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Little Butte Creek Watershed Analysis

Version 1.2

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EXECUTIVE SUMMARY

Human Uses

Immediately prior to Euro-American settlement in the Little Butte Creek Watershed, native people managed the land to enhance resources important to them; their primary tool was fire. Their activities combined with natural processes to produce a landscape with notable differences from that of today: riparian areas were wooded, and streams followed a braided course through the valleys; valleys and foothills (up to about 3,500 feet) were wooded with large pine and oak set in grassy savannahs interspersed with prairies; and coniferous forests grew in the canyons and uplands, broken by numerous meadows. In the 1820s and 1830s, British fur trappers worked the region, trapping out most beaver from the streams, thus contributing to early stream course channelization and other hydrological effects. Since 1850, Euro-American settlement and increasingly powerful technologies have brought further changes to the land: the hydrology, vegetation patterns, topography, and native species (plant and animal) have all been affected by numerous actions including agriculture, ranching, logging, road building, fire suppression, and settlement.

Today much of the watershed (48 percent) is under federal land management; federal policies have an important effect on watershed lands. Local community efforts to advise management of private lands and to coordinate among community and governmental groups and agencies are helping promote healthier streams and plant and animal communities. Community concerns reflect regional issues, especially over water rights and endangered species. The possible effects of past federal actions on streams during the 1997 flood is also an issue of local concern.

There are 28 BLM and 4 Forest Service grazing allotments in the watershed. Cascade Ranch is the biggest user of grazing lands (public and private), and operates under a cooperative agreement with various public agencies and private companies. All intensive management allotments in the watershed currently have a working allotment management plan. Grazing has decreased in the watershed on both public and private lands due to changing demand, increased settlement, and changing land-use priorities.

Commercial logging did not affect the upper reaches of the watershed until after World War II, following improvements in transportation and road building. Logging on federal lands was virtually halted in 1991 when the northern spotted owl was listed as a threatened species under the Endangered Species Act. Logging has resumed under the Northwest Forest Plan, using a variety of harvest methods, which may include commercial thinning, density management, and mortality salvage.

There are various recreational facilities on Forest Service lands (developed and dispersed campgrounds, trails and trailheads, and snoparks). Recreational use of the area takes place year-round and has been increasing over the last ten years. Currently, budget restrictions are reducing quality and quantity of facility maintenance and public contact.

There are numerous historic and Native American archaeological sites in the watershed on public and private lands. Unauthorized collecting and digging is a significant problem on public lands and is severely affecting the quality of these archaeological sites.

The Confederated Tribes of Siletz and the Confederated Tribes of Grande Ronde are the federally recognized tribes with closest ties to most of the watershed. In addition, the Klamath people used the easternmost part of the watershed, and the Klamath Tribes retain an interest in that part of the watershed. There are no specific Native American treaty rights reserved in the watershed.

Terrestrial Ecosystem

The vegetation of the Little Butte Creek Watershed is extremely diverse ranging from low elevation, dry pine/oak woodland savannahs to high elevation, wet, mountain hemlock forests. Historically, frequent fires kept vegetation stocking levels low and desired species were maintained according to the objectives of the inhabitants. Today, fire has been essentially eliminated from the landscape and the species composition has shifted towards many un-preferable species. Most of the woody vegetation is over 50 years of age and early seral shrubs are lacking. The vegetation is in an overstocked condition with the number of stems per acre at maximum biological stocking levels. Most untreated forest stands in the Interior Valley and Mixed Conifer zones have grown less than 1 inch in diameter during the last decade. As a result of low tree vigor, bark beetles are now causing tree mortality. This trend will continue if stocking levels are not reduced.

Fire was and is a major process affecting the watershed. Historic fires were important in maintaining open vegetation patterns such as grass and hardwood savannas and open, "park like" conifer stands. Fires of the past were generally low in severity and were important in maintaining a resilient ecosystem. The exclusion of fire due to fire suppression, has allowed dead fuels to accumulate and vegetation patterns to shift to higher density vegetation types. Examples of denser vegetation types include grass/oak savannas that have become choked with brush or open ponderosa pine stands that now have a dense understory of Douglas-fir and white fir. Fires of today are generally high in severity and have become an agent of ecosystem instability resulting in burned landscapes that may take decades or centuries to recover.

Wildlife habitat, vegetation, and topography is diverse throughout the elevation ranges of the watershed. Current habitat conditions are a result of human activities such as logging, agriculture, and fire suppression. Loss and modification of habitat, especially mature/old-growth forest, has produced the greatest impact to wildlife. Several historical species like the bighorn sheep, pronghorn, grizzly, and wolf no longer exist in the watershed, while non-native species like the opossum, bullfrog, and starling are now present and doing well.

Logging activities at higher elevations have increased forage species and the local elk herds in the watershed have increased significantly. These same activities have decreased the habitat of the northern spotted owl and several other species that have special protection status. The bald eagle and the American peregrine falcon, like the northern spotted owl, are protected under the Endangered Species Act and are present in the watershed.

Aquatic Ecosystem

The key aquatic issue within the Little Butte Creek Watershed is water quality. Streams not meeting water quality standards in the Little Butte Creek Watershed are identified by the Oregon Department of Environmental Quality (DEQ) as water quality limited streams due to temperature, habitat modification, sediment, flow modifications, and fecal coliform. High priority issues that affect water quality and limit factors for long-term sustainability of native fish and other aquatic species in the Little Butte Creek Watershed are:

- Temperature
- Habitat Modification
- Sedimentation

Anadromous fish species in the Little Butte Creek Watershed are chinook salmon, steelhead trout, coho salmon, cutthroat, and Pacific lamprey. Two special status fishes spawn and rear in the Little Butte Creek Watershed: trans-boundary coho salmon and Klamath Mountains Province steelhead trout. The National Marine Fisheries Service (NMFS) listed coho salmon in the Rogue River Basin as threatened and proposed listing steelhead trout under the Endangered Species Act. South Fork Little Butte Creek is one of the primary rearing areas and contains one of the largest populations of rearing coho salmon in the upper Rogue River Basin.

Temperature

High stream temperatures (approximately >70°F) are lethal to fish and limit summer rearing habitat within the watershed. Summer stream temperatures vary throughout the watershed with cooler temperatures generally found in most headwater streams. Elevated summer water temperatures are a limiting factor in Little Butte, North Fork Little Butte (below the National Forest boundary), South Fork Little Butte (below Beaver Dam Creek), Antelope, Conde, and Dead Indian creeks.

Human-caused factors affecting stream temperature are water withdrawals, riparian vegetation removal, and channel alterations. Streamflow patterns in North and South Fork Little Butte creeks are dramatically altered by water withdrawals including the transbasin water diversions to adjacent Bear Creek Watershed and local instream water withdrawal. Riparian vegetation removal through timber harvesting, road building, agricultural practices, and residential development has resulted in a lack of stream shading. Channel alterations such as channel straightening and confinement by roads have produced wide, shallow streams. The lack of stream shading and wide, shallow streams have increased solar radiation and water temperatures.

Natural-caused factors affecting stream temperatures are the hot summer air temperatures in southwestern Oregon, lack of vegetation following floods, and sedimentation from natural erosion and landslides.

Habitat Modification

Overall, the interrelated aquatic and riparian habitats in Little Butte Creek and its major tributaries are in poor condition and well below their potential for producing diverse ages and species of anadromous fish and large resident trout (greater than eight inches). Most of Little Butte Creek and its tributaries are riffle-dominated and lack historic side channel habitat, which coho salmon prefer. The habitat lacks quality pools and large wood material necessary for maintenance of pools, cover, hiding cover, side channel habitat, spawning material, low width-to-depth ratio, and bank stability. Habitat modification effects on fish are limiting to spawning and rearing habitat, which creates a downward trend in population, size, and reduces diversity. Historically stream habitat was multi-channeled, and is now predominately single channeled, which greatly reduces the edge effect and riparian/stream interactions. Factors contributing to stream habitat modification are channel straightening, adjacent road building, wood removal (from stream), timber harvesting, and residential and agricultural development.

Sedimentation

Sedimentation effects on fish are substrate embeddedness, poor pool quality, reduced hiding cover, and damaged fish gills. Geology of Little Butte Creek Watershed contains the Cascade Mountains Physiographic Province with two volcanic subprovinces: High and Western Cascades. High Cascades are young lava flows with stable slopes. Western Cascades have older geology and softer volcanic materials (unstable ash deposits and stable weathered basalt lavas). Natural-caused sediment impacts include landslides, surface erosion, and channel erosion due to floods. Human-caused sediment impacts include roads, clearcut logging in unstable areas, tractor logging, riparian vegetation removal and agricultural practices. Roads contribute the greatest amount of sediment in the watershed. High road densities, roads near stream channels, and clearcut harvesting often accelerate landslides and erosion.

Streams within the Little Butte Creek Watershed were heavily impacted by the 1997 New Year's Day flood. Habitat in the alluvial canyons and valleys was altered due to the 1997 flood. Much of the gravel, cobble, and sediment was delivered from streamside landslides and general slope failures within South Fork Little Butte and Dead Indian creeks.

Restoration

Types of watershed cooperation being accomplished on both public and private lands are: restoration projects (identification, work, and monitoring), public information meetings, grant proposals, and educational partnerships. The primary emphasis is to promote an education based platform that fosters stewardship towards the land. The four areas of emphasis for restoration projects are: roads, upland (soil and vegetation), riparian, and instream. Listed are on-going restoration work in each of these emphasis areas:

- **Roads:** decommissioning, stabilizing, or upgrading to reduce erosion.
- **Upland:** stabilizing landslides and reducing surface erosion.
- **Riparian:** riparian tree planting and thinning, riparian fencing, Riparian Reserves on federal lands, and decommissioning roads within Riparian Reserves.

- **Instream:** conversion of existing out-of stream rights to instream rights, water intake and usage modifications, creating habitat complexity, and removing fish barriers.

Future efforts for this watershed include expanding partnerships, as well as solidifying existing cooperative working agreements. Continuing old and beginning new restoration projects to protect fisheries habitat and water quality is vitally important in this key watershed. It is paramount for the success of restoring coho salmon populations that residents and agencies appreciate the importance of functioning alluvial valley streams as well as headwater streams. The life histories of salmonids and other fishes depend on a diverse mix of stream and riparian habitat types throughout the watershed.

INTRODUCTION

Objective of the Watershed Analysis

The Little Butte Creek Watershed Analysis documents conditions and interrelationships of ecosystem components for the analysis area. It describes the dominant features and physical, biological, and social processes within the watershed. The document compares prehistorical and historical (reference) conditions with current ecosystem conditions and discusses the causes of these conditions and future trends. It also ranks management objectives and recommendations for federal lands as high, medium, or low priority, and directs development of a landscape plan for federal lands. The analysis is intended to guide subsequent project planning and decision making in the Little Butte Creek Watershed. This document is not a decision document under the National Environmental Policy Act (NEPA) and there is no action being implemented with this analysis. Site-specific analysis incorporating the National Environmental Policy Act (NEPA) process would occur prior to any project implementation.

The Little Butte Creek Watershed Analysis was prepared by an interdisciplinary team of resource specialists from the U.S. Department of Agriculture, Forest Service, Ashland Ranger District and Rogue River National Forest Supervisor's Office and U.S. Department of the Interior, Bureau of Land Management, Ashland Resource Area and Medford District Staff (see List of Preparers). The team included two people from outside the Bureau of Land Management (BLM) and Forest Service: Brendan White, representing the U.S. Fish and Wildlife Service, and Lu Anthony, representing the Little Butte Creek Watershed Council. Their input at team meetings was invaluable and greatly appreciated by the BLM and Forest Service team members.

How the Analysis was Conducted

Specialists with the primary responsibility for attending meetings, gathering data, conducting analyses, and writing the report were identified as Core Team members. A Support Team was formed to provide data and assistance to the Core Team. Some Support Team members attended several meetings and provided reports. For each resource specialty represented on the Core and Support teams, both a BLM and Forest Service specialist were placed on the team. One specialist for each resource was assigned the lead role and was responsible for attending meetings and completing assignments. Their counterpart provided information from their agency. The team met 17 times between January and June 1997. Group discussions identified linkages between resources and resulted in an integrated, synthesized report.

Guidelines used to direct the preparation of the Little Butte Creek Watershed Analysis included: the *Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl* and *Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl* (USDA and USDI 1994) (these two documents are combined into what is known as the Northwest Forest Plan), *and Ecosystem Analysis at the Watershed Scale:* Federal Guide for Watershed Analysis, version 2.2 (USDA, USDI, EPA, USDC, and NMFS 1995).

The Little Butte Creek Watershed Analysis is based on existing information and addresses the entire watershed, although recommendations are only made for federal lands. Some information used in this analysis came from existing documents such as the Little Butte Creek Watershed Council Action Plan (LBCWC 1995) and the South Fork Little Butte Creek Project Specific Watershed Analysis (Barnes 1995).

Where resource information is missing, a data gap is identified. Data gaps are prioritized and listed in a separate section of the document. Missing information will be acquired as funding permits. The analysis process is dynamic and the document will be revised as new information is obtained. Types of new information may include resource data collected at the project level and monitoring data. An updated version of this document will be issued when new data and information collected indicate important changes in watershed conditions or trends.

Document Organization

The organization of this document follows the format described in the *Federal Guide for Watershed Analysis, version 2.2* (USDA,USDI, EPA, USDC, and NMFS 1995). The Issues and Key Questions section provides a focus for the analysis on the key ecosystem elements that are most relevant to the management questions and objectives, human values, or resource conditions within the analysis area. The Characterization section places the Little Butte Creek Watershed in context within the Upper Rogue Subbasin. It identifies the dominant physical, biological, and human processes or features of the analysis area that affect ecosystem functions or conditions. The Current Conditions section details current conditions of the physical, biological, and human ecosystem elements. The Reference Conditions section describes how ecological conditions have changed over time as a result of human influences and natural disturbances in the Little Butte Creek Watershed. The Synthesis and Interpretation section compares existing and reference conditions of specific ecosystem elements and explains significant differences, similarities, or trends and their causes. The Management Objectives and Recommendations section identifies management objectives for federal lands within the Little Butte Creek Watershed and prioritizes management activities to achieve the objectives. The Landscape Planning section synthesizes resource data to create landscape objectives and recommendations for federal lands. The Private Land Opportunities section lists possible opportunities that private land owners could do to improve and/or maintain the health of the Little Butte Creek Watershed. Prioritized data gaps and monitoring and research needs are included in separate sections.

Maps are grouped together and placed at the end of the document. All maps for the watershed analysis were generated using BLM Medford District and USFS Rogue River National Forest geographic information systems (GIS). Small scale maps included in this report are intended to provide general information. Larger scale maps were used for the analysis and are available for review at the BLM Medford District Office and the USFS Ashland Ranger District Office.

Public Involvement

Public involvement for the Little Butte Creek Watershed Analysis included two public meetings held at the Lakecreek Pioneer Hall. The first meeting was an Open House on March 4, 1997 from 5 to 7 p.m. There were two objectives for this meeting: to explain the watershed analysis process to the public and to receive information from the public on their issues and concerns, their knowledge of historic or current conditions, and their recommendations for future actions in the watershed. The meeting was publicized through: information sheets sent to local residents and local groups including the Little Butte Creek Watershed Council, Jackson County Stockman's Association, Southern Oregon Timber Industry Association and Headwaters; flyers posted at local public places; and newspaper articles in the *Upper Rogue Independent* and the *Medford Mail Tribune*. The information sheets also provided an opportunity for people to send written comments to the team. Thirty people signed in at the Open House. Team members received many good comments from the public. Information received from the public was incorporated in the Issues and Key Questions and Current and Reference Conditions sections of the Little Butte Creek Watershed Analysis. The participation of the Little Butte Creek Watershed Council's Coordinator (Lu Anthony) on the watershed analysis team was a result of comments received at the Open House.

The second public meeting was held on June 18, 1997 from 5:30 to 8 p.m. The objectives of this meeting were to provide a presentation highlighting the major findings of the watershed analysis and to allow the public the opportunity to ask questions and provide input. A letter regarding the meeting was sent to individuals and groups using the same mailing list as for the first meeting. Flyers were also posted and newspaper articles in the *Upper Rogue Independent* and the *Medford Mail Tribune* told of the meeting. Thirty-five people signed in at the meeting. The presentation covered the human dimension, vegetation, fire, erosion processes, hydrology, water quality, riparian areas, and fisheries. It was well-received and was followed by informal discussions between the public and agency specialists. A comment expressed by several people afterwards was that the team should have allowed more time for questions from the audience following the presentations. No new issues were received at the meeting.

ISSUES AND KEY QUESTIONS

ISSUE: Human Uses

Characterization

1. What are the major ways in which humans interact with the watershed?
2. Where are the primary locations for human use of the watershed?
3. What are the regional public concerns that are pertinent to the watershed (e.g., air quality, environmental degradation, commodity production, etc.)?
4. What are the public concerns specific or unique to this watershed?
5. Are there treaty or tribal rights in the watershed?
6. What road types are in the watershed and where are they located?

Current Conditions

1. Who are the people most closely associated with and potentially concerned about the watershed?
2. What are the current human uses and trends of the watershed (economic, recreational, other)?
3. What is the current and potential role of the watershed in the local and regional economy?
4. What are the current conditions and trends of the relevant human uses in the watershed:
   a. government facilities, structures, and communication routes
   b. authorized and unauthorized uses
   c. transportation system
      i. What are the current road conditions?
      ii. Are there concerns for public safety due to hazard trees?
      iii. What are the open and closed road densities (by road type) and where are high road densities located?
   d. logging
   e. special forest products
   f. grazing/agriculture
   g. minerals
   h. recreation
   i. cultural resources

ISSUE: Human Uses (Continued)

Reference Conditions

1. How did native people interact with the environment to create the native reference ecosystem?
2. What changes in human interactions have taken place since historic contact and how has this affected the native ecosystem?
3. What are the major historical human uses in the watershed, including tribal and other cultural uses?
4. What is the history or road development and use in the watershed?

Synthesis and Interpretation

1. What are the causes of change between historical and current human uses?
2. What are the influences and relationships between human uses and other ecosystem processes in the watershed?
3. What human effects have fundamentally altered the ecosystem?
4. What are the anticipated social or demographic changes that could affect ecosystem management?
5. What human interactions have been and are currently beneficial to the ecosystem and can these be incorporated into current and future land management practices?
6. What are the influences and relationships between roads and other ecosystem processes?
7. How do road stream crossings affect water quality, instream habitat, and fish migration?

ISSUE: Climate

Characterization

1. What are the climatic patterns in the watershed?

ISSUE: Geology and Geomorphology

Characterization

1. What is the origin of the broad variety of rock types in the watershed and where are they located?
2. How did the rock types influence landforms, soils, and vegetation?
3. What are the geomorphic units, how are they formed, and where are they located?

ISSUE: Erosion Processes

Characterization

1. What erosion processes are dominant within the watershed?
2. Where have they occurred or are they likely to occur?

Current Conditions

1. What are the current conditions and trends of the dominant erosion processes prevalent in the watershed?

Reference Conditions

1. What are the historical erosion processes within the watershed?
2. Where have they occurred?

Synthesis and Interpretation

1. What are the natural and human causes of changes between historical and current erosion processes in the watershed?
2. What are the influences and relationships between erosion processes and other ecosystem processes?

ISSUE: Soil Productivity

Characterization

1. How critical/vulnerable is soil productivity in the watershed?

Current Conditions

1. What are the current conditions and trends of soil productivity?
2. What areas within the watershed are most vulnerable to soil productivity loss by management actions?

Reference Conditions

1. What were the historical soil productivity characteristics?

Synthesis and Interpretation

1. What are the natural and human causes of change between historical and current soil productivity conditions?
2. How do natural disturbances affect long-term soil productivity?
3. What are the influences and relationships between soil productivity and other ecosystem processes?

ISSUE: Landscape Vegetation Pattern

Characterization

1. What is the array and landscape pattern of native and non-native plant communities and seral stages in the watershed?
2. What is the percent composition of the vegetation condition classes over the landscape?
3. What processes caused these patterns?

Reference Conditions

1. What is the historical array and landscape pattern of plant communities and seral stages in the watershed?
2. What processes caused these patterns?

Synthesis and Interpretation

1. Have non-native species and noxious weeds changed the landscape pattern of native vegetation?

ISSUE: Plant Species and Habitats

Characterization

1. Non-native Species and Noxious Weeds
   a. What is the relative abundance and distribution of non-native plants and noxious weeds?
   b. What is the distribution and character of their habitats?
2. Rare Vascular Plant Species
   a. What is the relative abundance and distribution of rare vascular plant species?
   b. What is the distribution and character of their habitats?
3. Survey and Manage Species
   a. What is the relative abundance and distribution of survey and manage plant species?
   b. What is the distribution and character of their habitats?

Current Conditions

1. Non-native Species and Noxious Weeds
   a. What are the current habitat conditions and trends for non-native species and noxious weeds?
2. Rare Vascular Plant Species
   a. What are the current habitat conditions and trends for rare vascular species?
3. Survey and Manage Species
   a. What are the current habitat conditions and trends for survey and manage species?

ISSUE: Plant Species and Habitats (Continued)

Reference Conditions

1. Non-native Species and Noxious Weeds
   a. What was the historical relative abundance and distribution of non-native species and noxious weeds and the condition and distribution of their habitats in the watershed?
2. Rare Vascular Plant Species
   a. What was the historical relative abundance and distribution of rare vascular species and the condition and distribution of their habitats in the watershed?
3. Survey and Manage Species
   a. What was the historical relative abundance and distribution of survey and manage species and the condition and distribution of their habitats in the watershed?

Synthesis and Interpretation

1. Non-native Species and Noxious
   a. What are the natural and human causes of change between historical and current species distribution and habitat quality for non-native species and noxious weeds in the watershed?
   b. What are the influences and relationships of non-native species and noxious weeds and their habitats with other ecosystem processes in the watershed?
2. Rare Vascular Plant Species
   a. What are the natural and human causes of change between historical and current species distribution and habitat quality for rare vascular species in the watershed?
   b. What are the influences and relationships of rare vascular species and their habitats with other ecosystem processes in the watershed?
3. Survey and Manage Species
   a. What are the natural and human causes of change between historical and current species distribution and habitat quality for survey and manage species?

ISSUE: Forest Density and Vigor

Current Conditions

1. What are the current conditions and trends of the prevalent plant communities and seral stages in the watershed?
   a. What are the current conditions and trends of the vegetation condition classes in the Fish Lake area?
2. What is the site index of the soils and how does it relate to present tree growth?
3. What vegetation condition classes are not meeting their growth potential?
4. What are the major mechanisms for vegetation disturbance?
5. Are there some vegetation condition classes promoting insect and disease problems?
6. Where are the tree insect and disease problem areas?

ISSUE: Forest Density and Vigor (Continued)

Reference Conditions

1. What was the historical tree vigor and growth pattern?
2. Were tree insects and disease a problem historically?

Synthesis and Interpretation

1. What are the natural and human causes of change between historical and current vegetative conditions?
2. What are the influences and relationships between vegetation and seral patterns and other ecosystem processes in the watershed?
3. Which processes or casual mechanisms are most likely responsible for similarities, differences, and trends?
4. What are the implications of the changes and trends, including the capability of the watershed to achieve objectives from existing plans?
5. What are the reasons for differences between current and reference tree growth patterns?

ISSUE: Fire

Characterization

1. What are the fire regimes?

Current Conditions

1. What role does fire currently have?
2. What vegetation conditions are contributing to high fire hazard and risk?
3. What are the current fire hazards and risks?
4. What are the high values at risk that could be impacted by a wildfire?
   a. What are the risks to public health and safety?
5. How is air quality impacted by prescribed fire and wildfires?

Reference Conditions

1. What was the historic role of fire within the watershed?

Synthesis and Interpretation

1. How have fire suppression efforts over the past 80 years caused changes between the historical and current role of fire?
2. How has the fire role change caused changes between historical and current vegetative species distribution?

ISSUE: Terrestrial Wildlife Species and Habitats

Characterization

1. Wildlife Habitat - General
   a. What is the relative abundance, distribution and character of the various habitat types found in the watershed?
2. Threatened and Endangered Species
   a. What is the acreage, distribution and character of habitat in the watershed?
   b. What is the role of the designated critical habitat in the watershed?
3. Special Status/Sensitive Species
   a. What is the amount, distribution and character of habitat for those special status species that are of management concern in the watershed?
4. Survey and Manage Species
   a. What is the amount, distribution and character of habitat for the survey and manage species found in the watershed?
5. Deer and Elk
   a. What is the amount, distribution and character of forage and cover on the deer and elk management areas in the watershed?

Current Conditions

1. Wildlife Habitat - General
   a. What are the current habitat conditions and trends for the various habitat types found in the watershed?
2. Threatened and Endangered Species
   a. What are the current habitat conditions and trends for the threatened and endangered species found in the watershed?
   b. What is the current role of habitat in the watershed?
3. Special Status/Sensitive Species
   a. What are the current habitat conditions and trends for the special status/sensitive species found in the watershed?
4. Survey and Manage Species
   a. What are the current habitat conditions and trends for the survey and manage species found in the watershed?
5. Deer and Elk
   a. What are the current forage and cover conditions and trends on the deer and elk management areas in the watershed?

ISSUE: Terrestrial Wildlife Species and Habitats (Continued)

Reference Conditions

1. Wildlife Habitat - General
   a. What was the historical relative abundance, condition and distribution of the various habitat types found in the watershed?
2. Threatened and Endangered Species
   a. What was the historical acreage, condition and distribution of habitat for threatened and endangered species in the watershed?
   b. What was the initial role of habitat for threatened and endangered species in the watershed?
3. Special Status/Sensitive Species
   a. What was the historical amount, condition and distribution of habitat for the special status/sensitive species found in the watershed?
4. Survey and Manage Species
   a. What was the historical amount, condition and distribution of habitat for the survey and manage species found in the watershed?
5. Deer and Elk
   a. What was the historical amount, condition and distribution of forage and cover on the deer and elk management areas in the watershed?

Synthesis and Interpretation

1. Wildlife Habitat - General
   a. What are the implications of natural and human caused change between historical and current relative abundance, condition and distribution of the various habitat types found in the watershed?
2. Threatened and Endangered Species
   a. What are the implications of natural and human caused change between historical and current acreage, condition and distribution of northern spotted owl habitat in the watershed?
   b. What are the implications of the change in role of the northern spotted owl critical habitat in the watershed?
3. Special Status/Sensitive Species
   a. What are the implications of natural and human caused change between historical and current amounts, condition and distribution of habitat for the special status/sensitive species found in the watershed?
4. Survey and Manage Species
   a. What are the implications of natural and human caused change between historical and current amounts, condition and distribution of habitat for the survey and manage species found in the watershed?
5. Deer and Elk
   a. What are the implications of natural and human caused change between historical and current amounts, condition and distribution of forage and cover on the deer and elk management areas in the watershed?

ISSUE: Hydrology

Characterization

1. What are the dominant hydrologic characteristics and other notable hydrologic features and processes in the watershed?

Current Conditions

1. What are the current conditions and trends of the dominant hydrologic characteristics and features prevalent in the watershed?

Reference Conditions

1. What were the historical hydrologic characteristics and features in the watershed?

Synthesis and Interpretation

1. What are the natural and human causes of change between historical and current hydrologic conditions?
2. What are the influences and relationships between hydrologic processes and other ecosystem processes?

ISSUE: Stream Channel

Characterization

1. What are the basic morphological characteristics of stream valleys or segments and the general sediment transport and deposition processes in the watershed?

Current Conditions

1. What are the current conditions and trends of stream channel types and sediment transport and deposition processes prevalent in the watershed?

Reference Conditions

1. What were the historical morphological characteristics of stream valleys and general sediment transport and deposition processes in the watershed?

Synthesis and Interpretation

1. What are the natural and human causes of change between historical and current channel conditions?
2. What are the influences and relationships between channel conditions and other ecosystem processes in the watershed?

ISSUE: Water Quality

Characterization

1. What beneficial uses dependent on aquatic resources occur in the watershed?
2. Which water quality parameters are critical to these uses?

Current Conditions

1. What are the current conditions and trends of beneficial uses and associated water quality parameters?

Reference Conditions

1. What were the historical water quality characteristics of the watershed?

Synthesis and Interpretation

1. What are the natural and human causes of change between historical and current water quality conditions?
2. What are the influences and relationships between water quality and other ecosystem processes in the watershed?

ISSUE: Riparian Areas

Characterization

1. What is the array and landscape pattern of plant communities in the riparian areas?
2. What processes caused these patterns?
3. What riparian-dependent species are present in the watershed?
4. What are the general distribution and character of their habitats?

Current Conditions

1. What is the current species composition of riparian areas?
2. What are the current conditions and trends of riparian areas?
3. Where are sensitive areas and what are the reasons for sensitivity?
4. What are the current conditions and trends of riparian habitat for riparian-dependent species?

Reference Conditions

1. What was the historical condition of riparian areas?
2. What was the historical species composition of riparian areas?
3. What was the historical distribution and abundance of riparian-dependent wildlife species (community)?

ISSUE: Riparian Areas (Continued)

Synthesis and Interpretation

1. What are the natural watershed characteristics and human activities influencing riparian areas and riparian-dependent species?
2. How have these characteristics and activities iinfluenced or changed riparian areas and habitat for riparian-dependent species?
3. What is the effect of riparian condition on instream habitat?
4. What are the influences and relationships between riparian areas and other ecosystem processes in the watershed?

ISSUE: Aquatic Wildlife Species and Habitats

Characterization

1. Habitat

   a. What is the distribution and character of aquatic habitat throughout the watershed, especially for threatened and endangered, special status, and sensitive species?
2. Species

   a. What are the relative abundance and distribution of threatened and endangered aquatic wildlife species?

   b. What are the relative abundance and distribution of special status/sensitive aquatic wildlife species?

   c. What are the relative abundance and distribution of other aquatic wildlife species present in the watershed?

Current Conditions

1. Habitat

   a. What are the current conditions and trends of instream habitat (e.g., quantity and quality) throughout the watershed?

   b. What are the current conditions and trends for specific habitat needs of threatened and endangered, special status, and sensitive species?
2. Relationship of Subbasin Habitat with Rogue Basin

   a. How does instream habitat in the Little Butte Creek Watershed fit into the "big habitat picture" for the Rogue Basin threatened and endangered fish stocks?

   b. How does instream habitat in the Little Butte Creek Watershed fit into the "big habitat picture" for the Rogue Basin special status/sensitive fish stocks?

ISSUE: Aquatic Wildlife Species and Habitats (Continued)

Reference Conditions

1. Habitat

   a. What was the historical condition and distribution of instream habitats throughout the watershed?

   b. What was the historical condition and distribution of instream habitats specific to threatened and endangered and special status/sensitive species?

2. Species

   a. What was the historical relative abundance and distribution of threatened and endangered species in the watershed?

   b. What was the historical relative abundance and distribution of special status/sensitive species in the watershed?

Synthesis and Interpretation

1. Habitat

   a. What are the natural watershed characteristics and human activities influencing species distribution and instream habitat condition?

   b. How have these characteristics and activities influenced or changed instream habitat condition, in general and specifically for threatened and endangered and special status/sensitive species?

2. Species

   a. How have changes in habitat condition influenced Little Butte Creek threatened and endangered and special status/sensitive aquatic species?

   b. What are the limiting factors for long-term sustainability of threatened and endangered and special status/sensitive aquatic species?

3. Ecosystem Processes

   a. What are the influences and relationships of aquatic species and their habitats with other ecosystem processes in the watershed?

WATERSHED CHARACTERIZATION

The purpose of the Characterization section is to identify the dominant physical, biological, and human processes or features of the watershed that affect ecosystem functions or conditions. The watershed ecosystem elements are related to those occurring in the river basin or province. The watershed analysis team identified the relevant land allocations and the most important plan objectives and regulatory constraints that influence resource management in this watershed.

The Little Butte Creek Watershed is located in the southern Cascade range and extends westward from the slopes of Mount McLoughlin into the Rogue Basin. The analysis area is within the extreme eastern portion of "interior southwest Oregon". The climate for this area has the highest average summertime temperatures and the lowest average precipitation within western Oregon and Washington.

The Little Butte Creek Watershed is within the Upper Rogue River Subbasin (Map 1). The Upper Rogue River Subbasin is one of five subbasins within the Rogue River Basin in southwest Oregon. Major tributaries to Little Butte Creek include Antelope Creek and the North and South Forks of Little Butte Creek. The watershed is located approximately 10 miles northeast of Medford, Oregon, primarily in Jackson County with the eastern edge in Klamath County. Little Butte Creek Watershed covers approximately 373 square miles (238,598 acres) and the elevation ranges from 1,200 feet where Little Butte Creek joins the Rogue River to 9,495 feet at the top of Mount McLoughlin. Land ownership is a mix of public and private. Private lands are predominately located in the lower elevations, Bureau of Land Management lands occupy a "checkerboard" pattern in the middle elevations, and Forest Service lands are mostly a contiguous block in the higher elevations (Table 1 and Map 2).

Table 1. Land Ownership

Ownership	Acres	Percent of Watershed
Bureau of Land Management (BLM), Medford District		
Ashland Resource Area	36,559	
Butte Falls Resource Area	17,702	
BLM, Lakeview District		
Klamath Falls Resource Area	492	
Total BLM	54,753	22.95
U.S. Forest Service (USFS), Rogue River National Forest		
Ashland Ranger District	49,697	
Butte Falls Ranger District	7,513	
USFS, Winema National Forest		
Klamath Ranger District	2,665	
Total USFS	59,875	25.09
State of Oregon	1,801	0.76
Eagle Point Urban Growth Boundary	2,046	0.86

Ownership	Acres	Percent of Watershed
Private	120,123	50.34
Total	238,598	100.00

The Northwest Forest Plan designates the portion of the Little Butte Creek Watershed above the confluence of the North and South Fork Little Butte creeks as a Tier 1 Key Watershed. Federal land allocations in the watershed are shown in Table 2 and Map 3.

Table 2. Federal Land Allocations

Federal Land Allocations	Acres
Congressionally Reserved Areas (Sky Lakes Wilderness Area)	3,642
Administratively Withdrawn Areas (Special Areas)[1]	1,073
Late-Successional Reserve	52,980
Riparian Reserves (estimated)[2]	10,791
Matrix	56,933
Tier 1 Key Watershed	86,776

1/ Special Areas are: Irene Hollenbeck Environmental Education Area (BLM), Lost Lake Research Natural Area (BLM), Round Top Research Natural Area (BLM), and Hole-in-the-Rock Area of Environmental Concern (BLM).

2/ Riparian Reserves occur across all land allocations.

HUMAN USES

The Little Butte Creek Watershed includes the town of Eagle Point, and several unincorporated rural neighborhoods that are focused around White City, Brownsboro, and Lake Creek. These communities all fall within the low elevation, valley portions of the watershed. The Bureau of Land Management (BLM) and Forest Service (FS) manage much of the hills and mountains above the valleys. People use the watershed not only for habitation, but for a variety of economic and recreational purposes. Ranching and farming characterize the private land uses in the valleys; timber harvest and recreational uses occur on the public lands at higher elevations. Federal policies guide management of the public lands, and human use of these lands reflects those policies. Local concerns reflect regional issues, especially over water rights and endangered species.

Native American Tribes

After the end of the "Indian War" of 1855-56, surviving native people were marched to reservations at Grand Ronde and Siletz in the northern Oregon Coast Range. Today, the Confederated Tribes of Grand Ronde and the Confederated Tribes of Siletz include descendants of these Upland Takelma people. They are the federally-recognized native groups with the closest ties to the watershed. Both tribes are active in promoting the heritage and current welfare of their members; they take a strong interest in the management of their native lands. In addition, Klamath people used the easternmost part of the watershed prior to modern settlement; the Klamath Tribes retain an interest in that part of the study area. There are no specific Native American treaty rights reserved in the watershed.

Roads

Roads in the watershed are owned or managed by the BLM, Forest Service, timber companies, Jackson County, and many private landowners. Oregon State Highway 140, which connects Medford and Klamath Falls, is a major transportation corridor through the Little Butte Creek Watershed. Major roads within the watershed include Oregon State Highway 62, Highway 722 (Dead Indian Memorial), County Road 1000, South Fork Little Butte Creek, Lake Creek, and Antelope Creek roads. These major roads and the BLM and Forest Service roads are shown on Map 4.

Travel routes are used by cars, trucks, heavy equipment, motorcycles, bicycles, horses, pedestrians, and other modes of transportation in the watershed. These routes are used for recreation, resource management, and private property access. The BLM and Forest Service provide a transportation system for many different recreation experiences and management opportunities (Map 4).

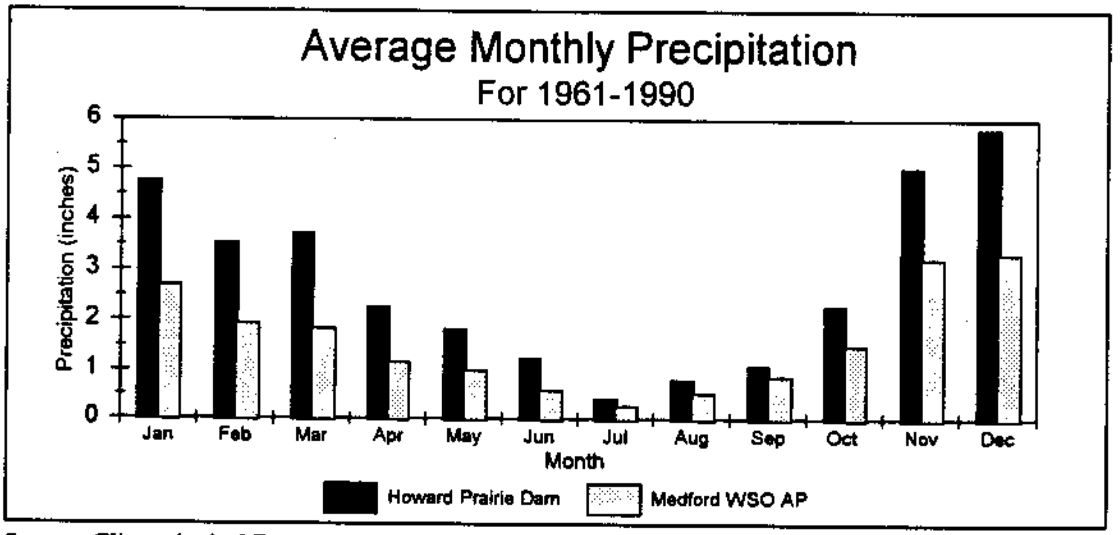
Three road surface types are found on BLM and Forest Service roads: bituminous (asphalt), rocked, and natural (no surface protection). Main access roads usually have a bituminous surface, but may have a crushed rock surface. Roads off main access roads usually have a crushed rock surface, and dead end spurs generally have a natural surface. Adequately surfaced roads generally allow for year-round travel and reduce soil erosion, which helps to minimize stream sedimentation. There are developed quarries on private and federal land in the watershed where rock may be obtained for surfacing roads and drainage protection.

CLIMATE

The Little Butte Creek Watershed is characterized by mild, wet winters and hot, dry summers. During the winter months, the moist, westerly flow of air from the Pacific Ocean results in frequent storms of varied intensities (USDA and USDI 1996). Average annual precipitation in the Little Butte Creek Watershed ranges from approximately 22 inches near the confluence with the Rogue River to 66 inches at Mount McLoughlin (Map 5). Winter precipitation in the higher elevations usually occurs as snow, which ordinarily melts during the spring runoff season from April through June (Barnes 1995). Rain predominates in the lower elevations with the majority occurring in the late fall, winter, and early spring. A mixture of snow and rain occurs between approximately 3,500 feet and 5,000 feet and this area is referred to as either the rain-on-snow zone or transient snow zone. Thirty-one percent of the Little Butte Creek Watershed area is within this zone (Map 6). The snow level in this zone fluctuates throughout the winter in response to alternating warm and cold fronts. Rain-on-snow events originate in the transient snow zone.

The National Oceanic and Atmospheric Administration (NOAA) weather station at Howard Prairie Dam (elevation 4,568 ft.), located approximately six miles from the upper reaches of the South Fork Little Butte Creek, provides precipitation data that is representative of the high elevation areas within the Little Butte Creek Watershed. The NOAA weather station located in Medford (elevation 1,300 ft.), approximately six miles south of the mouth of Little Butte Creek, provides precipitation data that is representative of the lower elevation areas within the Little Butte Creek Watershed. Precipitation distributions by monthly average for the Medford and Howard Prairie Dam stations are shown on Figure 1. The majority of precipitation falls during November through March (70 percent of the yearly total). Annual precipitation fluctuates widely from year-to-year in the Little Butte Creek Watershed. The 30-year average (normal) annual precipitation at the Howard Prairie Dam station is 32.78 inches and at the Medford station it is 18.86 inches (NOAA 1996). Figures 2 and 3 show the cumulative surplus/deficit over the past 30 years using a 5-year moving average for both NOAA stations. Below normal precipitation has occurred during 6 of the past 10 years (through water year 1996).

Figure 1. Precipitation at Medford and Howard Prairie Dam NOAA Stations



Source: Climatological Data Annual Summary (NOAA 1996)

Figure 2. Five-Year Cumulative Precipitation Surplus/Deficit at Howard Prairie Dam

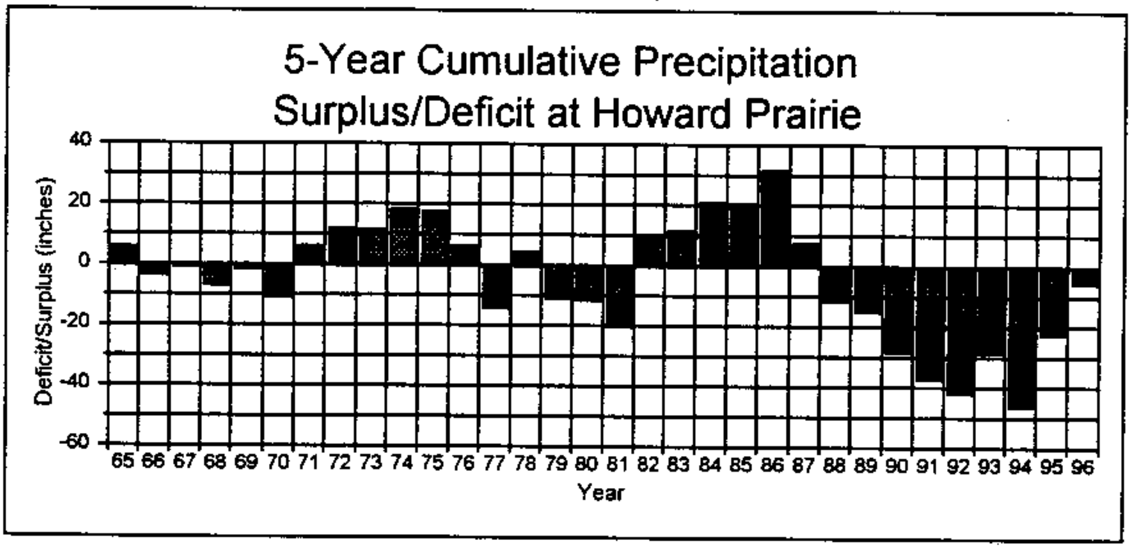
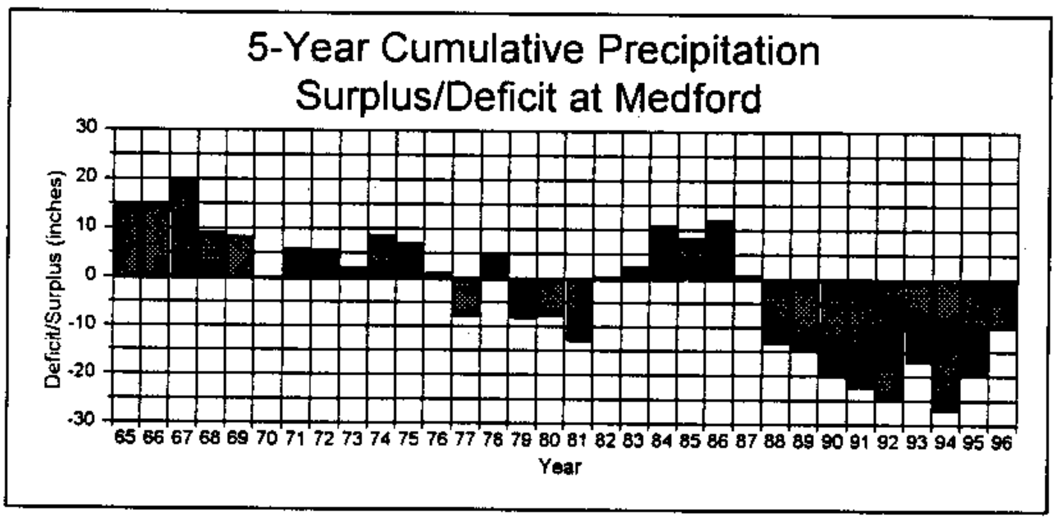


Figure 3. Five-Year Cumulative Precipitation Surplus/Deficit at Medford



During the summer months, the area is dominated by the Pacific high pressure system, which results in hot, dry summers. Summer rainstorms occur occasionally and are usually of short duration and limited area coverage. The nearest NOAA weather stations with air temperature data are located at Howard Prairie Dam and at the Medford Weather Station. Average monthly maximum, mean, and minimum air temperatures for these two stations are displayed in Figures 4 and 5.

Figure 4. Air Temperature at Howard Prairie Dam NOAA Station

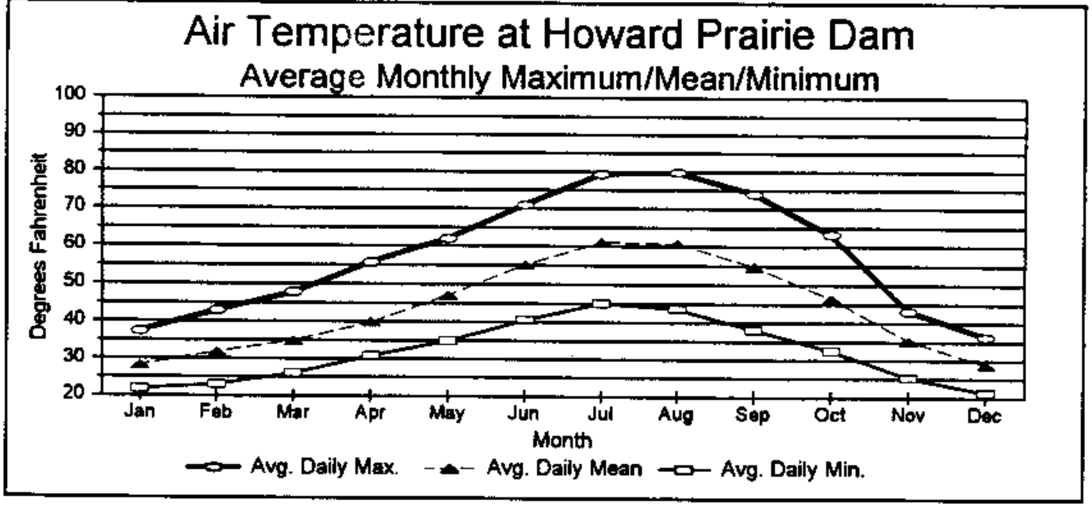
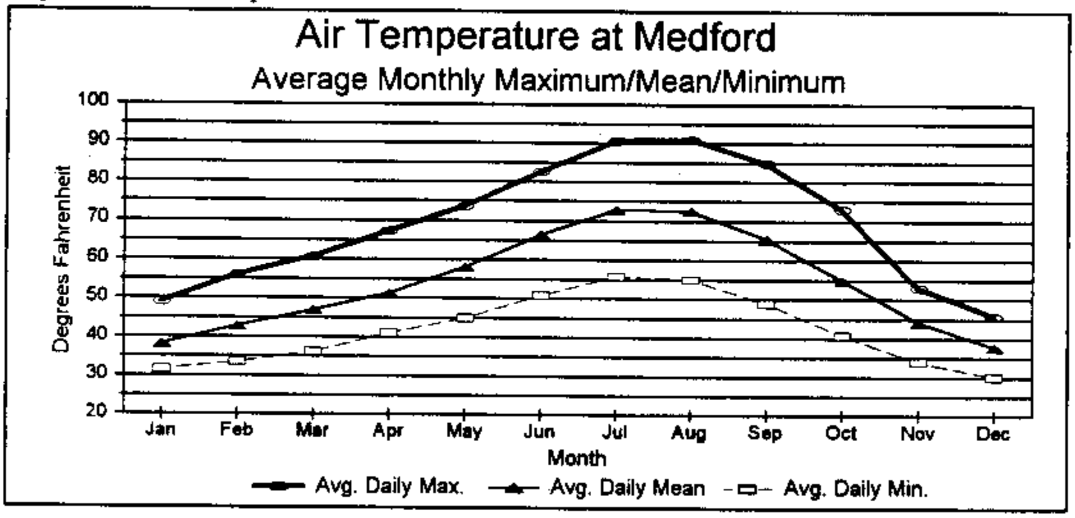


Figure 5. Air Temperature at Medford NOAA Station



Current climatic patterns need to be viewed with a long-term perspective. Based on tree-ring growth rates and recorded meteorological data, the past 200 to 300 years have been marked by cycles of hot, dry spells and temperate-to-cool weather that have lasted varying periods of time (LaLande 1995).

GEOLOGY AND GEOMORPHOLOGY

The Little Butte Creek Watershed is located in the Cascades Physiographic Province. This province is composed of two volcanic subprovinces, the Western Cascades and High Cascades, both represented in this watershed. The contact between the two subprovinces generally divides the area from north to south as shown on Map 7. The Western Cascades geology is composed of older, softer volcanic materials. High Cascade rock types are much younger and are composed mainly of harder lava flows. This watershed contains strata spanning 25 million years of volcanism and sedimentation (Hladky 1995).

Western Cascades Subprovince

The Western Cascades are located on approximately the western three-quarters of the watershed. This portion of the watershed is deeply dissected and has a well-developed dendritic drainage pattern in response to landsliding and surface erosion. The Western Cascades developed from large composite and shield volcanos. A majority of the Western Cascades are dominated in this watershed by lava flows of basaltic andesite, basalt, and andesite of the Wasson, Heppsie, and Roxy formations. These lavas are interlayered with softer pyroclastic flows of andesitic tuff, basaltic breccia, ash flow tuff, dacite tuff, and andesitic breccia (Appendix B and Map 8). These pyroclastic materials often interfinger with the lavas making the area subject to landsliding during rain-on-snow or intense storm events.

Volcanic activities/eruptions of the Western Cascades were constructional features during the early formation of the Cascade Mountains. Geologic mapping and potassium-argon ages suggest that Cascade Range volcanism was widespread approximately 35 million years ago (Sherrod and Smith 1989). Fluid basaltic lavas from small, broad shield volcanos built the ancient topography into a more gentle and flatter mountain range.

During late Oligocene and early Miocene time, basaltic and andesitic volcanos of moderate height grew and lavas were erupted onto mountainous terrain and filled valleys (Hladky 1995). Dacitic pyroclastic flows from distant sources were erupted and intermittently deposited in some of the lowland areas between and over portions of the basalt and andesite lava flows from larger stratovolcanos to the north. These softer rock types were eventually covered, at least partially, by newer lava flows and pyroclastic eruptions. Several millions of years later, as the climate became more moist, large earthflow landslides and significant surface erosion occurred which modified the smooth landscape. During this time, drainages slowly formed a more branching pattern as the Western Cascades developed.

The Lake Creek Quadrangle was recently mapped by the State of Oregon (Hladky 1995). This area of detailed mapping revealed that there are a series of six shallow lava flows located just south of Lake Creek, which extend south and west for several miles. These units are below the Wasson Formation known as the Roxy Formation. These lavas consist of mostly basaltic andesites flows. Three other lava flows of similar composition were mapped around Heppsie Mountain (Heppsie Formation). These flows are on top of portions of the Wasson Formation southwest of Lake Creek. This area also contains numerous landslide deposits.

Large bluffs of flow agglomerate, breccia, ash-flow tuff, and mudflow deposits (also Wasson Formation) are located in a band running through the central portion of the watershed. Thirty to 60 feet tall bluffs are common on the steep slopes north of the South Fork of the Little Butte Creek. Tuff and breccia outcrops grade laterally into lava flows of basalt and basaltic andesite composition.

This subprovince also includes small areas of alluvial, landslide and sedimentary deposits (Smith et al. 1982). Slopes are often unstable where steep terrain and/or pyroclastic rock types are found underlying lava flows. The geology map (Map 8) reflects the approximate locations of the largest landslides where the Qls symbol occurs. Most of the largest landslide deposits are generally located in the western half of the watershed. These landslides are from much older events than the active slides mapped on federal lands (see Riparian Reserves and unstable areas shown on Map 29 for active slides) in the eastern portion of the watershed.

High Cascades Subprovince

Millions of years later, after significant tilting, erosion, and landsliding altered the Western Cascades, the High Cascades began to erupt lavas over the eastern edge of the watershed. This episode of volcanism from local vents produced the more prominent peaks that form the High Cascades. The peaks still appear in sharp contrast to the Western Cascades. The lava from the larger volcanic cones masked some of the older topography and built a high plateau above it. The flows created a more subdued topography, that is less dissected and gentler than its western neighbor. Most of the largest alluvial stream terraces, located in the western third of the watershed, were constructed during this time. The High Cascades materials are less erodible and are not as unstable as the Western Cascades soils and rocks.

The High Cascades Subprovince originated from young volcanic cones from Brown Mountain, Mount McLoughlin, Bieberstedt Butte, Esmond Mountain, Pelican Butte, and Robinson Butte. Of these volcanos, only Pelican Butte and the northern portions of Mount McLoughlin are located outside of the watershed. All of these mountains are stratovolcanos (consisting of interlayered lavas and pyroclastic deposits). A majority of the lavas flowed into the watershed from the north and east, overlapping the eastern margin of the Western Cascades.

High cascades lava flows are characterized as having gentler, smoother, and much less dissected slopes than the Western Cascades. Rock types of the High Cascades include basaltic andesite, andesite, and basalt lavas (Map 8). There are also five small outcrops of cinders and flow breccia in the eastern quarter of the watershed. Soils are generally shallower and less weathered in this subprovince.

Stream terraces, derived from both High and Western Cascades lavas and sediment, are mostly located in the extreme western edge of the watershed just above the valley bottom. These terraces consist of unconsolidated deposits of gravel, cobbles, and boulders intermixed and interlayered with clay, silt, and sand. Terraces are located above present floodplains (Walker and Macleod 1991). The alluvium and valley bottom are much wider in the western part of the watershed.

Faulting and Earthquakes

There are several ancient faults located within the watershed. The best known is the Wasson Canyon Fault, which extends from the North Fork Little Butte Creek to the stream channel up Wasson Canyon. A majority of the other faults are located near the confluence of the South and North Fork Little Butte creeks and trend northwesterly parallel to South Fork Little Butte Creek. None of these faults cross the South Fork Little Butte Creek and typically these faults have only about 10 feet of displacement (Hladky 1995; Kienle et al. 1981).

Earthquakes have occurred in the watershed over time, but most of the recent earthquakes have an epicenter near Klamath Falls. The region is affected by Klamath Falls basin and range extensional faulting, which has resulted in numerous fault block movements over long periods of geologic time. Large earthquakes from Klamath Falls have occurred as recently as 1993. On October 27, 1993 an earthquake that measured at 6.1 on the Richter scale shook a large portion of southern Oregon. Buildings, roads, and bridges do not usually sustain damage from earthquakes of this size and at this distance from the epicenter.

Soil Development

Lava rock of the High and Western Cascades in the watershed were erupted directly at the surface of the ground. The weathering processes slowly broke down the rock for millions of year, until eventually soils were developed. After the eruptions little, if any, vegetation grew for long periods of time.

Most of the Western Cascades soils have a higher clay content than the High Cascades soils and, consequently, have much lower infiltration rates. Soils of the High Cascades contain more silt, sand, and gravels than the Western Cascades.

Soils of the watershed have been classified using the Soil Resource Inventory (Badura et al. 1977) on the Rogue River National Forest and by the Soil Conservation Service (USDA 1993) for a large majority of the area. These soil inventory documents should be utilized to assess impacts and mitigation measures needed for project specific work within the watershed.

Geomorphic Landforms

There are six principal geomorphic landforms/terrains found in the Little Butte Creek Watershed (Map 9). Table 3 displays the distribution of geomorphic subdivisions and their associated terrains. These geomorphic subdivisions were developed to stratify and describe processes and characteristics occurring in the watershed. This information is conceptual and should only be used for planning level and general analysis work.

Table 3. Terrain Characteristics by Geomorphic Landform

Terrain Characteristics	Geomorphic Landforms					
	Valley Floor	**Alluvial Bottom**	**Stream Terrace**	**Canyon Sideslopes**	**Lava Plateau**	**Volcanic Peak**
Percentage of Watershed	31	4	8	25	29	3
Elevation	1,300 to 3,200 feet	1,200 to 2,100 feet	1,350 to 2,000 feet	2,200 to 5,300 feet	4,400 to 6,000 feet	4,800 to 9,495 feet
Slope Gradient Range (percent)	5 to 45	2 to 7	2 to 12	35 to 80	3 to 55	30 to 75
Slope Shape	smooth, gentle with alluvial terraces and minor benches	irregular along stream channel; smooth on associated floodplains and alluvial fans	smooth, regular	concave and convex	smooth, gentle with concave and convex slopes	steep to moderately steep mountainous terrain, mostly smooth with some benches
Rock Types	andesite, basaltic andesite, breccia, agglomerate, tuff	volcanic breccia, tuff, agglomerate, basaltic andesite, basalt, and mixed alluvium	volcanic breccia, tuff, agglomerate, basaltic andesite, basalt, and other mixed alluvium	basaltic andesite, andesite, basalt, flow breccia, tuff, and agglomerate	andesite, basaltic, and minor ash flow tuff, cinders and breccia	andesite, basaltic andesite, minor cinders/tuff/ breccia
Major Slope Processes	earthflows, surface erosion, alluvial, ravel (associated with steeper slopes)	alluvial, channel erosion, deposition in floodplains	alluvial, depositional	earthflows, slumps, sheet erosion, ravel	ravel (associated with steeper slopes), soil creep, and surface erosion	ravel, soil creep, surface erosion and slumps
Erosion Potential	slight to moderate	moderate to high along stream channels, slight floodplain	low to moderate	high	slight to moderate	slight to moderate
Slope Stability	predominately stable	stable	stable	unstable to moderately stable	stable	stable

Terrain Characteristics	Geomorphic Landforms					
	Valley Floor	**Alluvial Bottom**	**Stream Terrace**	**Canyon Sideslopes**	**Lava Plateau**	**Volcanic Peak**
Site Productivity	high	high	high	low to moderately high	moderately high to high, except recent cinders are low	moderate except low in recent lava flow areas
Soils	loams, sandy loams, gravelly silt, silty clay ranging from 3 to 8 feet thick	sandy loams, gravelly silt loam, silty clay loam ranging from 2 to 5 feet thick	gravelly silt loam, silty clay loam, sandy loam ranging from 3 to 8 feet thick	loams, clay loams and silty clay loams, ranging from 3 to 10 feet thick	silty loams, sandy loams, silty clay, ranging from 2 to 8 feet thick	silty clay loam, loam, sandy loam, ranging from 2 to 4 feet thick

Valley Floor

Valley floor landform consists of the portion of the Western Cascades in the lower elevations with low to moderate relief. This landform is made up of lava and pyroclastic rock ranging in age from Oligocene to late Miocene. During the Miocene, the rock was uplifted, folded, faulted, affected by intruding shallow stocks, and then deeply eroded. Rock strata typically include beds of volcanic ash (tuff), large flows of andesite lava, and layers of andesite breccia and agglomerate.

Soils that formed in this landform were directly influenced by the weatherability of the parent material. The soils that formed in material from hard andesite and basalt are shallow and medium textured with coarse fragments. Soils that formed on concave slopes frequently are subject to increased weathering because of the concentration of water and the influence of easily weathered tuff and breccia. These alluvial soils are moderately deep or deep and commonly have dense subsoils or claypans, that slowly permeate.

Alluvial Bottom

Alluvial bottom landform consists of portions of the Western Cascades Subprovince along stream channels and floodplains of Little Butte, Yankee, and Antelope creeks. The surface is characterized by low relief and includes stream channels (some of which have been filled), point bar deposits, and abandoned meanders. The soils are generally very deep and are well drained. Accumulations of organic matter and weak grades of soil structure are the only morphological evidence of soil formation on this landform. The content of organic matter in these soils irregularly decreases as depth increases, indicating the parent material was recently deposited by water. The morphology of this landform changes constantly as the stream channels migrate and bed material is transported from the uplands.

Stream Terrace

Stream terrace landform consists of the portion of the Western Cascades Subprovince along stream terraces and alluvial fan terraces of Little Butte, Yankee, and Antelope creeks. The surface is characterized by low relief and patterned ground. The patterned ground suggests a nearly contemporaneous development that probably occurred during periods of extensive alpine glaciation in the Cascade Mountains. The soils range from shallow to deep usually with an associated hardpan or duripan and are somewhat poorly drained. On the basis of the position of the soils on the landscape and their degree of weathering, this landform is estimated to be late Pleistocene age (formed when the stream levels were higher).

Canyon Sideslopes

Canyon sideslopes landform contains steep to moderately steep and highly dissected terrain. Landsliding and erosion are common and helped shape the area. Large woody material and colluvial rocks transported from landslides and channel erosion in canyon sideslopes are generally beneficial to fisheries habitat over the long term. Soils are often mixed where large earthflow landslides occur.

Lava Plateau

Lava plateau landform covers a large majority of the eastern edge of the watershed. (This area is commonly referred to as the Dead Indian Plateau). Lava plateau terrain was formed primarily by geologically recent volcanic eruptions/flows of the High Cascades Subprovince. It is characterized by gentle landforms and fairly smooth topography. Rock outcrops are common in lava plateau terrain, especially along ridges. Soils have formed in residuum and colluvium of geologically recent volcanic parent material. Topsoils range from 8 to 12 inches in uncompacted conditions. Textures are primarily loams with 25 to 40 percent gravels and cobbles.

Volcanic Peak

Volcanic peak landform, formed from volcanic eruptions, covers small, round portions of the eastern edge of the watershed. It is characterized by smooth, moderately steep to steep slopes of the three youngest stratovolcanos. These areas include Robinson Butte, Brown Mountain, Mount McLoughlin, and other small cinder cones. Most of this landform supports a Shasta red fir forest plant community except for the recent lava and cinder cone terrain which lack tree cover. Slope gradients are some of the steepest of all landforms. Rock outcrops are common, especially on ridge lines, ridgetops, and adjacent to ridges.

Soils have formed on residuum and colluvium of recent volcanic parent material. Textures are primarily loams with 25 to 40 percent gravels and cobbles, grading to sandy loams near the cinder cones. Depth to bedrock is typically 2 to 4 feet, but can extend up to 12 feet in areas of cinder deposits.

EROSION PROCESSES

Mass Wasting

Mass wasting is a term for describing a wide variety of processes that involve natural or human-caused downslope movement of masses of soil and rock material. The term "landslide" is commonly used as a blanket term that covers several modes of slope instability (Haneberg and Sims 1995). When these processes are active, as they were during the January 1997 storm, large adjustments in stream channels and hillslopes can occur (Haneburg and Sims 1995). Landslides can transport material rapidly as in the case of debris torrents, or occur slowly as with earthflows or creep movement. These mass wasting events often cause adverse impacts to fisheries habitat by depositing large volumes of sediment into the streams. Road, bridges, and culverts are often damaged when major storm events such as the 1964, 1974, and 1997 floods trigger landslides.

Large portions of the Western Cascades and the western edge of the High Cascades Subprovince of the Little Butte Creek Watershed are moderately stable to unstable due to steep slopes, moderate precipitation rates, and the natural weakness of many of the volcanic soil/rock types.

The following are the landslide types that are found in the watershed and are listed in order by their potential for sediment delivery to area streams (see Riparian Reserves and unstable areas shown on Map 29 for active slides).

Earthflows: Earthflows are slow moving landslides that generally travel shorter distances downslope than debris flows/slides. Unless they occur adjacent to streams, earthflows enter streams less often and with less material than debris slides and flows. These slides can be very large and deep (areas with Qls symbol on Map 8). Earthflows may also occur in combination with other failure types. Earthflows occur in all subwatersheds, but are more concentrated on the western two-thirds of the watershed. Earthflows are the most common type of landslide in the watershed.

Debris slides: Debris slides are one of the primary mechanisms for the delivery of coarse sediment to streams. These are rapid mass wasting events that carry large volumes of rock, soil, and vegetation downslope. Debris slides are often associated with steep slopes, unstable stream channels, and other wetland areas. Several old debris slides are located along Dead Indian Creek Canyon on the lower third of the slopes and along the upper reaches of South Fork of Little Butte Creek Canyon. Debris slides are the second most common of the landslides.

Slump earthflows: Slumps are small localized failures that move as a unit and travel short distances from where they originate. Slumps are often associated with road cut and fill slopes or small localized areas of instability. Slumps generally do not deliver significant volumes of sediment to streams unless they are located adjacent to stream channels. Slumps are the third most common type of slide and occur in all subwatersheds of the watershed.

Debris flows/torrents: These slides transport large volumes of material and move further downslope producing more sediment than all other landslides. Large rocks and coarse woody material (CWM) are also transported to area streams with this type of landslide. Debris torrents are the least common type of landslides in this watershed.

Surface Erosion

Surface erosion is the wearing away of soil and rock by weathering through the actions of wind, water, and ice. Surface erosion transports large volumes of sediment to streams every year. The largest volumes of sediment are moved during intense storms of long duration. The main factors influencing erosion in the Little Butte Creek Watershed are high intensity storms, rain-on-snow events, clay and sandy soil types, and high water velocities.

Ravel is the continual down slope movement of soil and small rock particles under gravitational force. Ravel occurs most frequently when slopes are void of vegetative cover or sparsely vegetated and steep. Ravel and sheet erosion are more common in the volcanic peak, canyon sideslopes and stream terrace geomorphic landforms. Under natural conditions, sheet erosion occurs only when duff, litter, or plant cover has been significantly removed, exposing soils to the erosive forces of rainfall.

Rill and gully erosion occur most frequently when surface water run-off is concentrated and confined into narrow spaces, especially on coarse-grained soils. Rill and gully erosion are more common in the canyon sideslopes, stream terrace, and valley floor geomorphic landforms.

Map 10 gives a generalized erosion potential rating for each landform unit. It assumes that the soil is bare of vegetative or organic cover and the landscape is under a normal rainfall regime.

See Appendix C for inventory methods of landslide hazard zones.

SOIL PRODUCTIVITY

Soil of the Little Butte Creek Watershed serves two important functions: it is the primary medium for most vegetative life in the watershed, and it filters and stores water that is slowly released into the nearby stream courses.

Soil productivity is the capability of a soil to produce a specified plant or sequence of plants under specific management (USDA 1993). Soil productivity of forest lands is largely defined in terms of site quality, which is measured by the volume of timber the land can produce in a given time. Site quality within a given microclimate is associated with the soil's capacity to provide moisture and nutrients. The soil's ability to provide moisture is dependent on the texture, depth, and rock fragment content in the rooting zone. The ability of a soil to provide nutrients necessary for plant growth is dependent on soil organisms and organic matter content. Beneficial soil organisms control many biological processes within the soil, such as organic matter decomposition, nitrogen fixation, and plant nutrient uptake (Amaranthus 1989). A cool, moist environment with an abundance of suitable organic matter encourages the growth and productivity of these organisms. Surface duff and woody material insulate the soil layer and keep soil conditions cool and moist. Therefore, the depth of surface duff and the abundance of downed woody material is a good indication of site productivity. Generally, the more productive forest soils are found in areas of higher precipitation, on northerly aspects adjacent to streams, or in areas of dense forest canopy.

