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INTRODUCTION

The Eugene District (McKenzie Resource Area) of the Bureau of Land Management (BLM) contracted with SRI/SHAPIRO/AGCO, Inc. (SHAPIRO; formerly A. G. Crook Company) to conduct an analysis of the Lost Creek watershed. The analysis was completed pursuant to objectives outlined in *"Ecosystem Analysis at the Watershed Scale," Federal Guide for Watershed Analysis, Version 2.2* (Revised August 1995; Portland, Oregon).

The focus of this watershed analysis was to characterize the physical, biological, and human/social conditions, processes, and interactions of the Lost Creek watershed as they relate to four key issues identified by the BLM, including: 1) Human Uses, 2) Water Quantity and Quality, 3) Terrestrial Habitat Diversity, and 4) Aquatic Habitat.

Physical processes and social features related to the issues were analyzed using a variety of methods and resources. The results of individual resource analyses were integrated to provide a description of the dominant processes affecting the watershed at a landscape scale and to identify restoration opportunities and land management recommendations. Recommendations are intended to be general rather than site-specific. Data included in the appendices and accompanying GIS analysis files should provide sufficient detail for resource managers to facilitate a more site specific analysis (i.e. National Environmental Policy Act planning).

Watershed analysis is recognized as an iterative process that evolves as information gathering and analysis techniques are refined. The Lost Creek watershed analysis was an "initial analysis" based on existing and available data, except data collected related to roads and vegetation. The watershed analysis provides a framework on which to build future analyses.

The Lost Creek watershed analysis was conducted by an interdisciplinary team comprised of resource specialists who are professionally qualified to assess and interpret the structure, composition, and function of ecosystems, including human/social aspects. Following is a list of individual members of the interdisciplinary team:

SRI/SHAPIRO/AGCO, Inc.

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Steve Daggett	Water Quality
Aaron English	Terrestrial Wildlife
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Cheshire Mayrsohn	Special Status Plants
Greg Miller	Terrestrial Wildlife
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Alan Schloss	Hydrology

1.0 CHARACTERIZATION - STEP 1

The purpose of Step 1 is to identify the dominant human, physical, and biological processes and features of the Lost Creek watershed that affect ecosystem function or condition. This provides the watershed context for identifying elements that need to be addressed in the analysis, identifying the most important land allocations, objectives, and regulatory constraints that influence management in the watershed.

1.1 HUMAN USE CHARACTERISTICS

Early human use of the Lost Creek watershed can be traced to members of the Kalapuya Indian bands who probably established one or more winter villages in the area prior to Euro-American contact (Southard, 1997).

In 1853, the Free Immigrant Trail was opened across the Cascades, down the Middle Fork of the Willamette River and into the Willamette Valley. This route took the new settlers past the junction of Lost Creek and the Willamette River. The City of Eugene, then called "Skinner's," was established in 1847. Skinner's, population 40, was incorporated and renamed Eugene City in 1862 (Stelfox, 1997).

Agriculture was the first "industry" in what was then known as Lost Valley. Trees were cleared to make way for crops, and several small sawmills provided lumber for local needs. Thomas Williams operated the first of these sawmills in Wagner Creek in 1855 (Williams, 1996).

Previously named "Butte Disappointment," the old town of Dexter was the farthest upstream agricultural settlement on the Willamette River in 1860 (Williams, 1996).

In 1866, The O&C Railroad Act granted various alternate sections of land to the O&C Railroad Company for development of a railroad from Portland, Oregon, to the California border. In 1916, following a number of legal efforts, many of the granted lands returned to federal ownership (USDI, undated). The former O&C lands are now managed by the U.S. Department of the Interior (USDI), Bureau of Land Management.

Government Land Office survey notes indicate most of the land in the valley floor of Lost Creek was claimed by 1870 (Southard, 1997). The timber industry rose to importance in the early 1900's. The first timber sales from O&C lands may have occurred as early as 1916 (USDI, undated). Timber harvesting on private lands in the watershed was well underway in the 1920's. The Lewis and Giustina sawmills were operating in the drainage in the 1930's (Williams, 1997).

Timber harvest activities on BLM lands increased dramatically in the 1940's; probably to aid the war effort, over 3,300 acres of timber was harvested in that decade. A more moderate level of timber harvest of between 100 to 200 acres per year continued on BLM lands in the watershed through the 1980's (USDI, 1997a). In the early 1990's, legal actions throughout the Pacific Northwest prompted reconsideration of ecosystem health and timber production was greatly reduced.

Timber harvest on private lands has continued at a faster pace than on BLM lands. Currently, most private timber lands have received an initial regeneration harvest and some of the older regenerated stands are now being commercially thinned. Giustina Land and Timber, and Giustina Resources are the largest, single, private landowner in the watershed.

There continues to be considerable focus on commodity production from both private industrial forest land and BLM lands. Timber has been harvested, at least once, from 91% of the watershed. With the exception of lands remaining in pasture, home sites, and roads, the harvested areas have been quickly regenerated with young stands.

An extensive road system has been developed to manage the timber resources. The watershed has approximately 216 miles of road, which equates to a road density of about 4.0 miles of road per square mile.

No known sources of locatable minerals have been found in the Lost Creek watershed. There are several rock quarries that provide rock for local forest road development.

Several rural residents live on small land holdings within the Lost Creek watershed. The BLM lands within the watershed serve as an extended "backyard" for many adjacent landowners and other local residents. Many people in the region commute to jobs in the Eugene/Springfield area (US Department of Commerce, 1990).

The metropolitan area of Eugene/Springfield is only 20 air miles northwest of the center of the watershed. This places 224,100 people within a 30-minute drive of the 14,000 acres of public land in the Lost Creek watershed.

The watershed lies about 10 miles east of Interstate Highway 5 (I-5). Access from I-5 to the area is provided by State Highway 58 which continues eastward to the town of Oakridge and beyond. A complex system of county, private residential, and forest development roads provide access within the watershed.

Small farms and rural residents form a nearly solid block of privately owned lands in the lower half of the watershed (see land ownership map). A typical "checkerboard" ownership pattern exists elsewhere, with alternate sections of forest industrial and BLM lands.

Land Ownership	Acres	Percent of Watershed
Small Private	5,400	14
Private Industrial	15,429	44
Federal - BLM	13,768	40
Other Government	685	2

Total	35,322	100

Table 1. Acres by Land Ownership Class for the Lost Creek Watershed

Approximately 40% of the watershed is managed by the BLM. Management direction by land use allocation is provided in the *1995 Eugene District Resource Management Plan* (USDI, 1995) (see Table 2)**.**

BLM Land Use Allocation	Acres
Matrix -General Forest	12,014
Matrix - Connectivity/Diversity	2,178
Riparian Reserves	6,433*

* Riparian Reserve acres are included in acres of Matrix land

Table 2. Acres by BLM Land Use Allocation for the Lost Creek Watershed

Less than one percent of the watershed is managed by the U.S. Forest Service (USFS). All Umpqua and Willamette National Forest lands that lie within or adjacent to the Lost Creek watershed are managed as Late Successional Reserves.

There are numerous recreational facilities and opportunities within a few miles of the Lost Creek watershed. Over 30 water-oriented facilities are available along the McKenzie and Willamette Rivers and their nearby reservoirs. The adjacent Umpqua and Willamette National Forests have thousands of acres of open National Forest land as well as recreational opportunities at campgrounds, trails, and wildernesses.

Current recreational activities within the Lost Creek watershed include recreational driving, bicycling, hiking on and off trails, hunting for deer, elk, and grouse, and fishing. Some of these dispersed activities link into adjacent National Forest outside the Lost Creek watershed.

There are no developed campgrounds, designated trailheads, or developed parking areas within the watershed.

The watershed is used to gather several small forest products. Firewood, boughs, mushrooms, moss, and other natural materials are removed for both personal and commercial uses.

As a result of the "checkerboard" ownership pattern, the transportation system traverses both public and privately owned lands. The public's access to BLM lands served by such roads is not always assured. The land ownership pattern makes it difficult for the public to differentiate between public and private lands.

1.2 PHYSICAL CHARACTERISTICS

The Lost Creek watershed has a Mediterranean climate (Oberlander and Muller, 1987) that is typified by cool, wet winters and mild, dry summers. Annual precipitation averages 45 inches per year, most of which (60%) falls between November and February, with less than 10% falling from June through September. Within the upper reaches of the watershed (3,200 feet elevation), approximately 33% of the winter precipitation is in the form of snow, while in the lower reaches of the watershed (1,000 feet elevation) approximately 10% of the precipitation is snow (Oregon Department of Fish & Wildlife [ODFW], 1992a).

The Lost Creek watershed has a drainage area of approximately 55 square miles (35,200 acres). As shown in Table 3, the watershed contains approximately 270 miles of stream. The eastern portion of the watershed is dominated by Lost Creek proper, with the western portion of the watershed consisting of various named and unnamed tributaries that drain to Lost Creek. Other named tributaries within the watershed include Anthony, Carr, Gosage, Guiley, Eagle, Middle, and Wagner Creeks.

SUBWATERSHED	DRAINAGE AREA (sq. mi.)	STREAM LENGTH (mi.)
Buckhorn	4.5	30.21
East Lost Creek	4.57	23.39
Gosage	5	28.45
Guiley	6.85	43.66
Middle/Carr	8.21	38.12
Mount June	2.95	14.86
Rattlesnake Butte	1.79	6.71
North Anthony	2.77	7.37
South Anthony	4.88	15.26
South Dexter	4.54	22.79
Upper Lost Creek	6.07	31.9
Wagner	3.08	10.05
TOTALS	**55.21**	**272.77**

Table 3. Drainage Area and Stream Length for Subwatersheds within the Lost Creek Watershed

The Lost Creek watershed is characterized by steep ridges, narrow valleys, and volcanic soils typical of the western slope of the Cascades. Past episodes of glaciation and active stream erosion have created a highly dissected landscape that results in steep, high-gradient stream reaches within the upper parts of the watershed, and low-gradient stream reaches within the flatter, lower portions of the watershed. Lost Creek and its tributaries discharge to the Middle Fork of the Willamette River, approximately 3.0 miles northwest (downstream) of the outfall of Dexter Reservoir. Natural streamflow within the watershed reflects the seasonal precipitation pattern, with low flows occurring in the summer and highest flows occurring in the winter. Average annual flow is approximately 146 cubic feet per second (cfs). Monthly minimum and maximum stream flows for the year for Lost Creek are estimated to be 5 cfs and 826 cfs, respectively.

Within the lower reaches of Lost Creek (below Guiley Creek at RM 10.3), high water temperatures have been documented, which have been attributed to excessive withdrawals for uses such as agriculture. Lost Creek provides approximately 22.2 cubic feet per second (cfs) of water rights for agricultural activities annually. In addition to low flows within the stream reaches, insufficient riparian coverage may exacerbate high water temperatures.

The Lost Creek mainstem is a sixth-order stream, flowing predominantly through a low gradient (< 3%), unconfined to moderately confined channel (Rosgen types B, G, and C). The lower reaches flow through a mixture of residential and agricultural land ownership, while the upper reaches are located primarily on private and federal timber land. With the exception of the headwater reaches, Lost Creek is composed mainly of response reaches (<3% gradient), which are identified by the Washington Department of Natural Resources (WDNR) as being those reaches most susceptible to change in channel morphology due to changes in sediment supply (Washington Forest Practices Board [WFPB], 1995).

The main tributaries to Lost Creek, several of which are named, enter the system from the western side of the watershed. These tributaries are relatively large, ranging from second- to fourth-order, with the majority classified as fourth-order. Gradients are typically moderate (2% to 8%) in the tributary mainstems and steep (8% to 21%) in the tributary headwaters. Channels are generally moderate to well confined (Rosgen B and Aa+). Tributaries entering the western side of the watershed are mainly transport reaches (3% to 20% gradient), which will rapidly transport sediment loads to reaches downstream.

Tributaries entering the eastern side of the watershed are considerably smaller than those entering on the western side. These tributaries range from second- to fourth-order, but are mostly second- and third-order. With the exception of the lower reaches entering mainstem Lost Creek, gradients are steep and channels are well-confined (Rosgen Aa+). Eastern side tributaries are primarily source (>20% gradient) and transport reaches. Source reaches can be described as being probable locations for colluvium storage, often corresponding to debris-flow-dominated channels.

The 1996 303(d) list of streams designated by the Department of Environmental Quality (DEQ) does not list Lost Creek as water quality limited, however, portions of the Middle Fork of the Willamette River downstream from the confluence with Lost Creek are listed. As designated in the Oregon Administrative Rules, beneficial uses for the Willamette River and its tributaries are: water supply (public, private, and industrial); irrigation and livestock watering; anadromous fish passage, spawning, and rearing; resident fish, aquatic life, and wildlife; hunting and fishing; boating and water contact recreation; aesthetic quality; and hydroelectric power. The water quality parameters evaluated in support of these beneficial uses include dissolved oxygen, temperature, bacteria, pH, chlorophyll a, toxic compounds, and total phosphorous.

The forming factors of parent material, climate, vegetation, topographic relief, time, and organisms have formed a variety of soils in the Lost Creek watershed. Differences in elevation, aspect, rock type, and erosional processes have created soils that vary in depth, texture, and coarse fragment content. Those factors have created soils with different temperatures and moisture regimes, which result in different levels of productivity and resiliency.

The general soil map for Lane County, Oregon, shows the watershed as having shallow to deep, well-drained and moderately well-drained, silty clay loam and cobbly silty clay loam soils (USDA, 1987). These soils were formed in igneous and sedimentary rock, and from colluvium from sandstone or mixed sedimentary and igneous rock. The soils can be generally characterized as gently sloping to very steep.

Small areas of water-deposited soils occur in the stream valleys and along drainages. They are well-drained to poorly drained soils formed in gravelly silt loam to silty clay loam deposits.

The watershed analysis area is dominated by highly productive and resilient soils that occupy 58% of the area. These soils are generally deep, and have high levels of organic matter, nutrients, and plant-available moisture. Less than 7% of the analysis area has soils with low productivity and resiliency. These soils generally are shallow with a high volume of rock fragments.

Surface erosion not only delivers sediment to streams, but also affects the long-term productivity and resiliency of soils through loss of soil and water nutrients.

Less than 1% of the watershed has a high potential for surface erosion. Areas with a high potential usually are located on steep to very steep slopes. Unless damaged, the surface organic layer and the high infiltration capacity of forested soils greatly minimizes the potential for surface erosion. Areas with low or moderate surface erosion potential, 92% and 8% respectively, dominate the watershed.

Debris slides, small rotational failures, and loss of soils and geological materials on steep areas of weathered rock are the main mass wasting processes in the Lost Creek watershed. Loss of the protective organic layer and exposure of steep road cuts and fill slopes on unstable areas greatly increases the potential for mass wasting.

Areas with a high potential for mass wasting usually are those with highly weathered tuff and breccia bedrock, or very steep slopes with highly weathered igneous and sedimentary rocks. The majority of the basin (60%) has soils with a low potential for mass wasting. Approximately 18% of the soils in the watershed have moderate potential, and 22% have high potential.

Although surface erosion and mass wasting are contributing to the sediment budget for Lost Creek, road-related sedimentation probably is the primary source of increase in the watershed. As described earlier, an extensive road network has been developed to facilitate land management. This network is estimated to contribute an average 3.4-fold (range from 1.4- to 11.9-fold) increase in sediment yield when compared to background rates. While roads are contributing to this increase, active mainline, gravel roads probably are the greatest contributor.

1.3 BIOLOGICAL CHARACTERISTICS

The commercial forest lands in the watershed are dominated by mid-seral forests (40-80 years) established following timber harvest. Despite the continued history of timber harvest, only 31% of the watershed currently is in the regeneration and early-seral stages (0-40 years), and 53% is classified as the stem-exclusion phase of stand development (40-80 years). The upper portions of the watershed contain some late-seral forest (80-200 years), accounting for 6% of the area, but only a very limited area (3%) is classified as old growth.

The lower portions of the watershed encompass most of the non-timbered sites, accounting for 8% of the area. In these areas, forest land was cleared to allow agricultural and residential uses. Some of this area appears to have been in oak-grassland savannahs maintained by frequent fires.

In the middle and upper parts of the watershed, the current forest landscape pattern was formed by harvest activities. As mentioned earlier, logging began in earnest in the early 1900's. Block clearcutting across all ownerships created a mosaic pattern or fragmented landscape that presently is dominated by even-aged stands of Douglas-fir *(Pseudotsuga menziesii)* and other conifers.

Both fire and wind typically affect the forests of western Oregon. In the Lost Creek watershed, however, fire appears to have influenced the pattern of stand and landscape development in the watershed more dramatically. Stand replacement fires, as recently as 1914, have resulted in large conversion to young forest conditions.

Wind events have resulted in minor effects on timber stands within the watershed. This apparently is a result of topographic buffering from major storm tracks, with stand conditions undoubtedly playing a role. Even a major event such as the 1962 Columbus Day storm does not appear to have resulted in substantial windthrow in the area.

Detailed vegetation classification mapping has not been completed for the watershed. Most of the forest lands are classed within the western hemlock forest series, but the Douglas-fir forest series can be found on some of the drier sites. Within these two ecological classifications, the most common coniferous tree species include Douglas-fir, western hemlock (*Tsuga heterophylla*), western red cedar (*Thuja plicata*), incense cedar (*Calocedrus decurrens*), and grand fir (*Abies grandis*). Pacific yew (*Taxus brevifolia*) can be found in scattered locations as an understory conifer. Common broad-leafed trees in the watershed include bigleaf maple (*Acer macrophyllum*), red alder (*Alnus rubra*), and black cottonwood (*Populus trichocarpa*), with Pacific madrone (*Arbutus menziesii*) on hot, dry sites.

The commercial forest lands in the watershed have a high capability for timber production. Over most of the area, timber productivity is typified by Douglas-fir Site Class III. On a typical site, dominant trees will reach a height of 130 feet in an 80-year rotation. With density management, dominant trees will exceed 30 inches in diameter in the same time frame.

Unique vegetation communities or special habitats occur in the Lost Creek watershed. These generally are associated with wetlands; riparian areas; dry, rocky meadows; and rock cliffs. There are five known sites that support several Bureau Sensitive and one Survey and Manage species.

Generally, noxious weeds in the Lost Creek watershed grow in high traffic areas along roadsides and on disturbed ground, especially in intensively managed areas. Occurrences tend to be light and patchy rather than dense. A roadside weed inventory was completed on federal lands in the watershed in 1996.

The Lost Creek watershed supports both resident and anadromous fish species. Anadromous fish potentially using the basin include spring chinook salmon (*Oncorhynchus tshawytscha*) and winter steelhead (*Oncorhynchus mykiss*). The approximate anadromous fish distribution ranges from the mouth of Lost Creek to the confluence with Gosage Creek (approximately 9.4 miles) in the mainstem (Forsberg, 1994), with potential for limited distribution in some of the larger named tributaries (lower reaches of Wagner, Anthony, Middle, Carr, Gosage, and Guiley Creeks).

Resident fish species include cutthroat trout (*Oncorhynchus clarki*), rainbow trout (*Oncorhynchus mykiss*), speckled dace (*Rhinycthys osculus*), Western brook lamprey (*Lampetra richardsoni*), and various sculpin species (*Cottus spp*.). Cutthroat trout are widely distributed throughout the basin and can be found in most streams capable of supporting fish (<17% gradient). Rainbow trout are not as widespread as cutthroat and can be found in some of the larger, moderate-gradient streams (<7% gradient). Table 4 summarizes the extent of salmonid fish distribution in the watershed.

FISH SPECIES PRESENT	MILES	% of TOTAL STREAM MILEAGE (270 mi.)
Chinook Salmon	10.82	4
Rainbow/Steelhead Trout	21.06	8
Cutthroat Trout	48.33	18
No Fish	221.81	82

Table 4. Summary of Stream Miles Inhabited by Salmonids in the Lost Creek Watershed

Spawning and rearing habitat in the Lost Creek watershed may be limited due to problems associated with high water temperature, seasonal low water levels, low pool-to-riffle ratios, lack of habitat complexity, reaches scoured to bedrock, and reaches with increased levels of fine sediment. Many of the habitat deficiencies identified above can be directly associated with the low numbers of large woody debris (LWD) present instream and its low recruitment potential from nearby riparian zones.

Prior to European settlement the watershed was dominated by large interconnected blocks of mature and older conifer forests. Forest habitats within this landscape probably were structurally and vegetatively very complex. Nearly all habitats have been simplified. Forest practices and land ownership patterns have created sharp habitat boundaries, providing conspicuous contrasts between adjacent habitats. These habitat alterations have substantially reduced many wildlife species populations associated with riparian and old forest habitats.

Private lands in the watershed are intensely managed for timber and/or agricultural production. As a result, these lands rarely contain forests over 80 years old and provide only limited mature (>80 years) or old-growth (>200 years) habitat.

Federally listed species that could potentially occur in the basin include the endangered Peregrine falcon (*Falco peregrinus*), and the threatened Spotted owl (*Strix occidentalis*) and Bald Eagle (*Haliaeetus leucocephalus*).

There are eight spotted owl core areas located on federal land in the Lost Creek watershed. Although these core areas are evenly distributed throughout the watershed, there is a greater concentration of blocked habitat located in the southeastern portion of the watershed. Private lands and developed areas within the watershed provide limited or no spotted owl nesting or roosting habitat and are not expected to provide this habitat in the future.

There are no known nesting bald eagles in the watershed; however, an active bald eagle nest is located within one mile of the watershed. Although there are no lands designated by BLM for bald eagle habitat management within the watershed, a small portion of the watershed does provide suitable bald eagle roosting and nesting habitat.

Suitable peregrine falcon nesting habitat, in the form of rock cliffs, is located within the watershed. Migrating songbirds nesting in the Lost Creek drainage and waterfowl on Dexter and Lookout Reservoirs could provide prey for nesting falcons. Historic use within the watershed is unknown.

The Great gray owl (*Strix nebulosa*; GGO) is identified in the Northwest Forest Plan as a Protection Buffer Species (USDA, 1994b). GGOs are most common in lodgepole pine forest areas adjacent to meadows above 3,000 feet elevation, however, they also are found in other coniferous forest types. Some shelterwood harvesting systems may be beneficial to the species by opening up otherwise closed-canopy cover for foraging. There are no known GGO pairs within the watershed. A single adult response was documented in the southeastern portion of the watershed. There is no other information on abundance or distribution of GGO or their habitat in the Lost Creek watershed.

Red tree voles (*Phenacomys longicaudus*) have been identified as a Survey and Manage species (USDA, 1994b). No presence/absence surveys have been conducted for red tree voles within the watershed. Information on abundance or distribution is not known. A small portion of the watershed provides suitable red tree vole habitat.

The Evening field slug (*Deroceras hesperium*), Oregon megomphix (*Megomphix hemphilli*), Blue-gray Tail-dropper (*Prophysaon coeruleum*), Papillose Tail-dropper (*Prophysaon dubium*), and Oregon slender salamander (*Batrachoseps wrighti*) have been identified as both Survey and Manage (USDA, 1994b) and Bureau Sensitive species (USDI, 1995). There is no information on abundance or distribution of these species or their habitat within the watershed. These species potentially could occur within the watershed.

Various bat species also have been identified as Bureau Sensitive (USDI, 1995). There is no information on abundance or distribution of bat species or their habitats in the Lost Creek watershed. Bats breed and roost in cavities in large trees and snags, including cracks and deep fissures of bark. Caves, pit mines, and bridges also provide habitat. The watershed contains a small amount of potentially suitable habitat. There are no pit mines or known caves in the watershed.

Recreationally important species, such as elk, mountain lion, and black bear are all known to occur in the Lost Creek watershed. Specific surveys for these species have not been conducted by the BLM in the watershed. Observations of these species occur during visits by BLM employees to the watershed and are recorded into a resource area database.

2.0 ISSUES AND KEY QUESTIONS - STEP 2

The formulation of issues and key questions is an attempt to focus team efforts on the key elements of the ecosystem that are most relevant to management within the watershed. Four main issues were identified for the Lost Creek watershed by the Eugene District of the BLM. These include:

- Human Uses
- Water Quantity and Quality
- Habitat Diversity
- Aquatic Habitat

Identification of key questions will expand the themes of each issue and encompass a listing of selected questions the watershed analysis will attempt to answer. Lack of process and species-specific data, or a general lack of scientific consensus, may limit certain areas of the analysis. Some questions, therefore, may remain unanswered at this time.

2.1 HUMAN USES

2.1.1 Recreation Uses/Access

The Lost Creek watershed is very close to the Eugene/Springfield area. There are numerous and varied public recreational facilities and pursuits available at nearby County and State parks and adjacent National Forests. Residents within the Lost Creek watershed view the area as an extension of their backyard.

- What does the public value within the watershed?
- What are the best long-term recreational uses of the public lands within the watershed?
- Can recreation activities within the watershed benefit from or contribute to similar uses on adjacent National Forest lands outside the watershed?
- Can timber management activities enhance recreational use of the watershed?

The land ownership pattern in the watershed and the resulting transportation system does not provide the public full access to all BLM lands. The public has difficulty identifying BLM lands.

- Are there special areas or roads within the watershed to which the public desires entry?
- Should BLM lands be more easily identifiable on the ground?

2.1.2 Community Values/Aesthetics

A majority of the landscape in the watershed has little variety in land forms, vegetation, and water forms. The landscape has been considerably modified by past timber harvesting activities and cutting boundaries along property lines are very obvious.

- What opportunities are there to introduce more variety into the landscape?
- How can a more natural appearing landscape be developed?

Illegal dumping of trash and household items is a problem along some roads. Shooting within rock pits and gravel storage areas has littered these areas with the remains of targets and other debris.

- How can litter and dumping be reduced while still providing reasonable public access?

2.1.3 Commodity Production

There has been a considerable amount of timber harvested from both BLM and private lands in the past. *The 1995 Eugene District Resource Management Plan* directs scheduled timber harvest to continue from the Matrix-General Forest and Connectivity/Diversity blocks. The plan also directs all land management activities to meet Aquatic Conservation Strategy objectives.

- Where can regeneration timber harvest be scheduled in the next 10-year period?
- Where can commercial thinning be scheduled in the next 10 years?
- What pre-commercial timber management activities are appropriate and where should they be conducted?
- How will the harvesting of timber from private lands affect planned timber harvest on public lands?

2.1.4 Miscellaneous Forest Products

Several small forest products are collected in the watershed. Included in these are both personal and commercial gathering of fuel wood, saw timber, boughs, mushrooms, ferns, and floral materials.

- Are the collection areas and current levels of removal of these forest materials appropriate for implementation of the Northwest Forest Plan and the Aquatic Conservation Strategy within the watershed?

2.2 WATER QUANTITY AND QUALITY

Water quantity and quality are important issues for the Lost Creek watershed. This analysis will focus on gaining an understanding of the roles of physical and hydrologic events and processes that may determine whether water quantity and quality are in balance with the needs of the inhabitants and users of the watershed.

2.2.1 Water Quantity

- What are the water quantity concerns for the watershed?
- What are the dominant hydrologic (flow) characteristics for the watershed (such as peak flows, minimum flows, total discharge)?
- What are the relationships between hydrologic flow processes and other watershed processes (such as sediment delivery to streams and fish migration)?

2.2.2 Water Quality

- What water quality concerns are there in the analysis area?
- What beneficial uses of water exist in the analysis area? What beneficial uses occur on BLM lands or are most affected by activities that take place on BLM lands? Which water quality parameters are critical to these uses?
- What are the conditions and trends of beneficial uses and associated water quality parameters, and how do they compare to the historical or reference water quality characteristics of the watershed?
- What natural and human activities have resulted in a difference between current and historical (desired) water quality conditions in the watershed? (or... What are the natural and human causes of change between historical and current water quality conditions?)
- What beneficial uses occurring on or downstream of BLM lands are not being supported by current water quality conditions? What actions on BLM lands are contributing to identified water quality problems?
- What are the influences and relationships between water quality and other ecosystem processes in the watershed (mass wasting, fish habitat, stream reach vulnerability)?

2.2.3 Soils and Erosion Processes

- What natural erosional processes (such as mass wasting and hillslope erosion) are dominant in the watershed? Where do natural erosional processes tend to occur?
- Where in the watershed do erosional processes have the greatest potential to affect water quality?
- What amount of sediment generated by management activities will actually be, or has the potential to be, delivered to stream systems?
- Have management/human-related activities within the watershed affected erosion processes?

2.2.4 Road-related Sedimentation

Forest roads have been identified as a leading cause of increased sedimentation to stream systems.

- Where are springs and wet meadows affected by roads?
- Where are the stream/road intersections? Are these areas sediment sources?
- Where are the surface erosion problems?
- Where are culverts causing damage to stream channels?
- Which roads need more/adequate drainage?
- Which roads should be reconditioned or closed? Many road closures still have erosion problems and contribute sediment to streams; how can roads be closed effectively?

2.3 HABITAT DIVERSITY

2.3.1 Vegetation

- What was the historic vegetation pattern at the time of settlement?

- C What is the current vegetation pattern? What changes have occurred over the past 150 years, and at what rate did the change occur?
- C Based on the current BLM timber management program, what percentage of the watershed is expected to progress to a mature (>80 year) age class?

2.3.2 Forest Fragmentation

- C How can BLM design their timber management program to prevent future and reduce current fragmentation?

2.3.3 Rare plants

- C Where do Threatened, Endangered, and Sensitive species, Species of Concern, and Survey and Manage plant species occur within the watershed?
- C What percent of BLM lands within the watershed have been surveyed?

2.3.4 Noxious Weeds

- C What noxious weeds are present and how are they altering the composition of plant communities?
- C What are the dominant natural and introduced factors that influence vegetation and habitat conditions for noxious weeds (for example, road construction and maintenance, timber harvest, fire, grazing, and drought)?

2.4 Terrestrial Wildlife

The distribution of Federal lands within the Lost Creek watershed occurs in a patchwork with little connectivity, which presents a challenge for providing forest diversity and species habitat. The following questions will focus on Threatened, Endangered, and Sensitive species, Species of Concern, and Survey and Manage species habitat requirements that are known to occur or that potentially could occur within the watershed. The watershed contains suitable, or potentially suitable habitat for Species of Concern and special status species including, but not limited to, spotted owl, bald eagle, peregrine falcon, great gray owl (GGO), Roosevelt elk.

2.4.1 Spotted Owl Habitat

- C How many acres of spotted owl nesting, roosting, and foraging (NRF) habitat are there in the watershed? What is the distribution of NRF habitat in the watershed? What percentage of the watershed is this?
- C How should BLM design the timber management program to provide optimal dispersal opportunities for spotted owls across the landscape and over time?
- C Where are there opportunities to enhance late successional forest conditions in riparian reserves for northern spotted owl needs?

2.4.2 Peregrine Falcon

- C Is there suitable nesting habitat in the watershed for peregrine falcon?

- Are any of these sites historical peregrine falcon eyries?

2.4.3 Bald Eagle Habitat

- How should BLM manage existing bald eagle habitat in the watershed for potential nesting or roosting sites?
- Does bald eagle foraging habitat occur in the watershed? If so, is there a sufficient prey base to support eagles? Can BLM manage for bald eagle prey base species?

2.4.4 Great Gray Owl

- What acreage is above 3,000 feet and where is it located?
- Of the acreage above 3,000 feet, what percentage supports GGO habitat and where is it located?
- How should BLM design timber sale plans (harvest prescription) to provide GGO habitat?

2.4.5 Big Game Habitats

- What high interest species (elk, cougar, bear) occur in the watershed?
- Where is the habitat for these species located within the watershed?
- What human activity (logging, roads, farming) within the watershed limit use of the watershed by these species?
- How should BLM design the timber management program to improve distribution of these species across the landscape?

2.4.6 Roads

- What habitats and wildlife species are affected by roads?
- What effect do roads have on the introduction and transport of exotic plant and wildlife species?
- What are the existing and desired conditions for road density in the watershed?
- How can BLM manage the road system within the watershed to reduce impacts on wildlife?
- What opportunities exist to decrease road densities in the watershed?

