

Assess the situation at the Jack Lake trailhead (into Canyon Creek Meadows) and develop and implement a strategy for reducing the impacts (both social and environmental) on the wilderness area impacted by this trailhead.



C. Dispersed Camping Management - *Also see LA 2, 4, and 11*

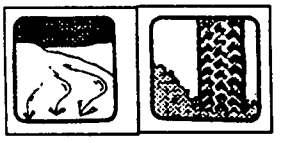
Many riparian areas are becoming overused as the demand for camping increases in the Metolius Basin. As more campers come and find campsites filled, new camps are created, increasing the roads along streams and the connection of the road network with the streams. Management of this problem could include closing some roads within 200 feet of streams and managing others for low density camping opportunities. Restricting vehicle access and reducting streamside compaction should be included in the restoration of the areas. Rehabilitate the scenic quality of closed sites.

4) Access Strategy and road restoration

A. Culvert Removal in Jack Watershed

In the 1980's we began to remove small culverts that would not be adequate for 50 year of 100 year floods. Additional work is needed in the Jack watershed to remove culverts from roads where the stream channel only flow for two weeks a year. These culverts only cause a damming effect and wash out the road. Traffic can be excluded from these areas during the runoff to prevent siltation to the streams.

Culvert inadequate for peak flows are between Road 1220 and Road 1232.

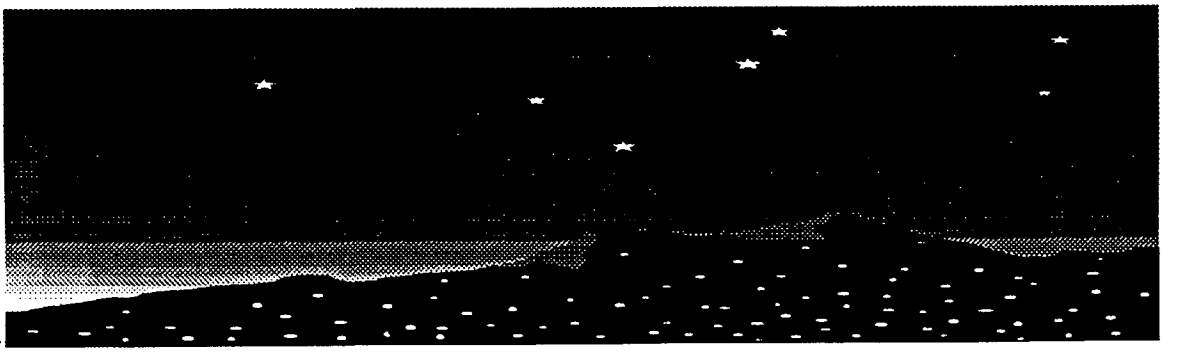


B. Road Closures and Obliteration

Reduce road densities to at least 2.5 miles per square mile. Road Closures and obliteration would reduce sediment input and improve stream conditions.

These include:

- Roads west of Road 1230
- East Abbot Butte
- Upper Canyon Road 090
- Jack Creek south of Road 1220



Landscape Area 9 - Green Ridge

Green Flag

Goal(s): Restore and maintain healthy mixed conifer and ponderosa pine late successional habitat. Provide effective big game summer range. Maintain the integrity of Castle Rock and the surrounding landscape as a potential peregrine falcon nest site.

Note: This area at the end of Green Ridge gets little use by the public. There is some hunting in the area. Other uses are a minor component. This area does include the **Castle/Cathedral Rocks Special Interest Area,** which is part of the **Metolius Special Management Area.** This area is to be managed as semiprimitive non-motorized.

1) Integrated Vegetation Management Features: Fire risk reduction, soil restoration, lower Metolius Fire Plan

Thin understories and reduce brush components to reduce the potential for high intensity wildfires. Determine if mechanical treatments or prescribed burning should be used to accomplish thinning and brush reduction. Consider the use of prescribed fire and/or mechanical treatments. Implement prescribed fire to improve forage conditions for big game.

Allow natural disturbances to influence the character of this landscape. Develop Fire Management Plan that provides guidelines for the use of natural fire.

2) Access Strategy

Close roads to reduce and maintain open road densities at 2.5 miles of road per square mile or lower. Close Road 1190 at its junction with Road 1150 to reduce disturbance to the Metolius Wildlife/Primitive Area.

Landscape Area 10 - Scarp

Green Flag

Goal(s): Maintain the scenic quality of the ridge. Maintain healthy pine and mixed conifer forests by allowing natural processes and disturbances to continue. Provide well connected late-successional habitats.

1) Integrated Vegetation Management Features: Fire risk reduction, soil restoration, lower Metolius Fire Plan

Allow natural disturbances to influence the character of this landscape. Develop Fire Management Plan that provides guidelines for the use of natural fire.

Using prescribed fire will be very difficult in this area because the slopes are steep and the fuel loads are high. Mechanical treatments on the steep slopes and erosive soils are not possible with current technology (except helicopter treatments). The effects of prescribed fire use or wildfire will be very visible from the Metolius River and the mountain peaks that attract many visitors. This area is not a high priority for treatment based on the visual sensitivity of the area and the difficulty of accomplishing treatments.

2) Special Features

Green Ridge Lookout

Maintain Green Ridge Lookout to serve as a backup for Black Butte and to provide additional detection coverage for the Metolius Basin.

Protect the Vernal Pool - a rare and unique feature.

Landscape Area 11 - Lower River

Green Flag

Goal : Reserve this area for the present and future benefit of riparian-dependent species by allowing the continuation of natural processes. Maintain riparian and in-stream habitats within range of historic variability. Maintain healthy mixed conifer stands that provide large trees for bald eagles. Provide semi-primitive, non-motorized recreation activities along the river and maintain existing developed campgrounds. Provide effective big game winter range. Provide primitive landscape setting.

1. Integrated Vegetation Management. Features: Maintain large tree character adjacent to Metolius River for bald eagles, osprey, and scenic quality.

Allow natural disturbances to influence the character of this landscape. Develop a Fire Management Plan that provides guidelines for the use of natural fire. The reintroduction of fire will benefit many species which have evolved with low intensity reoccurring fire.

Develop vegetation management strategies for Lower Bridge, Candle Creek, and Monty Campgrounds. Define campsites in Monty and Candle Creek Campgrounds to limit site impacts on soils and vegetation. Rehabilitate areas that are closed dispersed camping and effectively sign those areas that are closed.

Lower Metolius Bald Eagle Management Strategy should assess activities at Monty Campround to avoid impacts to roosting bald eagles.

Bald eagle needs should be balanced with spotted owl needs, but within established bald eagle nest stands, bald eagle management should be emphasized.

Access Key elk area to determine if it is necessary to include portions of the lower River.

2) Recreation/Aquatic Restoration/Access

Manage the lower River for a recreation experience that is consistent with the direction of the Metolius Wild and Scenic River designation.

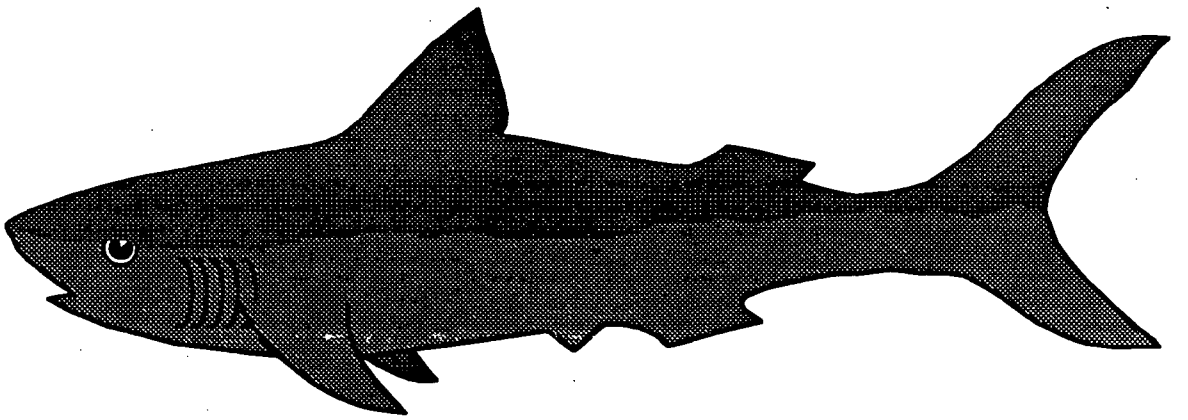
Rehabilitate closed roads and where necessary, those areas that have lost most of the ground cover due to uncontrolled vehicle and camping use. Rehabilitate riparian areas in the heavily used dispersed camping areas. Effectively close the area to motorized travel off of authorized roads and actively patrol the area. Where Roads 1499 and 64 remain open improve drainage to reduce erosion and sedimentation occurring from the roads.

Designate dispersed campsites back away from the river and tributaries at least 100 feet. Develop interpretive signing that informs users of the rules, and why they were implemented.

Limit use via a river permit system for this stretch of the Metolius. Develop put in and take out areas that minimize the impacts to soils and vegetation. Actively sign the put-in area to inform visitors of the importance of in stream woody material, and the reasons why management of this stretch of river does not include taking out the wood.

3) Access Strategy

Reduce motorized access and road below Bridge 99.



Monitoring

Aquatic

Evaluate the algal bloom at Suttle Lake and assess if the water quality is changing.
Ground water sampling should be coordinated to assess if water quality has been affected by failed drainfields in the Metolius River area.
Continue water resources monitoring in the tributaries to assess trends in temperature, fine sediment and rearing habitat. Monitor at a higher frequency the wood recovery of the Metolius River.
Continue monitoring bull trout and brook trout populations.

Soils

Evaluate management impacts on long-term soil productivity by comparing similar sites that have had different management activities.

Wildlife

Surveys and inventory should focus on focal wildlife species to determine population trends, US Fish and Wildlife Service (USFWS) Recovery Plan status, habitat capability and use, essential habitat, and impacts of forest management activities. Survey and inventory efforts should be coordinated with Oregon Department Fish and Wildlife and USFWS, and should be consistent with established protocols when available.
Monitor the development of forested stands following various silvicultural treatments designed for achieving late-successional habitat conditions.
Monitor the impacts of vegetation management activities on spotted owl habitat selection in the Matrix. This information will be the basis for habitat manipulation in Late-Successional Reserves.
Validate the snag densities and associated maximum population potentials described in the NW Forest Plan for cavity nesters.
Monitor open road densities to ensure meeting forest plan standards and monitor road closure effectiveness.

Species of Concern

Re-read Penstemon peckii Ecological Status Plots (established in 1989), for trend information.
Continue study of soil invertebrates associated with Shackle subsoiling project (5 years, after 10 years).
Update and record Penstemon peckii management treatment studies.

Recreation

Monitor use and types of use in key dispersed camping areas near water.
Establish photo points at recreation sites where heavy use may cause changes in site condition.
Assess if heavy use around high lakes is associated with fish stocking.
Monitor traffic counters to determine changes in traffic patterns in riparian/streamside associated roads.

A . Research the causes of the algae bloom on Suttle Lake, and after (or if) a cause is found develop a strategy to bring it under control.

B. Assess the impacts of high speed motorized boat traffic on Suttle Lake and the lake shore, and develop a strategy for combating the resource damage that is occurring.

Assess the effects of logging slash treatment in Wizard Timber Sale the area on the known population of Mountain Lady Slipper to learn more about the disturbance ecology of this species.

Data Gaps/Limitations of Analysis

Aquatic

- The direct link between road borne sediments and fish, insect and amphibian habitat are not well described. Measurements of sediment discharged from roads and identifying the roads with the highest risk will help in targeting road realignment, maintenance, closure or obliteration.

Vegetation

- Develop a more site specific upper limit Stand Density Index (SDI) by using plant association SDIs, calculated from healthy stands. More accurate stocking limits by plant association and productivity group would allow managers to determine when stands might be moving into potentially risky conditions.

Soils

- Better define large woody debris levels for different plant associations and the role it plays in long-term soil productivity by establishing baseline research soil carbon studies.

Wildlife

- Generally, spotted owl literature is specific to west-side spotted owl conditions, and there is a lack of east-side spotted owl information. The eastern Cascade Province is considered "high risk" because of the fire-dependent plant associations, yet spotted owl viability is dependent on these same associations. Specific information about spotted owl use in east-side systems is needed to address forest health and species viability concerns.
- An assessment is needed of habitat conditions and effects to terrestrial species under natural fire frequencies in ponderosa pine and mixed conifer stands. This information will help answer questions about managing habitat to mimic natural fire regimes

Recreation

- Map user-created trails and assess their impacts.
- Inventory types and extent of day use and overnight dispersed use in the watershed.
- Identify problem areas along trails to direct maintenance activities.
- Low elevation air photos are needed for redesign of developed campgrounds.

GLOSSARY

Anadromous fish – Fish that are born and reared in freshwater, move to the ocean to grow and mature, and return to freshwater to reproduce Salmon, steelhead, and shad are examples.

Andesite – Extrusive igneous rock of diorite composition; occurs as lava.

Aquatic ecosystem – Any body of water, such as a stream lake or estuary, and all organisms and non-living components within it, which function as a natural system.

Basalt – Extrusive igneous rock of gabbro composition; occurs as lava.

Basin – (River Drainage Area; Catchment) – The area of land that drains water, sediment and dissolved materials to a common point along a stream channel.

Biological diversity – (Biodiversity, Diversity) (1) The distribution and abundance of plant and animal communities. (2) The variety of life forms and processes, including a complexity of species, communities, gene pools, and ecological functions.

Canopy – The part of any stand of trees represented by the tree crowns; canopies may occur in layers.

Canopy closure – The degree to which the canopy (forest layers above one's head) blocks sunlight or obscures the sky. It can only be accurately determined from measurements taken under the canopy as openings in the branches and crowns must be accounted for.

Clearcut – An area of forest from which all merchantable trees have been removed by harvesting.

Clearcutting – A regeneration harvest method whereby all trees (with the exception of advanced regeneration) are removed from an area of the forest.