LANDSCAPE VEGETATION PATTERN

Landscape Patterns

The present day vegetation pattern across the watershed landscape results from the dynamic processes of nature and human influences over time. As a consequence, the variation and scales of landscape components are innumerable.

Landscape ecological analysis and design are not new concepts, but have been brought to the forefront of natural resource management with the concept of ecosystem-based management. Landscapes are thought of as aggregates of similar patches of vegetation and landforms that originate through climatic influences, geomorphic processes, natural disturbances, human activities, and plant succession (Forman and Godron 1986). Diaz and Apostol (1992) describe landscapes as having three elements: matrix, patches, and corridors. Matrix is defined as the most contiguous vegetation type; patches are areas of vegetation that are similar internally, but differ from the vegetation surrounding them; and corridors are landscape elements that connect similar patches through a dissimilar matrix or aggregation of patches.

Vegetation Classification

The vegetation of the Little Butte Creek Watershed is extremely diverse floristically and synecologically. Franklin and Dyrness (1973) classify the vegetation of the watershed into five distinct zones based on climax species: Interior Valley, Mixed Conifer, White Fir, Shasta Fir, and Mountain Hemlock zones (Map 11). The classification system is based on elevation, temperature, and moisture. As a result, bands or layers of vegetation create the landscape pattern. At a lower level of dichotomy, Atzet and McCrimmon (1990) describe plant associations within the forest zones. Some of these associations are discussed in the Current Conditions section.

A different vegetation pattern is evident (Map 12) when the vegetation structure (various seral stages of the endemic vegetation types and the inherent height differences) is analyzed within each vegetation zone. The vegetation pattern becomes more complex when more structural components are included in the analysis. A patchy vegetation pattern is the result of different vegetation diameter and height classes. The vegetation map is derived from Western Oregon Digital Image Processing (WODIP) satellite imagery data (Pacer Infotec Inc. 1993). The satellite imagery map categorizes the watershed vegetation into various vegetation types, landform types and seral stages. The percent composition of each plant classification in the watershed is shown in Table 4.

Table 4. Structural Components of Little Butte Creek Watershed Vegetation Map

Classification	Percent of Watershed	Description			
Water	1				
Rock	4	Defined as bare ground or rock.			
Urban/Agricultural	18				
Grassland/Shrubland	24				
Hardwoods	4	Defined as all hardwoods regardless of size or canopy closure.			
Early Seral Vegetation	1	Originally defined as recent clearcut but may also include grassland.			
		DBH	Vegetation Type	Structure	% Canopy Closure
Seedlings through Poles	24	< 10"	conifer & mixed	all stories	all closures
Large Poles	11	10-19"	conifer & mixed	all stories	all closures
Mature	7	>20"	conifer & mixed	all stories	<65
		>20"	conifer & mixed	1 story	≥ 65
Late Successional	6	>20"	conifer & mixed	2 story	≥ 65
		>30"	conifer & mixed	2 story	≥ 65

Source: Western Oregon Digital Image Processing (one pixel = 25 meters)

Within the Interior Valley Zone, the matrix is grasslands and shrublands. The conifer and hardwood forests occupy the cooler, more moist northern aspects. The opposite is true in the eastern part of the watershed. Conifer forest becomes the matrix and the shrublands and grasslands become much smaller in patch size on the dry, southern aspects.

Throughout the watershed, patch density is high and patches are numerous, small (3 to 25 acres), and adjacent to each other. In the Interior Valley Zone, human activity is the primary reason for the large number of patches within a defined area. Patch density is also high within the forest zones because of logging, topography and aspect changes, soil differences, plant succession, and the edge effect between the different forest zones. The result is a close proximity between neighboring patches and an extreme richness in the number of landscape elements.

Seral Stages

Natural succession will be continuously changing the landscape vegetation and there is no single stage of a forest that can be considered to be the only natural stage. The majority of the vegetation types shown in Map 12 are in the mature seral stage (approximately 80 to 200 years of age). This is the stage when vegetation vigor slows and structural diversity develops. As a general rule, the larger forested areas of mature and late-successional seral stages are not accessible by roads. In the lower elevations, or where roads access an area, more early (0 to 10 years) and mid-seral (10 to 40 years) vegetation is found.

The clearcut harvest method has had a pronounced effect on the landscape vegetation pattern, especially in the White and Shasta Fir zones. The high density of early and mid-seral stage patches created by clearcutting may have fragmented the historically continuous forest matrix in some areas. In the Interior Valley and Mixed Conifer zones, clearcutting has simulated some of the effects from fire by maintaining openings for early seral species.

Fire is an essential ecosystem process that sometimes has large-scale effects. Fire suppression is the primary reason that the succession of plant communities has progressed towards climax conditions. Currently, the primary influences on the dynamics of forest stand structure are drought and the smaller scale natural processes of frost action, plant succession, bark beetle infestations, forest pathogens, the encroachment of non-native species, and animal damage. All of these processes are slowly shifting the forests from the stem exclusion stage to the understory reinitiation stage and old-growth stages of forest stand development. Silvicultural practices may help to speed up the forest stand development process and maintain certain plant communities.

PLANT SPECIES AND HABITATS

Non-Native Plant Species and Noxious Weeds

There are at least 200 non-native plant species established in the watershed. Probably half of these are on the valley floor and in the low foothills where human disturbance has been most intense and climate is most favorable for the invaders. In these areas, the majority of the biomass of herbaceous vegetation is composed of non-native species. They are also abundant and often dominant in moist mountain meadows at higher elevations and other disturbed open areas where seeding has occurred in the past.

Noxious weeds designated by the Oregon Department of Agriculture (ODA) are divided into three groups: "T" (target list which are the highest priority for control), "A" (second highest priority for control), and "B" (third highest priority for control). A 1997 noxious weed inventory in the Little Butte Creek Watershed identified six noxious weed species: yellow starthistle ("T"), rush skeletonweed ("T"), Canada thistle ("A"), Scotch broom ("B"), spotted knapweed ("B"), and diffuse knapweed ("B"). Range monitoring in 1996 identified four additional noxious weed species in the watershed: leafy spurge ("T"), purple loosestrife ("A"), St. Johnswort (Klamath weed) ("B"), and medusahead rye ("B"). Other noxious weeds that are known to occur in the surrounding area and have the potential to spread to Little Butte Creek Watershed are: Squarrose knapweed ("T"), Tansy ragwort ("T"), French broom ("B"), Italian thistle ("B"), meadow knapweed ("B"), and Russian knapweed ("B").

Five unwanted species that have not been designated as noxious weeds by the ODA have also been seen in the Little Butte Creek Watershed: ripgut brome, hedgehog dogtail, dodder, Spanish broom, and common skeletonweed.

Descriptions of the noxious weed and unwanted species that have been found in the watershed are presented in Appendix E.

Special Status Plant Species and Habitats

There are 22 rare vascular plants known to occur in the Little Butte Creek Watershed. These include species with Forest Service (FS) or Bureau of Land Management (BLM) status, as well as species that are rare local elements of biological diversity but are more common elsewhere in Oregon or nationally. Of these 22, 7 are considered at high risk of extirpation from the watershed in the next 100 years and 2 more are considered at some risk of extirpation in the next 100 years.

There are four areas with special land allocations emphasizing botanical resources. They are: Irene Hollenbeck Environmental Education Area, BLM; Lost Lake Research Natural Area, BLM; Roundtop Research Natural Area, BLM; and Roundtop Preserve, The Nature Conservancy.

Survey and Manage Plant Species and Habitats

There are two Survey and Manage (strategy two) vascular plant species known to occur in the watershed and suitable habitat (likely occupied) for one more.

There is only one known occurrence of a Survey and Manage fungus in the watershed. There is potential habitat for many others. Species (including protection buffer species) that require a survey for potential habitat prior to ground-disturbing activity are three mosses, four liverworts, and six fungi in the watershed. There is no potential habitat for Survey and Manage lichens in the watershed.

Noteworthy habitats containing unusual plant communities and species not found in the majority of the watershed are: Subalpine and alpine communities on the south side of Mount McLoughlin and possibly at the summit of Brown Mountain; mounded prairie/vernal pool areas around Lake Creek and on the valley floor; remnant oak/pine savannah on the valley floor and lower foothills; scablands with shallow soils over basalt/andesite; basalt/andesite cliffs and outcrops; moist mountain meadows; western white pine component; Engelmann spruce stands; quaking aspen stands; and one or more bogs in the upper reaches of the watershed.

FIRE

Fire is recognized within the Northwest Forest Plan as a key natural disturbance process throughout the Klamath Geologic Province. An areas' fire regime is determined by the combination of climate, topography, and vegetation. Fire regime is a broad term that includes fire type, intensity, size, and return interval.

Vegetation zones are helpful in delineating fire regimes. The zones listed in Table 5 are taken from Vegetation of Oregon and Washington (Franklin and Dyrness 1973).

Table 5. Fire Regime by Vegetation Zones

Elevation (feet)	Southern Cascade Vegetation Zones
Above 8,200	Alpine
8,200-6,562	Mountain Hemlock
6,562-5,469	Shasta Red Fir
5,469-4,811	White Fir
4,811-3,058	Mixed Conifer
3,058-1,419	Interior Valley

Using vegetation zones as a basis for fire regime delineation, there are three broad fire regimes within this watershed: low to moderate, moderate, and high. The Interior Valley and Mixed Conifer vegetation zones at the lower elevations within the watershed are classified as a low to moderate severity regime. Fire effects to vegetation and soil are the usual indicators of fire severity. Currently much of the lower elevation areas have dense shrubs, hardwoods and conifer conditions due to decades of fire exclusion where previously open grass/oak/pine savannas or Douglas-fir and other conifers predominated. Before fire exclusion, a low-severity regime was characterized by the type of vegetation condition and normal summer temperatures and normal summer low precipitation amounts. Therefore, fires were frequent (1 to 25 years), burned with lower intensity, and were widespread. Fire effects to vegetation with low severity fires maintained vegetation conditions across the landscape. Moderate-severity regimes are characterized by long summer dry periods so fires are infrequent (25 to 100 years) and burn with different degrees of intensity. Stand replacement fires occur within this regime as well as low intensity fires. The overall effect of fire on the landscape is a mosaic burn. The high-severity regime is characterized by moist and cool conditions so fires are infrequent. When fires occur within these areas it is due to unusual conditions such as drought or low precipitation periods associated with high winds, and fires historically resulted in stand replacement.

Fire return intervals for the Mixed Conifer and drier portions of the White Fir zone areas of the Dead Indian Plateau range from 8 to 125 years with an average of about 35 years. Because of the gentle slopes of the plateau, fire ignitions that occurred did not spread to the same degree as ignitions with similar vegetation on steep slopes.

Within the Shasta Fir and Mountain Hemlock vegetation zones, fire return intervals are much longer than within similar zones in the Klamath Mountain Range (Atzet et al. 1982). Fire return intervals of 100 to 300 years are not uncommon. This can be partially explained by the higher precipitation amounts in the Cascades as compared with the extreme eastern Siskiyou Mountains.

In the lava fields, fires historically occurred from lightning and burned islands of trees. The Brown Mountain area has exposed lava fields with little or no ground fuels. When fire occurs and is left unsuppressed for a day or two, it may spread by tree torching and prolific spotting, resulting in many acres of fire. Field observations in the lava fields have shown that many of the large Douglas-fir and ponderosa pine have old fire scars.

TERRESTRIAL WILDLIFE SPECIES AND HABITATS

The plant communities and their associated vegetative classifications, as described in the Landscape Vegetation Pattern section, provide habitat for the variety of wildlife species found in the Little Butte Creek Watershed. Approximately 200 wildlife species are known or suspected to use habitat in the watershed for breeding, feeding, or resting.

Two species (northern spotted owl and bald eagle) listed as threatened, and one species (American peregrine falcon) listed as endangered under the Endangered Species Act of 1973, as amended, are present in the watershed. There are 41 northern spotted owl activity centers, 1 bald eagle nest site, and 1 peregrine falcon eyrie. There is a site-specific management plan for the bald eagle nest site; the Northwest Forest Plan is the accepted management plan for the northern spotted owl. Approximately 86,484 acres of the watershed are in northern spotted owl critical habitat unit (CHU) OR-37.

Twenty-three special status species are known or suspected to be present in the analysis area: 3 reptiles, 11 birds, and 9 mammals. These species are either federally-listed as endangered or threatened; are BLM sensitive or assessment species; or are United States Department of Agriculture, Forest Service sensitive species.

The great gray owl, which is recognized as a Protection Buffer species in the Northwest Forest Plan, is present in the watershed. The red tree vole, recognized as a Survey and Manage species in the plan, may be present. The watershed is within the area designated for protocol surveys for red tree voles.

Portions of the watershed are in elk and deer winter range and elk management areas. Management compliance for these areas are addressed in the Medford District Resource Management Plan (USDI 1995) and the Forest Plan for the Rogue River National Forest (USDA 1990).

HYDROLOGY

For purposes of the hydrology discussion, the Little Butte Creek Watershed is stratified into three analysis subwatersheds: North Fork Little Butte Creek, South Fork Little Butte Creek, and Lower Little Butte Creek (from the mouth of Little Butte Creek to the confluence of the North and South Forks) (Map 13).

Hydrologic Features

Groundwater supplies in the Little Butte Creek Watershed are limited due to the low permeability of the volcanic rocks found in the majority of the watershed. Sand and gravel materials within the alluvium at the mouths of Antelope and Little Butte creeks are more permeable, however, these materials are too small in extent to be major groundwater sources. The alluvium is recharged mainly by precipitation and to a lesser extent by infiltration of excess irrigation waters (LBCWC 1995).

Surface water in the Little Butte Creek Watershed includes streams, springs, lakes, wetlands, reservoirs, and ditches (Maps 13 and 14). There are approximately 784 stream miles in the Little Butte Creek Watershed. Table 6 displays stream miles by analysis subwatershed and by Northwest Forest Plan stream category (fish-bearing, permanently flowing nonfish-bearing, and intermittent streams). Only a portion of the nonfish-bearing streams have been inventoried to determine whether they are permanently flowing or intermittent. However, an approximation for the remainder of the nonfish-bearing streams was made to estimate miles of perennial and intermittent streams.

Table 6. Stream Miles by Stream Category

Analysis Subwatershed	Northwest Forest Plan Stream Category			Total Stream Miles
	Fish-bearing Streams Miles	Perennial Nonfish-bearing Streams Miles	Intermittent Streams Miles	
North Fork Little Butte Creek	19.99	1.01	76.04	97.04
South Fork Little Butte Creek	74.70	48.87	169.05	292.62
Lower Little Butte Creek	72.40	19.97	302.28	394.65
Total for Little Butte Creek	167.09	69.85	547.37	784.31

Source: Medford BLM and Rogue River National Forest Geographical Information System (GIS)

Wetlands identified by the U.S. Fish and Wildlife Service in their 1984 National Wetlands Inventory are shown on Map 13. Wetlands in the Little Butte Creek Watershed are classified as palustrine (ponds), lacustrine (lakes), or riverine systems. Many of the wetlands were created by excavations or dike construction. Table 7 summarizes information by analysis subwatershed for palustrine and lacustrine systems. Additional wetlands may be located during site-specific project analysis.

Table 7. Wetlands

Analysis Subwatershed	Palustrine System		Lacustrine System	
	Acres	Number	Acres	Number
North Fork	67.25	51	377.11	1
South Fork	899.57	286	0	0
Lower	416.21	387	315.93	14
Total	1,383.03	724	693.04	15

Source: USFW National Wetlands Inventory (1984)

Major reservoirs within the watershed include Fish Lake, Agate Lake, and Yankee Reservoir. There are numerous ditches and small reservoirs scattered throughout the watershed.

Hydrologic Characteristics

United States Geological Survey (USGS) gaging stations have been located throughout the watershed since the early 1900s, but the USGS has discontinued operation of all their stations. Five of the USGS gaging stations provide the most relevant data for this watershed analysis. They are: South Fork Little Butte Creek at Big Elk Ranger Station, South Fork Little Butte Creek near Lake Creek (0.5 mile upstream from intake of Rogue River Valley Canal), North Fork Little Butte Creek at Fish Lake (0.5 mile downstream from Fish Lake dam), North Fork Little Butte Creek near Lake Creek (1.2 miles upstream from Wasson Canyon), and Little Butte Creek below Eagle Point (four miles upstream from the mouth). Table 8 summarizes information for the five stations.

Table 8. USGS Gaging Stations

Station	Period of Record	Drainage Area (mi.^{2})	Peak Flow (cfs)	Minimum Flow (cfs)	Average Flow (cfs)	Average Runoff (acre-feet/yr.)
S. Fk. @ Big Elk Ranger Station	1927-1950	16.6	145	4	17.9	12,970
S. Fk. near Lake Creek	1922-1957 1961-1982	138	7,660	2	104	75,350
N. Fk. @ Fish Lake	1915 1917-1989	20.8	940	0	35.8	25,940
N. Fk. near Lake Creek	1912-1913 1917 1923-1927 1929-1964 1966-1985	43.8	1,750	11	71.9	52,090
Little Butte below Eagle Point	1908-1916 1924-1926 1946-1950	293	10,000	2	232	167,960

Source: U.S. Geological Survey Water Resources Data (USGS 1958, 1982, 1985, and 1989)

The USGS data was used to develop mean monthly hydrographs for Little Butte Creek below Eagle Point (Figure 6), South Fork Little Butte Creek near Lake Creek (Figure 7), and North Fork Little Butte Creek near Lake Creek (Figure 8) (Hydrosphere Data Products 1996).

Figure 6. Mean Monthly Streamflows for Little Butte Creek below Eagle Point

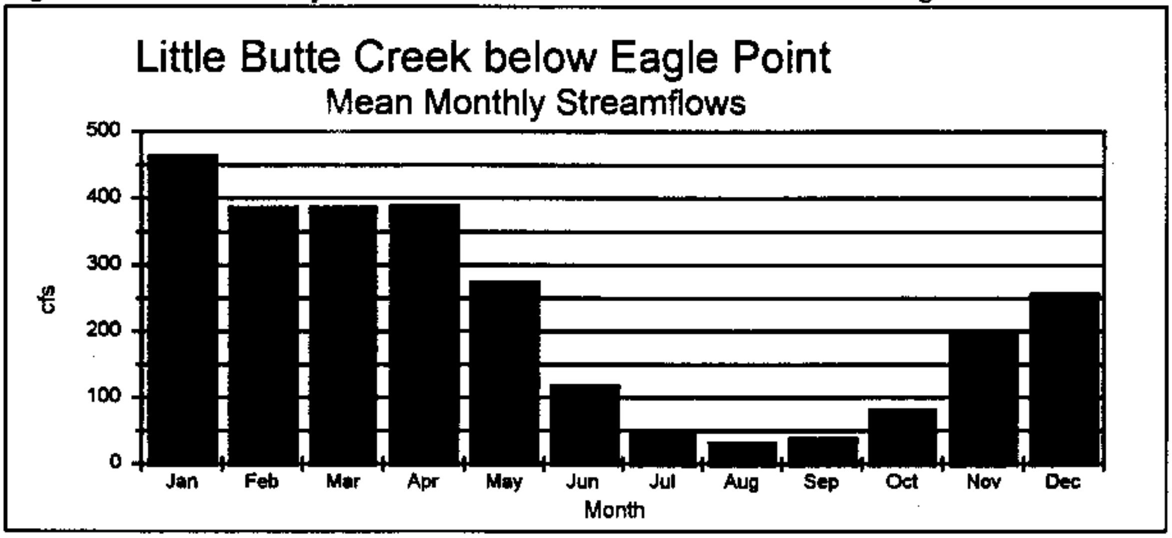


Figure 7. Mean Monthly Streamflows for South Fork Little Butte Creek near Lake Creek

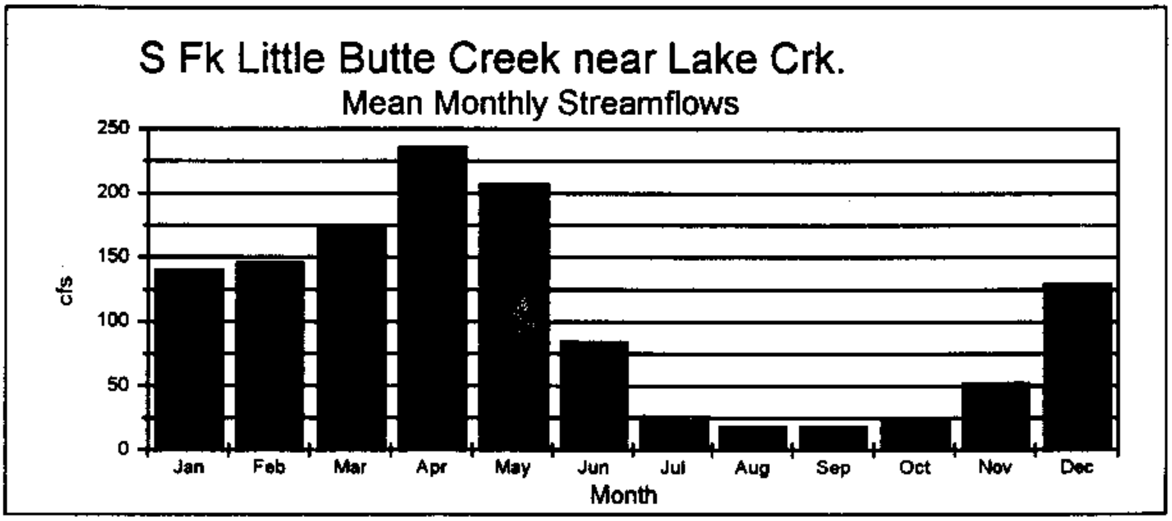
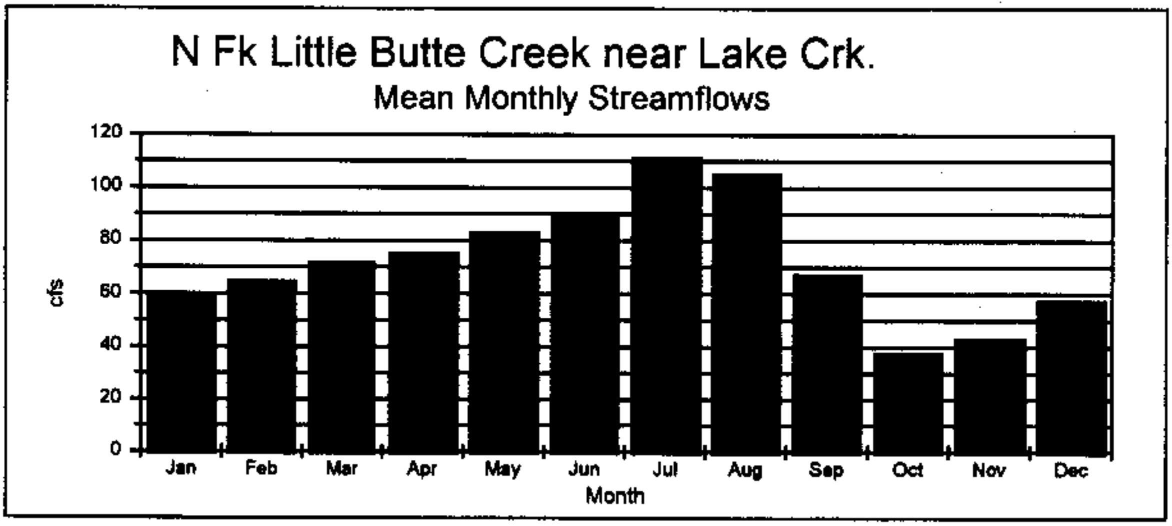


Figure 8. Mean Monthly Streamflows for North Fork Little Butte Creek near Lake Creek



Streamflow in the Little Butte Creek Watershed fluctuates with seasonal variation of precipitation. Moderate to high flows generally occur from mid-November through May. Streamflows during the months of April and May and part of June are augmented by melting snowpack in the high elevations. Low flows normally coincide with the period of low precipitation from July through September or October for Little Butte Creek (Figure 6) and South Fork Little Butte Creek (Figure 7). Streamflow patterns in North Fork Little Butte Creek are dramatically altered by the water transported to Fish Lake from Four Mile Lake in the Klamath Basin. Winter flows in North Fork Little Butte Creek are moderated by storage in Fish Lake and summer flows are greatly increased by releases from Fish Lake (Figure 8).

STREAM CHANNEL

Little Butte Creek is a seventh order stream where it joins the Rogue River. Major tributaries include Antelope Creek (sixth order), South Fork Little Butte Creek (sixth order), and North Fork Little Butte Creek (fourth order). These streams flow in a northwesterly direction. Valley and stream types are described in Aquatic Wildlife.

Stream reaches on the valley floor tend to have meandering patterns, although adjacent roads and dikes have constricted and straightened the channels in many places. Floodplains along streams on the valley floor are functioning and accessible to the streams during high water where the channel has not been confined by roads or dikes. Stream channels in the canyon sideslopes are narrow, V-shaped, relatively straight, entrenched and confined with little to no floodplain development. Streams in the lava plateau are predominantely meandering with developed floodplains in broad valleys and meadows. Some streams, such as Conde Creek, have become entrenched as a result of down-cutting and their floodplains are no longer accessible.

Landslides originating in the canyon sideslopes landform and roads are the primary sources for stream sedimentation in the Little Butte Creek Watershed. Transport mechanisms are debris torrents, earthflows, and high streamflows (Erosion Processes). Sediment transported out of steep reaches is moved downstream during peak flow events. It may be deposited in the low gradient reaches of the valley floor where it stays until the next major high water event moves it out of the Little Butte Creek stream system.

WATER QUALITY

Beneficial uses that are dependent on aquatic resources in the Little Butte Creek Watershed include domestic water supply (municipal and private), irrigation, livestock watering, cold water fish, other aquatic life, wildlife, recreation, and aesthetics (ODEQ 1992). The designation of beneficial uses is important because it determines the water quality criteria that will be applied to that water body. Flow modifications, temperature, dissolved oxygen, pH, bacteria/pathogens, turbidity, sedimentation, and habitat modifications are the key water quality indicators most critical to these beneficial uses for the Little Butte Creek Watershed.

RIPARIAN AREAS

Riparian vegetation in the Little Butte Watershed varies with aspect. North-facing riparian areas provide a cool, moist refuge, especially during southern Oregon's hot summers. The riparian plant community usually differs from those found in the uplands. North-facing drainages on permanently flowing streams have wide riparian areas with a large diversity of trees, shrubs, forbs, and non-vascular plants (mosses, liverworts, etc.). North aspects have more shade-tolerant and water-loving species like maple, alder, dogwood, and yew. South-facing areas on intermittent streams generally have narrow riparian areas, often with upland species like oak mixed in with riparian-dependant species like maple. Riparian areas have more sun-tolerant shrubs like vine maple, holly, wild rose, and oceanspray.

Riparian areas provide habitat for riparian-dependant wildlife species, a transition zone between riparian and upslope habitat, and dispersal corridors for terrestrial wildlife. For example, riparian areas are important for deer fawning and rearing and elk calving and rearing. Black bears often use riparian reserves for travel corridors.

Riparian habitats typically contain a greater wildlife species diversity and abundance than upslope habitats. Some of the animals that depend on riparian areas include fish, mollusks, amphibians, marten, tree voles, bats, beaver, western pond turtles, river otter, California mountain king snake, Cascade frog, bald eagle, dipper, great blue heron, and osprey. More species are found near perennial water; however, vernal pools and seasonal ponds, such as Big Elk Meadow, play a very important role for animals like sandhill cranes, frogs, and garter snakes.

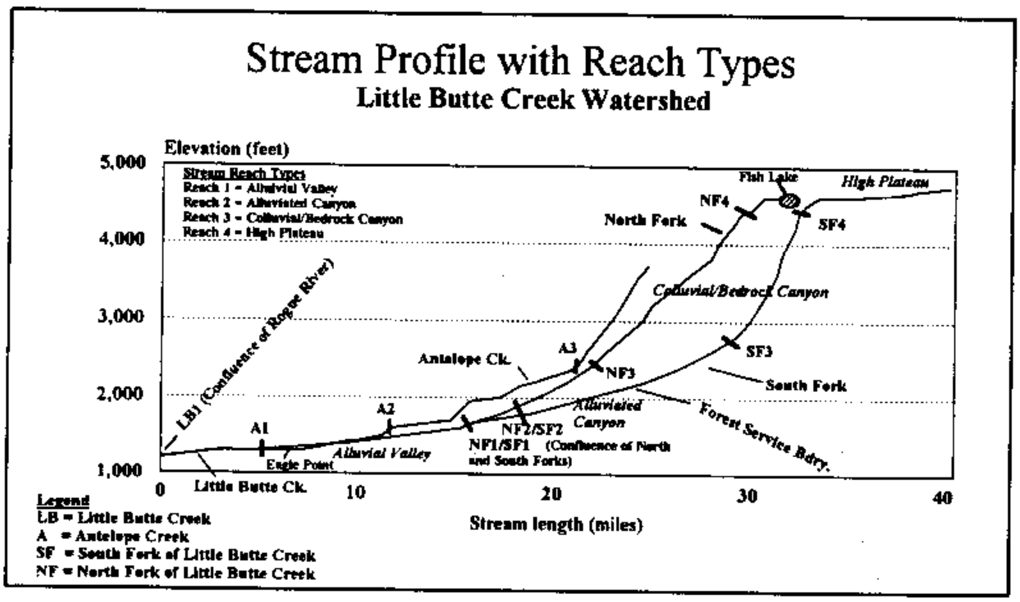
See the Aquatic Wildlife section for discussion of fish, macroinvertebrates, and amphibians.

AQUATIC WILDLIFE SPECIES AND HABITATS

Stream Habitat

Little Butte Creek Watershed is located in the Upper Rogue River Subbasin (Map 1) and lies almost entirely within the Cascade Range. This landscape experiences rapid runoff, erosion and landslides. Five principal valley types dominate the watershed: alluviated, colluvial and bedrock canyons, and alluvial and moderate slope-bound valleys (Frissell 1987). Stream types within these valley types include A, B, C, E, and F (Rosgen 1994).

Figure 9. Stream Profile by Reach Types



Streams in the Little Butte Creek Watershed can be divided into four distinct stream reach types that are based on valley types (Figure 9 and Map 15).

Type 1 reaches are in the lower five miles of the North and South Fork Little Butte creeks, in the lower 3 miles of Antelope Creek and the mainstem of Little Butte Creek. Type 1 reaches flow through 19 miles of private land and towns and account for 25 percent of the watershed. Streams in Type 1 reaches have less than 1 percent slope and are C3, C4, or C5 stream types (Rosgen 1994).

The lower middle segment (Type 2 reach) is from approximately Ellick Creek to approximately Lake Creek. Elevation ranges from 2,000 to 3,500 feet. This area contains alluviated canyons with inclusions of alluvial valleys. Alluviated canyons often have "flats" with more floodplains and terraces (Montgomery 1993). Alluviated canyons and valleys were historically the most productive segments of the stream systems, offering complex habitat of braided and side channels, wood, and deep scour pools. Streams in Type 2 reaches include C3, C4, B3, and B4 stream types (Rosgen 1994). Average slopes range from 1 to 3 percent. Private lands dominate the lower segment of Type 2 reaches and federal lands dominate the upper segment. The transition from Type 2 to 3 reaches is the upper limit of coho salmon habitat in South Fork Little Butte Creek and the most productive due to nonexistent road within this segment.

The upper middle segment (Type 3 reaches) descends from the plateau through steep, deeply dissected colluvial and bedrock canyons with inclusions of alluviated canyons and valleys. This segment is located in the Western Cascades Subprovince at an elevation of 3,500 to 4,000 feet. These streams (upper middle North and South Fork Little Butte creeks and tributaries) are an A1 or A2 stream type (Rosgen 1994) and have average slopes of 3 to 6 percent. Federal lands cover a major portion of these reaches.

The upper segment (Type 4 reaches) is located on the High Cascades Subprovince plateau, "Dead Indian Plateau", above 4,800 feet in elevation. These streams (upper North and South Forks and tributaries), have low gradients (< 1 percent), are unconfined and contain numerous beaver dams. Their stream type is classified as an E5 (Rosgen 1994). Federal lands cover a major portion of this reach.

Little Butte Creek Watershed has a history of management activities, such as agriculture, rural development, and forestry practices that seriously degraded instream habitat conditions (Reference Conditions, Human Uses). In areas where intensive timber harvesting, road construction, agriculture and rural development have occurred, entrenched stream channels, accelerated bank erosion and landslides, and increased channel slope have resulted. After the 1964 flood, the entire South Fork Little Butte Creek system was straightened and channelized by the (then) Soil Conservation Service using heavy equipment. This work removed sinuosity, closed side channels, caused pool and riffle ratios to skew, increased the width to depth ratio and denuded the banks of riparian vegetation. The net effect of all these management activities have been the simplification of aquatic and riparian habitat. Long riffles with few instream features and simplified fish habitat are common throughout the watershed. The stream channels have reduced ability to support diverse ages and sizes of salmon and trout.

Channel morphology has changed less significantly in areas where streams have not been influenced by forest management, agriculture, and rural residential development. These areas are mainly in reach 3, upper middle South Fork Little Butte Creek (unroaded canyon area). Stream temperatures are cold here, partially because of the elevation of these stream segments, resulting in a good steelhead and/or resident rainbow trout population. Presence of large wood and mature canopy cover creates quality salmonid habitat in these areas, however, the stream is too small here to support many large salmon and trout.

Threatened and Endangered Fish

Two special status fishes spawn and rear in the Little Butte Creek Watershed: Northern California/Southern Oregon Coho salmon *(Oncorhynchus kisutch)* and Klamath Mountain Province steelhead (*O. mykiss*). The National Marine Fisheries Service (NMFS) listed coho salmon in the Rogue River and Klamath Basins on June 6, 1997 as threatened under the Endangered Species Act. The NMFS proposed listing the Klamath Mountains Province steelhead under the Endangered Species Act in the March 16, 1995 Federal Register. Determination for the listing is currently scheduled for February 1998.

Anadromous Fish

Approximately 167 miles of streams are fish-bearing; of which 99 miles contain anadromous fish populations (Map 16). Moderate populations of chinook salmon (*O. tshawytscha*), depressed populations of coho salmon (*O. kisutch*), moderate populations of steelhead/rainbow trout, and unknown densities of Pacific lamprey (*Lampetra tridentata*) exist in these streams.

Overall, the Upper Rogue River Subbasin coho salmon stock is depressed (RVCOG 1997). The coho salmon population in the Little Butte Creek Watershed is depressed due to loss of habitat and poor water quality. Coho and chinook salmon spawn in the fall and incubating salmon eggs are more susceptible to fall and winter storm effects. South Fork Little Butte Creek is one of the primary rearing areas within the range of this depressed population of coho salmon. It contains fair numbers of coho salmon during most years. The local plan for the Oregon Coastal Salmon Restoration Initiative (Prevost 1996) designates Little Butte Creek as a core production area for coho salmon.

Coho salmon prefer complex riverain habitat that was once prevalent in the Little Butte Creek Watershed. Primary coho salmon habitat is alluvial valley stream types with diverse off-channel habitat. After the 1964 and 1974 flood events, habitat was simplified by channel straightening, large wood removal, and disconnecting the mainstem from its side channels and other off-channel rearing habitat.

Little Butte Creek Watershed contains two distinct runs of steelhead trout, summer and winter. Summer and winter steelhead trout spawn from January to May. Adult summer steelhead may encounter increased predation and warm stream temperatures during their summer resting in the Rogue River before migrating into the Little Butte Creek tributaries to spawn. Steelhead trout are ubiquitous throughout the watershed but primarily spawn and rear in headwater streams or upper segments of larger stream tributaries. These fish are the "Olympic athletes" and can migrate higher upstream than coho or chinook salmon. Steelhead are able to rear in fast-moving riffle habitat and are somewhat adaptable to degrading habitat conditions. A moderate population of winter steelhead and a reduced summer steelhead population exists.

Chinook salmon are mainstem dwellers. Juvenile chinook are less susceptible to high summer stream temperatures in Little Butte Creek because they migrate to the ocean soon after emerging from the redds. However, chinook are very susceptible to sediment because they spawn in low gradient stream segments where sediment tends to accumulate. Chinook salmon migration is impeded by a five-foot concrete water diversion located on Little Butte Creek. The structure is laddered and only during the spawning period with a good water year are some adult fish able to pass. During low water, passage over the diversion structure poses a significant barrier. This structure is located in the city of Eagle Point 3.5 miles above the confluence with the Rogue River. Chinook probably do not reach as far upstream in Antelope and South and North Fork Little Butte creeks because irrigation withdrawals exacerbate low flow conditions during the late summer and early fall.

Little Butte Creek Watershed Council's action plan contains in-depth spawning and rearing requirements for salmonids (LBCWC 1995).

The Lake Species and Habitat section addresses effects of nonnative warmwater and coldwater fish populations on salmonids.

Resident Fish

Native resident fish in these streams are: rainbow trout (*Oncorhyonchus mykiss)*, cutthroat trout *(O. clarki)*, Klamath smallscale sucker *(Catostomus rimiculus)*, and reticulate sculpin (Cottus perplexus). Resident fish distribution within the Little Butte Creek Watershed is shown on Map 17. Rainbow trout and sculpin are found throughout the watershed. Cutthroat trout tend to inhabit small headwater streams and are found in several tributaries. Searun cutthroat do not migrate up the Rogue River as far as Little Butte Creek (Haight 1995). Klamath smallscale sucker are probably found in habitat similar to coho salmon habitat. Little information exists about the distribution and abundance of sculpin and suckers in this watershed, however, research has established that they do not compete with salmonids.

Introduced Fish

Introduced fishes in the Little Butte Creek Watershed are: eastern brook trout (*Salvelinus fontinalis)*, largemouth bass *(Micropterus salmoides)*, black crappie *(Pomoxis nigromaculatus)*, redside shiners (*Richardsonius balteatus*), tui chub *(Gila bicolor*), brown bullhead *(Ictalurus nebulosus)*, yellow perch (*Perca flavescens)*, and bluegill *(Lepomis macrochirus*). Eastern brook trout exist on the Dead Indian Plateau. They were introduced to the watershed prior to 1960 and are not part of the escaped populations from Fish Lake. A few eastern brook trout were found in Lost Lake and North Fork in upper reach 2 and reach 4, probably from Fish Lake. Largemouth bass, black crappie, redside shiners, and bluegill are found in Agate Lake and private ponds. These fishes are also found in lower Little Butte Creek and Antelope

Creek, where summer stream temperatures exceed 70 degrees Fahrenheit (F). These fish were probably introduced from Agate Lake and private ponds. Redside shiners were introduced into the watershed in the late 1950s. The Klamath speckled dace infiltrated through diversions canals into the watershed from the Jenny Creek Watershed in the 1970s. Both can be found as resident species within the South Fork Little Butte Creek subwatershed (Haight 1995).

See Lake Species and Habitat section for effects of hatchery trout and warmwater fish on native fish populations.

Lake Species and Habitat

Little Butte Creek Watershed contains three significant fish-bearing lakes: Fish, Agate, and Lost lakes. Fish and Agate lakes are used for water storage for irrigation in the adjacent Bear Creek Watershed. All three lakes provide year-round fishing and recreation opportunities for people in the area, thus reducing fishing pressure in streams. Fish Lake (5,000 feet elevation) is spring fed and supplemented by transbasin water from Four Mile Lake in the Klamath Basin. Agate Lake (1,510 feet elevation) is supplemented by irrigation water from the Little Butte Creek stream channel.

Fish and Agate lakes function below their potential for fish production due to a lack of complex habitat in the shoal areas where fish forage. It is difficult for vegetation such as willow and other aquatic vegetation to establish along the shoreline of these lakes because water levels fluctuate. The complete effects that water withdrawals (water level fluctuation) and lack of habitat complexity are having on local fish populations in Fish and Agate lakes are unknown. A bathymetric map of Fish Lake created by Hoover (1971) was used to identify shoal areas for brush bundle placement and willow planting to enhance salmonid fish production and to increase edge for other aquatic species. Fish enhancement in Fish Lake has been ongoing since 1990 by the Oregon Department of Fish and Wildlife, fishing clubs, Boy Scouts of America, various private citizens, local clubs and the Forest Service.

Lost Lake is a natural lake. It is located in the upper reaches of Lost Creek at 3,600 feet elevation. Lost Lake is described in the Oregon Natural Heritage Plan (1987) as "an Aquatic Cell, low elevation lake, in the southern Cascades, surrounded by mixed conifer forest." There is a scarcity of high quality, low elevation lakes in an aquatic setting. As a result, four hundred acres around Lost Lake has been included in the Medford District Resource Management Plan as a Research Natural Area (RNA) (USDI 1995). This area has not been significantly disturbed by logging, grazing, and recreation.

Other lakes/ponds in the watershed are shallow and small with clay/silt bottom composition. Nonfish-bearing lakes in the watershed may rear sensitive aquatic flora and fauna specific to high elevation ecosystems. No known aquatic animal or plant species survey information is available for these lakes.

Fish Lake is the largest lake and most popular fishery in the Little Butte Creek Watershed. Besides rainbow and eastern brook trout, Fish Lake contains tui chubs. Tui chubs out-compete and predate on local trout populations resulting in sub-optimal sized trout. During the 1970s and 1980s, ODFW poisoned the lake with rotenone to eliminate the tui chub population. Because Fish Lake is spring fed, chemical elimination of the tui chub populations was unsuccessful. Oregon Department of Fish and Wildlife (ODFW) annually stocks trout to provide ideal fishing opportunities. The introduction of a predacious fish such as brown trout (*Salmo trutta*) into Fish Lake to extirpate the tui chub was considered by ODFW (Vogt 1997). This option was eliminated because of the risk that brown trout would escape into the Rogue River Basin stream system.

Agate Lake contains a good population of largemouth bass, yellow perch, bluegill, black crappie, and brown bullhead. Lost Lake contains eastern brook and rainbow trout. Oregon Department of Fish and Wildlife does not stock either lake. Numerous ponds on private lands throughout reach 1 contain various species of warmwater fish.

Escapement of warmwater fish and hatchery trout from the lakes/ponds and its impact on native salmonids are unknown. Hatchery rainbow and eastern brook trout from Fish Lake have been observed in reach 3 of North Fork Little Butte Creek. Possible impacts are food and spawning habitat competition. Little survival exists for warm water lake/pond species in streams due to their evolutionary adaptation to a lake environment. Warmwater fish from lakes and ponds do not thrive in the cooler fast-water stream habitat.

Fish Management, Aquatic Wildlife and Habitat, and Management of Fish Populations in the Current Condition section include information on fish stocking in lakes.

Amphibians

Amphibian surveys have not been conducted for the watershed. However, there are known locations for the more common species and those of concern (Terrestrial Wildlife Species). Most of the sites occur in the higher reaches of the perennial streams. Amphibians seem to be sensitive to sediment impacts, low flow and increased stream temperature. Increased sedimentation resulting from management activities and natural processes can affect aquatic habitat (see Aquatic Habitat for further discussion). Fine sediments fill cracks and crevices in the streams, thereby altering critical microhabitats used by some amphibians. Low gradient stream microhabitats can be persistently affected by fine sediments. Sediments are flushed out of high gradient streams, thus reducing build-up of fine sediments in substrate crevices. Those areas within the watershed that have increased sediment loading within streams probably have reduced populations of amphibians and macroinvertebrates. Decreased diversity and abundance of stream amphibians can be attributed to habitat loss and sedimentation (Bury and Corn 1988; Blaustein et al. 1995).

Warm temperatures in Little Butte Creek encourage the proliferation of introduced exotic fishes such as largemouth bass. Largemouth bass are voracious predators. Wildlife biologists cite bass as one of the reasons for the demise of Western pond turtles as well as native frogs.

Amphibian species have been observed during fish surveys. Pacific Giant Salamanders

(*Dicamptodon ensatus*) and aquatic garter snakes (*Thamnophis couchii*) have been observed throughout the Little Butte Creek Watershed; population unknown. See Terrestrial Wildlife section for additional information.

CURRENT CONDITIONS

The purpose of the Current Conditions section is to develop information relevant to the identified Issues and Key Questions. The Current Conditions section provides more detail than the Characterization section and documents the current conditions and trends of the relevant ecosystem elements.

HUMAN USES

The majority of the land within the Little Butte Creek Watershed is in public ownership (see Characterization section, Human Uses). Private land is concentrated in the lower elevations at the west end of the watershed and in the valleys that extend along the creeks into the foothills to the east. The people most closely associated with the watershed include those living within the communities in the valleys and those who work with the Forest Service and the Bureau of Land Management (BLM), which manage the watersheds' public lands. In addition, many groups and individuals have an interest in the watershed and use it for a variety of purposes including economic and recreational activities.

Eagle Point, the only incorporated community within the watershed, is located in a valley three miles east of the confluence of Little Butte Creek with the Rogue River. The population of Eagle Point is approximately 3,000 people (1990 census). White City, an unincorporated area with a population of over 5,000 people, is located just south of Eagle Point and is partially within the Little Butte Creek Watershed. The population of the watershed outside of Eagle Point and White City is approximately 1,500 to 2,000 people. The small rural communities of Brownsboro and Lake Creek provide a neighborhood focus to the valley lands which follow the creeks to the east (LBCWC 1995).

Current Human Uses and Trends

Farming and ranching characterized the early communities of the watershed (Wheeler 1971); descendants of early immigrants still reside in the watershed. Some of the larger farms have been subdivided among descendants, and few people sustain themselves economically by farming alone (Anthony 1997). Timber production and logging are important on the public lands and lands owned by private timber companies. As elsewhere in the region, farming, ranching, and logging are not growing along with the growing population. Service, trade, and some manufacturing sectors of the economy are growing at a faster rate; these trends are likely to affect the watershed as well. Small towns, such as Eagle Point are actively encouraging growth as evidenced by the construction of an 18-hole golf course with housing, hotel, and eating facilities located within the city limits. Eagle Point has become a service center for the Little Butte Creek area, as well as for the upper Rogue River area (LBCWC 1995).

Important issues in the watershed include: water rights and allocations, endangered species, rural interface, and concern over quality of life. Community efforts, such as that of the local watershed council, are aimed at facilitating education about land use issues and coordinating between local land owners and government agencies.

Elsewhere in the region there is a growing "commuter" class of residents in the rural areas (Preister 1994). These people reside in rural areas but commute from their rural homes and communities to jobs in the more industrial urban areas. This trend is likely to continue in the Little Butte Creek Watershed, with people commuting to jobs in Medford, White City, and surrounding towns.

Recreation on the public lands has been important in the past and is likely to continue in the future. Non-timber products and uses on public lands will probably receive more emphasis in the future. Interactions among private citizens, businesses, local groups, and government agencies will continue to be important for education and information sharing, and will probably be of increasing benefit to effective ecosystem management in the watershed.

Facilities and Structures

There are no established facilities on BLM-managed lands within the watershed. This is in marked contrast with the Forest Service, which has a number of recreational facilities on National Forest lands within the watershed: the Organization Camp (Camp Latgawa) on South Fork Little Butte Creek, Fish Lake Resort, Big Elk Guard Station, cross-country ski cabins, Dead Indian RAWS Station, and the concessionaire permit for Fish Lake-Doe Point Campground (see Table 17, Fire section). A cellular telephone communication site and fire lookout are located at Robinson Butte.

Authorized and Unauthorized Uses

A number of BLM authorizations have been granted for various uses within the Little Butte Creek Watershed. There are 10 right-of-way grants for roads, 13 right-of-way grants for utilities, 8 right-of-way grants for water use, 1 lease, and 2 Federal Energy Regulatory Commission withdrawals. Most of these authorizations are small in nature with the following three exceptions: the 500-kilovolt line to Pacific Power and Light, the Pacific Gas Transmission (PGT) buried gas line, and the U.S. West fiber optic line that pass through portions of the watershed. The fiber optic line is buried in the same trench as the PGT gas line. The leased area is for the International Wildlife Recovery Center located on South Fork Little Butte Creek. This facility is not operational yet. If an oil spill occurs, this facility will be used to clean and rehabilitate affected animals.

There are four known or suspected unauthorized uses. At this time there is one known unauthorized water development and one unauthorized power line on BLM-managed lands in the watershed. These cases are in a "pending" status awaiting a water rights decision from the state and site survey from the power company. Two suspected cases of unauthorized agricultural use on BLM-managed lands need further investigation before additional action can be taken.

There are several permits issued on National Forest lands for power lines, telephone lines, right-of-ways, road easements, fences, gates, and waterlines. Permits for recreation events in the area are also frequently issued for bike races and horse endurance rides.

Special Authorizations

In the past, there have been a number of land exchange actions within the watershed. Cascade Ranch and other parties have been involved in these exchanges. It is the BLM's intent to enter into another exchange with Cascade Ranch in the near future to carry through on a previous commitment. This exchange will be a 320-acre parcel of BLM-managed land located in the low foothills within the interior boundary of the ranch. The parcel legal description is T.37 S., R.2 E., Section 5 in the south half.

Transportation System

Geographical Information System (GIS) and Transportation Information Management System (TIMS) identifies approximately 1,115 total miles of road within the analysis area of which 48 percent are controlled by BLM and Forest Service. Roads in the analysis area vary from primitive four wheel drive roads to paved highways. BLM and Forest Service roads were constructed and are maintained for log hauling and administrative purposes. BLM and Forest Service inventories contain very little information about non-BLM/Forest Service controlled roads. Most of the county roads have a bituminous surface and the private roads are usually either rocked or are left unsurfaced.

The major access roads are located on flatter areas along South Fork Little Butte and Little Butte creeks as shown on Map 4. Early constructed roads were usually built on the flatter ground along streams and rivers where road construction was easier and access more important for homesteading, ranching, and mining.

Road maintenance is conducted by the different owners and management agencies. Water, oil, or lignin are usually applied to road surfaces when hauling during dry periods for dust abatement and to keep roads from disintegrating. There are developed water sources in the watershed where the BLM and Forest Service may obtain water. Water is used when placing surface rock and for road maintenance, which allows for proper processing and reduced segregation of the road surface rock.

The BLM and Forest Service charge fees for commercial use of roads and then use these fees to help pay for road maintenance. A reduction in timber harvest levels has resulted in a significant decrease in the primary funding source for maintaining the transportation system. Many roads previously maintained at a high level are not being maintained to that extent any longer. To reduce maintenance requirements and erosion potential, some unnecessary roads have been, or will be, decommissioned. Other roads are closed until future access is needed and many others are maintained at the lowest possible levels. All BLM and Forest Service roads have a maintenance level assigned to them. The roads are monitored and the maintenance levels are modified when needs and conditions change. Maintenance levels range from minimal standards on short roads to high standards on main roads. Sharing and maintaining roads with landowners has also reduced the amount of road necessary for access and maintenance costs. The goal is to maintain the entire transportation system in a safe and environmentally sound condition. The result is a transportation system that provides for various recreational activities, private access, logging, fire fighting access, and other land management uses.

Road maintenance includes removing safety hazards, reducing soil erosion potential and providing for fish passage at all potential fish bearing stream crossings. Proper maintenance of road drainage systems and stream crossing culverts is essential to avoid both erosion and fish passage problems. Most of the existing culverts were designed to withstand 50-year flood events. New drainage structures will be designed to withstand a 100-year flood event and when appropriate, provide for fish passage. Road protection measures include constructing drainage structures, grass seeding, blocking roads, placing road surface rock, and applying bituminous surfacing.

Hazard trees next to forest roads are removed if they are a safety concern. Hazard trees are those trees that have the potential to fall on roadways. They are usually dead, but may be alive with roots under-cut or with significant physical damage to the trunk or root system.

BLM and Forest Service roads are generally open for public unless blocked by gates or other methods. Gates and other road barriers regulate vehicle access to reduce maintenance costs, soil erosion, transfer of noxious weeds, and wildlife disturbance.

High road densities are discussed in the Erosion Processes and Hydrology sections.

Logging

The most recent advertised timber sales on BLM-managed lands were the Grizzly Knob and Ante-Climax timber sales. Ante-Climax timber sale contained 187 acres of partial cutting and 48 acres of clearcuts. Grizzly Knob timber sale contained 378 acres of partial cutting and 10 acres of clearcuts. These sales logged approximately 3.9 million board feet in the watershed and were completed in the summer of 1996. The last advertised timber sale on Forest Service-administered land was the Blowfish Salvage sale. This sale was a hazard tree removal project around Fish Lake Resort and summer homes. Approximately 129,000 board feet was removed during the early 1990s from over 625 acres, mostly leaning snags and other public safety hazards. Pursuant to the 1994 Northwest Forest Plan, a project-specific watershed analysis was prepared prior to project initiation.

Under the 1994 Northwest Forest Plan, logging has resumed on federal land. The first BLM advertised sale for the Little Butte Creek Watershed is tentatively scheduled for fiscal year 2000. The Forest Service, Butte Falls Ranger District has plans to resume logging in fiscal year 1998 within the matrix lands of the Little Butte Creek Watershed. There are no immediate plans to resume logging on other Forest Service-managed lands within the watershed as they have been designated as a Late-Successional Reserve.

Tables 9 and 10 summarize silvicultural treatments on the federal lands harvested during the intensive forest management period.

Table 9. Acres Harvested and Volume Removed on BLM-Managed Lands in the Little Butte Creek Watershed

Year of Sales	Clearcut Acres	Select-cut Acres	Salvage Acres	Shelterwood Acres	Overstory Removal Acres	Thinning Acres	Volume Removed (Millions of Board Ft.)
1950s	77	189	157	0	0	0	6.7
1960s	680	3,206	177	0	0	0	64.4
1970s	285	9,009	4,736	130	5	105	105.4
1980s	1,773	2,533	3,169	2,035	455	205	110.6
1990s	543	285	750	197	208	89	23.4

Table 9 reflects forest inventory data (Micro*Storms) as of February 26, 1997. Data may not be complete because all historic data may not have been input into the system. Small amounts of logging occurred in the 1930s and 1940s. Clearcuts include 675 acres of road right-of-way (additional road acres may be present near edges of the watershed). A little over 18,000 acres of the BLM-managed commercial forest land has had multiple entries.

Table 10 reflects forest inventory data (REFOR Database) as of May 5, 1997. Data may not be complete. Approximately 12,000 acres of commercial forest land has had multiple entries.

Table 10. Acres Harvested and Volume Removed on Forest Service-Managed Lands in the Little Butte Creek Watershed

Year of Sales	Clearcut Acres	Select-cut Acres	Salvage Acres	Shelterwood Acres	Overstory Removal Acres	Thinning Acres	Volume Removed (Millions of Board Ft.)
1950s	172	0	0	0	0	0	N/A
1960s	319	10,472	875	0	0	0	N/A
1970s	0	6,451	3,236	2,385	747	150	N/A
1980s	1,150	893	1,593	3,379	2,113	0	N/A
1990s	505	0	190	11	0	403	N/A

*N/A: not available.

In 1972, the State of Oregon legislated the Forest Practices Act which addressed all forest operations, including road construction and maintenance, timber harvesting practices, chemical use, slash disposal, and reforestation requirements (Pacific Logging Congress 1981). The act was amended in 1993 to provide additional protection for water quality and riparian vegetation. Forestry operations on state and private lands are required to comply with the Forest Practices Act.

Special Forest Products

The Forest Service and BLM recognize the importance of managing special forest products (SFPs) and are developing regional and national strategies. These strategies emphasize four themes: 1) to incorporate harvesting of SFPs into an ecosystem management framework with guidelines for sustainable harvest, species conservation, and protection of ecosystem functions; 2) to involve the public including industrial, Native American, and recreational users of these resources in making decisions about the future of SFPs on public lands; 3) to view the management of an accessibility to SFPs as major factors in assisting rural economic diversification in formerly timber-dependent communities; and 4) to develop and implement inventory, monitoring, and research programs to ensure species protection and ecosystem health (Molina et al. 1997).

Special forest products have been extracted from the watershed for at least 15 years. In order of importance, the main SFPs are fuelwood, salvage sawtimber, and cedar boughs. The level of fuelwood removal probably peaked in the late 1970s through the mid-1980s when logging activity and wood stove use were high. Since then, restrictions on wood burning in the Medford area, combined with decreasing timber sale activity, has resulted in a dramatic reduction in fuelwood cutting. The federal lands in the watershed will continue to be a source for individual/family Christmas tree cutting due to its close proximity to the Medford area. Harvesting levels for other SFPs, such as floral greenery and mushrooms, are at very low levels in the watershed.

Grazing/Agriculture

Cattle grazing is one of the primary uses on the 114,628 acres of federal land within the watershed. Eighty-six percent of the BLM-managed lands and 91 percent of the Forest Service-managed lands are allocated to 32 grazing allotments. Table 9 displays the lands allocated to grazing. Eight of these allotments have interagency and private industry management agreements.

Table 11. Grazing Information for Federal Lands within the Little Butte Watershed[1]

Federal Agency	Number of Allotments	Total Acres Managed	Total Grazing Acres	Total Preference (AUMs)[2]
Bureau of Land Management	28	54,753	46,949	4,326
Forest Service	4	59,875	54,479	2,247
Totals	32	114,628	101,428	6,573

1/ as of January 1997.
2/ AUMs = animal unit months.

Cattle operations are the number one commodity in Oregon, contributing 12.8 percent of the total gross value of agricultural products; Jackson County ranks 16th in the state (Andrews 1993). Within the watershed, cattle operations are the largest non-forestry agricultural venture. This is followed by raising horses and domestic or exotic poultry production. There are a few farm crop operations that produce hay or small "u-pick" type vegetables. Numerous small farms and ranches comprised of both horticulture and animal husbandry exist within the watershed.

The Little Butte Creek Watershed is designated as open range outside of incorporated towns or livestock districts. The largest private ranches in the watershed are the C-2 Cattle Company on North Fork Little Butte Creek and the Cascade Ranch on South Fork. C-2 currently raises horses on irrigated pastures and leases its cattle range to other operators. Cascade Ranch runs cattle on most of its 2,095 acres of improved pasture, as well as all of its permanent range and transitory grazing lands. Cascade Ranch also leases 15,184 acres of BLM managed grazing land encompassing three federal grazing allotments within the watershed: Lake Creek Spring, Lake Creek Summer, and Deer Creek. Cascade Ranch has grazing lease agreements with the timber companies having lands within the vicinity of their property. The combination of private and public lands utilized by Cascade Ranch totals 30,204 acres and forms the basis of the Coordinated Resource Management Plan of the Cascade Ranch complex. This cooperative agreement involves timber, livestock, wildlife, and riparian management strategies designed and overseen by the ranch, the timber companies involved, the BLM, Oregon Department of Fish and Wildlife, Oregon and Jackson County agriculture departments, and two U.S. Department of Agriculture representatives: Oregon State University Cooperative Extension and the Natural Resource Conservation Service (formerly Soil Conservation Service).

Federal grazing allotments are categorized by management requirements. Categorization concentrates funding and personnel where management is needed most. The following are the categories for prioritizing the allotments: 1) improve (the allotment will be managed intensively for improvement); 2) maintain (current management will be sufficient to maintain conditions that are satisfactory); and 3) custodial (a minimum amount of effort will be expended to maintain existing resources, often due to a large percentage of private lands).

All intensive management allotments in the watershed currently have a working allotment management plan. Management includes, but is not limited to, establishing season of use and allowable preference measured in animal unit months (AUMs). Season of use indicates the period during which cattle are allowed on the range. Preference is the maximum number of livestock allowed on the allotment. Animal unit month (AUM) is the amount of forage required by one cow or its equivalent during a one-month period. Preference is stated in AUMs rather than by fixed number of cattle to allow flexibility. Use may be by a few animals for a long period or many animals for a short period; however, when the allowable AUMs are used, the permittee's cattle must be removed from the allotment. At present, no allotment within the watershed is leased for horses or sheep. Total preferences for federal lands are shown in Table 11.

Table 1 in Appendix C summarizes information for each allotment in the watershed. Map 18 shows allotment boundaries in the watershed.

Range Condition

The Soil Vegetation Inventory Method (SVIM) survey conducted on Medford District BLM land between 1979 and 1983 established baseline transects for all range sites (habitat types) in the watershed, but were rated relevant to Potential Natural Community (PNC) assuming an old-growth forest climax. In 1994, the Medford District BLM correlated the SVIM data with data from the 1994 Jackson County Soil Survey, reevaluating range sites according to updated descriptions. The outcome of the reevaluation was to segregate sites having a PNC of forest from a PNC of oak grasslands, shrub grasslands, or simple grasslands. Forest sites grazed were designated transitory range because they are predominantly managed for timber, not grazing. Non-transitory (permanent) rangelands are comprised of those sites with environmental factors limiting their PNC to open canopy woodlands, shrub lands, or grasslands, each of which have a large, permanent, sustainable grass component. Only non-transitory rangelands (including non-transitory sites within transitory areas, such as meadows within a forest) are monitored for ecological status. Only those acres recorded in the SVIM survey give an extensive set of production data from clipped plots and a detailed baseline for comparison with an oak woodland, shrub, and grass PNC. Of the 33,491 acres surveyed by SVIM studies within the Little Butte Creek Watershed, 11,021 acres serve as baseline for non-transitory range. Table 2 of Appendix C gives the breakdown of these baseline acres.

Monitoring for range condition on BLM-managed lands is conducted using nested frequency transects, riparian photo points, and utilization surveys. Additional monitoring is anticipated for the purpose of evaluating trend in ecosystem function. Nested frequency is used to predict trend, but takes time to evaluate, with readings required at no less than five-year intervals. Riparian photo points have been done on an annual or bi-annual basis, but many established points will need reestablishment this spring due to the 1997 flood. Utilization is evaluated on each active "improve" category allotment for each season of use. Currently, on BLM-managed lands all evaluated nested frequency transects show a steady or improving trend in range condition over time. Utilization checks have been useful in identifying grazing patterns and help the federal range specialists and the permittees decide upon distribution and movement of cattle on a timely basis.

Minerals

There are no valid mining claims on federal lands within the Little Butte Creek Watershed.

On National Forest lands, the lava flows from Brown Mountain and Mount McLoughlin serve as a desirable source of lava rock. Black lava rock (andesite) is sought as a decorative rock in flower gardens and for building rock walls. There is an opportunity to develop a lava rock source for both personal and commercial purposes.

Recreation

Recreation activities occur on a year-round basis throughout the watershed and overall use of the area has shown a steady rise over the last ten years. Summer use is dominated by camping (at developed and dispersed sites), hiking, picnicking, cold water fishing, and big game hunting in the fall. Other activities include bird watching, viewing scenery (driving and walking), boating (both motorized and non-motorized), horseback riding, mountain biking, four-wheeling, swimming, and other miscellaneous activities such as wildlife and wildflower viewing, and huckleberry and mushroom picking.

Winter uses are primarily centered around nordic skiing and snowmobiling, and also includes activities such as viewing scenery, fishing (both ice and cold water at Fish Lake), winter camping, backcountry skiing and snowboarding, snowshoeing, snow play, picnicking, and Christmas tree cutting. In addition, the following three sites offer various recreation activities throughout the year: Camp Latgawa (organization camp), Fish Lake Resort, and Fish Lake summer homes.

Mountain biking, snowmobiling, and backcountry skiing/snowboarding are growing at very high rates while most other uses are showing smaller increases. Current winter recreation concerns are generally social in nature (conflict between snowmobilers and backcountry skiers) while summer problems are more resource oriented (damage to vegetation, compacted soil at developed sites, use of downed woody material for firewood, tree mortality in campgrounds and improper human waste disposal at dispersed camping sites).

Forest Service facilities (campgrounds, trailheads, trails, and snoparks) have been well-maintained in the past, but current budget and personnel costs are reducing quality and quantity of maintenance and public contact. Some facility infrastructure components are showing obvious symptoms of the need for heavy maintenance (i.e., leaking roofs, broken pipes and valves, and failing electrical lines). Quality public contact takes place on a less-frequent basis and is often limited to taking care of an immediate problem.

Appendix A contains a detailed discussion of recreation conditions on National Forest lands within the Little Butte Creek Watershed.

Cultural Resources (Archaeological and Historic Sites)

The watershed was important to people in the past and has been inhabited for thousands of years. Native sites occur along the major streams and tributaries and on the benches and knolls above the valley. Many sites are located at intermediate elevations in a zone characterized by warmer temperatures, especially in the spring and fall, and more frequent fires. Sites in upper elevation Forest Service lands are generally smaller and sparser, while sites reported on private lands closer to the mouth of Little Butte Creek are generally larger and probably represent permanent village occupations.

There are numerous recorded Native American and historic archaeological sites in the watershed. Native American Indian sites are known near the mouth of Little Butte Creek, on private land (Concannon 1996). Over 50 aboriginal sites are recorded within BLM boundaries and on BLM and on private lands. An additional 23 of these sites and isolated finds are recorded in the higher elevation National Forest lands.

Over half of these approximately 75 archaeological locations are listed as "lithic scatters", which are sites characterized by scatters of chipped-stone tools and debris on the surface of the ground. About a third of these lithic scatters represent quarrying activities, and are associated with the red and yellow jaspers used to make stone tools. The remainder of these lithic scatter sites were probably associated with short-term, temporary use of a location.

Approximately one-fourth of the aboriginal sites appear to represent places where people spent considerable time, and are either camps, seasonal hamlets, or small villages. These sites have remains of structures (housepits) or a wide variety of artifacts indicative of longer-term use of the location. Unfortunately, most of these sites have been so badly looted that it is not possible to obtain a good idea of their function from the surface evidence.

The remaining aboriginal sites consist of rockshelter sites and two rock feature sites. The rockshelters have all been heavily vandalized. The two rock feature sites may relate to past native spiritual quest activities, though some of the features at one site were constructed by BLM personnel. There are no known Native American traditional cultural properties or known currently used spiritual quest locations in the watershed.

Historic sites recorded in the watershed include sites related to logging (mills), ranching, hunting, and travel. Historic sites also include early-day National Forest administration and recreation areas.

Vandalism is an on-going and critical problem in the watershed, especially at sites related to past Native American Indian habitation and use. Many of these aboriginal sites are easily accessed today and have been ravaged by looting. Looting at these sites represents a major threat to the cultural resources in the watershed.

EROSION PROCESSES

Natural Processes Affecting Erosion Processes and Slope Stability

Floods

The primary natural event that affects water quality and fisheries is thick snow packs in the transient snow zone that are rapidly melted by warm rain storms. During the 1955, 1964, 1974, and 1997 rain-on-snow events, several earthflows and debris flows reactivated mainly in the canyon sideslopes landform. Several new slides also occurred in the steep canyon sideslopes terrain. These storms, especially the 1964 and 1997 events, caused both natural and management related slides to transport sediment to nearby streams.

Major stream channel erosion occurred during the January 1, 1997 storm event in the Little Butte Creek Watershed. South Fork Little Butte Creek and Dead Indian Creek canyons were especially active as several large banks failed. This channel erosion affected portions of the valley bottom, alluvial bottom, and canyon sideslopes. Large trees, rocks, and other debris charged the flow of water and undercut the toe of many of the stream banks above Latgawa Church Camp. South Fork Little Butte Creek below the church camp meandered 50 to 150 feet away from its previous channels and caused heavy damages to federal lands, private homes, and property downstream. Two cabins just downstream from this site at Latgawa Church Camp were undermined when Dead Indian Creek changed its course toward these banks. Fifteen to 20 feet of property were lost, and a cabin is hanging 5 feet over the new stream channel. Private landowners lost valuable property, and some residents lost their houses when South Fork Little Butte Creek flooded and changed its channel.