2.4.7 Red Tree Vole

- Where does red tree vole habitat occur within the watershed?
- How can BLM design the timber management program to maintain a sustainable level of red tree vole habitat over time?

2.4.8 Mature and Old Growth Forest Habitat

- What wildlife and plant species are associated with old growth habitat?
- How many acres of forest over 80 years old exists? How much of this forest is in small patches (<40 acres)?

2.4.9 Interior Forest Habitat

- C How much interior forest habitat exists within the watershed?
- C How is the interior forest habitat distributed across the watershed?

2.4.10 Snags

- C What forest stands in the watershed are lacking adequate snag numbers?
- C Where can snag creation projects be conducted in the watershed?

2.4.11 Dispersal Corridors

- C Where do dispersal corridors currently exist within the watershed and will they persist with the current management direction?
- C Where can dispersal corridors be designated to aid in migration and dispersal of wildlife species into, through, and out of the watershed?

2.5 AQUATIC HABITAT

2.5.1 Riparian Condition

- C What were/are the historic, existing, and desired conditions of the riparian zones?
- C What are the existing and desired conditions for composition and density of riparian vegetation?
- C Which riparian areas are lacking in age-class and species diversity of riparian conifers?
- C Is the riparian vegetation degraded?
- C Which riparian areas are lacking in canopy cover?
- C What types of management activities currently are affecting the riparian area (for example, harvests, roads, recreation, grazing)?
- C What restoration activities have occurred within the riparian area?

2.5.2 Channel Condition

- C How have past watershed disturbances affected channel form and stability? Where are stream channels degraded or unstable?
- C What are the basic morphological characteristics (Rosgen channel types) of the watershed? Where are source, transport, and response reaches? Where are sensitive reaches?
- C Is there evidence of channel change from historic conditions?
- **C** What are the dominant channel and habitat forming processes in different parts of the watershed?

2.5.3 Fish Habitat

- C Are existing or potential fish barriers present in the watershed?
- C Where has upstream passage been altered by human activity and how has it affected connectivity in the watershed?

- Is there adequate structure and habitat complexity present in channel? Is there an adequate source of LWD to sustain complexity and stability?
- Is habitat capable of supporting fish at all life stages? Is there sufficient spawning, rearing, and overwintering habitat available?
- Where are areas of limited habitat availability?
- What and where should stream restoration/enhancement efforts take place?

2.5.4 Aquatic Species

- What species are currently present in the watershed? What is their distribution and abundance?
- Are any Threatened and Endangered fish stocks or species present? What species were historically present in the basin?
- What limiting factors affect fish in the watershed?

3.0 CURRENT AND REFERENCE CONDITION - STEPS 3 & 4

Step 3, Current Conditions, is designed to develop information relevant to the issues and key questions formulated in Step 2, at a level more detailed than described in Step 1, Characterization. This portion of the analysis will document the current range, distribution, and condition of the core topics and other relevant ecosystem elements. Step 4, Reference Conditions, is designed to explain how ecological conditions have changed over time as the result of natural and anthropogenic disturbances. Where appropriate, a reference condition is determined and compared to current conditions and key management plan objectives.

3.1 HUMAN USES

3.1.1 Use of the Area by Native Americans

Past Use and Current Conditions

Prior to the major immigration of settlers into the Willamette Valley, Lost Creek was probably used year-around by members of one or more of the Kalapuya bands. The many bands of the Kalapuya were tied together by a common language and lived along the length of the Willamette Valley (Southard, 1997).

Cultural resource surveys have been conducted on BLM ground-disturbing project sites since 1975. These surveys indicate a number of prehistoric sites in the upland areas. There is a high probability that one or more winter village sites occurred in the lowlands. None of the archaeological sites that have been located are eligible for the National Historic Register (Southard, 1997).

Following settlement of the Willamette Valley in the 1850's, most of the Native Americans in the area were relocated west of the Coast Range on the Siletz and Grand Ronde Reservations. There, it is speculated, the passage of time and intermarriage with members of other tribes caused the remnants of the Kalapuya bands to loose their tie to the lands in Lost Creek (Southard, 1997).

Although 1990 U.S. Census Data reports 31 people in the Dexter, Oregon, zip code (97431) as American Indian, Eskimo, or Aleut (US Department of Commerce, 1990), there is no known use of the Lost Creek area for traditional religious or food gathering activities (Southard, 1997).

Trends

Little change from the present situation is expected in the future.

3.1.2 Development within the Watershed

Past Use and Current Conditions

Initial development in the Lost Creek area probably occurred in the open oak woodlands of the bottom lands. Prior to 1850, the prairies and oak savannahs of the Willamette Valley had been maintained by fire (Franklin, 1969). These savannah-like areas possibly were the first to be plowed when settlers arrived. Most portions of Lost Creek that were suitable for agricultural uses were claimed by 1870 (Southard, 1997).

Arrival of the railroad to Eugene in 1872 brought the economic reality of exporting lumber out of the Willamette Valley (Chronology, undated).

Between 1879 and 1900 there was considerable logging in the more accessible portions of the Lost Creek watershed. Logs were cut and skidded to the creek and floated to the Willamette River. Flotation of logs in Lost Creek was accomplished by "splash dams," the rush of logs and water from these events was sufficient for local residents to "complain that the splashes were injurious to the valley's roads (Chronology, undated)."

By the early 1900s, logging was a major activity in the Lost Creek watershed. The last log drives down Lost Creek were in 1903 when J.B. Hill moved six million board feet (Chronology, undated).

World War I and the economic boom that followed it created a market for lumber that made logging in remote valleys like Lost Creek more profitable. A number of new mills were located in the Lost Creek watershed (Williams, 1976).

Roads in the valley were poor and lumber hauling was limited to dry seasons. To resolve this problem, construction was started in 1921 on a 7.5 mile-long-lumber flume. Spanning the distance from Mt. Zion, south of Anthony Creek, it ran over the Willamette River to the finishing mill at Pengra. Moving up to 150,000 board feet of rough lumber a day, the Mt. June Flume Company operated from 1923 to 1942, when a great flood took out both the flume and the mill (Williams, 1976).

The Lewis and Giustina sawmills were established in the 1930s, and became the major mills in the watershed. Both mills initially transported their lumber on the flume. Later, truck transportation became the more efficient method of transportation for both lumber and logs (Williams, 1976).

In the 1930's, the Lewis mill constructed wooden plank roads and trestles to haul logs to the mill from portions of the watershed. As the plank roads were pushed higher into the watershed, sources of rock were available for road construction and the plank roads were replaced by more conventional road construction methods. The Giustina mill closed around 1945 and the Lewis mill followed in 1948 (Williams, 1997).

Timber sales on BLM lands started during World War I; another burst of activity, during World War II, harvested several thousand acres by the end of 1940's. Through 1954, approximately 5,600 acres of the BLM lands had been harvested and regenerated. By the 1970's most of the existing transportation system was in place on both BLM and private lands. Through 1995, at least 98% of the industrial forest land and 83% (11,380 acres) of the BLM lands had received initial harvest treatment. Currently, commercial thinnings and regeneration harvests are underway on some industrial forest lands that had been previously logged (See Table 29 in the vegetation section of this report for a breakdown of seral stage by ownership.)

Trends

Areas currently under agriculture production will remain close to current levels, and little additional timber land will be converted for this purpose. Any additional lands converted to agriculture will be on slopes above the bottom lands currently being used as farm or pasture land (Penhallegon, 1997).

Most future road construction will provide temporary access roads to harvest units that can not be logged by high-lead methods.

3.1.3 Residents Within the Watershed

Past Use and Current Conditions

Originally an area of small farms and homes for loggers and mill workers, uses within the watershed have expanded into a rural residential community. Most of the employed residents commute to jobs elsewhere in Lane County (U.S. Department of Commerce, 1990).

The relocated town of Dexter lies within the watershed adjacent to State Highway 58. In the 1950s, development of the Dexter Dam on the Willamette River flooded the old town and caused its relocation to the present site. Dexter currently has several commercial establishments, approximately 220 dwellings, and an estimated population of 560 residents.

The Lost Creek watershed, including Dexter, has about 450 homes (U.S. Postal Service, 1997). Most of the estimated 1,200 residents live on small parcels of land that are zoned RR1, RR2, RR5, or RR10 in the Lane County Comprehensive Plan. A few homes have been allowed within the "F2" Impacted (small woodlot) Forestry Lands and the "E" Agricultural Zones. There are no known residences within the "F1" Nonimpacted (industrial forest) Forestry Lands. Within the Forestry and Agricultural Zones, development of homes is limited by the requirement of a zoning exception (Barry, 1997).

The Lost Creek watershed serves as an extended "backyard" for the many local residents who live in the watershed. In addition, several homes are located within one-quarter mile of BLM lands. There are 180 acres of BLM land within this "Rural Interface Area." Concerns have been voiced by private land owners when timber harvest or other land management activities are planned on neighboring BLM lands.

Table 5 includes 1990 U.S. Census Data obtained for the Dexter, Oregon, zip code (97431). This data includes several people living outside the Lost Creek watershed in the Rattlesnake Creek and Trent areas. From a social standpoint, the three areas are fairly uniform; the percent of population numbers, below, should apply to Lost Creek.

	Population Number	% of Population
URBAN AND RURAL		
Rural farm residents	34	1
Rural nonfarm residents	2710	99
RACE		
White	2685	98
American Indian, Eskimo, or Aleut	31	1
Asian or Pacific Islander	28	1
RESIDENCE IN 1985 (persons 5 years and over)		
Same house as in 1985	1158	45
Different house in same county	741	29
Different house in Oregon, different county	181	7
Different State: Northeast	0	--
Different State: Midwest	12	< 1
Different State: South	54	2
Different State: West	407	16
TRAVEL TIME TO WORK		
Worked at home	26	
Less than 14 minutes	139	
Fifteen minutes or more	960	
EDUCATIONAL ATTAINMENT (persons 25 years and over)		
Less than 9th grade	147	9
9th to 12th grade, no diploma	271	16
High School or GED graduate	618	36
Some college, no degree	408	24
Associate degree	107	6
Bachelor's degree	123	7
Graduate or professional degree	37	2
OCCUPATION (Employed persons 16 years and over)		
Managerial and professional	207	18

Technical, sales, & admin. support	385	34
Service occupations	122	11
Farming, forestry, and fishing	41	4
Precision production and repair	141	12
Operators, fabricators, & laborers	237	21
HOUSEHOLD INCOME IN 1989		
Less than $5,000	38	N/A
Over $100,000	27	N/A
Median household income	$26,333	N/A
POVERTY STATUS (persons above 15 years of age)		
Income below poverty status	442	16
Income above poverty status	2289	84

Table 5. 1990 U.S. Census Data for Dexter, Oregon Trends (US Department of Commerce, 1990)

There will be continued demand for rural housing on private lands in the Lost Creek watershed; however, development already has occurred on most of the lots in Lost Creek zoned for rural residents. Lane County records indicate that only 16 lots in Dexter and 31 lots elsewhere in the watershed are available for new single-family development. Most new development would have to result from "exceptions" to the Lane County Comprehensive Plan (Hogland, 1997).

The actual sample of the population of Lost Creek is too small to establish general social trends. Since 85% of those employed commute to work elsewhere in Lane County, it is reasonable to assume that residents in Lost Creek will follow the economic trends of Lane County.

3.1.4 Nearby Populations and Employment

(Following population and employment information is derived from working papers supplied by Van Bloem, 1997)

Past Use and Current Conditions

Lane County extends from the Cascade Crest westward to the Pacific Ocean. Over the past 25 years, about 72% of the county's population has lived within the Eugene/Springfield metropolitan area.

The metro area's population of over 224,100 residents, including 26,000 students at the University of Oregon and Lane Community College, is only a short 30-minute drive from the center of the Lost Creek watershed and its 13,700+ acres of public land.
The population of Lane County and the Eugene/Springfield metropolitan area has increased as shown in Table 6:

Year	Metro Population	Lane County
1970	156941	215401
1980	197632	275226
1990	204359	282912
1995*	224100	308200

*1995 populations are estimated

Table 6. Population changes in Lane County and Eugene/Springfield

Between 1960 and 1980, employment in Lane County shifted away from the manufacturing sector (such as food and wood production) to the non-manufacturing sector (such as retail trade, finance, services, and government). Between 1980 and 1995 this shift appeared to have stabilized as shown in Table 7:

Year	Manufacturing		Non-manufacturing	
1960	16,290	36%	29,140	64%
1970	18,400	22%	15,250	74%
1980	19,800	19%	83,100	81%
1990	20,700	17%	97,600	83%
1995	19,300	15%	107,500	85%

Table 7. Jobs and Percent of Total Employment

Trends

Population. An additional 105,000 people, an increase from 34% from 1995, are expected to be living in Lane County by the year 2015 (see Table 8). Of this amount, 73% are expected to live in the Eugene/Springfield metro area.

Year	Metro Population	Lane County
1990	204,359	282,912
1995*	224,100	308,200
2000*	240,700	330,000
2005*	257,400	352,300

2010*	277,600	381,000
2015*	301,400	413,300

* populations are estimated

Table 8. Expected Lane County Population Increases Through 2015

Employment. Although there is an expected increase of 50,000 new jobs in Lane County by the year 2015, the ratio of manufacturing to non-manufacturing jobs is forecast to remain much the same (see Table 9).

Year	Manufacturing		Non-manufacturing	
1990	20,700	17%	97,600	83%
1995	19,300	15%	107,500	85%
2000	23,000	16%	116,900	84%
2005	27,000	18%	126,900	82%
2010	28,900	17%	136,500	83%
2015	30,700	17%	146,400	83%

Table 9. Jobs and Percent of Total Employment

3.1.5 Recreation

Recreation opportunities within Lost Creek must be considered in the context of opportunities at nearby recreation sites.

- Within a few miles of Eugene/Springfield, there are over thirty developed recreation sites along the Willamette or McKenzie Rivers. Operated by Lane County, the State of Oregon, and the BLM, they offer campgrounds and picnic sites, boat-launching sites, swimming areas, hiking trails, and equestrian activities.

- A privately owned recreational vehicle (RV) park is located in Dexter. Designed for larger trailers and motor homes, it offers typical RV park amenities.

- Dexter and Lookout Point Reservoirs have large areas of flat water for boating and water sports enthusiasts.

- The entire 800,000-acre southern half of the Willamette National Forest and the northern portion of the Umpqua National Forest lie with a one-hour drive of Eugene/Springfield. These two areas offer hundreds of miles of trail, winter sports activities, four large wilderness areas, and over 50 developed recreation sites.

Past Use and Current Conditions

Lost Creek does not contain unique natural features that draw large numbers of people. The most important recreation resource of the watershed is low-elevation public lands that are close to Eugene/Springfield, and that (mostly) can be easily accessed, year-around, on all-weather roads. These public lands also offer a greater freedom from administrative restrictions found in nearby developed sites.

The Recreation Opportunity Spectrum (ROS) classification of the watershed is "Roaded Modified" within the BLM and industrial forest lands and "Rural" within the area of small farms and home sites. Half of the BLM land in the watershed is generally unavailable to the public, because of locked gates on private land (This is discussed in the Access section that follows).

Current activities within the watershed include recreational driving, bicycling, hiking, target shooting, hunting for deer, elk, and grouse, and limited fishing. In the winter, if snow conditions are right, recreationists can cross-country ski and drive snowmobiles on area roads. A few of these dispersed activities link into adjacent National Forest lands.

An organized bicycle race, the "Tour de Lane," has used the Lost Creek Road/Eagles Rest Road loop twice as part of the race course.

No developed campgrounds or official parking areas are found within the watershed. Few convenient or appealing places to camp can be found near the road system.

There are three trails in the watershed:

- A half-mile trail provides access to the top of Eagles Rest, a 3,022-foot elevation point just west of Road 19-1-33.1.

- Access to Mt. June, in the Umpqua National Forest, is provided by Trail #1400 that leads from BLM Road 20-1E-31.3. Trail #1400 joins the Sawtooth Trail #1401, which leads into the Hardesty Mountain Unroaded Area. This ridge-line, unroaded area extends from Mt. June, eastward past Sawtooth Rock and beyond Hardesty Mountain. Elevations run from 3,600 to 4,600 feet. Trails in the area are closed to motorized use.

- Lost Creek Trail #3462 links BLM Road 20-1-20.1 to the Sawtooth Trail #1401. Trail #3462 runs the ridge line between Lost Creek, on the west, and Goodman Creek, on the east.

Evidence of target shooting exists in most rock pits and gravel storage areas. Litter associated with shooting is present in all areas used for this activity.

Most recreational use of the area appears to be relatively short-term "day trips," although some night-time activities, such as star-gazing parties, occur along the road system.

No data specific to recreational use has been collected. Between 1970 and 1984, a Lane County traffic counter was installed on the Lost Creek Road south of its junction with the Old Giustina Mill Road #20-1-4.1. Computed average daily traffic for the period was 240 vehicles per day. The lowest daily period was 1972 with 170 vehicles. The highest period was 1984 with 310 vehicles per day. Unfortunately, commercial, administrative, and residential traffic was not distinguished, and all use should not be considered recreational (Hogland, 1997).

In 1995, Schindler, List, and others developed a report titled "Initial Social Assessment of Proximate Communities - Central Cascades Adaptive Management Area." A portion of this report dealt with the recreation use of the Willamette National Forest by residents of the Eugene/Springfield area. Although the questions in the report were directed at the entire Willamette National Forest, the recreation interests displayed by the residents of the Eugene/Springfield area should be considered when planning recreation opportunities in the adjacent Lost Creek watershed (Table 10).

Visit Any Forest for Any Reason	**Percent of Residents**
Never	0.01
Occasionally	57%
Frequently	42%
Use the Willamette National Forest for:	
Day Hiking	70%
View/photo Wildlife	73%
Fishing	52%
Hunting	28%
Mushroom/berry Picking	33%
Bicycling	44%
Wood cutting	21%
Cross-country Skiing	29%

(Table 10 continued)

Use the Willamette National Forest for:	
Snowmobiling	6%
Motorcycle/OHV	14%
Horseback Riding	15%

Table 10. Recreational Use of Forests by People in Eugene/Springfield Metro Area (Schindler and List, 1995)

Trends

The Metro Area's cultural emphasis on personal fitness and environmental awareness should not change; this will place increased need for nearby public places to hike, run, jog, and bicycle in a pleasant and safe outdoor setting.

Although other recreation areas will continue to carry the majority of the activity, the contribution of the Lost Creek area will increase as the population of Eugene/Springfield increases. An equal increase in all current recreation activities should be expected in the watershed.

3.1.6 Public Access

Past Use and Current Conditions

Development of an efficient transportation system for forest management activities on both BLM and private lands was the goal as the watershed was first developed. Right-of-ways and road use agreements between the BLM and the Giustina Brothers have historically provided only for the "management and removal of timber and other forest products from the lands of the United States." BLM administrators have access, but the public's access to BLM lands served by such roads is not assured.

Most roads that access BLM lands within the Lost Creek Road/Eagles Rest Loop are available for public use. The Middle Creek Road (19-1-33) also is open to the public. There is unobstructed access to an estimated 6,940 acres of BLM land within the watershed.

Locked gates exclude the public, from all BLM lands west and south of Lost Creek, with the exception of Middle Creek. About 6,830 acres of BLM lands are behind gates that usually are locked. During deer and elk rifle-hunting season, signs are posted by the gates for "Hunting Access - Weekends Only." Local residents state, however, that most of the gates are open during the entire hunting season. The 1997 deer and elk hunting season runs from October 4 through November 23.

The boundaries of BLM lands are not well identified at road entry and exit points throughout the watershed, therefore, the public is unaware of when they enter public lands. Small signs with road numbers and BLM decals are the only visible reference to public lands.

Trends

Because the Eugene/Springfield area has become an established part of the environmental movement in the Pacific Northwest, the general public is much more aware of its ability to influence management of public lands than in the past. As previously mentioned in the Recreation section of this report, as the population increases, greater demands will be placed for reasonable access to all public lands. Eugene is likely to support more liberal ideas, whereas the other communities may tend to select a more moderate or conservative approach (Schindler and List, 1995).

Private land owners throughout the Pacific Northwest are concerned about strict application of Federal environmental laws to their private holdings. Burning of the nearby Forest Service Ranger Station at Oakridge, Oregon, and past vandalism and interruption of logging operations elsewhere in the area could cause some public land administrators and private landholders to doubt the wisdom of providing easy access to all lands.

3.1.7 Landscape Aesthetics

Past Use and Present Conditions

Prior to extensive logging, the visual condition of the landscape was controlled by fire, wind, and natural succession. These forces produced a landscape that had more variety in the structure of individual stands than is present today. The drier sites were much more open grown, due to low-intensity fires. The uplands had a greater mix of conifer age classes and species, more large trees, more snags, and more broken-topped trees. The forest floor contained more coarse woody debris (CWD), but would have been much more visually open than is currently found in the younger replacement stands.

Initial logging and fires following the turn of the century brought even more diversity into the landscape. Many stands appear to have been "high-graded" by removing the more valuable species of Douglas-fir for lumber and western red cedar for shakes and shingles.

Examination of aerial photographs taken in 1965 and 1995 shows the profound effect modern logging has had on the landscape. In the 1965 photos, extremely large clear-cut logging units were common. These large harvest areas were planted and soon filled with rapidly growing stands dominated by Douglas-fir and hemlock. Today when viewed from a distance, these stands appear as large areas of smooth green with trees of uniform size, form, color, and texture.

Most timber management activities on BLM lands have been designed to provide for efficient forest management and protection, but without special concern for visual resources. In the *1995 Eugene District Resource Management Plan*, the Rural Interface Area receives management direction to: "Partially retain the existing character of the landscape." There are only 180 acres of BLM lands within one-quarter mile of 1- to 20-acre lots along the Rural Interface Area. The remaining 13,588 acres of BLM land in the Lost Creek watershed are directed to: "Allow major modifications of the existing character of the landscape." The resource management plan further directs that Lost Creek be included as a Back Country Byway under the National Scenic Byway System.

There are several illegal dumping sites within the watershed. Most of the larger sites are on open roads in the eastern side of the watershed. There is a concern that toxic materials or other damaging agents may be dumped in the watershed (USDI, 1997a).

Trends

As the management direction of the *1995 Eugene District Resource Management Plan* is implemented on the ground, a landscape with greater diversity eventually will emerge on BLM lands. Application of the Aquatic Conservation Strategy as well as management direction for all Land Use Allocation and Resource Programs will provide for more downed material, a greater mix of species and age classes, and more snags. This will slowly break up the existing broad expanses of "clean green," single-age class stands.

As regulation and costs for proper refuse disposal increase, it can be assumed that increased illegal dumping on public and private lands will result.

In the 1995 report, Schindler stated, "... most residents are likely to expect continued access to their preferred sites and that some level of protection be given to these areas" (Schindler and List, 1995).

3.1.8 Special Forest Products

Past Use and Present Conditions

The forest has always been used for the small products it produces. Native Americans extensively used the forest for herbs, food, building materials, fuel, and materials for clothing and baskets.

Early settlers built log homes chinked with moss and a roof of split cedar shakes. Some tools, such as plows, were carried over the Oregon Trail without handles. The handles came from the forest when they arrived. As time passed, wood fueled everything from the steam donkey to kitchen range.

Currently, the watershed supplies a variety of small products to residents of the valley and beyond. A review was made of BLM small forest products permits for two townships within the watershed (Township 20 South, Range 1 West, and Township 20 South, Range 1 East) for the period from September 1986 through May 1994 (USDI, 1997b). Less than two permits per month were issued in this portion of the watershed. A total of 121 permits valued at over $7,000 was issued. Numbers for specific uses included: fuel wood - 78; sawtimber - 11; cedar bolts and shakes - 10; moss - 9; small poles - 4, posts - 2; ferns - 2; mushrooms - 1; and yew bark - 1.

Fuel wood was the most common item sought. Most fuel wood permits were for 1,000 board feet. Sawtimber permits varied between 2,000 to 5,000 board feet.

Trends

As the diameter of the available sawtimber decreases, gathering fuel wood will become more labor intensive. Implementation of the resource management plan guidelines will reduce the amount of standing dead and down wood available for permits. These two factors probably will result in fewer fuel wood permits in the future.

Most sawtimber and cedar permits were for a very limited number of trees that had fallen near the road system. These permits also will probably be reduced because of the size of material available and the need for down wood in the environment.

Insufficient information is available to establish trends for other small products.

3.2 PHYSICAL CHARACTERISTICS

3.2.1 HYDROLOGY

Introduction

The Lost Creek watershed drainage is approximately 55 square miles in size. BLM has delineated 11 subwatersheds, 12 including the Rattlesnake Butte subwatershed, each having a dendretic drainage pattern. Data pertaining to precipitation and stream flow for the Lost Creek watershed is lacking, consequently data from a similar watershed was analyzed and used to characterize the Lost Creek watershed hydrologic conditions. Gaged stream flow data from the Winberry Creek watershed (43 square miles) was used to evaluate stream flow conditions within the Lost Creek watershed (55 square miles).

Due to the lack of specific data within the Lost Creek watershed, steam flow and precipitation assessments are expected to represent current and reference conditions.

3.2.2 Precipitation/Runoff Characteristics

Climate

Lost Creek watershed has a Mediterranean climate (Oberlander and Muller, 1987) that is typified by cool, wet winters and mild, dry summers. Annual precipitation within the watershed ranges from 48 to 66 inches (Precipitation map). There is a lack of available data for direct precipitation within the Lost Creek watershed, consequently, data from an adjacent area were reviewed and presented in this report.

Measured precipitation data for Lost Creek watershed also is lacking. The closest and most appropriate precipitation data was taken from a National Oceanic and Atmospheric Association (NOAA) climate station (#5050), which is located on the Lookout Point Reservoir dam (Precipitation map).

NOAA has collected precipitation data since 1955 from Lookout Point Reservoir, which is located approximately 2 miles east of the Lost Creek watershed (Station #5050; 43.55N latitude, 122.46W longitude). A precipitation data summary is presented in Appendix A, Table 1.

The average annual precipitation for this station is 45 inches. In 1996, the recorded maximum annual precipitation will exceed 60 inches, a new annual maximum. In 1965, a minimum annual precipitation of 33 inches was recorded (Figure 2).

Average monthly precipitation data collected from Lookout Point Reservoir is presented in Appendix A, Table 1 and shown graphically in Figure 3. Data shows that approximately 44% of the total precipitation is received in November, December, and January. July is the driest month, with an average of 3.5 inches of rainfall.

General Runoff Characteristics

Runoff characteristics of this watershed are evaluated based on the amount of precipitation an area receives, water retention properties of the soil, aspect, drainage density, elevation, road density, and vegetation. The effects of road construction and timber harvest on local hydrologic characteristics have been examined by researchers, but are not easily quantified. Various research conducted in western Oregon indicates a majority of larger peak flows are a result of snowmelt during rainfall (rain-on-snow). Research also indicates that watersheds within the zone of transient shallow snowpacks have higher peak flow events due to rain-on-snow events that rain events alone (Harr, 1981). In conjunction with higher peak flows from rain-on-snow events, a greater propensity for landslides may occur when compared to landslides from rain events only (Harr, 1981). Channel morphology and sediment load characteristics of streams also may be affected by rain-on-snow events (Harr, 1981).

Nearly 50% of the Lost Creek watershed is located within the transient snow zone, which is estimated to be within 1,500 and 4,600 feet in elevation. The transient snow zone exhibits a high potential for runoff under conditions of a warm wind and rain following a period of snow accumulation. Aspect influences local precipitation patterns, snow melt, wind exposure, and the type of vegetation growing on a site. Southern and western slopes respond to snowmelt more quickly than northern and eastern aspects. About 13% of the Lost Creek watershed has a southern or southwestern aspect.

Figure 2

Figure 3

Groundwater storage capacity is directly related to the depth and type of soil, as well as the type of parent material, or bedrock. In general, deep soils have the capacity to store more water and contribute to the maintenance of base flows, whereas shallow soils are less prone to water storage and have a potential to be the greatest contributors to increased storm flows during peak events. Base flow is defined as the sustained runoff found in a drainage. Lost Creek base flow is estimated to be approximately 13 cfs.

Soils within the Lost Creek watershed generally consist of shallow to deep, well-drained, silty clay loam and cobbly silty clay loam. Soils were formed from igneous and sedimentary rock, and from colluvium from sandstone or mixed sedimentary and igneous rock. In general, deeper soils are associated with lower elevations and shallower soils are associated with higher elevations within Lost Creek watershed.

Vegetation can affect water yield and stream flow by alterating evapotranspiration rates. Closed or dense tree canopies can intercept some of the direct precipitation by absorption prior to reaching the ground. Dense stands of forest also potentially could protect an accumulated snowpack from rapid melting by reducing the amount of sunlight and wind velocity within the understory.

Basins with high stream (drainage) densities are characterized by a finely divided network of streams with short lengths and steep slopes. Conversely, a basin with low stream density is characterized by less dramatic topography, resulting in longer stream lengths, flatter valley sides, and larger distances between streams. Table 11 shows the drainage density for each subwatershed within the Lost Creek watershed. Drainage density is controlled by bedrock type, its resistance to erosion, and amount of precipitation. The highest drainage densities generally are associated with higher elevations within the Lost Creek watershed.

Subwatershed	Drainage Area (sq. mi.)	Stream Length (mi.)	Miles of Stream per Square Mile
Buckhorn	4.50	30.20	6.71
E. Lost	4.57	22.39	4.90
Gosage	5.00	27.96	5.59
Guiley	6.85	43.17	6.30
Middle/Carr	8.21	37.07	4.52
Mt. June	2.95	14.75	5.00
N. Anthony	2.77	7.38	2.66
Rattlesnake Butte	1.79	6.71	3.75
S. Dexter	4.54	22.80	5.02
Upper Lost	6.07	32.22	5.31
Subwatershed	**Drainage Area (sq. mi.)**	**Stream Length (mi.)**	**Miles of Stream per Square Mile**
Wagner	3.08	10.23	3.32

Total	**55.19**	**270.13**	**4.89**

Table 11. Drainage Density by Subwatershed for the Lost Creek Watershed

Construction of roads may alter the timing and magnitude of stream flows in comparison to an undeveloped watershed; however, without quantitative data, this is only speculation. Roads can increase stream channel density by providing access to direct routing of surface flows from roadside ditches to streams. Miles of road and road density by subwatershed is presented in Table 23 (in the Soils and Erosional Processes Section of this report).

Recorded Stream Flow Watershed Characteristics

Due to a lack of available stream flow data for the Lost Creek watershed, flow data from an adjacent drainage basin was used for this portion of the watershed assessment. Following a review of the U.S. Geologic Survey (USGS), *Statistical Summaries of Streamflow Data in Oregon* (Hubbard, et al., 1993), gaged stream flow data from Winberry Creek (representative watershed) was selected to represent flow conditions for Lost Creek (Ward, personal comm., 1996).

Winberry Creek is located within Lane County and is situated north of the Middle Fork Willamette River, and northeast of the confluence of Lost Creek and the Middle Fork Willamette River (Figure 4). Both Lost Creek and Winberry Creek are located within the same hydrologic unit and drainage basin.

A comparison between Winberry Creek and the flow estimated for Lost Creek using *Regionalized Flood Frequency Data for Oregon* (Wellman, et al., 1993) indicates the use of Winberry Creek flow data represents estimated flow data for Lost Creek. Based on the geographic flood frequency data similarities, Winberry Creek proved appropriate for use in estimating stream flow for Lost Creek.

Stream Flow Conditions

Stream flow fluctuations within the Lost Creek watershed responded to both precipitation and snow melt, with snow melt contributing dramatically to flow conditions in spring through fall. A graphical comparison of cumulative percent annual runoff to cumulative percent annual precipitation is presented in Appendix A, Figure 1. The comparison indicates that precipitation is greater than runoff during January through mid-April. Conversely, runoff is greater than precipitation during the remainder of the year. This indicates contributions to runoff from snow melt and groundwater discharge are dominant during the spring, summer, and fall.