Climax – describes a plant community in its final or stable stage of developement.

Coarse woody debris – Portion of a tree that has fallen or been cut and left in the woods. Usually refers to pieces at least 20 inches in diameter.

Congressionally Withdrawn Area – Areas that require congressional enactment for their establishment such as National Parks, Wild and Scenic Rivers, National Recreation Areas, National Monuments, and Wilderness.

Contrast – The degree to which tow adjacent ecosystems (edge) are different from one another.

Cover – Any feature that provides concealment for fish and wildlife. Cover may consist of live or dead vegetation and geomorphic features such as boulders and undercut banks. Cover may be used for the purposes of escape from predators, feeding, or resting.

Critical habitat – Under the Endangered Species Act, critical habitat is defined as (1) the specific areas within the geographic area occupied b a federally listed species on which are found physical and biological features essential to the conservation of the species, and that may require special management.

Crown Fire -- a high intensity fire that burns through the crowns of trees.

Domain – A sphere of common activities, knowledge, and processes. For convenience, analytical modules of the WEAVE process have been grouped into three domains: physical, biological, and social.

Eastside - Generally, east of the crest of the Cascade Range.

Ecological subsections -- broad areas of landscape characterized by similar topography, soils, and climate. The Metolius Watershed is part of three ecological subsections: Upper Cascades, Lower Cascades, and Green Ridge.

Ecosystem -- (a) A community of living plants and animals interacting with each other and with their physical environment. A geographic area where it is meaningful to address the interrelationships with human social systems, sources of energy, and the ecological processes that shape change over time. (b) The complex of a community of organisms and its environment functioning as an ecological unit in nature (219 REGS/DRAFT).

Ecosystem management -- The use of an ecological approach in land management to sustain diverse, healthy, and productive ecosystems. Ecosystem management is applied at various scales to blend long-term societal and environmental values in a dynamic manner that may be adapted as more knowledge is gained through research and experience.

Edge -- See Habitat Edge

Edge effect -- The effect of adjoining vegetative communities on the population structure along the margin, which often provides for greater numbers of species and higher population densities than either adjoining community. Edge may result in negative effects as well; habitat along an edge is different than in the patch of habitat, thus reducing the effective area of the habitat patch.

Effects -- Effects, impacts, and consequences are synonymous. Effects may be direct, indirect or cumulative and may fall in one of these categories: aesthetic, historic, cultural, economic, social, health or ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems).

Embeddedness -- describes the extent that large streambed particles are surrounded or "embedded" by small particles. Can be used to define quality of spawning gravels or aquatic invertebrate habitat.

Endangered species -- Any species of plant or animal defined through the Endangered Species Act as being in danger of extinction throughout all or a significant portion of its range, and identified as such in the Federal Register.

Endemic -- A species that is unique to a specific locality.

Fire regime -- The frequency, predictability, intensity, seasonality, and extent characteristics of fires in an ecosystem.

Fire severity -- The effect of fire on plant communities. Fore trees, it is often measured as the percentage of basal area killed by fire.

Floodplain -- Level lowland bordering a stream or river onto which the flow spreads at flood stage.

Forest types -- A classification of forest land based on the tree species presently forming a plurality of basal area stocking or crown cover of live tree.

Fragmentation -- The process of reducing size and connectivity of stands that compose a forest. See Habitat Fragmentation.

Fuel -- Dry, dead tree parts which can readily burn

Fuelbreak – An area of land on which the native vegetation has been removed or modified so that fires burning into it can be controlled more readily. Some fuelbreaks contain firelines which can be quickly widened with hand tools or by burning.

Graben – A trenchlike depression representing the surface of a fault black dropped down between two opposed, infacing normal faults.

Interdisciplinary team – A group of individuals with varying areas of specialty assembled to solve a problem or perform a task. The team is assembled out of recognition that no one scientific discipline is sufficiently broad enough to adequately analyze the problem and proposed action.

Intermittent stream – Any non-permanent flowing drainage feature having a definable channel and evidence of annual scour or deposition. This includes what are sometime referred to as ephemeral streams if they meet these two criteria.

Key Watershed – As defined by FEMAT a watershed containing (1) habitat for potentially threatened species or stocks or anadromous salmonids or other potentially threatened fish, or (2) greater than six square miles with high-quality water and fish habitat.

Late-Successional Reserve – An area of forest in its mature and/or old-growth stages that has been reserved under the ROD for the Nborthwest Forest Plan.

Moraines – An accumulation of rock debris carried by an alpine glacier or an ice sheet and deposited by the ice to become a depositional land form. The following are several examples of morines:

Terminal moraine – a moraine deposited as an embankment at the terminus of an alpine glacier or at the leading edge of an ice sheet.

Lateral moraine – a moraine formed by an embankment between the ice of an alpine glacier and adjacent valley wall.

Nesting, roosting, and foraging habitat – The forest vegetation with the age class, species of trees, structure, sufficient area, and adequate food source to meet some or all of the life needs of the northern spotted owl.

Neotropical – Relating to or constituting the biogeographic realm that includes South America, the Indies, Central America and tropical Mexico.

Oligotrophic – A term applied to a body of water low in nutrients and low in productivity.

Overstory – Trees that provide the uppermost layer of foliage in a forest with more than one roughly horizontal layer of foliage.

Park-like stands – Stands having scattered, large, seral overstory trees and open growing conditions usually maintained by frequent ground fires.

Prescribed fire – A fire burning within an approved, predefined and planned prescription. The fire may result from either a planned or natural ignition. When a prescribed fire exceeds the prescription and/or planned perimeter, it may be declared a wildlife.

Range of the northern spotted owl – The range of the northern spotted owl in the United States is generally comprised of land in western Washington and Oregon , and northern California.

Rate of spread (ROS) – The rate at which a fire moves across a landscape, usually measured in meters/second.

Record of Decision (ROD) – A document separate from but associated with an environmental impact statement that sets the management decision, identifies all alternatives including both the environmentally preferable and selected alternatives, states whether all practicable means to avoid environmental harm from the selected alternative have been adopted, and if not, why not.

Redd – A fish spawning area usually found in gravels.

Reforestation – The natural or artificial restocking of an area with forest trees; most commonly used in reference to artificial stocking.

Refugia – Locations and habitats that support populations of organisms that are limited to small fragments of their previous geographic range (i.e. endemic populations).

Restoration – Actions taken to return an ecosystem in whole or in part to a desired condition.

Riparian – Pertaining to land that is next to water, where plants dependent on a perpetual source of water reside.

Riparian area – As specifically defined in the FEMAT Report, a geographic area containing an aquatic ecosystem and adjacent upland areas that directly affect it. This includes floodplain, woodlands, and all areas within a horizontal distance of approximately 100 feet from the normal line of high water of a stream channel or from the shoreline of a standing body of water.

Riparian reserves – The area adjacent to streams, lakes and wetlands which is designed to protect aquatic and riparian functions and values.

Seral – (1) Successional; (2) A species or a community which will be replaced by another in succession.

Site potential tree – A tree that has attained the average maximum height possible given site conditions where it occurs.

Snag – A standing dead tree.

Soil productivity – Capacity or suitability of a soil, for establishment and growth of a specified crop or plant species, primarily through nutrient availability.

Stand – Vegetation occupying a specific area that is sufficiently uniform in composition, size, arrangement, structure, and condition as to be distinguished from the vegetation in adjoining areas.

Talus – Accumulation of loose rock fragments derived by rockfall from a cliff.

Threatened species – Those plant or animal species likely to become endangered throughout all or a significant portion of their range within the foreseeable future. A plant or animal identified and defined in accordance with the 1973 Endangered Species Act and identified as such in the Federal Register.

Underburn – low intensity surface fire that generally involves only ground fuels.

Understory – The trees and other woody species growing under the canopies of larger adjacent trees and other woody growth.]

Watershed – The drainage basin contributing water, organic matter, dissolved nutrients and sediments to a stream or lake.

Watershed analysis – A systematic procedure for characterizing watershed and ecological processes to meet specific management and social objectives. Watershed analysis is a stratum of ecosystem management planning applied to watersheds of approximately 20 to 200 square miles.

WEAVE – Acronym for the Watershed Analysis process developed by the Deschutes National Forest - (Watershed Evaluation and Analysis for Viable Ecosystems). It incorporates our ultimate purpose for doing watershed ecosystem analysis to sustain viable ecosystems. It evokes visions of an intricate tapestry of many colors and textures, each thread having an important function in creating a viable, interconnected whole. It also symbolizes that the work of many others is inextricably woven into the Deschutes process, and that each past and future thoughtful addition will add functionality and strength to the whole effort.

Westside – Generally, west of the crest of the Cascade Range

Wetlands – Areas that are inundated by surface water or ground water with a frequency sufficient to support, and under normal circumstances do or would support, a prevalence of vegetative or aquatic life that require saturated or seasonally wetted soil conditions for growth and reproduction (Executive Order 11990). Wetlands generally include, but are not limited to, swamps, marshes, bogs and similar areas.

Wilderness – Areas designated by congressional action under the 1964 Wilderness Act. Wilderness is defined as undeveloped Federal land retaining its primeval character and influence without permanent improvements or human habitation. Wilderness areas are protected and managed to preserve their natural conditions, which generally appear to have been affected primarily by the forces of nature with the imprint of human activity substantially unnoticeable; have outstanding opportunities for solitude or for a primitive and confined type of recreation ; include at least 5,000 acres or are of sufficient size to make practical their preservation, enjoyment, and use in an unimpaired condition; and may contain features of scientific, education, scenic or historical value as well as ecologic and geologic interest.

Zooplankton – A floating, often microscopic aquatic animal.

ACRONYMS

ACS:	Aquatic Conservation Strategy
BEMA:	Bald Eagle Management Area
CCC:	Civilian Conservation Corp
DBH:	Diameter at Breast Height
EA	Environmental Assessment
FEMAT:	Forest Ecosystem Management Assessment Team
FS:	Forest Service
GIS:	Geographical Information Systems
GLO:	General Land Office
HRV:	Historic Range of Variability
IDT:	Interdisciplinary Team
LA	Landscape Areas
LP:	Lodgepole Pine
LPD:	Lodgepole Pine Dry
LPW:	Lodgepole Pine Wet
LRMP:	Land and Resource Management Plan
LSR:	Late Successional Reserve
MCD:	Mixed Conifer Dry
MCW:	Mixed Conifer Wet
MH:	Mountain Hemlock
NRF:	Nesting, Roosting, and Foraging
NTMB:	Neotropical Migratory Bird
NW:	Northwest
ODFW:	Oregon Department of Fish and Wildlife
OHV:	Off Highway Vehicle
PAG:	Plant Association Group
PETS:	Potential Endangered, Threatened, or Sensitive (Species)
PP:	Ponderosa Pine
ROD:	Record of Decision
ROS:	Recreational Opportunity Spectrum
RV:	Recreational Vehicle
RVD's:	Recreation Visitor Days
SCORP:	Recreation Demand Information Statewide Recreational Need for Central Oregon
USFWS:	United States Fish and Wildlife Service
WEAVE:	Watershed Evaluation and Analysis for Viable Ecosystems

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APPENDIX 1:

FIRE

Metolius Watershed Large Fire History

1908 to 1994

For this analysis, the Warm Springs Fire of 1938, will not be included. There is insufficient supporting information about the location of this fire to make assumptions about its influence on the Metolius Watershed.

Information included in the accompanying descriptions of fires in the Metolius Watershed will not be used for fires less than 100 acres in size. All analysis will be based upon fires that are 100 acres or larger.

A total of 18 fires, excluding the Abbot Creek Fire, occurred in the Metolius Watershed from 1908 to 1994. The Abbot Creek Fire will not be included in estimates of fire sizes or acres burned because information about its size are not available.

Large fires in the Metolius Watershed have burned a total of 25,027 acres from 1908 to 1994.

Appendix Table 1: Acres burned by subwatershed in large fires.

Subwatershed	Acres
Metolius Horn	7,925
Scarp	870
Candle	4,521
Abbot	?????
Canyon	6,796
Jack/First	0
Suttle	3,699
Cache	1,216
Total Metolius Watershed	**25,027**

- 17 percent of the Metolius Watershed burned in large fires from 1908 to 1994:
- 25,027 acres burned/148,979 acres in the watershed = 17 percent

Appendix Table 2: Percent of acres burned in large fires, by subwatershed.

Subwatershed	Total Watershed Acres	Total Acres Burned	Percentage of Acres Burned
Metolius Horn	16,352	7,925	48%
Scarp	13,834	870	49%
Candle	19,383	4,521	24%
Abbot	?????	?????	?????
Canyon	22,390	6,796	30%
Jack/First	0	0	0%
Suttle	20,939	3,699	18%
Cache	25,812	1,216	5%

Average large fire size: 25,027 acres burned/18 fires = 1,390 acres per fire

Appendix Table 3: Average large fire size, by subwatershed

Subwatershed	Acres
Metolius Horn	1,981
Scarp	435
Candle	2,261
Abbot	?????
Canyon	1,699
Jack/First	0
Suttle	924
Cache	608

Appendix Table 4: Acres burned in large fires, by decade:

Subwatershed	Acres
1900-1909	600
1910-1919	5,164
1920-1929	5,416
1930-1939	1,070
1940-1949	6,682
1950-1959	0
1960-1969	2,154
1970-1979	0
1980-1989	3,750
1990-1994	146

An average of 2,634 acres have burned each decade in this watershed.

Metolius Watershed Large Fire History from 1908 to 1994

(Fires greater than 100 acres)

The information about these fires has been compiled from many sources. The primary source of information was the Deschutes National Forest Fire Atlas. Pat McCauley (retired) compiled much of the data about fire locations and size. Other information sources included aerial photo interpretation and conversations with Forest Service employees, past and present, who were involved with fire suppression or reforestation of some of the fires. Bob Sherman, a professor from Sonoma State University, while on sabbatical leave mapped the fires into the GIS system.

See "Metolius Watershed Data Dictionary" for additional information about the sources and accuracy of the information included in the GIS system database.

The fires will be grouped by subwatershed to facilitate identification.