After the 1997 storm, the approaches on the concrete bridge at the beginning of the 3730800 road were lost. The Latgawa Church Camp bridge on road 3730590 was completely washed-out on one end. The church camp bridge fell into a new channel created on the south side, but is still intact on the north side. The privately owned railroad flat car bridge across South Fork Little Butte Creek at the Deer Creek road crossing was also washed-out during this storm.

The lava plateau, stream terraces, and volcanic peaks terrain appear stable and have held up well against the January 1997 storm event.

Wildfire

Wildfire is a natural agent capable of removing extensive soil cover in the Little Butte Creek Watershed. Only when a significant rainfall event occurs within a year or two after the fire will there be substantial erosion from a fire-disturbed site. When vegetative cover or litterfall is reestablished within a year after a disturbance, soils are protected from further rainfall impact. When intense rainstorm events occur shortly after fire disturbance, there can be a significant amount of topsoil loss. Topsoil loss has probably been reduced over the past 70 years since fire suppression has resulted in fewer natural fires exposing soils. However, this situation increases the risk that a hot-burning wildfire will occur and may cause severe soil erosion and landslide problems.

During the late nineteenth and early twentieth centuries, large wildfire occurrences periodically swept across the Little Butte Creek Watershed, mainly in the lava plateau and canyon sideslopes (Reference Conditions, Human Uses). These wildfires were caused by lightning strikes igniting dry vegetation. The middle elevations of the watershed contain the highest fire occurrence and intensity in the watershed and are considered to be high risk wildfire areas. The canyon sideslope landscape is located in unstable and highly erodible terrain of South Fork and Dead Indian canyons.

Slope Stability

During slope stability mapping for the Shellick, Owens, and Dead Indian timber sales, numerous area of instability were located in the South Fork Little Butte Creek and Dead Indian Canyon. Most of these slides and severely eroded terrain were located on the steep to moderately steep slopes in the canyon sideslopes terrain. Many of the active slides were found within other older earthflows indicating that most of the sites had compound landslide features and had been active for long periods of time. These areas were classified as unsuitable for management and were not treated.

Sag ponds, springs, seeps, scarps, tension cracks, and anomalous tree growth are common in this earthflow terrain. Debris landslides are also commonly found within the larger earthflows and are most active in the lower half of the canyon sideslopes terrain, often falling into the valley floor terrain. These slides are likely to continue to occur due to the natural instability of the area.

Surface erosion is found where surface water is concentrated naturally in drainages/draws, or by road drainages (especially culverts) discharging water onto moderately steep to steep slopes. Sheet, rill, and ravel erosion occur most frequently on stream terraces, canyon sideslopes, and valley floor terrains. The largest amounts of sediment transported in these terrains are located on steeper slopes near streams.

Many of the hillslope processes are most active near managed areas or areas managed in the recent past, such as roads and clearcuts. Slumps, debris flows and tension cracks are often found in road prisms, cut slopes, and fill slopes. Minor slumps and surface erosion have been located on the lower slopes of a few clearcut units from logging in the 1970s and 1980s.

Human Activities Affecting Slope Stability

The following are the major human activities that have impacted erosion processes in Little Butte Creek Watershed. These activities are generally listed in order from largest impact to smallest impact potential.

Road Development

Road construction has been the largest human impact to the Little Butte Creek Watershed in terms of sediment delivered to streams and negative affects to fishery habitats. Roads that lack adequate drainage can result in rills, gullies, slumps, and earthflow landslides during peak flow events (especially the 1964, 1974, and 1997 storms).

Roads can intercept streams and concentrate the water into areas that can saturate weak soils and create conditions more likely for slope failures and surface erosion to occur. Many of the Little Butte Creek Watershed roads have been constructed with culverts and ditches or drain dips as the drainage structures. However, some of these roads are unsurfaced and usually do not have armoring below water-bars or drain dips to protect against erosion and mass wasting. Intense rain storms and rain-on-snow events have created heavy runoff from the roadways in these areas. As a result of the heavy run-off, roads sometimes contain rills and/or ruts on the steep grades. During heavy storms high energy runoff is often concentrated into rills on steep road grades which transports sediment into streams, especially at the stream crossings and/or where roads parallel streams.

During the 1997 flood, several landslides occurred in and/or below some roads and culverts in lower elevations of Forest Service roads 3730 and 3730800. At mile post 0.1 on Forest Service road 3700, a 120-foot long section of the road slumped with 1 to 2 feet vertical drop and will require restoration. Roads in this area were heavily damaged on federal, state, and private lands. On federal property, the first 0.1 mile of the 3730800 road was washed out and/or failed near the confluence of South Fork Little Butte and Dead Indian creeks. Just beyond the bridge, approximately 180 feet of the road was lost when the bankfull channel changed course during the storm and was directed toward the 800 road. At mile post 0.5 almost 200 feet of the road dropped five feet and was carried down slope and the fill slope failed into Dead Indian Creek. Several private access roads were washed out or failed when the stream channel shifted or flows were high enough to affect them. In a few locations, County road 1000 was washed out along with some of the spur roads. Several road cut slopes either eroded or slid into the roadway on the 1000000, 3730, 3730800, 3730400, and 3730200 roads. Some of the fill slopes associated with these roads also failed in the South Fork Canyon area.

As a result of the 1997 flood, portions of the 3730800 road will require expensive repairs and/or retaining wall construction to restabilize these facilities. Other options would be to close the road to traffic at the bottom-end and restabilize slopes or to relocate and construct a new route that might avoid the lower flood prone area.

Some culverts were plugged during the last three flood events, causing streams to be diverted into road ditches and low lying areas. The road fill and cutslopes were destabilized by these actions causing failures (slumps, earthflows, tension cracks) and surface erosion to occur. As a result, moderate to large volumes of sediment were transported due to this erosion and landsliding.

High road densities, greater than 4.0 miles per square mile, are found in some sections of the analysis area (see Appendix E and Map 19). When these high road densities are combined with weak soils and are near riparian and/or unstable areas, effects to the environment are the most severe. Road density is also discussed in the Wildlife and Hydrology sections.

Timber Harvesting

Clearcut timber harvesting is second only to roads in impacting streams, soils, and fisheries, but is not currently a major concern in the Little Butte Creek Watershed.

Table 12 shows the amount of clearcut logging on federal land by landform and slope during the past 30 years. Map 20 shows where these areas are located within the watershed. Clearcut units with slopes greater than 50 percent in canyon sideslopes have the highest risk for landslide activation and reactivation during peak flow events. Failures have occurred on only a few of the Forest Service clearcut units in the canyon sideslopes.

Table 12. Clearcut Acres by Landform on Federal Lands

Landform	Clearcut Acres			
	Slope ≤ 30 Percent	Slope > 30 Percent and < 50 Percent	Slope ≥ 50 Percent	Totals
BLM-Managed Lands:				
Lava plateau	602	388	53	1,043
Valley floor	44	20	8	72
Canyon sideslopes	1159	496	99	1,754
BLM Totals	1,805	904	160	2,869
Forest Service-Managed Lands:				
Lava plateau	1,461	30	6	1,497
Canyon sideslopes	14	25	11	50

Landform	Clearcut Acres			
	Slope ≤ 30 Percent	Slope > 30 Percent and < 50 Percent	Slope ≥ 50 Percent	Totals
Forest Service Totals	1,475	55	17	1,547

Clearcut logging can increase the groundwater available to unstable and potentially unstable terrain, which increases the likelihood of accelerating landslide movements. This type of logging has caused some minor surface erosion (rills and raveling) in swales and larger drainages. Most of the units with any erosion/slide features are located on or just above steeper slopes of the canyon sideslopes geomorphic terrain. Surface erosion and landslides often start at the base or just below the clearcut units. Some of these areas of erosion and minor sliding have revegetated and healed naturally over time, while some may require restoration work to reduce sediment sources.

Tractor Logging

Tractor logging has often concentrated surface run-off on many skid trails into unstable and potentially unstable areas in the watershed. Skid trails and non-system roads, especially in the lava plateau, resulted in several areas of surface erosion during the 1964 and 1974 storm events. Surface erosion features such as rills and sheet erosion are found extending down some of the skid trails and more may have occurred during the January 1997 flood.

Livestock Grazing

Intense streamside sheep and cattle grazing during the turn of the century may have been a contributing cause of historic changes in riparian area structure. Grazing, especially by sheep on the high-plateau, may have affected some of the riparian areas (Reference Conditions, Human Uses). In the past, streams, ponds and other wetlands have had concentrations of cattle and sheep, which may have contributed to a loss in vegetative cover and erosion in the lava plateau and edges of the canyon sideslopes. Erosion is the most severe near streams and on steep slopes. Concentrated grazing from cattle left without proper management may have contributed to compacted soils mainly in the lava plateau and valley floor landscapes. Currently, most compaction due to livestock grazing occurs in riparian areas of the watershed.

Prescribed Burning

Low intensity prescribed fires are used to remove slash following timber harvest in this watershed. Most prescribed burning has occurred on the lava plateau and valley floor landscapes on federal lands. Low intensity prescribed fires usually leave enough organic matter to keep the soils in place. However, even with low intensity prescribed fires there are often spots of high intensity fires within the burn that can adversely affect the soils and slope stability. Some sheet erosion has occurred where hot broadcast burns were followed by intense rain storms. High intensity fires can burn off the duff layers that protect soils from erosive and gravitational forces. These fires may also cause soils to become hydrophobic (that is, soils will not allow penetration of rainfall and snow melt), which causes much less infiltration and a higher risk for soil erosion and topsoil loss to occur.

Prescriptions for low intensity burns can be met by burning when the weather and fuel conditions are conducive for a "cool" burn. This is usually in the late winter, early spring, and late fall of most years.

Rock Quarries

Table 13 lists major high quality rock sources on federal property with their remaining reserves. Many of these quarries have been in operation and utilized by the BLM and Forest Service for decades. Erosion and slope stability mitigation have been built into the operation plans for the well-used quarries. Two smaller quarries, Cox Butte and Big Draw, are near depletion and/or may not be entered again due to wildlife considerations and concerns. These rock sources need to be rehabilitated in the near future.

There are also several private rock sources in the watershed including: Panther Crushing Inc. Rock Quarry, which is located approximately 8 miles east of White City on Highway 140, and LTM/Rogue Aggregate's quarry, which is 2.5 miles southeast of White City on Highway 140; Ed Dahak has a rock source in the canyon sideslopes near Poole Hill.

A majority of the existing rock sources are not in or near riparian areas. Any rock sources near or in Riparian Reserves will need a field inventory to determine if these sites are point sources of sediment that may need mitigation or closure.

Table 13. Major Rock Sources on Federal Lands with Their Remaining Reserves

Rock Source Name	Potential Reserves (Cubic yards)	Comments
Owens Quarry	75,000	High quality andesite, blocky.
Big Elk Cinder Pit	100,000	High and marginal quality pitrun cinders.
Ichabod Quarry	125,000	Mostly high quality andesite.
Rum Rye Quarry	100,000	High quality material andesite.
Cox Butte	20,000	Needs decision on other uses or reclamation alternatives.
Big Draw	15,000	High and marginal quality andesite in backslopes; reclamation needed.
Conde Creek Quarry	10,000	High quality basalt.
Sharon Lakes Quarry	8,000	High quality blocky basalt with areas of cinder.
Buck Point Quarry	25,000	High quality platy andesite.
Soda Canyon Quarry	20,000	High quality platy andesite.
Shale Divide Quarry	100,000	High quality basalt.
Sag Saddle Quarry	100,000	High quality basalt over cinders.
Heppsie Mountain	80,000	Medium quality basalt.
Deer Creek Quarry	10,000	High quality basalt.
Lazy Deer Quarry	30,000	High quality basalt.

Overall, it appears that there is plenty of high quality rock material in the major quarries for future construction and restoration projects in the Little Butte Creek Watershed. However, rock haul/construction costs could be reduced by opening a new rock source located in the eastern portion of South Fork Little Butte Creek. Large rip rap will also be in high demand in the watershed for restoration work and very little is currently available at existing quarries.

Mineral Resources

Mining in this watershed has been minimal. The main mineral activity of the watershed occurred during World War I, when several small producing manganese mines were developed in the vicinity of Lake Creek (Reference Conditions). Most of these mines consisted of scattered open pit mines and some with short adits. The largest of these mines was the Tyrrell Mine. Cinnabar and clay were also mined for a short time near Brownsboro. The clay was mined and used to make bricks, while the cinnabar was mined for its mercury. Currently, there are not any valid operational mining claims in the watershed and these mined areas are not considered a major impact to water quality or fisheries at this time.

Conclusion

Roads, clearcut timber harvest, tractor logging, and livestock grazing have accelerated the rate at which erosion and landslides can transport sediment and debris to streams. Of these, roads have had the greatest effect on moving sediment into streams. Thus, more sediment has been mobilized and deposited in streams in a much shorter timeframe. These human impacts are not the only reasons for the decline in these fish populations, but have significantly contributed to these reductions. Consequently, fish habitat and water quality have been adversely impacted to the point that coho are listed and steelhead are proposed for listing as threatened and endangered species.

Future Trends

The future trend for sediment production will remain high without restoration in heavily damaged (areas of the South Fork Little Butte Creek that failed during the 1997 flood) and managed areas that are continuing to contribute significant volumes of material to streams. As future storms move into the watershed, combined human uses will continue to accelerate mass wasting and surface erosion. Inadequately drained roads and unstable road cut and fill slopes will increase the likelihood that new failures will be initiated. Some road crossings are damaged to such a degree that roads will need to be closed or rebuilt before traffic can be afforded safe passage. In the canyon sideslope geomorphic terrain, active earthflows, slump/earthflows, and debris slides will move sediment into streams. Surface erosion from roads throughout the watershed will continue to transport sediment to streams. Sediment introduced into streams adversely affects water quality and fisheries habitat in Little Butte Creek Watershed.

The impact of future storm events and the extent they may affect the watershed is unknown. Natural landslide and erosion processes cannot be halted. Stabilization measures could be implemented to limit adverse impacts.

As the federal, state, and private landowners begin work on restoring roads, landslides, and instream projects from the 1997 flood, the trend for sediment production may decrease. In the future, human-caused sediment production may be reduced as road construction and regeneration timber harvesting decreases. A major and continued effort will be necessary to achieve the goal of monitoring and restoring the ecosystem.

SOIL PRODUCTIVITY

Soils in the watershed have been forming for thousands to millions of years. Environmental factors such as volcanic activity, wildfires, vegetation, and climate have been the major influence on soil formation and productivity. Only in the last one hundred years have human activities had an effect on soil productivity. Forest management activities such as timber harvesting, road building and wildfire suppression have interrupted the "natural" processes of soil development. Various agricultural activities may have had an impact on the soils ability to produce vegetation and provide clean water to the streams.

Timber harvested areas have experienced a decline in soil productivity. This loss in soil productivity is directly related to an increase in soil erosion rates due to the yarding of material and the loss of vegetative cover. This is especially true for steep, mountainous sideslopes that have been clearcut and broadcast burned.

Productivity losses can also be attributed to tractor logging that compacts the soil and decreases pore space used to store oxygen and water in the soil. Tractor logging has been used extensively on the lava plateau landform in the eastern portion of the watershed. Approximately 15 to 20 percent of the tractor logged units in the lava plateau landscape have drastically reduced productivity due to skid trail compaction. The amount of soil productivity lost is dependent on the amount of area compacted. Compacted skid roads experience a 50 percent reduction in site productivity.

On major skid trails and roads, increased compaction has resulted in some surface erosion and sedimentation in depressed areas. Soil recovery is slow and could take many decades. Recovery processes, while not well understood, probably depend on the type of vegetative succession that occurs, amount of existing site organic matter, and future disturbance regimes.

Tractor site preparation occurred during the 1960s and 1980s in some areas of the lava plateau landform, with the objective to remove portions of vegetation and portions of the topsoil that contained grass, forb, and shrub seedbanks. However, tractor site preparation altered soil characteristics and lowered site productivity by significantly removing topsoil, litter, duff, and large woody material. The loss of topsoil by ground-based equipment increases with slope gradient and the greatest topsoil loss is on the steepest slopes.

A small, yet important, portion of the lava plateau landform is occupied by shallow soils, that under undisturbed conditions, have a high water table in the spring due to the clay loam subsoil. These soils dry out by the summer. In areas where tractor logging occurred, gouging and compaction of the soil has changed the natural drainage and caused water to surface in seeps. This activity has extended the drying time of the soils into mid-summer.

Road construction has taken land out of production in the watershed. The soil productivity loss is directly proportional to the amount of road built in the watershed. Roads also have an indirect affect on soil productivity on steep mountain sideslopes. Roads built inadequately, on unstable slopes and/or in head wall situations, often cause slope failure resulting in landslides or debris torrents.

Fire suppression activities over the last 70 years have changed the local fire regimes in the watershed. Wildfire frequency has decreased, however, the fire intensity has increased, resulting in the consumption of more surface duff and large woody material. High intensity wildfires also heat the soil and greatly reduce the existing soil organism populations. Although the forest usually experiences a short-term flush of nutrients from the oxidation of burned organic material, the long-term nutrient cycling is interrupted. This same phenomenon has been observed as a result of broadcast burns with high fuel loadings.

Current conditions in volcanic peak terrain are mostly undisturbed. Roads and timber harvesting have been minimal and fires have been excluded. Soils have had few natural or human-caused impacts in the recent past.

Agricultural practices on the valley floor have increased the land productivity through irrigation, fertilization, crop rotation, and proper grazing practices. Many areas that used to be rangeland or shrubland have been converted to pasture by diverting water from streams.

PLANT SPECIES AND HABITATS

Non-Native Plant Species and Noxious Weeds

Non-native plant species are abundant and often dominant in the herbaceous vegetation layer at lower elevations in the watershed. They are also abundant and often dominant in moist mountain meadows at all elevations and other disturbed open areas where seeding has occurred in the past. Non-native species are likely to continue to spread in the watershed (Appendix E, Table 1). They affect the distribution and abundance of native organisms, the character of native plant communities following disturbance, and the course of ecological succession.

Non-native blackberries have taken over most lower elevation riparian corridors and presumably have a major influence on ecological processes now in those areas. Other non-native trees and shrubs have not established in the watershed to any significant extent. Currently, non-native trees and shrubs are only found close to human dwellings, urban areas, and possibly some of the lowest reaches of valley floor stream corridors.

Noxious weeds are unintentionally introduced by several modes. Historically, some may have escaped garden or field cultivation, been brought in on transportation conveyances, in livestock feed, or carried by imported animals. Modern sources of transport may also include vehicles used in road and power line construction. Any activity that creates disturbed soil and forms a corridor into an area, can act as a weed pathway. Once established, many of these species possess the ability to out-compete the native vegetation, even in the absence of a disturbance.

Federal land managers cooperate with Oregon Department of Agriculture's efforts to control and identify target species of noxious weeds by tracking their distribution on federal lands. Noxious weed populations must be located quickly to increase the effectiveness of control efforts. Integrated Weed Management (IWM) involves four general categories of management options including cultural, biological, physical, and chemical. IWM is a decision making process that uses site specific information to make decisions about treatment choices. IWM is based on the fact that combined strategies for weed management work more effectively than any single strategy. The current IWM practice method of choice for weed control is biological control. A seed fly and a seed weevil, which predate yellow starthistle, were released into the watershed in 1985 and 1987 respectively. Census counts have shown biological agents to be successful for controlling Klamath weed. Not all noxious weeds, however, have current biological predators to control their populations and there are concerns that even under Best Management Practices, populations of noxious weeds may continue to become established and/or expand.

Rare Vascular Plants

Table 14 lists plant species known to occur in the Little Butte Creek Watershed and in southwestern Oregon. In general, these species are considered rare. A number of them are considered rare or threatened on a state or national level.

Table 14. Rare Plant Species Known to Occur in the Little Butte Creek Watershed

Scientific Name	Common Name	Status[1]
Abies lasiocarpa	subalpine fir	
Allium campanulatum	Sierra onion	
Asarum wagneri	green-flowered wild ginger	BWO
Calochortus monophyllus	one-leaved mariposa-lily	BAO
Camissonia ovata	golden eggs	BAO
Cimicifuga elata	tall bugbane	BSO
Cypripedium fasciculatum	clustered lady's-slipper	BSO/S&M
Cypripedium montanum	mountain lady's-slipper	BTO/S&M
Drosera rotundifolia	round-leaved sundew	
Gentianopsis simplex	one-flowered gentian	
Iliamna rivularis	stream-bank globe-mallow	
Limnanthes flocossa ssp. bellingeriana	Bellinger's meadow-foam	BSO
Gentianopsis simplex	one-flowered gentian	

Scientific Name	Common Name	Status[1]
Iliamna rivularis	stream-bank globe-mallow	
Limnanthes flocossa ssp. grandiflora	large-flowered woolly meadow-foam	
Microseris laciniata ssp. detlingii	Detling's microseris	BSO
Mimulus pygmaeus	pygmy monkey-flower	
Perideridia howellii	Howell's yampah	BWO
Populus tremuloides	quaking aspen	
Ranunculus austro-oreganus	southern Oregon buttercup	BSO
Rhamnus alnifolia	alder-leaved buckthorn	
Saxifraga caespitosa	tufted saxifrage	
Scirpus pendulus (lineatus)	drooping bulrush	BSO
Utricularia minor	lesser bladderwort	BAO

1/ Status:
BWO - Bureau Watch Oregon
BSO - Bureau Sensitive Oregon
BAO - Bureau Assessment Oregon
S&M - Survey and Manage

Of the species in Table 14, the following seven are considered at high risk of extirpation from the watershed within the next 100 years.

***Allium campanulatum* (Sierra onion)**: One small occurrence is known in the watershed. Other occurrences may still be undetected. Threat of extirpation is due to small population numbers and annual livestock grazing of its meadow habitat. This species is more abundant east of the Cascades and in California.

***Calochortus monophyllus* (one-leaved mariposa-lily)**: One small occurrence is known in the watershed. Threat of extirpation is due to small population numbers and recreation use in the Grizzly Peak area. The two small Oregon occurrences are disjunct from the main distribution of this species in the foothills east of the Sacramento Valley in California.

***Camissonia ovata* (golden eggs)**: One or two small occurrences are known in the watershed. Threat of extirpation is due to small population numbers, heavy grazing of its habitat and other ground disturbance events. This species may be more abundant in Douglas County and it is more abundant in California.

***Cypripedium fasciculatum* (clustered lady-slipper orchid)**: One or two small occurrences are known in the watershed. This species is more or less associated with late-successional conifer forest but specific habitat and life-history requirements are not well understood. Threat of extirpation is due to small population numbers and logging activity. This species ranges over many western states and appears to be threatened to some degree throughout its entire range.

Cypripedium montanum **(mountain lady-slipper orchid)**: The situation is basically the same as for the clustered lady-slipper orchid, except outside of this region the mountain lady-slipper orchid is not always closely associated with late-successional forest and it is more common and secure in some parts of its range in North America.

Iliamna rivularis **(streambank globe-mallow)**: One small roadside population is known in the watershed. It is in a disturbed location. It is not known what kind of conditions would allow the population to persist. This species is more common east of the Cascades and farther north.

Limnanthes flocossa ssp. grandiflora **(large-flowered woolly meadow-foam)**: This Agate Desert endemic was collected once in the lower portion of the watershed approximately 20 years ago. Most currently known populations are on other portions of the Agate Desert beyond the watershed boundary. The species is threatened throughout the Agate Desert to some extent by grazing and more so by conversion of its habitat through agricultural, industrial, and residential development.

Two other species may be at some risk of extirpation from the watershed within the next 100 years.

Microseris laciniata ssp. detlingii **(Detling's microseris)**: Only a couple of sites are known in the watershed but it is probably under-reported. The risk of extirpation within the watershed is due to the widespread encroachment of non-native plant species into oak/pine woodland and to the gradual loss of openings and ecological succession in oak/pine woodland. These same processes are occurring throughout its limited range (Jackson County, Oregon).

Cimicifuga elata **(tall bugbane)**: At least one of the two or three populations in the watershed is large and apparently secure. It is not clear how ecological succession or a wildfire would affect populations where they currently exist.

The remainder of the rare vascular plant species listed above are expected to remain at viable population levels within the watershed over the next 100 years.

Survey and Manage, and Protection Buffer Plant Species and Habitats

Bryophytes, Lichens, Fungi, and Vascular Plants

Two Survey and Manage vascular plants, *Cypripedium fasciculatum* and *Cypripedium montanum*, are present in the watershed (see the discussion of these species in the rare vascular plants section). One truffle fungus, *Choiromyces alveolatus*, is known to be present. The 1994 Northwest Forest Plan requires the Forest Service and BLM to manage these known sites. There are no known occurrences of bryophytes or lichens in this category. *Allotropa virgata* (candy-stick) a vascular plant is probably present, but has not yet been reported in this watershed. There is potential habitat for many more bryophytes, lichens, and fungi whose known sites Forest Service and BLM will be required to manage, if or when they are found. Currently there is no requirement to conduct project level surveys for most of these species.

The watershed contains potential habitat for Protection Buffer species and Survey and Manage survey strategy two species. Table 15 lists the species requiring surveys before ground-disturbing activities.

Table 15. Species Requiring Surveys before Ground-Disturbing Activities

Species	Plant Type
Allotropa virgata	vascular plant
Cypripedium fasciculatum	vascular plant
Cypripedium montanum	vascular plant
Buxbaumia viridis	moss
Rhizomnium nudum	moss
Ulota megalospora	moss
Kurzia makinoana	liverwort
Marsupella emarginata var. aquatica	liverwort
Ptilidium californicum	liverwort
Tritomaria exsectiformis	liverwort
Aleuria rhenana	cup fungus
Bondarzewia montana	polypore fungus
Otidea leporina	cup fungus
Otidea onotica	cup fungus
Otidea smithii	cup fungus
Polyozellus multiplex	fungus

Special Areas with Botanical Resources

Irene Hollenbeck Environmental Education Area (BLM): This area is located on Dead Indian Memorial Road and has profuse wildflower displays in late spring. It is a field trip destination for the Southern Oregon University biology department and other organized groups interested in nature study. Most of the area is an open south exposure with shallow and rocky clay soils over andesite bedrock. Vernally moist areas support many of the wildflowers. The pygmy monkey-flower and possibly other rare plants are present.

Lost Lake Research Natural Area (BLM): Lost Lake is a low elevation lake formed by landslide deposits in the western Cascades and thus fills a natural areas cell recognized in the Oregon Natural Heritage Plan. Also present in this Research Natural Area is old-growth Douglas-fir and white fir forests and andesite cliffs with associated outcrop and scabland plant communities.

Round Top Research Natural Area (BLM) and Round Top Preserve (The Nature Conservancy): Together, these areas have good examples of several forested, shrubland, and grassland plant communities listed in the Oregon Natural Heritage Plan as representative of western Oregon interior valleys and foothills.

Noteworthy Habitats Containing Unusual Plant Communities and Species Not Found in the Majority of the Watershed

Mounded prairie/vernal pool areas around Lake Creek and on the valley floor: This unusual topography has formed over a hardpan (agate-winlo soils, agate desert, biscuit scabland, patterned ground) and supports a flora adapted to seasonal soil saturation or inundation in the inter-mound areas. Rare plant species are present in this habitat. The plant communities in this habitat are highly altered from their original condition. Massive invasion of non-native plant species, encouraged by long-term poorly managed livestock grazing disturbance have been responsible for the loss of habitat quality. The non-native annual grasses and forbs remain. Maintaining habitat quality will be a matter of helping the natives live with the invaders. The mounds and better drained areas are now entirely dominated by annual exotic grasses. The wetter and shallower areas usually have a higher percentage of their original native flora. Acreage in this habitat continues to be lost to agricultural, industrial, and residential development. Since there is only a fraction of this habitat on federal land, there is little that BLM and the Forest Service can do to influence future conditions.

Remnant oak/pine savannah on the valley floor and lower foothills: Oak and pine woodland and shrubland is fairly common in the foothill portion of this watershed. Most valley floor areas no longer support this or any other native plant communities. A savannah condition of open canopies of widely spaced mature trees with native grassland was once probably common, but is now almost gone. Fire exclusion has allowed dense trees and brush to grow. Also, a steady invasion of non-native herbaceous plants, particularly annual grasses, following historical disturbances such as logging, roads, and unmanaged livestock grazing has largely displaced the native herbaceous flora.

Scablands with shallow soils over basalt/andesite: These are areas where shallow clay soils have formed over old unfractured lava flows. They are quite rocky. They are fairly common at low and mid-elevations in the watershed. Soils are saturated during the wet season and bone-dry in the summer. Plant communities are largely composed of plant species that tolerate this seasonally moist condition. Non-native annual grasses have invaded to a large extent.

Basalt/andesite cliffs and outcrops: These prominent geographic features occupy only a small portion of the watershed and are fairly well distributed at mid-elevations. They support a different assemblage of plant species than the surrounding forestlands and make a noteworthy contribution to the biological diversity. There are no significant threats to these cliff and outcrop plant communities.

Moist mountain meadows: These are fairly common in the upper watershed. Most of these meadows no longer support their original native plant communities, primarily in response to historic disturbances, such as landings and/or intensive grazing sites under past poor management practices. Some plant communities have become dominated by introduced non-native perennial grasses and/or "increaser" species (those plants that tend to increase under grazing pressure). The soil and hydrologic character of these meadows has generally changed as well. Only a few remote mountain meadows in the watershed still retain an original plant community composition and structure.

Western white pine: In the past, occasional fairly pure stands of large overstory western white pines have been present in the watershed. More significantly, this species used to be a major co-dominant in forest stands on the Dead Indian Plateau and one of the most common conifers on high open rocky areas. In the last 20 years, a large die-off of western white pine has occurred in this watershed (and throughout our region). This mortality has occurred both in areas where competition with other conifers is a factor and where it is not a factor. Blister rust is undoubtedly a major cause, often operating synergistically with bark beetles and drought. Western white pine is now only a minor component in forested stands. The high open rocky areas where western white pine used to be prevalent are now more open with fewer trees.

Engelmann spruce stands: Engelmann spruce forms dominant stands along some riparian corridors and wetlands in the upper watershed. No significant human threats are occurring now.

Quaking aspen stands: These are present in a number of places in the Dead Indian Plateau. Most stands are clonal (reproducing vegetatively from one or a few original founders). Some stands have died in the last few decades. This area is on the fringe of the normal range of quaking aspen. Aspen is a fire dependent species and groves will show low reproduction without disturbance (fire). We have no information on the overall trend for aspen groves in the watershed.

One or more bogs in the upper reaches of the watershed: There are a few areas at higher elevations in the watershed where perennial wetlands have developed a peat-like vegetation mat supporting aquatic and wetland plants typically found in more northern latitudes. These areas are vulnerable to disturbances that change their hydrologic character or that disrupt the vegetation mat.

Subalpine and alpine communities on the south side of Mount McLoughlin and possibly at the summit of Brown Mountain: High elevation species such as subalpine fir and whitebark pine occur here. A whole host of high elevation herbaceous perennial plants are also present. Threats to these plant communities from local human activity are minimal. Whitebark pine does not seem to have the same problems with competition and bark beetles that lower elevation pines have. Local whitebark pine is not suffering dramatically from blister rust, unlike our western white pines and unlike whitebark pine in other parts of North America. Atmospheric ozone depletion and possibly global warming may cause problems eventually in these plant communities.

FOREST DENSITY AND VIGOR

Vegetation disturbance mechanisms (abiotic and biotic) that influence the watershed's forest stand structure are logging, fire and fire suppression, bark beetles, pathogens, and dwarf mistletoe species associated with Douglas-fir and true fir species. In most cases, the biotic factors are influencing the forest structure in response to the low vigor of the forest stands and are therefore secondary. The primary concern with the predominantly mature seral stage vegetation is the overstocked condition which causes low vigor and/or poor growth. Low vigor occurs when diameter growth falls below 1.5 inches over 10 years and results in trees that are more susceptible to bark beetle attack. (Hall 1995)

Interior Valley Zone

Vegetation in the Interior Valley Zone (Map 11) is not in a desired condition. Many serious problems exist: non-native species are out-competing native species; natural succession/fire suppression has allowed for the decrease in abundance of early seral, drought tolerant tree species such as ponderosa pine and incense cedar; and most vegetation is in the mature seral stage so plant vigor is decreasing. High vegetation stocking levels are also contributing to the decline in tree vigor and subjecting the trees to bark beetle attack.

Native grasses are being out-competed by non-native species in the lowlands. Fire suppression has allowed for shrubs, such as whiteleaf manzanita and buckbrush, to invade the grasslands. There are many impenetrable, overstocked patches of whiteleaf manzanita in the mature seral stage, seven to ten feet high.

Fire suppression has allowed most oak woodlands to become overstocked with trees and shrubs. Oaks resprouted after the last large fires at the turn of the century; now sprout clumps of three-to-five 100 year-old trees are common. Crown ratios and tree diameters tend to be small. These suppressed oak sprout clump trees are short in height and produce few, if any, acorns. Douglas-fir regeneration is growing beneath the oak trees as a nurse crop, thus compounding the competition problem. Some older Douglas-fir trees have already died in the oak woodlands due to the inability of the species to tolerate drought.

In the Douglas-fir/poison oak associations, most of the forest stands are overstocked and are in the mature seral stage. Old-growth pines and Douglas-fir within these stands are being out-competed by second growth Douglas-fir trees. Many Douglas-fir have already been killed by the Douglas-fir bark beetle (*Dendroctonus pseudotsugae*) and flatheaded fir borers (*Melanophila drummondi*), and ponderosa pine by the western pine beetle (*Dendroctonus brevicomis*) and the mountain pine beetle (*Dendroctonus ponderosae*). Remaining stands are low in vigor and are subject to further bark beetle attacks.

Mixed Conifer Zone

Fewer vegetation problems exist in the Mixed Conifer Zone (Map 11). The typical problem is overstocking of Douglas-fir in the Douglas-fir and ponderosa pine plant associations. The prolific second-growth Douglas-fir and white fir have out-competed ponderosa pine, incense cedar, and black oak in the mixed species stands. Many dead, large diameter oak trees can be found beneath the canopy of the Douglas-fir trees. Wasson Canyon, Deer Creek, Grizzly Peak, and the upper elevations of Lake Creek have severe infection rates of Douglas-fir dwarf mistletoe *(Arceuthobium Douglasii)*. At the higher elevations, shade tolerant white fir regeneration is abundant in the understory layer of the forest. Without large scale disturbance occurring, there may possibly be a reduction in abundance of shade-intolerant species such as pine.

White Fir Zone

The White Fir Zone (Map 11) is experiencing problems similar to the Mixed Conifer Zone. The lack of large scale disturbance in the white fir/Douglas-fir/Pipers Oregon grape plant association has allowed white fir to dominate the understory and the early seral species are less common. Individual trees within small patches of overstocked white fir have been killed by the fir engraver beetle (*Scolytus ventralis*). Overstocked patches of ponderosa and sugar pine are being infested by the mountain pine beetle (*Dendroctonus ponderosae*). Many large diameter ponderosa pine trees have already succumbed to the western pine beetle (*Dendroctonus brevicomis*).

Many biotic processes are influencing the forest stand dynamics and structure in the Fish Lake area. Laminated root rot (*Phellinus weirii*) and Armillaria root disease (*Armillaria ostoyae*) are causing stand mortality and moving forest stands to the understory reinitiation stage, the stage in which the tree canopy layer opens and allows regeneration to become established in the understory. The infected true fir trees are also susceptible to attack by the fir engraver beetle. Mistletoe species are also causing mortality, which has the same effect as the pathogens on stand dynamics. Indian paint fungus (*Echinodontium tinctorium*) is also common in the watershed. Windborne spores infect new hosts through tiny dead branch stubs and remain dormant until the tree is stressed, usually by wounding. All of these processes create unhealthy trees that become safety hazards when located near houses or recreation areas.

Shasta Fir Zone

Vegetation concerns in the Shasta Fir Zone (Map 11) are more subtle. In the mature/late-successional stands, western white pine is being out-competed by the true fir species. White pine blister rust (*Cronartium ribicola*) is a major pathogen killing the pines. White pine was noticed to decline in 1900. Quaking aspen is most often found on the edges of conifer stands in this zone. Aspen is a short-lived, disturbance-dependent species that cannot persist for a long period of time without stand-reinitiating disturbance. Conifers are out-competing aspens on the edges of forest openings. Cattle and elk grazing also contribute to the species decline. In addition, Engelmann spruce seems to be declining in abundance in moist areas. Without disturbances to create large openings for these species to regenerate, they may decrease in number.

The Dead Indian Plateau, located within the White Fir and Shasta Fir zones, is unique geologically in that it resembles a gigantic elevated saucer. As a result of the concaved shape of the area, frost and frost heaving of the soil present problems for conifer regeneration to become established. In addition to the severe climatic conditions, there are other reforestation challenges that occur mainly in old clearcuts: gophers that eat seedlings the first year of planting; various root rots and bark beetles that can kill trees in large patches when there is only a single susceptible species present; and porcupines that girdle almost all of the pine trees in plantations.

Mountain Hemlock Zone

The Mountain Hemlock Zone (Map 11) extends in elevation to the timberline on Mount McLoughlin and Brown Mountain. Tree species found in this zone include mountain hemlock, noble fir, alpine fir, Englemann spruce, and lodgepole, white and whitebark pine. One unique feature is the presence of whitebark pine at the highest elevations of the zone. Large scale disturbance in this zone is very infrequent, therefore, natural processes, including succession, will determine species composition of the zone. Water is not limiting in this zone, thus it is not considered to be a factor for affecting vegetation vigor.

Coarse Woody Material

Coarse woody material (CWM) appears to be the heart of numerous ecosystem processes and is a vital part of forest productivity. Perry (1991) lists various functions of CWM and how it affects forest productivity. Tree roots with their mycorrhizal hyphae transport nutrients into decaying logs. Nitrogen-fixing bacteria contained in decaying logs increases the nitrogen over time. Nitrogen-fixation within logs adds approximately 1.2 pounds per acre of nitrogen annually on a per unit weight basis, approximately two to five times more than in mineral soil. If measured as plant available rather than total, logs contain from 10 to 30 percent of the available nitrogen (N) and phosphorus (P). In old-growth forests, approximately four percent of the total ecosystem N and P are contained in CWM.

Older, decayed logs serve as water reservoirs and because of their water content, become centers of biological activity during the summer months. One process that may take place is nitrogen-fixation by free-living bacteria. During the summer, logs have more water and are better buffered against temperature extremes. Almost all woody plants form a root symbiosis with certain fungi. It is hypothesized that CWM facilitates the reinoculation of clearcuts with truffle-forming mycorrhizal fungi. *Rhizopogon vinicolor* is especially important in gathering water. Microbes and invertebrates directly affect primary productivity through affects on nutrient cycling.

Maintaining the maximum levels of CWM consistent with reasonable fuel loadings appears to have considerable potential for enhancing site quality. Mid-seral stands with no CWM may have yields 12 percent lower than stands with sufficient CWM. As a crude estimate, primary production may be increased by a few percent for each ten tons of CWM left on site. CWM also stores carbon, which probably mitigates the "greenhouse effect".

CWM is not abundant in the Interior Valley, Mixed Conifer, and parts of the White Fir zone forests due to the present stand age and forest stand structure. Most stands are 120 to 140 years of age and just entering the understory reinitiation stage of stand development, the stage at which biotic and abiotic processes begin to cause tree mortality. Also, the historic stands had significantly fewer trees per acre, thus CWM was probably found in lesser quantities.

Forest Productivity

Forest productivity is generally defined in terms of site quality, which is a measure of tree growth over a given period of time. Site quality is determined by the physical characteristics of the soil, steepness of slope, aspect, microclimate, and species present. An indirect method of measuring site quality is to determine the site index of the soil. Site index is simply the height a tree will grow in a given time period. The Soil Survey of Jackson County Area, Oregon (1993) uses a reference age of 50 years for Douglas-fir. The soil survey indicates most of the soil series in the watershed are capable of growing Douglas-fir trees to a height of 70 to 85 feet in 50 years. The best soil (Freezener series) will grow trees 105 feet in height in 50 years; the poorest soil (Medco series) has a site index of 65 feet. These site potentials may not have been met in the present-day overstocked forest stands.

For the majority of the mature seral Douglas-fir stands in the Interior Valley and Mixed Conifer zones, the average relative density index is approximately 0.70 (the ratio of the actual stand density to the maximum stand density attainable in a stand with the same mean tree volume) (Drew and Flewelling 1979). A relative density index of 0.55 is considered to be the point of imminent competition/mortality; and at this point, trees have a greater probability of dying from biotic factors, mainly bark beetles. In general, throughout the watershed, the overstocked, mature seral stage forests have a low level of growth or vigor and are susceptible to bark beetle attack and pathogens. The forest zones in need of treatment, in order of declining stand vigor are: Interior Valley, Mixed Conifer, White Fir, and Shasta Fir zones.

FIRE

Over the past century, fire suppression has effectively eliminated five fire cycles in southwestern Oregon mixed conifer forests that occur at low elevations (Thomas and Agee 1986). The historic fire cycle was 20 years or less in this region. The absence of fire has converted open savannas and grasslands to woodlands and initiated the recruitment of conifers. Oregon white oak is now a declining species largely due to fire suppression and replacement by Douglas-fir on most sites.

The absence of fire due to suppression efforts has changed the make-up of the local forests to fire-intolerant, shade-tolerant conifers and has decreased species such as ponderosa pine and sugar pine. This conversion from pine to true fir has created stands that are stressed, which increases their susceptibility to accelerated insect and disease problems (Williams et al. 1980).

Horizontal and vertical structure of local forests has also changed. Surface fuels and the laddering effect of fuels have increased, resulting in the escalated threat of crown fires which were historically rare (Lotan et al. 1981). This trend is leading the forests from a low-severity fire regime to a high-severity regime, characterized by infrequent, high intensity, stand replacement fires. Fire is now an agent of ecosystem instability as it creates major shifts in forest structure and function. This trend continues throughout southwestern Oregon, as well as most of the western United States.

Fire suppression efforts over the past decades have altered, to some degree, how fires burn within areas classified under the moderate-severity regime. Typically, fires now burn more acres with high severity stand replacement fires. This is due to higher tree densities and increased ground fuels within timbered stands. Impacts of suppression efforts are difficult to quantify within this regime due to the varying degree of how fires normally burn within this regime.

The high-severity regime is characterized by moist, cool conditions so fires are infrequent. When fires occur within these areas it is due to unusual conditions such as drought periods associated with high winds. Stand replacement fires are normal. Suppression efforts have changed the make-up of timbered stands within this regime. Surface fuels and ladder fuels have increased. For the most part, fire suppression efforts have not impacted how fires burn within this regime.

Over the past two decades, clearcutting within this watershed has created changes in vegetation patterns that would not have occurred over such a large area naturally. The early seral stages present now are more susceptible to fire because of the fuel types they represent.

Most of the upper reaches of the Mixed Conifer and White Fir vegetation zones had yew wood in the understory, usually an indication of moist, shaded conditions. The Dead Indian Plateau area is now drier during the summer months, due to previous harvest activities and various post timber sale treatments. This has resulted in large openings and reduced canopy closure.

Much of the Dead Indian Plateau (federal lands as well as private ownership) had a significant amount of pre-existing or newly created logging slash treated during the previous two decades. This was done for hazard reduction and site preparation. Much of the slash reduction conducted on federal lands in the Dead Indian Plateau was achieved by tractor or broadcast burning.

Fire risk is defined as the chance of various ignition sources causing a fire that threatens valuable resources, property, and life. Historic lightning occurrence indicates there is the potential of lightning fires starting throughout all elevations within the watershed. The highest fire risk areas are major ridge lines due to lightning strikes and lands adjacent to roads and private property because of the potential for human-caused fires.

Some of the higher values at risk within this watershed are private residential and agricultural property, water quality, forest resources (such as northern spotted owl core areas, mature/old growth stands, and plantations), recreation sites, historic sites, and research natural areas. Table 16 summarizes these values at risk within the watershed.

Table 16. Values at Risk Due to Fire Exclusion, High Intensity Wildfire, or Wildfire Suppression Activities

Resource	Values at Risk
Recreation/Social	Improvements: Fish Lake, Doe Point, Fish Lake Resort, Fish Lake Summer Homes, North Fork, Daley Creek, and Beaver Creek campgrounds, Camp Latgawa, and dispersed sites. Aesthetic: Visual, spacial, and spiritual.
Habitat	Irene Hollenbeck Botanical Area, Lost Lake and Round Top RNAs, Round Top Preserve (Nature Conservancy), 100-acre LSRs (owl sites), LSR (critical habitat, OR 37), Fisheries (Riparian Reserves, Tier 1 Key Watershed, core area for coho), threaten and endangered species, and thermal cover.
Improvements	Private homes, Southern Oregon University outdoor education facility, Robinson Butte Lookout, Fish Lake Snotel, Big Elk Guard Station, Dead Indian RAWS station, Dead Indian ski hut, and the natural gas pipeline.
Historic Sites	Fish Lake CCC shelter, Camp Latgawa and shelter, Big Elk Guard Station, Dunlop Meadows, homestead sites, Reter summer home, Covered Bridge, old ranch houses, Finley Cabin, Lake Creek Store, and historic home sites.
Archeological Sites	Numerous sites (vulnerable to suppression activities).
Soils/Geology	Increased surface erosion, loss of litter layer, decrease in site productivity, change in soil structure, slope stability, and accelerated landslide activity.
Economic	Suppression costs and loss of products (recreation, timber, special products, range, and rural development).
Botanical	Habitat: Oak/pine savannah, western white pine, quaking aspen, Detling's microseris, and mountain/clustered lady's slipper. All areas are susceptible to encroachment by non-native species in the event of high intensity fire. Suppression activities such as fireline construction, placement of camp sites, and vehicle use can impact all botanical habitat; moist mountain meadows are particularly sensitive.
Public Safety	Entrapment, visibility, power and telephone lines.
Air Quality	Public health and visual quality.

Fuel hazard assesses vegetation by type, arrangement, volume, condition, and location, all of which determine the threat of fire ignition, spread, and difficulty of control. Hazard ratings were developed using vegetation (type, density, and vertical structure), aspect, elevation, and slope. Map 21 displays the fire hazard rating distribution with the watershed and Table 17 summarizes the acres within each hazard rating.

Table 17. Fire Hazard Ratings

Hazard Rating	Acres
Low	29,335
Medium	147,457
High	61,788

In general, the existing fuel profile in the lower elevations within the Little Butte Creek Watershed represents a moderate to high resistance to control under average climatic conditions. Most of the timber stands have a dense overstory and a moderate amount of ground fuel and ladder fuels are present. This creates optimal conditions for the occurrence of crown fires which could result in large stand replacement fires. This type of fire also presents an extreme safety hazard to suppression crews.

The fuel profile at the higher elevations within this watershed generally has a high amount of ground fuels which create conditions conducive for stand replacement fires. Weather patterns generally limit this type of fire, thus resistance to control for most fires is low to moderate.

Air Quality

"Levels" or "concentrations" of smoke or air pollutants have only been measured over the past three to four decades. The Clean Air Act directed the State of Oregon to meet the national ambient air quality standards by 1994. The Oregon Smoke Management Plan identifies strategies to minimize the impacts of smoke from prescribed burning on smoke sensitive areas within western Oregon. Particulate matter the size of 10 microns (PM10) or less is the specific pollutant addressed in this strategy. The goal of the Oregon Smoke Management Plan is to reduce particulate matter emissions from prescribed burning by 50 percent by the year 2000 for all of western Oregon. Particulate matter has been reduced by 42 percent since the baseline period (1991).

Currently, the population centers of Grants Pass and Medford/Ashland are in violation of the national ambient air quality standards for PM10 and are classified as nonattainment areas for this pollutant. The nonattainment status of these areas is not attributable to prescribed burning. Major sources of particulate matter within the Medford/Ashland area are smoke from woodstoves (63 percent), dust, and industrial sources (18 percent). Prescribed burning contributes less than 4 percent of the annual total.

Emissions from wildfires are significantly higher than from prescribed burning. The wildfires that occurred in southern Oregon in 1987 emitted as much particulate matter as all other burning that occurred within the state that year. Prescribed burning under spring-like conditions consumes less of the larger fuels creating fewer emissions. Smoke dispersal is easier to achieve due to the general weather conditions that occur during the spring. The use of aerial ignition reduces the total emissions by accelerating the ignition period and reducing the total combustion process due to the reduction of the smoldering stage.

The effect of smoke produced from prescribed burning could reduce visibility within a project area or could concentrate the smoke around a project site or surrounding drainages. Prescribed burning would comply with the guidelines established by the Oregon Smoke Management Plan and the Visibility Protection Plan.

TERRESTRIAL WILDLIFE SPECIES AND HABITATS

Wildlife-General

The Little Butte Creek Watershed encompasses a broad elevational range and is primarily composed of the following natural plant communities (generally in order of low to high elevation): grass-forb dry hillside, mountain shrubland and chaparral, deciduous hardwood, mixed coniferous forest, temperate coniferous forest, and high temperate coniferous forest (Brown 1985). These plant communities and the associated condition classes provide habitat for approximately 200 terrestrial wildlife species that are known or suspected to inhabit the watershed. Table 18 lists wildlife species that are representative of the nonconiferous plant communities and the various condition classes of the coniferous plant communities.

Table 18. Representative Wildlife Species

Condition Class	Representative Species
Grass-forb dry hillside	Gopher snake, western meadowlark, California ground squirrel
Mountain shrubland and chaparral	Western fence lizard, wrentit, dusky-footed woodrat
Deciduous hardwood forest	Ringneck snake, acorn woodpecker, western gray squirrel
Seedling/sapling	Northwestern garter snake, mountain quail, pocket gopher
Pole (5-11" DBH)	Southern alligator lizard, golden-crowned kinglet, porcupine
Large pole (11-21" DBH)	Ensatina, Steller's jay, mountain lion
Mature/old-growth (21+" DBH)	Northern spotted owl, northern flying squirrel

Although wildlife species richness is high, elements of habitat decline are present. Grass-forb dry hillside habitat is less productive due to the encroachment of noxious species and is declining in abundance due to the encroachment of other native plant communities such as mountain shrubland and mixed conifer. Most regeneration of mountain shrubland vegetation is dependent on fire and in its absence, the trend has been toward decadence with little regeneration. The result is a lack of early seral conditions in this plant community. Abundance and condition of oak-woodland habitat has decreased due to the encroachment of conifers and overstocking of oaks and shrubs.

In the coniferous plant communities, snag density and down woody material is inadequate in much of the early seral and pole condition classes due primarily to timber harvest. Fire suppression has contributed to some pole and mature conifer stands becoming more dense than they would have under natural fire regimes. The lack of intrastand structure in these stands generally results in lower species richness in comparison to other condition classes. The abundance of mature/old-growth habitat has declined due to timber harvest.

Although supportive data are unavailable, the general decline in habitat condition probably has not resulted in a significant decrease in the variety of wildlife species. However, there has likely been substantial change in wildlife species abundance and distribution.

Lava flows, rock outcrops and the associated talus, and caves provide special/unique wildlife habitats in the watershed. In combination with the proper microclimatic conditions these habitats are important for several special status species in the watershed, such as bats.

Threatened/Endangered Species

Present in the watershed are the American peregrine falcon, a federally listed endangered species, and the bald eagle and northern spotted owl, federally listed threatened species. There are one peregrine falcon eyrie, one bald eagle nest site, and 39 northern spotted owl activity centers. Consultation with U.S. Fish and Wildlife Service is required under the guidelines of the Endangered Species Act (ESA) for any projects that affect these species.

A management plan for the peregrine falcon eyrie is in the process of being prepared. A site-specific management plan that identifies site specific habitat and management information has been prepared for the bald eagle site (USDI 1986). Refer to the Fish Lake Bald Management Plan.

There are 39,541 acres of suitable habitat for northern spotted owls within the watershed. Suitable habitat provides nesting, roosting or foraging functions for spotted owls, and generally has the following attributes: high degree of canopy closure (approximately 60 percent or more), multilayered canopy, and presence of large snags and coarse woody material. The distribution of suitable habitat in the watershed is illustrated on Map 22.

The amount of suitable habitat within the median home range of an activity center is often indicative of the probability of successful nesting and continued occupancy of a site. As an indication of how these acreages provide for spotted owl nesting, roosting and foraging, the U.S. Fish and Wildlife Service uses a threshold of 1,160 acres of suitable habitat within the median home range for determining incidental take; such as, if suitable habitat is being removed by an activity and existing suitable habitat is below or will be reduced to less than the threshold acres, incidental take occurs due to habitat loss. Of the 39 activity centers within the watershed, 34 are below this threshold.

Northern Spotted Owl Critical Habitat

Approximately 86,484 acres of the watershed are in designated critical habitat unit (CHU) OR-37. The U.S. Fish and Wildlife Service designates critical habitat to preserve options for recovery of the species by identifying existing habitat and highlighting areas where management should be given high priority (USDA and USDI 1994). In the case of the northern spotted owl, critical habitat was designated to protect clusters of reproductively-capable owls and facilitate demographic and genetic interchange (USDA and USDI 1994). The Late-Successional Reserve (LSR) system established in the Northwest Forest Plan (NFP) provides for clusters of reproductively-capable owls. The U.S. Fish and Wildlife Service, in its biological opinion for the Northwest Forest Plan (NFP), acknowledges that the LSR system is a reasonable approximation of designated critical habitat. Approximately 70,450 acres of

CHU OR-37 are within the boundaries of the Dead Indian LSR. The function of the remaining acres of CHU OR-37, which are in the matrix allocation, is to provide for connectivity between other LSRs, such as demographic and genetic interchange.

Map 22 shows critical habitat and LSR boundaries within the watershed and the distribution of suitable habitat within the CHU and LSR. There are 30,441 acres of suitable habitat within the CHU/LSR overlap and 8,057 acres of suitable habitat within the CHU outside of the LSR overlap.

Special Status Species

Special status species include those species that are listed by the U.S. Fish and Wildlife Service as threatened or endangered, proposed for listing as threatened or endangered, candidates for listing as threatened or endangered, are listed by the BLM as sensitive or assessment species, or are on the USFS Regional Forester Sensitive Species List.

Twenty-three special status species are known or suspected to be present in the Little Butte Creek Watershed. Table 19 lists these species, their status, and the primary reason they are listed as special status species.

Table 19. Special Status Wildlife Species

Species	Status[1]	Primary Reason(s) for Status
Western Pond Turtle (*Clemmys marmaorata*)	FSS/BS	Habitat loss/degradation, predation
California Mountain Kingsnake (*Lampropeltis zonata*)	FSS/BA	General rarity
Common Kingsnake (*Lampropeltis getultus*)	FSS/BA	General rarity
Greater Sandhill Crane (*grus conadensis*)	FSS	General rarity
Northern Spotted Owl (*Strix occidentalis caurina*)	T	Timber harvest
Bald Eagle (*Hailaeetus leucocephalus*)	T	Shooting, pesticides, disturbance
Northern Goshawk (*Accipiter gentilis*)	BS	Timber harvest
Great Gray Owl (*Strix nebulosa*)	BS/PB	Timber harvest
Flammulated Owl (*Otus flammeolus*)	BA	Timber harvest
Northern Saw-whet Owl (*Aegolius acadicus*)	BA	Timber harvest

Species	Status[1]	Primary Reason(s) for Status
Pileated Woodpecker (*Dryocopus pileatus*)	BA	Timber harvest
Lewis' Woodpecker (*Asyndesmus lewis*)	BA	Fire suppression, salvage logging following fires
Western Meadowlark (*Sturnella neglecta*)	BA	Development (residential and commercial)
Western Bluebird (*Sialia mexicana*)	BA	Development
Townsend's Big-eared Bat (*Plecotus townsendii*)	BS/PB FSS	General rarity and lack of information
Fringed Myotis (*Myotis thysanodes*)	BS/PB	General rarity, lack of information
Long-eared Myotis (*Myotis evotis*)	BS/PB	General rarity, lack of information, timber harvest
Yuma Myotis (*Yuma myotis*)	BS	General rarity, lack of information
Long-legged Myotis (*Myotis volans*)	BS/PB	General rarity, lack of information, timber harvest
Pacific Pallid Bat (*Antrozous pallidus*)	BS/PB	General rarity, lack of information
Red Tree Vole (*Phenecomys longicaudus*)	SM/FSS	Timber harvest
Silver-haired Bat (*Lasionyeteris noctivagans*)	PB	General rarity, lack of information
White-footed vole (*Phenecomys albipes*)	FFS	General rarity, lack of information

1/ Status:
- T - Listed as threatened under the ESA
- E - Listed as endangered under the ESA
- BS - Bureau sensitive
- BA - Bureau assessment
- FSS - Forest Service sensitive
- PB - Designated to receive protection buffers in the NFP
- SM - Designated as a Survey and Manage species in the NFP

The following species have also been considered for accelerated research under the USDA, Forest Service, Region Six, Threatened/Endangered/Sensitive (TES) Priorities Research Program: pileated woodpecker, white-headed woodpecker, three-toed woodpecker, Williamson's sapsucker, black-backed woodpecker, Vaux's swift, northern saw-whet owl, northern pygmy owl, flammulated owl, boreal owl, northern goshawk, American marten and fisher.

Most of these species have been identified in the watershed or on immediately surrounding lands. No systematic surveys have been conducted for the avian species, but cameras have been placed in limited locations for verification of marten and fisher occurrence. To date, only marten have been verified; reliable anecdotal information also places fishers within the watershed within the past 20 years.

Survey and Manage Species, Protection Buffer Species, and Bat Roost Sites

Eight species known or suspected to be present in the watershed are afforded extra protection in the Northwest Forest Plan under Standards and Guidelines for Survey and Manage Species, Protection Buffer Species, and Bat Roost Sites. These species are the red tree vole (Survey and Manage); great gray owl (Protection Buffer); Townsend's big-eared bat, fringed myotis, silver-haired bat, long-legged myotis, long-eared myotis, and pallid bat (Bat Roost Sites).

Red tree voles are suspected to occur in the watershed due to suitable habitat and their verified presence approximately 1.5 miles from the boundary of the Little Butte Creek Watershed. Surveys for red tree voles have not been done in the watershed. Red tree voles surveys are required for habitat altering projects if the amount of suitable habitat in a watershed does not exceed given thresholds. Red tree voles are thought to be highly associated with mid, mature, and old-growth Douglas-fir forests having a high degree of canopy closure.

Great gray owls are known to be present in the watershed. These owls are associated with forested areas that are proximate to grasslands and early-seral conditions of conifer plant associations. They nest in conifer stands and forage in grasslands and other open areas.

All six species of bats listed above, whose known roosts are provided protection by the standards and guidelines in the NFP, are present in the watershed. Several of these bat species have an affinity for roosts associated with large trees and snags where plated/sloughing bark and cavities provide the microclimatic conditions suitable for roosting (Cross 1996; Clayton 1997). Townsend's big-eared bats have been found in caves located on private lands within the watershed.

Deer and Elk

Roosevelt elk and black-tailed deer are other species of management concern present in the watershed. These animals receive considerable public attention due to their recreational value; both consumptive and non-consumptive. Populations in the watershed are judged to be stable or increasing.

A recently completed elk study conducted to ascertain migration routes and seasonal use patterns included a portion of the Little Butte Creek Watershed. There is also an ongoing black-tailed deer study that encompasses portions of the watershed. The objectives of the study are focused on age structure, mortality/survival rates, fecundity of adult does, and migration patterns.

Management for deer and elk in the analysis area is focused primarily on improving forage and cover conditions and decreasing the density of roads that are open to vehicular traffic, particularly in the winter period. High quality forage is very important to both deer and elk, especially on winter ranges, however, forage conditions are declining in the watershed. Introduced noxious herbaceous species, such as yellow starthistle and medusa, which usually do not provide high quality forage, are displacing native grasses and herbs which generally provide high quality forage. Also, due primarily to fire suppression, large acreages of important browse species such as wedgeleaf ceanothus have become decadent and are not providing the quality forage that younger plants provide.

Hiding cover is important to deer and elk because it provides areas for escaping predators and avoiding disturbances caused by other mechanisms, such as off-highway vehicles (OHVs) and other vehicles. Paradoxically, fire suppression which has negatively affected forage conditions, has generally improved hiding cover conditions in the watershed. In the absence of fire, shrubs and trees that provide hiding cover have become more dense.

Both winter and summer thermal cover generally have canopy closure values in excess of 60 percent. The high canopy closure moderates microclimatic extremes, and can benefit deer and elk by reducing the energy required to maintain body temperatures.

Big Game Winter Range

Under the guidelines of the land/resource management plans for the BLM and Forest Service, Big Game Management Areas/Winter Range have been identified as areas to promote forage, hiding, and thermal cover for deer and elk (Map 23).

Obtaining high quality forage is of primary concern for the winter herds in southwestern Oregon. For the deer herds this is met primarily through browse species. The lower elevation grasslands (often on private lands) are critical for wintering elk herds. Low nutrition level in the forage base is often the limiting constraint for deer and elk (Longhurst 1996).

Oregon Department of Fish and Wildlife (ODFW) suggests a 30-year rotation on brush fields to maintain vigor and nutritional value for blacktail. ODFW wants to increase their cooperation in coordinating and funding prescribed burns and other projects that improve forage to a higher quality. Cooperative funding sources are readily available through ODFW for projects including private lands (Thiebes 1996).

The winter range is located at lower to mid-elevations in the watershed, primarily on the south facing slopes which are advantageous for their ability to capture winter solar radiation. As a result, less energy is expended by the animals in maintaining normal body temperatures. It is also beneficial for big game animals if forage, such as grasses, forbs, and shrubs are maintained to a high quality in the winter range.

Historically, the oak/pine woodlands of the mid-elevation would have produced good forage from the mast, grasses, forbs, and shrubs to have been important to deer and elk as winter ranges. Many of these areas have been lost or are being lost as a result of fire exclusion and non-native plant intrusions. Reclamation of these areas would prove beneficial to deer and elk.

Hiding cover for escape from predators and in conjunction with roads is important. Maintaining road densities at, or below, one mile per square mile of land is desirable.

Thermal cover for big game winter range is not as critical in Little Butte Creek Watershed as it is in eastern Oregon due to the milder winters west of the Cascades. Although thermal cover may not be a major issue in this watershed, it can benefit big game animals by moderating thermal extremes.

Big Game Summer Range

As a result of the hot dry summers in the area, both deer and elk often have the need for summer thermal cover. This is often met by stands of late-successional and mature habitat in the mid to higher elevations during the summer and early fall months. In addition, the nutrition provided by grasses, forbs, and browse at these elevations play an important role in the conditioning of does and the survival of fawns. Therefore brushfields and meadows at mid and high elevations need to be managed for nutritional value.

HYDROLOGY

For purposes of the hydrology discussion, the Little Butte Creek Watershed is stratified into three analysis subwatersheds: North Fork Little Butte Creek, South Fork Little Butte Creek, and Lower Little Butte Creek (from the mouth of Little Butte Creek to the confluence of the North and South forks of Little Butte Creek).

Groundwater

Baseline information to assess the current status of groundwater quantity or quality is not available. Recent years of below normal precipitation have resulted in reduced recharge of groundwater supplies. Water rights for groundwater in the Little Butte Creek Watershed are minimal, 1.12 cubic feet per second (cfs) for irrigation use (OWRD 1997). Groundwater uses exempt from water rights include: stock watering, lawn or non-commercial garden watering of no more than 0.5 acres, and single or group domestic purposes for no more than 15,000 gallons per day. No information is available regarding the amount of exempt uses.

Streamflow

Peak Flow

Based on historical records from the U.S. Geological Survey gaging stations, maximum peak flows generally occur in December for the South Fork Little Butte Creek, in January through March for North Fork Little Butte Creek, and January through February for Little Butte

Creek. These high flows are often a result of rain-on-snow storm events that occur when a substantial amount of rain falls on snow accumulated in the transient snow zone (elevation zone of 3,500 to 5,000 feet). The combination of rain moving into the stream channels and the rapid snowmelt can result in flooding. A recent example of flooding resulting from a rain-on-snow event in Little Butte Creek Watershed occurred January 1, 1997. The transient snow zone occupies 72,882 acres (31 percent) of Little Butte Creek Watershed (46 percent of North Fork Little Butte Creek analysis subwatershed, 47 percent of South Fork, and 13 percent of Lower Little Butte Creek).

Upland disturbances, both natural and human-caused, can result in increased magnitude and frequency of peak flows. Increases in size and frequency of peak flows may result in accelerated streambank erosion, scouring and deposition of stream beds, and increased sediment transport. The natural disturbance having the greatest potential to increase the size and frequency of peak flows is a severe, extensive wildfire. Loss of large areas of vegetation due to a wildfire would likely adversely affect the watershed's hydrologic response. In the Little Butte Creek Watershed, the primary human disturbances that can potentially affect the timing and magnitude of peak flows include roads, soil compaction (due to logging, agriculture, and grazing), and vegetation removal (due to timber harvest and conversion of sites to agriculture use). Quantification of these effects on streamflow in the Little Butte Creek Watershed is unknown.

Roads quickly transport subsurface water intercepted by roadcuts and water from the road surface to streams (Wemple 1994). The road-altered hydrologic network may increase the magnitude of peak flows and alter the timing when runoff enters a stream. This effect is more pronounced in areas with high road densities and where roads are in close proximity to streams. Map 4 gives a visual portrayal of road densities for all ownerships and Map 19 shows sections with road densities greater than 4.0 miles/sq. mile. These sections with high road densities are listed in Appendix E. Road and stream crossing information is shown in Table 20 for analysis subwatersheds in the Little Butte Creek Watershed.

Table 20. Road Information by Analysis Subwatershed

Analysis Subwatershed	Total Road Miles[1]	BLM Roads[2] (percent)	Forest Service Roads[3] (percent)	Other Roads (percent)	Road Density (miles per sq. mile)	Stream Crossings (number)
North Fork	170.3	20	44	36	3.0	291
South Fork	466.4	30	40	30	3.3	956
Lower	477.6	19	0	81	2.7	1,239
Total	1,114.3	24	24	53	3.0	2,486

1/ Roads shown on the GIS transportation theme.
2/ Roads with BLM control or on BLM-administered land.
3/ Roads with Forest Service control or on National Forest land.

Soil compaction resulting from roads, yarding corridors, agriculture, and concentrated livestock grazing also affects the hydrologic efficiency within a watershed by reducing the infiltration rate and causing more rainfall to quickly become surface runoff instead of moving slowly through the soil to stream channels (Brown 1983). Soil compaction data has not been compiled for the Little Butte Creek Watershed.

Vegetation removal reduces interception and transpiration and allows more precipitation to reach the soil surface and drain into streams or become groundwater. Until the new vegetation obtains the same crown closure as the previous unmanaged stand, it is considered to be hydrologically unrecovered. Douglas-fir and white fir stands are considered to be 100 percent hydrologically recovered when they obtain 70 percent crown closure. Pine stands reach 100 percent hydrologic recovery when the crown closure is 30 to 50 percent; 30 to 40 percent would be for south and west aspects, while north aspects would be at 40 to 50 percent. Percent hydrologic recovery by analysis subwatershed is shown in Table 21. This data was calculated by applying recovery factors to the vegetation information derived from Western Oregon Digital Image Processing satellite imagery data (see Landscape Vegetation Pattern). Areas classified as water, rock, and grassland/shrubland are considered fully recovered for this analysis. Urban/agricultural areas are treated as 0 percent recovered. Recovery factors for hardwood and forested areas are based on full hydrologic recovery occurring when a forest stand reaches 75 percent crown closure (see Table 21, footnote 1). Forest stands with 40 percent crown closure are considered to be 50 percent recovered and forest stands with a crown closure of 5 percent or less are treated as 0 percent recovered.