Figure 4

Average Discharge

Monthly average stream flow for the period of record from the representative watershed is shown graphically in Appendix A, Figure 2. Modified data indicates that peak stream flow occurs during April, followed by a marked decline throughout the remainder of the year. Average annual stream flow is 146 cfs. A maximum stream flow of 5,566 cfs occurred in December 1964, and a minimum stream flow of 1.8 cfs occurred in September 1967 (Table 12). Since the gaging station on the representative watershed was discontinued in 1981, data for the February 1996 storm event is not available; however, February 7, 1996 provisional flow data for the Blue River watershed (45 square miles) was 9,030 cfs (Miller, personal comm., 1997). Total average annual yield for the Lost Creek watershed is estimated to be 104,298 acre-feet per year (Table 12).

	Lost Creek*	**Winberry Creek**
Avg. Annual Total Yield	104,298 ac-ft	85,490 ac-ft
Maximum Recorded Flow	5,490 cfs (12/64)	4,500 cfs (12/64)
Minimum Recorded Flow	1.8 cfs (9/67)	1.5 cfs (9/67)
Average Recorded Flow	144 cfs	118 cfs (1963 - 1981)

*Modified data from representative watershed

Table 12. Total Average Annual Yield Values for Lost Creek and Winberry Creek

Monthly maximum and minimum recorded flows are presented in Figure 5. From the data, the greatest variability between recorded maximum and minimum stream flows occurs in December, while August shows the least variability in extreme stream flows.

Instantaneous Peak Flow

Instantaneous peak flow is defined as the highest water level measured at a gaging station in a day. A recurrence interval is the probability that a certain magnitude of flood event will occur over a given time period. The USGS has estimated statistical measurements of 1.25-, 2-, 5-, 10-, and 25-year flood events within the Winberry Creek watershed (Table 13). The USGS, however, did not estimate the 50- and 100-year events. These data were extrapolated to the Lost Creek watershed. In order to estimate the 50- and 100-year events, 20 to 25 years of data, are required for the gaging station. The data presented in Table 13 for the 50- and 100-year events were computed by graphing (Gumble distribution) the USGS modified estimated events and drawing a best line fit.

Figure 5

Recurrence Interval (Years)	Exceedence Probability	Discharge (cfs)
1.25	80%	1,318
2	50%	2,123
5	20%	3,489
25	4%	6,137
50*	2%	6,963
100*	1%	7,930

* Estimated Using Linear Best Fit Methodology.

Table 13. USGS Estimated Statistical Measurements of 1.25, 2, 5, 10, and 25 Year Flood Events Within the Lost Creek Watershed (based on Winberry Creek Gage)

Figure 6 shows the modified instantaneous peak flows for the period of record and specific flood flow events. During the December 1964 flood, the peak instantaneous flow estimated was 5,566 cfs, which is greater than a 10-year, but less than a 25-year flood event.

3.2.3 Conclusions

Lack of available data for steam flow and precipitation within the Lost Creek watershed required analysis and modification of data from a similar watershed. Modified data indicate average annual precipitation of 45 inches and an average stream flow of 146 cfs. It is unlikely that human activities have altered the timing and amount of precipitation events within the Lost Creek watershed, however, the timing and amount of stream flow most likely has been altered from a reference condition.

Human activities within the Lost Creek watershed likely have caused changes in the expected, current hydrologic conditions prevailing in the watershed. Potential human activities that may affect the expected hydrologic regime include, but are not limited to, vegetation removal and alterations to infiltration and flow of surface and subsurface water.

Timber harvest and associated activities can alter the amount and timing of stream flow by changing onsite hydrologic processes (Keppeler and Zeimer, 1990; Wright, et al., 1990). These activities, which include harvest, thinning, yarding, road building, and slash disposal, can produce changes. These changes are either short- of long-term depending on which hydrologic processes they alter and the intensity of the alteration. Changes in the hydrologic system caused by road building, therefore, are more pronounced where road densities are the greatest. Similarly, the effects of clear-cut logging on hydrologic processes are greater than those resulting from thinning (Harr, 1983; Harr, et al., 1979).

Figure 6

3.3 Water Quality

3.3.1 Introduction

Water quality is an important issue in the Lost Creek watershed. The *1995 Eugene District Resource Management Plan* (USDI, 1995) contains Aquatic Conservation Strategy objectives applicable to all BLM lands:

> "Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain in the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities."

3.3.2 Beneficial Uses of Water in Lost Creek and its Tributaries

Beneficial Uses Established by the State of Oregon

The DEQ is the state agency that administers state and federal environmental laws including those addressing water quality. These laws are translated into action through the Oregon Administrative Rules (OARs) adopted by the Environmental Quality Commission (EQC), a five-member citizen commission whose members are appointed by the Governor. Chapter 340, Division 41 of Oregon Administrative Rules (OAR 340-41) provides a broad framework for protection of water quality for each major river or drainage basin. Within this framework, water quality standards have been established to protect designated beneficial uses (DEQ, 1994).

Beneficial water uses to be protected in the Willamette Basin are listed in OAR 340-41-442. Table 14 shows the beneficial uses for Willamette River tributaries including Lost Creek for surface water identified in the Lost Creek watershed; occurring on BLM lands; and affected by BLM activities. Beneficial uses occurring in the Lost Creek watershed and on BLM lands were determined through examination of Oregon Rivers Information System (ORIS) (Forsberg 1994), water rights categories, contacts with BLM staff, ODFW hunting and fishing regulations, and field observations.

Beneficial Uses of Willamette River Tributaries	Beneficial Use occurs in Lost Creek Watershed	Beneficial Use occurs on BLM Lands	BLM Activities Affect Beneficial Uses in Lost Creek Watershed

Water Supply - Public, Private, and Industrial	Y	N	Y
Irrigation and Livestock Watering	Y	N	Y
Anadromous Fish Passage	Y	Y	Y
Salmonid Fish Rearing and Spawning	Y	Y	Y
Resident Fish and Aquatic Life	Y	Y	Y
Wildlife and Hunting	Y	Y	Y
Fishing	Y	Y	Y
Boating	N	N	N
Water Contact Recreation	Y	Y	Y
Aesthetic Quality	Y	Y	Y
Hydro Power	N	N	N

Table 14. Beneficial Uses of Surface Water in Lost Creek

Water Quality Standards and Beneficial Uses to be Protected

Water quality standards not to be exceeded and the beneficial uses they protect in the Willamette River Basin are listed in OAR 340-41-445. The primary beneficial uses protected and the parameter used to monitor the applicable standard are shown in Table 15 (DEQ, 1994; Table 15).

Water Quality Parameter	Primary Beneficial Use Protected
Dissolved Oxygen	Fisheries and Aquatic Life
Bacteria	Water Contact Recreation
pH	Fisheries and Aquatic Life
Temperature	Fisheries and Aquatic Life
Turbidity	Fisheries and Aquatic Life
Total Dissolved Gas	Fisheries and Aquatic Life
Total Dissolved Solids	Drinking Water
Toxic and/or Carcinogenic Compounds	Drinking Water; Fisheries and Aquatic Life

Table 15. Oregon's Instream Water Quality Standards and the Primary Beneficial Uses They Protect

Additional beneficial uses protected by these standards include aesthetics, livestock watering, wildlife, and irrigation water supply.

Phosphorus criteria have been set for some lakes and stream reaches through the Total Maximum Daily Load (TMDL) program. Fisheries, aquatic life, and aesthetics are the primary beneficial uses protected by these limits.

There is a numeric criteria value for Chlorophyll a that is used to trigger further study. The primary beneficial uses of concern are aesthetics and fisheries.

Numeric water quality standards established by DEQ for the Willamette Basin (OAR 340-41-445) that are applicable to Lost Creek are shown in Appendix B, Table 1. These water quality standards were adopted by the EQC and became effective July 1, 1996.

State Reporting on Status of Water Quality

The DEQ reports on the condition of State waters in the *Biennial Water Quality Status Assessment Report*, also known as the 305(b) report because section 305(b) of the Clean Water Act requires the state to produce the report and submit it to the Environmental Protection Agency (EPA) every two years. In the 305(b) report, Oregon tracks its progress toward the goals of the Clean Water Act, describes activities and accomplishments of the DEQ Water Quality Program, and discusses water quality problems that need to be addressed. The most recent 305(b) report was issued in April, 1994.

When existing required pollution controls are not stringent enough to achieve the State's water quality standards, section 303(d) requires the State to identify those water bodies. For these waters, states are required to establish total maximum daily loads (TMDLs) in accordance with a priority ranking. A TMDL is the total amount of a pollutant that can enter a waterbody without causing it to violate the water quality standard for that pollutant. Once a TMDL is established, the "load" is divided into load allocations (nonpoint sources and natural background sources of pollution) and wasteload allocations (point sources of pollution). The final 303(d) list of "water quality limited" streams for the 1994 305(b) report was issued in July 1996. Lost Creek is not considered a high priority stream by DEQ and is not monitored. Its water quality status, therefore, is not reported on by DEQ in the 305(b) report and it is not a water quality limited water body included on the 303(d) list.

3.3.3 Water Quality Data - Quantitative, Qualitative, and Characterization

Historical Data and Conditions

There is no existing water quality data to document pre-European or reference conditions in the watershed.

Historical fishery and water quality data are listed in a June 1938 stream habitat survey (McIntosh, et al., 1995). The report contained the 1938 data listed in the next section. It was reported at rivermile 7.5 that a water diversion to a lumber mill flume diverted most of the later summer stream flow, and a resident reported "three flumes from lumber mills take practically all of the water from the stream in late summer." Identified pollution sources were sawdust, bark, and slashing from the three sawmills. General remarks noted the middle and upper portions of the surveyed stream were lined with banks of sawdust, and the mill pond at the Lewis Lumber Company was flushed out occasionally and contributed a large amount of loose mud and silt to the stream. Habitat conditions for anadromous salmonids were reported not to be ideal because of water diversions, pollution from sawmills, large quantities of silt, and algae. Residents reported historical presence of salmon; however, none were reported present within the last twenty years (1918-1938).

The same survey contained the following watershed characterization. At rivermile 0.0, the watershed was characterized as flat, open (fields and pastures), and 90% cultivated. Between rivermiles 0.0 and 4.6, the watershed was characterized as flat in the lower portion, as hills covered with second growth conifers in the upper portion, and 35% cultivated (USDA, 1995).

The Lane Council of Governments (LCOG) produced a water quality report (LCOG, 1974) describing hydrology, water quality, water use, and pollution sources in Lane County. The report includes a summary of 2.5 years of water quality data collected by Lane County at the Highway 58 bridge in Lost Creek. The summary water quality data is included in the following section.

Quantitative Water Quality Data

Historical quantitative water quality data for Lost Creek and its tributaries is limited and composed of stream temperature data from stream surveys conducted in 1938 (McIntosh, et al., 1995), water quality data collected by Lane County (LCOG, 1974), stream temperature data collected during stream surveys completed for the Oregon Forest Industries Council in 1993 (A.G. Crook Company, 1994), and stream temperature data collected during an ODFW survey in 1995-1996 (ODFW, 1996). All individual stream temperature measurements for Lost Creek and its tributaries are shown in Table 2 (Appendix B). A summary of water quality data collected by Lane County (LCOG, 1974) is shown in Table 16.

Based on the current state water quality standards for temperature, examination of the data in Table 2 (Appendix B) shows the maximum allowable stream temperature for the period June 1-September 30 was violated in several instances, and other temperatures were near the maximum. The violations all occurred in lower portions of the streams, not within BLM lands, and in the case of the 1938 data, likely prior to BLM management of its portion of the watershed. The water temperature standard prohibits human caused, measurable increases in temperature in a basin for which salmonid fish rearing is a designated beneficial use, and in which surface water temperatures exceed 64°F (It is important to recognize the current temperature standard does not require driving stream temperatures down to 64°F; when temperatures exceed 64°F, the standard discourages further increases from human activities).

Parameter	Units	Max.	Min.	Mean
Dissolved Oxygen	mg/L	11.3	8.3	10.2
Dissolved Oxygen	% saturation	108	97	102

Parameter	Units	Max.	Min.	Mean
Biological Oxygen Demand	mg/L	1.5	1.1	1.3
Chemical Oxygen Demand	mg/L	15	2.5	4
pH	su	7.9	6.6	7.2
Temperature	EC	24.5	7	14
Turbidity	JTU = mg/L SiO_2	9	1	4.3 (median)
Total Coliform	number/100 mL	70	2	43
Fecal Coliform	number/100 mL	79	12	35

Table 16. Summary Water Quality Data for Lost Creek (LCOG, 1974)

The Lane County report (LCOG, 1974) identifies turbidity as the major water quality problem in the Middle Fork Willamette Basin watershed. The report notes there were occasional reports of high bacteria levels in Lost Creek. It is noteworthy that, out of twelve stations with summary temperature data, the Lost Creek station had the highest minimum, maximum, and mean stream temperature. In regard to fecal coliform, Lost Creek had the second highest minimum, maximum, and mean counts out of the twelve monitoring stations. For the remainder of the parameters, Lost Creek fell within the range of values reported for the other stations.

Qualitative Water Quality Information

Qualitative water quality information for Lost Creek includes the 1988 Nonpoint Source Pollution Assessment (DEQ, 1988) and a reference to water temperature in an ODFW report (ODFW, 1992b).

The Nonpoint Source Pollution Assessment (DEQ, 1988) relied primarily on observations of water quality problems, limitations to beneficial uses, and probable causes of pollution. For this report, Nonpoint Source Pollution Assessment information was obtained by querying the ORIS (Forsberg, 1994) database for Lost Creek. Table 3 (Appendix B) lists information that was reported for reaches listed in ORIS.

Mark Wade, an ODFW Biologist (pers. comm., 1996) was contacted regarding existing water quality data. He was unaware of any water quality data for the watershed. The *Middle Fork Willamette Subbasin Fish Management Plan* (ODFW, 1992b) contains the following statement: "High water temperature causes problems in lower reaches of Lost Creek (below Guiley Creek at RM 10.3)...which are aggravated by excessive withdrawals for irrigation during naturally occurring low flows." Mr. Wade said no data supported the observation.

Other Sources Contacted for Water Quality Data

The following additional agencies and sources were contacted regarding existing water quality data:

- Chris Ward, BLM Hydrologist. Ms. Ward is unaware of any existing water quality data for Lost Creek and its tributaries (pers. comm., 1996).

- Karen Dodge, BLM Fisheries Biologist. Ms. Dodge is unaware of any existing water quality data for the Lost Creek watershed (pers. comm., 1997).

- Larry Caton, DEQ Environmental Specialist (pers. comm., 1996). DEQ was supplied with geographic coordinates of a polygon encompassing the Lost Creek watershed. A search of the EPA STORET database, based on the polygon, revealed that no stations or data exist within the watershed. STORET is the main national database for water quality data and contains data from EPA, U.S. Geological Survey, and other federal and state agencies, including Oregon DEQ.

- Kim Jones, ODFW Research and Development, Fisheries Biologist (pers. comm., 1997). Mr. Jones was involved with stream habitat surveys conducted on lower Lost Creek in 1995-1996. He was unaware of the existence of any additional water quality data for the Lost Creek watershed.

3.3.4 Conditions of Beneficial Uses and Associated Parameters

DEQ Characterization of Water Quality in the Middle Fork of the Willamette River

The DEQ monitors water quality four times per year at Jasper Bridge on the Middle Fork of the Willamette (approximately 5 miles downstream from the confluence of Lost Creek and the Middle Fork Willamette) as part of its statewide ambient monitoring program. DEQ reported the Middle Fork Willamette supported the beneficial uses of aquatic life, water contact, and aesthetics during all seasons of the year based on data for dissolved oxygen, fecal coliform bacteria, Chlorophyll a, and pH (DEQ, 1994). This monitoring station is outside the boundary of the Lost Creek watershed.

In the 1996 303(d) list, DEQ lists the Middle Fork Willamette as water quality limited for summer water temperature from the mouth to Dexter Lake, and from Hills Creek Lake to Staley Creek. Additionally, portions of three tributary streams--Buck Creek, Fall Creek, and Packard Creek are listed as being water quality limited for summer water temperature (DEQ, 1996). These stream reaches are outside the boundary of the Lost Creek watershed analysis.

Water Supply (private and industrial)

There are four water rights for domestic water supply and four water rights for industrial water supply within the watershed (Appendix B, Table 4). No monitoring data is available addressing water quality in the Lost Creek system related to private domestic uses. It is likely, however, based on qualitative water quality-related information, that excessive summer water withdrawals affect the beneficial uses of domestic and industrial water supplies. On BLM lands, any lack of streamside canopy may contribute to the effect on beneficial use by increasing evaporation from the streams and decreasing available downstream flows.

Irrigation and Livestock Watering

There are 51 water rights for irrigation and four for agriculture and livestock watering in the watershed (Appendix B, Table 4). No monitoring data are available addressing water quality in the Lost Creek system related to irrigation and livestock watering. It is likely, however, based on the qualitative water quality-related information, that excessive summer water withdrawals affect the beneficial use of domestic water supplies. On BLM lands, any lack streamside canopy may contribute to the effect on beneficial use by increasing evaporation from the streams and decreasing available downstream flows.

Anadromous Fish Passage; Salmonid Spawning and Rearing; Resident Fish and Aquatic Life

There are two water rights for fish and wildlife in the watershed (Appendix B, Table 4). These are very junior instream water rights and it is likely they are not preserved, based on existing senior water rights and observations of excessive water withdrawals in the lower reaches of Lost Creek.

The very limited existing water temperature data suggest beneficial uses for fish and aquatic life are affected, especially in the lower reaches of Lost Creek. Data available for BLM lands met the temperature standard. Insufficient information is available to determine if these data represent the historic temperature condition for the monitored streams. Any lack of riparian cover on BLM lands may contribute to the impact on beneficial use.

It is likely these beneficial uses are affected within the watershed and on BLM lands based on qualitative water quality-related information describing excessive summer water withdrawals, loss of riparian vegetation resulting in increased stream temperatures, road related barriers to fish passage, lack of large woody debris, turbidity, bank erosion, and road and harvesting-related sediment delivery.

Wildlife and Hunting; Fishing

Wildlife likely are affected by excessive summer withdrawals of water. The previous discussion regarding fish and aquatic life also is applicable to beneficial use of fishing. Hunting is not addressed.

Water Contact Recreation

No current monitoring data is available addressing water quality in the Lost Creek system related to water contact recreation. It is likely, however, that excessive summer withdrawals on private lands affect beneficial use on non-BLM lands.

Aesthetic Quality

No monitoring data is available addressing water quality in the Lost Creek system related to aesthetic quality. It is likely, however, that excessive summer withdrawals on private lands affect this beneficial use on non-BLM lands.

3.3.5 Conclusions

Human activities in the watershed have likely caused changes in water quality conditions and affected aquatic life and fish habitat uses more than any other designated beneficial use. Although no quantitative data is available to support this conclusion, qualitative descriptions and observations suggest impacts primarily are associated with harvesting and road building activities, which result in acceleration of landslides and debris torrents, road-related sediment delivery, road-related barriers to fish, and elimination of large woody debris recruitment potential. Other impacts are excessive summer water withdrawals, lack of riparian vegetation resulting in increased stream temperatures, turbidity, and bank erosion. The patchwork nature of BLM-managed lands in the watershed may result in Riparian Reserves, as required by the Record of Decision (ROD) Standards and Guidelines not adequately protecting the temperature standard in these lands because the standards do not apply to privately owned lands that may lie upstream or downstream of BLM-managed lands.

BLM activities may affect beneficial uses of water in Lost Creek and its tributaries, especially those stream reaches within BLM lands. Unfortunately, data collected from existing sources to assess the condition of water quality parameters for Lost Creek are very limited and, as a result, the discussion of conditions and trends of beneficial uses and associated water quality parameters is very limited. Because of the limited data, it is not possible to compare historical (desired) water quality conditions and current conditions, assess natural and human activities that may have affected current conditions, or address the more complex interactions between impacts, water quality, and other ecosystem processes.

Beneficial uses with the greatest potential of being affected on BLM lands or by BLM activities are aquatic life and fisheries. These beneficial uses most likely are affected by road-related erosion accelerating the delivery of sediment to streams (see soils and erosion section of report) and elevated stream temperatures. Although there is not enough data to determine if these problems are widespread, it would be prudent to determine where problems arise and take action to correct them. The limited data showing occurrences of stream temperatures greater than 64°F (June 1- September 30) and the assumption that increased stream temperatures are related to management activities suggest opportunities may be available to improve riparian vegetation and stream shading. Continuous summer monitoring of stream temperatures at multiple locations could provide valuable information to assist management, enhancement, and restoration planning.

3.4 Soils and Erosion Processes

3.4.1 Introduction

The careful use and management of soils is essential to ecosystem health. The ability of soils to provide mechanical support, nutrients, and water for plant growth over time is necessary for the long-term productivity of the land. Likewise, these provisions promote stability of slopes and soil surface, thereby reducing the risk of increased sediment delivery to streams. The following analysis describes soil properties and sediment yield relative to their potential.

3.4.2 Productivity and Resiliency

The Lost Creek watershed was stratified into low, moderate, and high productivity-resiliency units. The units are based primarily on the following soil characteristics: soil depth, drainage, aspect, texture, nutrient level, temperature and moisture regime. This information was interpreted from the Lane County Soil Survey (USDA, 1987) and is summarized in Table 17.

Category	Acres	Percent of Watershed
Low	2296	7
Moderate	12424	35
High	20636	58

Table 17. Soil Productivity and Resiliency for the Lost Creek Watershed Analysis

Soils with high productivity and resiliency (58%) were identified based on their ability to recover quickly from careful use and management of the land. They usually have udic moisture regimes, good moisture holding capacities, and a high level of nutrients and organic matter. With good management practices these areas recover quickly and have a nutrient level that will support long-term productivity of the land.

Soils with moderate productivity and resiliency (35%) are usually moderate in depth and often occur at higher elevations or on aspects that have xeric moisture regimes (lower moisture levels during the late summer).

Soils with low productivity and resiliency are shallow (< 20 inches deep) to bedrock. Areas of rock outcroppings often are scattered through these areas. Many areas have large amounts of coarse fragments (stones, cobbles, and gravel) in the profile. These areas are often droughty and have a limited supply of nutrients. They require very careful management to prevent erosion and loss of their limited ability to provide plant nutrients.

The Soil Resiliency and Productivity Map illustrates the distribution of soil resiliency and productivity ratings by category for the Lost Creek watershed. Appendix C, Table 1 includes a breakdown of these categories by subwatershed.

3.4.3 Erosional Processes and Sediment Delivery

Mass Wasting Potential

Old evidence of small slumps and instability occur mainly in areas with weathered tuff and breccia bedrock. Small unstable areas with weathered sedimentary and igneous rock also occur in the watershed. Some small areas of past debris flows occur along stream channels.

Recent evidence of debris flows and erosion, mainly associated with road crossings and undersized or plugged culverts, was observed along drainageways in the area. Several small areas of road cut and fill failures on steep slopes also were observed, mostly in areas with tuff and breccia, or with weathered sedimentary bedrock.

No detailed mass wasting inventory data was available for the watershed. The only information related to mass wasting had to be interpreted from the Lane County Soil Survey (USDA, 1987), the Geologic Map of Oregon (Walker and MacLeod, 1991) and a slope class analysis conducted in GIS.

The soil survey is limited, but relates closely with areas of tuff and breccia bedrock. The soil survey identifies parent materials and landform information along with limited interpretations for stability. The Geologic Map of Oregon breaks the watershed into seven broad mapping units at a scale of 1:500,000 (See Geology map).

Table 18 summarizes the areas by three broad slope classes: less than 30%, 30 to 65%, and greater than 65%. Approximately 1% of the analysis area has slopes greater than 65%, approximately 75% has slopes of less than 30%, and 24% is in the 30% to 65% range.

The Slope Class map illustrates the distribution of slope classes within the watershed.

Slope Class	Acres	Percent of Watershed
Gentle (<30%)	26516	75
Moderate (30-65%)	8485	24
Steep (>65%)	354	1

Table 18. Acres by Slope Class Category for the Lost Creek Watershed

These data were analyzed and separated into three categories of mass wasting hazard: low, medium, and high potential. The areas with high mass wasting potential (22%) were usually on slopes greater than 30% with weathered tuff and breccia bedrock. The areas of moderate potential (18%) usually have somewhat weathered or broken igneous or sedimentary rock, or are interbedded with tuff or breccia. Road cuts and fills through these bedrock types often produce small slumps and soil failures.

The majority of the watershed (60%) has a low mass wasting potential. These areas are dominated by competent igneous and sedimentary bedrock that has a low potential for mass wasting. The distribution of categories is illustrated on the Mass Wasting Hazard Map and summarized in Table 19 (Appendix C includes a breakdown of mass wasting potential by subwatershed.)

Mass Wasting Potential	Acres	Percent of Watershed
Low	21,250	60

Mass Wasting Potential	Acres	Percent of Watershed
Moderate	6,368	18
High	7,738	22

Table 19. Mass Wasting Potential for the Lost Creek Watershed

The locations of mass wasting events observed during the road maintenance inventory (December, 1996) closely correspond to areas identified as exhibiting high mass wasting potential. Most of the mass wasting activity observed occurred in Wagner, Guiley, North and South Anthony Creek subwatersheds. These areas also correspond to those areas identified on the Geologic Map of Oregon as Qls, areas of landslide and debris flow deposits. A detailed geologic inventory or detailed mass wasting inventory may be needed in the future to determine precisely the extent and location of unstable landforms in the Lost Creek watershed.

Surface Erosion Hazard

Surface erosion is most commonly observed on slopes with moderately detachable soils, located on moderate to steep slopes, when exposed to rain and overland and/or surface flow (USDI, 1996). The most important factors considered in the assessment of surface erosion potential from hillslopes include soil characteristics, steepness of the hillslope and the hillslopes' vegetative cover (WFPB, 1995). Surface erosion potential for the Lost Creek watershed was determined through application of the Department of Natural Resources manual for watershed analysis (DNR). Soil erodibility factors needed to run the model were assembled from the Lane County Soil Survey (USDA, 1987).

The Lane County Soil Survey was used to determine the soil erodibility factor (K factor) for soils in the watershed. The survey lists the K factor with an erosion rating for each soil type. The ratings take into account information on vegetative cover, topography, climate and infiltration, permeability, and texture of the soil.

> "The soil erodibility factor, K, indicates the inherent erodibility of a soil. K gives an indication of the soil loss from a unit plot 22m (72 feet) long with a 9% slope and continuous fallow culture. The two most significant and closely related soils characteristics affecting erosion are (a) infiltration capacity and (b) structural stability. The infiltration capacity is influenced greatly by structural stability, especially in the upper soil horizons. In addition, organic matter content, soil texture, the kind and amount of swelling clays, soil depth, tendency to crust, and the presence of impervious soil layers all influence the infiltration capacity.
>
> The stability of soil aggregates affects the extent of erosion damage in another way. Resistance of surface granules to the beating action of rain saves soil even though runoff does occur.
>
> The soil erodibility, or K factor, normally varies from near zero to about 0.6. K is low for soils into which water readily infiltrates, such as well-drained sandy soils. Erodibility indexes of less than 0.2 are normal for these readily infiltrated soils.

Soils with intermediate infiltration capacities and moderate soil structural stability generally have a K factor of 0.2-0.3 and the more easily eroded soils with low infiltration capacities will have a K factor of 0.3 or higher."

(Brady, 1990).

As outlined in the DNR's watershed analysis manual, erodibility ratings (K factor) were grouped into three classes to assess potential surface erodibility in the Lost Creek watershed (WFPB, 1995). These classes have been summarized in Table 20. Their distribution within the watershed can be found on the K-Factor Map (Appendix C includes a breakdown of K Factor classes by subwatershed).

Soil K Factor Category	Acres	Percent of Watershed
K<0.25 (Low)	22414	63%
0.25<K>0.40 (Moderate)	12780	36%
K >0.40 (High)	162	<1%

Table 20. Soil Erodibility (K Factor) by Category for the Lost Creek Watershed

Since K factor values have been developed for agricultural conditions with bare, tilled soils and a level of disturbance much greater than that which may be realized in the Lost Creek watershed, they may be misleading. K factors were developed for relatively flat areas (9%), devoid of the surface protective organic or plant layer, and would overstate the erosion potential for natural soils that have not been damaged by loss of surface soil, compaction, or displacement. Therefore, K factor alone, is not suitable for direct comparison to forested slopes in mountainous regions. If the analysis was based entirely on K factor, the erosion hazard ratings would likely over estimate the erosion potential in the watershed. Therefore, K factor values must be analyzed in conjunction with slope steepness to provide a more accurate assessment of surface erosion potential.

A digital elevation model was used to categorize slope steepness into three main slope classes. Slopes were broken into low (<30%), moderate (30-65%) and high (>65%) categories (Table 18), categories previously identified by the Washington DNR's watershed analysis protocol (WFPB, 1995).

Table 21 was used to summarize potential erodibility ratings for the Lost Creek watershed. The table provides erodibility ratings based on the slope and K factor classes outlined above. The model was developed by the Washington DNR (WFPB 1995) and adapted for use on the Eugene District by Eugene BLM soil scientists.

Slope Class	K<0.25(Not Easily Detached)	0.25<K>0.40 (Mod. Detachable)	K >0.40 (Easily Detached)
Gently <30%	Low	Low	Moderate
Moderate 30 - 65%	Low	Moderate	High
Steep >65%	Moderate	High	High

Table 21. Erodibility Ratings Based on K factor and Slope

Table 22 summarizes the resulting acres of surface erosion hazard by category for the Lost Creek watershed. The Surface Erosion Hazard map illustrates the distribution of surface erosion hazard categories across the landscape.

Erosion Hazard	Acres	Percent of Watershed
Low	32685	92
Moderate	2652	8
High	18	<1

Table 22. Acres of Erosion Hazard by Category for the Lost Creek Watershed

Areas with high surface erosion potential primarily occur on slopes >30%, characterized by easily (K>0.4) or moderately (0.25 <K> 0.40) detachable soils. Areas characterized by soils that are not easily detached (K<0.25), have a lower potential for erosion, even on higher (>65%) gradient slopes.

As summarized in Table 22, approximately 17.6 acres (<1%) of the soils in the Lost Creek watershed exhibit high surface erosion potential. The majority of soils in the watershed exhibit moderate (approximately 2,652 acres (7.5%)) and low (approximately 32,685 acres (92%)) potential.

Sediment Yield

Sediment from mass wasting, debris torrents, and surface erosion are likely contributing to the overall sediment budget for the Lost Creek watershed. Road-related sedimentation, however, probably is the primary source of human-caused increases in the watershed and the source most readily addressed through management.

Development in the Lost Creek watershed has resulted in approximately 216 miles of road. Based on data provided in the Geographic Information System (GIS), there are approximately 4 miles of road per square mile (Table 23).

Subwatershed	Drainage Area (sq. mi.)	Length of Road (mi.)	Road Density (mi./sq. mi.)
Buckhorn	4.50	17.40	3.86
East Lost	4.57	17.40	3.80
Gosage	5.00	20.20	4.04
Guiley	6.85	22.95	3.35
Middle/Carr	8.21	29.85	3.64
Mount June	2.95	14.80	5.02

North Anthony	2.77	12.30	4.44
Rattlesnake	1.79	9.10	5.08
South Anthony	4.88	15.65	3.21
South Dexter	4.54	15.20	3.35
Upper Lost	6.07	24.40	4.02
Wagner	3.08	16.50	5.36
Total	**55.19**	**215.75**	**3.90**

Table 23. Road Density by Subwatershed for the Lost Creek Watershed

No direct measures of the quantity of sediment from the Lost Creek watershed are available; therefore, the Washington State Department of Natural Resources' methods for evaluating background and road related sedimentation were used (WFPB, 1995). A field inventory was conducted on approximately 166 miles (77%) of road in the Lost Creek watershed. Data were collected on field forms and summarized in a database (Appendix C) for purposes of analysis.