The Narrative information included with each fire is referenced from "Deschutes National Forest Fire History, 1908 to 1992" by Pat McCauley.

Information about fires less than 100 acres are included in this report (Sugarpine Ridge Fire, 1975 and Pine Ridge Fire, 1994) because they are located in the same area as the larger Sugarpine Ridge fire that occurred in 1914.

Metolius Horn Subwatershed

1910-0005 Metolius/Jefferson Creek Fire
Started: 7/17/10 Origin: T11 R9 Sec. 36 Size: 2,196 Ac.
Narrative: This fire was named the Metolius/Jefferson Creek fire because it started along the Metolius River where Jefferson Creek runs into the Metolius River. The fire burned down the Metolius River for 4 or 5 miles and to the top of Green Ridge near Castle Rocks. The fire was square in shape.

1926-0002 Metolius Horn Metolius Fire
Started: 8/11/26 Origin: T11 R10 Sec. 11 Size: 2,964 Ac.
Narrative: The Metolius Fire was located along the Metolius River, up river from Monty Campground, in the Bean Creek area. The fire burned to the top of Green Ridge near Castle Rocks.

1941-0001 Lower Metolius Fire
Started: 7/6/41 Origin: T11 R11 Sec. ? Size: 2,110 Ac.
Narrative: This fire started on the Warm Springs Indian Reservation and spotted across the Metolius River.

1945-0001 Metolius Fire
Started: 6/20/45 Origin: T11 R9 Sec. 12 Size: 655 Ac.
Narrative: The Metolius Fire started along the (Metolius) River in Section 12, where the river starts to bend around the end of Green Ridge under Castle Rocks. The fire was up stream from the cabins at the end of the road along the river. The fire went from the Metolius River to the top of Green Ridge. The fire was suppressed by a crew of forest guards, loggers, conscientious objectors and fifty paratroopers who were flown into the Redmond Airport.

Scarp Subwatershed

1909-0004 Metolius Fire
Started: 8/28/09 Origin: T12 R9 Sec. 2/11 Size: 600 Ac.
Narrative: The Metolius Fire was located at the base of Green Ridge, east of the present day Bridge 99 and east of the Metolius Road (Road 14). The fire burned to the south, up stream, and along the Metolius Road to form a square shaped burn.

1981-0001 Black Butte Fire
Started: 9/17/81 Origin: T13 R9 Sec. 35 Size: 270 Ac.
Narrative: The Black Butte fire was caused by a late season lightning storm that started several fires at the same time. This fire started on the east slope of Black Butte just down slope from the lookout tower. The district decided that this fire was too dangerous to suppress that night. Based on the expected complexity of the fire, an overhead team was requested to manage the fire. The district was concerned about the fire burning toward the Head of the Metolius. No crews were enroute when the overhead team arrived so retardant was used to contain the fire until the crews could arrive. 75,000 gallons of retardant was dropped in the first afternoon.

Candle Subwatershed

1914-0002 Sugarpine Ridge Fire
Started: 7/27/14 Origin: T11 R8 Sec. 25/26 Size: 1,553 Ac.
Narrative: This fire was in the same area that burned in the 1975 Sugarpine Ridge Fire and the 1987 Cabot Lake Fire.

1975-0001 **Sugarpine Ridge Fire**
Started: 10/1/75 Origin: T11 R8 Sec. 12 Size: 67 Ac.
Narrative: The cost of suppressing this fire was more than $300,000 due to heavy use of helicopters in the wilderness. This fire occured late in the season and the crews camped outside of the wilderness and were flown in to the fire daily. This area was burned again in the 1987 Cabot Lake Fire.

1987-0003 **Cabot Lake Fire**
Started: 8/31/87 Origin: T11 R8 Sec. 27 Size: 2,968 Ac.
Narrative: The Cabot Lake and Brush Creek Fires were both started from a lightning storm that "hit" the entire state. They were both located in the Mt. Jefferson Wilderness. The Cabot Lake fire was the largest fire included in the Jefferson Complex. The fires in the Jefferson Complex were rated 87th in priority for resources. The limited availability of resources prompted the district to select the confine strategy for controlling this fire. The
objective was to confine the fire in the wilderness. The Cabot Lake Fire did come out of the wilderness a little ways. Both the Cabot Lake and Brush Creek fires burned into October.

1994 **Pine Ridge Fire**
Started: 7/27/94 Origin: T11 R8 Sec. 23 Size: 25 Ac.
Narrative: This fire was lightning caused. It burned in the same area that burned in the 1987 Cabot Lake Fire.

Abbot Subwatershed

9999-0006 **Abbot Creek**
Origin: T12 R9 Sec. 10
Narrative: This fire was described in the Sisters Fire Atlas (1950-1961) but no additional information was found.

Canyon Subwatershed

1924-0005 **Wasco Lake Fire**
Started: 8/10/24 Origin: T12 R8 Sec. 16 Size: 2,367 Ac.
Narrative: There were two stories in the newpaper about this fire. One story covered the burn-over of a firefighter and the other story covered a firefighter who "went mad" and tried to kill people. This area was burned again in the 1945 Minto Pass Fire.

1945-0002 **Minto Pass Fire**
Started: 8/20/45 Origin: Unknown Size: 3,917 Ac.
Narrative: This fire was discovered on August 20, 1945 near Rock Pile Mountain (Willamette NF). Ranger Gustafson and 17 men were on the fire when if blew up and made it's downhill run with 35 mph west winds. When the fire was controlled it included the area from Rock Pile Mountain down Brush Creek, nearly to Abbot Butte. At the peak of the fire suppression work, nearly 600 people were employed on the fire lines.

1987-0002 **Brush Creek Fire**
Started: 8/31/87 Origin: T12 R8 Sec. 4 Size: 380 Ac.
Narrative: The Brush Creek and Cabot Lake Fires were both started from a lightning storm that "hit" the entire state and were called the Jefferson Complex. They were located in the Mt. Jefferson Wilderness. The fires in the Jefferson Complex were rated 87th in priority for resources. The limited availability of resources prompted the district to select the confine strategy for controlling these fires. The objective was to confine both fires in the wilderness. Both the Brush Creek and Cabot Lake Fires burned into October.

1989-0001 **Canyon Creek Fire**
Started: 6/13/89 Origin: T12 R8 Sec. 27 Size: 132 Ac.
Narrative: This fire was started from an escaped prescribed burn on the Upper Canyon Timber Sale. The district managed the fire and no overhead team was assigned.

Suttle Subwatershed

1911-0005 **Lake Creek Fire**
Started: 7/28/11 Origin: T13 R9 Sec. 19 Size: 1,415 Ac.
Narrative: The Lake Creek Fire started at Suttle Lake and burned down Lake Creek for two miles. The fire formed two heads, one on each side of Lake Creek.

1928-0002 **Blue Lake Fire**
Started: 8/9/28 Origin: T13 R8 Sec. 22/28 Size: 130 Ac.
Narrative: This fire was located on the ridge north of Highway 20. It is the fire that created the brush field north of the Mt. Washington Overlook on Highway 20, west of Suttle Lake.

1960-0002 **Round Lake Fire**
Started: 7/17/60 Origin: T13 R8 Sec. 21 Size: 114 Ac.

1967-000 **Big Lake Airstrip Fire**
Started: 8/31/67 Origin: Willamette NF Size: 2,040 Ac.
Narrative: The total fire size was 7,000 acres. This fire started on the Willamette NF and burned east over Hoodoo Butte. This fire was filmed and used in the Forest Service film "Man Against Fire".

Subwatershed

1930-0003 **Dugout Lake Fire**
Started: 7/12/30 Origin: T14 R8 Sec. 27 Size: 1,070 Ac.
Narrative: Reforestation of this fire has been a problem due to sandy soils and gophers. According to Dave Priest, Sisters RD Reforestation Technician, this area was originally a lodgepole pine stand and it is a normal process for this area to become a meadow after a stand replacement fire. Animal damage has been the problem for reforestation, not the fire effects.

1991-0003 **George Lake Fire**
Started: 7/23/91 Origin: T14 R8 Sec. 31 Size: 146 Ac.
Narrative: This fire was lightning caused. The fire burned in hemlock stands. The fire spread was fairly slow but mop-up was difficult.

Warm Springs Indian Reservation

Warm Springs Fire

Started: 7/24/38 Size: 100,000 Acres
Narrative: According to Pat McCauley's "Deschutes National Forest Fire History, 1908 to 1992", the Newspaper reported a 100,000 acre fire, the biggest in Central Oregon history. The fire was on the Warm Springs Indian Reservation, on the bench north of the Metolius arm of Lake Billy Chinook. The Deschutes National Forest sent a Civilian Conservation Crew to help with the fire suppression effort. The possibility of back firing from the Metolius River was discussed by the Forest Supervisor and the Bureau of Indian Affairs representative but the decision was made not to implement the back fire. The fire stayed on the bench above the Metolius.

Metolius Watershed Fire Occurrance

1982 to 1994

The information for fire occurrance in the Metolius Watershed has been obtained from the fire occurrance information in the Sisters District GIS system and the Fire Report Summaries from the Sisters Ranger District fire shop. The data associated with the points in GIS is not in the GIS database. The "paper" records were used to obtain the information about date of fire start, size, and cause.

Appendix Table 5: Total number of fires in the Metolius Watershed from 1982 to 1994: 200 fires

Total number of fires by subwatershed:	
Subwatershed	**Fires**
Metolius Horn	21
Scarp	27
Candle	25
Abbot	9
Canyon	34
Jack/First	33
Suttle	36
Cache	15
Total	200

Average number of fires per year in the Metolius watershed:

Appendix Table 6:200 fires/ 12 years = 17 fires/year

The Average Number Of Fires Per Year By Subwatershed:		
Subwatershed	**Number of fires**	**Fires per year**
Metolius Horn	21	1.8
Scarp	27	2.3
Candle	25	2.8
Abbot	9	0.75
Canyon	34	2.1
Jack/First	33	2.75
Suttle	36	3.0
Cache	15	1.25

Total number of lightning fires in the Metolius watershed: 106 fires

Total number of human caused fires in the Metolius watershed: 87 fires

Total number of fires with insufficient data to determine cause: 7 fires

Percentage of lightning caused fires in the Metolius watershed:

106 ligtning fires/ 200 total fires = 53%

Percentage of human caused fires in the Metolius watershed:

87 human caused fires/ 200 total fires = 44%

Percentage of fires with insufficient data to determine cause:

7 fires with unknown cause/ 200 total fires = 3%

Appendix Table 7: Lightning Caused Fires

Fire causes by subwatershed (lightning):			
	Total #	# lightning	% lightning
Metolius Horn	21	15	71%
Scarp	27	10	37%
Candle	25	20	80%
Abbot	9	3	33%
Canyon	34	18	53%
Jack/First	33	13	39%
Suttle	36	18	50%
Cache	15	9	60%
Total	200	106	53%

Appendix Table 8: Human Caused and Unknown Causes Fires

Fire causes by subwatershed (human caused and unknown causes):					
	Total # of Fires	**# Human Caused**	**% Human Caused**	**# Unknown Causes**	**% Unknown Causes**
Metolius Horn	21	6	29	0	0
Scarp	27	16	59	1	4
Candle	25	5	20	0	0
Abbot	9	6	67	0	0
Canyon	34	16	47	0	0
Jack/First	33	16	49	4	12
Suttle	36	17	47	1	3
Cache	15	5	33	1	7
Total	200	87	44	7	3

Appendix Table 9: Size of Fire

Size of fires in the Metolius watershed:							
Subwatershed	**Size Classes**						
	A	**B**	**C**	**D**	**E**	**F**	**G**
Metolius Horn	9	9	3				
Scarp	23	3					
Candle	20	3	1				
Abbot	9						
Canyon	28	5			1		
Jack/First	26	3					
Suttle	34		1				
Cache	12	1		1			
Total #	161	24	5	1	1	1	0
% by size class	83	12	3	1	1	1	0

Size Class A = ¼ Acre or less

Size Class B = ¼ to 9 Acres

Size Class C = 10 to 99 Acres

Size Class D = 100 to 299 Acres

Size Class E = 300 to 999 Acres

Size Class F = 1,000 to 4,999 Acres

Size Class G = 5,000+ Acres

Appendix Table 10: Fire Occurance by Month

Fire occurrance by month in the Metolius watershed:							
Subwatershed	**Months**						
	Apr	May	Jun	Jul	Aug	Sep	Oct
Metolius Horn	0	2	3	2	12	1	1
Scarp	2	3	5	6	6	2	2
Candle	0	2	1	1	13	8	0
Abbot	0	0	0	3	4	2	0
Canyon	0	1	5	5	16	4	3
Jack/First	0	2	6	9	6	5	1
Suttle	0	1	4	9	14	5	2
Cache	0	2	1	4	6	1	0
Total by month	2	13	25	39	77	28	9
% by month	1	7	13	20	40	14	5

Appendix 2:

Wildlife

Species	PPD	LPD	LPM	MCD	MCW	MH_MH
American crow	4			1	1	1
American dipper	1			1	1	1
American kestrel	1			1	1	1
American robin	1	1	1	1	1	1
American wigeon	1					
Bald eagle	1			1	1	3
Barn owl	1			1	1	
Beaver	1	1	1	1	1	
Bewick's wren	1					
Black bear	1	2	2	1	1	1
Black-billed magpie	2	3	3	3	3	3
Black-capped chickadee	1	1				
Black-headed grosbeak	1	3	3	1	1	1
Blue grouse	1	3	3	1	1	3
Blue-winged teal	1					
Bobcat	2	2	2	1	1	2
Bohemian waxwing	3					
Brewer's blackbird	1			1	1	
Broad-footed mole	1	1	1	1	1	1
Brown creeper	3			1	1	
Brown-headed cowbird	1			1	1	
Bufflehead	1			1	1	1
Bullfrog	1					
Bushtit	3					
Bushy-tailed woodrat	2	2	2	2	2	2
California myotis	1	3	3	1	1	3
Canada goose	1					
Canvasback	1	1	1	1	1	
Cassin's finch	1	1	1	1	1	1
Cedar waxwing	1					
Chipping sparrow	1			1	1	1
Cinnamon teal	1					
Coast mole	1	1	1	1	1	
Common garter snake	1	1	1	1	1	
Common goldeneye	3			1	1	1
Common merganser	1	1	1	1	1	1
Common nighthawk	1					
Common raven	1	1	1	1	1	1
Cooper's hawk	1	1	1	1	1	1
Coyote	1	1	1	1	1	1
Dark-eyed junco	1	1	1	1	1	1
Douglas' squirrel	2	2	2	2	2	2
Downy woodpecker	1	1	1	1	1	1
Dusky flycatcher	3			1		
Elk	1	4	4	1	1	3
Evening grosbeak	1	1	1	1	1	1
Ferruginous hawk	4	4	4	4	4	4
Gadwall	1	1	1	1		
Golden eagle	1			1	1	