Large areas of vegetation removal in the transient snow zone are of particular concern due to alterations of the streamflow regime and resultant increased peak flow magnitudes (Christner and Harr 1982). Percent of hydrologic recovery in the transient snow zone is shown in Table 21.

Table 21. Percent of Hydrologic Recovery by Analysis Subwatershed

Analysis Subwatershed	Percent of Area Hydrologically Recovered[1]	
	All Lands	Transient Snow Zone
North Fork	77	82
South Fork	72	72
Lower	55	73
Total	65	75

1/ The satellite imagery data is only available in 10 percent increments, starting at 5 percent, so full recovery had to be taken at 75 percent instead of 70 percent. Also, the satellite imagery data does not have the capability of distinguishing between tree series and the pine stands had to be treated the same as Douglas-fir. Therefore, the percent hydrologic recovery shown in Table 21 is a conservative estimate.

Low Flow

Summer streamflows in the Little Butte Creek Watershed reflect the low summer rainfall (Figures 6, 7, and 8, Characterization section). Naturally low summer flows are exacerbated by periods of below normal precipitation (Characterization section, Climate). Many perennial, tributary streams in the Little Butte Creek Watershed have been drying up during summers in years with below normal precipitation. The greatest need for water occurs during the summer when demand for irrigation and recreation use is highest.

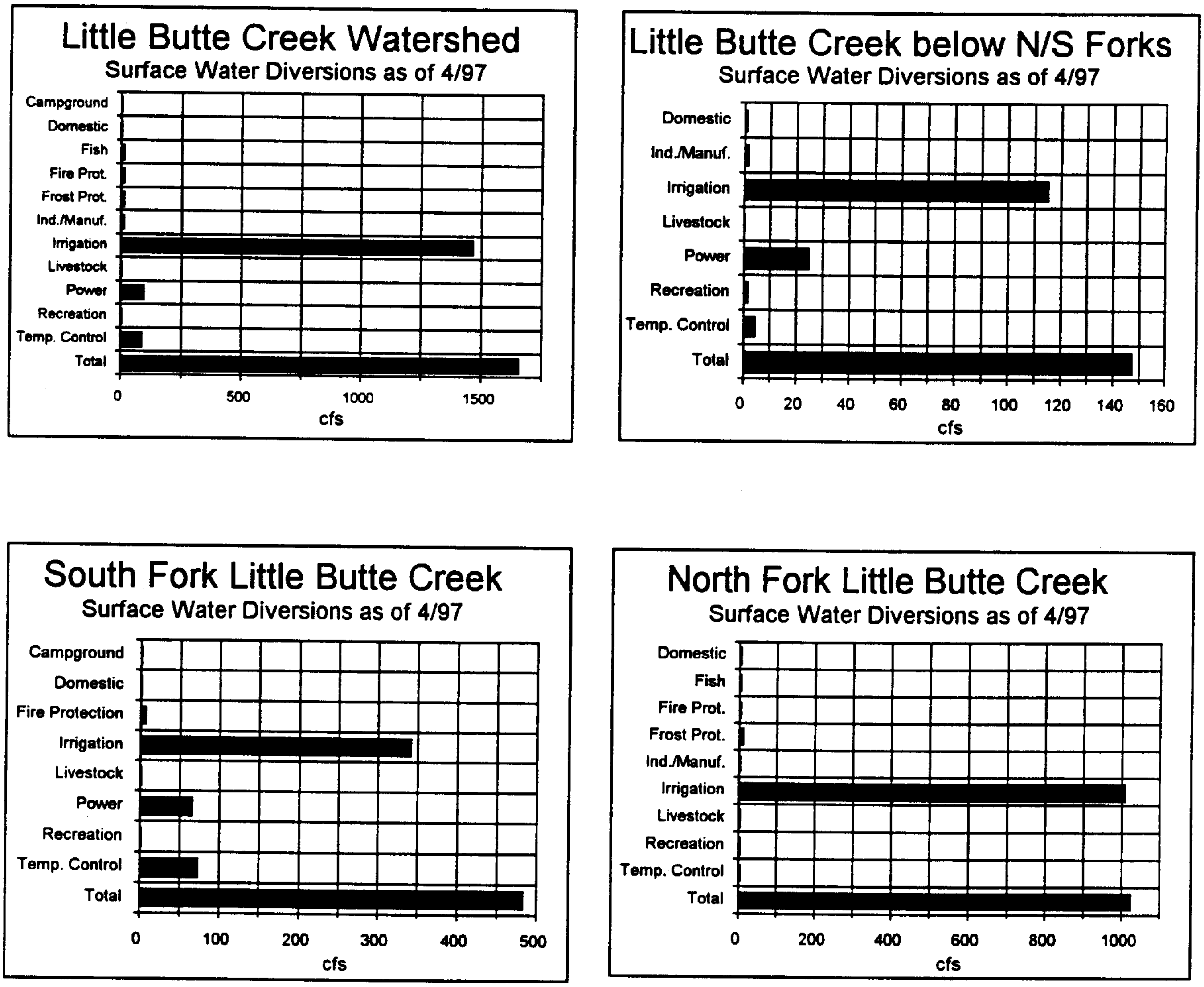
There are serious geographical and seasonal deficiencies in water supply within the Little Butte Creek Watershed (OWRD 1989). Summer streamflows have been dramatically altered by transbasin diversions. Water is diverted from South Fork Little Butte Creek and its tributaries into collection canals that transport the water to Howard Prairie Reservoir in the Klamath River Basin. There are five points of diversion located on Conde Creek, Dead Indian Creek, South Fork Little Butte Creek, Daley Creek, and Beaver Dam Creek. A total of 62,000 acre-feet is allowed to be transferred out of the South Fork Little Butte Creek and its tributaries during the irrigation season.

Water is diverted via the Cascade canal from Fourmile Lake in the Klamath River Basin to Fish Lake in North Fork Little Butte Creek analysis subwatershed. Outflows from Fish Lake are sent down North Fork Little Butte Creek to the confluence with South Fork Little Butte Creek where the water is diverted to the South Fork. From South Fork, water is diverted via irrigation ditches to supply Agate Lake with irrigation water for Bear Creek Watershed.

Map 24 displays diversion point locations associated with places of use within the Little Butte Creek Watershed. Numerous diversions are concentrated in Lost Creek and the lower reaches of South Fork Little Butte Creek. The Lower Little Butte Creek analysis subwatershed has a large number of diversions located in Lake Creek, Salt Creek, Lick Creek, Antelope Creek, and along the main stem of Little Butte Creek.

Figure 10 presents water right information obtained from the Oregon Water Resources Department (OWRD 1997) for each of the analysis subwatersheds and the total for the watershed. The majority of water right diversions in the Little Butte Creek Watershed are used for irrigation.

Figure 10. Water Rights for Each Analysis Subwatershed and Little Butte Creek Watershed
Source: OWRD 1997



The Rogue River Basin Program (OWRD 1989) established minimum perennial streamflows for Little Butte Creek, Antelope Creek, Lake Creek, and South Fork Little Butte Creek (Table 22).

Table 22. Minimum Perennial Streamflows

	Minimum Perennial Streamflows (cfs)											
Stream Name	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
Little Butte Creek @ mouth	120	100	100	100	100	100	100	60	20	20	20	120
Antelope Creek @ mouth	20	25	25	25	25	25	25	10	5	5	5	5/20
Lake Creek @ mouth	8	12	12	12	12	12	12	4	1	1	1	1/8
South Fork Little Butte Creek @ gage (RM 18.1)	50	70	70	70	70	70	70	30	30	20	20	20/50

Source: OWRD 1989

Trends

Peak flows on the main stem streams of each analysis subwatershed are not expected to noticeably change in the future. They will likely continue to result from major storm events that include rapid melting of snow in the transient snow zone. It is expected that peak flows in the headwater streams will decrease slightly as the areas recover hydrologically. Reduced harvest and restoration efforts under the Northwest Forest Plan will accelerate the recovery process. Roads will continue to affect peak flows.

The low summer flow situation in Little Butte Creek Watershed is not likely to change substantially in the future. Years of below normal precipitation will be especially critical for fish and other instream uses. Increased development in the watershed will place higher demands on streamflow. However, new surface water diversions are only being approved for domestic and stored water applications, therefore, additional major withdrawals are unlikely. The Oregon Water Trust is working with the Little Butte Creek Watershed Council to restore surface water flows in Little Butte Creek through acquisition and leasing of existing out-of-stream rights and conversion to instream water rights.

STREAM CHANNEL

The Oregon Department of Fish and Wildlife (ODFW) conducted a stream survey in Little Butte Creek Watershed during 1991 and 1994 (ODFW 1991 and 1994). The stream survey provided fish habitat information as well as channel information such as amount of large woody material, substrate composition, and percent of actively eroding streambanks. The stream channel information is summarized in Table 23.

Table 23. Stream Channel Summary

Stream Name (Number of reaches)	Description of Stream Reaches Surveyed	Large Woody Material[1] (Number pieces/100 meters)	Substrate (Percent wetted area)						Stream-bank Erosion (Percent actively eroding)
			Silt/ Org	Sand	Gra-vel	Cob-ble	Boul-der	Bed-rock	
Little Butte Creek (2)	Mouth to North/South confluence (30,265 meters)	1.2	17	1	36	16	3	27	4.2
North Fork Little Butte Creek (1)	Mouth to within ¼ mile of milepost 16 on Hwy 140 (3,029 meters)	4.0	18	7	33	23	14	5	12.6
South Fork Little Butte Creek (11)	Mouth to 1,731 meters beyond the confluence of Short Creek (28,624 meters)	8.8	16	7	34	28	13	2	21.5
Antelope Creek (6)	Mouth to small tributary at T. 37 S., R. 1E., Sec. 9, NE (16,613 meters)	NA	0	8	35	49	4	4	2.4
Lake Creek (5)	Mouth to center of T. 37 S., R. 2E., Sec. 20 (11,397 meters)	8.6	28	1	38	21	9	2	72.6
Lost Creek (8)	Mouth to T. 37 S., R. 2E., Sec. 35, SE (10,471 meters)	13.0	25	9	25	19	16	6	36.0
Deer Creek (4)	Mouth to T. 37 S., R. 2E., Sec. 25/36 (4,582 meters)	14.9	9	24	27	16	13	11	51.4
Soda Creek (3)	Mouth to T. 38 S., R. 3E., Sec. 5, NE (8,105 meters)	16.6	22	12	19	11	13	23	62.6

1/ Minimum size of large woody material was 15 cm diameter by 3 m length. Source: ODFW 1991/1994

Large wood in streams contributes to the form and structure of a stream's channel and largely controls the distribution of aquatic habitats (see Aquatic Wildlife), stability of streambeds and streambanks, and routing of sediments and water through the system. Large wood traps and slows the movement of sediment and organic matter through the stream system. Large wood is particularly critical for the steep tributaries because it creates a stepped stream profile, with stream energy dissipated in relatively short, steep sections of the channel.

The 1991 and 1994 stream survey results indicate a lack of large woody material in the stream channels. Table 23 summarizes the number of pieces per 100 meters for all reaches surveyed. Although a few stream reaches had greater than 20 pieces per 100 meters (two South Fork Little Butte reaches, one Lost Creek reach, and one Deer Creek reach), most reaches had very low amounts of large woody material. The amount of large woody material changed as a result of the 1997 New Year's Day flood, however, no large wood survey has been conducted since the flood. From preliminary observations after the flood, it appears that the amount of large wood in South Fork Little Butte Creek increased.

Substrate composition is a good indicator of sediment problems in the stream system and is also important for fish habitat (see Aquatic Wildlife). The substrate summary for each stream surveyed by ODFW in Little Butte Creek is presented in Table 23. The following streams are identified as having a high percentage of fine sediment: Little Butte Creek from the mouth to the North/South confluence, South Fork Little Butte Creek from the mouth to Beaver Dam Creek, Deer Creek, Lake Creek, Lost Creek, and Soda Creek (ODEQ 1996). No updated information on stream substrate composition after the 1997 New Year's Day flood is available. There are both regularly occurring and event related inputs of sediment into stream channels. Road surfaces, fill slopes, and ditchlines are a continual sediment source in the Little Butte Creek Watershed. Soil that moves into the ditchlines is carried to stream systems by ditch runoff. Landslides, both natural and human-caused (resulting from roads or clearcuts), transport large amounts of sediment to the stream system during major storm events (see Erosion Processes). Drainage areas with stream-adjacent unstable areas or high numbers of road stream crossings are likely to experience the most sediment movement into stream channels. Appendix E lists sections with high road densities and gives the number of stream crossings per section.

Channel erosion during peak flow events is another event related source of sediment as evidenced during the 1997 New Year's Day flood (see Erosion Processes). Table 23 shows the percent of the streambanks that were actively eroding in the reaches surveyed by ODFW in 1991 and 1994. An intensive stream inventory is needed to identify streambank erosion in the remainder of the watershed as well as to inventory the surveyed reaches after the 1997 New Year's Day flood.

Roads are adjacent to many of the stream reaches within the Little Butte Creek Watershed (Map 4). In addition to being a sediment source, these roads confine the stream channel and restrict the natural tendency of streams to move laterally. This can lead to downcutting of the stream bed or erosion of the streambank opposite the road.

The overall trend for stream channel condition on federal forest land should improve over the long term. Vegetation in riparian reserves will provide future large wood recruitment and reduce streambank erosion. Roads will continue to supply sediment, although maintenance and decommissioning would greatly reduce the sediment source. Vegetative recovery in old clearcut areas will reduce the landslide potential.

WATER QUALITY

Section 303(d) of the Clean Water Act requires each state to identify streams, rivers, and lakes that do not meet water quality standards even after the implementation of technology-based controls. These waters are referred to as "water quality limited" and states are required to submit 303(d) lists to the Environmental Protection Agency every two years. The Oregon Department of Environmental Quality's (DEQ) 1994/1996 list of water quality limited streams includes many streams within the Little Butte Creek Watershed (Table 24, Map 25).

Table 24. Water Quality Limited Streams

Stream Name	Description	Parameter
Antelope Creek	Mouth to headwaters	Temperature - summer
Conde Creek	Mouth to headwaters	Temperature - summer
Dead Indian Creek	Mouth to headwaters	Temperature - summer
Deer Creek	Mouth to headwaters	Sediment
Fish Lake	Reservoir	Chlorophyll a - summer pH - summer
Lake Creek	Mouth to headwaters	Habitat modification Sediment
Little Butte Creek	Mouth to North/South Fork confluence	Sediment Temperature - summer Water contact recreation (fecal coliform)
Lost Creek	Mouth to headwaters	Sediment
North Fork Little Butte Creek	Mouth to headwaters	Temperature - summer
Soda Creek	Mouth to headwaters	Sediment
South Fork Little Butte Creek	Mouth to Beaver Dam Creek	Flow modification Habitat modification Sediment Temperature - summer
West Fork Dead Indian Creek	Mouth to headwaters	Temperature - summer

Source: ODEQ 1996

The DEQ's 1988 Oregon Statewide Assessment of Nonpoint Sources of Water Pollution identifies six stream segments in the Little Butte Creek Watershed that are impacted by nonpoint source pollution. Table 25 identifies the impacted beneficial uses in each stream segment and Table 26 lists the probable causes and associated land uses.

Table 25. Impacted Beneficial Uses

Stream Name	DEQ Segment ID	Segment Location	Impacted Beneficial Uses
Little Butte Creek	287	Mouth to Nichols Branch	Cold water fish, other aquatic life, water based recreation, and aesthetics
Little Butte Creek	288	Nichols Branch to Salt Creek	Cold water fish, other aquatic life, and aesthetics
South Fork Little Butte Creek	289	Mouth to approximately 1 mile downstream of Deer Creek	Irrigation, livestock watering, cold water fish, other aquatic life, wildlife, and aesthetics
South Fork Little Butte Creek	290	Approximately 1 mile downstream of Deer Creek to Beaver Dam Creek	Irrigation, livestock watering, cold water fish, other aquatic life, wildlife, and aesthetics
Antelope Creek	291	Mouth to Yankee Creek	Cold water fish, other aquatic life, and aesthetics
Antelope Creek	292	Yankee Creek to Climax	Cold water fish, other aquatic life, and aesthetics

Source: ODEQ 1988

Table 26. Probable Causes and Land Use Associated with Nonpoint Source Pollution Watershed

DEQ Segment ID[1]	Probable Cause of Nonpoint Source Pollution	Land Use Associated with Nonpoint Source Pollution
287	Surface erosion, elimination of thermal cover to stream, vegetation removal, water withdrawal, channelization/wetland drainage, and irrigation return flows	Irrigated cropland/pastureland and livestock grazing
288	Surface erosion, elimination of thermal cover to stream, vegetation removal, water withdrawal, and channelization/wetland drainage	Irrigated cropland/pastureland
289	Surface erosion, elimination of thermal cover to stream, vegetation removal, water withdrawal, and channelization/wetland drainage	Non-irrigated cropland/pastureland, irrigated cropland/pastureland, livestock grazing, timber management, storm/flood, and drought
290	Surface erosion, elimination of thermal cover to stream, vegetation removal, water withdrawal, and channelization/wetland drainage	Non-irrigated cropland/pastureland, irrigated cropland/pastureland, timber management, storm/flood, and drought
291	Surface erosion and water withdrawal	Irrigated cropland/pastureland, livestock grazing, surface runoff (quality), construction, and transportation network

DEQ Segment ID[1]	Probable Cause of Nonpoint Source Pollution	Land Use Associated with Nonpoint Source Pollution
292	Surface erosion and water withdrawal	Irrigated cropland/pastureland, livestock grazing, surface runoff (quality), construction, and transportation network

Source: ODEQ 1988

1/ See Table 25 for segment location.

Water quality parameters most critical to the beneficial uses (Characterization section, Water Quality) in the Little Butte Creek Watershed are: flow modifications, temperature, dissolved oxygen, pH, bacteria/pathogens, turbidity, sedimentation and habitat modifications. Flow and habitat modifications are discussed in Hydrology and Aquatic Wildlife, respectively. The processes and disturbances affecting the other critical water quality parameters and current conditions are described below.

Temperature

Many factors contribute to elevated stream temperatures in the Little Butte Creek Watershed. Low summer streamflows, hot summer air temperatures, low gradient valley bottoms, lack of riparian vegetation, and high channel width-to-depth ratios result in stream temperatures that can stress aquatic life. Natural disturbances that can affect stream temperature are climate (high air temperatures), below normal precipitation (low flows), wildfires (loss of riparian vegetation), and floods (loss of riparian vegetation). Human disturbances affecting stream temperatures include water withdrawals, channel alterations, and removal of riparian vegetation through logging, grazing, or residential clearing.

The State water quality criteria for temperature is established to protect resident fish and aquatic life, and salmonid fish spawning and rearing. The temperature standard for summer temperatures in the Rogue Basin was revised in January 1996. The standard now states that the seven day moving average of the daily maximum shall not exceed 64°F. Streams in the Little Butte Creek Watershed that exceed the temperature standard are listed in Table 24 as water quality limited. DEQ has identified Soda Creek as a potential concern due to temperature (ODEQ 1996).

Figure 11 shows the 1996 daily stream temperatures for five sites in the watershed: Little Butte Creek at Eagle Point, North Fork Little Butte Creek above the confluence with the South Fork, South Fork Little Butte Creek above the confluence with the North Fork, Soda, and Conde creeks. Except for Soda Creek, these streams are all water quality limited due to summer stream temperatures. The 1996 seven day average maximum temperature at the Soda Creek monitoring site was 68.4°F. This value exceeds the temperature standard and consequently, Soda Creek will likely be added to DEQ's 1998 water quality limited stream list.

A cooperative stream temperature monitoring program has been on-going in the Rogue Basin since 1993 (Brazier 1994, 1995 and 1996). A summary of 1993 to 1995 seven-day average maximum temperatures for all monitoring sites in Little Butte Creek Watershed is presented in Appendix F.

Figure 11. 1996 Daily Stream Temperatures for Five Sites in Little Butte Creek Watershed

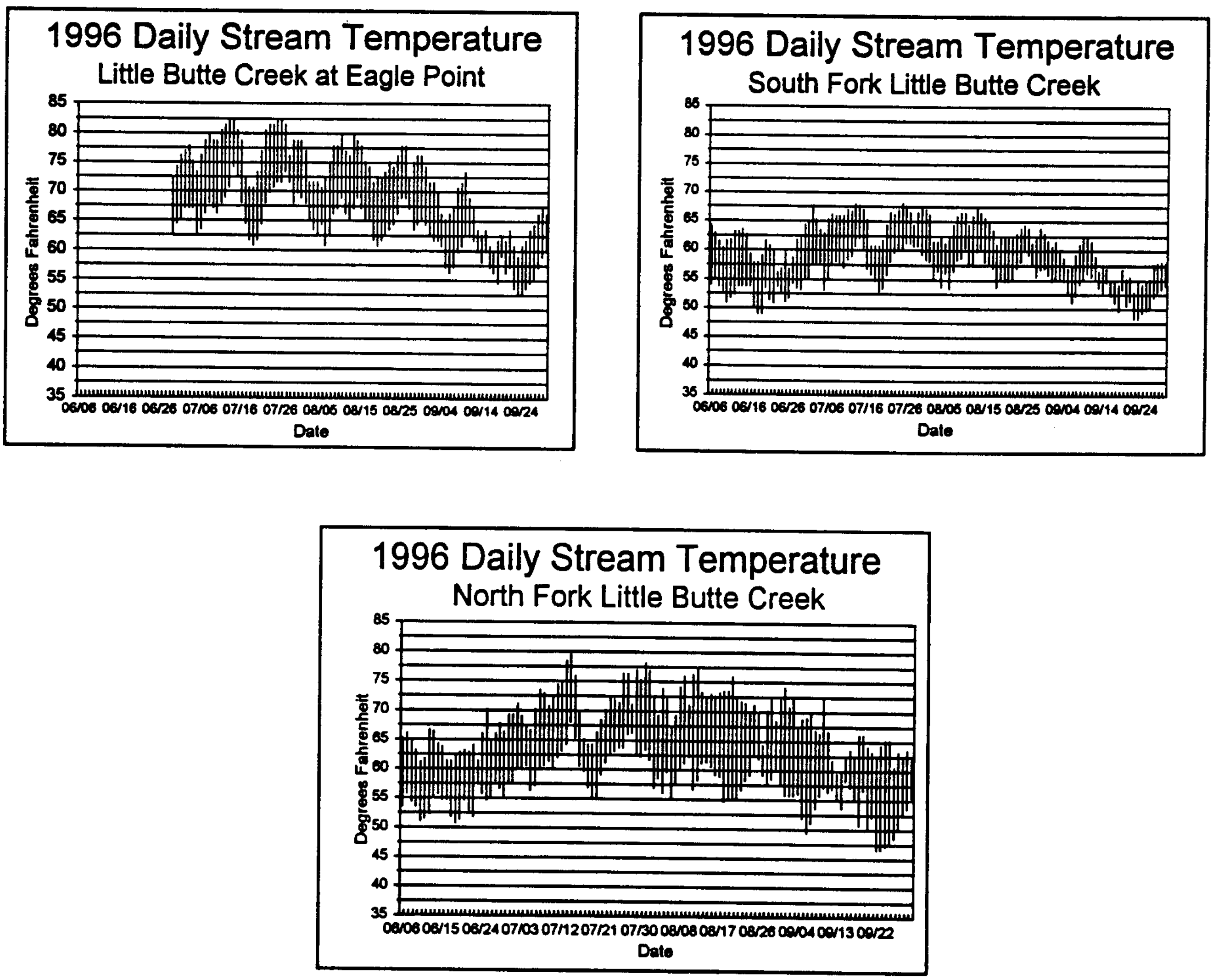
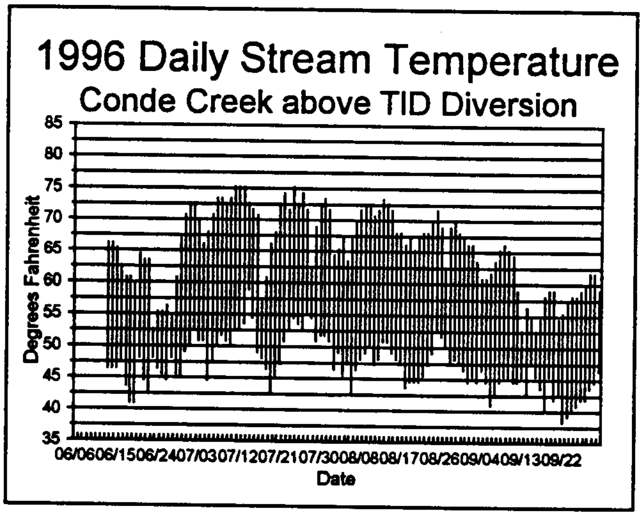
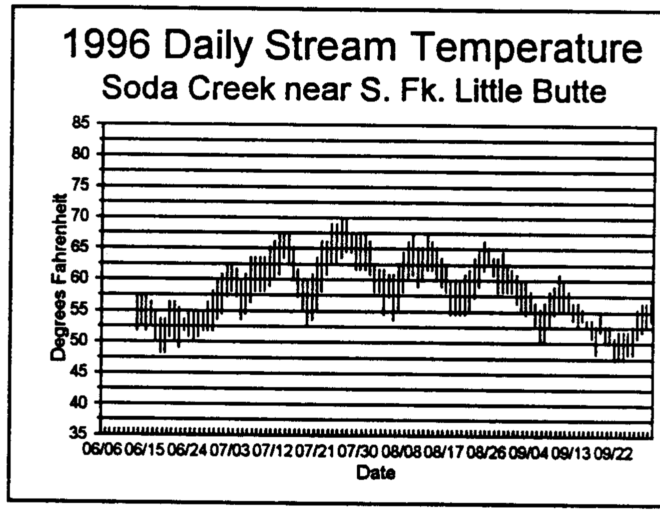


Figure 11 (continued). 1996 Daily Stream Temperatures





Dissolved Oxygen

Dissolved oxygen concentration refers to the amount of oxygen dissolved in water. Dissolved oxygen is critical to the biological community in the stream and to the breakdown of organic material (MacDonald et al. 1991). Dissolved oxygen concentrations are primarily related to water temperature (MacDonald et al. 1991). When water temperatures increase, oxygen concentrations decrease. Oregon's dissolved oxygen standard was revised in January 1996. The new standard describes the minimum amount of dissolved oxygen required for different water bodies (that is, waters that support salmonid spawning until fry emergence from the gravels, waters providing cold water aquatic resources, waters providing cool-water aquatic resources, etc.).

The DEQ measured dissolved oxygen in Little Butte Creek at river mile 1.4 for cold water aquatic life from April through September and for salmonid spawning from October through May during water years 1986 to 1995 (ODEQ 1996). Dissolved oxygen values measured were within the established criteria.

pH

pH is defined as the logarithmic concentration of hydrogen ions in water in moles per liter. pH can have direct and indirect effects on stream water chemistry and the biota of aquatic ecosystems. pH varies inversely with water temperature and shows a weak inverse relationship to discharge. Forest management activities can indirectly increase pH through the introduction of large amounts of organic debris and by increasing light to streams (MacDonald et al. 1991). State water quality criteria for pH in the Rogue Basin ranges from 6.5 to 8.5.

Average pH values at the surface of Fish Lake near the dam were 8.9 in August to September 1993 and exceeded the pH standard (ODEQ 1996). pH data collected between water years 1986 to 1995 for several sites on the mainstem of Little Butte Creek (river miles 1.4, 10.0, and 16.6) did not exceed the standard (ODEQ 1996).

Bacteria/Pathogens

Waterborne pathogens include bacteria, viruses, protozoa, and other microbes that can cause skin and respiratory ailments, gastroenteritis, and other illnesses. Most drinking and recreational waters are routinely tested for certain bacteria that have been correlated with human health risk. If the average concentration of these bacteria falls below the designated standard, it is assumed that the water is safe for that use and that there are no other pathogenic bacteria that represent a significant hazard to human health (MacDonald et al. 1991). The four groups of bacteria most commonly monitored are total coliforms, fecal coliforms, fecal streptococci, and enterococci. Fecal coliform bacteria are mostly those coliform bacteria that are present in the gut and feces of warm-blooded animals. They can be directly linked to sanitary water quality and human health risks.

State water quality criteria for bacteria states that for a 30-day log mean of 126 *Escherichia coli* (a species of fecal coliform) organisms per 100 ml, based on a minimum of five samples, no single sample shall exceed 406 *E. coli* organisms per 100 ml (ODEQ 1996). The purpose of the bacterial water quality standard is to protect the most sensitive designated beneficial use, which has been identified as water contact recreation.

Little Butte Creek, from the mouth to the North/South Fork confluence, has been designated as water quality limited due to the bacteria standard being exceeded.

Sediment and Turbidity

Sedimentation is the natural process of sediment entering a stream channel. However, an excess of fine sediments (sand-size and smaller) can cause problems such as turbidity (the presence of suspended solids) or embeddedness (buried gravels and cobbles). Sedimentation is generally associated with storm runoff and is highest during fall and winter. Natural processes occurring in the Little Butte Creek Watershed such as landslides, surface erosion, wildfire, and flood events contribute to increased sedimentation.

Accelerated rates of upland erosion in the Little Butte Creek Watershed are primarily caused by logging and road building. Clearcuts in unstable areas are prone to landslide activity. Older roads with poor locations, inadequate drainage control and maintenance, and no surfacing are more likely to erode and cause the sedimentation of stream habitats.

Managed livestock grazing in riparian zones, residential clearing of riparian zones, irrigation ditch blowouts, and poor irrigation practices all contribute to sedimentation (LBCWC 1995). Streambank erosion is accelerated by riparian vegetation removal. Annual maintenance of many diversion structures (especially push-up gravel dams) and irrigation return flows also cause sedimentation.

During stream surveys in 1994, Oregon Department of Fish and Wildlife measured a high percentage of fine sediment in most reaches of Little Butte Creek from the mouth to the North/South confluence, South Fork Little Butte Creek from the mouth to Beaver Dam Creek, Deer Creek, Lake Creek, Lost Creek, and Soda Creek (ODEQ 1996).

No winter season turbidity data is available for streams within the Little Butte Creek Watershed.

Trend

The water temperature trend in Little Butte Creek below the North/South confluence and in Antelope Creek, is likely to remain the same due to withdrawals, high width/depth ratio, and lack of riparian cover. Water temperatures in the North and South Fork Little Butte creeks may show some improvement in the long term as the Northwest Forest Plan is implemented on federal lands and riparian vegetation recovers along the tributary streams. However, high stream temperatures will still likely persist on the lower reaches due to withdrawals, high width/depth ratio, and lack of riparian cover. Riparian vegetation should recover over time in areas previously harvested along Conde and Dead Indian creeks. However, riparian vegetation is subject to grazing pressure that has slowed the recovery. Degradation of former wet meadows in the upper reaches of these two streams has resulted in downcutting and lowering the water table. Conde and Dead Indian creeks are also diverted for irrigation.

The dissolved oxygen, pH, and bacteria levels are not expected to change in the future within the watershed. Sedimentation and turbidity in the Little Butte Creek analysis subwatershed will probably stay at the existing level unless new road construction occurs (then it would increase) or roads are decommissioned (sediment and turbidity would decrease). Sedimentation and turbidity in the North and South forks of Little Butte Creek would likely remain the same or decrease since no net increase in roads are allowed within this area due to the Tier 1 Key Watershed designation, and clearcut harvesting will not occur on federal lands.

RIPARIAN AREAS

Riparian areas in the Little Butte Creek Watershed are dominated by human-altered vegetation: urban and agricultural (26 percent) and small-diameter conifers (35 percent) (Table 27). Riparian areas with large-diameter trees (mature and late-successional) only comprise 14 percent of the total riparian acreage. The older timber is generally in less-accessible areas, for example the Type 3 reach of South Fork Little Butte Creek. Grassland/shrubland vegetation includes natural meadows and willow thickets, which are mostly found in the Dead Indian Plateau.

Table 27. Vegetation Classification for Riparian Areas

Vegetation Classification	Acres	Percent of Total	Rating[1]
Urban/Agricultural	7,005	26	-
Rock	625	2	-
Grassland/Shrubland	4,741	18	o
Hardwoods	1,246	5	o
Early Seral	268	<1	-
Seedlings through Poles	6,120	23	-
Large Poles	3,243	12	-
Mature	2,002	7	+
Late-Successional	1,884	7	+

1/ Rating for benefit to riparian habitat: "-" indicates that the vegetation type does not contribute to riparian habitats, "+" indicates that it does, "o" indicates that it is neither a benefit nor detriment.

Riparian Areas in Primary Fish-Bearing Streams

The Characterization section, Aquatic Wildlife Species and Habitat, describes how streams in the Little Butte Creek Watershed can be broken out into four stream reach types, areas with similar valley shape, geomorphic processes and riparian and stream characteristics. In addition, these reaches are located in different vegetation zones: Interior Valley (below 2,200 feet in elevation), Mixed Conifer (2,200 to 4,200 feet in elevation), and White Fir (elevation 4,800 to 5,500 feet). These vegetation zones affect the species mix and age classes of riparian vegetation and habitat. The riparian areas along the primary fish-bearing streams of Little Butte, North and South Fork Little Butte, and Antelope creeks are described below in relationship to reach and vegetation zone.

Type 1 Reaches - Interior Valley Zone

The Type 1 reaches for the lower sections of Little Butte, Antelope, North Fork Little Butte, and South Fork Little Butte creeks occur in the Interior Valley Zone. The riparian areas in these Type 1 reaches are best described as strips of trees along the creeks. Red alder is the most prevalent hardwood species with cottonwood, bigleaf maple, and Oregon ash mixed in. Black oak and madrone are found in the riparian area above the floodplain. Introduced blackberry species are successfully out-competing most of the native riparian shrubs. The area just beyond the riparian strip includes urban development, pasture, open savannas with grass understory, oak woodlands, and forest stands with Douglas-fir and ponderosa pine. Almost all riparian zones have been settled for more than 100 years. Clearing brush and timber, draining wetland, and channelizing the stream has modified the riparian vegetation, thereby eliminating or severely reducing riparian habitats for many species of animals, birds, and plants.

Type 2 and 3 Reaches - Mixed Conifer Zone

The lower reaches of Antelope and North and South Fork Little Butte creeks are in the Mixed Conifer Vegetation Zone. In general, as the Interior Valley Zone of Type 1 reaches changes to the Mixed Conifer Zone of Type 2 and 3 reaches, the number and variety of conifer species increase and the understory changes. Conifers are also a bigger component of the riparian area, especially as elevation increases and the canyons begin to narrow. Douglas-fir is the most common conifer, but ponderosa pine, sugar pine, incense cedar, and Pacific yew are also present. The riparian vegetation appears patchy. Areas with many layers of riparian vegetation, including large-diameter riparian trees, are scattered in between clumps of even-aged alder and cottonwood and wide, shrub-dominated areas. Riparian shrub and hardwood species are the same as those mentioned for Type 1 reaches.

Type 2 and 3 reaches on Antelope Creek and North and South forks of Little Butte Creek have also been heavily influenced by humans. In the riparian areas, selective logging, road building, and clearing streams of woody material (after floods and logging) have confined the channel, removed woody material from riparian areas, narrowed the riparian area, and severed its connection (groundwater flow, wildlife passage, nutrient cycling) with upland areas.

Type 4 Reaches - White Fir Zone

Type 4 reaches of North and South forks of Little Butte Creek are in the Dead Indian Plateau within the White Fir Zone. Forested riparian areas contain mostly conifer species with patches of riparian hardwood trees. Conifer tree species include white fir, sugar pine, ponderosa pine, Douglas-fir, incense cedar, and Englemann spruce. Hardwood tree species include red alder, bigleaf maple, quaking aspen, and golden chinquapin (also prevalent in shrub form). Common shrub species include creambrush oceanspray, dwarf Oregon grape, currant, snowberry, snowbrush ceanothus, California hazel, greenleaf manzanita, and Oregon boxwood. Pacific yew is occasionally present. Meadow riparian areas are grass- and forb-dominated. Winter snow accumulation keeps the Dead Indian Plateau moister than lower reaches, therefore, vegetation suffers less from lack of moisture. Logging and irrigation diversions and grazing are the primary management activities affecting the riparian areas along Type 4 reaches of the North and South forks of Little Butte Creek. Also, construction of Fish Lake dam eliminated a wetland meadow on North Fork. Overall, these riparian areas are more intact than those along the lower reaches of the system.

Riparian Areas Along Intermittent Streams

Riparian areas along intermittent streams within the Interior Valley and Mixed Conifer zones usually are much narrower than those along perennial streams. Riparian vegetation is composed of conifer tree species that are predominantly even-aged and lack vertical stand structure. Douglas-fir is the predominant species with fewer numbers of ponderosa pine and incense cedar. Suppressed oak trees are commonly found in the understory. Pacific madrone is sometimes prevalent depending on the aspect. Shrub species may include serviceberry, creambrush oceanspray, snowberry, mountain mahogany, poison oak, and Indian plum. On the driest southeast to south aspects, typical riparian vegetation is uncommon or not present. Wedgeleaf ceanothus and whiteleaf manzanita are the predominant shrub species present with poison oak often in the stream channel.

In general, the riparian areas along intermittent streams within the Interior Valley and Mixed Conifer zones are overstocked with trees and subsequent bark beetle infestations have resulted in tree mortality. Mortality is especially high on the harsher sites (south-facing slopes with shallow soils) that cannot support a high number of mature trees. Douglas-fir does poorly in these areas. Drought-tolerant species like Oregon white oak, black oak, ponderosa pine, and incense cedar are better suited to these sites.

Riparian surveys conducted in 1995 and 1996 on BLM-managed land in Deer, Soda, and Conde creeks identified problems that appear to be due to land management practices. In Deer and Soda creeks, both north-facing drainages, riparian areas overwhelmingly lacked large woody material adjacent to and in the channel and lacked larger riparian vegetation species and vertical layering. As a result, the stream channels were downcutting, scouring in the winter, and providing little riparian habitat for amphibians, aquatic insects and riparian-dependant birds. Almost all the streams were rated as "Functioning at Risk."

In Conde Creek, the intermittent streams running through the upper meadows lacked almost any riparian vegetation except for grasses. Some stream channels were downcutting and others were widening as banks collapsed under grazing pressure. Forested channels were in similar condition to those in Deer and Soda creeks.

Effects of Human Activities on Riparian Habitat

Roads

Roads within riparian areas affect the quality of riparian habitat. Areas of greatest concern related to the impact of roads on riparian habitat are South Fork Little Butte, Dead Indian, Lake, and Deer creeks.

The following effects occur in riparian areas where roads parallel or cross streams and their associated riparian habitat.

- Solar radiation increases (especially when parallel roads remove vegetation on the south side of the stream) contribute to raised air and water temperatures and reduced humidity, stressing fish and destroying microhabitats for riparian plants.
- Road run-off increases sediment contributed to stream channels.
- Groundwater flow is interrupted, decreasing cool water inflow to creeks, and increasing water flow over the road surface.
- Slope stability is reduced.
- Current and future recruitment of LWD and snags are reduced from tree removal for road construction and hazard trees.
- Potential for hazardous spills into waterway is higher.

- Habitat is fragmented, impeding the movement of wildlife species and their ability to migrate and disperse within the watershed and to adjacent watersheds.
- Stormflow along roads makes streams "flashier" subject to extreme flow fluctuations over a short period of time.
- Logging traffic increases disturbance to the road bed and roadside vegetation, thus contributing to sediment production.

Timber Harvesting

Roads constructed to access timber harvest areas cause many timber-related impacts to riparian areas. However, past timber practices, such as clearcutting, regeneration harvest, and shelterwood cuts in and immediately adjacent to riparian areas, have also had major impacts on riparian habitat. Some results of removing trees are similar to road effects, namely increased solar radiation, reduced LWD availability, decreased soil stability, and habitat fragmentation. The current Forest Service and BLM practice of "thinning from below" retains the larger trees and removes only smaller, suppressed trees. This has and will have much less of an impact on riparian habitat.

Grazing

Consistently-used BLM allotments are in the Salt, Lake, and Conde creek areas. Cattle must be removed before "heavy utilization" (>60 percent of forage) occurs. There may be heavier utilization on private lands. Impacts from unmanaged livestock grazing may include bank degradation, channel widening, removal of riparian vegetation, and the inability of continuously-grazed riparian vegetation to mature or sprout.

Fire Suppression

With the advent of organized fire suppression in the early 1920s, fire return intervals greatly increased. Fewer fires meant that the density of trees and shrubs increased. Plant communities began to change. The lack of fire has undoubtedly affected riparian areas, especially on south-facing, more fire-prone slopes. However, without historical data, it is very difficult to quantify how riparian areas may have changed. Riparian areas on intermittent streams have probably been affected the most, as these riparian areas are much smaller than those on perennial streams. Along some intermittent streams, dense conifers may have shaded out the riparian understory; other riparian areas may now be more diverse.

Agriculture and Rural Development

See Aquatic Wildlife Species and Habitat section.

Effects of Human Activities on Riparian-Dependent Wildlife

The most obvious effect of human activities on riparian-dependent wildlife is loss of habitat. Narrowing the riparian area simply reduces the area available for nesting sites, dens, and foraging areas. This is especially significant on the mainstem streams like Little Butte,

Antelope, and South Fork Little Butte creeks where the riparian area used to be very wide, with beaver marshes and willow thickets.

Another effect of human activities on wildlife is reduction in food supply. Species like mink, otter, herons, kingfishers and osprey depend on a healthy fish population for food. Activities like logging in riparian areas, road construction through riparian areas, and over-grazing remove trees that would ordinarily fall in and create pools for fish, add sediment that can clog redds and fish gills, and damage banks that fish need for cover during winter freshets. When the fish population decreases, the numbers of fish-eating wildlife species decrease as well. Species like dippers and songbirds (especially neotropical migrants) depend on aquatic insects for food. Dippers pick insects out of the stream, whereas songbirds bring adult mayflies, stoneflies, and dragonflies to their young. Removing riparian vegetation reduces both nesting habitat for these birds, as well as foraging areas. Most aquatic insect adults rest on riparian vegetation after emerging.

One of the lesser-known, but equally as crucial effects of human actives on riparian areas is the impact on genetic exchange. Riparian areas create a network of cool, shaded, easily-traveled corridors, connecting the entire watershed in a huge "travel network." Some human activities fragment riparian areas, in other words, break up the wide, continuous riparian network into small pieces. Logging in riparian areas opens up the canopy; agricultural development on the floodplain removes the floodplain forest and marshes; roads parallel streams and narrow the riparian areas along the stream bank; and human settlement removes the riparian area along the large valley stream (Antelope, Little Butte, and South Fork Little Butte creeks). This fragmentation directly impacts the ability of many wildlife species to fully use these areas for travel and dispersal. Over time, the lack of genetic exchange through dispersal could affect population viability for many animals.

See Aquatic Wildlife Species and Habitat section for discussion of fish, amphibians, and macroinvertebrates.

Effects of Natural Processes on Riparian Habitat

Flooding, landslides, fire, insects, pathogens, and wind are all natural processes that alter the pattern (types and ages of plants present) and structure (stories, or horizontal levels) of riparian vegetation. These natural processes, sometimes called disturbances, create new, alter existing, and destroy old habitats for plants and animals. Some plant and animal species are adapted to stream/riparian systems with high disturbance frequencies; others are adapted to live in habitats that rarely experience disturbance. Some plant and animal species do not persist without disturbance, such as a large flood.

Landslides, fire and tree mortality from insects and pathogens are the primary "natural" processes that "disturb" the riparian vegetation and habitat along intermittent streams. The effects of fire are variable, depending on aspect, moisture, and the condition of the surrounding upland vegetation. Fire could be a severe disturbance in the Interior Valley and lower elevations of the Mixed Conifer zones (Franklin and Dyrness 1973). An additional problem in intermittent stream riparian areas is the overtopping of hardwoods by conifers. In most cases, this is happening because of fire suppression. Therefore, something that is a natural process on the landscape has become a problem due to human intervention.

As the size of a stream increases, floods become the primary natural process that creates and changes riparian habitat. In the wider valley bottoms, when the soil is saturated from high water tables, mature trees are sometimes toppled by wind.

See the Aquatic Wildlife Species and Habitat section for a discussion of the New Year's Day Flood of 1997.

Trends

Private Land

Most of the land along the primary fish-bearing streams in the Little Butte Creek Watershed is privately-owned. Along these streams, the New Year's Day Flood of 1997 created the potential for large patches of red alder and black cottonwood to become established along the floodplains of the streams where erosion and alluvial deposition has occurred. Conifer species can also be expected to seed-in where mineral soil is exposed and sunlight can reach the soil surface. Damaged and buried hardwoods will resprout, creating a new forest age class that will help improve the vertical stand structure of the riparian areas. Blackberry species will come back quickly, successfully out-competing most native riparian shrubs and forbs. The riparian zone will improve in areas where landowners plant willows, provide riparian easements, and alter agricultural practices, etc. In other areas, for example, through Eagle Point, improvement will be difficult.

Federal Land

On federal land, implementation of the Aquatic Conservation Strategy and allocation of Riparian Reserves will help riparian areas recover from roads, logging, and grazing. Areas capable of attaining late-successional forest will approach the historic distribution in all subwatersheds except those with significant private land ownership. This conclusion is predicated on the assumption that the Aquatic Conservation Strategy incorporated into the Northwest Forest Plan is implemented on public lands. It also assumes efforts to improve upland areas will continue, such as "thinning from below" instead of clearcutting, repairing culverts, decommissioning roads, monitoring grazing practices, etc. In addition, silvicultural thinning may be necessary in riparian areas that are dominated by a single, densely-growing age class of conifers or alders. The time-frame expected to attain historic distribution of late-successional characteristics on public lands is 50 to 80 years for those riparian areas currently in mid forest-succession. Those in early-successional stages will require a greater amount of time, perhaps over 100 years.

AQUATIC WILDLIFE SPECIES AND HABITATS

Relationship of Watershed Habitat with Rogue River Basin

The Little Butte Creek Watershed is located 132 river miles from the mouth of the Rogue River (Map 1). Headwater tributaries orginate in the snow-dominated High Cascades with the potential to provide quality water to canyon and valley habitats accessible to anadromous fish. Three significant (greater than 100,000 acres) watersheds in the upper Rogue River Basin (Elk, Bear, and Little Butte creeks) contain degraded stream habitats. Little Butte Creek Watershed is the largest of these and has the potential to contain highly diverse habitat for salmon and trout recovery if degraded conditions are restored.

Coho salmon, winter and summer steelhead, and spring chinook all use the Little Butte Creek system for both spawning and rearing. South Fork Little Butte Creek is one of the most important coho salmon spawning and rearing streams in the upper Rogue River Basin. A total of 10,685 coho passed over Gold Ray Dam in 1994, of which 3,078 were wild coho; approximately 12 percent of the wild coho spawned in South Fork Little Butte Creek in 1994 to 1995 (Vogt 1994 and 1995).

The North and South forks of Little Butte Creek Watershed are designated as a Tier 1 Key Watershed under the Northwest Forest Plan. South Fork Little Butte Creek is designated as a core stream under the Oregon Restoration Salmon Initiative by Oregon Department of Fish and Wildlife (ODWF); one of 27 core areas within the Rogue and South Coast Basins. It is an important connecting corridor designated by the American Fisheries Society under the Aquatic Diversity Area Delineation (LBCWC 1995). According to the Wilderness Society, there is a high risk of extinction for coho salmon in this watershed. They also designated a special status for summer steelhead and moderate status for winter steelhead trout. The Department of Environmental Quality (DEQ) has identified many stream segments in the Little Butte Creek Watershed as water quality limited. DEQ identified low flows, temperature, habitat modification, sediment, and coliforms as limiting water quality factors in the Little Butte Creek Watershed (Map 25).

Management of Fish Populations

Federal agencies are responsible for managing habitat on public lands. The agencies are required to meet the intent of the Aquatic Conservation Strategy of the Northwest Forest Plan and the Rogue River National Forest and Medford District BLM Land/Resource Management Plans, as amended by the Record of Decision (ROD) for lands within the range of the northern spotted owl.

Private lands must adhere to the State Forest Practices Act. Management of fish populations is the responsibility of the Oregon Department of Fish and Wildlife (ODFW). ODFW's May 1993 draft management plan summarizes the objectives for resident wild trout and anadromous salmonids. They are to maintain the genetic diversity and abundance of native trout and anadromous fish populations in the running waters of the Rogue River Basin; and minimize the impacts of hatchery rainbow on the production and genetic integrity of native trout and wild and anadromous salmonids.

Trout fishing is allowed by ODFW from May through October within the North and South forks of Little Butte Creek. Trout over four years of age (mature large fish) were rare according to Forest Service stream surveys done in 1990 and 1991. Fishing pressure is low, mostly from local people.

A hatchery program is in place in the Rogue River (river mile 157) at the Cole River hatchery to mitigate the effects of Lost Creek Lake Reservoir. It is possible that salmonids destined for the hatchery could stray and impact naturally reproducing stocks on Little Butte Creek. Spawning surveys during the 1994-1995 season on Little Butte Creek did not detect any hatchery strays. There are two "mini hatchery - hatchbox" programs in the Little Butte Creek Watershed. The ODFW Salmon and Trout Education Program (STEP) operates a summer steelhead hatchbox program on an unnamed tributary of South Fork Little Butte and Deer creeks. Eagle Point High School also has a hatchbox coho program. Data are unavailable to determine the impact on native salmon from the hatchbox program in the Little Butte Creek Watershed.

Numerous fish introductions by private individuals (without permits) and ODFW have occurred over the years. The exact stocking history of lakes is unknown (Vogt 1997). Previously, ODFW stocked Fish Lake every year with legal-sized rainbow trout and yearling-sized rainbow and brook trout. ODFW has determined that the yearling-sized trout are unable to compete with tui chubs and this year will only stock legal-sized rainbow trout. Brook trout were stocked by ODFW in Lost Lake. Warmwater species introduced by private individuals thrive in Agate Lake.

Limiting Factors for Aquatic Species

Limiting factors for long-term sustainability of native fish and other aquatic species include: high summer stream temperatures, sedimentation, riparian degradation, instream degradation, fish passage, fish carcass reduction, and wetland and floodplain losses.

High summer stream temperatures: Summer salmonids rearing habitat is limited due to high summer stream temperatures. See Water Quality for causal effects and DEQ limiting water quality factors.

Sedimentation: Activities increasing sediment delivery to streams are: logging and road building and natural and human-caused landslides adjacent to streams and in uplands. Fine sediment is evident in mainstem Little Butte Creek with embeddedness of spawning gravel and filling of pools. Other activities are grazing practices within riparian zones and residential clearing of riparian zones. See Water Quality for in-depth information.

Riparian degradation: Past management activities in riparian zones (harvesting, road building, livestock grazing, agriculture and rural development) have limited the amount of future large wood recruitment, stream shading, and streambank stability, and have changed the stream geomorphology. See Riparian Areas for effects on habitat.

Instream degradation: Habitat quality and quantity have decreased due to instream degradation. Stream channelization, instream wood removal, stream-adjacent roads, logging in riparian and sensitive (unstable) upland areas, poor farming and grazing practices, and residential development affect each type of salmonid species within the watershed. Stream channelization after flood events (1964 and 1974) and historic removal of large wood from streams reduced habitat complexity, scouring elements for pools and spawning gravels, and floodplain connectivity. Road building, agriculture practices, and residential development have confined streams within the watershed disconnecting streams from their floodplains, reducing or eliminating side channels, edgewater habitat, and flood refugia important for coho salmon. Logging and improperly managed grazing in riparian areas may have affected streambank degradation and reduced riparian vegetation necessary for stream shading and future large wood recruitment.

Fish passage: Adult and juvenile salmonid habitat connectivity is affected by fish barriers. Factors are: instream diversion structures, natural obstructions, unscreened and screened irrigation diversions and pumps, culverts, and natural waterfalls.

Fish carcass reduction: Salmon and steelhead trout historically provided significant nutrient input to streams within the Little Butte Creek Watershed from ocean minerals carried by their carcasses. The decline of salmon and steelhead carcasses in Little Butte Creek Watershed has an interrelated impact on future salmonid populations and other aquatic ecosystem components.

Wetland and Floodplain Losses: Loss and/or reduction of these habitats have resulted from forestry and agricultural practices on federal and privately managed lands. These areas provided unique habitat for fish, amphibians, and other aquatic species.

Aquatic Habitat Components

Large woody material, water/pool quality and quantity, stream substrate, and macroinvertibrates are key components for fish habitat in the Little Butte Creek Watershed. Stream attributes were surveyed in the watershed during the past seven years by ODFW and Forest Service (pre-1997 New Year's Day flood). Streams surveys have not been conducted since the recent 1997 New Year's Day flood. A quick assessment of streams (Little Butte, Antelope, and North and South forks of Little Butte creeks) were conducted after the 1997 New Year's day flood by one of the following: ODFW, Little Butte Creek Watershed Council and federal biologists. Stream attributes, such as wood per mile, pool quality and quantity and substrate were observed, but difficult to assess overall aquatic habitat conditions without having conducted stream surveys. Overall effects of the 1997 New Year's Day flood on aquatic habitat are discussed in 1997 Flood, Aquatic Wildlife.

Large Woody Material

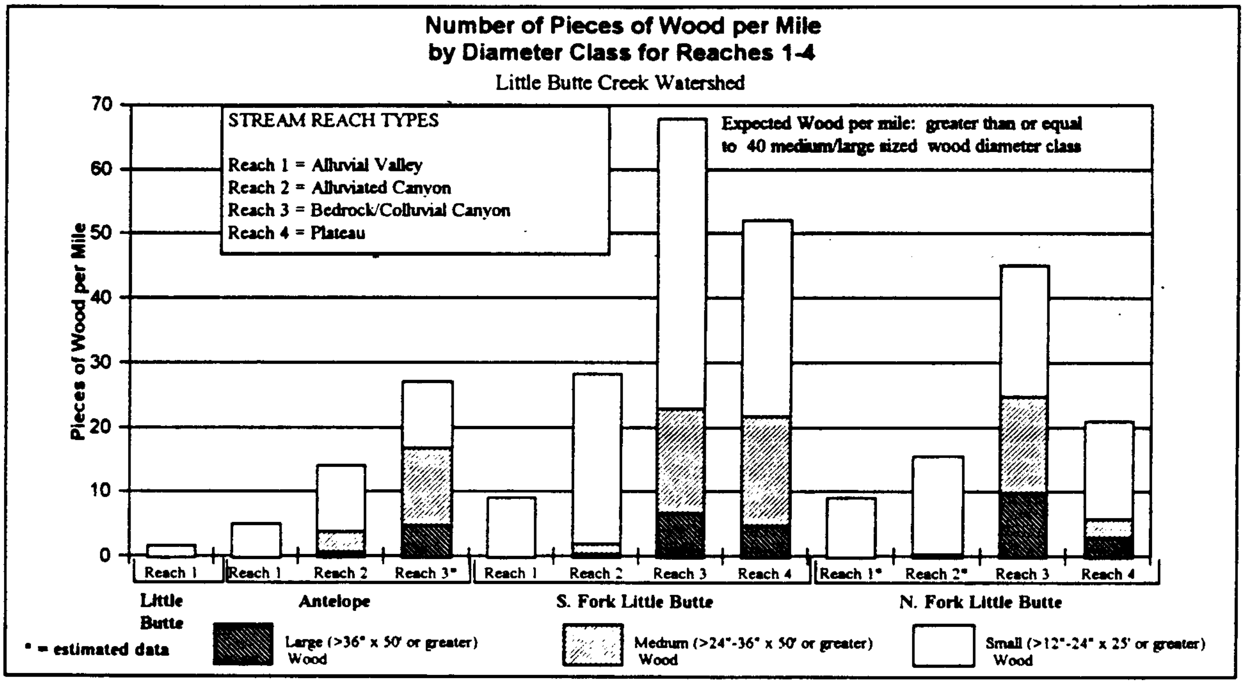
Woody material introduced to streams aids in furnishing future habitat for fisheries. However, unstable woody material deposited above homes and bridges (stream crossings) could pose a problem in the future. Water from large storm events could possibly dislodge and transport the material downstream and may cause damage to residences and bridges in the floodplain. The South Fork Little Butte Creek will need a post-1997 flood inventory to determine if there is unstable woody material that may need to be stabilized and placed along the stream.

Wood measuring greater than 24 inches diameter at breast height (dbh) by 50 feet or twice the bankfull width (medium and large-sized wood classes) is considered desirable for stream structure and fish habitat. Researchers have determined that key wood pieces with these dimensions are necessary in the stream system for stability during high flow events.

Amounts of medium/large wood pieces per mile observed during past stream surveys are below the desired range of conditions and indicate habitat degradation (Figure 12). Large woody material in the colluvial/bedrock canyon stream types of the watershed (Type 3 reaches) has a range of 23 to 62 pieces of wood per mile. Upper middle South Fork Little Butte Creek canyon area, Type 3 reach, has the highest amount of medium and large sized wood per mile due to its location in an unroaded area (Figure 12). Past timber harvest and stream cleanout have removed wood from Little Butte Creek and its tributaries (Type 1 to 4 reaches), except in unroaded areas (Type 3 reaches of South Fork and Dead Indian canyons). Wood is below expected conditions (greater than 40 medium/large sized pieces of wood per mile) for this watershed. It was observed during a quick post-1997 flood stream assessment that the number of large wood pieces deposited after the flood has not changed significantly and is comparable to past stream survey data.

Field observation in this watershed has shown a direct correlation between medium/large wood presence and high pool quality. When medium/large sized wood was absent, fewer large-sized fish and reduced overall abundance of fish was observed. Anecdotal information from a long-time resident indicates that pools associated with wood complexes were found at frequent intervals during the 1950s (Brady 1997). These pools purportedly held large salmon and trout. This large wood complex component is almost completely lacking in lower gradient segments today.

Figure 12. Medium/Large Pieces of Wood Per Mile



Pool Quality and Quantity

Pools per mile are below the desired range of conditions and indicate habitat degradation (Figure 13). Low quantity and quality (depth and cover) of pools were recorded where large wood has been reduced or eliminated. There is considerable literature documenting the importance of pools for salmonid fish production. Pools in managed stream segments near roads or otherwise accessible to heavy equipment lack complexity due to stream cleanout for flood control and timber and firewood harvest. Large wood removal has resulted in reducing sinuosity and closing side channels caused pool and riffle ratios to skew (Figure 14), increased width-to-depth ratio, and denuded riparian vegetation. Long riffles with few instream features and simplified fish habitat are common throughout the watershed.

Streams in the watershed with greater than four percent slope (Type 3 reaches) contain many small, short step pools or "pocket pools". Some of these pools may not have been accounted for during the stream survey in stream segments. Per ODFW and Forest Service Region Six stream survey protocol, any pool with a length less than the stream width was not reported. This exclusion of step pools may cause the total pool percentage to be significantly underestimated in this area.

Although step pools are important rearing areas for trout, there are fewer large trout per mile then would be expected in Little Butte Creek tributaries. This is partially attributable to the poor pool quality: lack of depth, wood cover, and microhabitat complexity.

Figure 13. Pools Per Mile and Average Pool Depth

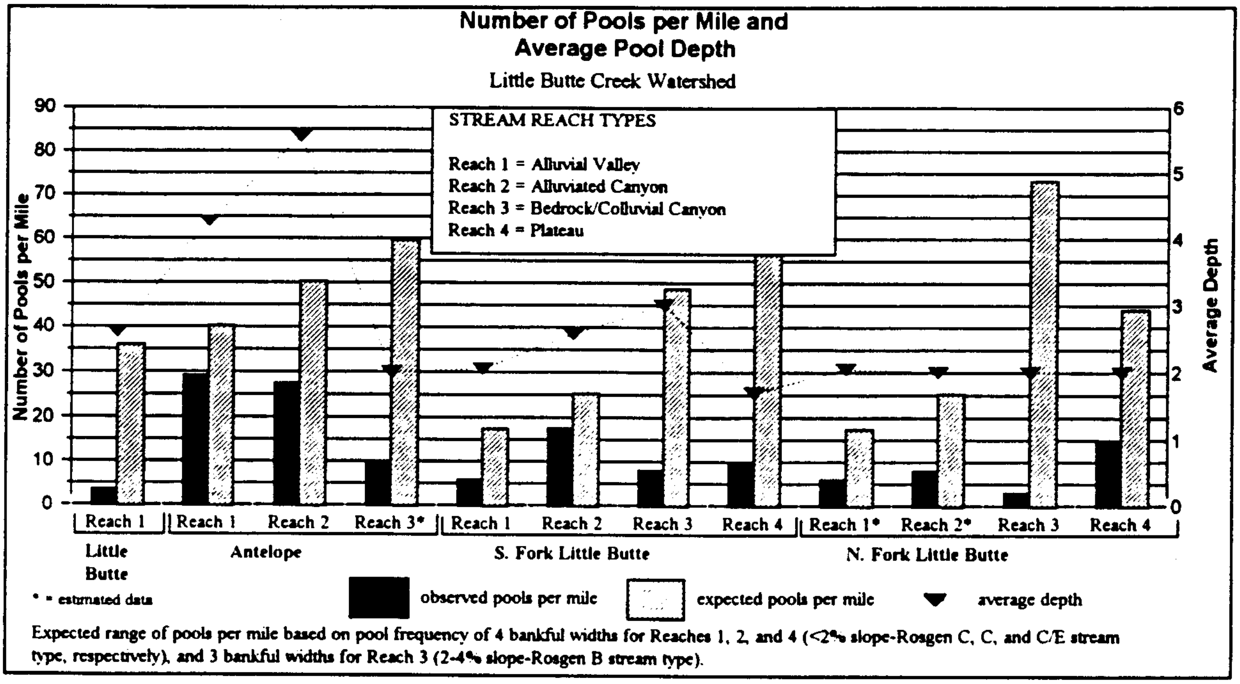
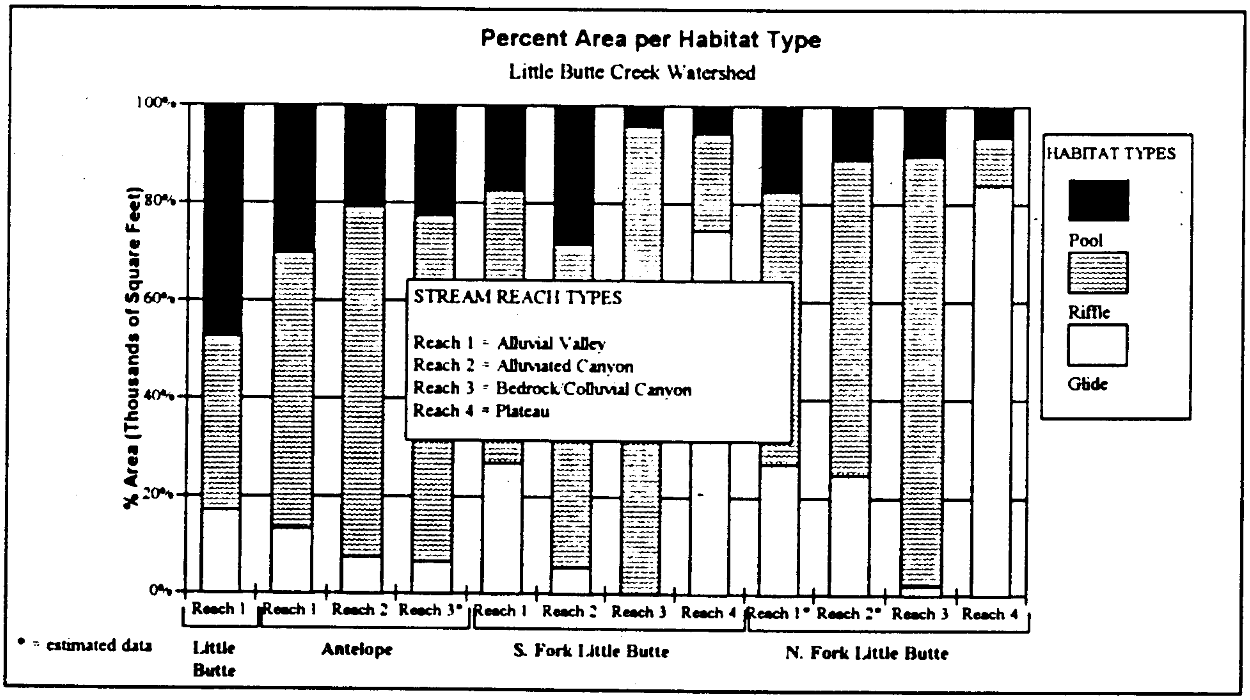


Figure 14. Pool/Riffle/Glide Ratio



Stream Substrate

Stream survey data illustrates the lack of variation in substrate size throughout the lower reach of the mainstem (ODFW 1991, 1992 and 1994; USFS 1991 and 1992). Streambed substrates are more homogenous because there are few instream "roughness elements" (log jams, root wads, etc.) to sort and grade gravels and cobbles. This results in poor spawning habitat, low quality pool habitat, and embedded stream cobbles. Fine sediment has filled in hyporheic interstitial spaces, reduced crevice space in the surface armor layer of riffles, and filled in pools. Many of the macroinvertebrate positive indicator groups or taxa, which are sediment intolerant, are absent or present in very low numbers. (See Macroinvertebrate Habitat, Aquatic Wildlife, for further discussion.)

During a recent spawning survey (November-December 1996) on South Fork Little Butte Creek, ODFW reported that coho spawners were only found on Forest Service lands. This may be due to higher channel roughness (medium and large sized wood pieces and jams) placed during stream restoration since 1989, which provided sorting of spawning gravels within this stream segment.

Substrate and stream ecology in North Fork Little Butte Creek has been altered because Fish Lake dam traps gravels, cobbles, and nutrients keeping them from entering downstream.