Road segment groups, based on surface type and use, were analyzed to produce rate estimates of sediment delivery for each road segment type. The rates then were applied to the segments of that type in each subwatershed. Road erosion potential was determined from several attributes: the relative areas of road in each prism component; the inherent erodibility of the parent material on which the road was constructed; the protection provided by cover materials (i.e. vegetation, surfacing); and the level of traffic use. The analysis, including the results summarized by road type for each subwatershed, is included in Appendix C, Tables 3 and 4. Table 24 and 25summarizes the length of road by surface type, use category, and erodibility.

	TYPE										
ERODIBILITY OF PARENT MATER-IAL	**BST**		**BST TOTAL**	**GRV**			**GRV TOTAL**	**NAT**		**NAT TOTAL**	**TOTAL**
USE	**AM**	**AS**		**AM**	**AS**	**I**		**AS**	**I**		
High	97.82	73.74	171.56	1399.55	293.6	338.5	2031.67	0	0	0	2203.24
Moderate	18.72	39.39	58.11	1612.36	612.9	406.2	2631.47	34.9	11.7	46.58	2736.16
Low	4.19	44.3	48.49	26.11	51.66	52.94	130.71	0	4.85	4.48	184.05
TOTAL	120.7	157.4	278.16	3038.03	958.2	797.6	4793.86	34.9	16.5	51.43	5123.45

Table 24. Sediment Yield in Tons Per Year by Surface and Road Use Types.

	TYPE										
ERODIBILITY	BST		BST TOTAL	GRV			GRV TOTAL	NAT		NAT TOTAL	TOTAL
USE	AM	AS		AM	AS	I		AS	I		
H	5.55	6.4	11.95	4.6	8.35	25.1	38.05	0	0	0	50
M	2.2	5.65	7.85	11.7	31.9	61	104.6	0.4	0.7	1.1	113.55
L	1	10	11	0.7	7.4	31.8	39.9	0	1.3	1.3	52.2
TOTAL	8.75	22.05	30.8	17	47.65	117.9	182.55	0.4	2	2.4	215.75

Table 25. Road Miles by Surface and Road Use Types

Road Use = AM - Active Mainline AS-Active Secondary I-Inactive/Abandoned
Road Type = BST-Blacktop GRV-Gravel NAT-Native

The increase in fine sediment yield from roads compared to background rates is the relative index used in this analysis. Table 26 summarizes the predicted sediment yields from roads by surface type, use category, and erodibility relative to background for subwatersheds (including Rattlesnake) in the Lost Creek watershed.

SUBWATERSHED	BACKGROUND SEDIMENT YIELD (TONS/YR)*	ROAD SEDIMENT YIELD (TONS/YR)*	TOTAL SEDIMENT YIELD (TONS/YR)	RELATIVE INCREASE FACTOR (TOTAL/ BACKGROUND)
Buckhorn	343	210	533	1.6
E. Lost	158	114	272	1.73

SUBWATERSHED	BACKGROUND SEDIMENT YIELD (TONS/YR)*	ROAD SEDIMENT YIELD (TONS/YR)*	TOTAL SEDIMENT YIELD (TONS/YR)	RELATIVE INCREASE FACTOR (TOTAL/ BACKGROUND)
Gosage	221	703	923	4.18
Guiley	334	908	1,242	3.71
Middle/Carr	254	958	1,212	4.77
Mt. June	156	103	259	1.66
N. Anthony	57	624	681	11.94
Rattlesnake	43	150	193	4.47
S. Anthony	110	1,041	1,150	10.45
S. Dexter	118	85	204	1.72
U. Lost	294	102	396	1.35
Wagner	55	126	181	3.3
Total/Average	2,143	5,124	7,267	3.39

Table 26. Estimated Background and Road-related Sediment Yield in Tons Per Year for Subwatersheds in the Lost Creek Watershed.

*Base on methods described in Washington Forest Practices Board, 1995.
Standard Methodology for Conducting Watershed Analysis-Version 3.0.
Department of Natural Resources, Forest Practices Division, Olympia, Washington.

Based on this analysis, potential increases in sedimentation due to roads could be significant. Figure 7 depicts the background, road-related and total sediment yields by subwatershed. Relative increases range from 1.4 fold 12 fold above estimated background rates (Figure 8).

No apparent correlation between road density and sediment yield was observed for the Lost Creek watershed. The primary differences in sediment yield among subwatersheds is the presence of active, mainline gravel roads. The level of “traffic use” used in the

Figure7

Figure 8

analysis has a large affect on estimated sediment yields from roads. Traffic use levels were based on professional judgement supported by current use observations during the field inventory (December 1996). It is likely that the level of use will vary over time depending on the level and location of harvest activity in the watershed. Therefore, these estimates could be considered a worst case scenario. Additional discussion relative to causal mechanisms for sediment yield are discussed in the following section (Steps 5 and 6).

3.5 VEGETATION

3.5.1 Introduction

The Lost Creek watershed is dominated by forest vegetation. From an ecological perspective, the primary forest series is western hemlock, with the Douglas-fir forest series on dry sites and at lower elevations. Douglas-fir is the most common forest tree throughout the watershed, both now and in the past. It occurs naturally as an early and mid-seral species in the western hemlock forest series and as the vegetative climax species in the Douglas-fir forest series. Other common species include western hemlock, western red cedar, incense cedar, red alder, bigleaf maple, black cottonwood, and madrone. Specific plant communities have not been determined for the area, but descriptions for similar types have been developed for nearby National Forest lands (Hemstrom, et al., 1993).

3.5.2 Historic Vegetation

The earliest records of vegetation within the watershed were obtained from the 1914 map compiled by the Oregon Department of Forestry (ODF). This map shows that most of the area was forested, with the exception of burned and non-timbered areas (Figure 9). During this era, timber harvest had already begun, and the fires are believed to have started in logging slash.

A more complete record of vegetation was developed from 1936 data (Table 27, Figure 10). By this time, many of the accessible portions of the watershed had been logged. Nevertheless, in 1936 most of the area was still in old-growth Douglas-fir. Some younger age classes had developed following logging and the large wildfire. These early disturbances seeded in naturally, creating a variety of stocking densities, with Douglas-fir as the dominant species.

Figure 9

Figure 10

SERAL STAGE (years)	BURNS (acres)	RECENT CUTS - POST 1920 (acres)	DF SEEDLING - SAPLING (acres)	DF SMALL 2ND GROWTH (acres)	DF LARGE 2ND GROWTH (acres)	DF OLD - GROWTH (acres)	HDWD ALDER ,ASH, MAPLE (acres)	NON - FORESTED (acres)
0 - 40	149	4316	2525					
40 - 80				4175				
80 - 200					1029			
>200						19787		
OTHER							54	3320

DF = Douglas-fir HDWD = Hardwood

Table 27. 1936 Vegetation in the Lost Creek Watershed

In 1936, more than half of the area was classed as Douglas-fir old growth. About 30% was less than 40 years old, primarily as a result of timber harvest. Other than old growth, only 15% of the watershed was in conifer stands exceeding 40 years of age. An additional 10% of the area was stocked with hardwoods. The vegetation in 1936 did not represent a balanced distribution of age classes across the landscape, but was heavily weighted to old growth.

The seral conditions tend to follow the stages of stand development described by Oliver and Larson (1990), and are similar to the age-related seral stages derived from the Lost Creek watershed inventory data as shown in Table 28.

Seral Stage - Oliver and Larson	Seral Stage - BLM Age Classification	Description/ Definition
Stand initiation stage	0-40 years	After a disturbance, new individuals and species continue to appear for several years.
Stem exclusion stage	40-80 years	After several years, new individuals do not appear and some of the existing ones die. The surviving ones grow larger and express differences in height and diameter; first one species and then another may appear to dominate the stand.
Understory reinitiation stage	80-200 years	Later, forest floor herbs and shrubs and advance regeneration again appear and survive in the understory, although they grow very little.
Old growth	200 years plus	Much later, overstory trees die in an irregular fashion, and some of the understory trees begin growing to the overstory.

Table 28. Comparison of Seral Stages (Oliver and Larson, 1990) with BLM Age Classifications

Causal Mechanisms - Disturbance Patterns and Processes

The 1936 vegetation data provide an ecological reference point from which to evaluate vegetative trends. The predominant vegetation patterns reflect the natural disturbances that typify the western Oregon Cascades.

In this area, fire and wind were the dominant natural forces that shaped entire landscapes. Intense wildfires covering hundreds of thousands of acres occurred at infrequent intervals, often 200-400 years apart.

Windstorms also affected large areas within the western Cascades, creating irregular stand and landscape structures. Wind, however, does not appear to be a major disturbance factor within the Lost Creek watershed. An examination of aerial photographs taken following the 1962 Columbus Day Storm showed little effect at the stand and landscape level. The resistance of the area to major windstorms is probably due to a combination of factors, including topographic protection from prevailing winds and the stand structures that existed at the time of disturbance.

Large-scale natural disturbances often resulted in vast continuous stands that extended across entire watersheds, with low levels of landscape fragmentation. Landscapes often appeared to be uniform, with broad areas of similarity. A common perception was that the forest was comprised entirely of old-growth. Recent ecological studies suggest, however, that there was far more landscape diversity in some areas than originally thought, often resulting from both wildfire and burning by native Americans.

Within-stand structure and composition in the pre-settlement forest tended to be complex, often as a result of remnant trees that withstood fire and wind. Older stands also developed increased diversity as shade-tolerant conifers grew beneath the forest canopy during the understory- reinitiation and old-growth stages.

Current Conditions

The diverse conditions created by natural disturbances within the Lost Creek watershed contrast with stands that developed following timber harvest. For example, stands created by logging and reforestation usually are smaller than those that developed following natural disturbance. Stand size often was affected by landownership pattern, owner objectives, regulatory controls, terrain, harvest method, and silvicultural system. As a result, forest landscapes today are more fragmented. Also, the structure within regenerated stands is generally more uniform, especially in stands that developed from plantations where older trees were not retained from the previous rotation. It should be noted that within the last decade older trees have been reserved from logging on federal lands to provide a more complex stand structure. In addition, a wider variety of species often is used to reforest logged areas.

The current forest landscapes in the watershed differ markedly from the 1936 landscape (see Figure 11). Timber harvest has reduced the area in old growth to less than 1,000

Figure 11

acres. Regrowth following logging has resulted in development of mid-seral (40-80 year old) stands on more than half of the area (Figure 12). Surprisingly, early seral (0-40 year old) stands have only increased by 10% from 1936 levels. From an ecological perspective, there is an excess of area in the stem exclusion stage (40-80 years old), and a lack of area in the understory reinitiation (80-200 years old) and old-growth (> 200 years) stages.

The current distribution of seral stages is even more varied at the sub-watershed level (Figures 13) Some sub-watersheds have a somewhat uniform distribution of seral stages (i.e., South Dexter), while others are heavily weighted to early or mid-seral stages (i.e., Gosage Creek). The acreage in stands greater than 80 years old is concentrated in a few watersheds, and is not distributed evenly across the landscape.

Land Ownership Patterns

Several land ownership patterns are apparent within the Lost Creek watershed. More than half of the forest within the watershed is owned by industrial timber companies. Within this ownership class, over 11,000 acres are in the 40-80 year age class (Table 29; Figure 14). Half of the young stand area (0-40 years) is on BLM lands, with an additional third on industrial lands. Virtually all of the stands over 80 years old are on BLM lands, including about 900 acres of old-growth forest (> 200 years).

Seral Stage (years)	BLM (acres)	%	GOV (acres)	%	IND (acres)	%	NIP (acres)	%	Total (acres)
0 - 40	5,749	16.3	213	0.6	3,628	10.3	1,241	3.5	**10,831**
40 - 80	5,632	15.9	158	0.4	11,458	32.4	1,543	4.4	**18,791**
80 - 200	1,436	4.1	186	0.5	285	0.8	184	0.5	**2,091**
>200	933	2.6	0	0.0	12	0.0	0	0.0	**945**
Non-Timber	18	0.0	129	0.4	46	0.1	2,471	7.0	**2,663**
Total	**13,768**	**39.0**	**684.0.7**	**1.9**	**15,429**	**43.7**	**5,440**	**15.4**	**35,321**

BLM - Bureau of Land Mgmt., GOV - Other Government, IND - Industrial, NIP - Non-Industrial Private

Table 29. Current Condition: Percent of Watershed and Acres of Seral Stage by Ownership

Vegetation Trends and Implications

The current vegetative pattern within the Lost Creek watershed will greatly influence opportunities for future management. Some of the more important considerations include:

Figure 12

Figure 13

Figure 14

C **Management of Mid-Seral Stands (40-80 years).** Large areas of 40- to 80-year-old stands have been created. Many of these stands are on industry lands. Some industrial landowners have adopted an aggressive program of commercial thinning, a practice that tends to lengthen rotations. If this practice continues on industry and BLM lands, there could be opportunities for developing substantial areas with the characteristics of late-seral stands. On the other hand, if these areas are harvested earlier, using the 40- to 60-year rotations common to industrial forest land, an imbalanced age class distribution will be created, with an excess of young stand conditions.

C **Lack of Older Stands.** The conversion of old-growth stands to young forest has resulted in a lack of late seral conditions in the watershed. Natural stand development can eventually result in late seral conditions, but stand manipulation can hasten this process. On BLM lands, a substantial area now in the 80- to 200-year old class could be considered as late-seral (old-growth) stand recruitment.

C **Riparian Stand Condition.** Many of the stands adjacent to fish-bearing streams are nearing the age or size classes where Large Woody Debris (LWD) can be produced. This could be especially important for stream habitat enhancement. Individual tree growth in these areas can be increased by density management (thinning), and the rate of development of LWD can be accelerated. Without density management, many of these riparian areas will not produce the target tree sizes for decades.

C **Increased Stand Diversity.** Current harvest practices on Federal lands are retaining some mature trees as a part of the new stand. This increases within-stand diversity and can potentially create wildlife habitats.

3.5.3 Special Status Plants (SSP)

Special Status Plant (SSP) species identified in the Lost Creek watershed include species classified as State Sensitive, Bureau Sensitive, and Survey and Manage species (Table 30). In addition to classified species, there are other uncommon plants within the watershed that are being reviewed by the Eugene District Botany Program and/or the Lane County (Emerald) Chapter of the Native Plant Society.

As of January 1997, 1,715 acres (12% of BLM holdings within the watershed or 5% of the total watershed area) of BLM lands have been inventoried in the Lost Creek watershed for SSP species. These surveys were primarily botanical clearances in support of other resource programs such as timber management, wildlife and fisheries enhancement, and recreation.

Survey and Manage Species

Under the *1995 Eugene District Resource Management Plan* (USDI, 1995), implementation of the standards and guidelines for Survey and Manage species will be required. These guidelines require management for many vascular and nonvascular plants and fungi. Lack of information on distribution, abundance, and habitat needs makes it difficult to predict the potential occurrence of these species. The only Survey and Manage species known to occur within the watershed is the candystick plant (*Allotropa virgata*).

Candystick plant is a non-green mycotrophic species, requiring an association between it, a fungus, and another vascular plant (usually a tree or shrub species) for establishment and survival. Its range is from British Columbia to southern Sierra Nevada in California. While the species is widespread, it is rare throughout its range. The species is known to occur in closed canopy pole, mature and old-growth forests in Douglas-fir, western hemlock, grand fir, Pacific silver fir (*Abies ammabilis*), and lodgepole pine (*Pinus* *contorta*) vegetation series. In the McKenzie resource area, it is known to occur in association with the rhododendron (*Rhododendron macrophylla*), beargrass (*Xerophyllum tenax*), and huckleberry (*Vaccinum sp.*) vegetation type, on south slopes above 1,500 feet. It does not appear to tolerate competition and typically occurs where there is little understory. Sites in the McKenzie-area ridge lines with dry, well-drained soils, little understory, and evidence of past fires (charcoal on the soil surface). Populations are highly isolated, raising questions of gene flow in the species. Due to small, short-lived seeds and its obligate mycorhizzal relationship, large and relatively unfragmented habitat areas may be important to maintain species viability and promote gene exchange between populations. Candystick plant may not flower or emerge above ground every year. The old flowering stems may persist for several years, making surveying possible. During its growing season, the plant is very distinctive and easily identified.

Little is known about the response of candystick plant to stand management. Populations where the overstory was harvested appear to have been extirpated. It is unknown whether the species can re-establish following ground-disturbing activities, or how it is affected by post-harvest burning. Potential habitat for the species occurs throughout the watershed, probably wherever the rhododendron\beargrass\huckleberry plant community occurs.

Bureau Sensitive Species

Spring phacelia *(Phacelia verna)* is only known from the Umpqua Valley in Douglas County to the Willamette Valley in Lane County. The species is a spring annual restricted to south facing grassy balds. The one site in the Lost Creek watershed is the most northerly population of this species. The species has not been found since 1993, but because it is an annual, seeds may remain in the soil seedbank.

Bug-on-a-stick moss *(Bubaumia piperi)*, is not a Survey and Manage species, but is known to occur with *Buxbaumia virdis* (Survey and Manage protection buffer species) and may indicate the presence of habitat for *Buxbaumia virdis*. This species is known to occur in the Lost Creek watershed, on a north-facing slope, on down logs, approximately 36 inches in diameter in decay class 4.

Virginia grape fern *(Botrychium virginia)* grows in moist forested habitats. There is only one known site in the Lost Creek watershed where this species is known to occur. Large portions of the watershed could be considered suitable habitat for this species.

Branching monita *(Montia diffusa)* grows in moist forested habitats. There are only two known sites where this species occurs in the watershed, however, large portions of the watershed could be considered suitable habitat.

Mendocino sedge (*Carex mendocinesis*) is a disadjunct species, more typically growing in coastal California and southern Oregon, often on serpentine soils.

Common Name	Scientific Name	Comments
Candystick plant	*Allotropa virgata*	Survey and Manage species. One known site in the watershed. Large and relatively unfragmented habitat areas may be important to maintain species viability. Potential habitat for this species occurs throughout the watershed.

Common Name	Scientific Name	Comments
Virginia grape fern	*Botrychium virginianum*	One known site in the watershed. Large amount of habitat exists for this species in the watershed.
Bug-on-a-stick moss	*Buxbaumia piperii*	May indicate the presence of Buxbaumia virdis, a Survey and Manage protection buffer species.
Mendocino sedge	*Carex mendocinensis*	Disadjunct population north of its typical range.
Branching montia	*Montia difusia*	Two known sites in the watershed. Large amount of habitat exists for this species in the watershed.
Spring phacelia	*Phacelia verna*	Found for many years on Eagle Rest. Has not been found since 1993. This is the most northerly population of this species.

Table 30. SSP Species that are Known to Occur within the Lost Creek Watershed

Species Not Known to Occur, but which are High Probability Species in the Watershed

Wayside aster *(Aster vialis)* occurs only in Lane, Douglas, and Linn Counties. While there are no known sites on BLM lands, there is potential habitat for this species on private lands bordering the Lost Creek valley. This species usually grows in association with oaks. Fire suppression, urbanization, and farming have resulted in reduction of suitable habitat. The lower elevation lands bordering the Lost Creek valley probably once were oak savannah that has grown into Douglas-fir forest. Openings within this forest are potential habitat for wayside aster. Little is known about the response of this species to stand management. Following clearcutting, individual plants have been seen to increase in size and flowering, but over time weedy species which also increase by cutting, may out-compete this species.

Tallbugbane (*Cimicifuga elata*) is a regional northwest endemic species. In the Western Cascades it occurs mostly in mixed Douglas-fir/bigleaf maple stands. Sites always are mesic throughout the dry season and are frequently steep and rocky. This species is not restricted to a particular stand age, and potential habitat exists throughout the watershed. Response of this species to stand management is mixed, with populations not directly affected appearing to survive clear cutting and thinning.

Noxious Weeds

Noxious weeds are defined in *Noxious Weed Strategy for Oregon and Washington* (BLM/OR/WA Pt-94+4220.9) as “Plant species designated by federal or state law as generally possessing one or more of the characteristics of being aggressive and difficult to manage, parasitic, and carrier of a host of serious insects or disease, and being non-native, new or not common to the United States.”

BLM Manual 9200 provides guidance for implementing integrated pest management on lands administered by the BLM. The objective is to ensure optimal pest management with respect to environmental concerns, biological effectiveness, and economic efficiency, while achieving resource objectives.

An inventory of noxious weeds in the Lost Creek watershed was completed in 1996. The results of this inventory were not available at the time this document was prepared. Scotch broom (*Cytisus scoparius*) and St. John's wort (*Hypericum perforatum*) are known to occur in the Lost Creek watershed.

3.6 TERRESTRIAL WILDLIFE

3.6.1 Introduction

The Lost Creek watershed supports a wide range of wildlife habitat and species. The scope of this analysis can not cover all species that occur or are suspected to occur, therefore, only Threatened and Endangered, Survey and Manage, and selected BLM Special Status species will be included. In addition, the watershed supports recreationally important species such as Roosevelt elk, cougar, and black bear (Table 31).

Conifer forests contain the most abundant habitat types in the Lost Creek watershed. Prior to European settlement the watershed was dominated by large interconnected blocks of mature and older conifer forests. Forest habitats within this landscape probably were structurally and vegetatively very complex. Intensive forest management practices and land ownership patterns have created sharp habitat boundaries, providing conspicuous contrasts between adjacent habitats. These past forest management practices have resulted in fragmentation and conversion of late-successional forests to young, even-aged forests, and are believed to have reduced the numbers of late-successional forest-dependent species that occur in the watershed.

Species and habitat information presented in this analysis reflects conditions on public and private lands within the watershed. Most BLM and private lands in the watershed have been and are managed with primary emphasis on timber production. As a result, the watershed is primarily dominated by forests 0 to 80 years old, and provide very limited mature (>80 year) or old-growth (> 200 year) habitat.

Species (common name)	Scientific Name	Status	Presence	Inventory
Bald eagle	Haliaeetus leucocephalus	FT	K	3
Peregrine falcon	Falco peregrinus	FE	U	N
Northern spotted owl	Strix occidentalis caurina	FT	K	4
Red tree vole	Phenacomys longicaudus	SM	S	N
Great gray owl	Strix nebulosa	SM	U	N
Evening field slug	Deroceras hesperium	SM	U	N
Oregon megomphix	Megomphix hemphilli	SM & BS	S	N
Blue-gray tail-dropper	Prophysaon coeruleum	SM & BS	S	N
Papillose tail-dropper	Prophysaon dubium	SM & BS	S	N
Roosevelt elk	Cervus elaphus roosevelt	Game	K	1
Black bear	*Euarctos americanus altifrontalis*	Game	K	1
Mountain lion	Felis concolor	Game	K	1
Bats	miscellaneous species	BS	K	N
Oregon slender salamander	Batrachoseps wrighti	BS	S	N

Table 31. Terrestrial Wildlife Species Addressed in the Lost Creek Watershed Analysis

Key

Status:	**Presence:**	**Inventory:**
FT = Federal Threatened	K = Known	N = No surveys done
FE = Federal Endangered	S = Suspected	1 = Casual, unstructured surveys
BS = Bureau Sensitive	U = Uncertain	2 = Structured spot surveys
SM = Survey & Manage (strategy 2)		3 = Structured surveys not to protocol
Game = Game Species		4 = Surveys to protocol

Northern Spotted Owl

Reference Condition. Based on the amount and distribution of mature forests (Vegetation Pattern Map 1936), spotted owls probably were fairly abundant and well distributed throughout the watershed. In the Oregon Cascade range, spacing of spotted owl pairs has been documented to be about 2.4 miles, depending on habitat suitability (ISC, 1990). A 1.2-mile-radius circle is used to determine the amount of suitable habitat around an owl site center. The amount of suitable habitat required within this 2,895-acre circle is 40% or 1,158 acres (USDI, 1990). Therefore, based on the 1936 vegetation map the Lost Creek watershed contained 19,500 acres of old growth forest that could potentially have supported approximately 16.8 pairs of spotted owl. While quality or "condition" of the forest can not fully be known, it is thought these forests provided suitable nesting, foraging, and roosting habitat through natural succession.

Current Condition. There are eight known spotted owl sites representing six pairs of owls on BLM lands located within the Lost Creek watershed. The majority of these owl sites (four) are concentrated in the southeastern portion of the watershed where BLM lands are close to Forest Service lands. The remaining four sites are scattered across the southern and western portions of the watershed. Of the eight owl sites in the watershed, all have been occupied by pairs in the last three years (1994,1995, 1996) and five of these pairs have produced young during the same three-year period.

Of the eight owl sites in the watershed, the majority likely are in a take situation (too little habitat). The information needed to assess specifically the amount of suitable spotted owl habitat within each of the owl site centers was not available when this document was prepared. Based on analysis of the Spotted Owl Habitat Map and the 1996 Vegetation Age Class Map, however, the following assumptions were made regarding habitat within spotted owl site centers.

The four owl sites located in the southeastern portion of the watershed may contain enough suitable habitat to meet the 40% habitat requirement. Old-growth ($200 years old) or late-seral (80 to 199 years old) stands constitute a portion of these four owl sites. Also, these sites are adjacent to Late Successional Reserve (LSR) designated lands east of the watershed boundary that may provide additional suitable habitat. The remaining four owl sites in the watershed likely do not contain enough suitable habitat. These owl sites occur in a patchwork of young (0 to 40 years old) and mid-seral (40 to 80 years old) stands and contain little to no old-growth forest habitat.

Suitable spotted owl habitat (nesting, roosting, and foraging) accounts for 21% of the federal lands within the watershed (Spotted Owl Habitat Map). There are 1,055 acres of suitable spotted owl nesting habitat and 1,913 acres of roosting and foraging habitat on federal lands within the watershed.

Regardless of ownership there are approximately 22,180 acres or 63% of the watershed that is considered suitable spotted owl dispersal habitat (this includes nesting, roosting, and foraging habitat). For the purposes of analysis within the context of this document, all stands consisting of trees $12 inches diameter at breast height (dbh) are considered dispersal habitat. This habitat allows young owls to disperse safely across the landscape with protection against predation and inclement weather. Spotted owl dispersal habitat is well distributed throughout the watershed (Table 32). In all but three subwatersheds, (Mt. June, South Dexter, and Upper Lost Creek) more than 50% of the forested stands provide dispersal habitat.

Subwatershed	Non-Habitat	Dispersal Habitat	Total
Buckhorn	916.50	1,964.40	2,880.90
East Lost Creek	1,362.00	1,560.00	2,921.90
Upper Lost Creek	2,238.00	1,645.00	3,882.80
Gosage Creek	563.30	2,633.60	3,196.80
Guiley Creek	623.30	3,760.10	4,383.30
Middle/Carr	1,483.80	3,769.20	5,253.10
Mount June	1,123.00	764.70	1,887.60
North Anthony	533.40	1,239.70	1,773.00
Rattlesnake	236.50	906.80	1,143.20
South Anthony	1,225.20	1,900.50	3,125.60
Dexter	1,889.40	1,016.70	2,906.10
Wagner	949.10	1,019.20	1,969.10
TOTALS	**13,143.50**	**22,179.90**	**35,323.00**

Table 32. Acreages of Spotted Owl Dispersal Habitat by Subwatershed: Ownership Wide

The information needed to assess the ability of the watershed to meet the 50-11-40 rule was not available at this time. Based on the large amount of acreage (20,656 acres) that is considered suitable spotted owl dispersal habitat, it is thought the majority of the watershed will meet the 50-11-40 rule.

Trends. Past forest management practices have resulted in fragmentation and conversion of late-successional forests to young, even-aged forest with short harvest rotations. These practices have reduced the amount of suitable spotted owl habitat and habitat that would otherwise return to suitable habitat over time after a similar ‘natural’ disturbance. Since 1936 (1936 Vegetation Pattern Map) suitable spotted owl nesting habitat has been reduced by approximately 95%.

Most available, suitable, spotted owl nesting and roosting habitat occurs on Federal lands, while the majority of dispersal habitat occurs on private lands. Private lands will likely continue to provide only dispersal habitat due to the 40- to 80-year rotations common on these lands. On BLM-managed lands, there is approximately 2,659 acres of mid-seral forest habitat (40- to 80-year age class) contained within the Riparian Reserve network that could be expected to mature into spotted owl nesting or roosting habitat in approximately 120 to 160 years (Forest Fragmentation Map). This represents only a small portion of the total watershed-wide potential "future habitat".

Peregrine Falcon

Reference Condition. It is unknown if peregrine falcons historically nested within the watershed. Habitat, however, has probably remained relatively unchanged from prehistoric times.

Current Condition. There are no known peregrine falcon nest sites within the watershed. Cliffs on Eagle Rest and a few other locations in the watershed may provide suitable nest sites. No protocol surveys of these cliff faces for the presence of Peregrine falcons have been conducted in the watershed. Foraging habitat occurs throughout the watershed. The agricultural fields in the lower watershed may provide better foraging opportunities due to the lack of escape cover for prey species. Dexter Reservoir and Lookout Point Reservoir located 1 and 2 miles, respectively, northeast of the eastern watershed boundary could provide foraging opportunities for waterfowl and some shorebird species.

Trends. Peregrine falcon habitat in the watershed has probably remained relatively unchanged from historic times. While human disturbance of certain cliff faces in the watershed likely has increased, the structural habitat requirements have remained unchanged. Peregrine falcons likely are not affected by current management activities within the watershed.

Bald Eagle

Reference Condition. There is no information on historic abundance and distribution of bald eagles in the watershed. Historically (1936 Vegetation Pattern Map) there was a significant, well-distributed amount of bald eagle nesting habitat in the watershed. If nesting habitat was the limiting factor affecting population and distribution, then historic forest conditions would have provided adequate amounts of habitat for optimum numbers
of bald eagles to occupy this area. Foraging habitat likely was limited to the lower reaches of Lost Creek or occurred outside the watershed along the Middle Fork Willamette River where open gravel bars existed.

Current Condition. There are approximately 945 acres of potentially suitable nesting habitat (forest stands > 200 years old) for bald eagles on BLM-administered lands. These lands are concentrated in the southeastern portion of the watershed.

There is very little bald eagle foraging habitat within the watershed. There are no federally administered lands along the lower reach of Lost Creek that could provide foraging habitat. Eagles nesting along river systems often rely on osprey as a source of food. As osprey return to their nests with fish bald eagles may "rob" the fish from the osprey (Jeff Bernapowitz, personal comm., 1992). There are at least two osprey nests in the lower portion of the Lost Creek watershed. These osprey could provide at least a portion of a forage base for bald eagles in the watershed. Foraging habitat occurs close to the watershed at Dexter and Lookout Point reservoirs, and along the Middle Fork Willamette River downstream of these impoundments.

Trends. Past forest management practices have resulted in fragmentation and conversion of late-successional forests to young, even-aged forests. These practices have reduced the amount of suitable nesting habitat for bald eagles. There should be an increase in amount and quality of nesting habitat over time on BLM land. There are 533 acres of mature to late-seral stage timber (80- to 199-year age class) and 2,659 acres of mid-seral stands (40- to 80-year age class) on BLM lands that lie within the Riparian Reserve network. These stands could be expected to mature into bald eagle nesting or roosting habitat within 100 to 160 years (Forest Fragmentation Map).

Land management practices on private lands in the watershed are directed toward tree farming on 40- to 80-year rotations. As a result, suitable forested habitat for bald eagles is very limited on private lands and likely will continue to be in the future.

According to the *Recovery Plan for the Pacific Bald Eagle* (USDI, 1986), two nesting pairs is the goal for recovery in Zone 12 (Dexter and Lookout Point Reservoirs). Currently there are three nesting pairs within 1 mile of Dexter and Lookout Point Reservoirs.