Species	PPD	LPD	LPM	MCD	MCW	MH_MH
Golden-crowned sparrow	3			3	3	
Golden-mantled ground squirrel	2	4	4	2	2	2
Gopher snake	1					
Gray flycatcher	3					
Great blue heron	1					
Great horned owl	1	3	3	1	1	3
Greater scaup	1	1	1	1	1	
Greater yellowlegs	3	3	3	3	3	3
Green-tailed towhee	3					
Green-winged teal	1					
Hermit thrush	3	1	1	1	1	
Hoary bat	1	1	1	1	1	1
Hooded merganser	1			1	1	1
House finch	3			4	4	
House wren	1			1	1	
Lesser scaup	1	1	1	1	1	
Little brown myotis	3	3	3	1	1	1
Long-legged myotis	1	3	3	1	1	1
Long-tailed vole	1			1	1	1
Long-tailed weasel	3	3	3	3	3	3
Long-toed salamander	1			1	1	2
MacGillivray's warbler	1	1	1	1	1	1
Mallard	1	1	1	1	1	1
Merlin	3	1	1	3	3	1
Mink	1	1	1	1	1	1
Mountain bluebird	4			4	4	4
Mountain lion	1			1	1	1
Mountain quail	1					
Mourning dove	1					
Mule deer	1	1	1	1	1	3
Northern alligator lizard	1			1	1	1
Northern flicker	1					
Northern flying squirrel	1					
Northern goshawk	1	1	1	1	1	1
Northern oriole	1					
Northern pintail	1					
Northern pocket gopher	2	2	2	2	2	2
Northern pygmy-owl	2			2	2	
Northern saw-whet owl	1	3	3	1	1	1
Northern shoveler	1					
Northern shrike	3					
Northwestern salamander	1	1	1	1	1	1
Olive-sided flycather	1	3	3	1	1	1
Osprey	1	1	1			
Pacific treefrog (Chorus)	1	1	1	1	1	1
Peregrine falcon	3	3	3	3	3	3
Pine siskin	1	1	1	1	1	1
Porcupine	3	4	4	3	3	4
Purple finch	1	3	3	1	1	

Species	PPD	LPD	LPM	MCD	MCW	MH_MH
Purple martin	1					
Raccoon	1					
Racer	4			4	4	
Red fox	1	1	1	1	1	1
Red-breasted merganser	4	4	4	4	4	4
Red-breasted sapsucker	1			1	1	
Red-eyed vireo	1			1	1	
Red-tailed hawk	1			1	1	3
Red-winged blackbird	1	1	1			
Redhead	1	1	1	1	1	
Ring-necked duck	1	1	1	1	1	
River otter	1	1	1	1	1	1
Rough-legged hawk	3			3	3	
Rough-skinned newt	1	1	1	1	1	1
Rubber boa	1			1	1	3
Ruffed grouse	1	3	3	1	1	
Sharp-shinned hawk	1	1	1	1	1	1
Solitary vireo	3	2	2	1	1	4
Southern alligator lizard	2					
Spotted frog	1			1	1	
Spotted sandpiper	1	1	1	1	1	1
Steller's jay	1			1	1	1
Swainson's hawk	3			3	3	3
Townsend's big-eared bat	1					
Tree swallow	1			1	1	
Turkey vulture	1	3	3	3	3	3
Violet-green swallow	1					
Warbling vireo	1			1	1	
Western bluebird	4			4	4	4
Western fence lizard	1					
Western gray squirrel	1			1	1	
Western jumping mouse	1	1	1	1	1	1
Western rattlesnake	3	3	3	3	3	
Western skink	1					
Western toad	1	1	1	1	1	1
Western wood-pewee	1	1	1	1	1	1
White-crowned sparrow	3	3	3			1
White-throated swift	3					
Wolverine	3	3	3	3	3	1
Wood duck	1			1	1	
Yellow warbler	1	1	1	1	1	1
Yellow-pine chipmunk	1	1	2	2	1	1
Yellow-rumped warbler	4	1	1	1	1	1
Yuma myotis	1	1	1	1	1	1

APPENDIX A

METOLIUS WATERSHED - WILDLIFE SPECIES IN MOUNTAIN HEMLOCK PAG 8/10/95

Species	MH_MH_early	MH_MH_mid	MH_MH_late
American crow	3	2	2
American kestrel	4	2	2
American robin	1	1	1
Badger	1	1	1
Bald eagle	3		3
Big brown bat	3		3
Black bear	1	1	1
Black-billed magpie	3	3	3
Black-headed grosbeak	3	3	1
Blue grouse	3	3	3
Bobcat	2	2	2
Broad-footed mole	1	1	1
Bushy-tailed woodrat	1	1	1
California myotis	3		3
Calliope hummingbird	1	1	
Cassin's finch	3	1	1
Chipping sparrow	1	1	1
Clark's nutcracker	3	3	1
Coast mole	1	1	1
Common raven	1		
Cooper's hawk	4	1	1
Coyote	1	1	1
Dark-eyed junco	1	1	1
Deer mouse	1	1	1
Douglas' squirrel	1	1	1
Elk	3	3	3
Ermine	1	1	1
Evening grosbeak	3	3	1
Ferruginous hawk	4	4	4
Golden-crowned kinglet	3	1	1
Golden-mantled ground squirrel	1	1	1
Gray jay	1	1	1
Great horned owl	3	3	3
Hermit warbler	1	1	1
Hoary bat	1	1	1
Little brown myotis	3		1
Long-eared myotis	3		3
Long-eared owl	3	1	1
Long-legged myotis	3		1
Long-tailed vole	2	2	2
Long-tailed weasel	2	2	2
Long-toed salamander	4	4	4
Marten	3	3	1
Merlin	3	3	1
Mountain beaver	1	1	
Mountain bluebird	4	2	2
Mountain chickadee	3	1	1
Mountain lion	1	1	1
Mule deer	3	3	3

Species	MH_MH_early	MH_MH_mid	MH_MH_late
Northern alligator lizard	1	1	1
Northern goshawk	4	4	1
Northern pocket gopher	1	1	1
Northwestern salamander	3	3	3
Olive-sided flycather	1	1	1
Pacific treefrog (Chorus)	3	3	3
Peregrine falcon	3	3	3
Pine siskin	1	1	1
Porcupine	4		4
Red fox	1	1	1
Red-tailed hawk	3	3	3
Rough-skinned newt	3	3	3
Rubber boa	3	3	3
Ruby-crowned kinglet	3	3	1
Rufous humingbird	1	1	1
Sharp-shinned hawk	1	1	1
Snowshoe hare	1	1	1
Solitary vireo	4	4	4
Steller's jay	1	1	1
Swainson's hawk	3	3	3
Townsend's chipmunk	1	1	1
Turkey vulture	3	3	3
Varied thrush	1	1	1
Western bluebird	4	2	2
Western jumping mouse	1	1	1
Western pocket gopher	1	1	1
Western red-backed vole	1	1	1
Western tanager	3	1	1
Western toad	3	3	
White-crowned sparrow	1	1	1
Willow flycatcher	3	3	3
Wilson's warbler	2	2	2
Winter wren	3	1	1
Wolverine	1	1	1
Yellow-pine chipmunk	1	1	1
Yellow-rumped warbler	3	1	1

HABITAT RELATIONSHIP KEY

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PPW = Ponderosa Pine Wet
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MH = Mountain Hemlock

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APPENDIX A

METOLIUS WATERSHED - WILDLIFE SPECIES IN LODGEPOLE PINE PAG 8/10/95

Species	LPD_early	LPD_mid	LPD_late	LPM_early	LPM_mid	LPM_late
American robin	1	1	1	1	1	1
Anna's hummingbird	1			1		
Badger	3	3	3	3	3	3
Black bear	2	2	2	2	2	2
Black-billed magpie	3	3	3	3	3	3
Black-headed grosbeak	3	3	3	3	3	3
Blue grouse	3	3	3	3	3	3
Bobcat	2	2	2	2	2	2
Broad-footed mole	1	1	1	1	1	1
Bushy-tailed woodrat	1	1	1	1	1	1
California myotis	3		3	3		3
Cassin's finch	3	1	1	3	1	1
Coast mole	1	1	1	1	1	1
Common raven	1			1		1
Cooper's hawk	4	1	1	4	1	1
Coyote	1	1	1	1	1	1
Dark-eyed junco	1	1	1	1	1	1
Deer mouse	1	1	1	1	1	1
Douglas' squirrel	1	1	1	1	1	1
Elk	4	4	4	4	4	4
Ermine	1	1	1	1	1	1
Evening grosbeak	3	3	1	3	3	1
Ferruginous hawk	4	4	4	4	4	4
Golden-crowned kinglet	3	1	1	3	1	1
Golden-mantled ground squirrel	4	4	4	4	4	4
Gray jay	1	1	1	1	1	1
Great horned owl	3	3	3	3	3	3
Hermit thrush	3	1	1	3	1	1
Hermit warbler	3	3	3	3	3	3
Hoary bat	1	1	1	1	1	1
Lapland longspur	3	3	3	3	3	3
Little brown myotis	3		3	3		3
Long-eared myotis	3		3	3		3
Long-eared owl	3	1	1	3	1	1
Long-legged myotis	3		3	3		3
Long-tailed weasel	2	2	2	2	2	2
Marten	3	3	3	3	3	3
Merlin	3	3	1	3	3	1
Mountain chickadee	3	1	1	3	1	1
Mule deer	1	1	1	1	1	1
Northern goshawk	4	4	1	4	4	1
Northern pocket gopher	1	1	1	1	1	1
Northwestern salamander	3	3	3	3	3	3
Olive-sided flycather	3	3	3	3	3	3
Pacific treefrog (Chorus)	4	4	4	4	4	4
Peregrine falcon	3	3	3	3	3	3
Pine siskin	1	1	1	1	1	1
Porcupine	4		4	4		4
Purple finch	3	3	3	3	3	3

Species	LPD_early	LPD_mid	LPD_late	LPM_early	LPM_mid	LPM_late
Red fox	1	1	1	1	1	1
Rough-skinned newt	3	3	3	3	3	3
Ruby-crowned kinglet	3	3	1	3	3	1
Ruffed grouse	3	3	3	3	3	3
Rufous humingbird	1	1	1	1	1	1
Sharp-shinned hawk	1	1	1	1	1	1
Snowshoe hare	2	2	2	2	2	2
Solitary vireo	2	2	2	2	2	2
Turkey vulture	3	3	3	3	3	3
Western jumping mouse	1	1	1	1	1	1
Western pocket gopher	1	1	1	1	1	1
Western rattlesnake	3	3	3	3	3	3
Western red-backed vole	1	1	1	1	1	1
Western tanager	3	1	1	3	1	1
Western toad	3	3		3	3	
White-crowned sparrow	3	3	3	3	3	3
Willow flycatcher	3	3	3	3	3	3
Winter wren	3	1	1	3	1	1
Wolverine	3	3	3	3	3	3
Yellow-pine chipmunk	1	1	1	1	1	1
Yellow-rumped warbler	3	1	1	3	1	1

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APPENDIX A

METOLIUS WATERSHED - WILDLIFE SPECIES IN WET MIXED CONIFER PAG 8/10/95

Species	MCW_early	MCW_mid	MCW_late
American crow	3	2	2
American kestrel	3	1	1
American robin	1	1	1
Anna's hummingbird	1		
Badger	1	1	1
Bald eagle	3		1
Barn owl	3		1
Big brown bat	3		1
Black bear	1	1	1
Black-billed magpie	3	3	3
Black-chinned hummingbird	2	3	3
Black-headed grosbeak	3	3	1
Black-throated gray warbler	1	1	1
Blue grouse	1	1	1
Bobcat	1	1	1
Brewer's blackbird	2	2	2
Broad-footed mole	1	1	1
Brown creeper	3	1	1
Brown-headed cowbird	2	2	2
Bushy-tailed woodrat	1	1	1
California myotis	3		1
Calliope hummingbird	1	1	
Cassin's finch	3	1	1
Chipping sparrow	1	1	1
Coast mole	1	1	1
Common raven	1		
Cooper's hawk	4	1	1
Coyote	1	1	1
Dark-eyed junco	1	1	1
Deer mouse	1	1	1
Douglas' squirrel	1	1	1
Elk	1	1	1
Ermine	1	1	1
Evening grosbeak	3	3	1
Ferruginous hawk	4	4	4
Flammulated owl	3	1	1
Golden eagle	3		1
Golden-crowned kinglet	3	1	1
Golden-crowned sparrow	3	3	3
Golden-mantled ground squirrel	1	1	1
Gray jay	1	1	1
Great horned owl	1	1	1
Hermit thrush	3	1	1
Hermit warbler	1	1	1
Hoary bat	1	1	1
House finch	4	4	4
House wren	3	1	1
Lewis' woodpecker	3	1	1
Little brown myotis	3		1