Water Quality and Quantity

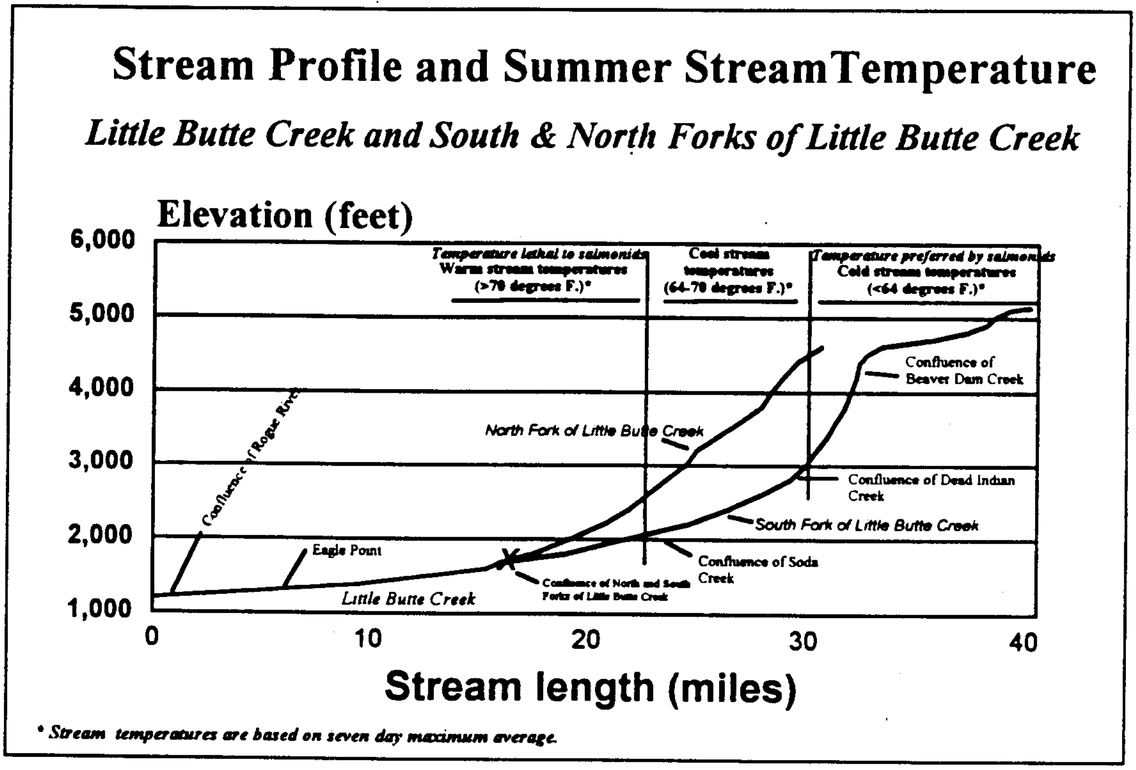
Stream temperatures for the mainstems of Little Butte, North Fork Little Butte, and South Fork Little Butte creeks tend to show a correlation with elevation: cooler stream temperatures are found in the stream reaches at higher elevations (Figure 15). Federal lands (located at higher elevations) account for 75 to 85 percent of the viable salmonid production during summer months. Stream temperature on the lower reaches of these streams warm to near-lethal (physiologically stressful) or lethal conditions for salmonids and other native fishes (sculpins, suckers, lamprey, etc.) during summer months due to habitat alteration. Warm stream temperatures limit fish production (growth) and occupation of habitat.

Temperature conditions (using the seven day maximum average) of tributaries to South Fork Little Butte Creek vary greatly: cool temperatures usually less than 64 degrees Fahrenheit (F) (high plateau to Dead Indian Creek), warm temperatures usually 64 to 70 degrees F (Dead Indian Creek to Soda Creek) and temperatures that are limiting to fish often greater than 70 degrees F (Soda Creek to mouth). Winter rearing habitat is limited throughout the system due to lack of habitat complexity.

The removal of riparian vegetation due to timber harvesting and agricultural/residential development has decreased instream canopy cover. This, in addition to channel widening from stream cleanout and channelization has increased solar radiation into the stream channel - resulting in increased stream temperatures.

Three irrigation districts have water rights to divert over 1,000 cubic feet per second (CFS)

Figure 15. Stream Profile and Temperature Conditions for the North and South Forks of Little Butte Creek



from the Little Butte Creek Watershed. This does not include water rights for supplemental irrigation from private landowners. Low stream flow resulting from both irrigation withdrawal and drought conditions limit the amount of available fish habitat and increase stream temperatures. Various springs within the creeks may provide a small amount of cool water refuge for fish. North Fork Little Butte Creek is part of the irrigation districts intertransport system, and as such, has an artificial flow regime. Lower flood peaks and pulses, higher summer flows and unseasonally cool stream temperatures in the summer months have altered the stream ecology. The transfer of favorable cooler stream water temperatures below the Fish Lake dam (50-60 degrees Fahrenheit) into a transbasin canal at river mile 3, and the alteration of stream flow from historical levels have degraded the aquatic biotic and fish assemblages in North Fork and Little Butte Creek Watershed.

See Hydrology, Stream Channel, and Water Quality sections for further information. See 1997 Flood, Aquatic Wildlife for further information regarding potential post-flood water quality conditions.

Macroinvertebrate Habitat: Indicator of Stream Condition

Aquatic macroinvertebrates (insects, snails, and other invertebrate taxa) are good indicators of stream habitat quality. Because the life cycles and habitat needs of many aquatic insects are known, the presence or absence of particular taxa provides a good indication of the year-round stream condition. For example, streams with high water temperature will not support insects that require cool water temperatures year-round. Different macroinvertebrates are sensitive or tolerant to fine sediments, substrate disturbance, water temperature, shade, or perennial flow.

In 1991, 1994, and 1995 the BLM and the USFS contracted macroinvertebrate sampling throughout the Little Butte Creek Watershed (Wissman 1991 and 1994-5). There were some disturbing trends. Upper South Fork and it's tributaries (Deer, Lost, and Conde creeks) had few or no taxa that should have been present in such small, mountain streams. Instead, these creeks contained large numbers of insect species that are very tolerant of high temperatures and lots of sediment, taxa that usually live in large rivers. This was unexpected, and signaled that the tributaries to South Fork are in poor shape.

Also notable are the differences between North and South forks of Little Butte Creek. All three South Fork sampling sites had very high amounts of fine sediments. The most downstream site (site #1, Table 28) had particularly high amounts of silt. Such fine sediments reduce both the quality and quantity of habitat for aquatic macroinvertebrates. All sites lacked large-sized wood. The lack of wood reduced the diversity of habitat for insects (and also fishes), in turn reducing the kinds of insects present. The lack of wood also meant that detritus was not captured and retained for shredding insects, and little habitat for wood-boring insects was available. Therefore, nutrients, the base of the food chain, would be in low supply

It was also noted that the summer water temperatures in the lower two South Fork sites were high enough to be lethal to almost all cold-water invertebrate taxa. Therefore, all sites had low numbers of temperature and sediment-sensitive taxa and high numbers of tolerant taxa. Prior to the 1997 New Year's Day flood, it was noted that catastrophic floods have greatly influenced habitat structure in South Fork Little Butte Creek. Substrates go through periodic massive resorting during flood events. Sampling results indicated that biotic integrity was "surprisingly low" for the stream's location in the watershed. The site appeared to have hit bottom as far as habitat and biotic integrity and was recovering. The site's recovery potential will depend on how rapidly sediment inputs can be brought under control and the degree of damage to the overall habitat structure.

North Fork Little Butte Creek, on the other hand, was in better shape. The temperatures were cool enough that it supported cold-water taxa. The habitat was somewhat complex, and detritus and other nutrient sinks were relatively retained, which increased insect diversity and contributed to the overall health of the stream ecosystem. However, the site had a high number of long-lived taxa (insects that take several years to complete their life cycles). This indicated that flow is perennial and the substrates are often undisturbed. While this may seem good initially, this lack of substrate movement during the winter has resulted in high amounts of fine sediments in the system. The stream does not have high enough flows in the winter to move the sediment out. Therefore, there were also an abundance of highly tolerant species in North Fork Little Butte Creek. The lack of springtime flushing flows is the result of the Fish Lake dam; flows are lower than normal during the winter and higher than normal during the summer.

Table 28 summarizes the habitat limitations of each stream.

Table 28. Habitat Limitations to Aquatic Macroinvertebrate Community Development

HABITAT LIMITATIONS	Ratings[1]						
	NFLB[2]	SFLB-1[3]	SFLB-2[4]	SFLB-3[5]	Deer[6]	Lost[7]	Conde[8]
Year-round water temperatures supportive of cold-water biota	Good	Poor	Poor	Mod.	Poor	Poor	Poor
Nutrient enrichment	Good	Mod.	Good	Good	Good	Good	Good
Other water quality limitations (low D.O., high alkalinity, toxins, etc.)	Good	Mod.	Good	Good	Good	Good	Good
Habitat complexity created by channel form and in-stream structures	Mod.	Poor	Poor	Poor	Mod.	Poor	Poor
Perennial flow and drought resilience	Good	Poor	Good	Good	Poor	Mod.	Mod.
Hydrograph flashiness and seasonal amplitude of peak and low flows	Good	Poor	Mod.	Mod.	Mod.	Poor	Mod.
Disturbance regime of intermediate nature to maintain habitat complexity	Poor	Poor	Mod.	Poor	Mod.	Poor	Poor
Intact riparian corridor to supply shade, large woody material and detrital inputs	Mod.	Poor	Mod.	Mod.	Mod.	Poor	Poor
Bank stability	Good	Good	Good	Good	Good	Poor	Poor
Scouring of substrates during annual peak flows	Good	Poor	Mod.	Poor	Poor	Poor	Good
Fine sediment embedding erosional armor layer rocks (closure of crevice space)	Poor	Poor	Mod.	Mod.	Mod.	Poor	Poor
Silt entrained in erosional habitat sediments (closure of hyporheos)	Poor	Poor	Mod.	Mod.	Poor	Mod.	Poor
Waterline fluctuation, stranding and exposure of stream margin habitat during low flows	Good	Poor	Mod.	Mod.	Poor	Poor	Poor
Embedding of pool, slackwater and stream margin rocks	Poor	Poor	Mod.	Mod.	Poor	Poor	Poor
Entrained and surface silt on pool, slackwater and stream margin rocks	Poor	Poor	Mod.	Mod.	Poor	Poor	Poor
Fouling of depositional habitats with (too much) filamentous algae/ bacteria	Good	Poor	Poor	Poor	Good	Good	Mod.

HABITAT LIMITATIONS	Ratings[1]						
	NFLB[2]	SFLB-1[3]	SFLB-2[4]	SFLB-3[5]	Deer[6]	Lost[7]	Conde[8]
Detrital habitat complexity and retention capability	Mod.	Poor	Poor	Poor	Mod.	Poor	Poor

Source: *Benthic Invertebrate Biomonitoring* (Wisseman 1991 and 1994-5)
1/ Rating:
Good = good quality
Mod. = moderate quality
Poor = poor quality
2/ NFLB = North Fork Little Butte Creek, sampled in T36S, R3E, Sec. 31, SE1/4 SE1/4.
3/ SFLB-1 = South Fork Little Butte Creek, site #1; sampled in T37S, R2E, Sec. 11, SW1/4, NW1/4, between Lost Creek and Deer Creek.
4/ SFLB-2 = South Fork Little Butte Creek, site #2; sampled in T37S, R3E, Sec. 17, NW1/4 NW1/4, in BLM habitat improvement project area.
5/ SFLB-3 = South Fork Little Butte Creek, site #3; sampled 500 feet downstream from FSR 3730-800 bridge.
6/ Deer = Deer Creek; sampled in T37S, R2E, Sec. 13, NE1/4 SW1/4, about 1/4 mile upstream from confluence with South Fork Little Butte Creek.
7/ Lost = Lost Creek; sampled in T37S, R2E, Sec. 9, NE1/4 SE1/2, above confluence with Coon Creek.
8/ Conde = Conde Creek; sampled in T38S, R3E, Sec. 9, SW1/4 SW1/4, upstream of pond.

Fish Passage Barriers

Adult anadromous fish migrate from the ocean to spawn in Little Butte Creek Watershed. Juvenile anadromous and resident fish move throughout the watershed to find suitable habitat, avoid lethal stream temperatures, and to move downstream for smolt migration. Fish passage throughout the watershed is important for both adult and juvenile salmonids and other fish and aquatic species. Fish barriers are located throughout the Little Butte Creek Watershed - both natural and human-made.

Numerous waterfalls located within the watershed are natural fish barriers. Soda Creek contains a falls one-half mile upstream from its confluence. Grizzly Creek contains a falls 1.5 miles upstream from its confluence. Dead Indian Creek has a 100-foot vertical falls approximately two miles from its confluence with South Fork Little Butte Creek. South Fork contains a 20-foot vertical falls approximately 1,000 feet below the confluence of Beaver Dam Creek. These falls prevent anadromous and resident fish passage. Other streams have fish barriers due to natural steep gradient and/or dry summer stream channel condition.

Numerous instream water diversion structures (permanent and temporary) and seasonal unscreeened and screened irrigation diversions and pumps are on private and public lands located throughout the Little Butte Creek system. These diversions are trapping fish or creating dams/obstacles for fish passage.

Two fish barriers/obstacles identified in the Little Butte Creek Watershed Action Plan (LBCWC 1995) have been restored. Crandall Dam Fishway was identified as an unscreened diversion canal. ODFW conducted a juvenile mortality study on the site, which indicated a 67 percent juvenile mortality. Cooperative efforts by the private landowner, Little Butte Creek Watershed Council, and ODFW are rectifying this situation (Anthony 1997). Antelope Creek diversion, located near Agate Reservoir, prevented fish passage for steelhead trout. Cooperative efforts by Little Butte Creek Watershed Council and ODFW are to provide fish passage by extending the fishway (Anthony 1997). Two other fish passage obstaclse were identified in this report - screens located downstream from the point of diversions on Medford Irrigation District diversions on North and South forks of Little Butte Creek. Little Butte Watershed Council and ODFW are studying actions to provide fish passage (BOR 1997). An additional fish obstacle/barrier exists at a culvert located on County Road 1000 on Grizzly Creek, 40 feet from its confluence with South Fork Little Butte Creek.

Stream Habitat Restoration

Cooperative efforts among private landowners and public agencies have resulted in the initiation of a watershed approach for landscape assessment and restoration in the Little Butte Creek Watershed. Stream and riparian restoration objectives include: 1) reinstate a diverse mature riparian conifer component for future instream large wood recruitment, stream shading, streambank and floodplain stabilization and connectivity; 2) diversify main channel habitat where summer stream temperatures are conducive to salmonids to provide rearing and cover habitat for all ages and classes, particularly 1+ age salmonids and 0+ age coho salmon; 3) reinstate side channel habitat for juvenile salmonids, particularly coho salmon; 4) monitor project implementation and effectiveness; and 5) educate and share information with private citizens and state and federal agencies through cooperative partnerships. The Forest Service has been restoring instream and riparian habitat since 1989. Stream and riparian restoration on BLM and private lands have been ongoing since 1994, with assistance from the Little Butte Creek Watershed Council and ODFW.

Efforts to restore riparian and stream habitat included: 1) fence and/or alter agricultural and livestock management; 2) plant conifers and hardwoods for future large wood recruitment and stream shading; 3) provide floodplain connectivity by placing large wood on floodplain to provide microsites for riparian vegetation, and/or vegetation protection during flood events; 4) restore instream and side channel habitat in areas where summer stream temperatures are conducive to salmonids; 5) stabilize streambanks; 6) monitor pre and post-projéct conditions; and 7) promote education of fisheries/watershed agriculture/rural/forest opportunities for an ecosystem approach.

Habitat was significantly altered to emulate unmanaged conditions upstream. See Reference Condition, Aquatic Wildlife, for historic conditions. Monitoring of project areas revealed coho salmon responded well to restored side channel habitat:greater than one coho parr/square yard (Maiyo 1996). Juvenile coho salmon and steelhead used microhabitat created by boulders and wood added to the stream channel. Total standing crop of 1+ age steelhead and 0+ age coho parr increased. Plantings of two year-old hardwoods and conifers was successful on the cobble-dominated 50 year floodplain. Large wood and boulder features were placed on these floodplains to protect young trees from flood events.

1997 Flood

Stream Changes

Streams within the Little Butte Creek Watershed were heavily impacted by the 1997 flood. Effects of the flooding varied within the watershed. Steeper stream sections appeared much less impacted by the high water than wider valley stream sections. Where streams entered low gradient zones or "flats", more changes from the high water were noticed. Channel shifts, deposits of sand, gravel and cobbles, and countless piles of tree lengths and wood pieces were observed. Much of the gravel/cobble sediment was delivered from streamside landslides and general slope failures in the watershed. Past studies confirm that these types of landslide events are more frequent in areas where road-building and timber harvest is common.

The 1997 flood uprooted many alders and other hardwoods. Streams will be less shaded during the warm dry summer months. However, stream temperatures may not necessarily increase. Increased inter-gravel (cool) water flow and the apparent reduction of low flow width-to-depth ratios (minimizes solar radiation) may counter the increased stream temperatures from vegetation loss. Additionally, the flood created new fish habitat. Many streams previously channelized by heavy equipment after the floods of 1964 and 1974 have re-established side channels, become more sinuous as they spread across the valley, and created unique pools and backwater areas, which are important in the livelihood of young trout, salmon, and other native fish and aquatic species.

Salmon, Steelhead and Trout During Floods

The effects of these flood events on trout, salmon, and other native fish and aquatic species are unknown. It is suspected that salmon eggs deposited in the fall of 1996 by coho and chinook salmon were disrupted during incubation. Normally, eggs begin to hatch in the early spring; if eggs are dislodged from the nest during a flood, the eggs are often damaged and die. Yearling age trout, steelhead, and salmon would have a difficult time finding refuge during streambed movement, channel shifts, and the high water conditions because of present habitat conditions and floodplain disconnectivity. It is expected that a low percentage of the incubating eggs and yearling trout and salmon survived. These organisms are highly mobile and repopulating of these streams will probably occur from straying adults and juveniles looking for unoccupied spawning and rearing habitat. During the flood, steelhead were just beginning to migrate to spawning areas and thus had newly-flushed clean gravels for depositing their eggs. It is expected that their populations will not be impacted.

Role of Trees and Riparian Vegetation

Large wood on the floodplain provides bank stability, microsites, builds and maintains gravel bars, furnishes protection for riparian vegetation and affords fish refuge during high flow. The few large conifer trees that fell into the stream from adjacent undercut streambanks during the flood event remained close to where they fell and appear stable. These wood features maintained and created quality pools and collected considerable organic material in the form of smaller wood pieces, leaves, conifer needles and other detritus, important food sources for aquatic insects. Alder trees, the dominant riparian vegetation along most of the streams, were easily mobilized by the high water flow during the flood and should be considered short term food sources and roughness features to create fish habitat. Hardwoods, such as alder, ash, maple, and cottonwood are an integral part of the suite of organic materials in a healthy stream. In lower valley segments of streams such as Little Butte Creek, cottonwood trees can grow large enough that when they fall in the stream they function like large conifer trees, collecting detritus and other tree pieces that normally flush in a simplified stream channel.

Past Restoration Efforts

The 1997 flood altered some of the stream restoration activities. The flood improved and enhanced stream conditions in many restoration areas. In other areas, the stream channel moved significantly away from restoration sites.

Many project streams contained a riffle-dominated system with little pool or habitat complexity for fish. In an attempt to improve fish habitat in these streams federal, state, and private biologists, watershed health councils, and private citizens placed wood pieces and boulders in channels. These habitat structures provided short-term hiding cover, pool scour, bank stability, and collected organic material. Follow-up surveys and monitoring show these instream elements to increase the carrying capacity for holding young fish and enabling them to grow large enough to spawn or migrate to the ocean successfully. After the flood, it appeared that some of the habitat structures moved off-site onto the floodplain or moved to another location.

Human impacts to the stream and riparian zone may exacerbate flood effects. There are inherent risks to stream restoration as many streams were changed by past harvest of mature streamside and instream trees, machine work to straighten the stream channel, and other manipulations often done to confine the stream into a small area. These habitat changes are evident throughout the Rogue River Basin where people settle within floodplain areas of large and small streams. To maximize pasture or cropland, cutting down trees along streambanks was a common procedure to otherwise tame stream channels for development.

As the Northwest Forest Plan is implemented on federal lands, protection of riparian zones and stream will allow regrowth of large mature conifer trees. These large conifer trees will help stabilize streambanks and landslides and provide canopy cover. In addition, they provide an important future instream wood component. These trees tend to be more stable than fish habitat structures because of their tree-length size and attached roots.

REFERENCE CONDITIONS

The purpose of the reference conditions section is to explain how ecological conditions have changed over time as a result of human influences and natural disturbances. This section provides a reference for comparison with current conditions.

HUMAN USES

People have been using the Little Butte Creek Watershed for thousands of years. During this time, although climate and other natural processes have dominated the watershed's environment, human activities have significantly influenced the conditions of the local landscape. This section describes historic human processes and activities influencing the watershed.

For purposes of the following discussion, the Little Butte Creek Watershed is divided into three major subareas: the lower valley, the upper valley/canyon section, and the high plateau.

The lower valley: This subarea at the westernmost portion of the Little Butte Creek Watershed extends from the mouth of the creek (located on the opposite side of the Rogue River from Upper Table Rock) east to approximately the confluence of the North and South forks of Little Butte Creek; the section also includes the lower Antelope Creek drainage below Bybee Peak.

The upper valley/canyon: This subarea includes extensive valley bottom lands near the Lake Creek community, but is dominated by the "twin" steep-walled canyons of the North and South forks of Little Butte Creek (which are separated from each other by the Heppsie Mountain ridge). This section also includes high-gradient tributary drainages that have been eroded into the old volcanic deposits of the Western Cascades (for example: Lake Creek, Lost Creek, Deer Creek, Soda Creek, Dead Indian Creek, and Wasson Canyon), as well as upper Antelope Creek.

The high plateau: This subarea forms the headwaters drainage of the Little Butte Creek Watershed, with the North and South forks of Little Butte Creek originating at Fish Lake and the moist meadows of the "Dead Indian Plateau" respectively. Although the high plateau includes the steep slopes of Mount McLoughlin and Brown Mountain, most of this section has fairly gentle, "rolling" relief, which consists of geologically recent andesite and basalt flows of the High Cascades.

The generally level terrain and mild climate of the lower valley, which includes the present community of Eagle Point and the bulk of the watershed's privately-owned lands, have made this section quite hospitable to permanent human habitation; thus, human modification of the landscape has been particularly intense in the lower valley. Outside of the Lake Creek vicinity, the upper valley/canyon section's deeply-incised drainages have confined most habitation there to the narrow floors of the two major canyons; much of the rest of the canyon section consists of federal land (Bureau of Land Management and Forest Service). Most historic human uses of the high plateau have been seasonal due to cold winters, deep snowpack, dense forest, and other factors. Federal land (mostly Forest Service) accounts for most of the high plateau section. The following discussion, while acknowledging and briefly summarizing the history of the lower valley, concentrates on relevant human activities that occurred in the upper valley/canyon and high plateau sections of the Little Butte Creek Watershed.

Prehistory and Native Groups (ca. 10,000 years before present to A.D. 1865)

The first human beings in southwestern Oregon are referred to as the Paleo-Indians by archaeologists. Archaeologists believe that the Paleo-Indians probably arrived about 11,000 years ago at the close of the Ice Age. The Paleo-Indians very likely would have hunted mammoth, giant bison, and other now-extinct mammals within the Little Butte Creek Watershed and elsewhere in the wider region. Although no sites or artifacts clearly linked to these earliest human inhabitants have been documented for the watershed, a few Paleo-Indian artifacts have been found elsewhere in the upper Rogue River drainage.

As floral and faunal communities characteristic of the Ice Age in southwestern Oregon disappeared, human inhabitants began nearly 10,000 years of adaptation to the changing opportunities offered by the land. Evidence of these people is contained in the archaeology of Little Butte Creek Watershed. Based on state archaeological site records, it is likely that most of the watershed's larger and more intensively occupied prehistoric settlements were concentrated in the lower valley section, particularly on flood-free stream terraces stretching from near the Rogue River to about Brownsboro. Some of these archaeological sites likely include winter villages and major seasonal base camps that were situated at important fishery sites, camas meadows, and acorn-gathering areas. Unfortunately, very little professional archaeological survey or excavation has occurred in the lower valley. Most of the known or probable sites are located on private land and have been substantially impacted by twentieth-century agricultural and residential development. Upstream, in the upper valley/canyon section of the watershed, archaeological sites tend to be relatively small (probably reflecting seasonal base-camp and single-task use by dispersed family groups) and are typically located close to the stream channels of the North and South forks of Little Butte Creek. On the high plateau, archaeological sites tend (with some exceptions) to be quite small, shallow, and contain very low-density deposits. This is usually the result of light, periodic (even single-episode) use by small groups of very mobile hunter-gatherers.

The "Annual Round" (Fishing, Hunting, and Gathering)

During the many centuries of human prehistory, the bulk of the Little Butte Creek Watershed may have formed the core subsistence-gathering territory for only a few affiliated extended family bands at any one time. At the time that Euro-American settlers arrived, the Little Butte Creek Watershed was inhabited by small bands of Latgawa (or Upland Takelma) people. Portions of the high plateau section were probably seasonally visited (largely for hunting game) by even smaller groups of Klamath people, who lived well to the east of the watershed along Upper Klamath Lake. The total population of people living in and using the watershed over the course of a year's time may well have been a few hundred at most. These people followed an "annual round" of fishing, hunting, and gathering. The annual round was a subsistence pattern that typically brought them from their low-elevation winter villages to the adjacent foothills by spring. As edible plants and game animals became increasingly abundant at higher elevations during the summer and early fall, the people "followed the harvest" into the watershed's uplands, returning to the winter villages by mid-autumn (Winthrop 1993; LaLande 1980).

Fishing

Little or no archaeological evidence of fishing is known for the watershed. However, ethnographic and historic accounts confirm that anadromous fish were a major component of the local native diet. In addition to chinook and coho salmon taken from major fishery sites along the Rogue (upstream and downstream of the mouth of Little Butte Creek), sizable numbers of fish would also have been taken from the waters of Little Butte Creek drainage.

Methods would have included dipnetting and spearing, as well as hand-catching exhausted (and even dead) spawners from slack water. Although undocumented for the upper Rogue vicinity, weirs and fish poisons (e.g., soaproot) may also have been employed, particularly in the lower valley and canyon sections of the watershed. Freshwater mussels, crawfish, and lamprey could have been exploited along the lower valley reaches as well. Overall, native take of salmon (and steelhead) probably had little effect on fish populations or their habitat.

Hunting

Deer and elk were the major game species of the watershed, although a variety of other animals were hunted as well. Among them were probably pronghorn antelope in the lower valley and, in the uppermost South Fork Canyon and rugged portions of the high plateau, were bighorn sheep. The presence of pronghorn in the Rogue River Valley was documented by an 1841 exploration expedition. Early historic accounts testify to the presence of bighorn in the High Cascades less than forty miles to the south. Blood residue studies of artifacts from archaeological sites within and near the watershed point to hunting of bighorn sheep. Hunting methods, aside from solitary hunting or snaring, included communal endeavors in the canyons that employed dogs and fire to help drive large numbers of deer into brush enclosures. Group-organized jackrabbit drives may have been occasional events in the lower valley. Such hunting pressure may have periodically resulted in substantially (if short-term) lowered game populations, but the natives' regular efforts at habitat enhancement (through the long-term use of fire to expand and maintain wildlife forage) would have been a positive force.

Gathering

Acorns (Oregon white oak and especially California black oak) were a staple wildland harvest from the lower valley floor and adjacent foothills. Poorly drained soils in the alluvial bottomlands and low-elevation benches supported blue camas; along with acorns, these bulbs were the key edible plant resource of the Latgawa. Brodiae and other bulbs were gathered from drier hillslopes. In the upper valley/canyon areas, California black oak, yampa, sugar pine, hazel, and chinquapin produced abundant quantities of food. Regular burning in the canyons would have enhanced the growth and productivity of these species. Similarly, on the high plateau, anthropogenic fire probably served to encourage and maintain the growth of serviceberry trees and huckleberry patches at favored areas. Camas was also available from the high, moist meadows such as Big Elk Prairie, Owens Prairie, and Dunlop Meadows.

In addition to edible/useful plants, certain mineral resources of the watershed were gathered by native people. Cryptocrystalline silicate rocks ("toolstone" or "glassy" rocks such as jasper and agate) useful for making into chipped stone tools occur as nodules and veins in the Western Cascade volcanics. Some of the toolstone rock may have been gathered from primary deposits near the headwaters of Dead Indian Creek in the southwestern corner of the high plateau. Most of the local supply was likely obtained from secondary deposits of the extensive, alluvial-terrace cobble deposits found in the lower valley. Fine-grained basalt (for large chopping tools) and coarser basalt/andesite (for mortars and pestles) were plentiful along most of the full length of Little Butte Creek (LaLande 1980).

Transportation (Native American)

Native people in the Rogue River area did not obtain horses until after 1830; obviously, all travel was by foot. Travel through the watershed included many traditional trails. Only one is documented: the 1854 General Land Office survey of the 1E/2E range line dividing Township 37 South mentions "an Indian Trail" paralleling the south bank of South Fork Little Butte Creek; no such trail was noted for the north side of the stream. This route likely accessed the canyons and high plateau of the watershed.

Post-Contact Epilogue

During the period between 1827 (when Euro-Americans first passed through southwestern Oregon) and 1855, the Latgawa adapted to many changes; metal trade goods, the horse, and devastating new diseases were major among these. Permanent Euro-American settlement of the watershed began in 1852-53, shortly after the discovery of gold near Jacksonville. Settlers were farmers/ranchers who had little appreciation for the native way of life. Some of them participated enthusiastically in the "Indian War of 1855-56." The war began in October 1855 with the settlers' attack on a Latgawa village at the mouth of Little Butte Creek, inhabited by Qua-chi's band. Qua-chi (known as "Jake" to white settlers) and his band fled to the canyons upstream; the settlers' militia forces again attacked them (probably somewhere in the vicinity of Wasson Canyon) on Christmas Day 1855. Survivors of the "Little Butte Creek band" were taken to Fort Lane and eventually forcibly relocated to a reservation in the northern Oregon Coast Range.

Immediately following 1856, Klamath Indians from east of the High Cascades apparently began to expand their seasonal territory westward into areas formerly used by the Latgawa.

Jacksonville newspaper accounts from the 1858 to 1862 period confirm that Little Butte Creek ranchers and other Rogue River valley settlers became seriously concerned about the increasing numbers of Klamaths in the area each summer. Local political pressure contributed to establishment of the Klamath Indian Reservation in 1863. The Klamath Indian Reservation was located approximately twenty miles to the east of the Little Butte Creek Watershed. With that event, Klamath Indian presence within the watershed became much less frequent and far more controlled (largely restricted to travel each summer along what was historically referred to as the "Dead Indian Road" to trade at Ashland, Phoenix, and Jacksonville). Traditional native use of the watershed was effectively ended.

Landscape Appearance Prior to Euro-American Settlement

Over the course of thousands of years, native inhabitants of the Little Butte Creek Watershed regularly used fire on the landscape for a wide variety of purposes. Combined with the effects of generally short-interval natural fire, anthropogenic fire would have contributed greatly to the vegetation patterns that characterized lower and medium elevations. In general, much of the lower valley would have been dominated by grassland, oak savanna, and open oak/pine woodland. As documented by impressionistic early accounts of travel through the adjacent Rogue River Valley during the spring, open groves of "majestic" oak and scattered ponderosa pine towered above lush grass that grew "belly high to a horse" (Applegate 1922). This kind of vegetation would have been far more extensive than it is at present. The notes taken during the 1854 General Land Office survey of Township 36 South, Range 2 East, W.M. (Ives and Hyde 1854) document the foothills of the Lake Creek area as containing "prairies" and "scattered pine and oak," and "oak openings."

Prime black oak acorn gathering territory probably existed in the upper valley/canyon section. These south aspect slopes (similar to those of the South Fork Canyon north of the present Latgawa Camp) would have continued the extent of oak/pine woodland to well over 3,500 feet in elevation. Many mixed-conifer stands of the canyon and high plateau sections were comparatively open, with a higher proportion of mature ponderosa and sugar pine than at present. Elsewhere on the high plateau, repeated anthropogenic burning of selected areas would have created huckleberry patches and helped maintain an extensive system of meadows at the headwaters of streams. Infrequent, stand-replacing natural fires on the high plateau may have played a dominant role overall (LaLande 1995).

Riparian vegetation along major stream courses of the lower valley and along lower North and South forks of Little Butte Creek probably was dominated by tall bigleaf maple with thickets of lower-growing alder and willow. Back from elevated bank edges, large black oak also would have contributed to shading of stream courses. The question of how important conifers (especially ponderosa pine) were to the make-up of these low-elevation riparian communities is open to debate. However, it is highly likely that open "galleries" of mature pine grew along many sections of lower/medium-elevation stream courses. This is supported by about 1875 to 1885 lithographic panoramas (which in turn were based on tracings of photographs) that show tall conifers growing abundantly along stream courses of the main Rogue River valley. In addition, the 1854 General Land Office survey notes for the range line between T.36 S., R.1

E. and T.36 S., R.2 E. document that large "yellow (ponderosa) pines" grew very close to the streambank of Little Butte Creek at the confluence of North and South forks of Little Butte Creek; the riparian vegetation along this stretch was described as "Timber, pine, oak, ash, balm [poplar] and alder, haw [thorn] and maple; undergrowth, hawthorn, plum, linebark [ninebark], briars and rushes."

Early Euro-American Use and Settlement (ca. 1827-1870)

Trapping

The first Euro-Americans to explore the interior of southwestern Oregon arrived in early 1827, when fur trappers of the Hudson's Bay Company (HBC) traveled through the Rogue River Valley. Led by Chief Trader Peter Skene Ogden, these men ascended the left (south/east) bank of the Rogue River well past the mouth of Little Butte Creek. A small detachment trapped the waters of Little Butte Creek for a few days' time in late February/early March, possibly reaching as far east as the North Fork/South Fork canyons (LaLande 1987). Later HBC trapping brigades of the 1830s to 1840s probably continued to take beaver from the lower Little Butte Creek Watershed. The "trap out the streams" policy of the HBC in this region may have resulted in a substantial decrease in beaver numbers (and hence resulted in changes to "beaver-caused" streamflow characteristics well before the first actual Euro-American settlement began).

Initial Settlement

Euro-American agricultural settlement of the Little Butte Creek Watershed was stimulated by discovery of gold in the nearby Siskiyou Mountains, which began in 1852-53. Approximately 20 individuals claimed land parcels along the lower sections of Little Butte and Antelope creeks under terms of the Oregon Donation Land Act. Among them were James Fryer (often credited as "founder" of the later community of Eagle Point), John Mathews, Nick Young, Larkin McDaniel, James Lupton, and Lewis Reese (Hegne 1990). Scattered farms, typically drawing a small amount of irrigation water from nearby stream courses, dotted the lower valley. Residents of the "Butte Creek precinct" (as the thinly-settled lower valley was termed in Jacksonville newspapers of the day) were located well off the main north-south travel route through southwestern Oregon. Living in a hinterland, they apparently formed a cohesive (and politically conservative) rural community. For example, during the Civil War, local pro-Union citizens considered the Butte Creek area to be a hotbed of Confederate sympathizers.

Grazing

Agricultural use of the watershed in the form of farming and ranching began when the area was first settled by Euro-Americans and is still important today as one of the major human interactions within the watershed. Most concentrations of large-scale farming and ranching in the Little Butte Creek area followed the acquisition and combining of land spurred by the Donation Land Act of 1850, which allowed a married man 640 acres, a single man 320 acres, and in time, a woman 320 acres of land. After initial claims, marriages and partnerships combined many smaller blocks into large tracts controlled by a few families. Some of these minor land barons can today be remembered through such place names as Nichols Gap and Brownsboro. Tradition at that time was to use individual homesteads for direct food and fiber cropping while treating all unclaimed land as common range for livestock grazing.

Little Butte Creek settlers, as well as ranchers from elsewhere in the Rogue River Valley, grazed livestock throughout the watershed during the 1850s to 1870s. Hogs ranged the lower valley woodlands for several decades. Although sheep were grazed in the watershed during these early years, they would become much more significant in terms of numbers (particularly at high plateau meadows) during the 1880s to 1890s (Leiberg 1900). Cattle were the mainstay of the watershed's agricultural economy from the early historic period to the present time. This was especially true during the 1860s to 1880s when Rogue River Valley cattle not only helped to feed the booming mining towns of Idaho, but also stocked the new ranges of the Inland West, from eastern Oregon to central Montana. Large numbers of cattle and sheep, driven from lower valley pastures to high plateau meadows each summer, would have contributed directly to changes in the watershed's forage species and range condition. These effects would have been concentrated along stream courses, at springs, and at meadows.

The southern portion of the high plateau was more easily accessed from the Ashland area than it was from lower Little Butte Creek. Some of the plateau's larger meadows became particularly important summer pasture at an early date. This was indicated by Ashland ranchers' 1858 and 1865 water rights to the headwaters of Dead Indian Creek for irrigation of northernmost Howard Prairie and Owens Prairie (Circuit Court 1949).

Hunting

Ranchers quickly set about trying to rid the country of large predators. Cougars survived the campaign of elimination, but grizzly bears and wolves would have been exterminated from the watershed by about 1900. Early settlers availed themselves of deer, elk, black bear, quail, grouse, and other game. The high plateau section became known before 1870 as a "hunter's paradise," a reputation it maintained into the early 1900s. Antelope and bighorn sheep populations (probably never large) likely would have disappeared due to hunting and introduced disease very soon after 1853.

Settlement of Upper Valley/Canyons, Related Use of High Plateau (ca. 1870-1900)

A New Wave of Settlers

Above Brownsboro, new arrivals came to the upper valley (which generally contained far less desirable farmland than did the lower valley section) beginning in the 1870s. According to Walling (1884), one of the earliest Euro-American residents in the upper valley/canyon area was a former Hudson's Bay Company employee; perhaps this man had trapped in the Little Butte Creek Watershed during the 1830s to 1840s. Upper Antelope Creek was settled as far upstream as Climax during the 1870s as well. Families that homesteaded the area during the

1870s to 1890s included American citizens of British heritage (e.g., McCallister, Brown, Charley, Tyrrell, Daley, Conley, Bradshaw, Walch) as well as a sizable contingent of recent immigrants from Germany (e.g., Bieberstedt, Meyer, Messal, Edler, Hoefft, Pech, Frey) and several arrivals from Switzerland and the Austrian/Italian area of Tyrol (Hegne 1990).

Grazing

Most agricultural endeavors in the upper valley/canyon section during this period centered on raising livestock. Although sheep from large Rogue River Valley operations grazed on the high plateau each summer, Little Butte Creek ranchers by this time concentrated on cattle and horses. Most ranches were small holdings, but the Hanley family's Little Butte Creek property proved to be an exception. Michael Hanley owned extensive acreage near Jacksonville and in the Applegate Valley. Expanding his cattle operation to the east, Hanley acquired several thousand acres near the confluence of the North and South forks of Little Butte Creek. Headquartered on the North Fork, near Wasson Canyon, the Hanley spread included over 1,000 acres of irrigated pasture.

Prior to the Forest Reserve Act of 1893, "management" of the range was open to individual interpretation. Locals had plenty of free range which allowed increases in private herds of livestock. Cattle were wintered in the lowlands and driven to spend the summers in the highlands of the Dead Indian Plateau. Stanley (1996) speaks of vast herds held by the old Canal Cattle Company roaming the Agate Desert and White City area. Rauhauser (1996) tells of large cattle drives up from Brownsboro, Lake Creek, and Antelope Creek into the former Hyatt and Howard Prairies and onto Conde Creek as well as east to Fish Lake and the Klamath meadows beyond.

Ranchers in most rural areas of southwestern Oregon continued the native practice of burning certain areas, however, it served a different purpose than native practices. Meadows and grasslands that were prime grazing areas were torched regularly to stop the encroachment of conifers. Hunters burned brushy areas so that the resulting new growth would attract deer. This "light burning" by local residents persisted until well after 1900.

Agriculture and Irrigation

A typical Little Butte Creek ranch included a vegetable garden and perhaps a small fruit orchard. The main demand for irrigation water, however, was for livestock pasture and hayfields. Flood irrigation from unscreened ditches was the norm; as a result, many small fish doubtless became unintentional fertilizer for alfalfa.

By the early twentieth-century, the North Fork was tapped by at least 15 separate ditch diversions for irrigating local ranches; the South Fork had a similar number of small ditch diversions. Excluding additional withdrawals from the two forks for large irrigation districts located outside of the Little Butte Creek Watershed (as well as for powering the McCallister sawmill, where the water was returned directly to the creek), a total of 27 cubic feet per second (cfs) of water from the North Fork was allocated to local irrigators shortly after 1900.

The Hanley property accounted for over 17 cfs of this amount. For the South Fork, the allocation was a little over 17 cfs (Circuit Court 1949).

Logging and Sawmilling

This period saw the first harvesting of timber from the canyon forests. The water-powered McCallister sawmill on the North Fork was probably one of the largest in the watershed at the turn of the century, but it actually produced comparatively small amounts of lumber for a local market. The Worlow sawmill near Climax, dating to the 1870s, also sold rough-cut lumber for use by area settlers. Aside from cutting the easily accessible low elevation white oak, madrone, and Douglas-fir for fuelwood, most of the small-scale logging of this era concentrated on sugar pine and ponderosa pine. This selective harvesting used teams of oxen and horses to move logs to the mill. This type of logging would have affected relatively small portions of the upper valley/canyon section close to the millsites. The timber of the high plateau remained virtually untouched, except for occasional felling of large sugar pines for manufacture into shakes (Leiberg 1900).

Recreation

Hunting, including the indiscriminate slaughter of deer and elk by commercial hide-hunters, would have continued during this period with little effective restriction by game limits. Local hunters found two mineral springs, one each on the North Fork (McCallister Soda Springs) and the South Fork (Dead Indian Soda Springs). The springs became popular summer "health resorts" for residents of the hot lower valley. Developments were minimal at both, and tent camping being the norm at Dead Indian Soda Springs until after 1900, when a few cabins were built (LaLande 1980). Anglers would have taken salmon and steelhead from the two canyons, but the historical record is almost silent on this subject.

Transportation

Most areas within the upper valley/canyon and high plateau sections of the watershed were accessible only by foot or by horseback. A network of trails up to and through the high country developed during this period. Wagon travel was limited to only a few routes. Within the watershed, Dead Indian Road (completed in 1870) was the only trans-Cascadian wagon road linking the Rogue River Valley and the Klamath Basin. However this road merely passed along the southern edge of the high plateau (connecting Ashland with Fort Klamath) and did not serve the needs of most Little Butte Creek settlers. Reflecting the pace of settlement in the upper valley, wagon roads were extended gradually up the North Fork and South Fork canyons from the Eagle Point/Lake Creek road. However, neither of these roads accessed the high plateau; from their termini, travelers bound for Fish Lake or the Klamath Basin had to unhitch their horses and ride. (Because of the formidable barrier posed by both the Brown Mountain lava flow and the steep slopes of the upper South Fork Canyon, this situation would continue until after Forest Service road construction projects in the 1930s.)

Due to the lack of a practical trans-Cascade transportation route through the Little Butte Creek

Watershed until well after 1900, the lower valley remained something of an economic and social "backwater" compared to similar-sized communities in the main Rogue River Valley.

Landscape Conditions (around 1900)

By the turn of the century, exclusive of Eagle Point, only a few hundred people lived within the Little Butte Creek Watershed, most of them engaged in ranching operations (with minor seasonal employment at a handful of small sawmills). Wildlife conditions, due to both predator control and over-hunting, probably reflected lessened populations and decreased diversity of larger species. Irrigated agricultural acreage, although not extensive, did modify the valley/canyon bottomlands significantly, and streamside grazing likely began to change the structure of riparian areas at this time as well. Grazing (especially by sheep) at high plateau meadows likely caused unfavorably changes to some of them. However, continued "light burning" by ranchers and hunters (as well as the lack of suppression of natural fires) probably meant that, in the upper valley/canyon section, some of the prehistoric appearance of the hillside grasslands, oak woodlands, and open pine-dominated forest remained.

Federal forester John Leiberg, visiting the Little Butte Creek Watershed in 1899, described the upper valley foothills (from Brownsboro to past Lake Creek) as open or brushy (dominated by dense thickets of mountain mahogany) and having little good quality timber--the "scanty" stands of good-quality mill timber "having long since been cut out." He recorded Township 37 South, Range 3 East (which centers on the upper canyon of the South Fork) as "steep, rocky" country, with scattered stands of "medium density" pine/fir forest that were "intersected by great numbers of small rocky glades." In the next township to the east (on the high plateau), Leiberg found that the fir-dominated forest south and southwest of Fish Lake contained "considerable tracts...burned within recent years"; he determined that many of the fires had been set "to provide browse for stock." Along the North Fork below Fish Lake were a series of "narrow swales of grazing land, marshy or merely wet during stages of low water, submerged during flood seasons" (Leiberg 1900).

Expanded Use and Federal Land Management (ca. 1900-1940)

The decades following 1900 brought increasing use of the watershed's resources. The major factor in the intensified use and extraction of natural resources was southwestern Oregon's link to the rest of the nation by railroad. Population of the main Rogue River Valley boomed, ranches of the main valley were subdivided into small irrigated farms, and a whole range of local commodities could now be shipped long distances from the growing new city of Medford. Uses of the watershed before 1900 were mainly by local people, and resources were typically utilized or consumed either by watershed residents or were sold to others in southwestern Oregon. This "local economy" focus of the watershed began to change after the railroad arrived, accelerating after 1900 as local resource use and consumption paled beside the reach of corporations and the draw of markets located outside of the immediate area.

Population centers grew around stationary enterprises such as the flour mill at Eagle Point. During the late nineteenth century, the Little Butte Creek Watershed supported cultivation of orchards, hay, cereal grains, market vegetables, small fruits, and the raising of livestock.

Despite rapid population growth elsewhere in Jackson County, the actual number of new settlers within the Little Butte Creek Watershed during the early 1900s was quite small. Had the proposed town of Eldrianna (platted on the lower North Fork in the mid-1890s) actually materialized, the situation might have been very different. Eldrianna was meant to become home to land-hungry families from the East Coast and Chicago, who would leap at the chance to purchase residential lots in the rustic woods of Oregon (Hegne 1990). The scheme never went beyond an initial land survey and some promotional efforts back East.

Much of the upper-valley/canyon section and virtually all of the high plateau were included in the Cascade Forest Reserve, proclaimed in 1893 but not given active management of any kind until 1900. Soon thereafter the Forest Reserve was renamed the Crater (later Rogue River) National Forest.

Oregon and California (O&C) railroad-grant lands within the higher elevations of the upper valley/canyon section were "revested" to the federal government in 1916. Administration of these lands passed from the General Land Office to the O&C Administration in 1937 and to the new Bureau of Land Management in 1946.

During the 1900s to 1930s, federal land managers in the watershed concentrated their efforts on building trails and a few roads, administering range allotments, and suppressing fires. Fire lookouts were built at Poole Hill and Robinson Butte and guard stations were erected at Dead Indian Soda Springs and Big Elk Prairie.

Grazing

During the war-time high beef prices of 1914 to 1918, Little Butte Creek ranchers, like many stockmen in Oregon, expanded their herds greatly, going into debt and overstocking the range. Soon after the war, the cattle market collapsed and many small ranchers left the business. The locally-owned Hanley operation was sold to distant interests during this period. By 1922, the number of cattle and sheep within the watershed probably had declined significantly.

No detailed range-condition reports are available for the area (as they are for other portions of the Rogue River National Forest) during this time, but if higher-elevation range conditions elsewhere in southwestern Oregon are used as a guide, the years of uncontrolled, competitive grazing in the watershed's canyons and high plateau had resulted in unfavorable range conditions by this time (LaLande 1995). Although raising livestock remained an important part of the watershed's economy throughout the rest of the twentieth-century, after 1930 sheep were excluded and the numbers of cattle more carefully distributed than before the Great Depression.

At its unregulated peak, the beef cattle industry had a significant impact on the natural vegetation within the watershed. Overstocking, year-round use of lowlands, free ranging of uplands and riparian areas, as well as the practice of water diversions to produce winter feed for beef cattle affected not only vegetation, but moisture availability in the soil and water quality and quantity in the streams. The dramatic decline in livestock prices combined with an obvious need to regulate livestock numbers to avoid continued unfavorable range conditions marked the 1930s as a major period of change in the western livestock community.

Along with the economic influences of the Great Depression, the passage of the Taylor Grazing Act (1934) and the Oregon and California Revested Lands Sustained Yield Management Act (1937) added to the Forest Reserve Act to begin more stringent management practices on lands used. These lands were administered by the Forest Service and the Grazing Service which later became the Bureau of Land Management (BLM). Seasons of use and carrying capacities were initiated.

Agriculture and Irrigation

The Rogue River Valley's orchard boom years began shortly before 1900. Thirsty orchards demanded water, and large-scale irrigation development of the Little Butte Creek Watershed began in 1897 with the first Fish Lake dam, a cribbed-log structure. The relatively small natural lake was impounded and enlarged by successive dams, built in 1911 and 1922. Its spring-fed waters were augmented by construction of the Cascade Canal, which brought water from Fourmile Lake (outside of the watershed). These projects, which at times significantly lowered flows of the North Fork during critical times for the anadromous fish, were largely meant to service farmers living in the Bear Creek Watershed; a supplementary diversion from the South Fork had similar effects. In addition, rapidly growing Medford obtained its domestic water supply from Fish Lake until 1926 (LaLande 1980).

Very little new agricultural land was improved during this period within the watershed. On the edge of the high plateau, a few hardy individuals homesteaded 160-acre claims between 1905 and 1915. The objective of some was to obtain ownership to meadows for summer grazing; the motivation of others was speculation: to acquire patent to potentially valuable timber and later sell the parcel to a timber corporation (LaLande 1980). (This is how many of the parcels of private land within the National Forest portion of the watershed were originally obtained.)

Logging

Because of the watershed's lack of railroad accessibility, as well as the scattered nature of its high-valued timber, large-scale logging did not occur during these years. A major railroad logging operation (Owen-Oregon/Medford Corporation) did develop immediately north of the watershed, in the Big Butte Creek Watershed, with railroad spurs tapping thousands of acres and carrying logs down through Butte Falls to the Medford mill. The Little Butte Creek forests, in contrast, echoed not to the whistle of steam locomotives but to the rhythmical sound of the occasional crosscut saw felling a pine; small mills (probably fewer in number than before 1900 because most of the accessible pine had already been cut) still produced some lumber for the local market. Some commercial cutting from Oregon and California railroad grant lands likely occurred in the lower hills of the canyon section during the 1920s.

Recreation

Recreational use of the watershed had been quite limited and widely dispersed until after 1920. About that time, an increasing population in the Rogue River Valley began to seek recreation opportunities at a few favored locales within the watershed, primarily at Dead Indian Soda Springs and Fish Lake. Auto roads (typically drivable only during the summer and early fall) had reached these two places by 1930. Forest Service recreational construction at both places during the Great Depression (employing Civilian Conservation Corps and Emergency Relief Work crews) helped both the springs and the lake become popular summer destinations for increasing numbers of people.

At Fish Lake, a resort with rental cabins augmented the Forest Service campground; additional cabins appeared at Dead Indian Soda Springs. Also during the Depression, near the former site of Eldrianna, a small group of co-religionists established a short-lived settlement called "The Golden Rule"; disagreements among the members quickly ended the experiment (Hegne 1990).

Mining

Compared to the Siskiyou Mountains, which form the west slope of the main Rogue River Valley, the volcanic formations that make up the Little Butte Creek Watershed contain almost no valuable mineral deposits of any kind; therefore, mining has been unimportant.

During the late 1930s, the clay exposed in an abandoned cinnabar (mercury ore) prospect near Brownsboro was briefly mined by a Klamath Falls brick manufacturer (State of Oregon 1943). The only mineral activity of any significance occurred during World War I, when about a dozen small-producing manganese mines were developed in the Lake Creek vicinity. The manganese ore occurs as nodules disseminated in the volcanic breccias of upper Lake Creek, Lost Creek, and as far north as Salt Creek.

With the high war-time demand for the metal in 1917 several manganese mines were developed in the watershed, but closed down soon after the 1918 armistice. Most of these mines consisted only of scattered open cuts and some short tunnels. The largest of the Lake Creek mines, known as the Tyrrell Mine, included a 20-ton concentrating mill. The Tyrrell Mine produced about 200 tons of concentrate (apparently shipped to Tacoma for further refining) before the owners closed the property permanently and shipped the machinery back to Tacoma in 1919 (State of Oregon 1943; Hegne 1990). Some short-lived water and air pollution may have resulted from the operation, but the only lasting legacy of the area's manganese "boom" are a few collapsed tunnels in the hills south of the Lake Creek store.

Transportation

Dead Indian Road remained the only trans-Cascade route through or near the watershed until the 1930s. In the 1910s, the Conde Creek road (a very rough wagon road) connected the South Fork to Dead Indian Road via the ridge west of Dead Indian Road Creek (this route closely parallels the present Conde Creek Road); in the 1920s, the Forest Service connected Fish Lake to Dead Indian Road by means of the "Big Elk Road" (present road 37), a rough dirt track through the forest that crossed higher but gentler terrain than the Conde route. In the 1920s, the Forest Service constructed a dirt road up the North Fork to Fish Lake and finished extending it east over the mountains by the mid-1930s. This road was built through the rugged Brown Mountain lava flow, which had long diverted most travel away from the upper North Fork. This road accessed the waters of Lake of the Woods and also provided direct travel between Eagle Point and the Klamath Basin during the drier months. As a result, the Little Butte Creek valley was no longer such a "blind alley" for easy travel across the mountains.

Other new routes developed during the 1930s included a road from Dead Indian Soda Springs to Big Elk Prairie via Robinson Prairie (present road 3730) and a road to the summit of Robinson Butte.

World War II and After (1940-1980s)

Grazing

BLM allotment files reflect management concerns for past grazing overuse to be reduced by 50 percent by the early 1960s and a further 50 percent since then. Seasons of use were initially split into "spring" for lowlands and "summer" for the highlands, but were later regulated by dates dependent upon range readiness, and now also allowing for fall regrowth and wildlife use. Utilization and distribution were being fine-tuned, and by the late 1980s were delicately balanced to avoid stresses on native vegetation due to early, late, little, or much use. Such stresses resulted in a decline in abundance and vigor (Holechek et al. 1995), hindering native plant populations' ability to compete with strongly competitive noxious weeds.

The introduction and grazing pattern of four domesticated animals (hogs, horses, goats, and sheep) has had strong, in some cases stronger, negative influences on vegetation than cattle in the watershed. Hickman attributes the wide distribution of wedgeleaf ceanothis (*C. cuneatus*), to large populations of free roaming goats in the late 19th and early 20th centuries, not to fire as had been previously thought (Stanley 1996). Free-roaming hog herds (LaLande 1980) had a significant impact on vegetation in the lower level oak groves, reducing grass and oak recruitment up into the late 1930s. The last "wild horse roundup" of the 1950s in the Obenchain area was a gathering of feral horses descended from abandoned free-roaming herds of the late 19th century (Stanley 1996). Horses had suppressed native grasses for so long, when Gene Hickman began seeing the returning oatgrass he at first thought it was a new weed (Stanley 1996). While sheep were primarily confined to pastures, their impact is still evident in many meadows along South Fork Little Butte Creek.

Agriculture and Irrigation

As with other resources in the area, water came under increasing demand after 1940. In the 1950s, the federally funded expansion of Talent Irrigation District's facilities, such as Howard

Prairie Reservoir, tapped the South Fork Little Butte Creek via a long canal and the Deadwood Tunnel. Water was transferred from the Little Butte Creek Watershed and used for irrigation as far away as the Siskiyou foothills of Ashland and Medford. The U.S. Bureau of Reclamation improved Fish Lake dam in the 1950s and enlarged it in 1996-1997. In the lower and upper valleys, major floods in 1964, 1974, and 1997 caused substantial erosion and deposition. Flood control work along the stream course in 1964 and 1974, which typically involved large earth-moving equipment, further modifying the hydrology and riparian vegetation of Little Butte Creek.

Logging

High wartime demand for wood products made the heretofore remote forests of the watershed's canyon and high plateau valuable for logging. Starting in 1943 and continuing through 1946, the Forest Service offered a number of timber sales in the higher elevation portion of the watershed. Accessing these stands of federal timber from Dead Indian Road, logging companies that cut selectively during this period included: Joe Hearin Logging (mouth of Big Draw Creek, Daley Creek), White Fir Lumber Company (upper Beaver Dam Creek), Alley Brothers (Deadwood Prairie), and Jansen-Edmonds Logging (north slope of Cox Butte) (LaLande 1980). The timber was processed at several small mills located along Dead Indian Road or hauled to mills in Ashland. Many of the companies mentioned above simultaneously logged nearby private parcels, generally by clearcutting the timber; these operations probably logged BLM timber in the Conde Creek area as well.

Following the war and lasting into the 1960s, Forest Service clearcut harvesting occurred on the high plateau; in the 1970s, silvicultural prescriptions changed to shelterwood harvests due to reforestation problems. By 1980, virtually the entire high plateau (with the notable exception of the Brown Mountain lava flow) had been roaded and logged intensively. Aside from selective "high grading" with tractors during the 1950s to 1960s, logging on the steep canyon slopes lagged behind that on the plateau, due to both intermingled ownership and the expense of road-building and skyline yarding systems. By the 1970s, timber in the upper drainages of Antelope, Lost, Deer, and Soda creeks had been accessed and logged.

Recreation

Recreation use increased greatly with the road-building of the post-war era. The proliferation of roads admitted more hunters throughout the canyons and high plateau. During the late 1940s and 1950s, the Forest Service built modest-sized but popular campgrounds along Big Elk Road. The Methodist Church acquired the special use permit at Dead Indian Soda Springs (changing the name to "Latgawa Camp" in the 1980s) and converted the site into a regional church camp. Fish Lake became quite popular as an angling and camping destination for local families. The Forest Service platted summer-home lots on the west end of the lake in about 1948, and a number of summer homes appeared in the 1950s to 1960s. The Forest Service enlarged the camping capacity on the north shore of the lake, the resort expanded, and winter uses such as snowmobiling and cross-country skiing drew more people to the high plateau during a time of the year when, previously, the area had been almost without any people.

Transportation

For the most part, watershed transportation development during the post-war period was an integral part of logging. The upper North Fork/South Fork "tie" road (present Forest Service road 2815) was built in the early to mid-1950s, as were the Daley Prairie loop (present road 3720), the first three miles of the road up Big Draw (road 2520), and the Little Elk Prairie route between Iron Spring Gulch and Deadwood Prairie (road 3710). Much of the rock used to surface the high plateau road system came from the Big Elk cinder pit, located about two miles southwest of Fish Lake. The BLM's Soda Creek Road was begun from the South Fork in about 1960 and reached the headwaters of Soda Creek by 1963.

Interties, spurs, and other tributary access routes proliferated during the 1970s. On the flat ground of the high plateau, tractor skid roads were extremely common. New recreation trail development during this period was restricted to the Pacific Crest National Scenic Trail (on the extreme eastern edge of the watershed) and a few shorter trails originating from Forest Service campgrounds at Fish Lake and Beaver Dam Creek. The recent BLM trail to the summit of Grizzly Peak (located on the southwestern edge of the watershed) became very popular with Ashland residents and others as soon as it was completed.

By far, the major transportation improvement in the watershed was construction of State Highway 140 up the North Fork Little Butte Creek and across the Cascades in the early 1960s. Billed as the "Winnemuca-to-the-Sea Highway" by the local chamber of commerce, it has become the main travel route between the Rogue River Valley and the Klamath Basin. The venerable wagon route of Dead Indian Road continues as an important commercial and recreational access road. (In response to opinions that the name of the road was offensive, the Jackson County portion was officially renamed "Dead Indian Memorial Road" in the 1990s; some people prefer to use the term "Indian Memorial Road" or "Indian Road.")

Landscape Condition

Douglas-fir and white fir have proliferated as "thickets" in many places. At lower elevations, areas of open grassland have shrunk as buckbrush, manzanita, and copses of white oak have expanded across the landscape. Sugar pine probably decreased significantly as a component of the mixed-conifer forest, due to a combination of selective logging for pine, white pine blister rust, and competition from fire-intolerant species.

Throughout the late nineteenth and early twentieth centuries, great fires swept periodically across the high plateau and the canyon slopes. Federal fire suppression efforts became truly effective after 1930; with increased road construction and air-tanker fire-fighting capability, very few fires grew beyond a few acres in size after 1960. Along with timber harvest, fire suppression efforts of the twentieth-century greatly changed the appearance of many forest stands in the watershed--particularly the more open pine-dominated areas of the canyons.

The period since World War II has witnessed steadily increasing resource use within the Little Butte Creek Watershed, particularly in the forests of the canyon section and high plateau.

Most of the extractive natural resources, particularly timber, were removed from the watershed for processing and use outside of the local area. By the 1980s to 1990s, declining populations of fish and nongame wildlife in the wider area had become the focus of regional and national attention. Much of the high plateau was included as a Late-Successional Reserve under the 1994 Northwest Forest Plan, and the North and South forks of Little Butte Creek were designated a Tier 1 Key watershed. On private lands in the lower valley/canyon section, residential construction has accelerated since 1970. New homes, ranging from modest mobile homes to large hilltop residences, dot the area. The hamlet of Lake Creek, with a restaurant and community hall to augment the store and grange hall, serves a growing "rural neighborhood," along with increasing numbers of visitors. The permanent human population of the upper valley/canyon is far larger than it ever was in the past.

EROSION PROCESSES

Historical erosion processes were very similar to current day processes, but total volumes of sediment produced and delivered to streams were somewhat less. The canyon sideslopes contained the most erodible terrain of the watershed. This landform generally has had, and continues to have, the steepest and most incised slopes of the watershed. Types of historical erosion have been mainly sheet, ravel and minor gully erosion. A large volume of sediment has been transported to area streams via sheet erosion and raveling of materials over long periods of time. This has produced steep slopes in the canyon sideslopes with broad valleys below in South Fork and Little Butte creeks.

The canyon sideslopes landform also contained the most unstable terrain of the watershed. Large earthflow landslides and smaller slumps and debris slides have continued over very long periods of time. Mass wasting helped shape today's topography; landslides are especially common in the upper portions of the South and North forks of Little Butte Creek and in Dead Indian Canyon. Slightly larger volumes of sediment and debris were produced from these processes than from surface erosion. A century ago there were fewer active landslides, because human activities were very minimal when compared to activities of the middle to late twentieth century.

The only other landform with considerable erosion activity over time is the alluvial bottom landform. This primarily occurred along the stream channels via stream bank erosion. Large channel erosion scars have occurred mainly along reaches of South Fork Little Butte Creek, and some smaller ones also occurred along Dead Indian, Little Butte and Antelope creeks. This type of erosion has continued for several million years in this area. Stream channels have been undermined by high flows during storm events and these processes continue to deepen and widen the valley. Larger stream bank failures would have been more common at a time when slopes were steeper near the streams in the upper valley areas. Active channel erosion was also a common feature during the past three large floods and caused numerous problems downstream. The streams changed their pattern and alignment, and damaged riparian vegetation. This process was responsible for transporting large woody material from channel sideslopes into streams. This movement of woody material and sediment caused large changes in the stream channel and subsequent stream bank erosion.

Slight to moderate amounts of erosion have occurred on the lava plateau. This landform is much younger than those mentioned above and, consequently, has not weathered and developed nearly as much. Moderate levels of sheet erosion and ravel have taken place where soils consist of clay, clay loam, and sandy loam. As a result of this erosion, and being less developed, top soils are not very thick in few areas. Therefore, when soil is lost through erosion in these shallow soil locations, not much productive material remains for plants to grow.

Historically, the main natural agents capable of removing extensive soil cover in the watershed were wildfires and floods. Throughout the late nineteenth and early twentieth centuries, large wildfires occurred periodically in the watershed across the lava plateau and the canyon slopes (see Human Uses). These large wildfire occurrences were often very detrimental to water quality and fisheries due to surface erosion and mass wasting that occurred for the following two or three years. The highest erosion rates occurred when there was a flood immediately following intense wildfires on erosive soils.

Due to fire suppression activities, topsoil loss has probably been reduced over the past 70 years since there have been fewer natural fires exposing soils. However, this situation sets up a higher risk that a hot burning wildfire might occur, causing severe soil erosion and landslide problems.

Slope instability and erosion processes have increased over time as a result of human influences in addition to the natural disturbances in the Little Butte Creek Watershed (see Current Conditions, Erosion Processes for human impacts).

SOIL PRODUCTIVITY

Historic soil productivity conditions were much the same as they are today in areas that have not had much human disturbance. Productivity in the watershed varies by elevation, aspect, topography and bedrock. On the lava plateau landform, soils were inherently deep with fine to moderate textures. Topsoils were mainly thick and soils had a high porosity. Soil organic matter, duff, litter, as well as large woody material were abundant on most sites. These soil properties, along with the mild summer temperatures at these elevations, created site conditions of high productivity in the historic past.

In the volcanic peak landform, where soils are shallow and rocky and where cinder deposits accumulate to depths of up to 10 feet, site productivity was very low. One of the primary reasons for this was the lack of adequate soil moisture holding capacity and lack of soil development, especially the development of a very thick topsoil. The parent material for many of these soils was very young, originating from volcanic activity that occurred in very recent geologic time. Drying winds and exposure to extreme cold temperatures was another major reason for the low site productivity.

The older soils of the canyon sideslopes landform were relatively productive on the north aspects where the soils were deep. Many of these areas were associated with old landslides. On south slopes, however, productivity was low due to high evapotranspiration demands. Many of the south slopes had shallow, rocky soils that dried out early in the spring. Many of these sites supported only dry meadows or oak woodland.

LANDSCAPE VEGETATION PATTERN

The vegetation native to the watershed is a result of time and the unique geology of the area. Over the last 60 million years, vegetation has migrated into this area from six different directions: the Oregon and California coast ranges via the Siskiyou Mountains (red alder, Pacific madrone and bigleaf maple); the Sierras and Cascades (baneberry, Shasta red fir, sugar pine, manzanita spp. and California black oak); the Klamath River corridor, and lowland chaparral area (juniper and mountain mahogany) (Atzet 1994).

Natural change in landscape pattern is inherent; natural succession is continuously changing the vegetation and there is no single stage of a forest that can be considered to be the only natural stage. Leiberg (1900) wrote that previous to 1855, the Native Americans were responsible for frequent, small circumscribed fires which resulted in forest stands with diverse age classes. Leiberg also notes that the Indians were responsible for some intense, large fires between 4,000 and 5,000 acres in size (T.37S., R.5E. and a similar tract in T.36S., R.5E.). Therefore, the Native Americans created forest stands with various patch sizes.

After Euro-Americans arrived, the forest stands probably became more open (fewer vegetation stems on a unit of size basis) and the forest patch size probably increased because of logging and the more frequent use of fire for various reasons. Because of the frequent disturbance there was more vegetation in the early and mid seral stages of development. Mature and old-growth fire resistant trees species, such as pine species, Douglas-fir, and incense cedar with thick bark survived the fires.

According to the 1947 forest type map created by the Pacific Northwest Forest and Range Experiment Station, USDA, the forests within the watershed were predominantly composed of pine and pine mixtures. The northern half was mapped as widely scattered ponderosa pine on rocky, low productivity sites. There were larger expanses of oak woodlands and grasslands scattered across the landscape as well. In the lowlands of the western portion of the watershed, larger patch sizes of grassland and oak-madrone woodland were present. The higher elevations to the east and south were composed of large patches of large diameter Douglas-fir and white fir.

Fire was the primary biotic process influencing the vegetation landscape pattern. Dense patches of trees were probably subject to bark beetle attack when high stocking levels were present. Pathogens were probably less noticeable because of a higher diversity of species making up the forest stands.

PLANT SPECIES AND HABITATS

Non-Native Plant Species and Noxious Weeds

A list of historically introduced plant species that commonly occur on rangelands within the Little Butte Creek Watershed appears in Appendix D. Little is known about the points of origin and distribution of these plants, a few of which are designated noxious weeds by the Oregon Department of Agriculture. Logical speculation favors assumptions that these weeds, as well as less pernicious species, were intentionally brought in by settlers for inclusion in gardens and then escaped, or were carried into the watershed by animals or transport conveyances in early days as is known to be typical today. Long established non-native plant species in the watershed include: cheatgrass, ripgut, medusa, dogtail, bulbous bluegrass, Klamath weed, yellow starthistle, spotted knapweed, and many landscape and horticulture escapees such as scotch broom.