Great Gray Owl

Reference Condition. There is no historic information pertaining to great gray owl habitat in the Lost Creek watershed. Areas that would meet the elevation criteria (potential habitat) are not very well distributed and are restricted to the outer edges of the watershed boundaries. The Lost Creek watershed is located on the western edge of the great gray owl range in Oregon. Historically (1936 Vegetation Pattern Map), the watershed was dominated by late-seral stage forest stands that provided little or no great gray owl habitat.

Current Condition. Only one sighting of a great gray owl exists for this watershed. There is no information on abundance or distribution of great gray owls in the watershed. In 1996 surveys for great gray owl were conducted in a small portion of the watershed. In recent years, the great gray owl has been found increasingly on the western slope of the Cascades, where clear cuts approximate their preferred meadow hunting habitat, and mature or old-growth forests are nearby for nesting habitat (Gillian, et al., 1994).

If one considers that potential great gray owl habitat is restricted to occur above 3,000 foot elevation (as proposed in the 1995 REIC survey protocol), then approximately 2,300 acres or 6.6 % of the Lost Creek watershed (all ownerships) could be considered potential habitat. All lands that occur above 3,000 feet are located along the southeastern watershed boundaries mainly in the Mt. June and Buckhorn Mountain areas. Currently proposed changes to the survey protocol suggest the elevational constraint for habitat should be set at lands above 1,700 feet (Huff, et al., 1996). If potential habitat is all lands above 1,700 feet, then approximately 18,500 acres, or 52%, of the watershed would be considered potential suitable great gray owl habitat.

Trends. With very little land above 3,000 feet in the watershed, determining trends is not very applicable. Areas where habitat occurs (> 3000 feet) are located on uplands and along ridges where most forest management and road construction likely will occur. With these types of activities occurring on BLM lands and 40- to 80-year rotation management on private lands, suitable habitat for great gray owls always will be extremely limited. The Lost Creek watershed mainly occurs at lower elevations and on the western edge of the great gray owl range. This species may be in the process of a range expansion, however, so this watershed and others like it may play a role in conservation of this species.

Red Tree Vole

Reference Condition. Historically, there was a large amount of suitable habitat for red tree vole in the watershed (19,500 acres of 100- year and older). According to the 1936 vegetation map, the available habitat would have been very well distributed. The 1914 burn (2,343 acres) divided the lower watershed in half. In addition, there were small amounts of bottom land, oak woodland, and agricultural lands in an arrangement in the valley that possibly could have fragmented the existing habitat more, making dispersal difficult.

Because red tree voles are small and live almost exclusively in the canopy of conifers, they may have limited dispersal capabilities (USDA and USDI, 1994b Appendix J2), and early seral stage forests may be a barrier (Carey 1989). Red tree voles may be vulnerable to loss or fragmentation of old-growth Douglas-fir forests (Huff, et al., 1992), however, the Vida/McKenzie Watershed Analysis (USDI, 1996b)states that they have been known to disperse through younger forests.

<u>Current Condition</u>. There is no information on abundance or distribution of the red tree vole in the Lost Creek watershed, and population ecology of this species is not well understood (USDA and USDI, 1994b Appendix J2). No surveys for this species have been conducted in the watershed.

Red tree voles could potentially occur in forest stands $30 years old (Carey and Johnson, 1995), however, suitable habitat generally does not occur in stands #100 years old. For the purposes of analysis in the context of this document potential habitat is determined to be stands $40 years old.

Regardless of ownership, there are approximately 21,800 acres of potential red tree vole habitat that is well distributed throughout the watershed. There are approximately 2,250 acres of the watershed considered suitable ($100 year) red tree vole habitat. This habitat is concentrated in the East Lost Creek, Upper Lost Creek, and Mt. June subwatersheds and a few adjacent watersheds. Private lands within the watershed provide potential red tree vole habitat (stands >30 years old), however, with the majority of these lands on 40- to 80-year rotation, actual suitable habitat likely is very limited.

<u>Trends</u>. Because of intensive forest management practices, private lands (60% of the watershed) may not provide much (if any) suitable habitat for red tree voles. These lands provide potential habitat ($40 years old), however, until the stands reach their approximate rotation age at 40 to 80 years old.

The connectivity of older forest corridors may be necessary to provide red tree vole breeding colonies between large reserves to facilitate gene flow from one reserve to another (USDA and USDI, 1994b Appendix J2). Riparian Reserves on BLM lands may provide important corridors linking vole populations together or providing areas of suitable habitat. Vole populations that may exist in refugia on BLM-administered lands may emigrate onto private lands; these lands may serve as temporary dispersal corridors linking subpopulations together. Administratively withdrawn areas (spotted owl core areas and Riparian Reserves) should ensure the continued existence of some suitable habitat for red tree voles within the watershed.

Implementing Riparian Reserves should benefit this species within the watershed by managing red tree vole breeding colonies in the Matrix, meeting the 50-11-40 rule, reserving the oldest and largest green trees in prescription for green tree retention, and protecting and managing for additional old growth and late-successional attributes.

Mollusks (Evening Field Slug, Oregon Megomphix, Blue-gray Tail-dropper, Papillose Tail-dropper)

<u>Reference Condition</u>. The apparent decline of these species on the Olympic Peninsula and the historic alteration of the Lost Creek watershed environment suggest these species, if they were present in prehistoric times, may have declined or disappeared during historic times (USDI, 1996b).

Historically, there would have been a well-distributed amount of suitable mollusk habitat. This determination is based on the amount of late-seral stage forests (19,500 acres) available and the network of streams in the watershed. The low lying area of the watershed that historically supported some open fields and oak woodlands never provided suitable habitat. Survivability may occur in second growth forests in areas of seeps, springs, and damp swales. A well-shaded and cool micro-climate is essential (Applegarth, 1995).

All mollusks have relatively poor mobility, therefore, their ability to recolonize potential habitat is likely to be especially poor. Colonization is likely to require either a continuous avenue of suitable conditions, or transportation, deliberately or accidentally, to a new and habitable location (USDI, 1996b).

Evening Field Slug

Reference Condition. The evening field slug is said to prefer thermal cover in the form of loose objects, such as woody debris and rocks, and the cooling effect of a relatively closed tree canopy. It is thought to favor old-growth conditions, but is able to survive in second-growth areas. Evening field slugs are able to retreat into the ground and become dormant to escape unfavorable weather conditions. Favorable habitat conditions for all native slugs include damp (skunk cabbage) swales; shady floodplains; the base of rocky and north-facing slopes; and areas with some hardwoods and large woody debris, especially near seeps, springs, and small streams (but above the zone that is seasonally flooded) (USDI, 1996b).

All literature records are from relatively low elevations. Two historic sites on the Olympic Peninsula are at 25 - and 2,000-foot elevation. Exact records for this species are not in the present version of the Survey and Manage database. The scarcity of ecological information prevents estimating the extent of potential habitat.

Current Conditions. There are no records for evening field slugs either in the Lost Creek watershed or in the Eugene District of the BLM. Literature records indicate this slug inhabits Washington and Oregon west of the crest of the Cascade Range. There is a reasonable possibility of finding this species in the Eugene District. More information is needed and should be available in the future because of the Survey and Manage status of this species.

Trends. As part of the Federal Ecosystem Management Assessment Team (FEMAT) (USDA, et al., 1993) process, regional experts considered Evening field slugs as an old-growth and riparian associate that was threatened by habitat loss. Most of the watershed is managed intensively for timber, which provides very little habitat protection for the evening field slug, and most of the potentially available habitat will continue to be affected. On public lands, however, implementation of the Final Supplemental Environmental Impact Statement (FSEIS) (USDA and USDI, 1994b) creates Riparian Reserve networks and lands reserved for other wildlife habitats (spotted owl) that should ensure the continued existence of some suitable habitat for this species within the watershed. Riparian setbacks (50 to 100 feet) on private land within the watershed may block movement of this species through the watershed.

Based on the forest condition and the network of streams on BLM lands, potential habitat for evening field slug is not well distributed in the watershed.

Because there are some questions about the identity of this species and there are no recent (since 1950) records for Oregon, it is unknown if evening field slug will be found in the Lost Creek watershed and Eugene District. Surveys have not been conducted to date, however, surveys will likely be conducted in the future in planned timber sales.

Oregon Megomphix

Reference Condition. The Vida/McKenzie Watershed Analysis (USDI, 1996b) states that this snail requires reliably cool, damp situations. It occurs near streams and upslope close to the ridge top, under late-successional and younger forests with large rotten logs from prior stands. Typically, big-leaf maple trees are present and may be a necessary component for this snail (pure conifer duff may be too acidic, or the absence of hardwoods could reflect a seasonality to subsurface moisture). On slopes, an impermeable bedrock covered by a thin mantle of rock rubble may provide reliably damp subsurface refugia. North-facing slopes are less affected by seasonal drought, and the bottoms of slopes may have conditions favorably moderated by riparian hardwoods. Live snails have been found in Douglas fir bark heaps, and shells have been found under big-leaf maple leaf litter (USDI, 1996b).

Current Condition. There is one record for this small land snail in the Lost Creek watershed. It was found in the 1995-1996 year in the upper reaches of the Lost Creek drainage in the southeastern portion of the watershed (Township20S, Range1W, Section 23). During 1995-1996 Oregon megomphix was found at four other locations in the Eugene District (Mill Creek, Mill Valley Creek, Timber Ridge, and Big Canyon).

This snail could be on virtually any slope within the Lost Creek watershed. Most lands within the watershed under 3,000 feet probably are within the elevation range of this species.

Trends. As part of the FEMAT (USDA et al., 1993) process, regional experts speculated that habitat conditions for Oregon megomphix were deteriorating. Other than the regional trend of a growing human population and a reduction in acres of late-successional forest, no habitat trend information is available. This snail possibly also survives in some special situations where they are not dependent on forest stand age. Replanting exclusively with conifer following harvest and control of deciduous trees, especially on private timber lands, may limit the habitat available for this species in the watershed.

It is anticipated that searches for Oregon megomphix and its management, if found, will become a regular part of land management decisions for the Lost Creek watershed.

Blue-gray Tail-dropper and Papillose Tail-Dropper

Reference Condition. The Vida/McKenzie Watershed Analysis (USDI, 1996b) stated that slugs in this species and genus are said to be favored by cool, moist conditions found in minimally disturbed coniferous forests. These slugs graze on mushrooms and decaying plants and often are found in association with skunk cabbage, hardwood trees, rotten logs, ferns, and mosses. Slugs, especially the small-bodied species, are vulnerable to desiccation. Environmental alterations from logging and fire seem to make all native tail-dropper slugs locally rare or absent. Some available observations for this species indicate areas with deep rock rubble, such as the volcanic soils of higher elevations in the Cascade Range, also can provide reliably damp conditions.

These slugs potentially could occur in any forested part of the Lost Creek watershed, but the most likely places would be on north-facing slopes, in skunk-cabbage swales, and in riparian zones of relatively stable streams. An apparent intolerance to logging and fire suggests these species will be rare or absent from most of the watershed due to extensive logging and fires that have occurred in the last 100 years.

Current Condition. There is no information on abundance or distribution of the blue-gray tail-dropper slug in the Lost Creek watershed. The range of this species includes the forested mountains of western Washington and Oregon. In eastern Lane County, this slug has been found at two locations (Township 24S, Range 5E, Sections 21 and 35) at moderately high elevations (3,660 and 4,500 feet). Elsewhere it has been found at elevations as low as 1,000 feet, so it potentially could occur at any elevation within the Lost Creek Watershed. Most records for this species are from intermediate and higher elevations in both the Coast and Cascade ranges. There are few museum and literature records for blue-gray Tail-dropper slug, and experts consider it an endangered species, but this apparent rarity may be biased by limited survey efforts to date.

There are no records for the papillose tail-dropper slug in the Lost Creek watershed. This is a rare species that has been found at widely scattered locations in the forested parts of the Pacific Northwest, in the vicinity of Puget Sound in Washington to Trinity County in northern California. This slug has been reported for only one location in Lane County--at Alderwood Wayside (Township 16S, Range 6W, Section 28) with an elevation of about 600 feet. Elsewhere it has been found as high as 1,500 feet (Lewis County, Washington).

This species probably could occur at most if not all elevations within the Lost Creek watershed. The few records for this species generally are from low elevations in both the Coast and Cascade ranges. Experts consider this an endangered species, but its apparent rarity may be biased by limited survey efforts to date.

Trends. Other than the regional trend of a growing human population and a reduction in acres of late-successional forest, no habitat trend information is available. Possibly, these slugs are gone or reduced to a few special habitat locations where they do not depend on old-growth forest conditions.

Surveys for the mollusks Survey and Manage species should be fairly easy, but the protocols are not yet available. (The survey protocols and management guidelines are being prepared by the mollusk subgroup of the Survey and Manage team.) Effects on forest management from all the mollusk species is expected to be minimal.

Oregon Slender Salamander

Reference Condition. Because no occurrences of Oregon Slender Salamander have ever been reported for the Lost Creek watershed, there is no information about its historic abundance and distribution. The historic condition and distribution of potential habitat also are unknown. With approximately 55% of the watershed existing in mature forests historically (Vegetation Pattern Map 1936) there would have been plenty of potential habitat available.

The Oregon slender salamander is a terrestrial species (it lays its eggs on land and avoids streams). Large rotten logs (decay classes 2-4), deep rock rubble, or a combination of both seem to be required, and local survival appears to be favored by a relatively closed conifer canopy and the presence of snags and partly down Douglas-fir and hemlock that are shedding their bark (USDI, 1996b). Reliable subsurface dampness seems to be critical.

The Vida/McKenzie Watershed Analysis (USDI, 1996b) stated that a large population of this species occurs in the vicinity of Hidden Lake in eastern Lane County (Township18S., Range 5E, Northwest quarter of Section 8, at approximately 3,350 feet elevation). This salamander is scarce or absent in thinned and clear cut units near Hidden Lake, indicating a need for reliable subsurface dampness and a relatively closed canopy. The greatest potential for finding Oregon slender salamander will be on north-facing slopes with abundant large rotten logs. Mid-slope terraces are most likely to be inhabited, while floodplains and ridge tops are least likely to be inhabited.

Current Condition. This is Oregon's only endemic amphibian and, in most locations, appears to be scarce. There are no records of the occurrence of this forest-dwelling amphibian within the Lost Creek watershed; however, Oregon slender salamander was known from nine locations in eastern Lane County (Willamette National Forest).

Potential habitat is not well distributed within the watershed. There are approximately 945 acres of old growth habitat (>200 years old) within the watershed. This habitat is concentrated in four subwatersheds.

Trends. Overall there has been a reduction in habitat and a progressive fragmentation of the distribution of this amphibian. Since this salamander uses upland habitats and is not strongly tied to riparian habitats, forest management on BLM-administered lands outside of the Riparian Reserves will significantly reduce the amount of potential future habitat. Private lands within the watershed currently provide little to no habitat for Oregon slender salamander and, due to 40- to 80-year harvest rotation, are not likely to provide habitat in the future. Lands reserved for other wildlife habitats (northern spotted owl) should ensure continued existence of some suitable habitat for the Oregon slender salamander within the watershed. Riparian Reserves may provide some salamander habitat, however, it is likely to be minimal due to the terrestrial nature of this species.

Roosevelt Elk

Reference Condition. According to the 1936 vegetation map, 10% of the watershed was recently burned. While the burned areas mainly occur in one large area, there were several smaller burns scattered throughout the watershed. These burned areas, and a smaller amount of land occurring in natural prairies, would have provided high quality forage for Roosevelt Elk. In the watershed, 55% was in late-seral forests that would have provided excellent thermal and hiding cover with some foraging opportunities. Approximately 5% of the watershed had a mixture of bottom land timber, scattered fir, and scattered fir and oak, which would have provided a variety of forage and hiding cover with some possible thermal protection. Historically, there was a mosaic of vegetative types dispersed across the landscape that likely provided good quality habitat for elk.

Current Condition. Lost Creek watershed falls within the ODFW Indigo Wildlife Management Unit. There are no specific population estimates for the watershed. A large number of elk occur within the watershed primarily in the upper watershed and along ridgelines.

There are four habitat variables that affect the availability (or effectiveness) of these habitats to elk. These variables consist of sizing and spacing of forage and cover areas; density of roads open to motorized vehicles; cover quality; and forage quality.

In the Lost Creek watershed there are approximately 215 miles of road, which equates to road density of approximately 4 miles/square miles (range 3.32 - 5.36 miles/square miles; see Steps 3 and 4, Soil and Erosion, Table 23). This figure requires that an average of 3.0 miles of road per square mile be closed to bring the density to ODFW maintenance target levels of 1 mile per square mile (ODFW, 1992c). It has been suggested that road closures be widespread, not concentrating the closures in any one given area (USDI, 1996b). This would promote a less concentrated use of any one area by hunters and enhance a road closure program. The road system in this watershed mainly is controlled by private landowners at a few key locations. Road access typically is closed to the general public year-round except during deer and elk hunting seasons when most roads are open to the public on weekends.

Most of the BLM lands are in forested conditions, which provide relatively good thermal and hiding cover for elk. Adjacent private lands are in many different seral stages. The varying conditions (stand ages, canopy closures, stocking levels) of private lands provide a mosaic of different habitat types that are fairly well distributed. With the relatively well-distributed public lands providing cover, and the intermixed private lands providing a variety of forage and thermal and hiding cover, elk habitat is fairly well distributed across the landscape.

To assess elk habitat across the watershed, variables were assigned to forest stand age classes. Forest stands #15 years old are considered forage habitat, stands 15 to 40 years old are considered hiding cover, stands 40 to 100 years old provide thermal cover, and stands $100 years old are considered optimal habitat (Miller, personal comm., 1997). Table 33 displays the age-class distribution across the watershed of elk habitat variables.

Subwatershed	0-15 FORAGE	15-40 HIDING	40-100 THERMAL	100+ OPTIMA L	NON-RESOURCE	GRAND TOTAL
Buckhorn	78.64	837.91	1812.31	152.02	0	2880.88
East Lost	386.86	957.46	880.26	446.2	251.11	2921.89
Gosage	217.11	271.72	2607.62	25.01	75.37	3196.83
Guiley	248.27	513.89	3562.38	6.22	52.49	4383.25
Middle/Carr	450.22	669.25	3656.58	82.11	394.9	5253.06
Mt. June	124.31	998.52	707.56	57.18	0	1887.57
N. Anthony	214.77	246.36	1253	1.16	57.69	1772.98
Rattlesnake	173.2	52.15	893.03	13.8	11.06	1143.24
S. Anthony	714.39	445.57	1860.77	51.88	53.02	3125.63
S. Dexter	223.41	437.25	948.61	42.19	1254.61	2906.07
Upper Lost	703.67	1520.66	1240.14	404.49	13.83	3882.79
Wagner	188.09	158.91	1115.91	7.21	499.01	1969.13
Grand Total	3722.94	7109.65	20538.17	1289.47	2663.09	35323.32

Table 33. Acres of Forage, Hiding, Thermal and Optimal Elk Habitat in the Lost Creek Watershed

Trends. Current land management within the watershed, regardless of ownership, should continue to provide a diversity of elk habitat. ODFW currently is developing an elk management plan for Indigo Wildlife Management Unit. Until this plan is complete, elk numbers likely will continue to increase within the Lost Creek watershed.

Cougar

Reference Conditions. No historic information on cougar populations is available for the watershed. Historically, there was a mosaic of vegetative types dispersed across the landscape that likely provided good quality habitat for cougars.

Current Condition. Cougar populations have been expanding throughout western Oregon in recent years and are believed to be at a point of saturation (Castillo, personal comm., 1997). Cougar in Oregon are thought to reach their highest population densities.
in the lower elevation, forested areas of the western slope of the Cascade range (Castillo, personal comm., 1997). This primarily is due to the high population density of deer that occur in these areas. Average density for Oregon has been estimated at 7.5-7.8 cougars per 100 square miles (Johnson and Strickland, 1992; ODFW, 1996). There are no population density estimates for cougar in the Lost Creek watershed. The watershed encompasses approximately 54 square miles and, therefore, could be estimated to support four cougar territories (7.8/100 square mile = 4.2/54 square miles). Complaints from residential landowners resulted in removal of several cougars from the lower watershed over the last several years (Castillo, personal comm.,1997).

Trends. Increased human use (passive recreation, hunting, rural homesites) of the watershed likely will result in a greater number of human/cougar interactions.

Black Bear

Reference Conditions. No historic information on black bear populations is available for the watershed. Historically, there was a mosaic of vegetative types dispersed across the landscape that likely provided good quality habitat for black bears.

Current Conditions. Black bear populations are believed to be close to capacity within Lane County (Castillo, personal comm., 1997). ODFW (1993a) provided the most recent density estimates for western Oregon at one black bear/1.1 square miles. There are no black bear population density estimates for the Lost Creek watershed, however, the watershed could be estimated to potentially support 49 bears (54 square miles ÷1.1 per square mile = 49). This population estimate does not consider the quality or condition of the habitat or influences from roads and other human-related disturbances. Actual population densities, therefore, are probably much lower.

Trends. Past forest management practices have reduced the amount of black bear den habitat within the watershed. Forests regenerated by clearcutting and site preparation, that commonly included broadcast burning and gross yarding, have reduced or eliminated the available structure of large trees, stumps, and logs preferred as den sites. The availability of large woody structures will continue to decrease in forest stands managed on 40- to 80-year rotations as remnant woody material from previous stands decays beyond an usable condition.

Bats

Bats are recognized as an important component of forest ecosystems. They are a main predator of nocturnally active adult forms of many forest insect pests. At least two species depend on trees for roosts that primarily are present in old-growth stands. Many other bat species rely on old-growth trees for roost sites when other structures (cliffs, caves, mines, buildings) are absent. Little is known of the distribution and species diversity in forests primarily managed for timber fiber. Distribution of individual bats and bat species in forests is non-random and the primary factor appears to be roost limitation (Perkins and Cross, 1988). There are five species of Bureau Sensitive bats that have the potential to inhabit the Lost Creek watershed (USDI, 1996b).

Old-Growth

The term "old-growth" is ambiguous. Depending on the user, old-growth may refer to stand age, forest stand composition, size of trees, or various other structural components. Franklin and Spies (1991) stated that "old-growth" typically denotes stands > 200 years old that contain large coniferous trees. Old-growth forests are known to have high biological diversity in groups as varied as plants, vertebrates, invertebrates, and aquatic organisms. Old-growth forests contain many specialized species, several of which appear to have clear preferences for old-growth habitats, based on their patterns of abundance. Old-growth forests tend to exhibit high structural diversity including wide ranges in tree sizes trees of large diameter and height; deep, dense tree canopies; and abundant dead wood (Franklin and Spies, 1991).

Reference Condition. Based on the 1936 vegetation pattern map, approximately 19,500 acres of old-growth forest habitat existed in the Lost Creek watershed. While quality or "condition" of these forested acres cannot fully be known, it is thought that, through natural succession, these forest would have exhibited old-growth characteristics.

Current Condition. In the Lost Creek watershed there are approximately 945 acres of old-growth (>200 years) forest. BLM lands contain 99% of all old-growth habitat in the watershed. Old-growth forest stands are not well distributed across the watershed, with 90% of these stands concentrated in four subwatersheds in the (East Lost Creek, Upper Lost Creek, Buckhorn, and Mt. June in the southeastern portion).

A decrease in the amount of old-growth forest habitat influenced by edge is one of the major effects of fragmentation. Microclimate change along patch edges alters the conditions of interior plant and animal species (Lehmkuhl and Ruggiero, 1991), reducing the amount of interior old-growth habitat. Along these edges, the habitat usually becomes drier and receives more light, increasing the abundance and vigor of early seral vegetation and the probability of their establishment in patch interiors (Lehmkuhl and Ruggiero, 1991). Estimates in Pacific Northwest forest by Lehmkuhl and Ruggiero (1991) suggest that microclimatic effects extend up to approximately 525 feet in from the patch edge. Based on these estimates, patches of old-growth 25 acres or smaller effectively are all edge and have lost the essential attributes of the old-growth condition (Lehmkuhl and Ruggiero, 1991).

Interior forest habitat is extremely limited in the Lost Creek watershed. There are approximately 222 acres of interior forest habitat consisting of stands $80 years old within the watershed (Forest Fragmentation). Approximately 90% of the interior forest habitat is concentrated in three subwatersheds (East Lost Creek, Upper Lost Creek, and Mt. June) located in the southeastern portion of the watershed. Half of the subwatersheds contain no interior forest habitat.

Of the 222 acres of interior forest habitat, approximately 130 acres falls within administratively withdrawn areas. Approximately 76 acres lies within spotted owl core areas and 55 acres within Riparian Reserves. The remainder (92 acres) occurs on BLM Matrix and private timber lands.

The majority of the interior forest habitat occurs in small (0.5 to 85 acres), isolated patches. Several of these patches are connected through corridors of similar age class stands to other patches within the watershed and to Late Successional Reserves located to the east on Forest Service lands. Riparian Reserves provide additional connectivity between several of these isolated patches in the southeastern portion of the watershed.

The role of the smaller patches to some of the plants and less mobile animals and invertebrates is not completely known. Management practices not only have increased the amount of habitat affected by edge, but have changed the character of edges and patch shapes. In unmanaged forests, natural disturbance processes such as fire, disease, and wind create irregularly-shaped patches. In the Lost Creek watershed, these patterns typically are geometrically-shaped with linear boundaries following ridge lines or property boundaries. Clearcutting has been the primary harvest method within these boundaries, creating a landscape with sharp patch edges and dramatic contrast between adjacent habitats.

<u>Snags</u>. Over 95% of the forested lands in the Lost Creek watershed have been harvested with the majority of the stands being managed on a second rotation and some being managed for a third rotation. Recent timber harvest units (regeneration or commercially thinned stands) during the past 20 to 30 years have retained few, if any, snags and few green trees to serve as future snag recruitment.

At least 36 wildlife species require standing dead trees for one or more life needs in the BLM Eugene District (USDI, 1995). The *1995 Eugene District Resource Management Plan* (USDI, 1995) requires retention of snags and green trees, 15 inches dbh or greater, at levels sufficient to support species of cavity nesting birds at 40% of potential population levels.

Table 34 shows the primary cavity-nesting birds that occur in the Lost Creek watershed. This table assumes 40% population levels. Numbers of snags per 100 acres are shown in parentheses. Snag densities refer to densities through time (adapted from Brown, et al,. 1985).

Snag Diameter Class (inches dbh)	Snag Decay Stage		Total Snags by Diameter Class
	Hard 2-3	Soft 4-5	
11+	Downy woodpecker (3)	Downy woodpecker (3)	(6)
15+	Red-breasted sapsucker	Hairy woodpecker (77)	(95)
17+	Northern flicker (9.5)	Northern flicker (9.5)	(50)
	Red-breasted nuthatch (31)		
25+	Pileated woodpecker (2)	N/A	(2)
Total Snags	**(63.5)**	**(89.5)**	**(153)**

Table 34. Snag Requirements for Nesting Woodpeckers Found in the Lost Creek Watershed

There is no information on density of snags within the Lost Creek watershed. It can be assumed, due to the lack of snag retention during timber harvest over the last 20 to 30 years, that the majority of the watershed does not support sufficient numbers of snags to meet the needs of snag- dependent species.

The Bureau conducted a inventory of snags and downed logs in the nearby Vida/McKenzie watershed (USDI, 1996b. Appendix E). This watershed is similar to the Lost Creek watershed with regards to forest fragmentation and seral-stage distribution. This study would suggest the Lost Creek watershed contains fewer snags than would occur in fire-regenerated stands for the #80-year age class, but contains more for the 80- to 200-year class. Furthermore, only 12% of the snags could be expected to be >15 inches dbh. It should be noted that none of the inventory plots for the Vida/McKenzie Watershed snag study were located in stands $ 200 years old. Based on the findings of this study, it could be determined that all stands #200 years old within the Lost Creek watershed do not contain enough snags to meet the Resource Management Plan requirements.

Table 35 list the averages for the various forest age classes inventoried in the Vida/McKenzie watershed as they pertain to the Resource Management Plan requirement of retaining snags at least 15 inches dbh for future timber management activities. This data is assumed to be representative of what would occur in the Lost Creek watershed.

Age Class (years)	Snags/Acre (# of plots)		Average DBH (inches)		Average Height (feet)	
	<15"	>15"	<15"	>15"	<15"	>15"
21-40	28.9 (8)	1.5	6.1	47.0	46.4	26.2
41-80	37.8 (12)	3.0	6.5	41.1	38.5	25.9
81-150	34.4 (2)	10.1	7.5	44.7	52.7	69.6
150+	25.6 (3)	13.5	7.0	32.3	30.7	12.8

Table 35. Averages of Snag Data by Forest Age Class for the Lost Creek Watershed

Most snags within the Lost Creek watershed will occur within the late-seral stage stands, with few if any existing in the younger-seral stage stands. The majority of snags that occur in younger-seral stage stands likely are remnant snags created from historic fires, wind damage, or disease, and are in later stages of decay. It is unlikely this snag condition will be sufficiently maintained or persist for any length of time on private lands given the short (40- to 80-year) rotation age for most of the stands. The best opportunity to maintain snags in various stages of decay, therefore, may fall upon the Riparian Reserves and the few administrative outs within the watershed.

Coarse Woody Debris. Coarse woody debris (CWD) is important in many ecological and physical processes in forest and stream ecosystems. Downed logs provide essential habitat for many plant and animal species. There are 150 terrestrial wildlife species known to use dead and down woody materials in the forests of Oregon and Washington west of the Cascade crest (Bartels, et al., 1985). This habitat component provides cover and serves as sites for feeding, reproduction, and resting for many wildlife species.

No information is available on levels of CWD in the Lost Creek watershed. CWD decays over time; thus, regular inputs are necessary. It is believed that 8%-15 % cover of large (>20 inches in girth), slightly to moderately decayed, CWD is adequate for the Oregon Cascades (Cary, et al., 1996). Based on the findings of the Vida/McKenzie Watershed Analysis, it could be determined that all stands #200 years old do not contain enough CWD to meet the Resource Management Plan requirements. Most CWD, therefore, will occur in the 945 acres of old-growth stands in the watershed.

In the Lost Creek watershed, where more than 97% of the forest lands have been converted to managed forests and agricultural fields, habitat complexity has been significantly reduced, subsequently affecting many species of wildlife, especially those associated with old-growth forests. Approximately 60% of these lands are privately owned and will continue to be managed primarily for commercial production of forest commodities and for rural homesites. These lands will provide only simplified, early seral habitats with limited value to a variety of wildlife, particularly those wildlife species associated with older, more complex habitats.

Trends. There are approximately 3,192 acres of mid- to late-seral (40 to 199 years old) age class forests on BLM lands that could be expected to mature into old-growth forest habitat within 100 to160 years if left out of the harvest base (1996 Vegetation Age Class map). The majority of these lands are designated as Matrix, however, and do not fall within administratively withdrawn areas. Of the 7,068 acres, approximately 3,692 fall within the administratively withdrawn spotted owl core areas (500 acres) and Riparian Reserves (3,192 acres) (Forest Fragmentation Map). These areas could be expected to mature into old-growth habitat, barring any major disturbance. This will only result, however, in a 7% increase in the total acres of old-growth habitat within the watershed.

3.7 AQUATIC HABITAT

3.7.1 Reference Condition

It is known that fish were relatively abundant near the turn of the century. It is also widely accepted that impacts from land management activities (such as timber harvest and road building) have altered many streams from the reference and/or pristine condition, although data is scarce.

Habitat loss and degradation have been identified as two of the leading factors influencing the decline of both anadromous and resident fish species in the Pacific Northwest since the turn of the century (USDA, et al., 1993).

Since the quality, quantity, and complexity of instream habitat is a critical component influencing fish use and fish abundance, established habitat guidelines can be used as suitable indicators of reference condition.