Species	MCW_early	MCW_mid	MCW_late
Long-eared myotis	3		1
Long-eared owl	3	1	1
Long-legged myotis	3		1
Long-tailed vole	2	2	2
Long-tailed weasel	2	2	2
Long-toed salamander	3	3	3
Marten	3	3	1
Merlin	3	3	3
Mountain beaver	1	1	
Mountain bluebird	3	1	1
Mountain chickadee	3	1	1
Mountain lion	1	1	1
Mule deer	1	1	1
Nashville warbler	1	3	3
Northern alligator lizard	1	1	1
Northern goshawk	4	4	1
Northern pocket gopher	1	1	1
Northern pygmy-owl	3	1	1
Northwestern salamander	3	3	3
Olive-sided flycather	1	1	1
Pacific treefrog (Chorus)	3	3	3
Peregrine falcon	3	3	3
Pine siskin	1	1	1
Porcupine	1		1
Prairie falcon	4		
Purple finch	1	1	1
Racer	3	3	3
Red fox	1	1	1
Red-tailed hawk	3	3	1
Rock wren	1		
Rough-legged hawk	3	3	3
Rough-skinned newt	3	3	3
Rubber boa	1	3	1
Ruby-crowned kinglet	3	3	1
Ruffed grouse	1	1	3
Rufous humingbird	1	1	1
Rufous-sided towhee	1	1	1
Sharp-shinned hawk	1	1	1
Shrew-mole	1	1	1
Snowshoe hare	1	1	1
Solitary vireo	1	1	1
Song sparrow	1	1	1
Spotted frog	4	4	
Steller's jay	1	1	1
Swainson's hawk	3	3	3
Swainson's thrush	1	1	1
Townsend's chipmunk	1	1	1
Tree swallow	3	1	1
Trowbridge's shrew	1	1	

Species	MCW_early	MCW_mid	MCW_late
Turkey vulture	3	3	3
Varied thrush	1	1	1
Western bluebird	3	1	1
Western gray squirrel	3	1	1
Western jumping mouse	1	1	1
Western rattlesnake	3	3	3
Western red-backed vole	1	1	1
Western spotted skunk	1	1	
Western tanager	3	1	1
Western toad	3	3	
Wild turkey	1	1	
Willow flycatcher	3	3	3
Wilson's warbler	2	2	2
Winter wren	3	1	1
Wolverine	3	3	3
Yellow-breasted chat	3	3	3
Yellow-pine chipmunk	1	1	1
Yellow-rumped warbler	3	1	1

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APPENDIX A

METOLIUS WATERSHED - WILDLIFE SPECIES IN DRY MIXED CONIFER PAG 8/23/95

Species	MCD_early	MCD_mid	MCD_late
American crow	3	2	2
American kestrel	3	1	1
American robin	1	1	1
Anna's hummingbird	1		
Badger	1	1	1
Bald eagle	3		1
Barn owl	3		1
Big brown bat	3		1
Black bear	1	1	1
Black-billed magpie	3	3	3
Black-chinned hummingbird	2	2	2
Black-headed grosbeak	3	3	1
Black-throated gray warbler	1	1	1
Blue grouse	1	1	1
Bobcat	1	1	1
Brewer's blackbird	2	2	2
Broad-footed mole	1	1	1
Brown-headed cowbird	2	2	2
Bushy-tailed woodrat	1	1	1
California myotis	3		1
Calliope hummingbird	1	1	
Cassin's finch	3	1	1
Chipping sparrow	1	1	1
Coast mole	1	1	1
Common raven	1		
Cooper's hawk	4	1	1
Coyote	1	1	1
Dark-eyed junco	1	1	1
Deer mouse	1	1	1
Douglas' squirrel	1	1	1
Dusky flycatcher	1	1	1
Elk	1	1	1
Ermine	1	1	1
Evening grosbeak	3	3	1
Ferruginous hawk	4	4	4
Flammulated owl	3	1	1
Golden eagle	3		1
Golden-crowned kinglet	3	1	1
Golden-crowned sparrow	3	3	3
Golden-mantled ground squirrel	1	1	1
Gray jay	1	1	1
Great horned owl	1	1	1
Hermit thrush	3	1	1
Hermit warbler	1	1	1
Hoary bat	1	1	1
House finch	4	4	4
House wren	3	1	1
Lewis' woodpecker	3	1	1
Little brown myotis	3		1
Long-eared myotis	3		1
Long-eared owl	3	1	1
Long-legged myotis	3		1

Species	MCD_early	MCD_mid	MCD_late
Long-tailed vole	2	2	2
Long-tailed weasel	2	2	2
Long-toed salamander	3	3	3
Marten	3	3	1
Merlin	3	3	3
Mountain beaver	1	1	
Mountain bluebird	3		1
Mountain chickadee	3	1	1
Mountain lion	1	1	1
Mule deer	1	1	1
Nashville warbler	1	3	3
Northern alligator lizard	1	1	1
Northern goshawk	4	4	1
Northern pocket gopher	1	1	1
Northern pygmy-owl	3	1	1
Northwestern salamander	3	3	3
Olive-sided flycather	1	1	1
Pacific treefrog (Chorus)	3	3	3
Peregrine falcon	3	3	3
Pine siskin	1	1	1
Porcupine	1		1
Prairie falcon	4		
Purple finch	1	1	1
Racer	3	3	3
Red fox	1	1	1
Red-tailed hawk	3	3	1
Rock wren	1		
Rough-legged hawk	3	3	3
Rough-skinned newt	3	3	3
Rubber boa	1	3	1
Ruby-crowned kinglet	3	3	1
Ruffed grouse	1	1	3
Rufous humingbird	1	1	1
Rufous-sided towhee	1	1	1
Sharp-shinned hawk	1	1	1
Snowshoe hare	1	1	1
Solitary vireo	1	1	1
Song sparrow	1	1	1
Spotted frog	4	4	
Steller's jay	1	1	1
Swainson's hawk	3	3	3
Swainson's thrush	1	1	1
Tree swallow	3	1	1
Trowbridge's shrew	1	1	
Turkey vulture	3	3	3
Varied thrush	1	1	1
Western bluebird	3		1
Western gray squirrel	3	1	1
Western jumping mouse	1	1	1
Western rattlesnake	3	3	3
Western red-backed vole	1	1	1
Western spotted skunk	1	1	

Species	MCD_early	MCD_mid	MCD_late
Western tanager	3	1	1
Western toad	3	3	
Wild turkey	1	1	
Willow flycatcher	3	3	3
Winter wren	3	1	1
Wolverine	3	3	3
Yellow-breasted chat	3	3	3
Yellow-pine chipmunk	1	1	1
Yellow-rumped warbler	3	1	1

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APPENDIX A

METOLIUS WATERSHED - WILDLIFE SPECIES IN PONDEROSA PINE PAG 8/10/95

Species	PPD_early	PPD_mid	PPD_late	PPW_early	PPW_mid	PPW_late
American crow	4	4	4	4	4	4
American kestrel	3	1	1	3	1	1
American robin	1	1	1	1	1	1
Ash-throated flycatcher	3		1	3		1
Badger	1	1	1	1	1	1
Bald eagle	3		1	3		1
Barn owl	3		1	3		1
Bewick's wren	1			1		
Big brown bat	3		1	3		1
Black bear	1	1	1	1	1	1
Black swift	1			1		
Black-billed magpie	2	2	2	2	2	2
Black-headed grosbeak	3	3	1	3	3	1
Blue grouse	1	1	1	1	1	1
Bobcat	2	2	2	2	2	2
Brewer's blackbird	2	2	2	2	2	2
Broad-footed mole	1	1	1	1	1	1
Brown-headed cowbird	2	2	2	2	2	2
Bushtit	3	3	3	3	3	3
Bushy-tailed woodrat	1	1	1	1	1	1
California myotis	3		1	3		1
Calliope hummingbird	3	3		3	3	
Canyon wren	1			1		
Cassin's finch	3	1	1	3	1	1
Chipping sparrow	1	1	1	1	1	1
Coast mole	1	1	1	1	1	1
Common nighthawk	1	3	1	1	3	1
Common raven	1			1		
Cooper's hawk	4	1	1	4	1	1
Coyote	1	1	1	1	1	1
Creeping vole	1					
Dark-eyed junco	1	1	1	1	1	1
Deer mouse	1	1	1	1	1	1
Douglas' squirrel	1	1	1	1	1	1
Dusky flycatcher	3	3	3	3	3	3
Elk	1	1	1	1	1	1
Evening grosbeak	3	3	1	3	3	1
Ferruginous hawk	4	4	4	4	4	4
Flammulated owl	3	1	1	3	1	1
Golden eagle	3		1	3		1
Golden-crowned kinglet	3	3	3	3	3	3
Golden-crowned sparrow	3	3	3	3	3	3
Golden-mantled ground squirrel	1	1	1	1	1	1
Gopher snake	1	1	1	1	1	1
Gray flycatcher	3	3	3	3	3	3
Great horned owl	1	1	1	1	1	1
Green-tailed towhee	3	3	3	3	3	3
Hermit thrush	3	3	3	3	3	3
Hoary bat	1	1	1	1	1	1

Species	PPD_early	PPD_mid	PPD_late	PPW_early	PPW_mid	PPW_late
House finch	3	3	3	3	3	3
House wren	3	1	1	3	1	1
Lewis' woodpecker	3	1	1	3	1	1
Little brown myotis	3		3	3		3
Long-eared myotis	3		1	3		1
Long-legged myotis	3		1	3		1
Long-tailed vole	2	2	2	2	2	2
Long-tailed weasel	2	2	2	2	2	2
Long-toed salamander	3	3	3	3	3	3
Merlin	3	3	3	3	3	3
Mountain bluebird	3	1	1	3	1	1
Mountain chickadee	3	1	1	3	1	1
Mountain lion	1	1	1	1	1	1
Mountain quail	1	1		1	1	
Mourning dove	1	1	1	1	1	1
Mule deer	1	1	1	1	1	1
Northern alligator lizard	1	1	1	1	1	1
Northern goshawk	4	4	1	4	4	1
Northern pocket gopher	1	1	1	1	1	1
Northern shrike	3	3	3	3	3	3
Northwestern salamander	4	4	4	4	4	4
Olive-sided flycather	1	1	1	1	1	1
Pacific treefrog (Chorus)	4	4	4	4	4	4
Pallid bat	3		3	3		3
Peregrine falcon	3	3	3	3	3	3
Pine siskin	1	1	1	1	1	1
Porcupine	1		1	1		1
Prairie falcon	4			4		
Pronghorn	4	4	4			
Purple finch	1	1	1	1	1	1
Purple martin	3	1	1	3	1	1
Racer	3	3	3	3	3	3
Red fox	1	1	1	1	1	1
Red-tailed hawk	3	3	1	3	3	1
Rock wren	1			1		
Rough-legged hawk	3	3	3	3	3	3
Rough-skinned newt	4	4	4	4	4	4
Rubber boa	1	3	1	1	3	1
Ruby-crowned kinglet	3	3	3	3	3	3
Ruffed grouse	1	1	3	1	1	3
Say's phoebe	1	1	1	1	1	1
Sharp-shinned hawk	1	1	1	1	1	1
Short-eared owl	3					
Solitary vireo	3	3	3	3	3	3
Southern alligator lizard	2	2	2	2	2	2
Spotted frog	4	4		4	4	
Steller's jay	1	1	1	1	1	1
Swainson's hawk	3	3	3	3	3	3
Townsend's big-eared bat	1	3	3	1	3	3

Species	PPD_early	PPD_mid	PPD_late	PPW_early	PPW_mid	PPW_late
Townsend's solitaire	3	3	3	3	3	3
Tree swallow	3	1	1	3	1	1
Trowbridge's shrew	1	1		1	1	
Turkey vulture	1	3	3	1	3	3
Violet-green swallow	3	1	1	3	1	1
Western bluebird	3	1	1	3	1	1
Western fence lizard	1	1	1	1	1	1
Western gray squirrel	3	1	1	3	1	1
Western jumping mouse	1	1	1	1	1	1
Western rattlesnake	3	3	3	3	3	3
Western skink	1	1	1	1	1	1
Western spotted skunk	1	1		1	1	
Western tanager	3	1	1	3	1	1
Western toad	3	3		3	3	
White-crowned sparrow	3	3	3	3	3	3
White-throated swift	3			3		
Wild turkey	1	1		1	1	
Wolverine	3	3	3	3	3	3
Yellow-pine chipmunk	1	1	1	1	1	1
Yellow-rumped warbler	4	4	4	4	4	4

HABITAT RELATIONSHIP KEY

PPD = Ponderosa Pine Dry
MCD = Mixed Conifer Dry
LPD = Lodgepole Pine Dry
MH = Mountain Hemlock

PPW = Ponderosa Pine Wet
MCW = Mixed Conifer Wet
LPW = Lodgepole Pine Wet

1 = Primary use is breeding, roosting, foraging
2 = Secondary use is breeding, roosting, foraging
3 = Primary use is other than breeding; roosting, foraging and dispersal
4 = Secondary use is other than breeding; roosting, foraging and dispersal

Appendix 3:
Vegetation

Table 11: Comparison of PAGs to Mt. Jefferson Study Series.

COMPARISON OF PAGS TO MT. JEFFERSON STUDY SERIES BASED ON TEMPERATURE AND WATER					
METOLIUS PLANT ASSOCIATION GROUPS	**PAG**	**SIMILAR MT. JEFFERSON SERIES**	**INDICATOR**	**FIRE RETURN INTERVAL**	**FIRE PROBABILITY**
Mt. Hemlock, Silver Fir, Whitebark Pine, Sub-Alpine	HIGH	TSME, ABAM, ABLA2, PIAL	long-lasting snow 75-100" precip.	100-250+	Low
Mixed Conifer Grand Fir Series Douglas-Fir Series	MCD / MCW	ABGR	cooler / wetter 35-75" precip.	15-100	Moderate to High
Ponderosa Series	PPD / PPW	NONE	warmer / drier 15-40" precip.	5-25	High
Lodgepole Pine Series	LPD / LPW	NONE	wet or dry 15-80" precip.	15-130	Moderate

SD&I

The table below shows the maximum SDI levels that need to be maintained so larger ponderosa pine can be maintained in healthy condition.