Herbaceous vegetation layers at all elevations in all habitats were composed of native plants. Herbaceous vegetation layers at lower elevations stayed greener later in the summer and probably produced less yearly flashy fuels. This presumably helped to keep wildfires at lower intensities. Native plant species diversity was higher in open areas at lower elevations. Pioneer native plant species colonized disturbed areas more readily than non-natives species. Biological diversity was higher along lower elevation stream corridors where non-native blackberries now predominate. Movement of terrestrial wildlife in these areas was not restricted by blackberries.

Rare Vascular Plants

Historic and prehistoric population levels, distribution, and habitat conditions for most rare vascular plants within the Little Butte Creek Watershed cannot be estimated with any certainty. Reference conditions can be inferred in a few cases and are described below only for a few species at risk of extirpation from the watershed.

***Allium campanulatum* (Sierra onion)**: Habitat is typically primary or secondary range, the plant is palatable to livestock, and livestock have used these meadows for a very long time. Plant species composition has changed dramatically in moist meadow habitat. It is likely that this species was once more abundant in this watershed.

***Cypripedium fasciculatum* (clustered lady's slipper orchid) and *Cypripedium montanum* (mountain lady's slipper) (orchids)**: Based on herbarium collections and observations of long-time residents, it is generally accepted that the mountain lady's slipper was once much more abundant in western Oregon. The clustered lady's slipper has probably always been uncommon. However, based on the number of herbarium collections at sites where plants no longer exist, it is thought that this species has also declined in abundance. Lower elevation late-successional forest was probably the best habitat for both of these orchids and very little of this is left in an undisturbed condition. Long term effects of fire exclusion on populations and habitat are unknown. These orchids do not survive high intensity stand replacement fire.

***Limnanthes flocossa ssp. grandiflora* (large-flowered woolly meadow-foam):** Populations were undoubtedly more abundant in the past. Conversion of the mounded prairie/vernal pool habitat to industrial, residential, and agricultural uses has eliminated much suitable habitat in the watershed and throughout this plant's range in the Agate Desert area.

***Microseris laciniata ssp. detlingii* (Detling's microseris):** This species was probably more abundant in pine/oak savannah before non-native species came to dominate the herbaceous vegetation in these areas, and before fire exclusion allowed much of this habitat to become overtaken by brush and young forest.

Survey and Manage Species, and Protection Buffer Plant Species and Habitats

Bryophytes, Lichens, Fungi, and Vascular Plants

Except for the lady's slipper orchids discussed above, no reference condition information about these survey and manage organisms is available for the Little Butte Creek Watershed. Reference condition information occasionally available from other parts of these species range may or may not be applicable to this watershed.

Special Areas with Botanical Resources

Irene Hollenbeck Environmental Education Area (BLM): Native grass and sedge cover was probably greater in the past. Non-native annual grasses were not present. Decreaser species (which decrease in abundance under long-term grazing) were probably more abundant and perhaps dominant in parts of the area. Soils were probably not as pocked and compacted. The general openness of the habitat and the presence of spring wildflower displays has probably not changed.

Lost Lake Research Natural Area (BLM): The lakeshore was probably less disturbed before heavy recreation use began late this century. Wildfires were more frequent in the past. Otherwise, reference conditions may have been similar to current conditions.

Roundtop Research Natural Area (BLM) and Roundtop Preserve (The Nature Conservancy): Frequent low intensity fires probably maintained an open oak/pine woodland in much of the area in the past. The moist meadow areas probably had higher cover of native grasses and sedges. Non-native annual grasses were not present.

Noteworthy Habitats Containing Unusual Plant Communities and Species not Found in the Majority of the Watershed

Mounded prairie/vernal pool areas around Lake Creek and on the valley floor: The mounds and better drained areas were dominated by native grasses and forbs instead of the current annual exotic grasses. The wetter and shallower areas probably had more rushes and sedges, and native wetland grasses, along with the native vernal pool forbs. There was perhaps twice as much of this habitat before so much was leveled for agricultural, industrial, and residential development.

Remnant oak/pine savannah on the valley floor and lower foothills: Open canopies of widely spaced mature trees with native grassland beneath were once common. Frequent low intensity wildfires maintained this condition and a variety of other more open habitats.

Scablands with shallow soils over basalt/andesite: Native perennial grasses occupied much of what is now dominated by annual exotic grasses. The native forb composition may not have been much different from the present day.

Basalt/andesite cliffs and outcrops: Conditions were probably similar to current conditions.

Moist mountain meadows: Native grasses and sedges dominated many of these meadows. Where native forbs dominated, the ratio of species likely was different than at present; in addition, willows were often more dominant. Some meadows would have been considerably wetter or wetter later in the summer than they are now. Decreaser species were more common and sometimes dominant in moist mountain meadows.

Western white pine: This tree was a major co-dominant of forest stands on the Dead Indian Plateau, as well as more prevalent in almost all habitats at higher elevations before blister rust was introduced and before competition was increased due to fire exclusion.

Engelmann spruce stands: Conditions were not significantly different than current conditions. There was probably somewhat more acreage in the past (assuming some of the riparian habitat was logged at one time at these higher elevations).

Quaking aspen stands: Long-term livestock grazing has occurred in most aspen stands in this watershed. Also, presumably beavers were once more plentiful than they are now. Both these variables may have affected population numbers and habitat to some unknown degree. However, there is no information that allows the description of reference conditions in comparison to current conditions.

One or more bogs in the upper reaches of the watershed: It is not known how many of these areas existed in the past nor how they differed from today. The one known bog, on a tributary of South Fork Little Butte Creek, may have been altered to a small degree by road construction and livestock grazing.

Subalpine and alpine communities on the south side of Mount McLoughlin and possibly at the summit of Brown Mountain: Reference conditions are not likely to be much different than current conditions except western white pine was a more prominent member of these communities.

FOREST DENSITY AND VIGOR

Core samples from ponderosa pine and Douglas-fir between the ages of 146 and 322 years indicate that these present day, large diameter trees were free to grow when they first became established (USDI 1996). This indicates low stocking levels or more open growing conditions. Sample trees grew 3 to 4 inches per decade in diameter and gradually decreased to 1.5 inches per decade in diameter over a period of 30 to 100 years. None of the sample trees were suppressed at the time of establishment. Diameter growth has been decreasing below 1.5 inches per decade since 1947 or before. This data matches diameter growth data in the adjacent Jenny Creek Watershed. Forest stand growth started to decline during the same time period.

Historical information is somewhat misleading in regard to actual tree stocking levels early in the 1900s. Although forest mapping indicated that there were few large trees on a per acre basis, natural regeneration was abundant. There were thousands of seedlings per acre. One stand in T.35S., R.2E., Section 31 that is approximately 110 years of age still has 545 trees per acre and is at the maximum stocking level for Douglas-fir. A 113-year-old stand in T.37S., R.2E., Section 17 still has 1,321 trees per acre and is also at maximum stocking.

As tree growth and vigor declined late in the 1940s, bark beetles probably started to become an important factor in changing the height and size class structure of the forests. The western pine bark beetle caused mortality in the large diameter ponderosa pine, the mountain pine beetle in patches of small diameter pine species, and the Douglas-fir bark beetle in suppressed Douglas-fir trees. Pathogens (root rot diseases) probably became more apparent as more even-aged stands became established and matured.

FIRE

The historical fire regime of this watershed was characterized by frequent (1 to 25 years) and widespread fires resulting from the hot, dry summers. Accounts documented by early settlers of Oregon indicate that wildfires were common, widespread, and produced substantial amounts of smoke which impacted visibility and the health of local residents (Morris 1934). These periodic fires consumed understory and ground fuels thus leaving a large gap between the overstory and ground. This in turn reduced the probability of a crown fire. Typically, fire intensity was low because frequent fires limited the time for fuel accumulation. Consequently, the effects of individual fires on flora, fuels, and fauna were minor, creating a more stable ecosystem.

Fires maintained most valley bottomlands and foothills as grasslands or open savannas. Forests created from frequent, low intensity fires have been described as open and parklike, uneven-aged stands characterized by a mosaic of even-aged groups. Ponderosa pine, Douglas-fir, sugar pine, and white fir were the most common species. Depending on understory vegetation conditions, these species have some resistance to fire as mature trees. As saplings, ponderosa pine is the most resistant followed by sugar pine, Douglas-fir, and white fir. Frequent fires had major structural effects on young trees favoring ponderosa pine as a dominant species and white fir as the least dominant in this forest type. Without fire, Douglas-fir and white fir became the dominant species because these species are more tolerant of understory competition than the pine species.

TERRESTRIAL WILDLIFE SPECIES AND HABITATS

Wildlife - General

Historical habitat conditions and relative wildlife abundance in the watershed prior to and in the beginning of the historic period (early 1800s) are difficult to precisely determine. The Human Uses section provides insight as to what the general habitat condition might have been.

The first human influence in the area is believed to have occurred approximately 11,000 years ago as described in Human Uses. These early people likely hunted mammoth, giant bison, and other extinct mammals of the period.

Prior to Euro-American contact, Native Americans influenced habitat conditions throughout most of the watershed. The natives routinely burned areas to maintain conditions suitable for the plants and animals they relied upon for their subsistence, including roots, hazelnuts, huckleberry, deer, and elk. The native burning maintained an early seral condition, grasses and low shrubs, open California black oak and sugar/ponderosa pine woodlands, moist mountain meadows, and the growth of serviceberry and huckleberry in the fir stands of the higher plateau. As a result of these habitats, deer, elk, and pronghorn were probably in the valley floor and canyon reaches, while bighorn sheep were in the South Fork Little Butte Creek Canyon. Grizzly bear, gray wolf, and other carnivores were likely found from the valley floor up and into the plateau. Healthy populations of beaver and river otter were probably found from the headwaters of the plateau throughout the watershed. During this period, beaver probably had a stabilizing influence on streams.

As described in the Human Uses section, some of the earliest Euro-Americans to explore the area were fur trappers of the Hudson's Bay Company. With their "trap out the streams" policy it is likely that a substantial decrease in beaver numbers occurred during the early to mid-1800s. This changed the "beaver-caused" streamflow characteristics and habitat associated with it well before the first actual Euro-American settlement began.

The lower to middle elevation stream courses were well vegetated with bigleaf maples, alder thickets and willow, while large black oak shaded from above the bank edges. It is likely that "galleries" of mature pine grew along many of these streams, creating habitat corridors that connected the hills surrounding the valleys. Many mixed-conifer stands of the canyon and high plateau sections were likely comparatively open, with a higher proportion of mature ponderosa and sugar pine than at present (see Human Uses).

Although it is impossible to ascertain acres of reference vegetation it is highly likely that the amount of mature/old growth has decreased drastically with the loss of valley pine galleries, canyon pockets, and higher elevation mixed conifer stands through agricultural pursuit, human habitation and logging.

Most species currently present in the watershed were likely present in the early to mid-1800s, with the exception of some introduced species such as starling and Virginia opossum. Some species that were present then and have now been extirpated include the bighorn sheep, pronghorn, grizzly bear, and gray wolf. The bighorn sheep of the upper canyon reaches, especially South Fork Little Butte Creek, and the pronghorn of the valley floor have both been extirpated due to human influences. The desire for meat was the primary demise of the bighorn along with diseases from domestic stock. However, of the large predators that once roamed freely, only the cougar, the coyote, and the black bear (although often considered a more opportunistic omnivore) remain. The Klamath Grizzly and the gray wolf were both extirpated from the area. As the area became more populated by people, the ability for these species to function in their historic roles decreased and were eventually lost from the watershed.

Threatened/Endangered Species

The gray wolf (*Canis lupus)* is listed as endangered in Oregon, but is considered extirpated in the state. The last bounty collected in Oregon for confirmed wolves was in 1946 on the Umpqua National Forest (Marshall et al. 1996). The last confirmed sighting of a wolf near the watershed was to the east near the town of Fort Klamath in 1927 (Ingles 1965). Wolf sightings continue throughout the Cascades and eastern Oregon. Several unconfirmed anecdotal references have come from the watershed over the past 50 years. The last confirmed wolf was in Baker County, Oregon near the town of Huntington in 1974. Most sightings are unable to be confirmed, however, it is possible that individual wolves may wander into Oregon from Idaho (Marshall et al. 1996).

The grizzly bear (*Ursus arctos*) is listed as threatened for the State of Oregon, but is considered extirpated throughout its historical range in the state. The Klamath grizzly (*Ursus arctos Klamathensis*) was found throughout the Cascade Mountains and western Oregon. The Forest Service reported the last known bear in 1933 on the Willamette River (Ingles 1965; Marshall et al. 1996).

Two threatened species, the northern spotted owl and the bald eagle, and one endangered species, the peregrine falcon, are found in the watershed and are presumed to have been present in the early to mid-1800s. Although the presence of these three birds could not be confirmed, habitat conditions at that time would indicate their presence.

The abundance of mature/old-growth habitat indicates spotted owls were present, and possibly in greater numbers, since the total amount of habitat would have been greater and habitat fragmentation was less. The presence of the small natural lake where Fish Lake is now located along with the proximity to Lake of the Woods, Klamath Lake, and the Rogue River, and an abundant supply of fish in these waters would indicate that bald eagles likely used the watershed at least for foraging. The rocks that currently provide nesting habitat for peregrine falcons were present in the pre-1800s and pesticides were not; therefore, the probability of peregrine falcons in this area historically is quite high.

Northern Spotted Owl Critical Habitat

Although it is highly likely that northern spotted owl habitat was in greater abundance prior to the early to mid-1800s, reference conditions for northern spotted owl critical habitat will be addressed on the basis for its designation in 1992 since critical habitat did not exist in the early to mid-1800s. Critical habitat is designated under the auspices of the Endangered Species Act of 1973. The designated critical habitat in the watershed was established to provide for nesting, roosting, and foraging habitat in an area of high habitat fragmentation (USDI 1994) and to help in providing a habitat link between the Cascade and Siskiyou Mountains.

Special Status Species

Based on the habitat associations assumed to be present in the watershed in the early to mid-1800s, all currently designated special status species were likely present at that time (see Current Conditions, Terrestrial Wildlife Species and Habitats). However, most of the threats associated with their current status were generally of no consequence prior to Euro-American presence. Without these threats, populations of the various species were probably greater and more stable.

Survey and Manage Species and Protection Buffer Species

As with the special status species, it can be assumed that the survey and manage species known to exist here, the bats and the great gray owls, were present in the watershed when Euro-Americans arrived. Currently the red tree vole has not been confirmed in the watershed. However, if confirmation is made, it can be inferred that the species was present prior to the 1800s. All of these species appear to be positively associated with mature/old-growth conifer forest; since threats to the species were minimal, populations were probably greater than today and more stable.

HYDROLOGY

Prior to the introduction of irrigation in the Little Butte Creek Watershed, summer streamflows were directly related to the amount and timing of precipitation events. Years of high rainfall and large spring snow packs resulted in summer flows that provided adequate water supplies for aquatic dependent species. Drought years produced low flows and likely there were some dry stream channels by the end of the summer. Irrigation withdrawals that began in the late 1800s and became more extensive in the early 1900s greatly reduced summer streamflows throughout the watershed. Historic low flows in the Little Butte Creek Watershed were associated with years of low precipitation. Drought conditions for southwestern Oregon were noted in 1841, 1864, 1869-1874, 1882-1885, 1889, 1892, 1902, 1905, 1910, 1914-1917, 1928-1935, 1946-1947, 1949, 1959, 1967-1968, 1985-1988, 1990-1992, and 1994 (LaLande 1995; NOAA 1996).

Historically, major flood events were generally the result of rain-on-snow events. The most severe floods in southwestern Oregon took place in 1853, 1861, 1890, 1927, 1948, 1955, 1964, and 1974 (LaLande 1995). Extreme flows recorded at several gaging stations in the watershed occurred on December 2, 1962 for South Fork Little Butte Creek, December 22, 1964 for North Fork Little Butte Creek, and December 30, 1924 for the station near the mouth of Little Butte Creek (records for this site were only kept sporadically from 1908 to 1950). The completion of Fish Lake dam in 1915 modified the winter streamflow regime in North Fork Little Butte Creek. Fish Lake stored the winter runoff and moderated the peak flows occurring downstream in North Fork Little Butte Creek.

STREAM CHANNEL

Prior to Euro-American influences, headwater streams in the Little Butte Creek Watershed likely had adequate amounts of large woody material to provide channel structure and dissipate the energy of peak flows. Streams in the valley bottoms probably had greater sinuosities, side channels, some braiding, lower width/depth ratios, an ample amount of large woody material, and easily accessed their floodplains without any constricting berms or roads adjacent to the channels. Floodplain and meander widths were much greater and there were likely multiple channels in the valley bottoms. Beavers present in the Little Butte Creek Watershed prior to the advent of fur-trappers (around 1830) built dams that added woody material to streams, trapped and stored fine sediments, and reduced water velocities.

The advent of Euro-Americans in Little Butte Creek Watershed began a dramatic change in channel morphology that has continued to the present time. Activities such as fur trapping, grazing, conversion of riparian zones to agricultural pastures, stream channelization, logging, and road building were the major human-caused disturbances that affected the stream channels.

Fur trapping in the 1830s to 1840s resulted in a substantial decrease in the beaver population and the associated loss of beaver dams. The loss of beaver dams likely resulted in scouring of channel beds and banks, increased width/depth ratios, and fine sediment deposition in pools.

Large numbers of cattle and sheep were introduced in the watershed in the mid-1800s and continued until the early 1900s. They tended to concentrate along stream courses and likely caused stream bank deterioration as they moved in and out of channels. Over time, this could have contributed to the development of wider and shallower channels. Historic livestock concentrations in meadow areas could have increased the soil compaction, reduced infiltration rates, and lowered the water table possibly causing lower summer base flows in nearby channels.

Logging and land clearing for agricultural use resulted in the removal of large woody material from stream channels in addition to removal of stream-adjacent trees. This depleted the existing large wood and future large wood recruitment sources. Floods became more destructive without sufficient instream structure to slow the high stream energy. As more streambank erosion occurred, the channels widened, and as the streams downcut, the channels became entrenched.

Roads were constructed adjacent to streams and many streams were channelized or straightened during the early to mid-1900s. These actions confined the channels, which restricted the natural tendency of streams to move laterally. Channelization of the main stems occurred to prevent the loss of agricultural lands to flood damage. The low gradient, valley bottom streams became entrenched and were not able to access the adjacent floodplain except during major peak flow events. Channel width/depth ratios increased and sinuosities were lowered as stream gradients increased. Stream velocity decreased along with a decrease in bedload transport capability which lead to increased sediment deposition.

Less sediment was available to the stream system prior to ground-disturbing activities such as road building, logging, land clearing, agriculture, and unmanaged livestock grazing. Prior to Euro-American settlement, sediment primarily originated from naturally occurring mass movement and surface erosion that occurred after an intensive wildfire and/or a flood event. Less sediment was transported out of the stream system and deposition was greater because large woody material was more prevalent historically. The large wood was capable of trapping and storing more sediment. As ground-disturbing activities increased in the 1900s, more sediment became available to the stream system. The amount of sediment in the stream exceeded the stream's capability to transport it downstream and resulted in filling pools and degrading aquatic habitat.

WATER QUALITY

Water quality in the Little Butte Creek Watershed was probably very good prior to Euro-American settlement: low summer water temperatures, acceptable chemical and biological parameters, and low sediment/turbidity levels. This was due to the wide, diverse riparian zones, low width/depth ratios, greater summer flows, and low sediment input.

Land clearing activities in the late 1800s and early 1900s resulted in a reduction of riparian vegetation allowing more solar radiation to reach the streams. Increased water temperatures were likely a result of this activity. Irrigation withdrawals during this same time period lowered streamflows and contributed to increased stream temperatures. Logging in the mid-1900s contributed to increased water temperatures as trees within the riparian zones were harvested. Logging also resulted in less large woody material in the stream channels. Loss of large wood and stream channelization resulted in greater width/depth ratios. Wide, shallow streams tend to have higher stream temperatures.

Ground-disturbing activities such as road building, logging, land clearing, agriculture, and unmanaged livestock grazing contributed sediment to streams. Sediment and turbidity levels increased substantially after extensive logging and associated road building occurred, especially on steep slopes.

Unmanaged livestock concentrations adjacent to and in streams likely resulted in increased fecal coliform levels.

RIPARIAN AREAS

Based on the present day species composition and age classes of the riparian area vegetation, assumptions can be made as to the historical condition of the riparian areas of the 1800s. Within the Interior Valley and Mixed Conifer zones (Franklin and Dyrness 1973), the historical ephemeral and intermittent stream riparian areas had fewer trees per acre and were composed of early seral, drought-tolerant tree species. Ponderosa pine, incense cedar, and oak species were more prevalent, but Douglas-fir was always a stand component. Because of frequent fires, a variety of tree age classes were scattered about in small patches, thus providing diverse vertical stand structure. The oak woodland and shrubland riparian areas were also less dense and composed of early seral stage vegetation.

The higher order intermittent and emphemeral streams had to be more open, also with fewer trees per acre. The species composition along these lower elevation streams was predominantly coniferous species. Fires created openings in these riparian areas allowing ponderosa pine to become established. Hardwoods such as red alder, bigleaf maple, black oak, and Oregon ash were always present but in fewer numbers. After the early historic settlers harvested the open pine stands in the riparian zones, these hardwood species may have become more abundant. Even-aged patches of trees provided a variable structure. As the fire frequency decreased, other disturbances occurred on a smaller scale, and vegetation quickly established in unoccupied openings. Conifers eventually overtopped many of the hardwoods, but many bigleaf maple on the edge of the stream bank still maintain a codominant position in the tree canopy layer today.

The combination of homesteading, unmanaged cattle grazing, logging, road construction, and the loss of beaver from both forks of Little Butte Creek resulted in a change of riparian vegetation over time. Historically, the upper reaches of both forks had patches of old-growth Douglas-fir as well as patches of old-growth ponderosa pine (such patches still existed in 1947 according to a USDA Forest Type Map for Jackson County). In the Douglas-fir stands, red alder and bigleaf maple were probably a minor component. On the lower reaches of the North and South forks of Little Butte Creek, stands of red alder, willow species, and bigleaf maple probably dominated the riparian areas.

Below the confluence of the two forks, where the floodplain is much wider, the pattern of the vegetation was different. Historically, the creek probably contained large accumulations of woody material that created a complex aquatic environment. Channel constrictions caused frequent floodplain flooding and a complex network of channels. Beavers probably managed to dam some of the smaller channels and create swampy areas. In these wide floodplains, there were probably patches of even-aged black cottonwood, red alder, and willow species. Frequent flooding and landslide events would damage trees in these patches causing them to resprout and new niches would be created for seed. Over time, a variety of age classes became established and a diverse vertical stand structure developed. Where the water table was not as high, ponderosa pine was probably the dominant conifer, along with scattered groves of black oak trees. Shrub species that occupied the riparian sites were the same as today (snowberry, serviceberry, creambrush oceanspray, ribes species, and Indian plum).

Historic riparian areas of the White Fir Zone were probably more open due to fire and varied in species composition and stand structure. More Douglas-fir, ponderosa pine, sugar pine, and incense cedar were in these stands because of the fire disturbance. The patches created by fire helped to create diverse stand structure. Common riparian shrub species included Pacific yew, creambrush oceanspray, California hazel, greenleaf manzanita, dwarf Oregon grape, ribes species, snowberry, snowbrush ceanothus, and Oregon boxwood.

Historically, fires were probably more of an influence than at present in the Shasta Fir and Mountain Hemlock zones. Fire was possibly of less frequency yet greater in intensity than in the lower elevation riparian zones. As in the White Fir Zone, this would result in a variable forest stand structure. Landslides or debris flows in this area would create new habitats for the early seral pine species thus making these species more prevalent than today. Smaller, more uniform patches of Shasta red fir may have existed than what we see today. Mountain hemlock, noble fir, and subalpine fir were the higher elevation stand components. Common shrub species in the riparian areas would have included Pacific yew, huckleberry species, creeping snowberry, pinemat manzanita, and snowbrush ceanothus.

AQUATIC WILDLIFE SPECIES AND HABITATS

Stream Habitat

Historically, riparian areas were comprised of diverse, mature, conifer and conifer-hardwood forests in upper Type 1 reach and Type 2 to 4 reaches. Large wood material (tree lengths greater than fifty feet in length) was generally abundant in the stream channel. Complex aquatic habitat types existed in many locations. Spawning habitat was excellent due to wood complexes and habitat complexity. Biological productivity was high with wood loading in streams and salmon carcasses supplying important nutrients from the Pacific Ocean. Sediment delivery to streams occurred as a result of natural landslides and erosion. Streams were in a more stable condition and able to adjust to fluctuations in stream flow and sediment loads with floodplain connectivity and building of bars and terraces.

Historically, low gradient, alluvial valleys and alluviated canyon segments (Type 1 and 2 reaches) provided good quality habitat for juvenile chinook, chum and coho salmon, steelhead, rainbow, and cutthroat trout, and other native fish and aquatic species. Beaver were an important part of the aquatic ecosystem. Stream channels in these low-gradient segments were connected to floodplains with numerous side channels, willow and cottonwood sloughs and beaver marshes. Such complex, sinuous stream habitat created optimum salmonid habitat: deep pools with lots of overhead cover capable of rearing large adult trout and high densities of juvenile salmon and steelhead trout. Side channels also provided crucial winter habitat for juvenile coho salmon. Marshes and beaver dams also trapped nutrients and increased valley water storage. During the summer months, cool water from marshes dispersed slowly into the stream channel. Water temperatures stayed moderate with less fluctuation, favorable for year-round growth.

The steep canyon areas in Antelope, South and North forks of Little Butte Creek (Type 3 reach) contained quality pocket pools with an abundance of large wood and boulders. Streams on the Dead Indian Plateau (Type 4 reach) were deep, narrow, low gradient, cool streams with an abundance of beaver dams.

Human activities changed instream and riparian habitat as early as the mid-1800s when fur trappers arrived. Trappers eliminated the beaver population in the alluvial valleys and canyons, which began the breakdown of stream channels. Later settlers arrived and began to settle the fertile floodplains. Floodplains in alluvial valley reaches contained productive soils. These areas were exploited early for agriculture and timber. The exploitation of these resources was detrimental to fish habitat. Road building, stream cleanout, and channel manipulation to drain hyporheic zones created a wide, shallow singular channel. This channel widening increased instream solar radiation, causing water temperatures to increase significantly during the summer months. By the turn of the century, a complex irrigation system was in place. Irrigation ditches were rarely screened. Historic records indicate that thousands of steelhead fry perished each year in these ditches. Some ditches are still unscreened today. In the past few years, the Little Butte Creek Watershed Council has focused on creating fish screens across these ditches.

Activities such as commercial timber harvest and road construction within riparian zones, instream wood removal, channel straightening, and rural residential development greatly simplified aquatic habitat. Few legacies of stream conditions remain today that allow us to assess how these actions have altered the channel morphology and riparian zones from their historic condition (South Fork Type 3 reach). Overall, the interrelated aquatic and riparian habitats in Little Butte Creek and its major tributaries are in poor condition and well below their potential for producing diverse ages and sizes of salmonids and other native fishes.

Species

Historically, anadromous fish populations flourished in the Rogue Basin (Map 26). There was an abundance of chinook salmon, coho salmon, winter and summer steelhead trout and Pacific lamprey, which were well distributed throughout streams in the Little Butte Creek Watershed (Map 27). Resident fishes (rainbow and cutthroat trout, sculpin, Klamath smallscale suckers) and amphibians flourished (Map 28). Macroinvertebrate species were mostly cold water taxa intolerant of warm stream temperatures, frequent channel changes, and excessive fine sediment.

Estimates of historic runs for Oregon coastal salmon south of the Columbia River and north of California range up to 1.6 million adults in the early 1900s, but in the last decade, the run may have declined to below 100,000 adults. The Rogue and South Coast system may have represented between 5 and 10 percent of west coast total salmon production.

Throughout the last half of this century, the Rogue Basin fishery has probably functioned on the lower edge of the threshold of survivability. Actual levels of natural production in southwestern Oregon are difficult to estimate. In the 1890s, the Rogue Basin supported an estimated 60,000 native coho, based upon estimates projected from cannery shipments. Between 1899 and 1936, upper Rogue wild coho production was greatly overshadowed by privately- operated hatcheries, which produced between 64,000 to 5,242,000 fingerlings/year. Thus, there is no reliable or accurate estimate of wild coho production for this period (RVCOG 1997). The best data on the historical native coho population in the Rogue Basin during this century is from the period between 1936 to 1976. During this period, natural production ranged from a high of 10,000 natives to a low of 200 adults/year. The production trend line for this period is clearly declining, reaching fewer than 500 adults/year between 1964 and 1978. Little Butte Creek is estimated to spawn and rear 10 percent of the Rogue River Basin native coho salmon population.

Lake Species & Habitat

Fish Lake was a shallow lake/wetland with a low population of rainbow and cutthroat trout. Agate Lake, Yankee Reservoir, and other ponds in the watershed were nonexistent or smaller catchments. Lost Lake was formed by a natural landslide and probably contained cutthroat trout.

SYNTHESIS AND INTERPRETATION

The purpose of the Synthesis and Interpretation section is to compare current and reference conditions of specific ecosystem elements and to explain significant differences, similarities, or trends and their causes.

HUMAN USES

History

Two radically different patterns have characterized land use in the Little Butte Creek Watershed. For thousands of years, indigenous people followed a hunting-fishing-gathering way of life, based on a small-scale, subsistence-oriented economy. Approximately 150 years ago, the advent of Euro-American settlement brought fundamentally different land use patterns based on complex technologies, agriculture, and an economic system connected to global markets.

Prior to this change, native people managed the land by working with natural processes, such as fire, to enhance a broad spectrum of resources important to them. Indigenous technologies combined the use of simple tools with a sophisticated understanding of the landscape to promote habitat for game animals and abundant vegetable products needed for food and materials.

This pattern of resource enhancement gave way to patterns of resource extraction, beginning with the actions of the first fur trappers in the early nineteenth century. Following the removal of native people in the 1850s, the Little Butte Creek Watershed became home to settlers who brought with them increasingly powerful technologies, as well as attitudes that promoted the transformation of the native environment through a wide variety of actions.

Although a small-scale agricultural economy generally characterized the watershed in the late nineteenth century, the twentieth century has seen increasing integration of the watershed with national and global markets. The advent of the railroad in the late nineteenth century opened the watershed to the wider region. Subsequent improvements in local transportation have brought all parts of the watershed into increased economic production. These changes have perhaps been most effective in bringing the upper regions of the watershed into the logging economy.

Major Changes

The last 150 years have contributed to substantial changes in the landscape of the watershed. In the nineteenth century, newcomers cleared land for ranches and for fuelwood; introduced a host of new plant (agricultural crops and weeds) and animal (farm and ranch animals) species; plowed under native meadows for farms; dammed, diverted, and channelized streams; and hunted unwanted predators (grizzly bears and wolves) and other species (antelope and bighorn sheep) to local extinction. In the twentieth century, logging has expanded with the post-World War II explosion of roads and improvements in transportation; fire suppression has affected the local vegetation; and a host of state, federal, and local policies guide human operations on both public and private lands.

The effects of these actions are written on the land: the hydrology of the watershed has been altered through irrigation, water withdrawals, dams, roads, channelization, and other actions; erosion is more severe in some places than in the past; soil productivity has been affected in some areas by compaction, hot fires, and changes in vegetation patterns; vegetation patterns are altered through agriculture, fire suppression, grazing, and other actions; topography has changed in places through the construction of quarries and roads, and stream alterations; and native species (plants and animals) have disappeared or become reduced through a number of human actions or through competition with non-native species.

Roads contribute the greatest amount of sediment to streams in the watershed. Roads located in unstable areas and adjacent to streams, as well as those with inadequate drainage control and maintenance and no surfacing are most likely to cause sedimentation of stream habitats. Stream-adjacent roads confine the channel and restrict the natural tendency of streams to move laterally. Roads crossing through riparian areas have fragmented riparian habitat connectivity. Some culverts impede or prevent fish passage.

Forest roads diminish soil productivity simply by taking the area they occupy out of production. This, traditionally, has been viewed as "the cost of doing business." There is no natural occurrence that can be compared to road construction. A maintained road surface is out of production as long as it is maintained. Vegetation may fill in the road surface when maintenance is stopped, but the growth rate is far less than for undisturbed soil. Four miles of road per square mile is roughly equivalent to 10 acres per square mile that is taken out of production.

Roads affect wildlife in two primary ways: habitat removal and altered behavioral patterns. Construction of roads inevitably removes habitat for various wildlife species. Vehicles using roads disturb wildlife and change behavioral patterns. Habitat within varying distances of roads is not used to the extent it would be if the roads were not present. This may have a far greater impact on wildlife than the immediate loss of habitat. There is little disturbance to wildlife from roads that are totally closed to vehicles.

Trends

Regarding the future, local demographic trends indicate continued population growth within the watershed. Ranching and logging will probably remain important economic pursuits, although recreational use may grow significantly. Issues regarding water rights will continue to be important, as will the related issue of fish habitat and endangered fish species. The advent of ecosystem management suggests a shift from an extractive perspective to one combining economic concerns with stewardship practices. Given the high percentage of watershed land under federal management, federal land management policies will continue to have a significant effect in the watershed.

Similarities Between Native/Historic

Past and present human actions have also benefitted the natural ecosystems. Regular burning by native people maintained healthy prairies, shrublands, the oak/pine savannahs, and upland meadows. Restoration efforts by modern people and current regulations have helped promote healthier streams as well as plant and animal communities. Community efforts at outreach and education are developing better understanding and coordination among community and governmental groups and agencies regarding the health of the land.

Policy Implementation

The twentieth century has also witnessed the advent of federal land management policies that affect a large proportion of the watershed's lands. Fire suppression policies have operated with timber harvest to change the character of the forests in the watershed, and numerous laws and regulations now guide human actions on these federal lands.

EROSION PROCESSES

Natural erosion process effects have been altered and/or accelerated by human management and activities such as road building, timber harvest, grazing, wildfire, and prescribed burning.

Major storms such as the 1964, 1974, and 1997 rain-on-snow events caused both natural and management related slides to transport sediment to nearby streams. Several earthflow and debris flows were reactivated mainly in the canyon sideslopes landform and several new slides also occurred in this steep terrain. Active channel erosion was a major contributor to stream channel changes, damages to homes, and access roads. It also caused three bridges in the eastern half of the watershed to be damaged or lost during these storms.

Roads near streams were washed-out and/or slid into the creeks during these major storms. Several of these roads were in or near the riparian zones in South Fork and Dead Indian creeks. Large portions of the roads near the confluence of Dead Indian and South Fork Little Butte creeks were damaged or totally lost during these storm events. County road 1000 had several areas where fill slopes failed or were washed-out by South Fork and the main branch of Little Butte Creek.

Surface erosion from road cutslopes, fill slopes and the road prism are common on the following roads in the Little Butte Creek Watershed: Forest Service roads 3730, 3730800, 3730590 and county road 1000 received some of the worst damages from the flood due to their proximity to the streams and in some cases inadequate drainage. Inadequate drainage is found especially on the lower portions of road 3730800. Culverts adding water into unstable areas is another problem at the Poole Hill Slide at mile post 0.25 to 0.3 of the 3730800 road.

Road density is another factor to consider when examining road effects and potential road closures or other restoration opportunities in the watershed. Generally, average road densities are moderate in the watershed, however, some areas have high road densities (Appendix F).

The increase in fuel loading due to fire suppression in the Little Butte Creek Watershed has increased the potential for a high intensity wildfire. High intensity fires can burn off the duff layers that protect soils from erosive and gravitational forces. These fires may also cause soils to become hydrophobic (soils that do not allow penetration of rainfall and snow melt), which results in much less infiltration and a higher risk for soil erosion and topsoil loss. A high intensity wildfire in the lower half of the canyon sideslopes would increase the potential for the burned area to be more susceptible to landsliding and severe erosion for at least two to three years following a fire.

Where hot broadcast burns have occurred and were followed by intense rainstorms, some sheet erosion has occurred.

Concentrations of cattle and sheep along streams, ponds, and other wetlands may have contributed to a loss of vegetative cover and subsequent erosion in the lava plateau and upper edges of the canyon sideslopes. Erosion from grazing is the most severe near streams and on steep slopes.

SOIL PRODUCTIVITY

Natural levels of soil productivity have been reduced where ground-based logging has occurred on the relatively flat lava plateau landform. Tractor logged areas with designated skid roads have soil productivity losses ranging from 5 to 10 percent, while areas with unrestricted tractor logging have soil productivity losses near 20 percent. The majority of the soil on this landform is fine textured with a large amount of fine pore space and a lesser amount of medium pore space. Actions that further reduce the amount of medium pore space in these soils limit the availability of water and gas exchange, particularly hydrogen. In addition, once the soil in the area has been compacted, ameliorative efforts such as ripping often further limit soil productivity by loosening cobbles and boulders that are then lifted to the surface as a result of frost heaving. Livestock have minimal influence on reducing soil productivity through compaction, except in areas where they concentrate such as water sources. Soil erosion associated with skid and jeep roads has reduced soil productivity. A high amount of these existing non-system roads on the lava plateau have taken land out of production.

Soil productivity on the canyon sideslopes and valley floor landforms has been limited by actions that have decreased the amount of soil on these landscapes. The increase in erosion rates, as a result of land management actions, have decreased soil depth and the amount of topsoil available to supply water and plant nutrients. Road building has taken land out of production and has indirectly reduced soil productivity by increasing landslides and slumping. Clearcutting, burning, and historical over-grazing may have contributed to diminished soil productivity by increasing erosion rates and reducing vegetative cover and plant material that would otherwise be recycled into the soil. Timber harvest and associated burning has also reduced the amount of coarse woody material across the landscape. There is usually a high amount of insect and small mammal activity associated with large logs on the ground in the forest. Additionally, coarse woody material and surrounding soil retains moisture longer into the summer providing a refugia for insects and soil microbes that decompose organic matter into plant nutrients. Although individual occurrences may not be significant, cumulative effects to the soil could be very limiting over a long period.

The stream terraces and alluvial bottom generally consist of relatively recent soil deposits that are often coarse textured. Moisture holding capacity often limits the productivity of the soils on these landforms. Some of the soils on these landforms, particularly the stream terrace, are limited by the existence of a hard pan that limits soil depth. Most of the soils on these landforms are very productive in the spring, but unless irrigated are unable to sustain shallow rooted vegetation throughout the summer months. Soils with hard pans are poorly drained and often have a perched water table throughout the spring creating environmental conditions conducive to a narrow range of plants.

The volcanic peaks consist of mostly rubble or shallow, rocky soil that support a limited amount of plant life. Soils on this landform are relatively young and soil productivity is limited by the shallow soil.

LANDSCAPE VEGETATION PATTERN

Fire suppression, plant succession, and logging are the main processes that have designed the landscape since the turn of the century. In the Interior Valley and Mixed Conifer zones, the forest land matrix has become more contiguous and larger in size because of the lack of fire disturbance and the process of plant succession (Franklin and Dyrness 1973). These two processes have allowed for high stocking levels of trees and shrubs to become established. Forest management selection methods and small sized patch cuts have allowed for the creation of distinct patches within the matrix and have simulated fire in regard to maintaining open patches in the landscape pattern, but have not lowered vegetation densities in the remainder of the forest.

Within the White Fir and Shasta Fir zones, clearcut harvests (less than 40 acres) have interrupted the historic continuous forest matrix by creating a pattern of dispersed uniform openings across the landscape. The present day clearcut openings are more uniform than the variable patchiness created by historic fires.

Although there are more non-native species present today and their abundance is greater than in historic times, these species have not influenced the vegetation pattern across the landscape to any large extent. Since these non-native species are herbaceous in form they are commonly found in the grasslands, shrublands, and agricultural areas, and may tend to maintain the openness of these areas. The effects of non-native species are more subtle. In general, natural succession of native species is usually retarded by the non-native species invading their habitat and out competing them for nutrients and light. Suitability decreases as native species decrease in abundance and decreases the quality of wildlife habitat, agricultural productivity, and recreation areas. The effects of the loss of native species is probably not yet realized.

PLANT SPECIES AND HABITATS

Non-Native Plant Species and Noxious Weeds

Noxious weed populations appear to be increasing in the Little Butte Creek Watershed. The economical and ecological elimination of some species such as yellow starthistle is unlikely. If present trends continue, the ability to control other species will also diminish.

Noxious weed populations must be located quickly to increase the effectiveness of control efforts. The Oregon Department of Agriculture is focusing research on identifying biological control agents. Biological control agents are successful at controlling some species. This control method appears promising for several species, although, it is still too early to draw any definitive conclusions.

Most of the problem species are strong colonizers and persistent once established. Any disturbance event such as poorly managed livestock grazing, fire, earth-moving and soil-exposing activities is an opportunity for these species to spread. A number of them will spread into suitable habitats without disturbance. Interactions in some lower elevation plant communities that were once maintained by fire have probably changed. The presence and dominance of non-native annual grasses may now be a controlling influence on plant community development following a fire or other disturbance event.

Deliberate introductions of non-native forage grasses has occurred in most high elevation moist meadows in this watershed. Erosion control seeding has introduced some permanent and aggressive exotics in our uplands.

Carefully designed grazing systems and certain kinds of prescribed fire may be less damaging or even beneficial to native plant communities. Implementation of these types of management actions may have economic constraints.

Non-native blackberries will probably continue to occupy most of the lower elevation stream corridors in the watershed because of the difficulty of removing them and keeping them out. They suppress the regeneration of native riparian trees and shrubs, decrease species richness in the herbaceous plant layer, and inhibit the ability of terrestrial wildlife to live in and move through riparian corridors. In areas where these streams pass through pasture land and residential developments, the blackberries often function to protect the streambanks from disturbance and provide some cover for wildlife trying to exist in a human dominated environment.

Rare Vascular Plants

It is suspected that there has been a change between current and reference conditions for the following rare vascular plants considered to be at risk of extirpation.

***Allium campanulatum* (Sierra onion):** It is likely that the long history of livestock grazing in the moist mountain meadow habitat where this species occurs is responsible for the presumed downward change from past conditions. The risk of extirpation could be reduced if grazing practices changed in suitable habitat.

***Cypripedium fasciculatum* (clustered lady's slipper orchid) and *Cypripedium montanum* (mountain lady's slipper) (orchids):** Loss of habitat through many decades of logging old-growth forest, particularly at lower elevations, is probably responsible for the presumed downward change from past conditions. It is unknown if fire exclusion has contributed to this change. The risk of extirpation could be reduced over time if the percentage of the watershed in late-successional condition increases.

***Limnanthes flocossa* ssp.*grandiflora* (large-flowered woolly meadow foam):** Conversion of the mounded prairie/vernal pool habitat to industrial, residential, and agricultural uses has caused the loss of habitat. Over-grazing has probably been responsible for a loss of populations and individuals. Moderate or light grazing does not cause declines of this species. Since none of the known populations are on federal land, it is unlikely that any actions on the part of BLM or the Forest Service could influence the viability of this species.

***Microseris laciniata* ssp. *detlingii* (Detling's microseris):** Fire exclusion is probably responsible for a loss of habitat. Competition from non-native plant species is likely responsible for a loss of populations and individuals. Planning to achieve certain landscape conditions within suitable habitat for this species could lead to an increase in populations and individuals in the watershed. Competition from non-native plant species can probably not be effectively reduced on a large scale in areas where non-natives already dominate. Preventing the spread and increase of non-natives could be useful for maintaining the viability of this species in the watershed.

Survey and Manage, and Protection Buffer Plant Species and Habitats

The lady's slipper orchids are reviewed above. Otherwise there is no reference information from which interpretation and synthesis can be done for these Survey and Manage organisms.

Special Areas with Botanical Resources

Irene Hollenbeck Environmental Education Area (BLM): Long-term livestock grazing may be partially responsible for the presumed change between reference conditions and current conditions. Proper grazing management is likely to be the biggest influence on future conditions.

Lost Lake Research Natural Area (BLM): The lakeshore disturbance is primarily caused by human recreation use. Fire exclusion is likely to have caused at least some changes from past conditions. The introduction of game fish has undoubtedly changed the aquatic ecosystem, probably having a large impact on amphibians and macroinvertebrates, and possibly on aquatic vegetation. The game fish are now probably a permanent influence.

Roundtop Research Natural Area (BLM) and Roundtop Preserve (TNC): Fire exclusion, past poorly managed livestock grazing, and some invasion of non-native species have caused the changes that have occurred. Ecological succession with the complicating presence of non-native species will be the primary influences in the future.

Noteworthy Habitats Containing Unusual Plant Communities and Species Not Found in the Majority of the Watershed

Remnant oak/pine savannah on the valley floor and lower foothills: Agricultural, industrial, and residential development have caused loss of habitat on the valley floor. Fire exclusion has caused loss of habitat in the foothills. Invasion by non-native plant species, often accelerated by poorly managed livestock grazing disturbance, has caused loss of habitat quality where remnants of this plant community structure still exist. Re-creating the plant community structure is possible by using prescribed fire or other means. There are ways to encourage the native herbaceous species, but it is unrealistic to consider getting rid of the non-natives now.

Scablands with shallow soils over basalt/andesite: Poorly managed livestock grazing probably provided disturbance opportunities for many of these areas to be colonized by non-native annual grasses. However the nature of the soils and habitat is very conducive to these annual grasses and many sites were probably invaded without appreciable livestock disturbance. Equilibrium between natives and non-natives probably exists now on many of these scablands.

Moist mountain meadows: Intense long-term livestock grazing, and often deliberate seeding of non-native perennial grasses is responsible for the change from reference conditions. Improvements in ecological condition or some change in the direction of reference conditions are possible on most areas. A complete return to reference conditions is impractical on a large scale.

Western white pine: White pine blister rust and competition from other conifers due to fire exclusion is responsible for the major decline in abundance and dominance. It may be impractical to reverse this trend on any large geographic scale.

Quaking aspen stands: Influences have included poorly managed livestock grazing and beaver trapping, and also fire exclusion to an unknown extent. Aspen is a short-lived disturbance-dependent species. A long-term strategy to maintain or increase the abundance of aspen in the watershed would include cutting, prescribed fire, or other fairly severe disturbance in the later life stages of individual stands, followed by protection of the new suckers from grazing and browsing. Similar measures could be applied on the perimeter of younger-stands to encourage them to spread.

Bogs in the upper reaches of the watershed: The degree and type of change is unknown. Influences may include anything that changes the character of the water table. Grazing may be an influence on the margins of these bogs.

Subalpine and alpine communities on the south side of Mount McLoughlin and possibly at the summit of Brown Mountain: No change in this habitat except for the western white pine discussed above.

FOREST DENSITY AND VIGOR

Core samples from 146 to 322 year-old trees of the Interior Valley Zone (trees that became established in the 1600s and 1700s) show they were growing at least 1.5 inches in diameter every decade for 3 to 10 decades before decline in diameter growth started. This indicates that these trees that are now considered to have late-successional characteristics, grew with no surrounding tree competition. Frequent fires kept tree stocking levels low. The present day, younger tree age classes, which became established in the late 1800s and now predominate the landscape, grew under maximum stocking conditions and do not show periods of rapid diameter growth. High tree stocking levels have been maintained since Native Americans stopped using fire across the landscape and fire suppression was initiated. As a result, there are more uniform forest stands in the Interior Valley Zone and lower elevations of the Mixed Conifer Zone (Franklin and Dyrness 1973).

The species composition of the present day forests is also different from the forests of the 1700s and 1800s. Historically, forests had more pine species, incense cedar, and oak species in the Interior Valley and Mixed Conifer zones. With the reduction in fire frequency, natural plant succession has allowed more shade tolerant species such as Douglas-fir and true fir to dominate the species composition of the forests, including some dry sites. This is not desirable because the pine species and incense cedar have better drought resistant characteristics that can influence tree vigor.

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The decrease in fire frequency has also allowed natural plant succession to change the species composition and structure of grasslands, shrublands, and oak woodlands. Shrubs and trees have invaded grasslands, decreasing the size of these open, native grass communities. The historic, relatively open, shrublands have become overstocked, more uniform in structure, and present a severe fire danger today. The open oak woodlands that were managed for acorns by the Native Americans have also changed dramatically. Shrub species have invaded the woodlands because of fire suppression; more oaks became established and Douglas-fir is prevalent in the overstory and understory. These factors have resulted in the decline of oak tree vigor and acorn production.

The conifer forests and their various stages of development are also influenced by numerous ecological and physical processes. Coarse woody material (CWM) appears to be the heart of numerous ecosystem processes and it is a vital part of forest productivity. CWM is defined as fallen trees and tree pieces, fallen branches larger than 1 inch in diameter, dead roots, and standing dead trees. As a general rule, CWM decreases from high to low elevations. In the Interior Valley Zone, CWM is usually less than 10 tons per acre.

In the historic forests, bark beetles and pathogens were probably more benign due to low tree stocking levels. The present day overstocked forests have allowed for a decline in forest growth and vigor resulting in the dramatic increase of bark beetle populations and increasing tree mortality. The various bark beetles throughout the watershed that are causing extensive tree mortality on the drier sites are moving the forest stands to a more open condition. Where the Douglas-fir trees are dying adjacent to shrublands and woodlands and on dry ridge-tops, there is an opportunity to reestablish drought tolerant species such as ponderosa pine and incense cedar. Root rot diseases, especially in the White Fir Zone, are also functioning in the same manner. Forest stands that were predominantly Douglas-fir, pine species, and incense cedar historically and are now predominantly true fir species, are reverting back to the early seral species. Where white fir is dying because of laminated root rot, disease tolerant pine species and incense cedar can once again be reintroduced. Dwarf mistletoe species are also causing tree mortality on a smaller scale.

As forest stands increase in age, there is a higher probability of some type of disturbance. Since many of the predominant, mature second growth forest stands in the watershed are approximately 120 years of age, they are currently more susceptible to disturbance. Some stands are still in the stem exclusion stage of development, but many stands are entering the understory reinitiation stage because of the ecological processes discussed (Oliver and Larson 1990). These processes are also part of the formation of late-successional forests by creating multi-cohort, multi-storied forests. Wind damage is another important process in mature forests for creating openings and the reintroduction of a new forest age class and seedlings of the desired species.

These various ecosystem processes must be monitored carefully if fire suppression across the landscape continues. Natural vegetation succession may not be desired everywhere. Without large openings in forest stands, shade tolerant species such as true fir species and Douglas-fir will predominate most forest stands, and early seral species will continue to decline. Silvicultural methods will be necessary to maintain and manipulate the structure and species composition of the forest stands if fire does not. Reduction of vegetation stocking levels is also needed if individual tree and forest vigor is to be maintained.

In summary a few conclusions are apparent:

1. Forests in the lower elevation Interior Valley and Mixed Conifer zones should not be expected to develop into large continuous matrix areas of dense, lush late-successional forests (Franklin and Dyrness 1973). These dry, low elevation forests must be maintained at lower stocking levels with drought resistant species predominating. Openings are essential for maintaining the drought resistant early seral species. If the stocking levels of the vegetation are not managed, physical and ecological processes will continue to naturally thin the vegetation and the species composition of the early seral species may continue to decline.

2. It must be recognized that mature, overstocked forest stands across the landscape are being observed at one point in time. Numerous processes will continue to affect the forest stands' stocking levels and structure. As small scale, physical and ecological processes continue to create openings in the present day forest stands, more diverse stand structure will develop over time. With these processes and silvicultural treatments to control stocking levels, the potential exists for more forests with late-successional characteristics in the future.

3. Without vegetation stocking level management or low intensity fire, individual shrub and tree vigor will remain low and high levels of vegetation mortality may occur. Large stand replacement fires are also probable without stocking level management. Grasslands will continue to decrease in size, and open, parklike oak woodlands will disappear.

FIRE

Historically, frequent, low intensity fires maintained most valley bottomlands and foothills as grasslands or open savannas. Forests fashioned from frequent, low intensity fires have been described as open and parklike, uneven-aged stands, characterized by a mosaic of even-aged groups. Douglas-fir, ponderosa pine, sugar pine, and white fir were the most common species. Depending on understory vegetation conditions these species have some resistance to fire as mature trees. As saplings, ponderosa pine is the most resistant followed by sugar pine, Douglas-fir, and white fir. Frequent fires had major structural effects on young trees favoring ponderosa pine as a dominant species and white fir as the least dominant in this forest type.

Fire suppression over the past century has effectively eliminated five fire cycles in southwest Oregon mixed conifer forests (Thomas and Agee 1986). The absence of fire has converted open savannas and grasslands to woodlands and initiated the recruitment of conifers. Oregon white oak is now a declining species largely due to fire suppression and its replacement by Douglas-fir on most sites.

Fire-intolerant, shade-tolerant conifers have increased and species such as ponderosa pine and sugar pine have declined. This conversion from pine to true fir has created stands that are subject to stress, making them susceptible to accelerated insect and disease problems (Williams et al. 1980).

The horizontal and vertical structure of the forest has also changed. Surface fuels and the laddering effect of fuels have increased and this increases the threat of crown fires, which were historically rare (Lotan et al. 1981). Fire suppression changed a low-severity fire regime to a high severity regime. This is characterized by infrequent high intensity, stand replacement fires. Fire is now an agent of ecosystem instability as it creates major shifts in forest structure and function on a large scale.

TERRESTRIAL WILDLIFE SPECIES AND HABITATS

Wildlife- General

Vegetative conditions are the primary influence on terrestrial wildlife/animal populations and their distribution within the watershed and across the greater landscape. Among the processes that have changed the vegetation within the watershed over time are disturbances that include natural succession, natural disturbances, and human-caused disturbances. Current conditions of the watershed differ from reference conditions primarily due to human-caused disturbances such as timber harvest, agriculture, fire suppression, location of communities, and location of residences.

A direct comparison of the acreage of current and reference condition for vegetative conditions is not possible. However, mature/old-growth vegetation has declined, especially in the valleys along the riparian corridors, the mid-elevation, and the upper canyons and plateau.

The riparian areas were removed for agriculture, and the lower and mid-elevation stands of mature/old-growth were harvested for early construction needs. Although agriculture and settlement impacted the riparian areas that functioned as connectivity across the landscape from lowlands to highlands to lowlands, some of these riparian areas may have been stressed by the heavy removal of the beaver in the early 1800s. Beaver helped to stabilize the streams, raise the water tables, and broaden these riparian areas, providing unique habitat for many wildlife species.

Most of the current early/seedling-sapling and pole habitat is the result of timber harvest. Consequently, snags and coarse woody material are often lacking in these areas. Populations of species requiring snags and large coarse woody material in these condition classes have likely declined, while populations of species not requiring the snag and large/coarse woody component have likely increased. Early successional species such as deer and elk have actually benefited from the increased forage base. This can be seen by the increase in size of the elk herd in and around the watershed. In the early 1970s, the herd consisted of about 30 to

50 animals. Currently the herd is estimated at over 400 (Thiebes 1995).

The absence of fire has allowed much of the oak and oak/pine woodlands to become over-dense, and has also allowed conifers to encroach on them to unhistorical levels. The lack of fire and the conifer encroachment rate have resulted in increased mortality, reduced growth, and diminished mast (acorn) production. Large oaks, which provide natural cavities, and acorns are important to a variety of wildlife species. Populations of many species that utilize these two features of the oak and oak/pine woodlands have probably declined.

The quality of shrubland habitat has declined due to fire suppression. Generally, fire is the primary agent for creating early seral stages in this plant community. In the absence of fire, much of this habitat type has matured and early seral stages are deficient. Therefore, the habitat that often is the most critical for deer winter range foraging is being lost.

The quality and quantity of grass/forb/herbaceous habitat in meadows and grasslands throughout the watershed has declined due to the invasion of non-native grasses and forbs and the encroachment of shrubs and conifers, respectively. Encroachment has primarily been the result of fire exclusion over the past century. This decline in quality and quantity of habitat has had an adverse impact on herbivores in the watershed.

Overall, it seems apparent that some species have been adversely affected by general decline in habitat within the watershed from historical levels. Loss or modification of habitat is probably most pronounced in the mature/old-growth condition class, and wildlife species associated with this habitat have likely been the most affected.

Threatened/Endangered Species

Northern spotted owls are highly associated with the mature/old-growth forest condition class. The decrease in the acres of this condition class from historic to present levels is apparent. Due to this decrease in suitable habitat, it can reasonably be assumed that northern spotted owl populations are now lower than in the historic period.

Bald eagles likely utilized this area historically and probably foraged along streams and in the original Fish Lake area. Currently, a pair nests annually at Fish Lake, although reproductive success has been low. These eagles are also observed intermittently foraging along the lower reaches of Little Butte Creek.

Peregrine falcon cliff habitat has remained about the same. Currently, one eyrie is known in the area. It is likely that higher populations were once prevalent, however, historic levels and locations are not accurately known. High mortality due to pesticides devastated the peregrine falcon and present populations are slowly starting to increase.

Northern Spotted Owl Critical Habitat

Northern spotted owl critical habitat was not designated until 1992. Prior to that time, the area within the watershed that is now critical habitat was under varying management treatments. Some lands were managed for timber while most of the critical habitat fell into areas that had previously been set aside as spotted owl habitat areas (SOHAs). The management emphasis in the area designated critical habitat was to be protection and enhancement of owl habitat conditions in order to provide for clusters of reproductively capable spotted owls. However, with the adoption of the Northwest Forest Plan in 1994, the issue of providing for clusters of owls in that portion of critical habitat which is outside of Late-Successional Reserves (the areas under the Forest Plan that are to provide the clusters of owls) is somewhat moot, since the Forest Plan is being recognized as the federal contribution to recovery of the northern spotted owl. The apparent primary function of critical habitat is now to help provide for spotted owl dispersal/connectivity between the Late-Successional Reserves. Eighty percent of the critical habitat unit within the watershed became a Late-Successional Reserve under the Forest Plan. Only a small portion of the critical habitat, that was on BLM-managed lands, was not included in the Dead Indian Plateau Late-Successional Reserve.

Special Status Species

The decrease in mature/old-growth habitat via timber harvest is primarily responsible for the listing of many of the special status species found in the watershed. These species prefer mature/old-growth mixed conifer forest for feeding, breeding, and/or sheltering. Due to the habitat loss, populations of these species are likely reduced.

The designation of many of the special status species is often compounded by other factors, such as competition from non-native animals that have arrived over the past several decades. Of concern are introduced species like the bullfrog (*Rana catesbeiana*), the opossum, and birds such as the starling and the brown cowbird. The western pond turtle has faced the impact of habitat loss and the introduced predator, the bullfrog. The opossum has impacted avian and mammalian species as a predator/scavenger. Many of the neo-tropical migrants are facing habitat loss in the southern hemisphere, as well as locally, and then are being impacted by species such as the opossum and the non-native birds. Agriculture and livestock grazing has removed much of the low elevation riparian vegetation and replaced it with plowed fields, blackberries (a non-native invader), and trampled banks. Logging, road building, and grazing impacts at higher elevations have also adversely affected or depleted these habitats often used by nesting species.

Survey and Manage, and Protection Buffer Species

All survey and manage and protection buffer species, great gray owl, bat species, and red tree vole (if present in the watershed), are generally associated with and are believed to prefer mature/old-growth habitat conditions. Great gray owls use this type of habitat for nesting, but forage in meadows, agricultural land, and the early seral stages of mixed conifer forests. It is unknown how management in the watershed has affected overall habitat for the great gray owls. Populations of the various bat species listed in the Northwest Forest Plan have likely declined as many are linked with the bark fissures of old-growth and the snag component of these stands. If the red tree vole's range extends into the watershed, it is likely that it, too, has declined from historic levels due to the loss of mature/old-growth habitat.

HYDROLOGY

The streamflow regime in the Little Butte Creek Watershed reflects human influences that have occurred since Euro-American settlers arrived.

Road construction, timber harvest, land clearing, water withdrawals, and fire suppression are factors that have the potential to adversely affect the timing and magnitude of both peak and low streamflows in the watershed. Changes in the streamflow regime due to human disturbance have not been quantified in Little Butte Creek or its tributaries.

Potential effects due to peak flows may include channel widening, bank erosion, channel scouring, landslides, and increased sediment loads. These are normal occurrences in a dynamic, properly functioning stream system; however, increases in the magnitude and frequency of peak flows due to human-caused factors can magnify the effects. Extensive road building, timber harvest, and land clearing in Little Butte Creek Watershed have raised the potential for increasing the magnitude and frequency of peak flows in the tributaries and main stem. Openings in the transient snow zone are of particular concern as they tend to produce higher streamflows during rain-on-snow events. As vegetation planted in the harvested areas recovers, the increase in magnitude and frequency of peak flows will diminish. Permanent road systems intercept surface runoff and subsurface flow, which prevents the streamflow regime from returning to pre-disturbance levels.

Water withdrawals have had the greatest impact on summer streamflows in the Little Butte Creek Watershed. The majority of water diverted from streams in the watershed is used for irrigation. Transbasin diversions out of Little Butte Creek Watershed dramatically decrease streamflows in the diverted tributaries and downstream reaches during the irrigation and reservoir storage seasons.

Fire suppression has resulted in areas of dense vegetation throughout Little Butte Creek Watershed. These areas remove more water from the soil for transpiration and thus less water is available for streams and subsurface flow during the summer low flow season. This trend will continue until the areas are thinned or a wildfire burns through the watershed.

STREAM CHANNEL

Channel conditions and sediment transport processes in the Little Butte Creek Watershed have changed since Euro-American settlers arrived in the 1830s. The changes have primarily resulted from flooding, which is a natural occurrence, and a combination of human-caused disturbances including: removal of beavers, channelization, landslides in unstable areas, road building, and removal of riparian vegetation. Floods have historically produced substantial changes in channel morphology. However, management activities such as road building, timber harvest, and riparian vegetation removal tend to increase the effect of a flood event on stream channels. This is due to greater wood and sediment loads transported during high flows and reduced channel stability. The loss of beaver dams due to fur trapping in the 1830s to 1840s resulted in scouring of channel beds and banks, reduction in the number of stream reaches with multiple channels, increased width/depth ratios, and increased fine sediment deposition in pools. Channelization resulted in entrenched channels with greater width/depth ratios. Decreases in sinuosity accompanied by increased stream gradients and reduced bedload transport capability were a consequence of the larger width/depth ratios.

Sediment is mainly transported to streams from landslides (natural and human-caused), road surfaces, fill slopes, and ditchlines. Human-caused landslides have mostly resulted from road building and clearcuts in unstable areas. Increases in road-produced sediment loads are generally highest during a five-year period after construction, however, they continue to supply sediment to streams above natural levels as long as they exist. Road stabilization, maintenance (including drainage improvements), and decommissioning would reduce the amount of sediment moving from the roads to the streams. Roads constructed adjacent to stream channels tend to confine the stream and restrict the natural tendency of streams to move laterally. This can lead to downcutting of the stream bed and bank erosion. Obliteration of streamside roads would improve the situation.

Removal of riparian vegetation has had a major detrimental affect on channel stability and the presence of large woody material in the stream channels. Stream reaches lacking riparian vegetation are more susceptible to streambank erosion during peak flow events. This is especially true in the valley bottoms, where large volumes of water during flood events can erode massive amounts of streambank material. There is a minimal amount of large woody material in stream channels; many reaches lack the potential for short-term future recruitment. Large woody material is essential for reducing stream velocities during peak flows and for trapping and slowing the movement of sediment and organic matter through the stream system. It also provides diverse aquatic habitat. Riparian Reserves along intermittent, perennial nonfish-bearing and fish-bearing streams will eventually provide a long-term source of large wood recruitment for streams on federal land.

WATER QUALITY

Changes in water quality from reference to current conditions are predominantly caused by riparian vegetation removal, water withdrawals, and roads. Water quality parameters known to be affected the most by human disturbances are temperature, bacteria, sediment, and turbidity. Lack of riparian vegetation and water withdrawals have contributed to increased stream temperatures that can stress aquatic life and limit the long-term sustainability of fish and other aquatic species. Summer water temperatures for Antelope, Conde, Dead Indian, Little Butte, North Fork Little Butte, South Fork Little Butte, and West Fork Dead Indian creeks exceed the state temperature criteria and these streams are designated as water quality limited. Soda Creek is identified by the Oregon Department of Environmental Quality (DEQ) as a potential concern for temperature. When cattle are not properly managed, concentrated livestock grazing near streams can contribute to increased levels of fecal coliform. Little Butte Creek from the mouth to the North/South forks confluence is water quality limited due to fecal coliform levels that exceed the state criteria. Surface erosion and mass wasting from roads, timber harvest, and riparian vegetation removal are the primary cause of stream sedimentation in the Little Butte Creek Watershed. High sediment levels in Deer, Lake, Little Butte, Lost, Soda, and South Fork Little Butte creeks have placed these streams on the State's list of water quality limited streams.

Protection of vegetation providing stream shade and recovery of riparian vegetation should bring about the reduction of stream temperatures in Conde, Dead Indian, and West Fork Dead Indian creeks. The riparian areas along these streams will need to be protected from poorly managed cattle grazing. Water temperatures are likely to maintain the same pattern in Antelope, Little Butte, North Fork Little Butte, and South Fork Little Butte creeks due to withdrawals, high width-to-depth ratio, and lack of riparian cover. Road stabilization, maintenance, and decommissioning would decrease sedimentation and turbidity in Deer, Lake, Lost, and Soda creeks.

RIPARIAN AREAS

Natural Disturbances

Riparian disturbances, such as sediment deposition, bank cutting, debris torrents, earthflows, and landslides can be caused by bankfull and flood events. Wind, fire, insects, pathogens, human disturbances, animal damage, and plant succession itself have also altered the pattern and structure of the riparian vegetation. These disturbances create new habitat, alter existing habitat, and destroy old habitat for vegetation and aquatic and terrestrial wildlife.

The 1997 winter flood created the potential for large patches of red alder and black cottonwood to become established along the floodplains of the streams where erosion and alluvial deposition occurred. Conifer species can also be expected to seed-in where mineral soil is exposed and sunlight can reach the soil surface. Damaged and buried hardwoods will resprout, creating a new forest age class, which will help improve the vertical stand structure of the riparian areas.

Human-Caused Disturbances

Past regeneration (clearcut, shelterwood, overstory removal, etc.) timber harvesting on federal lands now allocated to Riparian Reserves have impacted riparian habitat. Private land use activities have also impacted riparian habitat. The percentage of riparian habitat dominated by late-successional ($>$24 inch diameter) conifer forest is low.

Roads, timber harvesting, agricultural, rural development, irrigation, and livestock grazing have impacted riparian and aquatic habitat, which has lead to habitat degradation by: fragmenting connectivity of riparian habitat; reducing snags and coarse woody material; reducing stability of streambanks, increasing sediment production to streams; and reducing stream shading, thus increasing solar radiation.

See Aquatic Wildlife Species and Habitat for additional riparian habitat synthesis and interpretation. See Aquatic and Terrestrial Wildlife Species and Habitat for riparian-dependent species, such as fish, macroinvertebrates, amphibians, and mammals.

AQUATIC WILDLIFE SPECIES AND HABITATS

The majority of anadromous fish habitat in the Little Butte Creek Watershed is located in mainstem Little Butte, Antelope, and South Fork Little Butte creeks. Anadromous fish species in these streams are chinook salmon, steelhead trout, coho salmon and Pacific lamprey. Two special status fishes spawn and rear in the Little Butte Creek Watershed: transboundary coho salmon and Klamath Mountains Province steelhead. The National Marine Fisheries Service (NMFS) listed coho salmon in the Rogue River Basin as threatened and proposed listing steelhead under the Endangered Species Act. The upper Rogue River Basin coho salmon run is depressed due to loss of habitat and extensive ocean fishing (RVCOG 1997). South Fork Little Butte Creek is one of the primary rearing areas and contains one of the highest populations of rearing coho salmon in the upper Rogue River Basin. The local analysis plan for the Oregon Coastal Salmon Restoration Initiative designates Little Butte Creek as a potentially productive area for coho salmon. Moderate winter steelhead and poor summer steelhead populations exist.