PACFISH established desired conditions for habitat in salmon streams in the Pacific Northwest (USDA/USDI, 1994a). Guidelines were established for pool frequency, water temperature, number of pieces of large woody debris, bank stability, and width:depth ratio (See Table 36). These guidelines will serve as a reference condition for this analysis. It should be noted, however, that PACFISH guidelines were designed for larger, lower gradient salmon streams and may not directly apply to many of the smaller, steeper, trout streams present in the Lost Creek basin.

POOL FREQUENCY	WATER TEMP.	LARGE WOODY DEBRIS	BANK STABILITY	WIDTH:DEPTH RATIO
Varies w/ stream width	< 68EF	>80 pieces/mi. 24" diam x 50' long	> 80% Stable	< 10:1

Table 36. Summary of PACFISH Guidelines

The first documented stream survey performed on Lost Creek was conducted by the Bureau of Fisheries (BOF; currently National Marine Fisheries Service [NMFS]) in 1938. The survey included the lower 7.5 miles of stream, ending at the Lewis Lumber Company dam. These surveys were part of a larger survey designed to assess current condition of all streams in the Columbia River basin that provided or had provided spawning or rearing habitat for salmon and steelhead (McIntosh, et. al., 1995).

This report contains the earliest known record of fish presence in the basin and will consequently be used for the reference condition for fish presence. The report listed whitefish, suckers and chub minnows (Oregon chub) as abundant in Lost Creek. Cutthroat trout were considered scarce but present, and residents reported that salmon had not inhabited the stream for the past 20 years. The absence of chinook salmon in Lost Creek may be due to water quality problems identified in the 1938 report (see water quality section of this report). Rainbow trout are native to the Middle Fork Willamette River basin, but were not mentioned in the BOF report.

Although other fish species occur in the watershed (i.e. sculpin, lamprey), this analysis will focus on salmonids and their habitat. Salmonids often are the best choice for monitoring, due to their value as game fish, and their sensitivity to habitat change and water quality degradation.

3.7.2 Current Condition

Channel Morphology

Channel morphology was assessed based on the concept of "sensitive stream reaches." A sensitive stream reach can be classified as any reach susceptible to large variations in runoff, sediment supply, and large woody debris (LWD). These reaches typically are the low-gradient, unconfined reaches where lower flows allow the fine substrates (sand and silt/organics) to settle out. This creates wider and shallower floodplains, fills instream rearing pools, and embeds spawning gravel.

The classification of sensitive stream reaches in the Lost Creek watershed was determined through use of stream survey data and Digital Elevation Modeling (DEM). Stream survey data was provided by the BLM, ODFW, and Giustina Land & Timber. Sensitive stream reach classifications were based on the following methods:

1) Source, Transport, and Response Reaches (WFPB, 1995); and

2) Rosgen Channel Classification (Rosgen, 1996).

Source, Transport, and Response Reaches

Source, transport and response reaches were delineated by generating stream gradient classes from DEM. Stream segments with a gradient less than 3% were classified as response reaches. Streams with gradients ranging from 3% to 20% were considered to be transport reaches, while streams with a gradient greater than 20% were classified as source reaches (WFPB, 1995).

Response reaches are identified by the DNR as being those reaches most susceptible to change in channel morphology due to changes in sediment supply (WFPB, 1995). Response reaches often provide the most diverse and productive fish habitat. Due to their susceptibility to change and their importance to fish, these reaches are considered sensitive. Transport reaches are intermediate streams that will rapidly transport sediment loads to downstream reaches. Source reaches can be described as being probable locations for colluvium storage, often corresponding to debris-flow-dominated channels. Due to the steep nature of source reaches, they are strong candidates for mass wasting events (WFPB, 1995).

Of the 270 stream miles in the Lost Creek watershed, transport reaches represent 50% of the length (Table 37). Source reaches represent an additional 44%, and response reaches represent only 6% of the length.

		Reach Type		
Subwatershed	**Response**	**Transport**	**Source**	**Total Miles**
Buckhorn	**0**	**12.53**	**17.67**	**30.2**
East Lost	**2.63**	**9.38**	**10.38**	**22.39**
Gosage	**0.07**	**15.6**	**12.29**	**27.96**
Guiley	**0.15**	**32.98**	**10.04**	**43.17**
Middle/Carr	**1.55**	**29.27**	**6.25**	**37.07**
Mt. JUNE	**0**	**0**	**14.75**	**14.75**
N. Anthony	**1.05**	**1.82**	**4.51**	**7.38**
Rattlesnake	**0**	**6.44**	**0.27**	**6.71**
S. Anthony	**0.65**	**4.21**	**10.39**	**15.25**
S. Dexter	**6.47**	**10.33**	**6**	**22.8**
Upper Lost	**1.36**	**8.48**	**22.38**	**32.22**

		Reach Type		
Wagner	**2.26**	**4.07**	**3.9**	**10.23**
Total:	**16.19**	**135.11**	**118.83**	**270.13**
% of Watershed:	**0.06**	**0.5**	**0.44**	**1**

Table 37. Source, Transport, and Response Mileage by Subwatershed

With the exception of headwater reaches, the Lost Creek mainstem is composed mainly of response reaches. The headwater reaches are comprised exclusively of source and transport reaches. Additional response reaches can be found in Wagner Creek, Anthony Creek, and the lower reaches of some of the unnamed tributaries. Western side tributaries are mainly transport reaches, while eastern side tributaries have a higher concentration of source reaches (see Source, Transport and Response Reach Map).

<u>Rosgen Channel Classification</u>

Rosgen channel classification separates individual stream segments into homogenous sections of stream (reaches). Similar stream reaches typically exhibit comparable valley and channel configuration, including like values for variables such as channel entrenchment, width-to-depth ratio (W:D), dominant particle size, stream sinuosity, and gradient. Similar reach types, therefore, would be expected to exhibit similarities in function, such as flow, sediment/debris transport, and fish habitat.

Little detailed stream channel data is available in the Lost Creek watershed, making accurate Rosgen channel typing difficult. Where complete habitat surveys existed, a more detailed channel classification was determined. All Rosgen stream classifications were based on available information, tempered with professional judgement. No Rosgen field survey data exists for the watershed. Where surveys were incomplete or non-existent, alternate methods were used. Because stream gradient is a primary variable for Rosgen channel typing, DEM was used to separate reaches into various gradient classes. Based on these criteria, a Rosgen channel type was determined. Because of variance and overlap of channel variables (such as entrenchment, gradient, and W:D), it was not possible to classify many additional Rosgen channel types through this method. This procedure primarily resulted in identification of those stream reaches with gradients greater than 10% (Aa+ channel types).

<u>“Aa+” Channel Types</u>. These channels can be characterized as very steep (>10%), entrenched (<1.4), debris transport channels. Aa+ channels have low width-to-depth ratios (<12) and low sinuosity (<1.2) (Rosgen, 1996). They are most often found in headwater reaches, and correlate well with segments identified earlier as source or transport reaches. Waterfalls, chutes, cascades, and plunge pools are often characteristic of Aa+ channel types. Due to the steep nature of these channel types, they provide only limited fish habitat availability (primarily for cutthroat trout). According to this analysis, approximately 215 miles of Aa+ channel types occur in the Lost Creek watershed, most of which occur in or near the headwaters. This represents nearly 80% of the total stream mileage in the watershed.

<u>“B” Channel Types</u>. These channels can be characterized as low to moderately steep (<10%) in gradient, moderately entrenched (1.4 - 2.2), riffle-dominated channels. B channels have moderate width-to-depth ratios (>12) and moderate sinuosity (>1.2). They usually are very stable, and most often are found as intermediate reaches, flowing through narrow, gently sloping valleys (Rosgen, 1996). B channels correlate well with reaches identified earlier as transport and response reaches. Riffles, rapids, scour pools and plunge pools all are characteristic of B channel types. This channel type typically provides good to excellent fish habitat, but generally

contains less pools than other low gradient channel types. Approximately 19.5 miles of B channel were identified in the Lost Creek watershed.

"C" Channel Types. These channels can be characterized as low-gradient (<4%), highly sinuous (>1.4), and slightly entrenched (>2.2). C channels typically have moderately high width-to-depth ratios (>12) and usually are established within well-developed floodplains (Rosgen, 1996). These lesser gradient channel types provide for excellent fish cover and habitat, typically comprised of low-gradient riffles and lateral scour pools. Approximately 0.5 mile of C channel were identified in the Lost Creek watershed.

"G" Channel Types. These channels can be characterized as low- to moderate- (<4%) gradient, narrow channel, and deeply entrenched (<1.4). G channels have low width-to-depth ratios (<12) and moderate sinuosity (>1.2). Except when present in bedrock or boulder-confined channels, this channel type is relatively unstable and often exhibits grade control problems and high rates of bank erosion. These channels often generate high bedload and sediment transport rates (Rosgen, 1996). Although the gradient of G channels correlates best with reaches identified earlier as response reaches, the function of unstable G channels may be more similar to transport reaches. Step pool systems often are characteristic of G channel types. Approximately 3.5 miles of G channel were classified in the Lost Creek watershed.

Based upon the lack of available information, approximately 32.5 miles of stream could not be classified into a particular Rosgen channel type. It is likely that additional streams in the basin may exhibit B or G channel characteristics.

Where data exists, channel types were further broken down based on dominant substrate type (i.e., B1, C2). Numerical codes representing dominant substrate are as follows:

1) Bedrock; 3) Cobble; 5) Sand; and
2) Boulder; 4) Gravel; 6) Silts/Organics.

Table 38 summarizes the Rosgen channel types found in the basin (detailed breakdown can be found in Appendix E, Table 1).

ROSGEN TYPE	MILES IN WATERSHED	DATA SOURCE *
Aa+	215	5
B1 to B5	19.5	1, 2, 3 &4
C2	0.5	3
G2 & G6	3.5	2

*** Data source: 1 - 1991 BLM Habitat Survey 2 - 1993 Giustina Habitat Survey**
3 - 1995 ODFW Habitat Survey 4 - 1996 BLM Channel Survey
5 - Digital Elevation Model

Table 38. Miles of Rosgen Channel Type in the Lost Creek Watershed

Once classified, stream sensitivity can be determined. Table 39 identifies stream sensitivity by Rosgen channel type (see Sensitivity to Disturbance Map). The A3 - A5 and the G6 channel types are the most sensitive classified in the basin. Sensitivity of these channel types to disturbance ranges from very high to extreme, with high sediment supply and streambank erosion potential. Assuming a natural recovery once the instability is corrected, recovery potential for these channel types is poor. B and C channels typically are more stable, with much less sensitivity to disturbance, lower sediment supply, and streambank erosion potential. The recovery potential is excellent for B channels and very good for C channel types (Rosgen, 1996).

Based on the Rosgen channel typing reaches identified in Table 39, Table 40 summarizes the miles of low, moderate, and high sensitivity to disturbance by subwatershed. These reaches are mapped on the Sensitivity to Disturbance Map. Lack of detailed Rosgen Channel Typing data for the remaining reaches (approximately 237 miles) prohibits their classification into the various sensitivity classes.

CHANNEL TYPE	SENSITIVITY TO DISTURBANCE	SEDIMENT SUPPLY	STREAMBANK EROSION POTENTIAL	RECOVERY POTENTIAL
A2	Very Low	Very Low	Very Low	Excellent
A3	Very High	Very High	Very High	Very Poor
A4	Extreme	Very High	Very High	Very Poor
A5	Extreme	Very High	Very High	Very Poor
B1	Very Low	Very Low	Very Low	Excellent
B2	Very Low	Very Low	Very Low	Excellent
B3	Low	Low	Low	Excellent
B4	Moderate	Moderate	Low	Excellent
B5	Moderate	Moderate	Moderate	Excellent
C2	Low	Low	Low	Very Good
G2	Moderate	Moderate	Moderate	Fair
G6	Very High	High	High	Poor

Table 39. Management Interpretations of Various Stream Types (Rosgen, 1996)

Most of the stream mileage (approximately 75%) in the analysis area is comprised of firs and second order streams (see Table 41), which is highly indicative of a watershed dominated by Aa+ channel types. Although small streams of this magnitude are typically not fish bearing, they are generally considered a source of water, large woody debris, and nutrients to downstream reaches bearing fish and other biota (USDA, 1994).

SUBWATERSHED	LOW	MODERATE	HIGH
BUCKHORN			
E. LOST			0.82
GOSAGE	1.55	1.32	1.75
GUILEY		2.32	

MIDDLE/CARR	2.53	3.29	1.69
MT. JUNE			
N. ANTHONY	1.39	0.98	1.77
RATTLESNAKE			
S. ANTHONY		2.31	0.63
S. DEXTER			4.34
UPPER LOST		1.51	1.73
WAGNER	1.29		1.28
TOTALS:	**6.76**	**11.73**	**14.01**

Table 40. Miles of Low, Moderate, and High Sensitivity to Disturbance

STREAM ORDER	TOTAL MILEAGE IN WATERSHED	% OF WATERSHED TOTAL
1	149.22	55.2
2	54.94	20.3
3	37.97	14.1
4	13.12	4.8
5	6.89	2.6
6	7.99	3.0
TOTALS:	270.13	100

Table 41. Percent of Stream Order Present in the Lost Creek Watershed

Fish Habitat

In addition to the 1938 survey, habitat surveys were performed by the BLM (1991). These surveys, however, only covered short sections of stream flowing through lands administered by the BLM. Segments of Lost Creek, Anthony Creek, West Fork Anthony Creek, and Middle Creek were included.

More recent and more comprehensive surveys were performed in 1993 under the Oregon Forest Industries Council, Aquatic Inventory Project (Crook, 1994). These surveys were conducted according to ODFW's Aquatic Inventory Methodology (Moore, et. al., 1993) and included Anthony Creek, West Fork Anthony Creek, Carr Creek, and Wagner Creek. The only other fish habitat inventory known to have taken place in the watershed was performed by ODFW in 1995. ODFW used their own protocol to survey the lower 4.6 miles of Lost Creek. The most recent and comprehensive surveys will be used to assess the current condition of fish habitat (habitat summaries for each surveyed stream are included in Appendix E).

Stream survey data consistently suggests several deficiencies in habitat conditions within the Lost Creek watershed. The primary deficiencies common to most surveyed reaches include:

1) Low pool frequency (pools/mile);
2) Poor width to depth ratios;
3) Low frequency of small and large LWD instream;
4) Low LWD recruitment potential; and
5) Lack of instream cover complexity.

Table 42 compares guidelines established under PACFISH with streams surveyed in the Lost Creek watershed.

SURVEYED STREAM	REACH	POOL FREQUENCY * (varies w/ stream width)		PACFISH STANDARDS			
		ACTUAL # PER MILE	PACFISH STANDARD	WATER TEMP <68 F	LARGE WOODY DEBRIS >80 pieces/mile	BANK STABILIT Y >80% Stable	WIDTH: DEPTH <10:1
Anthony	1	25	56	64	38	79	28
Anthony	2	19	56	62	52	87	45
Anthony	3	4	96	62	153	89	20
Carr	1	25	96	58	27	87	21
Carr	2	26	96	54	134	76	17
Carr	3	12	96	56	204	95	14
Carr	4	5	96	56	302	98	17
Lost	1	13	47	50	20	60	33
Lost	7-9	69	96	54	23	30	19
Middle	1-2	65	96	58	5	50	20

SURVEYED STREAM	REACH	POOL FREQUENCY * (varies w/ stream width)		PACFISH STANDARDS			
		ACTUAL # PER MILE	PACFISH STANDARD	WATER TEMP <68 F	LARGE WOODY DEBRIS >80 pieces/mile	BANK STABILITY >80% Stable	WIDTH: DEPTH <10:1
West Fork Anthony	2	14	96	54	81	96	46
West Fork Anthony	3	5	96	58	203	99	44
Wagner	1	23	96	68	14	48	8
Wagner	2	6	96	56	105	91	13

* Pool Frequency from PACFISH: Wetted Width (ft.): 10 20 25 50 75
#Pools/Mile: 96 56 47 26 23

** Note: Min. size LWD under PACFISH is 24" diameter x 50' long. Except for Lost Ck. Reachers 7-9 and Middle Ck. Reaches 1 through 2 (BLM Survey Results), numbers shown were based on min. size class for ODFW survey (approx. 6 " diameter x 10' long).

Table 42. Current Habitat vs. PACFISH Guidelines (USDA and USDI, 1994a)

Pool Frequency

The PACFISH guideline for pool frequency is intended to vary with the wetted width of the stream. Frequency ranges from 96 pools/mile (10-foot-wide stream) to 9 pools/mile (200-foot-wide stream). None of the stream reaches surveyed in the Lost Creek watershed met their respective PACFISH guideline for pool frequency (see Table 42).

Trends. The only known historical stream survey data available for comparison with recent surveys exists for the lower 7.5 miles of Lost Creek (BOF, 1938). The 1938 survey was comprised of two reaches. The first reach was 2 miles long and had a frequency of 22.5 pools/mile, while the second reach was 5.5 miles and had a frequency of 20.7 pools/mile. The average pool frequency for the 1938 survey was 21.2 pools/mile (McIntosh, et. al, 1995). Only 4.6 miles of Lost Creek was surveyed in the 1996 ODFW stream survey (ODFW, 1996), but pool frequency was lower at only 13 pools/mile. Caution must be used in data interpretation due to potential for a large range of natural variability and sampling error. This analysis suggests a decrease in pool frequency over time.

Width:Depth

The PACFISH guideline set for width-to-depth ratio is > 10:1. Only one of the stream reaches surveyed in the Lost Creek watershed met the respective PACFISH guideline for width:depth (Table 42).

Trends. Comparison of chronological habitat or channel morphology surveys provides the best indicator of trends in width-to-depth ratio. Due to the limited amount of stream survey data available in the Lost Creek watershed, no trend is suggested.

Large Woody Debris

The streams surveyed in the Lost Creek watershed revealed a shortage of LWD throughout the majority of the basin. Although this was only a subsample of streams, the frequency likely represents LWD distribution throughout the basin. Most survey reaches show significantly less than the 80 pieces of LWD/mile established as a PACFISH guideline (Table 42).

The number of pieces/mile counted during the 1993 stream ODFW surveys (reflecting current condition) greatly exaggerates the number of pieces of LWD/mile in comparison to PACFISH guidelines (24" diameter and 50 feet long). The ODFW stream survey methodology counts all pieces of LWD with over 6-inch diameter and 6-foot length.

Survey data was used to assess current in-channel LWD. A model was developed (Appendix E) to assess LWD recruitment potential. Stand composition, density, age class, and influence zone width were considered. Approximately 3,764 acres (88%) of the riparian zone had low potential, 367 acres (9%) had moderate potential, and 138 acres (3%) had high potential for LWD recruitment (see LWD Recruitment Map). Figure 15 summarizes the recruitment class potential by subwatershed. Regions of high potential for LWD recruitment were scattered throughout the watershed, with the majority located in the Buckhorn, Mt. June, South Anthony, East, and Upper Lost subwatersheds.

Trends. The reference condition for vegetation suggest the watershed was composed primarily of mature/late-seral stage coniferous forests. This would have provided a high potential for LWD recruitment. Current conditions suggest a predominantly low potential for LWD recruitment.

Habitat Complexity

Habitat in the Lost Creek watershed is dominated by low-gradient riffle, cascade, and straight scour pools. These habitats often lack the depth and complexity required for salmonids for overwintering or periods of low flow. Substrate, undercut banks, overhanging vegetation and turbulence all play a role in the complexity of fish habitat. Pool depth, pool frequency, and the number of pieces of LWD, however, are three of the most important components in complex habitat; all of these apparently are lacking in the Lost Creek watershed.

Trends. Trends in habitat complexity cannot be interpreted directly from the chronological habitat survey data. Since pool frequency and LWD are primary

Figure 15

components of describing habitat complexity and their trend has not been improving, however, it was inferred that habitat complexity has likewise not improved.

Fish Presence and Distribution

Including the Rattlesnake Butte subwatershed, the Lost Creek watershed encompasses approximately 270 miles of stream. Of this, approximately 48 miles (18%) are thought to be fish bearing.

The Lost Creek watershed supports both resident and anadromous fish species. Anadromous fish potentially using the basin include spring chinook salmon (*Oncorhynchus tshawytscha*) and summer/winter steelhead (*Oncorhynchus mykiss*). No fall chinook salmon are thought to use the Lost Creek basin (M. Wade, personal comm., 1996).

Resident fish species found in the basin include cutthroat trout, rainbow trout, speckled dace (*Rhinycthys osculus*), Western brook lamprey (*Lampetra richardsoni*), and various sculpin species (*Cottus spp.*). Cutthroat trout are widely distributed throughout the basin, and can be found in most streams capable of supporting fish (see Fish Distribution map). Rainbow trout are not as widespread as cutthroat trout and can be found in some of the larger, moderate-gradient streams (<6% gradient). Populations of mountain whitefish (*Prosopium williamsoni*) and Oregon chub historically inhabited the Lost Creek basin, but have not been found in recent fish sampling surveys. Bull trout (*Salvelinus confluentus*) also were native to the Middle Fork Willamette basin, but no record of their presence or use of the Lost Creek (current or historical) watershed exists.

Little fish presence or fish population data exists for the Lost Creek watershed. ODFW performed a juvenile fish population survey in Anthony Creek and Lost Creek in 1989, while the BLM performed an electrofishing survey on Middle Creek, Anthony Creek, and Lost Creek in 1991. No additional fish sampling data was known to be available at the time of this report. Due to the lack of information, the BLM recommended a potential fish distribution model (see Table 43) (Armantrout, 1995). This model was used to predict salmonid distributions throughout the watershed. Where available, distribution ranges were fine tuned with stream survey and fish population data.

SPECIES	STREAM ORDER	GRADIENT (%)	DRAINAGE AREA (Acres)
Cutthroat Trout	2	< 17	142
Steelhead Trout	2	< 6	236
Chinook Salmon	4	< 3	1,892

Table 43. Potential Fish Distribution Model for Salmonids (Armantrout 1995)

The Oregon Rivers Information System (ORIS), developed by ODFW and the Bonneville Power Administration, also was queried to provide additional documentation of potential fish distributions in the basin (Forsberg, 1994). ORIS fish population information was available for all named tributaries in the Lost Creek watershed.

<u>Chinook Salmon (*Oncorhynchus tshawytscha*)</u>**.** Spring chinook salmon are native to the Middle Fork Willamette basin. The basin may have historically supported the largest run of spring chinook of any Willamette subbasin above Willamette Falls (approximately 20% of the run passing the falls). Spring chinook hatchery stock have been released into the basin since 1919. The stocks were originally implemented to increase the run for commercial and sport fishing in the Willamette River basin. Today, the run is comprised mostly of hatchery stock; wild stocks are believed to be extinct in the basin. Fall chinook are not native to the Middle Fork Willamette River basin and are considered absent from it except for occasional strays from releases elsewhere in the Willamette basin (ODFW, 1992b).

<u>Current Status in Lost Creek Watershed</u>**.** Chinook salmon are most likely to be found in larger streams and river systems. Favorable chinook habitat typically is comprised of streams that are fourth order or larger, with low gradients (< 3%) and drainage areas > 1900 acres (Armantrout, 1995). Based on this model, potential chinook distribution in the Lost Creek watershed likely would be limited to mainstem Lost Creek and lower Anthony Creek.

The model predicts that the potential chinook distribution in Lost Creek extends from the mouth to Guiley Creek (approximately 9 miles)(see Fish Distribution Map). Distribution in ORIS differs slightly, ranging from the mouth to Gosage Creek (approximately 8 miles) (Forsberg, 1994). The model also predicts that the lower 1.8 miles of Anthony Creek also may provide suitable chinook salmon habitat. ORIS does not list Dexter Creek as an anadromous stream.

Neither Lost Creek mainstem nor Anthony Creek appear to have much suitable habitat for chinook salmon. Chinook prefer diverse, deep pool habitat with abundant woody debris or undercut banks for cover. Although pools in Lost Creek are relatively deep (83% > 3 feet deep) the habitat complexity is deficient. The lack of complexity can most likely be attributed to a shortage of large woody debris instream (20 pieces/mile in Lost Creek).

Should chinook spawn successfully in Lost Creek, limited surface flow (diversions) and high summer water temperatures (occasionally > 70E F)(Forsberg, 1994) could affect rearing habitat and, consequently, juvenile survival. A similar lack of habitat complexity also is found in mainstem Anthony Creek. Very few pieces of LWD (38 pieces/mile in Anthony Creek., Reach 1) is present and the pools are significantly shallower (average maximum depth of 2 feet) than those on Lost Creek.

No chinook were found in ODFW's *1989 Juvenile Fish Population Survey of Anthony or Lost Creek*. Similarly, no chinook were found in either stream in the BLM's 1991 electrofishing survey.

<u>Rainbow/Steelhead Trout (*Oncorhynchus mykiss*</u>. Rainbow trout are native to the Middle Fork Willamette basin, occurring in the larger streams of the basin; however, steelhead are not native to the basin. Winter

steelhead were first introduced in 1953, while summer steelhead were not introduced until 1981 (ODFW, 1992b).

Current Status in Lost Creek Watershed. Rainbow/steelhead are most likely to be found in the larger streams of the basin. Favorable rainbow/steelhead habitat typically is comprised of second order or larger streams, with low to moderate gradients (<7%) and drainage areas > 235 acres (Armantrout, 1995). Based on this model, rainbow/steelhead potentially are found in the Lost Creek mainstem and the lower reaches of each of the larger named tributaries (see Fish Distribution Map).

The BLM model predicts that the potential rainbow/steelhead distribution in Lost Creek extends from the mouth to the crossing of BLM road 20-1-10.3 (approximately 12½ miles). It also predicts that the lower segments of Wagner Creek, Anthony Creek, Middle Creek, Carr Creek, Gosage Creek, and Guiley Creek, and lower reaches of other unnamed tributaries may provide suitable habitat for rainbow/steelhead (an additional 8.5 miles).

Distribution in ORIS differs slightly, with winter steelhead ranging from the mouth up to Gosage Creek (approximately 8 miles). ORIS does not list any of the Lost Creek tributaries as anadromous fish bearing streams (Forsberg, 1994).

Seasonal problems associated with low flow and high water temperature may affect juvenile rearing and survival in the Lost Creek watershed. The lack of habitat complexity also may be a limiting factor for rainbow/steelhead in the watershed. Except for these problems, the Lost Creek watershed seems to provide fair habitat for rainbow and/or steelhead trout. Habitat in the basin is dominated by fast-water streams with a high proportion of riffles to pools, a situation suitable for rainbow/steelhead trout.

In ODFW's *1989 Juvenile Fish Population Survey*, pre-smolt steelhead were found in both Lost Creek and Anthony Creek. Rainbow/steelhead also were confirmed present in Lost Creek, Anthony Creek, and Middle Creek during the BLM's 1991 electrofishing survey.

Cutthroat Trout (*Oncorhynchus clarki*). Cutthroat trout are native to the Middle Fork Willamette basin. They are widely distributed throughout the basin and can be found in most streams capable of supporting fish. Nearly 40,000 non-native fingerling cutthroat trout were released below Dexter Dam in 1985, likely influencing cutthroat trout populations in the Lost Creek watershed (ODFW, 1992b).

Current Status in Lost Creek Watershed. Cutthroat trout are widespread in the Lost Creek watershed, with distribution ranging from the Lost Creek mainstem to small, unnamed second order tributaries (approximately 48 miles, 18% of the watershed). Favorable cutthroat trout habitat typically is comprised of second order or larger streams, with moderate to steep gradients (<17%) and drainage areas > 142 acres (Armantrout, 1995). Based on this model, cutthroat trout distribution likely would range from the Lost Creek mainstem to virtually all Lost Creek tributaries (see Fish Distribution Map).

The model predicts that the potential cutthroat trout distribution in the Lost Creek mainstem extends approximately 13.25 miles upstream. ORIS identifies cutthroat trout as being the primary species present in all named tributaries of the watershed (Forsberg, 1994). Based on the model used by the BLM, significant portions of Wagner Creek, Anthony Creek, Middle Creek, Carr Creek, Gosage Creek, and Guiley Creek, and lower to middle reaches of other unnamed tributaries provide potential suitable habitat for cutthroat trout.

In ODFW's *1989 Juvenile Fish Population Survey*, cutthroat trout were found in Lost Creek, Gosage Creek, and Anthony Creek. The BLM's 1991 electrofishing survey also found cutthroat trout in Lost Creek, Anthony Creek, and Middle Creek.

Oregon Chub - (*Oregonichthys crameri*). The Oregon chub is endemic to the Willamette River basin (ODFW, 1992b). This species currently is listed as endangered under the Endangered Species Act of 1973. The species was listed as endangered in 1993 (USDI, 1993). The current distribution of the Oregon chub is mostly confined to a 15-mile stretch of the Middle Fork Willamette River (Marshall, 1996).

Current Status in Lost Creek Watershed**.** Although the 1938 stream survey report listed the Oregon chub as abundant in the Lost Creek mainstem, no current populations are known to exist in the basin. No Oregon chub were found during a sampling visit in 1991 (Paul Scheerer, Fisheries Biologist and Oregon chub specialist for ODFW). Mr. Scheerer spot sampled via seine and dip-net, with sampling extending from the mouth of Lost Creek to its confluence with Wagner Creek (approximately 4.5 miles). His preliminary observations found that Lost Creek did not provide suitable habitat for Oregon chub. Although not found in Lost Creek, Oregon chub were found nearby in a Middle Fork Willamette slough immediately east of Lost Creek (Elijah Bristow State Park). They also were found in the lower reaches of Rattlesnake Creek (Scheerer, personal comm., 1996), the headwaters of which have been included in this watershed analysis.

Life histories and habitat preferences for each of the above-listed species can be found in Appendix E.

Riparian Reserves

One of the four components of the Aquatic Conservation Strategy is Riparian Reserves. Riparian Reserves are delineated through Watershed Analysis (another component of the Aquatic Conservation Strategy). Riparian Reserves are portions of watersheds where riparian-dependent resources receive primary emphasis and where special standards and guidelines apply. Through the Lost Creek Watershed Analysis, critical hillslope, riparian, and channel processes have been identified. These processes are the foundation from which Riparian Reserve width recommendations are made.

Riparian Reserve mapping for the Lost Creek Watershed Analysis used site-potential tree height widths. A site-potential tree height is the average maximum height of the tallest dominant trees ($200 years old). Site potential tree height was determined to be approximately 210 feet within the Lost Creek watershed.

Riparian Reserve boundary recommendation for first and second order streams were set at 210 feet and 410 feet (slope distance), respectively. Riparian Reserves encompass 6,433 acres of BLM lands within the watershed (1996 Vegetation Age Class Map). This equates to 47% of BLM-managed lands or 18% of the entire watershed.

These prescribed widths for Riparian Reserves apply to the Lost Creek watershed until further refinement through site-specific analysis is conducted and described, and the rationale for final Riparian Reserve boundaries is presented through the appropriate National Environmental Policy Act (NEPA) decision-making process.

Table 44 displays the number of acres by age class contained within the interim Riparian Reserve designation for the Lost Creek watershed.

SUBWATERSHED	AGE CLASS (Years)					
	0-40	40-80	80-200	200+	Non-resource	Grand Total
Buckhorn	467.11	216.16	6.15	87.4	0.00	776.82
East Lost	227.92	97.01	54.95	134.57	0.42	514.87
Gosage	134.75	441.36	91.24	8.12	0.00	675.47
Cuiley	134.87	811.42	40.43	4.28	0.00	991.00
Middle/carr	269.06	432.56	34.11	2.00	0.61	738.34
Mt. June	588.13	4.39	149.78	40.30	0.00	782.60
North Anthony	74.91	165.47	0.00	0.00	0.00	240.38
Rattlesnake Butte	50.60	81.81	0.00	1.96	0.00	134.37
South Anthony	146.65	232.43	1.96	25.14	0.00	406.18
Upper Lost Creek	650.77	124.65	151.23	130.11	1.81	1,058.57
Wagner	59.00	51.97	3.46	0.00	0.00	114.43
GRAND TOTAL	**2,803.77**	**2,659.20**	**533.31**	**433.88**	**2.84**	**6,433.03**

Table 44. Acres by Age Class and by Subwatershed Contained within the Interim Riparian Reserve Designation

4.0 SYNTHESIS AND RECOMMENDATIONS - STEPS 5 AND 6

Step 5 of the watershed analysis is an attempt to explain how physical and anthropogenic processes may have contributed to changes observed in the Lost Creek watershed over time. The process synthesizes and interprets, using an interdisciplinary approach, data gathered during the previous four steps. Current and reference conditions are compared for key ecosystem elements, identifying significant changes, causes (natural or anthropogenic), and trends.