Table 12: Density Table

Density Table	
Suggested Maximum Stand Density Index (SDI) for Deschutes National Forest Managed Plant Associations	
Managing for Ponderosa Pine in CW, CD Series	
Plant Association	Suggested MAX. SDI
(High Productivity)	
CW-C2-12	195
CW-S1-13	202
(Moderate & Lower Productivity)	
CW-S1-15	156
CW-S1-12	143
CW-C2-11	177
CW-C2-13	150
CW-H1-11	149
(CD Series)	
CD-S6-14	210
CD-S6-13	266
CD-S6-12	258
Managing for Douglas Fir in CD Series	
Plant Association	Suggested MAX. SDI
CD-S6-14	**170**
CD-S6-13	**264**
CD-S6-12	**240**

MCD - SDI Table

The density table included in the previous MCD PAG discussion, shows the maximum SDI levels that need to be maintained in order to manage stand densities at levels where larger ponderosa pine or Douglas-fir can be maintained in healthy condition (verified with Pat Cochran and Fred Hall)

The table below shows the maximum healthy SDI levels that need to be maintained in ponderosa pine plant associations in order to manage stand densities at levels where larger and smaller ponderosa pine can be maintained in healthy condition.

The maximum healthy density determinations (MAX SDI) with each PAG vegetation summary were calculated using a revised draft paper by Cochran, Geist, Clemens, Clausnitzer, and Powell (January 1994 draft), which describes a method of setting maximum SDI to sustain healthy stand conditions for forest stands in northeastern Oregon and southeastern Washington. These procedures were adapted for the Deschutes National Forest, with review by Pat Cochran and Fred Hall. The descriptions and recommendations for species composition shown in each PAG summary are based on the Deschutes Forest Plan, the Northwest Forest Plan, and on biodiversity and long-term forest health and sustainability considerations for the major plant associations mapped in the Metolius Watershed Analysis Area.

Table 13: Density Table

Density Table	
Suggested Maximum Stand Density Index (SDI) for Deschutes National Forest Managed Plant Associations	
CP Series	
Plant Association	Suggested MAX. HealthySDI
(High Productivity)	
CP-S3-14	153
CP-S3-11	145
CP-G2-12	238
CP-S2-17	124
(Moderate Productivity)	
CP-S2-16	76
CP-S1-11	73
CP-S2-12	110
CP-S2-15	104
CP-S2-18	104
CP-S3-12	102
CP-S2-13	92
CP-S2-11	115
(Low Productivity)	
CP-S2-14	67
CP-S1-12	47

To keep stands at lower risk from catastrophic beetle attack, the lodgepole pine maximum SDI levels in the density table below can be used.

Table 14: Density Tables

Density Table	
Suggested Maximum Stand Density Index (SDI) for Deschutes National Forest Managed Plant Associations	
CL Series	
Plant Association	Adjusted MAX. SDI
(High Productivity)	
CL-M3-11	119
CL-M4-11	119
CL-G4-12	119
CL-G4-11	119
CL-S2-12	119
(Moderate Productivity)	
CL-S4-12	119
CL-G3-13	119
CL-M2-11	106
CL-S2-13	106
CL-S2-14	119
CL-S9-11	109
CL-G3-14	109
CL-S2-15	98
CL-S2-11	93
CL-S2-16	119
CL-S1-12	87
(Low Productivity)	
CL-G3-11	76
CL-S3-11	71
CL-G4-13	56

Table 15: Known wind storms and blowndown events in northwest and central Oregon from newspaper reports and historical accounts. Wind speeds reported from airport stations. Sources include the Oregonian, the Bulletin, National Weather Service Climatic Records and Terry Brock, soil scientist, notes.

Year	Date	Area of Report	Wind Speed mph	Effect
1880	Jan 1	Willamete Valley	65-85	
c1900		Metolius River		Similar to 1931 storm
1921	Jan 20	Willamete Valley	113	
1931	Apr 21-24	Camp Sherman		10mm BF blowdown
1951	Nov 10-11	Entire state	40-80	
1951	Dec 4	Entire state	40-57	Powerline down
1955	Dec 21-23	The Dalles	60-69	Blowdown
1958	Nov 3	Willamete Valley	70	Millions BF blowdown
1962	Oct 12	Columbus Day	90-104	175-200 million $ damage
1963	Mar 27	Eugene	48-75	Damage to property
1967	Nov 2	Central Oregon	70	Damage to property
1969	Nov 13			
1971	Mar 25-26	Redmond	40	Damage to property
1981	Nov 13-14			
1990	Jan 5	Black Butte		Blowgate Salvage sale
1994	Oct 31	Sisters		Halloween 0.5 mm BF salvaged

Appendix Table 16: 1988 Size Class from PMR Pixel Data

1988 SIZE CLASS		
SIZE CLASS	**1988 PMR PIXELS**	
	ACRES	PERCENT
NON-FOREST GRASS / FORB /SHRUB	11,197	7%
SEED / SAP * 0-4.9"	11,974	8%
POLE TREE 5-8.9"	8,750	6%
SMALL TREE 9-20.9"	51,477	35%
MEDIUM / LARGE TREE 21"+	65,520	44%

* PMR includes some pole acres in this class

Vegetation

Ecology plot data may be good for this, as plot selection was aimed at healthy, well-stocked stands. If the computerized plot data could be retrieved, it could be queried for SDI. The Eastside Assessment Team is currently entering this information into a useable database, and Bill Johnson is coordinating with Brad Smith to make sure we get that information as soon as it is available.

Since the ecology plot data only includes trees greater than or equal to 6 inches dbh, it should be noted that the resulting maximum SDI calculations do not include trees less than 6 inches dbh. The SDI's used in the prognosis growth model do include trees less than 6 inches dbh. Lacking computerized ecology plot data, existing stand examination or other data could be used for site specific calculations. The procedure being used in the draft Deschutes report, a modification of Cochran's draft procedure for the Wallowa-Snake Province of the Wallowa-Whitman National Forest, can be further adjusted for site specific projects with additional local data.

The 1953 and 1991, mapping were both done on aerial photos and therefore can be compared with the most confidence.

Specific areas that exceed sustainable maximum density levels are currently being mapped as part of the forest Eco-mapping contract, and will be available for project-level planning. The densities being mapped with the contract are an estimate of the higher end of the maximum sustainable density levels for high medium and low productivity plant associations. These grouping correlate closely with the plant association groupings developed for Watershed Analysis

Species composition was mapped from 1991 and 1953 photo interpretation. Species recognition was considered the weakest part of the satellite mapping on some areas of the forest, so the 1991, aerial photos were used to identify species for this analysis..

Species Composition

A stand exam database and queries have been developed to allow cross-checking of species typing and acres with ground-verified stand exam vegetation data for project planning. The acres of major and minor species combinations from the 1953 mapping are available in the analysis files.

The vegetation information included in late 1800's landline survey notes shows some interesting patterns of species distribution. Figure , shows the historic distribution of larch, cedar, pine, Douglas-fir and white fir in surveyed areas. Larch was common in the watershed during that time. The Mt. Jefferson wilderness was not surveyed, which is why no data shows on the maps for that area, but Simon's report provides information on year of origin of all the stands in that area, and historic conditions can be inferred from the relatively natural successional patterns and disturbance events that have occurred there.

Using the mapped plant associations and the information contained in the Deschutes Plant Association Guide, "Plant Associations of the Central Oregon Pumice Zone,"

historical maps and records, and knowledge of how disturbances affect ecosystems over time. The associations were combined into productivity groups, as the Forest did for the Forest Plan. SDI Calculations for maximum "safe" densities have been completed for the major groupings in the Mixed Conifer Wet and Dry (MCW & MCD), ponderosa pine (PP), and lodgepole pine (LP) series, which are the associations most changed from historical conditions.

Data Sources

There are some good sources of data for historical forest conditions in this area. The public land surveys, many of them conducted prior to 1900, include a wealth of observations on the size and species of trees, shrubs and ground vegetation. That information has been mapped and entered into an Access database by Gean Davidson and linked to the GIS public land section survey map for analysis purposes. Coville (1898) described the vegetation zones of the Oregon Cascades at the turn of the century, including some comments regarding the role of fire in shaping forest vegetation. There is also a 1901, vegetation map of the Cascades, which may soon be digitized by OSU. The entire analysis area was typed on 1991 aerial photos. There are also 1953, county vegetation maps in GIS. The detailed fire study conducted in the Mt. Jefferson wilderness by Simon in 1991 has a wealth of fire history and vegetation information that does not exist for the remainder of the Forest. Carol Murdock and Bill Johnson has made this information available for use in GIS.

There is also PMR vegetation mapping pixel data of vegetation size, structure, canopy closure, and species based on a 1988 satellite image, district reforestation, harvest, TSI, and stand exam layers and databases, 1994-95 inventory plots, 1991 forest decline mapping, 1995, mortality and basal area plots, insect and disease aerial survey mapping, and plant association and series mapping.

Table 17: Treatment Summary by Landscape Area

POTENTIAL OPPORTUNITIES BY LANDSCAPE ARE								
LANDSCAPE AREA	LA #	TOTAL	REGEN		TSI		HARVEST A	
		Acres	Acres	%	Acres	%	Acres	%
WILDERNESS	1	42,775	3	0%				
CENTRAL BASIN	2	19,844	1,671	8%	2,363	12%	6,119	30%
HIGHWAY 20 CORIDO	3	3,988	350	9%	141	4%	1,325	33%
MEADOW LAKE BASIN	4	7,018	1,956	28%	723	10%	410	5%
BLACK BUTTE	5	3,427	220	6%	381	11%	880	25%
CACHE	6	16,279	2,571	15%	1,236	8%	4,229	25%
SUTTLE LAKE	7	2,163	199	9%	3	0%	415	19%
UPPER TRIBUTARIES	8	30,521	5,371	18%	1,388	5%	8,773	28%
GREEN RIDGE	9	4,528	1,168	26%	427	9%	1,749	38%
SCARP	10	14,833	766	0%	248	2%	1,253	8%
LOWER RIVER	11	3,597						

Appendix 4:

Social

Commodities Information

Cinder Clay, & Gravel Pits, and Hard Rock Quarries in the Watershed
(interview with Bob Jensen)

Attached

Metolius Watershed Analysis

Social Domain analysis material in project file:

Map- Social Domain, Outdoor Experiential, Metolius Watershed

Metolius Watershed, Developed and Dispersed Rec Sites

Metolius Management

Metolius Utilities, Pits, and Viewponts

Metolius Watershed, Variety Class

Metolius Traffic Levels

Metolius Watershed Commodities, existing

Gravels, Rocks, & Geothermal

Historic Travel Routes, contextual module

VQO minimum standards, 1990 Forest Plan

VQO standards (from VQS map printed in conjunction with the 1990 FP)

Recreation Concentrations

Metolius Watershed Areas seen from Green Ridge Lookout

Metolius Watershed Areas seen from Black Butte

Metolius Watershed Areas seen from 3-Fingered Jack

Metolius Watershed Areas seen from Mt Washingtion

Maps from Suttle/Jack/Canyon/Abbott preweave, social domain

Geothermal

Archeological Sites map (not included in file for confidentiality)

Deschutes National Forest 1911

Deschutes National Forest 1915

Designated Cutting Area Map 4-1-95/ 11-30-95

Partial Cut Areas Circa 1953

Harvest Units on Layer B

Harvest Units on Layer A

Regeneration Units

Plant Association Groups

*In some cases zerox copies of maps are included and originals are on file with the specialists

*Information interviews are on file with district specialist

MESSAGE SCAN FOR RODNEY D. BONACKER

R.Bonacker:DSIS

From: Lisa Anderson
Postmark: Sep 27,95 4:19 PM Delivered: Sep 27,95 4:19 PM
Status: Previously read
Subject: Forwarded: WATERSHED REFERENCES

Comments:
From: Lisa Anderson:
Date: Sep 27,95 4:19 PM
for you

Previous comments:
From: Donald Zettel
Date: Sep 26,95 2:25 PM
This is a list of sources that could be referenced. All that I could think of off the top of my head. We had some maps of the transportation system through time and a map of Heritage site distribution but I am not sure where they ended up. It seems like we did Transportation maps of 1860 to 1900, 1900 to 1920, and 1920 to 1950. If you can find the maps they say what the temporal breakdown we used are. Hope this is helpful.

-------X-------

Information Souces for Watershed Analysis:

Brown, Edward
1915 "Ownership Map of Central Oregon Timber Holdings in Crook, Klamath, and Lake Counties, Oregon". Map on file at Sisters Ranger District, Sisters, Or.

Deschutes National Forest Township Maps, 1913.

GLO Plat Maps

Gould, Robert B.
1915 "Map of Deschutes Valley, Central Oregon". Map on file at Sisters Ranger District, Sisters, Or.

Miscellaneous maps of Deschutes National Forest and Sisters Ranger District, dated from 1910 to 1939. Maps on file at Sisters Ranger District, Sisters, Or.

Sisters Ranger District Cultural Resource Heritage Site and Survey Atlas.

Sisters Ranger District Heritage Site database and GIS layers. On file at Sisters Ranger District, Sisters, Or.

Sisters Ranger District Land Status Book.

Appendix 5:
Soils, Geology, and Hydrology

Soils

Upper Cascades

The glacial till areas (from approximately Forest Road 12 to the west) cobble and stone soils south of Canyon Creek. South of First Creek, the eruption of Sand Mountain deposited a thick layer of ash over the till and the depth to cobbles is greater. These soils have a predominantly high soil quality. On the steep slopes of the moraines, much of the ash cap has been eroded and more cobble and stone till is exposed at the surface and the soil quality is moderate. Although rock fragments are a component in these soils, for moderate levels of precipitation with a temperature regime that allows biological activity for long periods enhances, the ability of these soils to produce vegetation. The higher organic matter component and the higher rock contents in these soils make them less sensitive to disturbance. Throughout this area, due to compaction of the till during glaciation, there are areas that perch water during spring runoff. This results in saturated surface conditions, and high sensitivity to management impacts. During other times of the year, these areas have a low to moderate sensitivity to management impacts.