Overall, the interrelated aquatic and riparian habitats in Little Butte Creek and its major tributaries are in poor condition and well below their potential for producing diverse ages and species of anadromous fish and large resident trout (greater than eight inches). Most of Little Butte Creek and its tributaries are riffle-dominated and lack historic side channel habitat, which coho salmon prefer. The habitat lacks quality pools and large woody material necessary for maintenance of pools, cover, spawning material, and bank stability. Table 29 summarizes reference and current aquatic habitat conditions.

Table 29. Estimated Reference and Current Conditions for Aquatic Processes and Functions

Parameters	Little Butte Creek		Antelope		South Fork		North Fork	
	Reference Condition	*Current* Condition	*Reference* Condition	*Current* Condition	*Reference* Condition	*Current* Condition	*Reference* Condition	*Current* Condition
Large Woody Material[1] (wood per mile by reach (R))	R1 - 40	R1 - 0	R1 - 40 R2 - 40 R3 - 40	R1 - 0 R2 - 4 R3 -17	R1 - 40 R2 - 40 R3 - 40 R4 - 40	R1 - 0 R2 - 2 R3 - 24 R4 - 22	R1 - 40 R2 - 40 R3 - 40 R4 - 40	R1 - 0 R2 - 0 R3 - 25 R4 - 6
Pools per mile[2]	36	4	178	57	168	42	182	32
Pool/Riffle/ Glide Ratio (avg.)	50/20/30	18/32/50	40/40/20	8/65/27	45/40/15	12/60/18	35/55/10	8/77/15
Side Channels per mile	High	Poor	Good	Good	Poor	Poor	Good	Poor
Rosgen Classification (dominate/sub-dominate)	C	F	C/B	F/G	C/B/E	F/B/E	C/B/E	F/G/E
Stream Temperature (summer)	<62°F	>65°F	<62°F	>62°F	<62°F	62-76°F	<58°F	<5
Spawning Gravels	Good	Poor	Good	Poor	Good	Poor	Good	Poor
Riparian Canopy (%)	80	25	75	40	90	50	90	75
Riparian Component[3] (%)	60/40	90/10	60/40	80/20	60/40	80/20	60/40	80/20
Salmonids (adult fish) per mile: **Chinook** **Steelhead** **Coho Salmon** **Rainbow Trout** **Cutthroat Trout**	 High High High High High	 Fair Low None Low Low	 High High High High High	 Low Low None Low Low	 Fair High High High High	 Low Fair Low Low Low	 Fair High Fair High High	 Low Low Low Low Low
Macroinverte-brates (relative density of positive indicator groups[4])	Good	Poor	Good	Poor	Good	Fair/Poor	Good	Poor
Amphibians	Good	Poor	Good	Poor	Good	Fair/Poor	Good	Poo

1/ Large woody material dimensions are greater than 24" dbh x 50'.

2/ Reference conditions based on expected pool frequency of 4 bankfull width (<2% slope - Rosgen C stream type) and 3 bankfull widths (2-4% slope - Rosgen B stream type) and 2.5 bankfull widths (>4% slope - Rosgen A stream type).

3/ Riparian Component - percent of sapling/pole-size hardwood and conifer trees is listed first followed by the percent of mature conifer trees.

4/ Positive indicator groups or taxa in a healthy stream system are highly intolerant taxa which are particularly sensitive to high summer stream temperatures or impairment due to habitat quality limitations (sedimentation, high winter scour, opening of the riparian canopy, reduction of channel depth).

Activities within Riparian Reserves, such as commercial timber harvest, road construction, in-stream wood removal, channel straightening, livestock grazing, clearing and maximizing land for agriculture use, rural residential development, water diversions, and withdrawals for irrigation have greatly simplified aquatic habitat. Few records of stream conditions prior to human disturbances remain today

Changes in channel morphology have been less significant in areas where streams have not been influenced by forest management, agriculture, and rural residential development. These areas are mainly in the unroaded canyon area in the upper middle South Fork Little Butte Creek (Type 3 reach). Stream temperatures are cold here, partially because of the elevation of these stream segments, resulting in a good steelhead and rainbow trout population. Presence of large wood and mature canopy cover creates quality salmonid habitat; however, the habitat area is limited and will not support large numbers of juvenile salmon and adult trout.

The flat, unconfined areas associated with the alluviated canyon and alluvial valley stream segments (Type 1 and 2 reaches) were areas first developed and affected by roading, agriculture, and timber harvest. Flats are important deposit areas for wood, detritus, and sediment. In these sections, riparian forests and instream wood have been removed, eliminating necessary ingredients for complex habitat: pools, hiding cover, bank stability, and the sorting of spawning gravels. The removal of wood and increase in sediment have also contributed to channel widening. In part due to easy accessibility, large trees have been harvested in the riparian zone, reducing stream shading. Once multi-channeled, stream habitat is now singular channel in nature, greatly reducing edge effect and riparian/stream interactions. This, coupled with channel widening has increased solar radiation and water temperatures. This is most prevalent in privately-owned valley habitat.

Summer stream temperatures vary throughout the watershed. National Forest lands encompass 30 percent of the watershed, but contain 85 percent of the fish-rearing habitat during summer months; elevated summer water temperatures are a limiting factor downstream of National Forest lands.

Limiting Factors for Long-term Sustainability of Native Fish and Other Aquatic Species

The major limiting factors influencing aquatic species distribution and instream habitat condition are (in order of priority): high summer stream temperatures and sedimentation in response reaches (wide alluvial valleys). High summer stream temperatures are primarily due to human activities such as channel widening (resulting in high width to depth ratios), riparian vegetation removal (resulting in reduced stream shading), and irrigation withdrawals (resulting in low summer flows). Sedimentation results primarily from a combination of natural disturbances (flooding and landslides) and human activities such as road builing and timber harvest in riparian areas and on steep slopes.

Other limiting factors include: degradation of riparian habitat and sensitive upland areas from road development and timber harvest; irrigation diversions, which obstruct fish passage; cleanout of large woody material (instream habitat simplification); reduction in fish carcasses supplying nutrients from the ocean to stream habitats; and wetland and floodplain losses, including entrenchment and lowering of water tables.

Fish Lake Dam on North Fork Little Butte Creek produces an inverse flow regime that results in more water transported during the summer than in the winter due to water releases for irrigation. This current hydrologic regime has negatively altered the North Fork stream ecology.

1997 Flood

Streams within the Little Butte Creek Watershed were heavily impacted by the 1997 New Year's Day flood. Alluvial canyons and valleys (Types 1 and 2 reaches) were the most affected. Habitat was altered, and much of the gravel/cobble sediment was delivered from streamside landslides and general slope failures in the watershed.

In the Cascade Mountains, these episodic flood events create many beneficial changes for fish habitat in a matter of hours and are long-established natural events. On private lands where farms and residences are located, people may continue to do some cleanup (channel straightening and wood removal) after the flood to protect their property investment. These cleanup activities can often be detrimental to salmon and trout habitat in open valley streams where some of the highest biological potential for fish and wildlife exists. Public lands serve as zones of high water quality and fish habitat with little or no intervention on these natural processes.

Lakes

Little Butte Creek Watershed contains three significant fish-bearing lakes: Fish, Agate, and Lost lakes. These lakes provide year-round fishing opportunities and recreation for folks in the area, reducing fishing pressure in streams. The lakes are below their potential for fish production because they lack complex habitat in the shoal areas where fish forage. Fluctuating water levels from dam releases in Fish and Agate lakes make it difficult for willows to establish along the lake shores.

Fish Lake is the largest lake and most popular fisheries in the Little Butte Creek Watershed. Fish Lake contains tui chubs in addition to rainbow and eastern brook trout. Tui chubs out-compete and prey on local trout populations resulting in sub-optimal sized trout. Agate Lake contains a large population of largemouth bass, yellow perch, bluegill, black crappie, and brown bullhead. Lost Lake contains eastern brook and rainbow trout. Numerous ponds on private lands contain various species of warmwater fish. Non-native fish populations from these lakes are preying upon and competing with native fishes and amphibians throughout the watershed.

Summary

Floods such as the New Year's flood of 1997 illustrate the power of water and that human actions are subject to reactions by streams. Many buildings were lost or damaged during the flood and much of the instream project work done to improve fish habitat in channelized streams was moved or changed. Floods may help us learn to modify our lifestyles and work more in harmony with stream ecology. It appears that every 15 to 20 years most streams in the Rogue River Basin will experience high flows. The stream channels will change and water will spread, flooding areas "inconceivable" to most stakeholders not acquainted with stream and watershed dynamics.

A cooperative effort among private landowners, Little Butte Creek Watershed Council, ODFW, BLM, USFS, local schools and clubs has resulted in the initiation of a watershed approach for restoration and monitoring in Little Butte Creek Watershed. Key issues and opportunities were identified and prioritized during the analysis process. This process has helped this group toward their goal, which is to sustain and improve the anadromous trout and other native fish and aquatic populations in this watershed. Types of cooperative efforts are restoration work, public information meetings, grant proposals, educational partnerships, and monitoring of projects. Restoration efforts include obtaining instream water rights, water intake and usage modifications, riparian planting and fencing, restoration work (instream, upland, and road), and monitoring project effectiveness. This work is being accomplished on both public and private lands. The primary emphasis is to promote an educational-based platform that fosters personal ownership as well as good stewardship towards the land.

Little Butte Creek Watershed analysis and restoration is an evolving, learning process. Future efforts for this watershed include expanding partnerships, as well as solidifying cooperative working agreements already in existence. It is paramount for the success of restoring coho salmon populations that residents and agencies appreciate the importance of functioning alluvial valley streams as well as headwater streams. The life histories of salmonids and other fishes depends on a diverse mix of stream and riparian habitat types throughout the watershed.

MANAGEMENT OBJECTIVES AND RECOMMENDATIONS FOR FEDERAL LANDS

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
HUMAN USES			
Economic Development	Encourage opportunities for local contractors to compete effectively on contracts for projects in the watershed.	1. Promote small-scale projects in forest, range, riparian, and other resources suitable for local administration and contractors.	High
	Produce a sustainable timber supply and other forest commodities on Matrix lands to provide jobs and contribute to community stability.	1. Conduct timber harvest and other silvicultural activities in that portion of Matrix lands with suitable forest lands.	High
	Maintain and develop opportunities for special forest products to facilitate community economic development consistent with other resource objectives.	1. Work with local groups to develop opportunities to harvest and sell special forest products.	Medium
	Promote ecological and heritage tourism.	1. Develop public/private partnerships to promote the interpretation and display of the watershed's cultural heritage, history, and ecology.	Medium
Public Involvement	Maintain and promote contacts with local groups, landowners, community leaders, tribal and public agencies to facilitate continuing dialogue on the management of public lands in the Little Butte Creek Watershed.	1. Maintain and expand contacts with local groups, such as the Little Butte Creek Watershed Council, the Lake Creek Historical Society, and other local groups.	High

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
Public Involvement	Provide opportunities for public and private entities to exchange information and develop consensus concerning land management actions within the watershed, and to enhance awareness of local public concerns and issues affecting management of the watershed's ecosystem.	1. Utilize local avenues of communication, such as the Upper Rogue Independent newspaper, local newsletters and bulletin boards, and the Little Butte Creek Watershed Council's announcements; utilize local meeting spots, such as the Lake Creek Store for informal meetings with local residents. 2. Identify and incorporate tribal representation into all public involvement, and keep them informed of land management activities in the watershed.	High High
Archaeology	Minimize or stop the on-going looting of archaeological sites.	1. Work through partnerships with the Lake Creek Historical Society and other local groups to promote appreciation and understanding of the watershed's cultural resources.	High
	Assess archaeological sites to determine their scientific and heritage values and protect or recover those values as necessary.	1. Define the types of historic and American Indian archaeological sites that are likely to occur within the watershed.	Medium
Transportation	Manage the transportation system to serve the needs of the users and meet the needs identified under other resource programs.	1. Develop and maintain a road closure management plan. 2. Maintain all roads for the target vehicles and users. 3. Provide for initial fire suppression access. 4. Maintain a safe transportation system by removing hazards (e.g., hazard trees). 5. Develop and implement Transportation Management Objectives for individual roads. 6. Develop and implement a Transportation Management Plan for the entire area.	High High High High Medium Medium
	Maintain a transportation system that meets the Aquatic Conservation Strategy and Riparian Reserve objectives.	1. Maintain the transportation system to minimize sediment delivery to streams. 2. Reconstruct, stabilize, reroute, close, obliterate, or decommission roads and skid roads that pose substantial risk to Riparian Reserves. Landings that pose a risk to Riparian Reserves will be stabilized, reconstructed, or obliterated. 3. Accommodate for 100-year runoff events when installing new stream crossing structures and for existing stream crossing structures that pose substantial risk to Riparian Reserves.	High High High

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
Transportation	(continued)	(continued) 4. Provide for fish passage at all potential fish bearing stream crossings; wherever possible maintain a natural stream bed. 5. Follow the Best Management Practices in the Rogue River National Forest and Medford BLM land and resource management plans. 6. Evaluate the condition of all roads in Riparian Reserves.	High High High
	Maintain a transportation system that meets the Erosion Process objectives and recommendations.	1. Reduce road densities in high density areas. 2. Maintain all road densities in all drainage areas as low as is operationally possible and with a target of less than four miles per square mile. 3. Develop and implement plans for decommissioning/obliterating roads with greater than or equal to four miles per square mile. 4. Survey roads to identify sites where concentrated flow causes gullying to occur on roads or drainage outlets. Plan and implement projects with highest priority given to gullies (>6 inches deep), or erosion causing removal of duff layer/surface soil, or down-cut ditches (>6 inches below design ditch bottom).	High High High High
Road Rights-of-way and Other Authorizations	Cooperate with individuals, companies, counties, the state, and federal agencies to achieve consistency in road location, design, use, and maintenance.	1. Maintain and implement reciprocal road right-of-way agreements. 2. Implement road use and maintenance agreements. 3. Evaluate and provide road right-of-way grants. 4. Obtain road easements for the public and resource management.	High High High High
Other Rights-of-way and Authorizations	Coordinate with individuals, companies, nonprofit groups, counties, state, and other federal agencies on all inquiries/applications for non-road rights-of-way, leases, permits, and exchanges on federally managed lands.	1. Review each request on its own merits. 2. Respond to all requests in a courteous and timely manner. 3. Ensure consistency, fairness, and legal/environmental compliance in all decisions.	High Medium Medium
Grazing	Manage livestock in a manner that maintains or improves Riparian Reserves to meet the goals of the Aquatic Conservation Strategy.	1. Stress the importance of properly functioning riparian areas in the issuance of grazing authorizations. 2. Implement Best Management Practices and the Northwest Forest Plan to ensure movement toward land use objectives.	High High

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
Grazing	Continue to provide livestock forage on designated allotments to meet societal needs, without compromising the ecological integrity of the uplands.	1. Develop management strategies in consultation with the permittee to resolve resource conflicts that arise. 2. Update allotment plans as needed. 3. Control noxious weeds. 4. Maintain a list of vacant allotments, including specific management constraints and concerns, for future inquiries.	High High High Medium
Minerals	Continue to coordinate with individuals, companies, counties, state, and other federal agencies on all inquiries/applications for mineral exploration and development.	1. Respond to all inquiries/applications in a timely manner.	High
	Rehabilitate disturbed areas due to past mineral activity. On disturbed sites, ensure public safety and enhance other resources values such as riparian or fisheries habitat.	1. Evaluate and prioritize known disturbed areas for rehabilitation. 2. Develop rehabilitation plans including a budget for targeted areas. Do this through an interdisciplinary effort. 3. Implement plans in a timely manner.	Low Low Low
	Provide for federal and public use of mineral materials.	1. Monitor pit development plans during extraction. 2. Develop mineral sources as necessary for public use (such as lava rock.) 3. Coordinate with local watershed councils and state agencies in developing new rock sources in the watershed. 4. Prepare, or where existing, update long-term rock quarry management plans to ensure quality rock material is economically available for the future.	High Medium Medium Low
Recreation	Work with recreation groups to jointly remedy problems, assist in project planning, and develop opportunities to prevent future problems.	1. Address recreation issues and conflicts in a timely manner. 2. Continue to encourage dispersed recreational opportunities by working with landowners and state agencies to maintain minimal access to public lands.	High High

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
Recreation	Provide the opportunity for a high quality recreation experience for summer and winter recreationists in a few selected areas.	1. Maintain current campgrounds, trailheads, trails, snoparks, and shelters to a high standard. Refrain from adding new facilities unless they finish or "round out" a certain type of recreation opportunity. 2. Target certain types of recreation users. The watershed is suitable for providing high-quality winter (at 4,500-feet-plus elevations) and summer recreation. 3. Maintain a summer focus in the Road 37 and Fish Lake areas.	High High High
Unauthorized Use	Minimize and/or reduce unauthorized use including dumping on federally-managed lands.	1. Continue coordination with state/county agencies to ensure that resource needs on adjacent public lands are considered and accommodated in private actions. Utilize law enforcement resources when appropriate. 2. Re-establish and update land boundaries according to current policies. 3. Review and prioritize backlog cases and take steps to resolve in a timely manner.	High High Medium
EROSION PROCESSES			
Erosion	Improve, maintain, or restore federal road systems with an emphasis on adequate drainage and surfacing.	1. Maintain adequate drainage facilities, such as when installing new culverts to provide for a 100-year flood event, on all federally-maintained roads open for administrative access during the wet season. 2. Maintain a minimum of four inches of rock surfacing on all federally-maintained roads open for administrative access during the wet season. 3. Prioritize watershed restoration projects in areas where roads accelerate landslide and erosion near Riparian Reserves. 4. Improve or install new drainage systems and surfacing on non-system roads near Riparian Reserves or unstable terrain. 5. Consider closing or rerouting the lower end (first mile) of Forest Service road 3730800. 6. Close all natural surface roads during the wet season.	High High High High High Medium

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
Erosion	(continued)	(continued) 7. Consider closing roads on federally-administered land where high road densities exist (see Table 2 of Synthesis/Interpretation section). 8. Decommission or obliterate roads not critical for future management activities as identified in a Transportation Management Objective (TMO) plan. 9. Provide a vegetative surfacing (native grass and conifers) on natural surface roads that are closed year-round.	Medium Medium Medium
	Protect active and potentially active landslides and severely eroding areas.	1. Designate Riparian Reserves to include active and potentially active landslides. Buffer any management activities 200 feet above, to the bottom of slide deposits, and 75 feet along the sides of active and potentially active landslides. 2. Recent or active landslides in or near Riparian Reserves should be the highest priority when selecting restoration activities. 3. Restore active landslides and eroded terrain that contribute sediments to streams by planting conifers, installing retaining structures or other stabilizing material. 4. Inventory all federal lands to identify and prioritize potential restoration projects. 5. Avoid regeneration harvest treatments in canyon sideslope terrain. 6. Avoid regeneration harvest in the lava plateau and valley floor terrain landforms until areas with forested stands less than 30 years old is 15 percent or less of total forested land base.	High High High High Medium Low
	Reduce sediments and pollutants from rock quarries.	1. Avoid developing rock quarries in Riparian Reserves. 2. Rehabilitate abandoned rock sources to reduce sediments and pollutants.	High Medium
SOIL PRODUCTIVITY			
Soil Productivity	Minimize the effects of fire to the soil.	1. Avoid prescribed burning in areas where severe erosion and/or landslides occur (unsuitable - U3 terrain on USFS).	High

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
Soil Productivity	(continued)	(continued) 2. Implement cool prescribed burns to maintain 50 percent duff and litter on site. Consider aspect, slope steepness, soil depth, and duff/litter cover when writing burn plans.	Medium
	Minimize soil productivity losses due to compaction.	1. Limit tractor skid roads to less than 12 percent of the harvest area with less than 6 percent loss in soil productivity. 2. Accomplish skidding during the time of the year when soil moisture levels are low (less than 15 percent) in areas with fine-textured soils and high rock content where mitigation efforts are difficult.	High Medium Clay soils
	Restore land that has been taken out of production.	1. Consider decommissioning or obliterating roads in areas where road densities are high in order to put land back into plant production (see Appendix F).	Medium
	Manage for an abundance of coarse woody material in various decaying conditions in forested areas across the landscape.	[redacted]	High
	Minimize loss of topsoil.	1. Maintain a vegetative cover on the soil across the landscape throughout most of the year. 2. Minimize and mitigate bare soil areas caused by logging, road building, burning, and overgrazing.	High Medium
PLANT SPECIES AND HABITAT			
Non-Native Plant Species and Noxious Weeds	Prevent or discourage the spread of non-native plant species and noxious weeds. Prevent or discourage any increase in abundance of these species where they currently exist in the watershed.	1. Use grazing systems designed to encourage native grasses and discourage non-native annual grasses on upland range. Where this is not possible or practical, set livestock forage utilization limits and distribution requirements that do not contribute to further increase of non-native species on the range.	High

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
Non-Native Plant Species and Noxious Weeds	(continued)	(continued) 2. Emphasize prevention activities. In addition to the recommendation for rangelands above, other prevention activities are: a. Minimize ground disturbance in the watershed. b. Use native species from local gene pools when plant materials are needed for project use. If the native species are unavailable or unsatisfactory, use non-invasive or non-persistent non-native species. c. Clean vehicles and equipment after being in known noxious weed infestation areas. 3. Follow recommendations for control and/or eradication of noxious weeds in Vegetation. 4. Consider use of sterile and/or competitive grasses on disturbed sites to prevent encroachment of noxious weeds, especially on low elevation sites. Later, if appropriate, convert to native species.	High High High
Survey and Manage, and Protection Buffer Species	Maintain or enhance the viability of survey and manage, and protection buffer bryophytes, lichens, fungi, and vascular plants.	1. Protect, maintain, or improve known special status species habitats. 2. Survey potential habitat for component two species, non-vascular plants, and fungi in the watershed.	High High
Special Areas with Botanical Resources	Maintain or enhance the natural area qualities and botanical resources in the special areas.	1. Monitor livestock use and make appropriate changes to grazing management if needed to maintain native plant communities in Irene Hollenbeck Environmental Education Area. 2. Monitor recreation use around lakeshore in Lost Lake Research Natural Area. Take remedial action if current conditions appear to be detrimental to native aquatic organisms or ecosystem processes. 3. Consider using prescribed fire to encourage desirable structure and composition of plant communities in Round Top Research Natural Area.	High High High

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
Rare Vascular Plants	Maintain or enhance the viability of rare vascular plant species in the watershed.	1. Initiate population and habitat monitoring for the eight species that occur on federal land, which are thought to be at risk of extirpation within the next 100 years. 2. Initiate habitat improvement efforts and enhancement activities for the species at risk of extirpation when effective methods appear to be available. Initially, consider effective projects may be: a. Fencing to exclude livestock from populations of *Allium campanulatum* and *Camissonia ovata.* b. Prescribed fire to create or maintain habitat for *Microseris laciniata ssp. detlingii.* 3. Continue the process of surveying project areas for rare plant populations, assessing the effects of proposed projects on these populations, assessing the importance of these populations to species viability at a variety of geographic scales, and mitigating or protecting as needed.	High High High
Noteworthy Habitats and Unusual Plant Communities	Maintain, enhance, and/or restore noteworthy habitats and unusual plant communities not found in the majority of the watershed.	1. Monitor, evaluate, and adjust livestock management practices where appropriate to maintain or improve native plant communities on moist mountain meadows. 2. Follow recommendations in the vegetation section for "pine series stands", "native grass/oak woodland", and "shrublands" to maintain or increase acreage of oak/pine savannah on appropriate sites. 3. Use silvicultural techniques and planting stock that encourage the future presence of western white pine on favorable sites at middle and higher elevations in the watershed. 4. Use cutting, prescribed fire, or other disturbance to regenerate older declining aspen stands, followed by protection of new suckers from grazing and browsing. Consider these same activities on the perimeter of younger stands to encourage them to spread.	High High High High

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
VEGETATION			
Seedlings through Poles, Large Poles, Mature, and Late-Successional Vegetation Classes	Increase growth, quality, and vigor of individual trees. **This objective is the most critical for preventing mortality of additional trees.** The stocking level of Douglas-fir needs to be managed in the Interior Valley and Mixed Conifer zones, and white fir in the White Fir Zone.	1. Reduce timber stand densities when the stands have a relative density index of 0.55 or greater by using appropriate silvicultural prescriptions to decrease the number of trees per acre (or basal area), to a relative density index of approximately 0.30 to 0.40. 2. Manage for species composition by aspect (pine on south and west aspects; Douglas-fir on east and north, etc.). 3. Use pruning as an option for improving wood quality in fast-growing pole stands.	High High Low
	Design and develop a diverse landscape pattern and contiguous areas of multi-layered, late-successional forest (timber stands with diversified stand structure in regard to tree height, age, diameter classes, and species composition through uneven-aged management) over time. To meet the retention requirement on federal forest lands, no less than 15 percent would be in a late-successional class (Appendix H). Additional late-successional stands will be present outside of Riparian Reserves and areas of connectivity, most likely as isolated pockets of refugia. The remainder of the forest lands would be in earlier stages of seral development.	1. Prescribe silvicultural treatments that promote contiguous areas of mature and late-successional forest land. 2. Use single tree selection, group selection, irregular uneven-aged and intermediate cutting treatments (thinning and release) methods, in combination or singly, when necessary to create diversified stand structure of varying seral stage development and create late-successional stand characteristics. 3. Commercial thin even-aged, single-story canopy stands that are within the designated 15 percent late-successional retention areas. 4. Consider selective harvest where dwarf mistletoe infestations have killed moderately sized patches of trees within the retention areas.	High High High High
	Treat low elevation pine stands selected to meet the 15 percent late-successional retention requirement as soon as possible to restore pine species as the dominant species.	1. Use the single tree selection and group selection methods to establish pine species regeneration on dry, ponderosa pine sites. Douglas-fir should be the species targeted for harvest from these sites. 2. Create open park-like pine stands over time that have diverse stand structure (many different age classes and canopy layers).	High High

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
Seedlings through Poles, Large Poles, Mature, and Late-Successional Vegetation Classes	Create openings and suitable seedbeds to promote the establishment and growth of pine species (especially white pine), incense cedar, Engelmann spruce, and Douglas-fir. Increase the species composition of these species in forest stands where they are under represented.	1. Use the group selection method to create openings of 0.25 to 2.0 acres. Approximately 5 to 20 percent of the commercial forest lands would receive the group selection method of harvest with a random pattern of group distribution across the landscape. 2. Create favorable seedbed conditions for ponderosa pine through prescribed burning or other methods that would reduce the thickness of the soil duff layer, especially around the pine trees. Plant trees in the openings to ensure adequate stocking of pine species.	High High
	Assure survival of individual trees with late-successional characteristics by reducing vegetation competition in second growth timber stands. This also preserves genetic material.	1. Reduce competition in matrix lands by removing second growth trees that surround trees with late-successional characteristics. Create an approximate 25-foot crown space between the old tree and the remaining second growth trees. Cut only trees that are not associated (crowns entwined) with the late-successional tree.	High
	Design silvicultural prescriptions to manage dwarf mistletoe infestations (for Matrix lands, but may be applied to late-successional areas).	1. Use selection method, pruning, and prescribed burning methods to control the rate and intensity of the parasite. Keep the mistletoe in draws and off of ridges.	High
	Use selection silvicultural methods to manage for root rot (*Phellinus weirii* and *Armillaria mellea*) where prevalent in forest stands (for Matrix lands, but may be applied to late-successional areas).	1. Use single tree and strip selection methods to control the spread of the root rot. 2. Plant resistant species in openings created by tree mortality. 3. Use the selection silvicultural methods to develop diverse stand structure and species composition over time in the infected areas.	High High High
	Reduce the fire hazard of the timber stands by decreasing the ladder fuels while meeting the needs identified under other resource programs (for Matrix lands, but may be applied to late-successional areas).	1. Decrease the ladder fuels in forest stands by cutting only dense patches of suppressed tree regeneration and shrub species, and the pruning of tree limbs. These treatments should eliminate fire fuels to a height of 6 to 12 feet above ground level. Cut tree limbs that extend into the pruning height area. 2. Form a mosaic of vegetative patterns by leaving untreated patches of vegetation scattered throughout the landscape.	High High

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
Seedlings through Poles, Large Poles, Mature, and Late-Successional Vegetation Classes	Retain at least 15 percent of all project areas, distributed throughout the landscape in an untreated condition. Untreated areas should be a minimum of 2.5 acres in size and can be in any combination of vegetation condition classes.	1. Use landscape design to maintain designated patches of untreated vegetation in strategic locations (e.g., Riparian Reserves; critical habitat; wildlife corridors; areas between existing tree plantations, shrublands, woodlands, etc.).	High
	Provide for well distributed coarse woody material (CWM - Any large piece of woody material having a diameter greater than 4 inches and a length greater than 39 inches) across the landscape for maintaining the ecological functions of the species dependent on coarse wood (Appendix I). Protect the largest coarse woody material already on the ground from management activities to the greatest extent possible.	1. Leave a minimum of 120 linear feet of class 1 and 2 logs per acre greater than or equal to 16 inches in diameter at the large end and 16 feet in length in regeneration harvest areas (USDA AND USDI 1994 & Appendix I).	High
		2. Amounts of CWM can be modified in areas of partial harvest to reflect the timing of stand development cycles that provide for snags and subsequent CWM from natural suppression and overstocking mortality. The advantages of treatment to improve habitat conditions beyond natural conditions should be assessed. The amount of CWM to leave should fall within a range of the average natural distribution. For projects in the watershed, no less than 15 to 20 percent ground cover of CWM or less than 4.5 tons/acre will be acceptable. Smaller log pieces may be counted when they meet designated standards (Appendix J). Leaving green trees and felling to provide a source of CWM should be part of the partial harvest prescription. The intent is to provide a source of CWM well distributed across the landscape after harvesting. Amounts of CWM to be retained across the landscape should be analyzed at the project level.	High
		3. Perform surveys to determine average amounts of coarse woody material over the landscape for the commercial timber land base and the respective vegetation zones.	High
		4. Gradually recruit CWM levels over time in partial harvest areas that are appropriate for the site (for each respective vegetation zone). It may take two to three stand entries to acquire desired amounts of CWM especially in regard to large end log diameter requirements.	Medium

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
Early Seral and Seedlings Vegetation Classes	Enhance structural diversity of existing, young even-aged forest stands.	1. Enhance the structural diversity of these vegetation classes by precommercial thinning treatments at staggered intervals and favoring trees of different heights and species at the time of treatment. 2. Perform release treatments as needed.	Medium Medium
Hardwood Vegetation Class	Maintain or improve the natural functions and processes of the native grass/oak woodlands plant associations where appropriate.	1. Manipulate vegetation species as necessary to maintain the natural functions and processes of the native grass/oak woodland plant associations. 2. Discourage high stocking densities of conifers by using manual treatments and prescribed burning. 3. Manage the abundance of shrub and noxious weed species. 4. Reduce the density of hardwoods to increase water and nutrient availability to the hardwoods for mast production where necessary. 5. Use prescribed burning to accomplish recommendations 1 through 4. 6. Seed native grass species into areas of exposed, disturbed soil before noxious weeds become established.	High High High High High High
	Introduce a younger age class into the oak woodlands.	1. Cut suppressed and intermediate crown class trees to induce sprouting. Manage the sprout clumps to favor growth of the dominant sprouts. After the vigor is restored to the oak trees, acorn crops should provide for more natural regeneration. 2. Plant oak trees where appropriate.	Medium Low
	Maintain well distributed quaking aspen stands.	1. Use coppice methods or prescribed burning to manage for young, even-aged stands of aspen. 2. Consider cutting or burning adjacent conifer stands that have encroached upon historic aspen sites to enlarge the quaking aspen stands. 3. Consider fencing aspen stands to prevent grazing damage to the stands.	High High Medium
Shrub Vegetation Class	Maintain the integrity of the shrublands.	1. Manage the density and species composition of the shrubs. 2. Concentrate density reduction efforts on the extremely dense shrublands on the south facing slopes and where there is critical big game habitat. 3. Manage tree species to maintain the dominance of the desired shrub species. 4. Control or retard the spread of non-native species especially noxious weeds.	High High Medium Low

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
Grass Vegetation Class	Maintain and/or improve the species composition of the native grasslands.	1. Treat tree and shrub species with prescribed fire to maintain the dominance of native grasses. 2. Seed native grasses on recently disturbed areas to prevent the establishment of noxious weeds. 3. Control or retard the spread of non-native species especially noxious weeds. 4. Develop a native grass propagation program for grasses found in the watershed.	High High Medium Medium
FIRE			
Resource Protection	Promote long-term resistance of the lower and mid elevation areas to stand replacement wildfires by reducing the fuel hazard.	1. Treat areas of continuous high hazard fuels in order to help reduce the size and intensity of wildfires. High priority areas would be adjacent to the rural interface area and adjacent to high values at risk. Treatments should include commercial thinning of overstocked stands and treatment of ground and ladder fuels in both commercial and noncommercial timber lands. 2. Develop overall project strategy to reduce fuel hazard in previously harvested areas. As stand improvement projects are implemented, there is the potential for the creation of large continuous acres of high hazard fuel. The project strategy will determine how to treat activity fuels that are created, and how many acres at any given time should be treated in order to minimize the amount of acres that would be in a high fuel hazard condition. 3. Utilize prescribed burning to maintain plant communities such as grasslands and oak woodlands. Fire will not only maintain these communities but also reduce the fuel hazard of these areas.	High High High

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
Safety	Improve firefighter and public safety conditions for future wildfire incidents across the landscape. Safety is jeopardized as fuels accumulate.	1. Treat high hazard areas around the rural interface areas. Reduce canopy closures, ground and ladder fuels in order to increase protection of private lands and structures. Treatment of fuels within the rural interface is mostly dependent on factors outside the control of the BLM and Forest Service.	High
		2. Maintain current fire access routes. These routes are needed to allow quick response times to wildfire starts and escape routes for the public and firefighters.	High
		3. Treat fuels adjacent to identified high values at risk such as recreation and historic sites. Treatments would include underburning, slashing and brushing, lop and scatter, and handpile and burn.	High
		4. Allow for viewing visibility around the Robinson Butte Lookout.	High
TERRESTRIAL WILDLIFE SPECIES AND HABITAT			
Terrestrial Wildlife Species and Habitat	Maintain or enhance current native terrestrial wildlife populations and distribution.	1. Develop and maintain an appropriate amount and distribution of seral stages of the various plant communities found in the watershed.	High
		2. Identify, protect, and where appropriate, enhance the special habitats identified in the agencies resource/land management plans, such as caves/mines, talus, wetlands, and meadows.	High
		3. Maintain adequate numbers of snags and amounts of coarse wood material (see Vegetation section) for those species that require these special habitats for breeding, feeding, or sheltering.	High
		4. Identify and protect, maintain, or improve dispersal corridors within the watershed and between adjacent watersheds.	High
		5. Develop site specific management plans for federally-listed species currently lacking plans.	High
		6. Close roads in subwatersheds where densities are greater than 1.5 miles per square mile of land.	High
		7. Restore oak/pine woodlands through prescribed fire and appropriate silvicultural methods.	High
		8. Rehabilitate/rejuvenate shrub/winter range for deer and elk through prescribed fire.	High

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
Terrestrial Wildlife Species and Habitat	Ensure management activities do not lead to listing of special status species as threaten or endangered.	1. Inventory special status species suspected to occur in the watershed. 2. Protect, maintain, or improve habitat conditions as necessary for those special status species found.	High High
HYDROLOGY			
Hydrology	Maintain and enhance in-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. Protect the timing, magnitude, duration, and spatial distribution of peak, high, and low flows (Aquatic Conservation Strategy Objective #6).	**Reduce the potential for altering the timing, magnitude, duration, frequency and spatial distribution of peak flows through the following:** 1. Reduce soil compaction by decommissioning or obliterating roads and where appropriate, ripping skid trails. Particular emphasis should be given to areas with high road density (Appendix F). 2. Manage for no net increase in the amount of roads in the Key Watershed. 3. Allow for 100-year runoff events, including associated bedload and debris, when installing new stream crossing structures and for existing stream crossing structures that pose substantial risk to riparian reserves. 4. Manage vegetation within the transient snow zone to minimize large openings. Analyze site-specific projects for cumulative watershed effects on a drainage area (generally less than 6,000 acres) basis. Assess watershed conditions (e.g., riparian and stream channel condition, geomorphic landform, slope stability, precipitation, and compacted area) and reference conditions (including natural variability) to determine the percent hydrologic recovery that is appropriate for each drainage area. The following crown closure percentages (based on a combination of hardwoods and conifers) listed by forest zone, tree species, and aspect are considered to represent full hydrologic recovery.	 High High High High

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
Hydrology	(continued)	4. (continued) Interior Valley Zone Series / Aspect / % Canopy Closure Pine / south, west / 30-40 Pine / north, east / 40 Douglas-fir / north / 60 Douglas-fir / south, west, east / 50 Mixed Conifer Zone Series / Aspect / % Canopy Closure Pine / south, west / 40 Pine / north, east / 40-50 Douglas-fir / north / 70 Douglas-fir / south, west, east / 60 White Fir Zone Series / Aspect / % Canopy Closure White fir / all / 70	
		5. Reduce upland fire hazard to minimize potential for catastrophic wildfires.	High
		Attempt to increase summer flows through the following:	
		6. Develop public/private partnerships to work on methods that efficiently transport ditch water, conserve water, and maximize in-stream flows.	High
		7. Encourage compliance with State regulations and permit limitations for water diversions, ditches, and pipelines on public lands.	High
		8. Encourage spring protection and minimize surface/groundwater diversions on public lands to ensure attainment of the Aquatic Conservation Strategy Objectives.	High
	Maintain and enhance the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands (Aquatic Conservation Strategy Objective #7).	1. Avoid wetlands when constructing new roads.	High
		2. Minimize soil compaction due to existing roads or skid trails in meadows and wetlands by decommissioning or obliterating roads and ripping skid trails.	High
		3. Follow interim Riparian Reserve widths identified in the ROD Standards and Guidelines for wetlands greater than one acre. Designate Riparian Reserve widths of 100 feet slope distance from the outer edge of wetlands less than one acre.	High

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
STREAM CHANNEL			
Stream Channel	Maintain and enhance the natural channel stability by allowing streams to develop a stable dimension, pattern, and profile. Allow the natural dynamic actions of streams to connect with their floodplain.	1. Evaluate roads that are adjacent to stream channels and consider decommissioning, obliteration, or rerouting to restore the floodplain. 2. Consider not rebuilding the USFS 3730800 bridge. If rebuilt, provide for floodplain drainage through bridge approaches by using culverts or spanning the floodplain or other methods that are effective. 3. Reduce stream width-to-depth ratios in appropriate stream reaches, while maintaining a stable dimension, pattern, and profile. Methods for reducing width-to-depth ratios include promoting point bar development through riparian vegetation and other energy dissipators.	High High Medium
	Maintain and enhance the physical integrity of the aquatic system, including stream banks and bottom configurations (Aquatic Conservation Strategy Objective # 3).	1. Promote growth of conifer trees within Riparian Reserves, using silvicultural methods if necessary to reach late-successional characteristics (where capable) for future large wood recruitment (see Riparian section). 2. Maintain or enhance the streams' ability to dissipate the energy from high flows. Forms of energy dissipation include meanders, large woody material or boulders, and riparian vegetation. 3. Minimize livestock grazing impacts on streambanks and riparian vegetation.	High High High
	Maintain and enhance the sediment regime under which the aquatic ecosystem evolved (Aquatic Conservation Strategy Objective # 5).	1. Stabilize eroding stream banks. 2. Minimize sediment delivery to streams from roads and unstable areas (see Water Quality recommendations). 3. Reduce the potential for altering the timing, magnitude, duration, frequency, and spatial distribution of peak flows (see Hydrology section).	High High High

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
WATER QUALITY			
Water Quality	Maintain and enhance water quality necessary to support healthy riparian, aquatic, and wetland ecosystems (Aquatic Conservation Strategy Objective # 4). Increasing summer flows and reducing summer stream temperatures and sedimentation are the principal water quality objectives in the Little Butte Creek Watershed.	1. Apply appropriate Best Management Practices (BMPs) to minimize soil erosion and water quality degradation during management activities.	High
		Increase summer flows: See Hydrology recommendations.	
		Reduce summer stream temperatures through the following (see Stream Channel recommendations):	
		2. Plant or maintain native species (from local genetic stock) in riparian areas and wetlands to provide adequate stream shading.	High
		3. Protect riparian vegetation that provides stream shading as specified in the Riparian recommendations.	High
		4. Reduce stream width-to-depth ratio (see Stream Channel recommendations).	Medium
		Reduce stream sedimentation through the following (see Stream Channel recommendations):	
		5. Obliterate, decommission, or upgrade (i.e., improve drainage, surface and stabilize) roads as necessary to reduce sedimentation and meet transportation management objectives. Highest priorities for road treatments are roads contributing large amounts of sediment to streams and roads in riparian reserves, unstable areas, and midslopes. (Map 29)	High
		6. Stabilize actively eroding landslide areas that are contributing sediment to streams. (Map 29)	High
		7. Continue to exclude the Upper Lake Creek deferral area (Map 29) from management activities that would increase the cumulative effects in the drainage area.	High

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
RIPARIAN AREAS			
Riparian Reserves	Maintain and enhance Riparian Reserve habitat to support well-distributed populations of native plant, invertebrate, and vertebrate riparian-dependent species, especially taking into consideration long-term plant community changes. Maintain Riparian Reserves whose climax vegetation structure includes conifers in a range of stand conditions possessing late-successional characteristics from those with open park-like conditions where fire is a frequent occurrence to the dense multi-layered stands where fire is less frequent. Allow Riparian Reserves whose climax vegetative structure does not include conifers, but which historically were hardwood or non-forest type (grass, herbaceous, shrub, or barren), to revert to and be maintained in those conditions.	1. Follow the interim Riparian Reserve widths outlined in the ROD until site-specific analysis occurs at the project level. 2. Follow the Riparian Reserve module to implement Riparian Reserve boundary changes. The following recommended actions which will maintain, improve, or hasten attainment of the objectives are detailed in Section C of the Standards and Guidelines (S&Gs) in Attachment A to the Record of Decision pertaining to the Northwest Forest Plan. These S&Gs address specific constraints to timber management, roads, grazing, etc., on public lands. Some of the more important S&Gs pertaining to the Little Butte Creek Watershed are listed below. ***Riparian Silviculture (listed in order of priority)*** 1. Give Riparian Reserves located adjacent to coho salmon and steelhead trout fish-bearing streams the highest priority for restoration to late-successional characteristics. 2. Implement riparian silviculture to reduce fire hazard and/or risk of bark beetle attacks where the large conifer component (>24 inch DBH) within the Riparian Reserves of fish-bearing streams at risk of damage (or elimination) due to high fire hazard/risk or bark beetle attacks. * 3. Implement riparian silviculture (density management and riparian planting) in Riparian Reserves to increase the large conifer component in fish-bearing streams, with early and mid-successional stands. * 4. Implement riparian silviculture to reduce fire hazard and/or risk of bark beetle attacks where mid-successional stands in the Riparian Reserves of intermittent and ephemeral, non-fish-bearing streams are at risk of damage (or elimination) due to high fire hazard/risk or bark beetle attacks. *	High High High High High Medium

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
Riparian Reserves	(continued) Manage for Riparian Reserves that will support a diversity of native plants, provide canopy closure that maintains stream temperatures, provide connecting habitat, support healthy populations of wildlife species, serve as effective filters of sediment from upslope sources, provide stable streambanks and promote a future diverse, large, mature, conifer component which contribute to high quality aquatic habitat.	4. (continued) * **Leave a "no touch" riparian buffer (25 to 50 feet on both sides of stream) along fish-bearing and perennial streams in commercial thin units to protect canopy cover, microclimate, water quality, area stability, macroinvertebrates, and other aquatic components.** **Consider leaving a "no touch" riparian buffer (25 to 50 feet on both sides of stream) along intermittent streams in commercial thin units and all streams in pre-commercial thin units to protect canopy cover, microclimate, water quality, area stability, macroinvertebrates, and other aquatic components.**	
		Roads, Skid Trails, and Landings	
		Give the highest priority for restoration to Riparian Reserves most impacted by road development and/or located in the unstable upland and landslide bench terrain.	
		1. Where possible, obliterate existing roads within Riparian Reserves and reroute them to less sensitive areas; replant these road corridors to native tree species.	High
		2. Stabilize roads within Riparian Reserves that will not be removed to control sediment (see Erosion Processes recommendations).	High
		3. Decommission skid trails and landings located within Riparian Reserves; plant conifers where they have not yet recovered.	High
		Grazing	
		1. Identify specific grazing problems in Riparian Reserves, especially wetlands and streambanks and institute corrective measures.	High

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
AQUATIC WILDLIFE SPECIES AND HABITAT			
Aquatic Wildlife Species and Habitat	Maintain viable anadromous and resident salmonid fish populations with individuals of all life stages throughout their habitat. Maintain or enhance aquatic wildlife populations including listed and proposed for listing species, their distribution, habitat and long-term sustainability. Restore and protect aquatic habitat for all anadromous and resident fish. Restore and protect spatial and temporal connectivity within and between watersheds.	1 Ensure that management activities on public lands meet the Aquatic Conservation Strategy (ACS), Rogue River National Forest (RRNF) and Medford BLM land and resource management plans, and Best Management Practices (BMPs) by following recommendations in the Matrix of Factors and Indicators for Properly Functioning Conditions (Appendix L).	High
		2. Restore and/or diversify fish habitat and floodplain connectivity to maintain pool habitat, fish cover, spawning gravels, and bank stability.	High
		3. Promote future large wood recruitment in Riparian Reserves. High priorities for restoration are the "flats" in South Fork Little Butte and Antelope creeks.	High
		4. Average between 40 to 100 pieces per mile of large wood material (greater than or equal to 24 inches at the smaller end and 50 feet or two times the bankfull width in length) in the stream channel. This amount will vary by channel morphology and vegetative conditions. This condition will not be achieved for 100 to 300 years unless wood structures are placed instream. Wood structures in some segments may not be appropriate until the sediment and temperature regime has been corrected.	High
		5. Re-create complexity and maintain side channel habitat adjacent to lowgradient stream segments (<2 percent/Rosgen C type, "flats") necessary for coho rearing.	High
		6. Accomplish restoration in South Fork Little Butte Creek and its tributaries, which are in a critical watershed that supplies high quality cool water.	High
		7. Inventory and prescribe restoration measure for roads in hyperzhoic zones and unstable sideslopes.	High
		8. Provide for spatial and temporal connectivity within and between drainages. Replace existing stream crossings (e.g., culverts, low water fords) to facilitate fish passage for all fish species and age classes during all flow conditions.	High
		9. Improve stream channel dimension, pattern, and profile. Adhere to Stream Channel recommendations.	High
		10. Design new or reconstruct old bridges to allow for stream meandering during high flow events.	High

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
Aquatic Wildlife Species and Habitat	(continued)	(continued)	
		11. Acquire available private land within riparian areas for federal ownership to ensure protection under the ACS.	High
		12. Improve water quality and increase water quantity. Adhere to Water Quality and Hydrology recommendations. In the short term, attain summer seven day average of the maximum daily stream temperatures less than 65 degrees Fahrenheit throughout the watershed. In the long-term, maximum daily temperatures are reduced to approximately historic levels, 56 to 62 degrees Fahrenheit.	High
		13. Minimize grazing impact to streambanks and riparian areas. Adhere to Riparian recommendations.	High
		14. Reduce stream substrate embeddedness by minimizing erosion. Channels with gradients of less than 2 percent will have less than 35 percent embeddedness of cobbles and gravels providing interspaces available for insects, fish, and amphibians.	High
		15. Identify and repair roads contributing to excessive sediment delivery to streams. Analyze roads adjacent to stream courses in Riparian Reserves. Correct areas with inadequate road drainage to reduce sediment delivery to aquatic habitats. Replace culverts in streams identified as insufficient to carry 100-year flood events. Adhere to Hydrology and Erosion recommendations.	High
		16. Provide educational opportunities for "in-house", Little Butte Watershed Council, and local schools and groups regarding improving and maintaining aquatic habitat.	High
		17. Maintain or improve vegetation within 100 feet of headwater streams/bogs/springs/wetlands for amphibian, macroinvertebrates, and other wildlife. Consider fencing springs, seeps, and water developments to protect water quality and riparian ecosystems. Develop and implement recovery plans for riparian areas as necessary.	High
		18. Maintain or enhance turtle basking habitat in slow-moving water.	High
		19. Encourage and protect beaver populations and their habitat in the Little Butte Creek Watershed to improve and diversify aquatic wildlife habitat and populations.	High

RESOURCE	OBJECTIVES	RECOMMENDATIONS	PRIORITY
Aquatic Wildlife Species and Habitat	(continued)	(continued)	
		20. Review recreation and fish objectives for lakes: stocking vs. natural production. Coordinate with ODFW and Little Butte Watershed Council.	Low
		21. Continue creating habitat complexity in Fish Lake by adding structures: brush rows and willow planting.	Low
		22. Coordinate with Little Butte Watershed Council to improve aquatic habitat, especially along low gradient stream segments.	Low
		23. Coordinate with Little Butte Watershed Council, state and federal groups to manage water diversions to restore or maintain fish passage during all lifestages, sediment routing, and irrigation ditch screening.	Low
		24. Coordinate with ODFW, DEQ, and Little Butte Watershed Council to restore necessary stream and riparian nutrient component; utilize fish carcasses.	Low
		25. Coordinate with irrigation districts, Little Butte Watershed Council, ODFW, and federal groups to develop a plan to mimic natural flows from Fish Lake dam when possible while protecting private land and residence in North Fork in order to maintain fish habitat, especially spawning gravels and coho rearing areas.	Low
		26. Coordinate with ODFW and Little Butte Watershed Council agencies to review local fishing regulations.	Low

PRIVATE LAND OPPORTUNITIES

The following is a list of possible opportunities that private land owners could do to improve and/or maintain the health of Little Butte Creek Watershed. Information regarding technical support and funding assistance for watershed restoration projects may be obtained by contacting the Little Butte Creek Watershed Council.

RESOURCE	OBJECTIVES	POSSIBLE OPPORTUNITIES
Human Uses	Promote effective public/private partnerships.	1. Participate in local watershed council meetings and other such public meetings and forums. 2. Maintain a watershed perspective (i.e., in-stream, riparian, and upland areas) of the processes that affect public and private lands.
	Preserve and protect the rich cultural heritage of the Little Butte Creek Watershed.	1. Avoid unnecessary impacts to archaeological sites on private lands (Native American and historic settler sites). 2. Coordinate with local historical societies and public agencies to share information regarding the watershed's cultural heritage. 3. Help discourage illegal collecting and digging of archaeological sites on public lands.
Non-Native Plant Species and Noxious Weeds	Prevent or discourage the spread of non-native plant species and noxious weeds.	1. Monitor, evaluate, and adjust livestock management practices where appropriate to maintain or improve native plant communities. 2. Emphasize noxious weed prevention activities such as: a Minimize ground disturbance in the watershed. b. Use native species from local gene pools when plant materials are needed for project use. If the native species are unavailable, use non-invasive or non-persistent non-native species. c. Clean vehicles and equipment after being in known noxious weed infestation areas.
All Vegetation Classes	Decrease fire hazard and increase plant vigor through vegetation density reduction operations.	1. Thin vegetation in forests, shrublands, and woodlands. Vegetation treatments in conjunction with adjacent landowners will increase the effectiveness of the operation.

RESOURCE	OBJECTIVES	POSSIBLE OPPORTUNITIES
Oak Savannah	Maintain and restore the oak savannah ecosystem.	1. Use only native grasses. 2. Employ prescribed fire. 3. Avoid conversion to coniferous forest lands.
Vernal Pools of the Agate-Winlow Soil Series	Maintain the integrity of the mounded prairies landscape.	1. Preserve the topography of the mounded prairie landscape by avoiding the leveling of fields within the Agate-Winlow soil type.
	Maintain the native flora and fauna of the mounded prairie ecosystem.	1. Restrict grazing while sensitive plants are in bloom during March, April, and early May and when the ground is saturated during the winter.
	Maintain the surface hydrology in this soil series.	1. Prevent any disruptions (channeling, impounding, etc.) of the natural surface water flows that feed the mounded prairie habitat. 2. Prevent activities that perforate or disrupt the natural hardpan that underlies the mounded prairie ecosystem.
Hydrology	Maintain and enhance in-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing.	1. Explore and utilize methods that efficiently transport ditch water, conserve water, and maximize in-stream flows. 2. Be attentive to state regulations and permit limitations for water diversions, ditches, and pipelines on public lands.
	Maintain the integrity of wetlands.	1. Avoid wetland disturbance whenever possible. 2. Adjust livestock grazing practices to keep livestock off meadows and wetlands when soil moisture conditions would result in compaction.

RESOURCE	OBJECTIVES	POSSIBLE OPPORTUNITIES
Stream Channel	Maintain and enhance the physical integrity of the aquatic system, including streambanks and bottom configurations.	1. Maintain or enhance the streams' ability to dissipate the energy from high flows. Forms of energy dissipation include meanders, large woody material or boulders, and riparian vegetation. 2. Promote growth of conifer trees within riparian areas for future large wood recruitment. 3. Stabilize eroding stream banks where possible. 4. Limit heavy equipment work in streams. 5. Be attentive to permits required for in-stream channel operations.
	Allow the natural dynamic actions of streams to connect with their floodplains.	1. Evaluate roads that are adjacent to stream channels and consider decommissioning, obliterating, or rerouting to restore the floodplain. 2. Limit development to outside the floodplain. 3. Explore alternatives to stream channel alterations.
Water Quality	Increase summer flows, reduce summer stream temperatures, and decrease sedimentation to maintain and enhance water quality necessary to support healthy riparian, aquatic, and wetland ecosystems.	1. Work with the Little Butte Creek Watershed Council and Oregon Water Trust to restore summer streamflows. 2. Plant or maintain native species (from local genetic stock) in riparian areas and wetlands to provide adequate stream shading. 3. Protect riparian vegetation that provides stream shading as specified in the Riparian Areas section. 4. Minimize sediment delivery to streams from roads, low-water fords, irrigation return flows, and unstable areas
Riparian Areas	Maintain a healthy riparian zone and a stable streambank.	1. Maintain at least 25 feet or greater of riparian vegetation such as willow, conifers, and alders along each side of all stream channels. 2. Encourage planting and maintaining native trees and shrubs; replace blackberries. 3. Assess riparian conditions on a site-by-site basis to determine the need to protect streambanks, soil, and vegetation. Consider fencing to manage livestock impacts in these areas.

RESOURCE	OBJECTIVES	POSSIBLE OPPORTUNITIES
Riparian Areas	Reduce surface erosion and mass wasting in or near riparian areas.	1. Restore eroded and unstable areas by planting native grass and tree species. 2. Protect unstable areas by conducting management activities (such as timber harvest and vegetation removal) only in stable locations.
Aquatic Wildlife Species & Habitat	Maintain or enhance aquatic wildlife populations, including listed and proposed for listing species, their distribution, habitat and long-term sustainability. Restore and protect aquatic habitat for all anadromous and resident fish. Restore and protect spatial and temporal connectivity within and between watersheds. Maintain viable anadromous and resident salmonid fish populations with individuals of all life stages throughout their habitat.	1. Coordinate with the Little Butte Creek Watershed Council to improve aquatic habitat especially along low gradient stream segments. 2. Coordinate with the Little Butte Creek Watershed Council and state and federal groups to manage water diversions to restore or maintain fish passage during all life stages, sediment routing, and irrigation ditch screening. 3. Coordinate with the Little Butte Creek Watershed Council to restore necessary stream and riparian nutrient component; utilize fish carcasses. 4. Avoid creating barriers to fish passage such as "push-up" dams.

LANDSCAPE PLANNING OBJECTIVES AND RECOMMENDATIONS

Recognizing that the landscape of the Little Butte Creek Watershed is a complex web of interacting ecosystems the watershed analysis team blended individual resource information to develop a landscape picture for federal lands. The team looked at the current condition of the terrestrial and aquatic components of the landscape and synthesized the information to formulate landscape level objectives and recommendations. These landscape level objectives and recommendations provide valuable information for planning projects and making management decisions. Map 29 shows areas across the landscape that need special consideration prior to project planning.

LANDSCAPE AREA	OBJECTIVES	RECOMMENDATIONS
Riparian Reserves	Maintain and enhance Riparian Reserve habitat to support well-distributed populations of native plant, invertebrate, and vertebrate riparian-dependant species, especially taking into consideration long-term plant community changes.	1. Follow the interim Riparian Reserve widths identified in the ROD Standards and Guidelines. 2. Follow Riparian Reserve module to change boundary widths. 3. Use silvicultural treatments as needed to meet Aquatic Conservation Strategy objectives. 4. Reroute, obliterate, and/or decommission roads, skid trails, and landings within Riparian Reserves where appropriate.
Active Landslides Designated as Riparian Reserves	Protect unstable and potentially unstable areas.	1. Designate Riparian Reserves to include active and potentially active landslide areas. 2. Buffer any management activities 200 feet above, to the bottom of slide deposits, and 75 feet along the sides for active and potentially active landslides.
Late-Successional Reserve (LSR)	Protect and enhance conditions of late-successional and old-growth forest ecosystems, which serve as habitat for late-successional and old-growth forest related species including the northern spotted owl.	1. Define desired conditions for amounts of coarse wood and number of snags per acre for LSR stands. 2. Implement silvicultural treatments as needed to attain desired levels identified for coarse wood and number of snags per acre.

LANDSCAPE AREA	OBJECTIVES	RECOMMENDATIONS
Late-Successional Reserve (LSR)	(continued)	(continued) 3. Assess connectivity within the LSR for late-successional dependent species. Target younger stands for conversion to late-seral stages which would increase connectivity across the landscape. 4. Reduce road density within the LSR by rerouting, obliterating, and/or decommissioning roads, skid trails, and landings where appropriate.
Wilderness Area	Manage the Sky Lakes Wilderness to protect its resource values and to maintain its natural conditions.	1. Follow the management strategy for wilderness in the Rogue River National Forest Land and Resource Management Plan and the Sky Lakes Wilderness Implementation Plan.
Key Watershed Designation	Provide refugia for at-risk stocks of andromous salmonids and resident fish species in the Tier 1 Key Watershed.	1. Reduce existing system and nonsystem road mileage, resulting in no net increase in the amount of roads in the Key Watershed. 2. Emphasize watershed restoration in the Key Watershed to improve water quality and increase summer streamflows.
15 Percent Late-Successional Retention Areas	Meet or exceed the 15 percent late-successional retention requirement on federal forest lands to provide habitat to function as refugia for old-growth associated species that have limited dispersal capabilities such as fungi, lichens, bryophytes and vascular plants.	1. Identify and maintain all stands that currently meet the retention criteria (multi-storied stands with greater than 21" d.b.h. and greater than 60 percent canopy cover). 2. Reserve late-successional stands in all vegetation zones. 3. Spread retained areas evenly over the landscape where possible. 4. Identify and treat target stands for conversion to late-successional or old-growth habitat that will support a more connected network of continuous habitat than currently exists. 5. Treat reserve stands to maintain and create late-successional components, such as canopy cover, snags, and class I and II coarse wood (see Management Objectives and Recommendations, Vegetation, for coarse woody material amounts).

LANDSCAPE AREA	OBJECTIVES	RECOMMENDATIONS
15 Percent Late-Successional Retention Areas	(continued)	(continued) 6. Prescribe silvicultural treatments aimed at restoring and preserving late-successional pine characteristics in pine associated stands that have been identified for retention, but are overstocked with Douglas-fir and other species.
Special Areas	Manage Hole-in-the-Rock as an area of critical environmental concern, for scenic and geological values. Manage Lost Lake and Round Top Research Natural Areas for scientific research and baseline study area. Manage Hollenbeck Environmental Education Area for environmental education.	1. Follow management specified in the BLM Medford District Resource Management Plan.
Deferred Areas	Maintain or improve water quality in Upper Lake Creek deferral area.	1. Continue to exclude the Upper Lake Creek deferral area (as identified in the BLM Medford District Resource Management Plan) from management activities that would increase the cumulative effects in the drainage area.
High Fire Hazard Areas	Treat all vegetation condition classes in strategic locations, especially commercial forest stands, to ensure their survival from insects and fire, and enhance seral and structural development of the condition classes.	1. Develop prescriptions that reduce fire hazard and improve vegetation health to protect natural resources or sites of cultural value from biotic disturbances (fire and wind). 2. Manage vegetation density of all vegetation condition classes to accomplish this objective. 3. Use selection silvicultural harvest methods to create or enhance the development of late-successional forests. 4. Treat pine series forest in the commercial base to create open park-like structure. 5. Target Douglas-fir stands for density management adjacent to shrublands or woodlands on south and west slopes, or on ridges that receive sunlight for most of the day.

LANDSCAPE AREA	OBJECTIVES	RECOMMENDATIONS
Wildlife Connectivity	Maintain connectivity between the Little Butte Creek Watershed and surrounding watersheds.	1. Develop management/action plans for habitat reserves, e.g., Riparian Reserves, Unmapped Late-Successional Reserves, and other reserves that meet the 15 percent late-successional retention standard and guide criteria. 2. Provide a variety of vegetative condition classes in the matrix surrounding the habitat reserves.
Critical Habitat Unit OR-37 (Matrix lands)	Provide nesting, roosting, foraging and dispersal habitat.	1. Manage the landscape adjacent to activity centers to protect them from large-scale landscape disturbances such as wildfire. 2. Maintain high canopy closure in mature/late-successional conifer stands adjacent to activity centers. 3. Avoid reduction of conifer stand canopy closure below 40 percent on expansive areas.
Transient Snow Zone	Protect the timing, magnitude, duration, and spatial distribution of peak streamflows.	1. Manage vegetation within the transient snow zone to minimize large openings. Analyze site-specific projects for cumulative watershed effects on a drainage area (generally less than 6,000 acres) basis. Assess watershed conditions (e.g. riparian and stream channel condition, geomorphic landform, slope stability, precipitation, and compacted area) and reference conditions (including natural variability) to determine the percent hydrologic recovery that is appropriate for each drainage area. The following crown closure percentages (based on a combination of hardwoods and conifers) listed by forest zone, tree species, and aspect, are considered to represent full hydrologic recovery.

LANDSCAPE AREA	OBJECTIVES	RECOMMENDATIONS
Transient Snow Zone	(continued)	(continued) Interior Valley Zone Series / Aspect / % Canopy Closure Pine / south, west / 30-40 Pine / north, east / 40 Douglas-fir / north / 60 Douglas-fir / south, west, east / 50 Mixed Conifer Zone Series / Aspect / % Canopy Closure Pine / south, west / 40 Pine / north, east / 40-50 Douglas-fir / north / 70 Douglas-fir / south, west, east / 60 White Fir Zone Series / Aspect / % Canopy Closure White fir / all / 70
Roads of Concern	Reduce road density and road-caused erosion, stabilize roads that are unstable, and reduce road-caused wildlife harassment.	1. Review roads of concern listed in Appendix K and consider stabilizing, closing, or decommissioning.

DATA GAPS

This section identifies information that was not available for the analysis. Items under each ecosystem element/subelement are listed in priority order.

Human Uses

Unauthorized Use

1. Property lines in locations where unauthorized use is suspected.

Transportation

1. Road condition surveys.
2. Transportation management plan.
3. Updated transportation management objectives.
4. Updated maintenance operation plan.

Grazing

1. Potential cooperative livestock related projects on private lands within the watershed.

Archaeological Sites

1. Systematic archaeological survey.
2. Formal evaluation of known archaeological sites.

Erosion Processes

1. Field inventory and GIS mapping of all recent and active landslides and severely eroded terrain on federal lands.
2. Sedimentation rates/volumes from surface erosion and landslides.
3. Quantification of landslide and erosion rates accelerated by federal land management (i.e., roads and clearcut harvesting) versus natural erosion rates.

Soil Productivity

1. Duff thickness for various vegetation types within the watershed.
2. Rates of ravel movement for varying surface conditions.
3. Extent of soil productivity reduction caused by intense fire and/or fire related salvage logging.
4. Inventory of erosion sites.
5. Quantification of disturbance effects on long-term soil productivity.
6. Amount of coarse woody material (by decay class) across the landscape.

Plant Species and Habitats

1. Survey and manage (and protection buffer) bryophytes, lichens, and fungi that occur in the watershed, and their individual habitat requirements at a local level.
2. Inventory, map, and evaluation for noxious weeds.
3. Review literature for treatment/control of noxious weed populations.

Forest Density and Vigor

1. Comprehensive data on drought tolerance for tree and shrub species (in bars of water tension).
2. More statistical data regarding the historic range, frequency, and distribution of vegetation over the landscape (should include all pine species, incense cedar, oak species, quaking aspen, Engelmann spruce, black cottonwood, red alder, and Oregon ash).

Fire

1. Exact acreage and location of existing and past high hazard, medium hazard, and low hazard areas.
2. Data regarding the range, frequency, distribution, and interaction of insects, animals, vegetation and fire intensities.
3. Wildfire intensities and consumption rates over the landscape during differing climatic conditions through time.
4. Cultural understanding of fire use during prehistoric times.
5. Complete fire start information (e.g., location, cause, time) prior to 1969.
6. Classification of land by plant association within and outside fire regimes.

Terrestrial Wildlife Species and Habitats

1. Existing and desired abundance and patch size distribution of the vegetation condition classes found in the watershed.
2. Occurrence, distribution, and population data for those wildlife species found in the watershed.
3. Snag and coarse woody material abundance by vegetation condition class.
4. Map showing spotted owl dispersal habitat on Forest Service lands.

Hydrology

1. Stream categories for nonfish-bearing streams (permanently flowing or intermittent).
2. Soil compaction analysis for the watershed.
3. Changes in streamflows due to management activities.
4. On-the-ground wetland inventory.

Stream Channel

1. Sediment source locations.
2. Stream classification using Rosgen's methodology.
3. Field determination of stream substrate materials for nonfish-bearing streams.
4. Stream channel stability and condition.
5. Location, size, and amount of large woody material in nonfish-bearing streams.

Water Quality

1. Water quality data for Little Butte Creek and tributaries (dissolved oxygen, pH, bacteria sediment, turbidity, and nutrients).

Riparian Areas

1. Amount of large woody material in riparian areas.
2. Amount, diversity, and age of riparian vegetation.

Aquatic Wildlife Species and Habitats

1. Spawning escapement of coho salmon and steelhead trout.
2. Habitat requirements of non-salmonid native fish species.
3. Impacts of introduced fish on native species.
4. Distribution and relative abundance of non-salmonid species.
5. Number of Little Butte Creek-produced anadromous fish harvested in the ocean and Rogue River.
6. Inventory and distribution of aquatic insect species.
7. Upstream distribution and relative abundance of all native fish species.
8. Habitat condition including percent of shading along streams, geomorphology, pool/riffle/ratios, pool depth, and substrate composition.

MONITORING

The following monitoring recommendations are made in order to gain a better understanding of the watershed processes and conditions within the Little Butte Creek Watershed. Items under each ecosystem element are listed in priority order.