Step 6 brings the results of the previous steps to conclusion by focusing on management recommendations that respond to watershed processes previously identified. Enhancement opportunities, monitoring, and research studies that respond to issues and key questions are suggested. Data gaps and limitations of the analysis also are addressed.

4.1 Dominant Processes Affecting the Watershed at the Landscape Level

During preparation of Steps 1 through 4 of the watershed analysis, it became evident that several processes were responsible for the majority of changes that have affected the watershed on a landscape level. Due to the complexity of ecosystems, it is unlikely all processes involved in forming the watershed's current condition have been identified. These processes, both natural and anthropogenic, are described briefly below.

4.1.1 Fire

Historically, infrequent wildfires consumed hundreds of thousands of acres in the Pacific Northwest. Fire is a natural process that has the potential for shaping entire landscapes. Depending on the intensity of the fire, stands are either entirely or partially replaced. The resulting stand complexity depends on the extent and intensity of the fire. Pockets of unburned stands often are interspersed throughout the landscape after a low-intensity fire, but not after a high-intensity fire. High-intensity fires often created single-age stand structure with little diversity. Wildfires usually are suppressed under current forest management, thus decreasing the likelihood of significant future impacts on the watershed from this process.

4.1.2 Timber Management/Harvest

Timber harvest has occurred in the Lost Creek watershed since the late 1800s. Early harvest probably was focused on removal of large individual conifers. Today management has shifted to larger cutting units, which concentrate on cutting stands from surrounding hillslopes. Slow-growing, older conifer stands have been replaced with fast- growing, younger conifers. A watershed that historically was dominated by old-growth is now dominated by second-growth timber. Timber harvest can effect the hydrologic response of a watershed by vegetation removal. Harvest of mature or old-growth conifers in riparian areas reduces the potential for future large woody debris (LWD) recruitment to the stream system. This can have long-lasting, detrimental effects on channel morphology and fish habitat.

4.1.3 Roading

Road building is an anthropogenic process directly related to timber management activities. Roads can affect the landscape by increasing erosion and sediment loading, altering channel morphology, and changing runoff patterns (Furniss, et al., 1991). Increased sediment loads often have negative impacts on aquatic biota and their habitat.

Roads often affect fish and wildlife directly, affecting migration patterns of wildlife (such as elk and mollusks), while also forming migration barriers at site specific locations (fish - impassable culverts). By increasing access to the landscape, roads directly increase effects on a watershed's forest resources (such as hunting and mushroom picking).

4.1.4 Non-timber (Agricultural and Rural/Residential)

Agricultural and rural/residential development plays a significant role in formation of the watershed landscape. Low-lying forest and oak savannahs were cleared in the Lost Creek watershed for fields, pasture, and housing. Natural vegetation was replaced with grass and ornamental trees and shrubs. Stream channel characteristics often change as a result of development, as residents channelize and attempt to prevent flooding.

4.2 HUMAN USES

Recreation, landscape aesthetics, and public access issues are interrelated and should be understood as a whole. The dominant causal mechanisms linking these three issues are timber harvesting and associated road construction on both BLM and private lands.

4.2.1 Recreation

During the early settlement days, recreation opportunities in the watershed were typical of primitive and semi-primitive landscapes. There were few trails and no roads. Early recreation activities probably included hunting and fishing.

As time passed, both logging and road development reached higher into the watershed. Early recreationists probably followed the transportation systems as they became available. Today, most recreation activity is focused on or near the road system. The experience has slowly changed from the primitive (finding one's way in trailess backcountry), to following skid-trails on foot, to driving four-wheel-drive vehicle along roads. The users' recreation goals, however, remain mostly unchanged: hunting, hiking, fishing, and simply going to the woods where there are few restrictions.

Three trails that receive moderate use are located in the Lost Creek watershed, but it does not contain outstanding recreation attractions that claim public attention and become points of destination. The Lost Creek watershed, however, has a nearby population of 224,000 people that is estimated to grow to 300,000 by the year 2015. This population has a strong environmental concern and an interest in physical fitness. A greater level of all current recreation activities, therefore, can be expected.

Recommendations

Continue to manage the Lost Creek watershed for dispersed recreation activities focused primarily on the existing road system. Recognize the area's potential to provide close-at-hand "day-use" opportunities for the Eugene/Springfield population to enjoy the out-of-doors. Manage recreation activities on the majority of BLM lands to Roaded Modified Standards (ROS).

Form a joint BLM/Forest Service team to evaluate and administer shared recreation objectives, opportunities, and facilities in the Eagles Rest, upper Lost Creek, Hardesty Mountain, and Mount June areas.

Search for common ground with industrial forest landowners for acceptable recreation uses of the road systems currently closed to public entry. An example would be public hiking on gated roads that currently are not used for log hauling. Include public user groups and industrial forest owners in development of an annual site-specific Transportation/Access Management Plan for the watershed. This plan should link the recreation needs of Eugene/Springfield and local communities, Resource Management Plan, and the objectives for management of the industrial forest lands within the watershed.

Prepare for possible inclusion of the Lost Creek/Eagles Rest Road Loop as a Back Country Byway in the National Scenic Byway System. Manage recreation resources around the loop to the Roaded Natural Standards (ROS). Alternatively, amend page 81 of the Resource Management Plan to exclude the proposal.

4.2.2 Landscape Aesthetics

Prior to human activity, the visual landscape was controlled by fire, wind, and natural succession. The landscape had more variety in the structure of individual stands. Old-growth stands containing large trees, numerous snags, more broken trees, and multiple canopies dominated the landscape.

Settlement of the area altered the landscape in the lower valley as oak savannahs and stands of conifers were replaced with farms, homes, roads, sawmills, schools, a church, a flume, splash dams, and other signs of civilization. As time passed, the lower valley slowly changed into a "rural American" landscape in the lowlands containing scattered homes blending with stream, pasture, and woodlot. This local landscape character has become the acceptable norm to most residents (Slusher, 1997).

In the middle and upper portions of the watershed, the landscape on BLM and industrial forest lands also has been greatly altered by past logging. Individual young trees that quickly filled the logged areas appear much more uniform in size, color, and texture. The large tree character is gone from all but a few scattered patches. The young stands are visually quite closed, and it is difficult to see into or through them to more distant vistas.

Implementation of the Aquatic Conservation Strategy and all Land Use Allocations and Resource Programs will slowly change the broad expanses of single-age class stands and provide more landscape diversity.

Entry of roads into the area has been accompanied by illegal dumping at landings and lower standard roads. Littering from target shooting is a growing problem at most rock source and gravel storage areas.

The *1995 Eugene District Resource Management Plan's* visual resource objectives place 1% of BLM land in the VRM Class III (partially retain) and the remainder in Class IV (major modification). Lost Creek has been proposed as a Back Country Byway under the National Scenic Byway System.

The number of people who will visit and view the area will increase as the population of Lane County increases. The number of residents in the Lost Creek Rural Interface Area may increase slightly.

Recommendations

Consider modifying timber management activities, as viewed from the Eagles Rest/Lost Creek Road Loop to: (1) meet Partial Retention Visual Quality Objectives in the foreground viewing areas, and (2) meet the Modification Visual Quality Objective in the middle ground.

Consider opening view points along the Eagles Rest/Lost Creek Loop through thinnings, pruning, and other stand tending opportunities. This may help to relieve extensive human use of Eagles Rest, a prime view point and a unique habitat area within the watershed.

4.2.3 Public Access

Prior to development of the valley, the public had adequate access to both public and private lands. At first, there were just a few trails and skid roads providing little reason for anyone to be excluded. As the road systems in the watershed continued to expand and public use of the roads increased, public access to all lands resulted in difficulties. Concerns about vandalism to property and equipment, dumping, liability, litigation, and privacy have resulted in several roads being gated where they enter private land.

Public access generally is not available to half of the BLM land in the watershed. Gates usually are open weekends during the hunting season. Gates serve some beneficial purposes such as protecting wildlife, reducing erosion from roads, and preventing some illegal activities.

Public BLM lands in the watershed cannot be easily distinguished from private lands.

Recommendations

Begin a series of discussions with industrial forest land owners concerning their needs for resource production and the public's desire for access. Consider use of a neutral third party to aid in the discussions. (see Recreation, above)

Begin a program of clearly identifying BLM and private land ownership at road and trail entry and exit points.

Manage illegal dumping and litter by aggressive cleanup measures, increased law enforcement presence after 5 p.m. and on weekends, and public information.

Include possible road closures to dumping areas in the Transportation/Access Management Plan.

4.2.4 Forest Products

The forest always has been used for the small products it produces. The watershed has almost completely been converted from an old-growth forest into young, rapidly growing, second-growth stands. The effect of this conversion on availability of miscellaneous forest products is not fully known. Each seral stage has a mixed set of products. The current number of permits being issued does not seem excessive.

A considerable volume of timber has been harvested from BLM lands, in the past, with some additional harvest scheduled. As the result of past timber management practices, much of the watershed does not meet the *1995 Eugene District Resource Management Plan's* standards and guidelines for Riparian Reserves, Matrix-General Forest, and Matrix-Connectivity/Diversity Blocks. Future silvicultural practices may be used to enhance current conditions and meet standards in a more timely fashion. Opportunities recommended in the following discussions are intended to move the watershed towards compliance with the Resource Management Plan, including the Aquatic Conservation Strategy Objectives.

Recommendations

Rotate location of permits for species such as mushrooms and moss until sufficient information is available about these plant's contribution to the environment.

4.3 Physical Characteristics

4.3.1 Hydrology

Changes in hydrologic processes can be grouped into two classes of causal mechanisms: removal of forest cover, and alterations to the surface and subsurface infiltration and water flow routes. Natural disturbances, such as fire, and management-related disturbances, such as timber harvest, remove vegetation. The effects on hydrology from natural or management-related causes, in part, depend on the physical characteristics of the watershed, the location of vegetation removal in the watershed, and the quantity and distribution of devegetated areas within the watershed.

Processes that depend on the amount and size of forest vegetation include rain or snow interception, fog drip, transpiration, snow accumulation, and snow melt. These processes, most of which are energy-dependent, all increase the amount or timing of water arriving at the soil surface and the resultant amount of water flowing from a logged watershed. In general, these changes in the hydrologic process tend to diminish in 30 or 40 years following logging and are related to vegetation characteristics such as tree height, leaf area, canopy density, and canopy closure.

In most forested areas, removal of trees through logging or wildfire greatly reduces evapotranspiration and causes an increase in annual water yield. Harr (1983) estimated initial increases in annual water yield as high as 20-acre-inches for watersheds in the western slopes of the Cascades. Clear-cut harvesting and wildfire often cause an increase in summer low flows for several years (Helvey, 1973). The effects of clear-cut harvesting on peak flows is still being debated. For example, most research in the Pacific Northwest indicates that harvesting trees probably does not affect the magnitude of peakflows (Brown, 1972). Due to a lack of data for the Lost Creek watershed, however, the impacts of logging on peakflows is unknown. In watersheds between 20 and 200 square miles, increased peak flows have been detected after road building and clear cutting occurred (Christner and Harr, 1982). Whether such increases are caused by soil compaction during logging, or altered snowmelt rates during rain-on-snow conditions is not known. Higher flows may result from a combination of wetter, more efficient water-transporting soils following reduced evapotranspiration, increased snow accumulation and subsequent snow melt during rainfall, surface runoff from roads, and/or the extension of drainage networks as a result of roadside ditches.

The effect of fire on peak flows usually depends on changes in the physical properties that occur at the soil surface. Wildfires have the capability to alter peak flows in forested watersheds. Reduced infiltration rates as a result of formation of a hydrophobic layer can cause water to reach a channel more rapidly through overland flow. The most recent fire of significant intensity was around the early 1900s. The impacts of the fire on water quality and quantity are unknown.

A second causal mechanism that can alter the hydrologic process consists of altering soil infiltration rates and surface and subsurface flow patterns through construction of forest roads. Roads generally are impervious surfaces that can cause accelerated surface runoff and bypass longer, slower subsurface routes. The longevity of changes in the hydrologic process resulting from forest roads is as permanent as the road. Until the road is removed and natural drainage patterns restored, the road likely will continue to affect the routing of water through the watershed. The effects of roads on peakflows in the Lost Creek watershed is not known, however, the extensive road network likely is altering hydrologic responses to some degree.

Recommendations

The capability of the BLM to significantly affect hydrologic responses with timber harvest may be minimal due to their limited ownership in the watershed. Restoration efforts, therefore, should focus on improving the diversity of channel morphology (and fish habitat) and improving the vegetation structure of Riparian Reserves downstream. These opportunities are discussed in more detail in the following sections. Restoration efforts focused on improving road drainage and road decommissioning may reduce the potential impacts on hydrologic responses due to roads.

Due to a data gap regarding stream flow for the Lost Creek watershed, it is difficult to confirm anecdotal information suggesting the Lost Creek mainstem runs dry toward the late summer and early fall. As discussed later in the Aquatic Habitat recommendations, it is suggested that instream flows be monitored on the Lost Creek mainstem to determine if water flow or lack of flow may be a limiting factor to salmonids in the watershed. Installation of a gaging station would best provide this information, but also would be expensive and potentially cost prohibitive. Should budget constraints prohibit a gaging station, a series of cross-sectional discharge (flow meter) measurements with reference to the Winberry Creek gage may provide the necessary information at less expense.

4.3.2 Water Quality

Because of limited data, it is not possible to compare historical (desired) water quality conditions to current conditions; assess natural and human activities that may have affected current conditions; or address the more complex interactions between impacts, water quality, and other ecosystem processes.

Human activities in the watershed likely have caused changes in water quality conditions and affected aquatic life and fish habitat uses more than any other designated beneficial use. Issues most likely affected in the Lost Creek watershed include increased water temperature and increased levels of sedimentation. Although no quantitative data exists, qualitative descriptions and observations suggest the impacts are associated primarily with harvesting and road building activities that result in acceleration of landslides and debris torrents, road-related sediment delivery, and loss of riparian vegetation that may result in increased water temperatures. These processes and associated impacts, along with recommendations, are discussed in more detail in the Aquatic Habitat and Channel Condition section of Steps 5 and 6.

Recommendations

A data gap currently exists documenting stream temperatures in the Lost Creek watershed. As stated in Steps 3 and 4 of this document, however, information (ORIS) suggests water temperatures occasionally are in excess of 70EF in lower Lost, Anthony, and Wagner Creeks. Temperatures in this range are not suitable for salmonids, and would be considered a limiting factor for them in this watershed. It is recommended, therefore, that the BLM attempt to gather at least some baseline temperature information to determine if temperature may constitute a limiting factor to fish in the watershed. Warm water may partially explain the apparent extirpation of chinook salmon from the watershed. Continuous monitoring of summer-time stream temperatures in Lost Creek and other main tributaries (Anthony, Middle, Gosage, and Guiley Creeks) crossing BLM lands is recommended. Portable temperature recorders are suggested for this process, representing a relatively cheap approach that has the capacity to repeatedly monitor minimum and maximum temperatures throughout a season.

4.3.3 Erosion Processes and Sediment Delivery

Water is the primary mechanism for transporting substances within and from forested lands. The processes of precipitation, interception by plant surfaces, transpiration, infiltration of water into the soil, and stream runoff are common to all forests. The magnitude and relative importance of processes varies considerably, however, between forest types. Furthermore, management practices can alter these processes, which then produce changes in soil and water characteristics.

Sedimentation involves detachment, transport, and deposition of particles by this flowing water. The "natural" or "background" sediment rate varies dramatically depending on the geology, soil erodibility, land form, vegetation, and local hydrology and climate. The background sediment rate for the Lost Creek watershed was estimated at approximately 39 tons/square mile/year (based on creep rate). This estimate is a relative index generated for comparison to road-related sedimentation and should not be considered absolute. The inherent variability in natural systems makes it difficult to isolate a background sedimentation rate due to the difference in geology, soils, vegetation, and climate of different geographic areas.

Forest management activities associated with timber harvesting can affect the physical, chemical, and biological properties of the soil. If these activities increase soil erosion, then water quality may decrease through stream sedimentation, with an accompanying loss of long-term site and stream productivity (Swank, et al., 1989). The type and magnitude of erosion depends on the amount of soil exposed by management practices, the kind of soil, steepness of the slope, weather conditions, and treatments following disturbance, such as broadcast burning. It can be inferred, however, that under undisturbed forest conditions, surface erosion is quite low because enough material is on the forest floor to protect the soil surface. Soil permeability and strength normally is high and little or no overland flow occurs.

Any management activity that exposes and/or compacts the soil and reduces infiltration can concentrate surface runoff, thereby accelerating erosion. The act of felling trees seldom causes erosion, although some soil compaction and surface gouging may occur during the operation (Swank, et al., 1989). In contrast, road building, skidding and stacking logs, and some site preparation activities can produce major soil surface disturbance that greatly increases erosion on a site.

Soil disturbance is more related to type of logging operation than to silvicultural system in the Pacific coast region. Brown and Krygier (1971) showed that clear-cut logging may produce little or no change in sediment concentrations in small streams in comparison with road construction. Beschta (1978) reported a five-fold increase the first year after logging and slash burning in the Oregon Coast Range. An analysis to determine the quantity of fine sediment (relative to background) being contributed by logging operations (excluding roads) in the Lost Creek watershed was not conducted. Instead, the analysis focused on surface erosion potential based on inherent characteristics of soils and topography (Surface Erosion Hazard Map). Given that logging operations have occurred for nearly a century, sediment yield in the Lost Creek watershed likely is greater than would be expected under undisturbed forest conditions.

Substantial increases in sediment yields have been noted on watersheds during and following construction of forest roads. Beschta (1978) and Brown (1971) found that mid-slope roads in steep terrain were the leading factor of increased sediment production in the Oregon Coast Range. Erosion rates on roads and landings in southwestern Oregon were 100 times those on undisturbed areas, while erosion on harvested areas was seven times that of undisturbed sites (Swank, et al,. 1989). The road network in the Lost Creek watershed (216 miles) is undoubtedly contributing to increases in sediment yield.

The relative road-related sediment increases estimated for the Lost Creek watershed range from 1.4- to 12.0-fold above the estimated background rate (Step 3, Figure 8). As previously stated, these estimates are an index and should not be considered absolute. Gosage, Guiley, Middle/Carr, and South Anthony subwatersheds are estimated to contribute the largest increases in road-related sediment yield in the watershed. This analysis attributes gravel, active, mainline roads as the primary source of road-related sedimentation in the watershed for several reasons: these roads are identified in the analysis as receiving the greatest level of use in the watershed; and they likely are the oldest roads in the watershed and lack sufficient drainage relief and maintenance. For example, 86% of the estimated road-related sediment yield is being produced by 30% of the road miles in the South Anthony subwatershed. Overall, 59% of the estimated road-related sediment yield is being produced by 8% of the road miles (17 miles of gravel, active Mainline) in the Lost Creek watershed.

The effects of increased sedimentation on the aquatic environment is discussed in the Aquatic Habitat section that follows.

The two primary processes by which roads contribute sediment to stream systems are surface erosion of road prisms and transport of this material into streams (discussed above); and increased incidence of mass soil failures in a watershed (Bilby, et al., 1989). Thus, road construction can likely be expected to increase mass erosion hazards because of failures in both cut and fill slopes. This is particularly true with older roads constructed of sidecast materials. Mass erosion is most likely to occur during large rainfall and/or snow events when subsurface flows are generated in side slopes or in road cut and fill slopes (Beschta, 1978; Megahan, 1972), or when drainage features fail. A watershed, therefore, must not only have the potential for failure but also a hydrological event of sufficient magnitude before an increase in sediment production occurs (Beschta, 1978). Precipitation and runoff during the February and November 1996 events appeared sufficient to trigger several road failures and deliver sediment to Lost Creek and its tributaries.

Evidence of debris torrents and small landslides were observed in the Lost Creek watershed during road inventories (December 1996). These occurred following the November 1996 hydrologic event, and in most cases, were associated with a road. These mass wasting events were observed mainly in the headwaters of the Wagner, North Anthony, and South Anthony Creeks subwatersheds, and appear to be the result of failed drainage features (undersized culverts) with a subsequent failure of road fill. Proper forestry practices addressing drainage, road construction and maintenance, compaction of road fill, and incorporation of organic debris can reduce this type of landslide-related erosion (Swank, et al., 1989). Data was unavailable to compare sediment yield from natural (background) landslides to management-induced landslides in the watershed. The analysis focused on mass wasting hazard (potential) based on inherent characteristics and did not quantify estimates of sediment yield (Mass Wasting Hazard Map).

Road age likely contributes to the potential for sediment production from roads. The exact age of roads in the Lost Creek watershed is unknown. For purposes of sediment yield analysis, they were considered to be more than two years old (WFPB, 1995), but many likely are decades old. Past road construction practices frequently involved over-steepened cut and fill slopes (sidecast material) and lacked sufficient drainage features (ditches and relief culverts). In addition, older roads consistently have undersized culverts, increasing the potential for plugging and subsequent road washout.

If future road construction occurs in the watershed, it likely will incorporate current Best Management Practices that include, among others, end-haul construction, improved design (larger culverts), and increased frequency of drainage features. These forest practices substantially reduce the risk of mass wasting and reduce the potential for surface erosion.

Recommendations

Gravel roads have been identified as the primary source of road-related sedimentation in the Lost Creek watershed. Priority should be given to these roads when considering restoration opportunities. The sediment yield analysis (see Appendix C) includes a breakdown of erosion potential by road segments and should be used to prioritize and focus initial restoration efforts.

Efforts to reduce erosion and subsequent sediment yield should focus on stabilizing cut and fill slopes, increasing the number and maintenance frequency of ditch relief culverts to reduce delivery of sediment from cutslope ditchlines, and replacing or repairing culverts identified as erosion hazards (see Potential Culvert Problem Map).

Road decommissioning should be considered where cost-effective, erosion-control measures have been exhausted, or where Aquatic Conservation Strategy Objectives cannot be achieved through alternate means. Additional recommendations relative to sedimentation are described in the Aquatic Habitat section that follows.

4.4 BIOLOGICAL CHARACTERISTICS

4.4.1 Vegetation

Timber harvest is the primary cause of change in vegetative condition in the Lost Creek watershed. Accelerated cutting on industry lands during World War II created new stands that are now within the stem exclusion (40-80 years old) stage. Harvest on BLM-managed lands increased later, resulting in a more even distribution of the stand initiation stage (0-40 years old) and older stands, especially those within the 40- to 80-year class. Old-growth stands (> 200 years) have been eliminated from most of the watershed.

The results of these changes have both direct and indirect effects on seral patterns and other ecosystem processes within the watershed. Major considerations include management of 40- to 80-year-old stands, lack of older stands, riparian stand condition and potential, stand diversity and wildlife habitat development, and distribution of seral stages.

Management of vegetation within the Lost Creek watershed will greatly control the extent to which objectives for the area are met. Although this report focuses mostly on federal lands managed by the BLM, the interrelationships between all lands will be of great significance to each individual landowner. Management of the timber resource, including rate of cutting, location and size of harvest areas, silvicultural systems, and intermediate stand treatments, therefore, will be important on all forested areas. It will determine the extent to which objectives are met for creating desired stand conditions in mid-seral stands, developing late-seral stand conditions, improving riparian functions, developing more diverse stand conditions that provide scarce wildlife habitats, and distributing activities across the watershed.

Management of 40- to 80-Year-Old Stands

Large areas of 40- to 80-year-old stands have been created. Most of these stands are now of commercial size. Although some industrial landowners and the BLM have adopted an aggressive program of commercial thinning to reduce overstocked conditions, many of these stands have not yet been thinned.

Density management, such as commercial thinning, extends the productive years of the timber stand; in other words the physical productivity (Mean Annual Increment, or MAI) peaks later than in unthinned stands. This increases diameter growth of the remaining trees, which results in a price premium. When coupled with other intermediate stand practices such as pruning or fertilization, density management can further increase economic return. From a biological standpoint, it also can increase windfirmness, reduce mortality, and maintain stand health and vigor.

Recommendations

- C Give high priority to thinning in connectivity blocks and riparian reserves on federal lands to accelerate development of large trees and other desired conditions.

- C Increase the amount of commercial thinning on BLM Matrix lands. Where feasible, consider two thinnings to maintain stand vigor and gain additional revenue.

- C Modify silvicultural prescriptions for commercial thinning. Thin heavily to increase individual tree diameter growth response, gain greater economic return, and encourage understory response of shrubs and shade-tolerant conifers where appropriate.

- C Consider pruning and fertilization in commercially thinned stands on BLM Matrix lands to increase economic return.

Location. Highest priority areas are 40- to 80-year age classes in Riparian Reserves and Connectivity Blocks, as shown on the map: Treatment Opportunities for Late Seral Stage Stand Development. Initial treatments should be directed to stands with slopes of 30% or less, and low erosion hazard.

Timing and Relative Priority. Activities can begin at any time. This is not a sequential activity; it can be carried out concurrently with other actions. Since density management is revenue-generating, it may provide support for other improvements within the watershed.

Lack of Older Stands

Conversion of old-growth stands to young forest has resulted in a lack of late-seral conditions in the watershed. Natural stand development eventually can develop late-seral conditions, but the process takes centuries. Stand manipulation can accelerate development of stands with the desired characteristics. Recognized techniques include density management, retention or underplanting of shade-tolerant conifers, and creation of snags.

Stands in the 40- to 80-year-old age class in Connectivity Blocks and Riparian Reserves offer the best opportunities for developing areas with late-seral characteristics. Modified silvicultural techniques such as heavy density reduction, variable-density thinning, development of a multi-storied canopy, and enhancement of species diversity, should be considered.

Recommendations

Accelerate development of late-seral stand conditions in 40- to 80-year-old stands in Riparian Reserves and Connectivity Blocks by density reduction, retention or underplanting of shade-tolerant conifers, and creation of snags.

Location. See map: Treatment Opportunities for Late Seral Stage Stand Development. Approximately 3,700 acres of potential treatment area have been identified within the watershed, as shown in Table 45.

Timing and Relative Priority. Density management of these stands is a high priority and should begin as soon as possible.

Land Classification	Acres
Connectivity Blocks, Age Classes 40-80	777
Riparian Reserves, Age Classes 40-80	2,656
Riparian Reserves in Connectivity Blocks, Age Classes 40-80	274
Total	**3,705**

Table 45. Treatment opportunities for late seral stage stand development, Lost Creek watershed

Riparian Stand Condition

Many stands adjacent to fish-bearing streams are nearing the age or size classes where LWD can be produced. Individual tree growth in these areas can be increased by density management, and the rate of development of LWD can be accelerated. Without density management, some of these riparian areas will not produce the target tree sizes for decades.

Recommendations

Recommendations for development of late-seral stands should be followed. Additional silvicultural treatments include:

- Encourage growth of conifers by cutting competing hardwoods.
- Include density management of young stands where feasible. Favor fast-growing conifers in species selection.
- Release riparian conifers from competition with hardwoods.
- Where feasible, fell some LWD into important stream reaches where structure is currently lacking.
- Underplant shade-tolerant conifers in riparian gaps.
- Convert riparian hardwoods to conifer stands in appropriate areas where other alternatives are not feasible. This treatment may involve complete removal of the mature hardwood component, and should be used judiciously and only in small-patch applications.

Location. Fish-bearing reaches, lower-gradient areas.

Timing and Relative Priority. Activities can begin at any time. Characteristics of specific streams and reaches should be evaluated using existing information to determine greatest need and potential response. No specific areas have been identified in this analysis.

Stand Diversity and Wildlife Habitat Development

Current harvest practices on federal lands are retaining some mature trees as a part of the new stand. These modified regeneration harvest prescriptions increase within-stand diversity and can create habitats that are now in short supply, such as snags and other structures needed by cavity-dependent wildlife.

In application, these prescriptions often are applied with a high degree of uniformity. Reserve trees are spaced regularly across the harvest area. Harvest area boundaries form straight lines, with little transition between cut and uncut stands.

Recommendations

- Increase the use of modified silvicultural practices, such as clearcutting with reserve trees. These prescriptions currently are being used on BLM lands, consistent with the President's Forest Plan.

- Use variable spacing of reserve trees. Clump and cluster reserves. Include untreated enclaves as inclusions within the harvested area to provide aesthetic and ecological diversity.

- Use transitional stocking at the edge of the harvest area by feathering the harvest area edges to provide aesthetic and ecological diversity. Use this technique where compatible with logging systems.

- In conjunction with timber harvest, create snags in areas where trees are large enough to provide desired habitat structure.

Location. BLM stands considered for regeneration harvest, or portions of stands immediately adjacent.

Timing and Relative Priority. Activities should be included in all future timber harvests on Matrix lands.

Distribution of Seral Stages

The current distribution of seral stages is highly variable between subwatersheds (see Appendix D, current seral stages by subwatershed). In the past, seral stages were not "balanced" across the landscape; in other words, there was not an even distribution of age classes. Since disturbance regimes were driven by large-scale stand-replacement fires, one age class or seral stage was broadly represented across the entire area.

Presently, many stands are now nearing conventional rotation ages. These age classes are not evenly distributed across the subwatersheds. For example, some drainages have large expanses now ready for harvest. If these areas are logged within a short time period, there could be significant impacts on resources. These effects have not yet been analyzed at the subwatershed level.

Recommendations

- In developing timber harvest plans, consider the distribution of seral stages at both the watershed and subwatershed levels. Although a balanced distribution of age classes within subwatersheds is not necessarily an objective, the cumulative effects of accelerated harvest should be considered.

- Develop seral stand distribution objectives for subwatersheds and the Lost Creek watershed as a whole.

- Use GIS-based analysis tools, such as SNAP (Sessions and Sessions, 1994), to evaluate the effects of harvest plans and activities.

Location. Entire watershed.

Timing and Relative Priority. Determination of objectives and analysis of effects should be completed as an initial step in developing a harvest scheduling plan for the area. This should be a part of the five-year harvest plan for the Lost Creek watershed.

4.4.2 Terrestrial Wildlife

The watershed contains habitat for several species listed as threatened, endangered, Bureau sensitive, or Survey and Manage. Aside from spotted owls, there is very little biological data on other wildlife species that are either known or have the potential to occur within the watershed. This makes it difficult to understand and properly manage other resource programs in a way that is compatible with the biological resources; and for assessing the effects of ecological functions and processes.

Historically, fire was the predominant disturbance process in the Lost Creek watershed. Fires likely created a mosaic of different age class stands that provided a variety of habitat types within the watershed. These habitat types moved spatially and temporally across the watershed in an approximately 200- to 400-year cycle. Fire killed trees, creating snags and coarse woody debris within the watershed. Historic, large, stand- replacement fires, such as those documented on the 1914 Vegetation Map may have created barriers to low mobility species. Additionally, large fires may have created temporary extirpation of species from burned areas.

Intensive forest management and modern fire suppression techniques have allowed for the control of fires at their ignition point, substantially limiting natural- and anthropogenic-caused fires in the Lost Creek watershed. Stand replacement harvest rotations of 40- to 80-year intervals now occur in the place of fires. These changes have altered forest structure, ecosystem function, and wildlife habitats. As a result, fire currently plays a much smaller role in shaping the landscape within the watershed.