The area around Abbot Butte has some of the oldest tills on the north slopes and remnants of High Cascade volcanic colluvium on the southern slopes. Both are cobbly within two feet of the surface and the older tills have weathered to clay loam textures in the subsoil. This area has a low to moderate sensitivity to the forces of erosion, compaction and displacement, a lower site index, and so is rated a moderate soil quality.

Higher elevation soils, even though subjected to high precipitation, are cryic, which means they are cold for long periods. Biological activity slows down or stops, and nutrient availability is substantially reduced. Many of these soils occur in the steeper areas of glacial scour where rock or scree slopes have developed The soil quality of these areas is rated low. High elevation soils are highly variable in it their sensitivity to disturbance factors.

Lower Cascades

Soils in the southern portion of the watershed are dominated by tephra (volcanic ash and/or cinders) from the Sand Mountain and Blue Lake eruptions. These sandy loams lack horizon formation. The cinder portions around Blue and Suttle Lakes lack the ability to hold water, are low in organic matter, and are droughty. All of these soils are easily displaced, moderately compactible, and have a low erodibility. Overall, they have a moderate sensitivity to disturbance. Changes in the inherent soil properties, through compaction or loss of surface cover can make these soils highly susceptible to both erosion and nutrient loss.

West and southwest of Black Butte the soils have a thin covering of this and older tephras, which overlie either glacial outwash or lava. The outwash areas are susceptible to compaction and nutrient loss with a low ability to restore themselves due to coarse textures and low organic matter content. Soil on lava somewhat resists compactive forces due to coarse fragment content and higher organic matter content, which makes them less sensitive to management impacts.

North and west of Black Butte, from the Head of the Metolius on the south to First Creek on the north and about 2 ½ miles to the west, Suilotem soils are found. These are a mixture of somewhat poorly drained soils. West of this area, to the base of the glacial tills, there is a concern about high water tables during the spring runoff season between April and June. These soils have a low to moderate sensitivity to management impacts during the dry seasons.

The soils between First Creek on the south and Canyon Creek on the north, and from 2 ½ miles west of the Metolius River to glacial till are formed in a thin layer of volcanic ash mixed with outwash material from the Jack Creek glaciation period. These are soils of the Allingham series. They are sensitive to both compaction and nutrient loss with low resilience making them highly sensitive to management impacts. They are well drained and do not have a high water table at any time throughout the year. As a result of their slightly higher landscape position, lower rainfall, and lack of sub-irrigation, they are generally less productive than adjacent areas and have a moderate soil quality rating.

North of Canyon Creek, the low lying areas are somewhat poorly drained soils of the Wizard Series. They are slightly less productive than the Suilotem soils to the south. The Wizard soils have the water table 0 - 2 feet below the surface during periods of high runoff from April to June. These soils have a moderate to low sensitivity to management impacts. Allingham gravely sandy loams are also within this area but occupy the higher landscape positions.

Green Ridge

The highly eroded steep slopes of the Horn of Green Ridge are a mixture of shallow, low productive soils over weathered andesites and basalts, unweathered bedrock exposed as hard rock outcrops, and deep cobble, and somewhat more productive soils in colluvium. Slope steepness, variability of soil depths, and rockiness in this area lower the soil quality.

On the uplands, the soils are a mixture of ash, colluvium and residuum. They are the oldest soils in the watershed and are expressed as loam to clay loam textures at the soil surface. Soil textures, slope steepness, and low organic matter contents make these soils moderately to highly sensitive to disturbance by management activities. On the lower slopes, cobbles and stones are prevalent within 2 feet of the soil surface. These soils are rated a moderate soil quality with the deeper, less rocky, more gently sloping areas having a higher soil quality. The eastern fringe of the Green Ridge area has less rainfall and, consequently has a low soil quality.

Wizard Ridge has soil that formed in thin layers of volcanic ash and has mixed with residual soil developed from volcanic bedrock. The soils are similar to those on Green Ridge. They have a moderate soil quality and are moderately to highly sensitive to disturbance.

On Black Butte, the soils are a complex of volcanic ash and colluvium. The Yapoah soils have a very low water holding capacity and as a result are droughty. They also have a high rock content close to the surface. The Sisters soils on the lower slopes, are deeper ash and occupy the more productive portions of the butte. Red cinders cover the top of the butte and have a very low productivity. The butte has soils of low, moderate and high qualities.

Flow Regimes

Abbot Creek, Jack Creek, Roaring Creek and Lower Brush Creek are very stable spring-fed stream systems. The drainages are characterized by a steeper slope region to the west and the flat outwash region to the east. The springs that form these creeks surface above the Metolius River in the transition between the glacial and alluvial outwash materials. Water temperatures are low due to the influence of cold water springs and flow remains relatively constant throughout the year.

First Creek and Canyon Creek follow glacial canyons with head waters originating near the crest of the Cascades. Both streams are highly variable in character with the most fluctuating flow regimes of any of the tributaries in the watershed. Their flows vary from dry channels in some reaches during parts of the year to high flooding in others. The size of the watersheds and their wide elevation spans make these streams susceptible to more frequent flood events than other Metolius tributaries. These characteristics make these streams useful for monitoring of sediment delivery and transport.

Jefferson Creek, and Candle Creek have flows that are influenced by many small springs and small tributaries. The flow regime of these tributaries is relatively stable due to the stable nature of the springs. Moderate increases in discharge occur during the springtime snow melt period.

Lake Creek is a lake-controlled system and being the outlet to Suttle Lake, has a warming influence on the Metolius River. The ephemeral streams of Green Ridge are dry most of the year carrying runoff water only during storm events.

Stream Types

Stream types were classified for individual reaches using the Rosgen rating system (Table). The classification system is based on the premise that stream pattern morphology is directly influenced by eight major variables which include channel width, depth, velocity, discharge, channel slope, roughness of channel materials, sediment load, and sediment size (Leopold el. al., 1964).

Streams in the Upper Cascade subsection are generally Rosgen types A3 and A4 near the crest of the Cascade and change to Rosgen types B3 and B4 as they flow east. Rosgen types A3 and A4 indicates a relatively steep slope category of 4 to 10 percent with cobble and gravel type substrate materials and steep, cascading, step/pool bed features. Stream types B3 and B4 have a slope category of two to four percent with cobble and gravel type bed materials and riffle-dominated type streams with rapids and infrequently spaced scour-pools at bends or areas of constriction.

Streams in the Lower Cascade subsection are generally Rosgen types C3 and C4. This indicates a relatively flat slope category of less than two percent with cobble and gravel type bed materials and a gentle gradient and riffle/pool features. Streams in the Green Ridge subsection are ephemeral and thus only flow during storm events. Streams in this area are generally Rosgen types Aa+. This indicates a very steep slope category of greater than 10 percent with frequently spaced, vertical drop/scour-pool bed features.

Table 18: Channel types in the Metolius Watershed based on the Rosgen stream classification. Only stream reaches that were surveyed have been classified using this system.

Stream	Reach	Gradient(%)	Sinuosity	Substrate	Rosgen Type
Abbot	1	3	1.9	GR/GR	C4
Abbot	2	5	1.0	SA/GR	B5
Bear V.	1	5	1.0	CO/SB	A3
Bear V.	2	1	1.1	SA/GR	C5
Brush	1	2	1.4	GR/GR	C4
Brush	3	1	2.1	SA/GR	C5
Brush	4	7	1.2	GR/CO	A4
Candle	1	1	1.2	GR/GR	C4
Candle	2	2	1.1	CO/GR	B3
Canyon	1	1	1.2	CO/GR	C3
Canyon	2	1	1.2	CO/GR	C3
Canyon	3	7	1.4	CO/SB	A3
Canyon	4	4	1.0	SA/GR	B5
Canyon	5	8	1.0	CO/GR	A3
First	1	1	1.2	GR/CO	F4
First	2	2	1.4	CO/GR	B3
First	3	5	1.1	CO/SB	A3
Jack	1	1	1.2	GR/SA	C4
Jack	2	1	1.2	GR/SA	C4
Jefferson	1	1	1.1	CO/GR	C3
Jefferson	2	3	1.1	CO/GR	B3
Lake	1	1	1.3	SA/GR	C5
Lake	2	1	1.2	SA/GR	C5
Lake	3	1	1.3	GR/CO	C4
Lake	4	2	1.2	SA/CO	B5
Metolius	1	1	1.1	CO/GR	B3
Metolius	2	1	1.2	CO/GR	B3
Metolius	3	1	1.2	GR/CO	C4
Roaring	1	1	1.1	GR/SA	C4

A local study on the effect of biotic communities was done in the Metolius Basin to answer the question, **How has the ecology of the soil been altered?**

Soil invertebrates are key players in decomposition and nutrient cycling functions of forest ecosystems. As explained by Olsen (1992), "thinned and fragmented forests often appear to retain many characteristics associated with old-growth forests, especially from vertebrate-oriented and forestry viewpoints, but may actually experience substantial damage to fragile understory environments." This may be particularly true for soil invertebrates affected by soil compaction.

Regional Forester's Challenge Grant studies on the Shackle Soil Restoration project in the Metolius Basin found soil invertebrate numbers and community composition differed in compacted, subsoiled, and non-impacted areas. Soil invertebrates were found to represent more diversity than above ground plant or vertebrate communities with 81 species of invertebrates found in soils of the project area.

Fungivorous orabatid mites were the most common invertebrate (21 species) composing 54 percent of the community in unimpacted soils, and 34 percent in compacted landings. One year after subsoiling total invertebrate numbers were lowered in subsoiled areas than in compacted but species composition shifted toward more fungivorous orabatid mites and fewer predatory mites, similar to species composition found in unimpacted soils. Compacted landings and skidtrails had more nematodes (averaging 170 nematodes per gram of dry soil). These studies are preliminary but demonstrate that both compaction and subsoiling affect underground community functional groups and that we have little understanding of how these communities and their ecosystem functions respond to management treatments. Long term studies are needed to assess how subsoiling and compaction affect underground communities and nutrient cycling.

The process of soil formation is set back by compaction and soil displacement until the properties that facilitate it, including decomposition, aeration, and porosity, are restored either naturally over a long period of time, or by mechanical restoration, i.e., subsoiling.

Utilization of wood fiber and machine piled woody debris to reduce fuel loads resulted in the compaction of additional ground. These activities result in large woody material, fine litter, and duff either being removed from the site or incorporated into the surface soil, both of which alter the rate of nutrient cycling. The removal of material from the site truncates nutrient cycling by eliminating a major source of carbon and nitrogen. Incorporating material into the soil accelerates nutrient cycling by bringing the source in more direct contact with moist soil where the soil organisms are active.

Machine planting operations also degraded soil quality by removing large and fine organic and surface soil horizons during the planting operations.

Prescribed fire and wildfires were not considered to cause detrimental soil conditions. The fires usually leave behind surface litter and/or cover the area in a mosaic pattern so that recolonization of sites can occur. Fire plays a natural role in this watershed. The role includes recycling stored carbon and nutrients back into the soil which in turn, regulates the moisture storage capacity. Burning of slash piles, however, significantly reduced the soil organic matter component immediately under the slash piles and was considered detrimental.

Water

Table 19: Mean percentage fine sediment measured in fish spawning areas of the streams of the Metolius Watershed using a McNeil core sampler in the year 1988 to 1991 (adapted from Riehle 1993).

Stream	Year	N	Mean %<6.4mm	Percent %<2.0 mm	Fines %< 0.85 mm
Abbot	89	10	–	17	10
Brush	89	10	–	12	7
	93	10			
Candle	88	5	–	17	8
Canyon	88	8	–	11	4
	91	7	22	12	5
First	89	9	–	18	9
Jack	88	8	–	22	13
	91	7	32	17	10
Jefferson	88	9	–	19	10
	91	8	24	16	10
Metolius @ Lake	89	7	–	15	7
Roaring	88	9	–	21	12
	91	9	33	19	11
	92	9	22	12	6
S. Fork Lake	89	8	–	17	9

Table 20: Annual peak flow in subwatersheds of the Metolius expressed as cubic feet per second per square mile of area. Flows calculated from crest gauges stage and modeling flows using profiles and Manning equation. Data for 1983 water year from McCammon (1993).

Subwatershed	Acres	Water year peak flow (cfs/mile 2)							
		83	89	90	91	92	93	94	95
Candle-1290rd	16.9	20	25	27a	25	27	24	--	10
Canyon-12rd	24.2	--	17	15	--	--	10	--	--
Bear Valley	6.8	35	--	--	--	--	--	--	13
Wasco-1235 rd	5.4	20	7	15	5	12	7	--	10
First Creek 1210 rd	11.5	42	32	31a	29	29	30	15	--
Booth-up 1210rd	5.8	33	33	81a	39	81	48	22	81
Square-low 1210rd	5.7	26	32	--	19	--	11	8	---
Brush-12rd	9.6	--	--	--	--	--	--	--	25a
Upper Brush - 1280rd	3.8	--	--	--	--	--	--	--	103

**flow reported to exceed culvert capacity, or water flowed around culvert.*

Table 21: Monthly maximum, minimum and mean temperature (C) for streams monitored in the Metolius watershed in 1994.

Stream Station	June			July			August		
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
Abbot Creek lower 12 rd *a	6	11	8	6	10	8	5	11	8
Candle Creek 500 rd	5	8	6	6	8	7	6	7	6
Candle Creek 1290 rd	5	7	6	5	7	6	5	7	6
Canyon Creek 12 rd	4	10	7	5	10	8	4	9	7
Canyon Creek 1420 rd	4	11	7	5	11	8	5	10	7
Jack Creek 1420 rd	3	11	7	4	11	8	4	10	7
Jefferson Creek 1290 rd	4	9	7	6	9	8	6	8	7
Metolius River Bridge 99	6	10	8	6	10	8	6	10	8
Roaring Creek 1260 rd	4	8	6	5	8	6	5	8	6
S. Fork Lake Creek 090 rd	10	21	15	14	24	19	13	21	17

*Note * a=1993 data available only, which may have been an unusually cloudy, wet year.*

Appendix Table 22: Habitat measurements from the stream survey of stream understudy. Information was collected according to USFS, Region 6 protocol and Smart program output. Canyon Creek, Roaring Creek and the first reaches of Jefferson Creek and Jack Creek were generated prior to the Smart program.

Stream	Reach	Bankfull width/depth ratio	% side channels	Pools %	Pools per mile	Logs per mile			
						Large	Small	Brush	Total
Abbot	1	8	5	7	6	19	65	69	153
	2	7	<1	<1	<1	21	112	153	286
Bear	1	3	5	20	55	29	77	71	177
Valley	2	9	<1	6	–	–	–	–	–
Brush	1	4	1	3	4	3	44	104	151
	3	22	<1	<1	<1	10	131	208	348
	4	3	<1	2	5	10	94	98	202
Candle	1	–	16	3	[illegible]	–	–	–	–
	2	–	5	5	[illegible]	–	–	–	–
Canyon	1	6	5	30	21	19	78	42	141
	2	9	13	18	22	22	262	186	470
	3	6	<1	1	3	85	160	136	318
	4	6	2	43	42	21	486	184	754
	5	7	3	6	11	13	181	106	320
First	1	dry	–	–	<1	–	–	–	–
	2	5	2	40	27	28	49	99	176
	3	9	<1	13	22	52	81	141	275
Jack	1	–	17	8	20	–	–	–	–
	2	30	3	<1	<1	35	205	486	725
Jefferson	1	9	1	12	7	–	–	–	–
	2	9	1	12	6	49	149	78	277
Lake	S Fork	6	3	16	17	21	123	95	240
	N Fork	7	0	10	16	32	127	163	322
	M Fork	6	2	1	1	25	80	49	136
	Main	8	6	3	1	10	26	49	85
Metolius	1	32	<1	5	2	20	20	13	54
	2	4	1	3	1	8	8	37	75
	3	5	<1	3	2	3	3	38	65
Roaring	1	–	11	2	10	–	–	–	–

Appendix 6:
Trends

Metolius Watershed
Table 2: Ecological Risk and Trend Rating

Landscape Area

Trends	Susceptibility	Resiliency	Risk to Ecosystem	Trend Rating
1. Increased sediment delivery and change in flow regimes.				
2. Lowered soil quality.				
3. Greatly increased stand densities; shifting species composition and stand structure.				
4. Horizontal landscape structure is heterogeneous.				
5. Human use of the watershed is continuing and increasing.				
6. Late stage of successional development.				
7. Reduced density of instream wood.				
8. Interaction of native and non-native aquatic species.				
9. Decrease in water quality and clarity.				

Metolius Watershed
Table 2a: Ecological Risk and Trend Rating

Landscape Area 1: Wilderness

Trends	Susceptibility	Resiliency	Risk to Ecosystem	Trend Rating
3. Greatly increased stand densities; shifting species composition and stand structure.	Moderate- large trees still exist; current densities ok, but will increase.	Moderate- increased stress; still potential for normal disturbance regimes.	High- loss of mixed conifer and late successional habitat	Yellow
5. Human use of the watershed is continuing and increasing.	High- continued desire for day use.	Moderate- high elevation and short growing season. Recovery process is slow.	High- loss of riparian function, plant diversity, and high elevation riparian meadows; change in recreation experience (loss of solitude).	Red
6. Late stage of successional development.	Low- reflect conditions normally found after (150-300) year fire return interval.	Low- fire and other disturbances will play out their normal role.	Low- late successional hemlock stands at risk; disturbance likely to continue at normal scale and intensity.	Green
8. Interaction of native and non-native aquatic species.	Moderate- native species have small and isolated habitats.	Moderate- loss of small portion of habitat or population can affect viability of entire population.	High- loss of native amphibians and aquatic invertebrates; potential for genetic isolation.	Yellow

Metolius Watershed
Table 2b: Ecological Risk and Trend Rating

Landscape Area 2: Central Basin

Trends	Susceptibility	Resiliency	Risk to Ecosystem	Trend Rating
1. Increased sediment delivery and change in flow regimes.	Low- intact riparian areas and adequate flushing mechanisms.	Moderate- small systems allow recovery	High- impacts to spawning gravel; high potential with certain streams and/or weather events; bull trout.	Yellow
2. Lowered soil quality.	High- already harvest impacts.	Low- long-term recovery in pumice soils.	High- minimal soil productivity; invert diversity.	Red
3. Greatly increased stand densities; shifting species composition and stand structure.	Moderate- already happened.	Moderate- disturbance or treatment can reduce risk.	High- loss of late successional/old growth, (Douglas-fir, larch, and especially pine); open widely spaced stands; no regeneration.	Yellow
4. Horizontal landscape structure is heterogeneous.	High- already happened.	Moderate-stands will grow back.	High- loss of connectivity and interior habitat.	Red
5. Human use of the watershed is continuing and increasing.	High- continued desire for day use; dispersed camping.	Moderate- small impact area; good recovery if use is removed. (High resiliency- riparian functions).	High- change in human experience including crowding, loss of scenic quality; and setting; (Low risk to riparian functions).	Red
7. Reduced density of instream wood.	High- already happened.	Moderate- can recover in time with natural input.	High- bull trout.	Red
8. Interaction of native and non-native aquatic species.	Moderate- still strong population of wild fish in Metolius	Moderate- (amphibians) High- (trout) if non-natives removed.	High- rainbow trout; amphibians.	Yellow

Metolius Watershed
Table 2c: Ecological Risk and Trend Rating

Landscape Area 3: Highway 20 Corridor

Trends	Susceptibility	Resiliency	Risk to Ecosystem	Trend Rating
2. Lowered soil quality.	High- already happened	Low- low soil productivity and long recovery.	High- soil productivity and stand health in viewshed.	Red
3. Greatly increased stand densities; shifting species composition and stand structure.	High- already happened	Moderate- pine stands still in good shape.	High- loss of late successional/ old growth in critical viewshed (Douglas fir and pine); loss of major elements of scenic quality; some ponderosa pine stands west of road 14 have good structure).	Yellow
5. Human use of the watershed is continuing and increasing.	High- already happened	Low- narrow corridor concentrates use.	Moderate- loss of opportunity to experience byway features due to crowding; increase in disturbance to bald eagles; loss of high quality travel experience, scenery, uncongested easy access; increased roadkill of migrating wildlife; loss of native vegetation due to an increase in the introduction of non-natives.	Yellow

Metolius Watershed
Table 2d: Ecological Risk and Trend Rating

Landscape Area 4: Meadow Lake Basin

Trends	Susceptibility	Resiliency	Risk to Ecosystem	Trend Rating
1. Increased sediment delivery and change in flow regimes.	High- already happened.	Low- low flushing and intermittent streams.	Moderate- loss of aquatic habitat.	Yellow
2. Lowered soil quality.	High- already happened.	Low- low soil productivity and long recovery.	High- loss of riparian function; sedimentation; unique habitats (sand dunes, cache, RNA)	Red
3. Greatly increased stand densities; shifting species composition and stand structure.	High- already happened.	Moderate- potential for normal disturbance, but remnant patches of LS habitat at risk.	High- loss of late successional/ old growth (Patchy remnants of old growth);loss of few remaining large Douglas-fir and ponderosa pine.	Red
4. Horizontal landscape structure is heterogeneous.	High- already happened.	Low- Moderate- stands will grow.	High- loss of interior habitat and connectivity.	Red
5. Human use of the watershed is continuing and increasing.	High- already happened.	Moderate- sensitive habitats and intense use.	High- loss of riparian function/ habitat; Moderate risk- wildlife use/ special habitats (elk summer range, bald eagle/ osprey perching, foraging and roosting); change in recreation experience (loss of solitude/ quiet)	Red
8. Interaction of native and non-native aquatic species.	Moderate- High- small unique habitats.	High- will recover if stocking stopped.	Low- loss or isolation of amphibian populations, but habitat is well connected.	Yellow

Metolius Watershed
Table 2e: Ecological Risk and Trend Rating

Landscape Area 5: Black Butte

Trends	Susceptibility	Resiliency	Risk to Ecosystem	Trend Rating
3. Greatly increased stand densities; shifting species composition and stand structure.	High- already occurred.	Low- normal disturbance regimes can occur, but impacts high, scenic quality would be severe.	Moderate- loss of large Douglas-fir and Ponderosa pine/ habitat; loss of whitebark pine; loss of major elements of scenic quality.	Yellow
5. Human use of the watershed is continuing and increasing.	High- desire for day use.	Low- sensitive alpine habitat; high intensity of use.	Moderate- recreation experience; native vegetation; soil productivity; increase in impacts to historic and prehistoric.	Yellow

Metolius Watershed
Table 2f: Ecological Risk and Trend Rating

Landscape Area 6: Cache

Trends	Susceptibility	Resiliency	Risk to Ecosystem	Trend Rating
1. Increased sediment delivery and change in flow regimes.	Low- little surface water to affect.	Moderate- High- no surface water	Moderate- vegetation diversity; loss of seasonally wet habitats. Low- soil productivity (not erosive).	Green
2. Lowered soil quality.	High- already occurred.	Moderate- better soil productivity.	Moderate- soil productivity (more resistant); decrease in late successional/ old growth, and forb and fungi diversity.	Yellow
3. Greatly increased stand densities; shifting species composition and stand structure.	High- already occurred.	Moderate- LS habitat is rare- high percent of private forest lands with different management objectives.	Moderate- loss of large Douglas-fir and pine (tree densities on private land are lower); loss of late successional/ old growth habitat.	Yellow
4. Horizontal landscape structure is heterogeneous.	High- already occurred.	Low- high percent of private forest lands with different management objectives.	High- loss of late successional/ old growth habitat; interior habitats and connectivity.	Red

Metolius Watershed
Table 2g: Ecological Risk and Trend Rating

Landscape Area 7: Suttle Lake

Trends	Susceptibility	Resiliency	Risk to Ecosystem	Trend Rating
1. Increased sediment delivery and change in flow regimes.	Moderate- occurring	Moderate- good flushing and intact riparian	High- soil productivity; aquatic habitat at lake shore; water lobelia	Yellow
2. Lowered soil quality.	High- already happening	Moderate- soils resistant to compaction	Moderate- loss of campground vegetation; loss of late successional/ old growth habitat and forb and fungi diversity	Yellow
3. Greatly increased stand densities; shifting species composition and stand structure.	High- already happening	Moderate- Low- big trees important and will take a long time to replace	High- loss of campground vegetation; loss of late successional/ old growth habitat (large Douglas-fir and pine eagle habitat, which is already gone on private land; loss of eagle roost and nest areas)	Red
4. Horizontal landscape structure is heterogeneous.	High- already happening	Low- more than average in seral from regen harvest- long recovery	High- loss of late successional/ old growth habitat; interior habitats and connectivity	Red
5. Human use of the watershed is continuing and increasing.	High- desire for day use and other large lake activities	Low- intensity and variety of use	High- recreation experience (competition/ conflicts for recreation space; congestion; safety); riparian habitat quality; wildlife disturbance (bald eagles); water quality; increase in human fire starts	Red
7. Reduced density of instream wood.	High- already happening	Low- lack of large tree replacement	High- loss of habitat complexity; loss of rearing capacity	Red
8. Interaction of native and non-native aquatic species.	High-	Low-	Moderate- loss of aquatic species (bull trout, amphibians	Yellow
9. Decrease in water quality and clarity.	High- occurring in Link Creek and small lakes	Low- small, isolated populations	High- water quality; safe swimming; fish survival; bald eagles	Red

Metolius Watershed
Table 2j: Ecological Risk and Trend Rating

Landscape Area 10: Scarp

Trends	Susceptibility	Resiliency	Risk to Ecosystem	Trend Rating
3. Greatly increased stand densities; shifting species composition and stand structure.	Moderate- occurred, but several low intensity fires have kept densities in some areas low	Moderate- potential for normal disturbance	Moderate- late successional/ old growth habitat	Yellow
5. Human use of the watershed is continuing and increasing.	Low- limited access	Low- effects are visible from every where	Moderate- scenic quality (background texture and foreground large tree character)	Yellow

Metolius Watershed
Table 2k: Ecological Risk and Trend Rating

Landscape Area 11: Lower River

Trends	Susceptibility	Resiliency	Risk to Ecosystem	Trend Rating
3. Greatly increased stand densities; shifting species composition and stand structure.	High- already occurred	Moderate- potential for normal disturbance	High- bald eagle habitat; large tree character	Red
5. Human use of the watershed is continuing and increasing.	Moderate- desire for day use, but access is limited	Moderate- intense use on small local areas	Moderate- recreation experience (competition for recreation space); decrease in riparian habitat quality; wildlife habitat use (bald eagle roost area, winter range); wildlife disturbance	Yellow
7. Reduced density of instream wood.	Moderate- occurring	Low-lack of large replacement trees	Moderate- loss of habitat complexity; loss of rearing capacity; bull trout	Yellow

Metolius Watershed

Table 3: Landscape Area Trend Rating

Trends	Landscape Areas										
	Wilderness	**Central Basin**	**Highway 20 Corridor**	**Meadow Lake Basin**	**Black Butte**	**Cache**	**Suttle Lake**	**Upper Tributaries**	**Green Ridge**	**Scarp**	**Lower River**
1. Increased sediment delivery and change in flow regimes.		Yellow				Green	Yellow	Red	Yellow		
2. Lowered soil quality.		Red	Red	Red		Yellow	Yellow	Red	Red		
3. Greatly increased stand densities; shifting species composition and stand structure.	Yellow	Yellow	Yellow	Red	Yellow	Yellow	Red	Red	Yellow	Yellow	Red
4. Horizontal landscape structure is heterogeneous.		Red	Yellow	Red		Red	Red	Red	Yellow		
5. Human use of the watershed is continuing and increasing.	Red	Red		Red	Yellow		Red	Yellow		Yellow	Yellow
6. Late stage of successional development.	Green										
7. Reduced density of instream wood.							Red	Red			Yellow
8. Interaction of native and non-native aquatic species.	Yellow	Yellow		Green			Yellow	Yellow			
9. Decrease in water quality and clarity.							Red				