The changing landscape patterns resulting from land management practices of the last century have had dramatic effects on the ecology of forests in the Lost Creek watershed. The old-growth forest-dominated landscape of the early 1900s has been converted to a fragmented landscape of young forests, plantations, and agricultural fields in which less than 3% of the landscape remains in an old-growth (>200 years old) forest condition. While these isolated, remnant, old-growth patches represent a small portion of the total watershed, they are ecologically significant in functioning as refugia for a host of old-growth-associated species, particularly those with limited dispersal capabilities not able to migrate across large landscapes or younger stands.

On public lands within the Lost Creek watershed, forests outside of the administratively withdrawn areas will be predominately managed under a short-rotation (40 to 80 years) prescription. The uplands in these areas will encompass forest primarily in the early-seral stages. Vegetation structure and complexity will remain fairly simple. Wildlife species associated with early seral habitats will benefit from this management prescription.

On private commercial forest lands, it is assumed that forest rotation will be 40 to 80 years. Management of these lands will be required to meet Oregon State Forest Practices Act rules (ODF, 1995). Incorporation of these rules will provide for maintenance and creation of some late-successional stand attributes within young-seral aged stands that dominate private lands within the watershed. Private timberland likely will continue to provide little structural diversity in the form of large green trees, snags, and downed logs.

Within the watershed, Riparian Reserves, spotted owl core areas, and other administratively withdrawn areas on BLM lands will be the areas in the watershed where stands dominated by large trees will occur. Many of these areas are in a young-seral age class, which will become mature forest stands over the next 100 years. The existing older forest stands are small, generally isolated, and severely fragmented.

The portion of the Riparian Reserves in the young seral habitat condition will, within 100 years, become mature forest, providing structural and vegetation complexities and begin providing habitat for species associated with older forest conditions. These riparian areas also will be important to retention of both large- and small-diameter snags and downed logs in the later decay classes. As these reserves grow older, they will begin to compliment the existing older stands, and also provide travel corridors across the landscape for many mobile and less mobile species that exist or potentially exist in the watershed. The Riparian Reserves and spotted owl core areas will be the land use allocation by which maintenance of biological diversity and its processes (gene flow, species richness, community- and landscape-level interactions), and habitat for older forest-dependent species will be provided in the otherwise early seral forest landscape that dominates the Lost Creek watershed.

The majority of the existing late-seral stands are concentrated in the southeastern portion of the watershed along upper slopes and ridgelines. Old-growth and interior forest patches occur primarily in a patchwork of younger-seral (0 to 80 years old) stands. As a result, the old-growth and interior forest stands are isolated from one another within the watershed and to some degree from the LSR designated Forest Service lands east of the watershed. The relationship of the remaining late-successional stands with adjacent watersheds is unknown.

Many of the old-growth and interior forest stands are adjacent to, or fall at least partially within, a portion of the network of Riparian Reserves (Seral Stage Map). The Riparian Reserves will provide connectivity between several of the old-growth and interior forest stands. Due to the checker board ownership pattern within the watershed, however, the Riparian Reserve system will not provide connectivity corridors throughout the watershed for species requiring contiguous avenues of suitable habitat.

Road density in the watershed is approximately 4 miles of road per square mile. This extensive road network can serve as a conduit for introduction of exotic plant and animal species into the forest landscape. Exotic species compete with, and sometimes outcompete native flora and fauna. This is especially a problem in the few remaining old-growth and interior forest stands where interior forest species already are vulnerable to reduction in numbers.

Roads, whether gated or not, provide increased human access that could lead to wildlife poaching, or accidental or purposeful wildlife harassment, and could provide potential access for human-caused fires. Roads affect wildlife habitat by further fragmenting it particularly in remaining old-growth and interior forest habitat. Roads that bisect Riparian Reserves reduce the effectiveness of these areas as connectivity corridors and increase the amount of edge, thereby reducing value of the areas for certain wildlife species. Additionally, roads may act as barriers to less mobile species diminishing their ability to move through otherwise suitable habitat.

Management of lands within the Lost Creek watershed for agricultural and rural residential housing has resulted in long-term exclusion of forest habitat from approximately 2,650 acres of the watershed. Agriculturally managed lands may act as a barrier to less mobile species and/or a corridor for exotic species to enter the watershed. Wildlife depredation on crops and/or residential landscaping results in the removal (usually fatal) of animals from the watershed.

Domestic dogs can cause serious impacts on wildlife. Dogs prey on a wide variety of animals from big game to rodents and birds. The presence of barking dogs can result in reduced use or avoidance of an area by wildlife. Domestic cats prey on small mammals, birds, and snakes. Repeated hunting by cats in the same area can result in locally reduced populations of some small bird and mammal species.

Spotted Owls

The four spotted owl core areas located along the eastern watershed boundary have some connectivity to other habitat through either mid-seral stands within the watershed, or LSR designated lands on adjacent Forest Service lands east of the watershed. Additionally, at least all or part of these core areas contain old-growth forest stands. As a result, spotted owl could be expected to continue to occur in this portion of the watershed in the future. Unless the amount of habitat surrounding each spotted owl site is known, it cannot be determined if these sites are temporary or are suitable for continued occupancy.

The remaining four core areas occur as islands in a patchwork of younger seral (0 to 80 years old) stands. These core areas are predominantly isolated from other areas of suitable nesting habitat by several miles of younger forest. They contain little or no old-growth forest stands, and little potential for development of additional habitat in the near future. As a result, these four core areas may not continue to support spotted owls into the future.

A portion of all spotted owl core areas are incorporated into Riparian Reserves. This will allow for development of corridors of suitable habitat as stands within these administratively withdrawn areas mature. Additionally, as wider Riparian Reserves (410 feet on either side of the stream) mature, they could provide additional nest sites outside of existing core areas.

<u>Recommendations</u>

The Lost Creek watershed has few acres of late-successional and old-growth habitat. These older forest stands are highly fragmented by roads and younger age class stands. The structural diversity of forest stands across the watershed has become simplified. Snags and downed, large coarse woody debris (CWD) required by numerous wildlife species are lacking from the majority of the watershed. Recommendations for the watershed, however, focus on reducing fragmentation of the remaining old-growth and interior forest habitat, thus providing connectivity between these stands and enhancing the amount of structural diversity, snags, and course woody debris. Recommendations are as follows:

- Minimize impacts on remaining stands dominated by large trees within the watershed. Retain as many of these stands as possible to protect remnant populations of species associated with old-growth, and facilitate their recolonization of recovering habitats in Riparian Reserves, spotted owl core areas, and other administratively withdrawn areas.

- Concentrate management of old-growth-associated species in the eastern portion of the watershed. Establish a network of forest stands in addition to the Riparian Reserves that are $40 years old. This will help provide connectivity between isolated patches of interior and old-growth forest habitats located along ridgelines and upper slopes to adjacent LSR-designated lands. The following sections would be the most optimal areas to establish these connecting stands: Township 19 South, Range 1 West, Section 35; Township 20 South, Range 1 West, Sections 1, 2, 11, 12, 13, 24, and 25; and Township 20 South, Range 1 East, Sections 19, 20, 29, 30, and 31.

- Manage interior and old-growth forest stands to reduce edge effects. Avoid, where possible, harvest within or near these remnant stands, and manipulate adjacent stands to provide protection from edge effects. Decommission interior and border roads, where possible, to promote revegetation and reduce fragmentation of these stands. Concentrate closures in East Lost Creek, Upper Lost Creek, Buckham, nad Mt. June subwatersheds.

- Decommission, where possible, roads that occur within, or bisect, Riparian Reserves to promote revegetation and reduce fragmentation of these areas.

- Close and/or decommission roads in an attempt to reduce overall road density. This will improve habitat quality for wildlife species sensitive to human activity. Due to ongoing timber operations within the watershed, it is unlikely road density could be reduced to ODFW target levels.

- Close roads during hunting season. This will provide enhanced hunting quality for individuals that prefer road closure areas, and reduce potential poaching and harassment.

- Develop a watershed-wide snag creation plan. Concentrate on creating snags $15 inches dbh to meet the *1995 Eugene District RMP* (USDI, 1995) requirements for cavity nesting birds at 40% of potential population levels.

C Survey for and map special habitats and maintain, protect, and enhance these area. Fence portions of Eagles Rest that support or could potentially support Special Status Plant species (SSP). Enhance wetland areas (marshes, bogs, and ponds) to improve fish and wildlife habitat and other wetland functions.

- Control exotic species (plants and animals) that are harmful to native biota.

- Control access to areas with Special Status species (i.e., Eagles Rest, spotted owl core areas).

The following baseline surveys are recommended:

C Protocol surveys should be conducted for all Threatened, Endangered, Survey and Manage, and Bureau Sensitive species identified in the Wildlife Section of Steps 3 and 4.

C Monitor effectiveness of Riparian Reserves and spotted owl core areas in providing habitat, connectivity, and distribution for old-growth and/or interior forest dependent species across the watershed and into adjacent watersheds.

4.4.3 Aquatic Habitat and Channel Condition

Habitat loss and degradation have been identified as two of the leading factors influencing the decline of both anadromous and resident fish species in the Pacific Northwest since the turn of the century (USDA, et al., 1993). Although limited historical fish habitat data exists for the Lost Creek watershed, the available information suggests several habitat deficiencies consistent with many managed streams throughout western Oregon. As discussed in Steps 3 and 4 (Current/Reference Conditions), the deficiencies include, but may not be limited to, decreased pool frequencies, poor width-to-depth ratios, low amounts of LWD instream, low LWD recruitment potential and lack of instream cover complexity. Each of these deficiencies likely have been influenced by the four processes identified at the beginning of this chapter; fire, timber management, roading, and non-timber (agricultural and rural/residential).

The lack of LWD and its low recruitment potential presents a major concern for fish habitat and fish distribution throughout the watershed. Instream LWD plays a significant role in pool formation and distribution of fish habitat, providing both cover and habitat complexity (USDA, et al., 1993). Low amounts can, therefore, be directly related to lower pool frequencies, lower cover complexity, and consequently lower fish abundance. As discussed in the Fish Habitat section of Step 3, the number of pieces of LWD/mile observed in surveyed streams typically was lower than the guideline recommended by PACFISH (see Table F7), especially in the lower reaches of the mainstem and its tributaries. A combination of fire, roading, timber management, and agricultural/residential activities have negatively affected amounts of LWD available instream and available for recruitment from riparian zones, consequently lowering pool frequency and habitat complexity.

The wildfire in the early 1900s significantly altered riparian vegetation in portions of the Lost Creek watershed. The fire burned primarily in the creek bottoms, burning along the majority of Lost Creek mainstem and lower segments of many of its major tributaries (see 1914 Vegetation Map). Canopy lost during the wildfire likely affected stream temperatures, bank stability, and LWD recruitment potential. It is unclear to what extent dead trees in the riparian zone were salvaged after the fire. Some snags created by the wildfire were readily observed in 1964 aerial photographs, many of which had succumbed to windfall in the Columbus Day Storm.

Harvesting trees from riparian zones can have a significant effect on amounts of instream LWD and LWD recruitment potential (WFPB, 1995). Timber harvest has occurred in the basin since the turn of the century. These early efforts were probably focused on removal of large individual conifers, many of which were growing within the riparian zones of the watershed. Today management has shifted to larger cutting units, concentrating on stands of trees from the surrounding hillslopes. Regulations designed to retain trees within riparian zones have been established for both federal (USDA and USDI, 1994c) and private (ODFW, 1995) lands. The widths of streamside protection zones vary greatly depending on land ownership however, and consequently, provide varying levels of protection for shade and LWD recruitment potential. Although buffer zone windfall is a common occurrence when riparian zones are opened to the elements, it is unclear what effect, if any, this process may have had in the Lost Creek watershed.

Road construction also has removed trees from riparian zones in the watershed. Roads currently cross and parallel portions of mainstem Lost, Anthony, Middle, and Guiley Creeks. Trees removed during construction likely have had significant impacts on riparian zone composition. In addition to physically removing trees during construction, other trees likely were lost to windfall as riparian zones were opened to the elements. More importantly, the capacity of these areas to produce future LWD has been permanently removed.

Roads also have provided easier access for recreational fishermen, consequently increasing pressure on fish populations. Most fish bearing streams are readily accessible to fishing in the watershed. Roads have further affected fish distribution by creating migration barriers. For example, a 3.5-foot drop from a culvert at the mouth of Eagle Creek represents a significant barrier to upstream fish migration.

Agricultural and residential development also has affected the current condition of the Lost Creek watershed. Vegetation was cleared from floodplain and riparian zones as the watershed became populated. The floodplain was converted from its natural state to conditions suitable for building houses and farming. This pattern was not limited to mainstem Lost Creek, but extended into the lower reaches of many of the larger tributaries (Wagner, Anthony, Middle, Carr, Gosage, and Guiley Creeks).

Agricultural water withdrawals likely play a significant role in the survival and abundance of fish and other aquatic biota in lower Lost Creek. Anecdotal information suggests that the mouth of Lost Creek often is dry in the late summer/early fall due to excessive water withdrawal. This condition also may be due to changes in channel morphology (aggradation) that result in intermittent flow during late summer. Lost Creek also may have historically gone dry during periods of drought.

Over time riparian zone composition has responded to these impacts by becoming hardwood dominated (primarily red alder). Hardwoods recruited to the stream from riparian zones typically are smaller and decay much more quickly than most conifers. Consequently, these hardwoods spend less time in the system benefitting fish as habitat, and wash downstream relatively quickly.

Habitat complexity also may have been affected by splash damming and stream cleaning activities. Between 1879 and 1903, splash damming sent more than one million board feet per year down mainstem Lost Creek, reaching a maximum of 6 million board feet in 1903 (Cronology of Log Flotation, undated). Stream cleaning was mandated in streams throughout the range of the northern spotted owl from the 1950s to the 1970s (USDA, et al., 1993). During that period, wood was removed from streams to make passage easier for both fish and watercraft. Many streams have yet to recover from this effort due to low LWD recruitment potential.

Lack of LWD is not the only factor affecting pool frequency and habitat complexity in the Lost Creek watershed. Stream segments channelized by roads, particularly along mainstem Lost Creek, have played a large role in simplifying instream habitat over time. Channelization affects pool frequency and complexity by decreasing lateral scour pools (characteristic of a meandering system), and decreasing the roughness of pools, riffles, and streambanks. Channelization also results in increased stream velocity, thus, showing a corresponding increase in erosion potential. Stream degradation often works upstream in the form of headward erosion, with the channel adjusting either vertically or laterally (Gordon, et al., 1992). To prevent erosion, armoring of streambanks (rip-rap) at outer meanders is common where bridges and residential land ownership occur. This inhibits the stream's capability to adjust laterally and effectively decreases the stream's potential to interact with its floodplain. The stream's ability to create complex, off-channel refuge habitat often required for salmonids during periods of rearing or high flow is affected.

Bankfull width-to-depth ratio (W:D), when compared to the reference condition identified by PACFISH (<10), was poor in all but one surveyed stream segment. This may be misleading, however, because PACFISH applies this guideline generically to all stream segment types. Width-to-depth ratios strongly depend on streambank composition. Streams flowing through bedrock or silt/organics typically are narrower and deeper than those flowing through sand beds (Gordon, et al., 1992). In Rosgen Channel Typing, W:D vary with channel type. W:D greater than 12 are considered to be characteristic of "B" channel types which are, considered to be relatively stable. Aggradation, degradation, and general erosion rates are normally low in this channel type (Rosgen, 1996).

The W:D ratio identified during the stream surveys is based on a series of measurements taken at one point in time. This number reflects only the current condition, representing a snapshot in geologic time. W:D ratios should be monitored over time to determine trends in channel adjustment. Minor change is expected in stable reaches. Aggrading reaches tend to become wider and shallower, while degrading reaches tend to narrow and deepen (Gordon, et. al., 1992).

Although not identified as an immediate problem to fish or fish habitat in this analysis, increased sediment yields delivered to the basin from roads should not be ignored. Increased levels of sediment can be detrimental to fish and their primary food source (aquatic macroinvertebrates). Juvenile survival is reduced, and emergence becomes more difficult for salmonids as the interstitial spaces between coarse substrates fill with fine sediments (Bjornn, 1991). The diversity and abundance of aquatic invertebrates may be negatively affected by increases in fine sediment and loss of organic material (woody debris) (USDA and USDI, 1994b). As reported by the Federal Ecosystem Management Team (FEMAT) in 1994:

> "Road networks in many upland areas of the Pacific Northwest are the most important source of management-accelerated delivery of sediment to anadromous fish habitats ....Road-related landsliding, surface erosion and stream channel diversions frequently deliver large quantities of sediment to streams, both chronically and catastrophically during large storms."

As discussed in Step 3, sediment delivered from roads in the Lost Creek subwatersheds show a relative increase factor ranging from 1 to 12 times over background. Several recent landslides, associated primarily with forest roads, contribute sediment to the watershed. The majority of these mass wasting events seem to be occurring in the headwaters of the Wagner, North, and South Anthony Creek subwatersheds.

Instream water temperature may pose an additional threat to fish in the Lost Creek watershed. Other than spot temperatures gathered during stream survey efforts, little data exists regarding water temperatures in the basin. The lower reach of Wagner Creek had the highest water temperature recorded during the surveys (68EF). This temperature is at the upper limit of the range outlined by PACFISH. The fact that temperatures taken during other stream surveys in the basin were <68EF, however, does not mean that these streams do not have water temperature problems. Relatively few measurements over a short period of time are recorded in stream surveys. The maximum water temperature fluctuates with both the season and daily weather patterns. Recordings gathered during the stream survey do not necessarily represent the season high water temperature. As mentioned in Step 3, Water Quality, ORIS suggests that stream temperatures occasionally are in excess of 70EF in lower Lost, Wagner, and Anthony Creeks (Forsberg, 1994).

As previously stated, fish abundance and distribution is directly related to the quantity, quality and complexity of fish habitat. It is likely, therefore, that overall fish populations also have declined as habitat was affected. Oregon chub, chinook salmon, and mountain whitefish appear to have been extirpated from the basin.

Since fish abundance and distribution can be directly linked to habitat complexity and connectivity, enhancement opportunities should focus on restoration of habitat complexity and connectivity within the watershed. Management direction should focus on objectives described under the Aquatic Conservation Strategy (USDA and USDI, 1994c).

Recommendations

Management direction for fisheries and riparian zones on the Eugene District was provided in the *1995 Eugene District Resource Management Plan* (USDI, 1995). Management in this plan was based upon strategy provided by the BLM's *Fish and Wildlife 2000 Plan* and the *Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl* (USDA and USDI, 1994c). According to these documents, fish and riparian zones will be managed according to Aquatic Conservation Strategy Objectives. A complete list of the Aquatic Conservation Strategy Objectives can be found in Appendix E.

Since fish distribution and abundance can be directly linked to habitat complexity and connectivity, enhancement opportunities in the watershed should focus on restoration of these components. Attempts should be made to reverse or stabilize negative habitat trends in the Lost Creek watershed. Efforts should concentrate on improving the habitat deficiencies outlined in Steps 3 and 4. This activity should work toward meeting Objectives 1 and 2 of the Aquatic Conservation Strategy (ACS): to maintain or restore the distribution, diversity, and complexity of watershed features; and to maintain or restore spatial and temporal connectivity within the watersheds.

To be effective on a watershed scale, habitat enhancement or improvement must be looked at on the watershed level. Efforts cannot be directed solely at lands administered by the BLM, but must be a cooperative effort between federal, industrial, and private landowners. Watershed restoration should begin at the landscape level, focusing first on upland rehabilitation, followed by riparian rehabilitation, and then on actual instream rehabilitation. Before instream habitat can be adequately addressed, it is important that efforts are made to minimize or eliminate the processes that are responsible for Lost Creeks' current habitat conditions, especially anthropogenic processes.

Upland rehabilitation should be the first priority in a holistic restoration program. This will initiate recovery of the hydrologic and erosional processes (Murphy, 1995). Priority in upland rehabilitation should be focused on road stabilization, closure, or obliteration. In addition, culverts identified as fish barriers or erosion hazards should be replaced or upgraded.

Upland Rehabilitation

Recommendations for upland rehabilitation in the watershed include:

- Seasonal road closures/road decommissioning,
- Fix roads with high sediment contribution,
- Complete cut/fill erosion control,
- Replace or upgrade culverts identified as fish barriers or erosion hazards.

Since roads have been determined to be a major contributor of fine sediment to streams, and excessive amounts of fine sediment negatively impact aquatic biota, efforts to minimize road-related sediment input need to be employed. ACS Objective #5 is designed to maintain or restore the sediment regime to a level consistent with which aquatic systems evolved. Currently there are approximately 216 miles of road in the watershed, representing a road density of approximately 4 miles/square mile. The average density for the entire Eugene District was reported as 3.94 miles/square mile. This density is slightly higher than that for all lands administered by the Forest Service and the BLM within the range of the northern spotted owl (3.38 miles/square mile) (USDA, et al., 1993).

To minimize sediment yield, road condition must be improved and road density should be reduced. Roads deemed necessary for management objectives should be stabilized, while unnecessary roads should be closed or obliterated. The native roads remaining in the basin should be surfaced (gravel or asphalt), reducing the amount of sediment contributed to streams through surface runoff. Unvegetated or poorly vegetated cut and fill slopes should be stabilized basin-wide, with initial efforts concentrated on basins with high erosion potential (upper portions of Gosage, North and South Anthony, Middle, and Wagner subwatersheds).

A combination of road obliteration and temporary road closure should be employed in the Lost Creek watershed. In areas prone to mass failure, roads and road prisms should be obliterated and hillslopes returned to their natural contours, restoring the natural drainage pattern to the landscape (Murphy, 1995). In more stable regions or regions where future management is expected (such as future harvest, fire management), roads should be temporarily closed. Berms are an effective method of temporarily closing roads, while maintaining the actual road prism for future land management or emergency use. Road closures and decommissioning should focus on subwatersheds with the highest road densities. Watersheds with densities greater than 4 miles/square mile should be considered critical (Gosage, Mt. June, North Anthony, Rattlesnake, Middle, Upper Lost, and Wagner subwatersheds). Seasonal traffic closures (gates) should be maintained to limit unnecessary traffic on roads.

Culverts identified as barriers to fish distribution or as erosion hazards should be replaced or upgraded. Replacement of the culvert at Eagle Creek (3 to 4 foot drop) would allow access to approximately 1.25 miles of suitable cutthroat trout habitat. This culvert currently is functioning as a complete barrier to upstream fish migration. Replacement of the Gosage Creek culvert on BLM Road 20-1-4 would allow access to approximately 1 mile of additional cutthroat habitat. This replacement is necessitated by a 1- to 1.5-foot drop at high water flows. Although it may not be a barrier at high flows, it likely is a seasonal migration barrier to fish populations at lower flows. Undersized or plugged culverts were often the cause for road failures observed during the road survey performed in conjunction with this analysis. These culverts have been identified as erosion hazards and should be upgraded, repaired, or stabilized. Their locations have been mapped on the Potential Culvert Problem Map.

The next phase, or concurrently, in a holistic watershed restoration process should be riparian zone rehabilitation. Management should be directed at all riparian zones in the basin, with priority going to the lower-gradient, fish-bearing streams under BLM ownership (primarily transport and response reaches of mainstem Lost, Carr, Gosage, Middle and West Fork Anthony Creeks).

Objective ACS # 8 is intended to maintain or restore the species composition and structural diversity of plant communities in riparian zones. Riparian zones should provide adequate thermal regulation, nutrient filtering, bank stabilization, and enough LWD to sustain physical complexity and stability. In order to achieve this objective, large conifers should be restored to riparian zones. A combination of riparian treatments is recommended to determine the best approach for the Lost Creek watershed.

Riparian Rehabilitation

Recommendations for riparian rehabilitation in the watershed include three major practices, discussed below in suggested order of priority:

Silvicultural Treatments - Primarily Transport and Response Reaches

- Conifer Release,
- Stand Conversion,
- Conifer Underplanting.

Due to low light levels, poor conifer seed source, and lack of downed wood or mineral soil necessary for adequate seedbed, riparian zones dominated by alder are susceptible to poor conifer regeneration (Murphy, 1995). Consequently, active riparian management may be required to initiate riparian zone recovery.

In situations where conifers are growing within the alder stand, alder removal can result in accelerated growth of conifers. Thinning of over-dense stands to encourage conifer release is a common approach currently employed for riparian rehabilitation.

Underplanting native conifers is a cost-effective, long-term approach to riparian zone restoration. Western hemlock and western red cedar are recommended for planting under hardwood canopies. When planting conifer seedlings, efforts should be taken to minimize animal damage (such as tubing), primarily from wild ungulates and rodents.

Stand conversion is a more aggressive approach to riparian rehabilitation. Dense stands of red alder without significant understory can be clearcut and planted with conifers. Although effective, this method will not show immediate results, taking decades for conifers to mature. Localized increases in water temperature, and decreases in bank stability and LWD recruitment potential could be expected as a result of this procedure.

ACS Objective #4 is intended to maintain or restore water quality to a level necessary to support a healthy ecosystem. It also mandates that water quality remain in a range that benefits the survival, growth, reproduction, and migration of individuals composing aquatic communities. Since water temperature already has been identified as a critical component to salmonid survival, it should be monitored on a regular basis. The seasonal temperature monitoring studies, recommended in the Water Quality section of this report, would allow the District to better monitor water quality in the watershed. High temperatures during the summer season are important and should be monitored. Restoration of large conifers to the riparian zone is an effective, long-term, low maintenance remedy to high water temperatures.

Once impacts from upland and riparian zone processes are eliminated or minimized, focus should shift to instream rehabilitation. Response and transport reaches were identified in Step 3 as providing the greatest potential for productive fish habitat. Habitat restoration or enhancement efforts should, therefore, focus primarily on these areas. Due to its important role in the anadromous fish life cycle, specific efforts should be made to improve habitat complexity in mainstem Lost Creek.

Instream Rehabilitation

Recommendations for instream rehabilitation in the watershed include:

Aquatic Habit Improvement - Focus on Transport and Response Reaches
- Add LWD to stream,
- Add instream structures,
- Increase off channel habitat - backwater pools, side channels.

Installation of fish habitat structures should be considered for temporary watershed improvements. Initial efforts should be focused primarily on the lower gradient, fish- bearing streams under BLM ownership (primarily transport and response reaches of mainstem Lost, Carr, Gosage, and Middle Creeks). Habitat structures can be used to temporarily increase pool frequency, habitat complexity, and trap spawning gravels. Deflector logs, diagonal weirs, and boulders often are used to increase pool frequency. Root wads can provide excellent juvenile rearing habitat, while log-boulder complexes create complex pool habitat used for both juvenile rearing and adult holding (Murphy, 1995). With the exception of several habitat structures already present in lower Anthony Creek (cabled logs), no habitat improvement projects are known to have occurred in the watershed.

If implemented in conjunction with a riparian restoration initiative, habitat improvement structures can provide a temporary fix until natural processes have a chance to recuperate and take over. As riparian zones mature, LWD recruitment to the stream will increase, thereby increasing pool frequency and habitat complexity, and eliminating the need to construct and maintain additional fish habitat structures.

To monitor changes in the quality of aquatic habitat and the abundance and distribution of fish, a series of baseline studies are recommended for implementation in the basin.

Limiting Factor Analysis. A limiting factor analysis for fish was identified as being necessary prior to any stream restoration initiatives under the BLM's *Management of Anadromous Fish Habitat on Public Lands Plan* (USDI, 1996a). This will confirm the types and extent of restoration efforts needed to benefit fish populations in the watershed.

Stream Gage. A stream gage at the mouth of Lost Creek would allow the District to better monitor water quality and minimum/peak flows in the watershed. This will help determine if low flows are a limiting factor in the watershed and if the watershed meets ACS Objective #7 (instream flows sufficient to create and sustain aquatic ecosystems).

Fish Population Surveys. Very little information exists on fish population or distribution in the watershed. Presence/absence surveys should be performed basin-wide to validate the distributions identified in this analysis. Spawning and rearing/overwintering studies should be performed to identify areas critical to salmonid production in the watershed.

Rosgen Channel Classification. Rosgen channel typing should be performed throughout the basin, particularly in areas identified as response and transport reaches. Rosgen channel typing will allow the District to better plan the types of habitat improvement structures that should be implemented in the watershed.

4.4.4 SUMMARY OF RECOMMENDATIONS

Recreation

- Form a joint BLM/Forest Service team to evaluate and administer shared recreation objectives and opportunities.

- Identify BLM and private land ownership at road and trail entry and exit points.

Visual Resources

- Consider modifying timber management activities, as viewed from the Eagles Rest/Lost Creek Road Loop to meet Visual Quality Objectives.

- Manage illegal dumping and litter.

Roads

- Continue to manage the Lost Creek watershed for dispersed recreation activities that are primarily focused around the existing road system.

- Work with industrial forest landowners for acceptable recreation use of the road system currently closed to public entry.

- Prepare for possible inclusion of the Lost Creek/Eagles Rest Road Loop as a Back County Byway in the National Scenic Byway System.

- Include possible road closures to dumping areas in the Transportation/Access Management Plan.

- Stabilize cut and fill slopes.

- Increase the number and maintenance frequency of ditch relief culverts.

- Road decommissioning should be considered where cost-effective erosion control measure have been exhausted.

- In stands of old-growth and interior forest, decommission interior and border roads where possible to promote revegetation and reduction of fragmentation of these stands.

- Decommission where possible, roads that occur within or bisect Riparian Reserves to promote revegetation and reduce fragmentation of these areas.

C Replace, repair, or upgrade culverts identified as fish barriers or erosion hazards.

- Close and/or decommission roads in an attempt to reduce overall road density.

- Seasonal road closures.

Timber Management

<u>40- to 80-Year-Old Stands</u>

- Thin heavily to increase individual tree diameter growth response, gain greater economic return, and encourage understory response of shrubs and shade-tolerant conifers.
- Consider pruning in commercially-thinned stands to provide economic return and incentive for retaining stands longer.
- Delay regeneration cutting on thinned stands, where feasible.

<u>Management of Late-Seral Stand Structure</u>

- Accelerate the development of late-seral stand conditions in older stands (80 to 200 years) by intermediate stand treatments, retention or underplanting of shade-tolerant conifers, and creation of snags.
- Accelerate stand structural development as described for stands 40 to 80 years old.

<u>Riparian Stand Condition</u>

- Commercially thin riparian stands (following the recommendations in 40- to 80- year-old stands). Encourage growth of conifers by cutting competing hardwoods.
- Precommercially thin younger riparian stands.
- Release riparian conifers from competition with hardwoods.
- Underplant shade-tolerant conifers in riparian gaps.
- Clearcut riparian hardwoods and plant with fast-growing conifers.

Aquatic Habitat Diversity

- Where feasible, fell some LWD into important stream reaches where structure is currently lacking.
- Install fish habitat structures for temporary aquatic habitat improvements.

Terrestrial Habitat Diversity

- Increase the use of modified silvicultural practices, such as clearcutting with reserve trees.
- Rotate locations of Special Forest Products permits (i.e., mushrooms and moss) until sufficient information is available about the contributions of these plants to the environment.
- Determine seral stand distribution objectives for subwatersheds and the Lost Creek watershed as a whole.

- Use GIS-based analysis tools to evaluate the effects of harvest plans and activities.

- Minimize impacts on remaining large-tree-dominated stands within the watershed.

- Concentrate management of old-growth-associated species in the eastern portion of the watershed. Establish a network of forest stands $40 years old to provide connectivity between isolated patches of interior and old-growth forest habitats to adjacent LSR-designated lands.

- Manage interior and old-growth forest stands to reduce edge effects.

- Develop a watershed-wide snag creation plan targeting snags in size classes to provide desired habitat structure.

Data Needs

- Conduct a limiting factor analysis for fish.

- Install a stream gage at the mouth of Lost Creek.

- Conduct fish population surveys.

- Conduct a Proper Functioning Condition Assessment

- Conduct Rosgen Channel Classification.

- Conduct protocol surveys for Threatened and Endangered, Survey and Manage, and Bureau Sensitive species known or suspected to occur in the Lost Creek watershed.

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