Human Uses

1. Monitor cultural resource site conditions (looting and natural deterioration),
2. Monitor cultural resource effectiveness of past survey strategies to locate sites.
3. Monitor effectiveness and condition of public interpretation facilities (e.g., High Lakes Trail interpretation signs).
4. Monitor changing public opinions, values, and expectations regarding land management issues.

Soil Productivity

1. Survey duff thickness for various vegetation types in the watershed prior to and after management actions.
2. Measure duff thickness after any surface disturbing project and compare against thickness before project. Suggested standard is >90 percent thickness over 90 percent or more of forest project sites.
3. Measure and compare amount of area compacted before and after management actions using ground base equipment, especially in plateau landscape.

Forest Density and Vigor

1. Monitor commercial forest stands for vigor by using relative density as an index.
2. Measure individual tree growth in commercial forest stands.
3. Analyze canopy closure before and after vegetation treatment.
4. Monitor amounts of coarse woody material before and after timber harvesting operations.
5. Monitor the number and quality of snags (and perhaps how the trees were killed: insects or pathogens).
6. Monitor acorn crops after oak woodland treatments.
7. Monitor the survival of individual pine trees after release treatments.

Fire

1. Monitor changes in hazard ratings after all the vegetation classes have been treated.

Terrestrial Wildlife Species and Habitat

1. Monitor site occupancy, reproductive status and reproductive success of threatened/endangered species found in the watershed.
2. Monitor population trend of the special status and other priority species found in the watershed.
3. Monitor rate of recruitment/loss of snags and coarse woody material.
4. Monitor rate of seral stage change in the vegetative communities found in the watershed.

Hydrology

1. Monitor changes in transient snow zone openings.
2. Monitor changes in road density and soil compaction.
3. Monitor changes in streamflow as watershed conditions change.

Stream Channel

1. Establish permanent monitoring monuments to determine changes in channel morphology in Little Butte Creek and tributaries.
2. Monitor changes in channel morphology using permanently monumented transects.
3. Monitor changes in channel stability and condition.
4. Monitor changes in sediment sources.
5. Monitor changes in large woody material.

Water Quality

1. Continue monitoring stream temperatures.
2. Monitor dissolved oxygen and pH on a regular basis at temperature sites.
3. Monitor sediment, nutrients, and bacteria at selected sites.

Riparian Areas

1. Assess the ability of the Aquatic Conservation Strategy and the Rogue River National Forest and BLM Medford District land and resource management plans' standards and guidelines to provide the anticipated level of protection to interim Riparian Reserves.
2. Determine if vegetation management in selected portions of Riparian Reserves can be performed to enhance slope stability conditions by promoting healthy forest stands.
3. Monitor shading of fish and nonfish-bearing streams using the solar pathfinder or comparable method.
4. Monitor riparian habitat (i.e., large woody material, shading, microclimate) before and after implementing management prescriptions.

Aquatic Wildlife Species and Habitats

1. Monitor and reinventory aquatic/riparian habitats, stream temperatures, water quality and fish populations at regular intervals in mainstream of Little Butte, South Fork Little Butte, Dead Indian, Soda, Grizzly, Deer, Lost, Lake, and Antelope creeks.
2. Assess instream and riparian project work; report findings.
3. Monitor instream large wood locations in Little Butte, South and North forks of Little Butte, and Antelope creeks as related to site capability, aspect and species. Revise, if necessary, the desired large wood per-mile estimates in the watershed.
4. Monitor sediment impacts to fish habitat in all fish-bearing streams in the watershed. This may address deposition and/or embeddedness.
5. Conduct monitoring on fish populations in all streams of the watershed not currently inventoried. Resurvey areas previously inventoried at suitable intervals; compare to baseline data.
6. Monitor water withdrawals and effects on aquatic species in South and North forks of Little Butte, Little Butte, and Antelope creeks.
7. Monitor non-salmonid native fish populations and introduced fish populations.
8. Monitor spawning escapement of coho salmon and steelhead trout.
9. Monitor habitat requirements of non-salmonid native fish species.
10. Monitor distribution and relative abundance of all native fish species.
11. Monitor impacts of introduced fish on native species.
12. Monitor distribution and relative abundance of non-salmonid species.
13. Monitor number of Little Butte Creek-produced anadromous fish harvested in the ocean and Rogue River.
14. Inventory aquatic insect species and distribution.
15. Collect baseline data on macroinvertebrate populations to determine the biotic integrity of stream habitat and trends in the watershed.
16. Conduct water quality testing, lake surveys and fish populations census on Fish, Agate, and Lost lakes.
17. Monitor irrigation dams for possible fish barriers and irrigation canals for sedimentation sources.
18. Monitor effect of exotic species such as brook trout and bullfrog on salmonid and western pond turtle populations in the lakes.
19. Collect baseline data on amphibians such as foothill yellow-legged frog populations to determine the biotic integrity of stream habitat and trends in the watershed.

RESEARCH

The following research recommendations would provide additional understanding of ecosystem processes in Little Butte Creek Watershed. Items under each ecosystem element are listed in priority order.

Soil Productivity

1. Study rates of ravel movement for various surface conditions.

Plant Species and Habitats

1. Determine what kinds of prescribed fire are most beneficial to native herbaceous plant species and least beneficial to non-native plant species.
2. Determine what grazing systems are practical and beneficial (or at least not detrimental) to native plant communities facing encroachment from non-native species.
3. Determine what techniques are effective for restoring native plant species composition in moist mountain meadows.
4. Determine what techniques are effective for restoring native plant species composition in the herbaceous layer of lower elevation dry grassland, shrubland, and oak woodland.
5. Determine what habitat conditions are most important for the rare vascular plant species at risk of extirpation from the watershed.
6. Develop methods of controlling noxious weeds.

Forest Density and Vigor

1. Research the soil carbon/nitrogen ratios for various soils in the watershed.
2. Study the available trace elements in the various soils of the watershed and the requirements for the tree species.
3. Perform more comprehensive studies on the ecological requirements of Oregon white and California black oak to produce acorn crops, including optimum tree density (stems/acre), impact of competing vegetation (how much and which species can grow around the oaks?), and the occurrence, frequency, and intensity of fires needed to return nutrients to the soil to maintain healthy, productive oak woodlands.
4. Research how long conifer and hardwood trees can live on low elevation, drought-prone sites.
5. Determine the evapotranspiration rates for all endemic tree and shrub species (in inches of water).
6. Determine how many old-growth trees are needed on a per-acre basis to maintain ecosystem functions of late-successional forests.
7. Determine what the coarse woody material requirements of the watershed are in order to maintain site productivity.

Terrestrial Wildlife Species and Habitat

1. Use the MAXMIN approach, as described by Raphael (1991), to determine the optimum mix of age classes/seral stages of the vegetative communities found in the watershed in order to maximize the probability of viability of all indigenous species.

Hydrology

1. Determine the change in streamflows resulting from density management treatments (are losses due to interception and transpiration in overly-dense stands offset by increased water uptake by remaining trees?).
2. Determine the effect of density management prescriptions on snow accumulation and melt in the transient snow zone.

Stream Channel

1. Determine amounts of large woody material needed in steep headwater channels.

Water Quality

1. Determine potential for water quality limited streams to exceed state temperature criterion even with riparian canopy providing full shade to stream.

Aquatic Wildlife Species and Habitats

1. Study the impacts of introduced fish on native fish populations in the watershed.
2. Determine impact of flow alteration from Fish Lake Dam and water withdrawals on native fish habitat.
3. Study side channel and main channel habitat biological and physical differences in relation to habitat preference for coho salmon.
4. Determine effects of irrigation diversion in North Fork on smolts migrating to the ocean and interference with imprinting mechanisms which may cause straying.

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[1] Where more than one team member is listed for the same responsibility, the team member listed first had the primary responsibility.

GLOSSARY OF TERMS

Accelerated erosion: Erosion at a rate greater than normal for a site on the land surface or in drainageways.

Agglomerate: A volcanic breccia formed by disruption of a solidified crust or hardened plug of lava.

Airshed: A geographic area that shares the same air mass due to topography, meteorology, and climate.

Alluvial: Originated through the transport by and deposition from running water (FEMAT 1993).

Alluvial stream: A stream whose boundary is composed of appreciable quantities of the sediments transported by the flow and which generally changes its bed forms as the rate of flow changes.

Alluviated canyons and alluvial valleys: Valley types that often have "flats" (Montgomery and Buffington 1993), with floodplains and terraces, and are classified as Rosgen C or F stream types (Rosgen 1994). F channels are common in these valley types and indicate downcutting and abandonment of the adjacent floodplain. Alluviated canyons historically were productive segments of the stream systems with complex braids and side channels, wood and deep scour pools. These were areas of deposition and stored wood and sediment.

Alluvium: Stream-deposited debris.

Andesite: A dark-colored, fine-grained volcanic rock.

Anthropogenic: Deriving from or caused by human action.

Archaeological site: The location of some past human activity, indicated by physical remains from that activity.

Archaeology: The study of human history and culture through the analysis of material remains.

Armoring: The formation of a resistant layer of relatively large particles by erosion of the finer particles.

Bankfull discharge: The flow rate at which the channel is flowing full and the water surface is at floodplain level.

Basalt: A dark colored volcanic igneous rock.

Bedload: Material moving on or near the stream bed by rolling and sliding with brief excursions into the flow three or four diameters above the bed.

Bed material: The sediment mixture of which the stream bed is composed.

Boulder: A large rounded rock greater than 2 feet in diameter.

Braided river: A wide and shallow river channel where flow passes through a number of small interlaced channels separated by bars or shoals.

Breccia: A coarse-grained rock, composed of angular broken rock fragments held together by a mineral cement or a fine-grained matrix.

Channel: A natural or artificial waterway that periodically or continuously contains moving water or which forms a connecting link between two bodies of water.

> **Depth:** The vertical distance between the water surface and a specified point on the streambed.
>
> **Discharge:** The quantity of flow passing through a cross section in a unit of time.
>
> **Roughness of channel materials:** A quantitative description of the variables in the stream channel that impede the flow of water.
>
> **Sediment load:** The mass of the sediment per a measured volume of water-sediment mix.
>
> **Sediment size:** The size of particles carried by the stream.
>
> **Slope:** The difference in water surface elevation per unit of stream length.
>
> **Velocity:** The speed at which water moves downstream.
>
> **Width:** The distance across the wetted channel during high or low flows.

Climax: The final stages of a vegetation succession through seral stages to the most stable, moisture and shade-tolerant association the site can support.

Coarse woody material (CWM): Portion of a tree that has fallen or been cut and left in the woods. Usually refers to pieces at least 20 inches in diameter (FEMAT 1993).

Cobbles: Fluvial sediment particles 2.5 inches to 2 feet.

Colluvial and bedrock canyons: Valley types that generally have gradients greater than 4 percent and contain Rosgen A or B stream types (Rosgen 1994). Streams within these valley types with greater than 10 percent gradient (usually in the headwaters) are classified as Rosgen AA stream type. These stream types have a low width to depth ratio, bedrock and/or boulder streambed, and the ability to transport sediment and wood downstream. Canyon streams are often topographically shaded and are important for cold water production and large wood supply.

Colluvium: A general term applied to loose and incoherent deposits, usually at the base of a slope or cliff, which has been deposited there primarily by gravity.

Coppice cutting: Vegetative cutting that results in regeneration by stumps sprouting.

Crown fire: A fire that advances from top to top of trees or shrubs, more or less independent of the ground fire.

Deferral area: An area identified in the BLM Medford District Resource Management Plan as having high cumulative effects from management activities and deferred from additional management activities for ten years, starting January 1993. Management activities of a limited nature (e.g., riparian, fish or wildlife enhancement, salvage, etc.) could be permitted in these areas if the impacts will not increase the cumulative effects.

Degradation (pertaining to streams): The geologic process that lowers the elevation of streambeds, floodplains and the bottoms of other water bodies through the water-caused removal of material.

Duripan (Hardpan): The duripan (L. *durus*, hard, plus pan; meaning hardpan) is a subsurface soil horizon that is cemented by silica to the degree that fragments from the air-dry horizon do not slake during prolonged soaking water. Duripans vary in the degree of cementation by silica and, in addition, they commonly contain accessory cements, chiefly iron oxides and calcium carbonate. Water often stands temporarily on top of the pan during the rainy season and they are virtually impenetrable to roots of many plants.

Ecosystem: A community of plants, animals, other living organisms, and the nonliving factors of their environment, whose interactions result in an exchange of materials and energy between the living and nonliving components of the system.

Erodability: The erosion potential.

Fire cycle: The average stand age of a forest whose age distinction fits a mathematical distribution (negative exponential or Weibull).

Fire danger: Resultant of both constant and variable factors—weather, terrain, fuel, and risk—that affect the inception, spread, and difficulty of control.

Fire event (fire occurrence, fire incident): A single fire or series of fires within an area at a particular time.

Fire frequency: A general term referring to the recurrence of fire in a given area over time.

Fire hazard: A fuel complex defined by kind, arrangement, volume, condition, and location that forms a special threat of ignition.

Fire hazard reduction: Any vegetation treatment that reduces threat of ignition, spread of fire, and its resistance to control. This may involve removal, burning, rearranging, burying, or modification such as crushing or chipping.

Fire interval (fire-free interval or fire-return interval): The number of years between two successive fire events in a given area.

Fire risk: The chance of various potential ignition sources causing a fire, threatening valuable resources, property, and life.

Fish-bearing stream: Any stream that contains any type of anadromous or inland fish population.

Flats: See response reach.

Floodplain: The relatively flat area adjacent to the channel that is formed by floods and overflowed by the stream or river at a recurrence interval of about two years or less.

Floristics: The branch of botany concerned with the study of vegetation in terms of the number of different species present in the flora (Hale and Margham 1991).

Formation: A body of rock strata that consists dominantly of a certain lithologic type or combination of types. It is the fundamental lithostratigraphic unit.

Fuel type: An identifiable association of fuel elements of distinctive species, form size, arrangement, or other characteristics that will cause a predictable rate of fire spread and difficulty of control under specific weather.

Geomorphology: The science that treats the general configuration of the earth's surface; specific to the study of the classification, description, nature, origin, and development of landforms and their relationships to underlying structures, and the history of geologic changes as recorded by these surface features.

Gravel: Fluvial sediment particles between 2.0 and 64 mm in size.

Greenhouse effect: This effect is the capacity of the atmosphere to transmit heat energy from the sun to the earth's surface, but to absorb heat energy in different wavelengths radiating from the earth's surface and to return some of this heat by eradiation back to the earth's surface (Whittaker 1970).

Ground fire: Fire limited to the mantle of organic material such as duff or peat, that accumulates on top of the mineral soil. Characterized by glowing combustion and little smoke.

Ground fuel: All combustible materials below the surface litter, including duff, tree roots, punky wood, peat, and sawdust, that normally support a glowing combustion without flame.

Gully: A narrow channel produced by running water in earth or weathered rock that is one foot deep or greater.

Human dimension: The term used by federal agencies in watershed analyses to indicate any type of human concern within the watershed (e.g., economic, historic, cultural, political, sociological, etc.), though the focus is generally on economic and historic patterns of human interaction with the natural environment. This term also includes interactions among various human groups, which have a bearing on watershed issues.

Hydraulic geometry: Describes the way stream channel properties such as bankfull width, mean depth, mean velocity, and cross sectional area change with streamflow.

Hyporheic zone: The interface forming the boundary between groundwater and channel water in streams; important in the storage of dissolved gases and nutrients.

Intermittent stream: A stream channel which shows annual channel scour or deposition in a definable channel (USDA and USDI 1994).

Lacustrine system: Includes wetlands and deepwater habitats with all of the following characteristics: (1) situated in a topographic depression or a dammed river channel; (2) lacking trees, shrubs, persistent emergents, emergent mosses or lichens with greater than 30 percent areal coverage; and (3) total area exceeds 20 acres. Includes permanently flooded lakes and reservoirs, and intermittent lakes (USDI 1979).

Ladder fuels: Fuels that provide verticle fuel continuity between strata as between surface fuels and crowns.

LS/OG forest (or stands): Late-successional and/or old-growth. Forests or stands consisting of trees and structural attributes and supporting biological communities and processes associated with old-growth and/or mature forests.

Mass movement: The downslope movement of earth caused by gravity. Includes, but is not limited to, landslides, rock falls, debris avalanches, and creep. However, it does not include surface erosion by running water. It may be caused by natural erosional processes, by natural disturbances (e.g., earthquakes or fire events), or human disturbances (e.g., mining or road construction) (FEMAT 1993).

Meander: One of a series of sinuous curves, bends, or loops produced in the floodplain of a mature stream.

Miocene: An epoch of the early Tertiary period of geologic time from 23.7 to 5.3 million years ago, after the Oligocene and before the Pliocene; also, the corresponding world-wide series of rocks.

Natural areas cell: Artificial constructs used by the Natural Heritage Program to inventory, classify, and evaluate natural areas in Oregon. Cells contain one or more ecosystem elements such as an assemblage of organisms, plus the environment supporting these organisms (Oregon Natural Heritage Plan 1993).

Noxious weeds: Defined by the Oregon State Weed Board as "[Those plants] which are injurious to public health, agriculture, recreation, wildlife, or any public or private property." They have been declared a menace to public welfare (ORS 570.505) (Oregon Department of Agriculture 1995).

Paleo-Indians: The people who first inhabited North America at the end of the Ice Age.

Palustrine system: Includes all nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens. It also includes wetlands lacking such vegetation, but with all of the following characteristics: (1) area less than 20 acres; (2) active wave-formed or bedrock shoreline features lacking; and (3) water depth in the deepest part of basin less than 2 meters at low water. Includes vegetated wetlands traditionally called by such names as marsh, swamp, bog, fen, and prairie as well as small, shallow, permanent or intermittent water bodies often called ponds (USDI 1979).

Parr: A young salmon, having dark crossbars on its sides. The young of certain other fishes.

Patterned ground: A topographical area with similar relief where naturally formed features contrast such that a nearly uniform surface may be interrupted by mounds, swales, or pits.

Perennial stream: A stream that typically flows year-round.

Physiographic province: A geographic area having a similar set of biophysical characteristics and processes due to effects of climate and geology, which result in patterns of soils and broad-scale plant communities. Habitat patterns, wildlife distributions, and historical land use patterns may differ significantly from those of adjacent provinces (FEMAT 1993).

Prehistory: The history of people before the advent of written records. In the United States, this term refers to the history of native peoples prior to the advent of European exploration and settlement.

Pyroclastic: Pertaining to clastic rock material formed by volcanic explosion or aerial expulsion from a volcanic vent; also, pertaining to rock texture of explosive origin.

Range of natural variation: Natural processes of succession as influenced by natural disturbance mechanisms. Considers the range of conditions environmentally that would naturally occur through succession. For the eastern portion of interior southwest Oregon, before effective organized fire suppression, fire was a major disturbance mechanism influencing succession and vegetative conditions (live or dead).

Reach: A relatively homogenous section of stream having a repetitious sequence of habitat types and relatively uniform physical attributes such as channel slope, habitat width, habitat depth, streambed substrate, and degree of interaction with its floodplain.

Research Natural Area (RNA): An area set aside by a public or private agency specifically to preserve a representative sample of an ecological community, primarily for scientific and educational purposes. The federal agencies designate research natural areas to ensure representative samples of as many of the major naturally occurring plant communities as possible (FEMAT 1993).

Residuum: An accumulation of weathered rock debris remaining essentially in place after all but the least soluble constituents have been removed, usually forming a comparatively thin surface layer concealing the unweathered or partially altered rock below.

Resource Management Plan (RMP): A land use plan prepared by an agency under current regulations in accordance with the Federal Land Policy and Management Act (FEMAT 1993).

Response reach: Low gradient, unconfined stream segments which tend to be depositional areas for fine and coarse sediment and wood. It is usually located in an alluvial valley or alluviated canyon.

Rill: A small channel, less than one foot in depth in soils and weathered rock, which was created by running water or surface erosion.

Riparian area: A geographic area containing an aquatic ecosystem and adjacent upland areas that directly affect it.

Riparian Reserves: Land allocation that designates areas along all streams, wetlands, ponds, lakes, and unstable or potentially unstable areas where the conservation of aquatic and riparian dependent terrestrial resources receives primary emphasis (USDA and USDI 1994).

Rosgen stream type: The Rosgen classification system defines stream channels based on the level of investigation. The office phase (level 1) of stream inventory permits surveyors to assign a letter label (alpha class: Aa+, A, B, C, D, DA, E, F, or G) to each stream reach. These labels attempt to distinguish the broad landscape differences in stream character due to valley gradient, valley width, and the apparent sinuosity of the stream observed on 1:24,000 scale USGS maps and aerial photography. Field measurements are essential to refine these landscape-level channel designations.

Sag pond: A small body of water occupying an enclosed depression or sag formed where active faults and/or landslide movement has impounded drainage.

Sand size: Fluvial sediment particles 0.062 to 2.0 mm in size.

Sediment: Particles derived from rocks or biological materials that are or have been transported by water.

Sediment discharge: The mass or volume of sediment passing a stream cross section in a unit of time.

Seral stages: The series of relatively transitory plant communities that develop during ecological succession from bare ground to the climax stage. There are five stages.

> **Early seral stage:** The period from disturbance to the time when crowns close and conifers or hardwoods dominate the site. Under the current forest management regime, the duration is approximately 0 to 10 years. This stage may be dominated by grasses and forbs or by sprouting brush or hardwoods. Conifers develop slowly at first and gradually replace grasses, forbs, or brush as the dominant vegetation. Forage may be present; hiding or thermal cover may not be present except in rapidly sprouting brush communities.
>
> **Mid-seral stage:** The mid-seral stage occurs from crown closure to the time when conifers would begin to die from competition, approximately age 10 to 40. Stands are dense and dominated by conifers, hardwoods, or dense brush. Grass, forbs, and herbaceous vegetation decrease. Hiding cover for big game is usually present.
>
> **Late seral stage:** Late seral stage occurs when conifers would begin to die from competition to the time when stand growth slows, approximately age 40 to 80. Forest stands are dominated by conifers or hardwoods; canopy closure often approaches 100 percent. Stand diversity is minimal; conifer mortality rates and snag formation are rapid. Big game hiding and thermal cover is present. Forage and understory vegetation is minimal except in understocked stands or in meadow inclusions.
>
> **Mature seral stage:** This stage exists from the point where stand growth slows to the time when the forest develops structural diversity, approximately age 80 to 200. Conifer and hardwood growth gradually decline. Developmental change slows. Larger trees increase significantly in size. Stand diversity gradually increases. Big game hiding cover, thermal cover, and some forage are present. With slowing growth, insect damage increases and stand breakup may begin on drier sites. Understory development is significant in response to openings in the canopy created by disease, insects, and windthrow. Vertical diversity increases. Larger snags are formed.
>
> **Old-growth:** This stage constitutes the potential plant community capable of existing on a site given the frequency of natural disturbance events. For forest communities,

this stage exists from approximately age 200 until when stand replacement occurs and secondary succession begins again.

Sere: A sequence of plant communities that successionally occupy and replace one another in a particular environment over time.

Sheet erosion: The more or less uniform removal of soil from an area by raindrop splash and overland flow, without the development of water channels exceeding 300 mm in depth.

Shifting gap stage: The stage of forest stand development when the last of the original cohort of overstory old-growth trees dies and all trees in the canopy have established following smaller gap-type disturbances of various types.

Site productivity: See soil productivity.

Snag: A standing dead tree or standing portion from which at least the leaves or foliage and smaller branches have fallen. Often a stub if less than 20 feet tall.

Soil productivity: This is determined by soil properties which include rooting depth, water holding capacity, cation exchange capacity, and bulk density. These properties represent the framework on which organic and biological influences occur. Climate, slope, and aspect are other environmental and physical elements that affect productivity.

Standards and guidelines: The rules and limits governing actions, and the principles specifying the environmental conditions or levels to be achieved and maintained.

Stand maintenance fire: Fire, usually on a landscape basis due to the vegetative (type, density, and arrangement), topographic, moisture, and atmospheric conditions, which results in perpetuation of a certain type of plant community.

Stand replacement fire: A fire because of its intensity relative to the type of fuel (live or dead) that is burning; and the area that the fire covers and the type of overstory burned that results in the death of the dominant overstory.

Stratovolcanos: A volcano that is constructed of alternating layers of lava and pyroclastic deposits, along with abundant dikes and sills.

Streambank erosion: The removal of bank material by flowing water.

Stream discharge: The quantity of flow passing through a stream cross section in a unit of time.

Stream order: A hydrologic system of stream classification. Each small unbranched tributary is a first order stream. Two first order streams join to make a second order stream. A third order stream has only first and second order tributaries, and so forth.

Succession: The gradual supplanting of one community of plants by another, the sequence of communities being termed a sere, and each stage seral or successional.

Surface erosion: A group of processes whereby soil materials are removed by running water, waves and currents, moving ice, or wind (FEMAT 1993).

Surface fire: Fire that burns surface fuels such as, litter or other loose material of the forest floor and small vegetation.

Survey and manage: Standards and guidelines that provide benefits to amphibians, mammals, bryophtes, mollusks, vascular plants, fungi, lichens, and arthropods as described in the 1994 Northwest Forest Plan.

Suspended sediment load: The weight of suspended particles continuously supported by the water.

Synecology: The study of plant communities and the interactions of the organisms which compose a particular community.

Terrace: An abandoned floodplain.

Terrain: A tract or region of the earth's surface considered as a physical feature, an ecological environment, or a site of some planned activity of man (e.g., an engineering location).

Thalweg: The line connecting the lowest or deepest points along a stream bed, valley, or reservoir, whether underwater or not.

Tuff: A general term for all consolidated pyroclastic rocks with a fine-grained matrix of volcanic ash.

Unconsolidated deposits: Sediments that are loosely arranged with particles that are not cemented together. Includes alluvial, glacial, volcanic, and landslide deposits (FEMAT 1993).

Unstable and potentially unstable lands: The unstable land component of the Riparian Reserves includes lands that are prone to mass failure under natural conditions (unroaded, unharvested), and where human activities such as road construction and timber harvest are likely to increase landslide distribution in time and space, to the point where this change is likely to modify natural geomorphic and hydrologic processes (such as the delivery of sediment and wood to channels), which will in turn effect aquatic ecosystems including streams, springs, seeps, wetlands, and marshes.

The following types of land are included: 1) active landslide and those that exhibit sound evidence of movement in the past 400 years; 2) inner gorges; 3) those lands identified as unstable by a geologic investigations, using the criteria stated above (includes lands already classified by the Forest Service as unsuited for programmed timber harvest due to irreversible soil loss and by the Bureau of Land Management as unsuitable fragile lands). Highly erodible lands (i.e., lands prone to sheet and rill erosion) are not included in this definition (FEMAT 1993).

Uplift: A structurally high area in the earth's crust, produced by positive movements that raise or upthrust the rocks (FEMAT 1993).

Vegetation zone: A land area with a single overstory dominant as the primary climax dominant. Occasionally zones are named after major seral species. Other associates exist in the zone.

Watershed (catchment): All lands enclosed by a continuous hydrologic surface drainage divide and lying upslope from a specified point on a stream.

Watershed analysis: A systemic procedure for characterizing watershed and ecological processes to meet specific management and social objectives. Watershed analysis provides a basis for ecosystem management planning that is applied to watersheds of approximately 20 to 200 square miles (FEMAT 1993).

Water table: The static level of groundwater below surface held in intergranular pores of soil or rock at pressures greater than atmospheric.

Wetlands: Areas that are inundated by surface water or groundwater with a frequency sufficient to support, and under normal circumstances do or would support, a prevalence of vegetative or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction (Executive Order 11990). Wetlands generally include, but are not limited to, swamps, marshes, bogs, and similar areas (FEMAT 1993).

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APPENDICES

APPENDIX A
Recreation on Forest Service-Managed Lands

Summer Recreation

Fish Lake is the primary developed hub of activity within the watershed and most facilities are located on the lake's north shore. Forest Service facilities include Fish Lake Campground with 19 camping units and Doe Point Campground with 30 camping units. Each campground includes a day use area while Fish Lake also includes a boat ramp, fish cleaning station, and historic Civilian Conservation Corps (CCC) picnic shelter. Both campgrounds are operated by a concessionaire. Fish Lake Resort, located adjacent to Fish Lake Campground, is open throughout the year and is operated under a special use permit. Thirty "summer homes" are also located at Fish Lake. Twenty-five are accessible by road on the lake's northwest shore while the remainder can only be reached by boat or on foot on the southwest shore. Each residence is under a separate special use permit. On the south shore of Fish Lake at the end of Forest Road 920, is Cascade Field Center, which is operated as an outdoor education center under a special use permit by Southern Oregon University.

Camp Latgawa, Fish Lake Resort, and Fish Lake Summer Homes are used on a year-round basis. Camp Latgawa is an organization camp operated by the United Methodist Church. Approximately 25 structures are located within the permit area, three of which are eligible for the National Register of Historic Places (including the Soda Springs Shelter which is owned by the Forest Service). Groups often rent all or part of the facilities for natural resource education functions, business/government retreats, and other purposes. Fish Lake Summer Homes are private cabins located on Forest Service land and are used by owners, friends, and family.

Two highly used trails are located at Fish Lake. The nine-mile High Lakes trail begins at Fish Lake Campground and ends at Great Meadow, one mile east of Lake of the Woods. Approximately three miles of this trail are located within the watershed. This trail, a compacted gravel surface primarily constructed for mountain bikers, was completed in spring 1996, and is also attractive to hikers and runners. The five- mile Fish Lake Trail begins at Forest Road 37 directly across from North Fork Campground and ends at the Pacific Crest National Scenic Trail on the northwest flank of Brown Mountain. This trail receives very high use where it passes through Fish Lake Resort and Doe Point/Fish Lake Campgrounds and along its westernmost stretch where it follows the highly scenic riparian/lava flow zones of North Fork Little Butte Creek.

The eight-mile corridor along Forest Road 37 is a secondary, but high use route. Three Forest Service-operated campgrounds are located along this paved road. North Fork, Daley Creek, and Beaver Dam campgrounds offer adjacent hiking trails, creeks, wildflowers, and fishing opportunities. A total of 19 rustic camp units may be found at the three sites. Although primarily designed for tent camping, some units will handle recreational vehicles (RVs) and large pickups with camper shells.

"Project Camp," Big Elk Guard Station, and Robinson Butte Lookout are other sites commonly used by recreationists along the Road 37 corridor. "Project Camp" is the most highly used dispersed camping site on the Ashland Ranger District. It is located in a small grove of very large Douglas-fir along the north bank of South Fork Little Butte Creek (Forest Road 3700120). Big Elk Guard Station, site of the first Forest Service-built structure in the Southern Oregon Cascades, is often visited for both its historical significance and its highly scenic setting. The adjacent Big Elk Meadow provides an open foreground to views of Mount McLoughlin and Brown Mountain. Robinson Butte is less seldom visited; the 360 degree view is outstanding from the 70-foot lookout tower. The entire corridor is the most popular area in the watershed for huckleberry picking and mushroom gathering (and Christmas tree cutting in late November/early December).

Most other summer recreation activities are of a dispersed nature. Fifty-nine dispersed recreation features, excluding trails and two shelters (South Brown Mountain and Soda Springs), have been identified on the Ashland Ranger District portion of the watershed. Approximately half of these features are dispersed camping sites such as Grizzly Road Camp, Big Draw Camp, and Delsman Camp. Examples of the remaining types of dispersed features are scenic ("31 Bluffs" and "Old Baldy"), historic ("Dunlop Ranch" and "Short Creek Cabin"), or water-related ("Zen Springs" and "Upper Dead Indian Creek Waterfalls").

A major component of summer recreation activity is centered on trail use. On the Ashland Ranger District portion of the watershed, users will find seven separate trails for a total length of 34 miles. Outside the District, still within the watershed, users will find two miles of the Pacific Crest National Scenic Trail (PCNST). All trails are closed to motorized use and some have closures on mountain bikes and/or pack and saddle stock. The PCNST trail is closed to mountain bikes and all motorized use.

Winter Recreation

Unlike many types of summer activities such as camping, fishing, and lodging, winter activities tend to be more dispersed in nature. Visitors tend to park and then either ski or snowmobile to other destinations before returning to their vehicle. Sledding and ice fishing are notable exceptions to this general difference in seasonal use. Winter camping and lodging use rates are on the rise, although, most winter activity is based on a day use activity. Winter use represents about 15 percent of total recreation use in the watershed. Once again, the Fish Lake area provides the most facilities and has the greatest amount of use. Fish Lake Snopark, located at the campground's boat ramp parking lot, accommodates a large number of vehicles (35-50, depending on number of trailers and RVs) and is the starting point for both designated snowmobile and nordic ski trails, which radiate in all directions. The snopark is also used by people who enjoy ice fishing (Fish Lake is open year-round to fishing), picnicking (primarily at the CCC-built Fish Lake Picnic Shelter), snowplaying (sledding is limited due to the gentle terrain), snowshoeing (sometimes for ascents of Brown Mountain), and scenery viewing.

From the snopark, skiers have access to the popular Lollipop trail system (8.4 miles), Fish Lake Tie (1.5 miles), and Lund's Link (1 mile). Snowmobilers have direct access to the Resort (9 miles) and Fish Lake (9 miles) snowmobile trails. Other snowmobile connector trails within the watershed lead to Howard Prairie/Hyatt Lakes to the southwest and to Fourmile Lake and Pelican Butte to the northeast. Watershed snowmobile trails total 62.6 miles (61.1 on the Ashland Ranger District).

Eight snoparks are located along the Highway 140 corridor between Fish Lake and the Great Meadow, the highest concentration of snoparks/mile in the state. They include, from west to east: Summer, South Rye, Fish Lake, Summit, Summer Home, Fourmile, Lake of the Woods Resort, and Great Meadow. The first four are located within the Little Butte Creek Watershed.

Dead Indian Memorial Highway (DIMH) also provides winter access to the watershed. There are two designated snoparks within the watershed on DIMH, Deadwood and Pederson (22 and 32 miles east of Ashland). They have been formally established within the watershed in the past five years due to public demand and safety concerns. Winter recreationists are still "discovering" the area such as South Brown Mountain Shelter (2.0 miles north of Pederson Snopark) built in 1993. This shelter was built through a unique cost-share agreement between the Forest Service, Pacific Crest Trail Association, and the National Guard. It is especially popular for skiers who usually access it via the Pederson Nordic Trail (2 miles) and to a lesser extent for snowmobilers who access it from the Hyatt Lake-Lake of the Woods Snowmobile Trail (32 miles between the two lakes).

Designated snowmobile trails lead through the Deadwood, Big Draw, and Pederson areas and provide access to many of the same locations described above in the Highway 140/Fish Lake areas. The previously-mentioned Pederson Nordic Trail is the only marked and designated ski trail accessed from DIMH. The Rogue Snowmobile Club periodically grooms the 60 miles of designated snowmobile trails on the Ashland Ranger District portion of the watershed and many skiers take advantage of these trails.

Brown Mountain offers one of the most premier backcountry experiences in southern Oregon for skiers, snowboarders, and snowmobilers. The extensive basalt lava flows of this "recently" formed shield volcano have the appearance of ski runs in the winter months. All flanks of the 7,000-acre Brown Mountain Roadless Area receive winter use, however, the northeast to northwest quadrant receives the most visitors due to closer vehicle access and higher quality snow conditions. Skier and snowboarder access is generally from Highway 140 and snowmobiler access from the Resort Snowmobile Trail. Mount McLoughlin, in Sky Lakes Wilderness, also receives winter use from skiers, snowboarders, and climbers; its use is far lower than at Brown Mountain because of longer distances to suitable terrain and high avalanche danger.

Use, Trends, and Challenges

The Fish Lake area receives the greatest amount of concentrated use within the watershed. Vehicle counts indicate that well over 100,000 visitors per year enjoy the myriad of opportunities centered at and near the lake. Fish Lake and Doe Point campgrounds and Fish Lake Resort are generally at capacity on weekends from Memorial Day through Labor Day. Campground use at the two Forest Service campgrounds averages 60 percent for the entire operating season (early May to mid-October). Golden Age passport holders account for nearly 50 percent of visitors at Fish Lake Campground and 25 percent at Doe Point Campground. It is estimated that over 10,000 visitors per year use the short section of the Fish Lake Trail between Doe Point Campground and Fish Lake Resort. The rest of the trail is most likely used by an additional 2,000 to 2,500 hikers per year. Winter use accounts for about 15 percent of visits with the majority being skiers and snowmobilers. Sled dog teams are also beginning to use the groomed snowmobile trails, but use is still very light, perhaps four to six times per season.

Hiking, dispersed camping, auto driving (Sunday drive), fishing, hunting, botanizing, birdwatching, and other activity use figures have not been systematically gathered. However, some relative observations can be made about amount of use. The PCNST receives moderate to high use near the Summit Trailhead and where the Fish Lake and High Lakes trails join the PCNST. Hikers will commonly walk south on the trail across the Brown Mountain lava flows for outstanding views of Mount McLoughlin and Fish Lake. The PCNST is also used by hikers who spend the summer hiking from Mexico to Canada. Fish Lake is an important and welcome stop after one of the longest dry stretches of the entire trail--Griffin Pass to Fish Lake. Moderate use occurs on the PCNST from the Pederson Trailhead located on DIMH and lower use occurs elsewhere. Beaver Dam Trail receives moderate to high use while the Brown Mountain Trail receives moderate use, particularly from horseback riders. Remaining trail use varies from low to moderate.

Primary winter use occurs from December 1 to March 15. Depending on snowfall and overall weather patterns, the season may run from November 1 through late May/early June (for skiers/snowboarders on Brown Mountain and Mount McLoughlin).

Increased recreation use does not come without its own set of problems and concerns. On Brown Mountain, the typical backcountry skier goes out for a day of relative solitude and the chance to carve fresh ski tracks through powder snow. The typical backcountry snowmobiler goes out to "high mark" (snowmobiler term for getting to the highest point on a given slope) and to cover a lot of ground. Both get out for the outstanding scenery and to spend time with friends and/or family in the winter environment. For skiers, the noise, fuel fumes, and especially the rutted snowmobile tracks criss-crossing over the skiable slopes detracts from both the aesthetic experience and the ability to navigate the skis through the ruts. Whereas as a skier will take a run or two a day, three or four snowmobilers can literally be "all over the mountain" in the same time frame. This conflict is mainly from the skier's point of view. This problem has been recognized for over 10 years, but the conflict is increasing due to a greater number of participants in each sport and the tremendous technological advances in snowmobiles (more power, lighter, wider tracks, etc.) and the rider's skill levels.

Another winter recreation concern is centered around Forest Road 37, which is a designated snowmobile trail and a skier "route." In this case, skiers and snowmobilers get along quite well, but the challenge for four-wheel-drivers "to go as far as they can" seems irresistible. The result is imbedded and sometimes frozen ruts which makes it difficult for both skiers and snowmobilers. The Ashland Ranger District is proposing that Road 37 be gated, which would also help to prevent increasing winter vandalism (estimated at $3,000 last winter) to campgrounds, Big Elk Guard Station, and road signs.

Most winter problems tend to be social and not resource oriented, although, a few people have raised issues about the possible negative effect of snowmobiles on wildlife. Forest Service wildlife biologists believe there is little, if any, effect on wildlife in this area. In fact, elk have been seen using groomed snowmobile trails as travel routes after early-season heavy snowfalls.

Common summer problems are more resource oriented. Common resource problems include damage to vegetation from cutting and chopping, compacted soil at developed sites, lack of downed woody material (used for firewood), significant big tree mortality in campgrounds (especially white fir and western white pine), and improper human waste disposal at dispersed camping sites along creeks and streams. These are common problems that are not unique to the watershed. In fact, most resource problems associated with recreation use have been kept to a minimum at the Ashland Ranger District's facilities.

Conclusion

Federal lands in the Little Butte Creek Watershed receive year-round use from a wide variety of users. Nearly three-quarters of all users come from either the Rogue Valley or Klamath Basin areas. Mountain biking, snowmobiling, and backcountry skiing/snowboarding are growing at very high rates while most other uses are showing smaller increases. Current winter problems are generally social in nature while summer problems are more resource oriented.

Forest Service facilities (campgrounds, trailheads, trails, and snoparks) have been well-maintained in the past, but current budget and personnel costs are reducing quality and quantity of maintenance and public contact. Some facility infrastructure components are showing obvious symptoms of the need for heavy maintenance (i.e., leaking roofs, broken pipes and valves, and failing electrical lines). Quality public contact takes place on a less-frequent basis and is often limited to taking care of an immediate problem. There is no longer a trail crew on the Ashland Ranger District and campground help has been cut in half. Remaining recreation personnel have collateral duties in other disciplines and districts, therefore, a quality recreation program will be challenging to maintain in the future without added funding, volunteers, and efficient use of time within the government framework of doing business.

APPENDIX B
Description of Symbols Used on Geology Map 8

Map Symbol	Description of Map Units
QTba	Basalt and basaltic andesite (Pleistocene and Pliocene)
QTmv	Mafic vent complexes (Pleistocene, Pliocene, and Miocene)
QTp	Pyroclastic rocks of basaltic and andesitic cinder cones (Holocene, Pleistocene, Pliocene, and Miocene)
Qal	Alluvial deposits (Holocene)
Qba	Basaltic andesite and basalt (Holocene and Pleistocene)
Qls	Landslide and debris-flow deposits (Holocene and Pleistocene)
Qt	Terrace, pediment, and lag gravels (Pleistocene)
Thi	Hypabyssal intrusive rocks (Miocene)
Tib	Basalt and andesite intrusions (Pliocene, Miocene, and Oligocene)
Tmv	Mafic vent complexes (Miocene)
Tn	Nonmarine sedimentary rocks (Eocene)
Trb	Ridge-capping basalt and basaltic andesite (Pliocene, upper Miocene)
Tub	Undifferentiated basaltic lava flows (Miocene and Oligocene)
Tus	Undifferentiated tuffaceous sedimentary and volcaniclastic rocks (Miocene and Oligocene)
Tut	Undifferentiated tuff (Miocene and Oligocene)

APPENDIX C
Forest Service Inventory Methods of Landslide Hazard Zones

Three methods have been utilized to locate the high risk landslide areas in the Little Butte Creek Watershed area. The following is a description of each method and how they are used.

Landslide Hazard Zonation (LHZ)

The Rogue River National Forest (RRNF) uses this LHZ layer to show mapped active landslides and areas with high potential for slope failures within areas planned for future management. Not all of the locations of unsuitable (U3) terrain (hazard zone 1) are currently in GIS, but all U3 areas are on large scale maps in several areas that were planned for management in the late 1970s and 1980s. These U3 areas represent active landslides, wetlands, severely eroded areas, and potentially active landslide areas, which were mapped during site-specific work for project areas.

The following are descriptions of the hazard zones utilized by the RRNF when mapping lands for management activities.

Landslide Hazard Zone 1 is the highest risk for management and is equivalent to U3 terrain. The Rogue River Forest Plan U3 is considered unsuitable for land management. Sensitive areas to avoid entirely would be landslide scarps, headwalls, currently active areas, and toes of landslides. An engineering geologist will be necessary to identify areas inside U3 that may be considered for future project-specific work on Forest Service property.

Hazard Zone 2 (moderately high risk) is also considered sensitive and should be managed with a "light touch" according to the Land and Resource Management Plan (LRMP- see prescription 21). Hazard zone 2 mapped to date covers approximately 5 percent of the study area. All of the LHZ mapping completed has been done exclusively on National Forest lands. LHZ mapping has been done in the portions of the North and South forks of Little Butte Creek and the Dead Indian Canyon area. Much of the high hazard terrain (hazard zones 1 and 2) is located in or near stream channels, springs, or other wetlands. Generally, sediment in this zone has an increased likelihood of being transported to larger streams (Little Butte Creek, Dead Indian Creek, and the Rogue River).

The LHZ mapping of Forest Service lands is not reflected on a GIS layer, however, several project areas have been mapped/hazard zoned during the past decade. Hazard zone 1 (U3 terrain) should be added to the riparian reserves before projects proceed in the watershed. The projects where field mapping and hazard zonation have been completed during the past 10 years should be documented and added to this layer for future reference to better reflect the unstable and potentially unstable (U3 terrain) portions of the riparian zones.

Timber Suitability U3 (TSU) Mapping

A second map that has been used for purposes of locating unstable or potentially unstable terrain is the Timber Suitability U3 Map. This is a map of computer generated unsuitable (U3) areas on Forest Service property. This GIS layer shows the areas that contain the highest landslide hazards. This terrain has high potential to be unsuitable for management due to irreversible resource damage and is used for planning level information if there is not any LHZ mapping completed. Timber suited 2 (S2) is equivalent to hazard zone 2 LHZ and is not shown on this map. Computer generated U3 and timber suited 2 match fairly well with the LHZ map, which will generally point out potentially unstable areas for future project level work. The percentage area of U3 on the TS Map appears to be similar in size as the LHZ mapped terrain. TSU mapping is much less reliable than LHZ and should only be used for planning purposes. Detail and accuracy can be obtained during project level work when LHZ mapping is conducted.

Relative Landslide Potential

The third way used to identify high landslide risk terrain is the relative landslide potential method. This method uses various strength of materials combined with slope class ranges to develop a high, medium, or low rating for each type of material (see Table 1).

Approximately 28 percent of the Little Butte Watershed is composed of weak geologic materials such as canyon sideslopes terrain and portions of the valley floor terrain. In general, when slopes exceed 70 percent in these weak geologic materials, the relative landslide potential is extreme. When these geologically weak slopes exceed 51 to 70 percent, the landslide potential is high and is moderately weak for 30 to 50 percent slopes. Potential for landslides to occur on slopes of less than 30 percent is low. Sediment delivery potential is high for weak material types.

Table 1. Relative Landslide Potential Matrix

Slope Class/Rock Type by Percent	Resistant	Intermediate	Weak	Unconsolidated
<30	Low	Low	Low	Low
30 to 50	Low	Moderate	Moderate	Moderate
51 to 70	Moderate	Moderate	High	High
>70	Moderate to High	High	Extreme	Extreme

The volcanic peak terrain, lava plateau, and approximately 27 percent of the watershed analysis area are considered resistant for strength and relative potential for landslides. See Table 1 for the values at different slope classes. Sediment delivery potential for these terrains are classified as moderate to low.

Alluvial bottom and a majority of stream terrace are classified as unconsolidated for strength, and low (<30 percent slopes) to moderate (30 to 50 percent slopes) for landslide potential. These unconsolidated areas make up approximately 10 percent of the watershed, and relative landslide potential is mostly low.

The remainder of the watershed areas is valley floor terrain, approximately 35 percent, and is considered intermediate for strength and potential for landslides. The relative landslide potential for valley floor is low since slopes are less than 30 percent.

The relative landslide potential values reflected in Table 1 should only be used for planning in areas that have not been mapped (on LHZ layer) or are not reflected on the Timber Suitability U3 GIS layer. The first two GIS layers are the most reliable landslide hazard maps to use.

During slope stability mapping for the Shellick, Owens, and Dean Indian timber sales, numerous areas of instability were located in the South Fork of Little Butte Creek and Dean Indian Canyon. Most of these slides and severely eroded terrain were located on the steep to moderately steep slopes in the canyon side-slopes terrain. Many of the active slides were found within other older earthflows indicating that most of the sites had compound landslide features and had been active for long periods of time. These areas were classified as unsuitable for management and were not treated with any of these timber sales.

Sag ponds, springs, seeps, scarps, tension cracks, anomalous tree growth are common in this earthflow terrain. Debris landslides are also commonly found within the larger earthflows and are most active in the lower half of the canyon side-slopes terrain and often fall into the valley floor terrain. These slides are likely to continue to occur due to the natural instability of the area.

Surface erosion is found where surface water is concentrated naturally, in drainages/draws, or by road drainages (especially culverts) discharging water onto moderately steep to steep slopes. Sheet, rill, and ravel erosion occur most frequently on stream terrace, canyon side-slopes, and valley floor terrains. The largest amounts of sediment transported in these terrains is located on steeper slopes near streams.

Many of the hillslope processes are most active near managed areas or areas managed in the recent past, such as roads and clearcuts. Slumps, debris flows, and tension cracks are often found in road prisms, cut slopes, and fill slopes. Minor slumps and surface erosion have been located on the lower slopes of a few clearcut units from logging in the 1970s and 1980s.

APPENDIX D
Range Condition Evaluation

Evaluation of range condition (ecological status and/or ecosystem health) is done by establishing and monitoring study sites on each "Improve" (I) category allotment. Currently, ecosystem condition is determined as seral percent of climax by the BLM. In the 1994 Soil Survey of Jackson County, each range site type has a description of full climax (100 percent of potential natural community). Potential natural condition (PNC) is dependent upon soil, climate, aspect, slope, and other environmental factors. Monitored sites are periodically compared to PNC and rated a percentage accordingly for that vegetation type. Early seral is 0 to 24 percent of PNC, mid is 25 to 50 percent, and late is 51 plus percent. A site is considered at climax or PNC for that site type when its vegetative community is above 75 percent of the population composition predicted for that site naturally.

While past range evaluations rated conifer forests (transitory grazing lands) along with standard rangelands, future evaluation of range condition will be based only on monitoring non-transitory range sites. Logged-over sites with a forest potential climax are grazed, but the land and vegetation communities of non-climax seral stages are considered transitory range. Oak woodlands, shrublands, and grasslands are classed as true rangeland and managed as permanent or non-transitory. The baseline of the Soil Vegetation Inventory Method (SVIM) survey (late 1970s) showed the Little Butte Creek Watershed containing 11,021 acres of non-transitory range. Of this range, 2,982 acres were rated in mid- to late seral by 1982. An accounting of monitored acreage in 1996 showed 7,978 acres rated in mid- to late seral, while all allotments in the I category on the Little Butte Creek Watershed showed pastures with a steady or improving condition. Additional acreage added to the baseline after SVIM has not yet been totalled; this is due to the short time elapsed since establishment or because counting and evaluation would be obsolete since the Bureau is joining all range managers in changing from the PNC evaluation system to the proper functioning condition (PFC) method of analysis for upland and riparian ecosystems. Recently established monitoring sites were placed with this change in mind. The first PFC evaluations will not be available before 1999.

Table 1. 1997 Allotment Summaries

Allotment (Name and Number)	Federal Land (Acres)	Non-transitory Range (Acres)	Range Condition (Acres)[1/]	Preference (AUMs)	Season of Use	Fish Stream (Miles)
Bureau of Land Management						
Obenchain 10014	120	117	ES-117 (upward)	12	vacant/ spring	0.3
Lick Creek 10015	200	140	ES-140 (upward)	15	4/16-5/15	0.0
Browns-boro Park 10016	380	291	ES- 291 (upward)	68	4/16-5/31	0.0
Kanutcheu 10017	2,157	1,821 (approx.)	ML-593 ES-1,220 (upward)	178	4/16-5/31	0.0
Nichols Gap 10018	280	0 (seeded)	N/A	18	vacant/ spring	0.0
Big Butte 10024	21,595	6,604	ML-2,246 ES- 4,358 (upward)	2,662	4/16-10/15	13.1
Lick -- 80 10033	80	80	ES-80 (steady)	24	vacant/ spring	0.0
Salt Creek 10044	1,360	293	ML-20 ES-179 (upward)	44	4/16-6/30	0.0
Deadwood 20106	9,984	199	ML-20 ES-179 (upward)	768	6/16-8/15* 8/16-10/15	0.5
Poole Hill 20113	1,760	292	ML-292	50	10/01-10/15	3.4
Keene Creek 10115	22,863	2,504	ML-456 ES-2,048 (steady)	1,612	6/16-10/15	9.5
Conde Creek 20117	5,346	429	ML-149 ES-280 (upward)	592	6/16-9/30	3.5
Grizzly 10119	5,167	1,318	ML-168 ES-1,204 (upward)	378	6/1-10/15	0.0
Baldy 10120	798	479	ML-168 ES-311 (upward)	87	5/1-9/30	0.0
Lake Creek Spring 10121	4,679	3,017	ML-1,459 ES-1,558 (upward)	478	5/16-7/15	0.3

Allotment (Name and Number)	Federal Land (Acres)	Non-transitory Range (Acres)	Range Condition (Acres)[1/]	Preference (AUMs)	Season of Use	Fish Stream (Miles)
Lake Creek Summer 10122	5,561	906	ML-765 ES-141 (upward)	692	6/30-10/15	3.8
Lost Creek 10123	80	80	ES-80 (steady)	6	5/1-6/15	0.0
Deer Creek 10124	4,025	1,055	ML-233 ES-822 (upward)	162	5/1-9/30	0.5
Heppsie 10126	3,471	1,355	ML-928 ES-427 (steady)	294	5/1-10/15	0.2
Cartwright 10127	40	N/A	N/A		vacant/ summer	0.0
Antelope Road 10132	400	269	ML-54 ES-215 (upward)	30	4/16-5/30	0.0
Browns-boro	80	73	ML-27 ES-46 (upward)	8	4/16-6/15	0.0
Yankee Reservoir 10134	120	120	ML-15 ES-105 (steady)	24	5/1-6/15	0.0
Canal 10136	440	326	ES-326 (upward)	58	4/16-6/16	0.0
Bybee Peak 10144	363	85.5	ES-85.5 (upward)	36	vacant/ spring	0.0
Devon South 10043	465	314.7	ML-246 ES-68.7 (upward)	33	4/15-6/31	0.0
Buck Lake 10104	492**	492	ML-50 ES-442 (upward)	280	6/1-10/1	0.0
U.S. Forest Service						
Deadwood	18,150	15,972		1,596	*6/16-8/18 8/16-10/16	
Conde	3,330			150	7/1-9/30	
South Butte	21,750	19,140		787.5	7/1-10/15	
Fish Lake & Rancheria Combined	7,494			1,608 (odd years) 2,067 (even years)	7/1-10/15 (odd year) 6/1-10/15 (even year)	

[1/] ES: Early seral
ML: Mid/Late
Trend (upward, steady) is for ES condition.

*Deadwood BLM and Deadwood USFS alternate season of use odd and even years.
**Acres reported within the watershed.

Table 2. Soil Vegetation Inventory Method Baseline (1982 and 1996)

Seral Stages[1/] (1982)	Oak Woodlands (acres)	Grass/Shrubs (acres)	Total (acres)
Total Late Seral	26	73	99
Total Mid-Seral	1,834	1,072	2,906
Total Early Seral	3,111	4,905	8,016
Total Acres Surveyed	4,971	6,050	11,021
Seral Stages[2/] (1996)	**Oak Woodlands (acres)**	**Grass/Shrubs (acres)**	**Total (acres)**
Total Late Seral	295	465	760
Total Mid-Seral	4,191	3,027	7,218
Total Early Seral	485	2,558	3,043
Total Acres Surveyed	4,971	6,050	11,021

Source: Soil Vegetation Inventory Method (SVIM) baseline.

1/ Number of acres within the Little Butte Watershed used as monitoring baseline for seral stages of non-transitory range in the 1979 to 1982 SVIM.

2/ Current status of baseline acres within the Little Butte Watershed.

APPENDIX E
Non-Native Species and Noxious Weeds

These plants are Superior Competitors designated by the Oregon Department of Agriculture's Noxious Weed Control Program. There is concern that even under the guidance of Best Management Practices, populations of these weeds may continue to expand.

Yellow Starthistle (*Centaura solstitalis*)

This is an annual that will germinate in fall, winter, or spring. The flowerhead is 0.50 to 0.75 inches. It blooms from July through September. This species is aggressive and spreads rapidly. Feeding on the plant can cause a nervous disorder in horses known as "chewing disease," which can be fatal. Control of Yellow Starthistle is limited to biological or management efforts rather than chemical efforts on BLM lands. The seed fly (*Urophora sirunaseva*) was released in Jackson County, 1985. The seed weevil (*Bangasternus orientalis*) was released in Jackson County, 1987.

Canada Thistle (*Cirsium arvense*)

The Canada Thistle is a creeping perennial that is difficult to control because of its aggressive nature and a root system that may extend as deep as 2.5 feet. The root system branches extensively, making an auxiliary reproductive system of the roots. The flowers are either white or light purple. (Note: The Siskiyou subspecies has white flowers and is listed as Threatened.) The flowers are 0.5 to 0.75 inches in diameter, borne at the tips of the branches, often in clusters, from early July to late August. Canada Thistle stems are smooth instead of spiny and "winged" as are the stems of Scotch or Bull Thistles.

Common St. Johnswort (*Hypericum perforatum)* AKA (Klamath Weed)

This plant causes photosensitization in light colored animals, with young being particularly susceptible. Although seldom fatal, economic losses can easily occur. Cattle and sheep normally will not consume this plant when mature, but young shoots in the spring may be eaten. Biological control agents have been very successful for this plant.

Ripgut Brome (*Bromus rigidus*)
Medusahead Wildrye (*Elymus caput-medusae*)
Hedgehog Dogtail (*Cynosurus echinatus*)

These annual grasses not only can cause mechanical injury when grazed upon because of the "foxtail"-like awns, but along with other short lived annual grasses, form a carpet on the soil and interfere with germination of perennial grasses. The annual grasses compete strongly, lower range quality and ecosystem functionality, and slow progression in ecological condition. Range management is the only control technique now in use on BLM rangelands.

Dodder (*Cuscuta sp.*)

Dodder is a parasitic plant that is troublsome over much of the United States. The small root system disappears once the plant becomes established on a host plant. Seeds are long lived and infestations may occur in areas where host plants have not grown for several years. (Dodder had been identified using *Ceanothus cuneatus* as a host plant.)

Purple Loosestrife (*Lytherum salicaria L.*)

This 6 to 8 feet tall rhizomatous perennial distantly resembles Alaska Fireweed, having tall erect stems, long upright purple floral racemes, and long lancelike oposite or whorled leaves. Purple Loosestrife grows in moist or marshy areas such as stream banks, pond shores, and wet meadows where standing water lingers. This escaped European ornamental species has been reported to reduce wildlife habitat due to strong competition rather than toxins.

Brooms: Scotch/Spanish (*Cytisus spp.*)

These are woody shrubs up to 10 feet tall with many more or less erect branches that are angled and dark green. Leaves are mostly 3-parted with entire leaflets. Flowers are showy, yellow, orange, or pink, and abundant. Pea-like seed pods are flattened, hairy, and may become black with maturity. Scotch Broom has moved into the interior from the Pacific coastal strip, where it is a heavily successful competitive pestersome and widespread escaped ornamental. Spanish Broom is only now evident in this area and promises to be as much a pest as its cousin. These shrubs can become a problem in pastures, forests, and disturbed places. Their seeds remain viable in the soil for many years.

Rush Skeletonweed (*Chondrilla juncea L.*)

Rush Skeletonweed is a perennial, 1 to 4 feet tall, somewhat resembling a tumble mustard, but with a dandelion-like basal rosette, yellow "chicory" flowers borne in clusters of 7 to 15 on the ends of stems. This is an introduced Eurasian species that presently infests several million acres in Idaho, Oregon, Washington, and California. It generally inhabits well-drained, light textured soils along roadsides, in rangelands, grain fields, and pastures. Soil disturbancy aids establishment. The deep and extensive root system makes skeletonweed difficult to control. Cut surfaces exude a milky latex. Flowering and seed production occur from mid-July through the frost season.

Skeletonweed (*Lygodesmia juncea Pursh*)

Skeletonweed resembles Rush Skeleton weed, with two observable exceptions: Skeletonweed does not exceed 18 inches tall, so appears "miniaturized" in comparison, and bears pink blooms singly on the tips of its stems. ts habitat is similar to Rush Skeletonweed, and both may be found in the same spots. This species is not controlled by most herbicides, therefore, it is increasing in density in many areas.

Probable Future Weeds

While not yet established in the watershed, these species may quickly encroach. Their progress needs to be monitored and control plans devised.

Leafy Spruge (*Euphorbia esula*)

This 3-feet tall perennial reproduces by rootstalks as well as seed. Leaves are alternate, narrow, 1 to 4 inches long. Stems are thickly clustered. Flowers are yellowish green, small, arranged in numerous small clusters and subtended by paired heart shaped yellow green bracts. This plant has a milky sap that causes severe irritation of the mouth and digestive tract, which in ruminants may cause death. Leafy Spurge may have been spotted in the Salt Creek area. Monitoring will begin there in summer 1997.

Spotted Knapweed (*Centaurea maculosa*)

This member of the Centauria group has purple flowers and no spines, but a tuft of persistant bristles on the fruits. Knapweeds readily establish on disturbed soils and have been seen along roadsides leading into the Little Butte Watershed from the east (Highway 140).

Table 1. Introduced Plant Species

Introduced Plant Species	Common Name	Scientific Name
Annual Grasses	Ripgut Brome* Soft Brome Medusahead Wildrye* Hedgehog Dogtail* Six-week Fescue Silver Hairgrass Little Quaking Grass Cheatgrass Annual Rye	*Bromus rigidus* *Bromus mollis* *Taeneantherum asperum* *Cynosurus echinatus* *Festuca bromoides* *Aira caryophyllia* *Briza minor* *Bromus tectorum* *Lolium multiflorum*
Perennial Grasses	Kentucky Bluegrass Canada Bluegrass Common Velvetgrass Perennial Ryegrass Intermediate Wheatgrass Pubescent Wheatgrass Orchardgrass Blue Wildrye Timothy Cereal Rye	*Poa pratensis* *Poa compressa* *Holcus lanatus* *Lolium perenne* *Agropyron intermedium* *Agropyron trichophorum* *Dactylis glomerata* *Elymus glaucus* *Phleum pratense* *Secale cereale L*
Forbs	Knotted Hedge Parsley Wild Carrot Prickly Lettuce Filaree Common St. Johnswort* Common Dandelion English Plantain Spreading Bedstraw Canada and Bull Thistle* Yellow Starthistle* Birdsfoot Trefoil	*Torilis nodosa* *Daucus carota* *Latuca serriola* *Erodium circutorium* *Hypericum perforatum* *Taraxacum officinale* *Platago lanceolata* *Galium divaricatum* *Cirsium spp .* Centaurea solstitialis Lotus cornicalatus
Forbs	Subclover Slender Vetch Common Vetch Dodder* Purple Loosestrife* Spotted Knapweed* Rush Skeletonweed* Skeletonweed*	*Trifolium subterraneum* *Vicia tetrasperma* *Vicia sativa* *Cuscata sp.* *Lythrum salicaria* *Centaurea maculosa Lam* *Chondrilla juncea* *Lygodesmia juncea*
Shrubs	Scotch Broom/Spanish Broom	*Cytisus spp.*

*Noxious weeds

APPENDIX F
Road Densities >4.0 mi/mi 2

Township	Range	Section	Landform[1]	Roads (mi/mi^2)	Stream Crossings (number)	Near Unstable Area? (Y/N)
Lower Little Butte Creek Analysis Subwatershed						
35	1E	35	VF	4.3	10	N
35	1E	36	VF	7.3	11	N
35	2E	27	CS	4.5	5	N
35	2E	32	VF	4.7	11	N
35	2E	34	CS	4.5	13	N
35	2E	35	CS	5.3	18	N
36	1W	3	AB/ST	8.2	16	N
36	1E	5	ST/VF/AB	5.7	14	N
36	1E	7	ST	4.4	15	N
36	1E	13	VF/AB	4.6	7	N
36	1E	18	ST/VF	5.0	11	N
36	2E	1	CS	4.7	9	N
36	2E	2	CS	5.6	14	N
36	2E	3	CS	4.0	10	N
36	2E	4	CS/VF	4.5	6	N
36	2E	10	CS/VF	5.5	14	N
36	2E	11	CS	5.7	23	N
36	3E	7	CS	5.4	10	N
37	1E	6	ST/VF	4.2	8	N
37	1E	8	VF	5.5	12	N
37	1E	12	CS/VF	4.7	18	N
37	1E	15	VF/CS	4.3	12	N
37	1E	16	VF	6.5	14	N
37	1E	21	VF	4.2	12	N
37	1E	26	VF/CS	4.4	12	N

Township	Range	Section	Landform[1]	Roads (mi/mi^2)	Stream Crossings (number)	Near Unstable Area? (Y/N)
37	1E	36	VF	4.0	13	N
37	2E	18	CS/VF	5.9	18	N
37	2E	20	VF/CS	4.1	8	N
37	2E	29	CS	7.2	10	Y
37	2E	32	CS	4.4	10	N
38	2E	8	CS	5.0	16	N
North Fork Analysis Subwatershed						
36	2E	13	CS	6.8	8	N
36	2E	17	CS	5.1	2	N
36	2E	18	VF/AB/CS	4.9	9	N
36	2E	24	CS	5.5	15	N
36	2E	27	CS	4.1	13	N
36	3E	19	CS	4.3	13	N
36	3E	20	CS	4.1	14	N
36	3E	21	CS	6.7	5	N
36	3E	27	CS	5.8	0	N
36	3E	28	CS	7.0	13	N
36	3E	29	CS	5.2	7	N
36	3E	34	CS	6.8	15	N
36	3E	35	CS	6.3	4	N
36	3E	36	CS/VF	8.1	6	N
36	4E	33	LP	5.3	0	N
36	4E	34	LP	7.2	6	N
36	4E	35	LP	6.1	9	N
37	3E	6	CS	6.6	17	Y
37	4E	4	LP	6.5	4	N
37	4E	5	CS/VP	5.2	2	N
37	4E	6	CS/VF	6.0	4	N
37	4E	16	LP	5.9	5	N

Township	Range	Section	Landform[1]	Roads (mi/mi²)	Stream Crossings (number)	Near Unstable Area? (Y/N)
South Fork Analysis Subwatershed						
37	2E	13	CS/VF	4.4	28	N
37	2E	16	VF	4.4	12	N
37	2E	23	CS	6.2	20	N
37	2E	24	CS/VF	4.3	9	N
37	2E	25	CS	5.0	16	Y
37	2E	28	VF/CS	5.0	14	N
37	2E	33	CS	6.7	14	N
37	2E	34	CS/LP	7.9	8	N
37	2E	36	LP/CS	5.2	19	N
37	3E	11	CS/LP	5.0	5	N
37	3E	12	LP/CS	4.4	5	N
37	3E	14	LP/CS	6.4	6	N
37	3E	18	VF/CS	4.9	7	N
37	3E	19	VF/CS	4.9	6	N
37	3E	22	CS/VF	5.4	11	Y
37	3E	28	CS/LP	4.6	6	N
37	3E	29	CS/VF	5.1	10	Y
37	3E	30	CS/VF	8.9	16	N
37	3E	31	LP/CS	5.8	11	N
37	3E	32	CS	4.8	13	N
37	3E	33	CS/LP	8.2	9	N
37	4E	17	VP/LP	6.0	3	N
37	4E	21	LP	6.0	14	N
37	4E	28	LP	6.3	16	N
37	4E	32	LP	8.0	14	N
37	4E	36	LP	5.7	2	N
37	5E	21	LP	5.3	0	N
37	5E	29	LP	4.6	4	N

Township	Range	Section	Landform[1]	Roads (mi/mi²)[2]	Stream Crossings (number)	Near Unstable Area? (Y/N)
38	2E	1	LP	5.7	7	N
38	2E	3	LP	6.2	12	N
38	2E	11	LP	4.3	7	N
38	3E	1	LP	4.7	2	N
38	3E	4	LP/CS	4.2	10	N
38	3E	5	LP/CS	4.7	12	N
38	3E	7	LP	7.2	9	N
38	3E	9	LP	4.8	11	N
38	3E	15	LP	4.2	13	N
38	3E	17	LP	5.9	12	N
38	3E	19	LP	5.4	3	N
38	3E	21	LP	5.3	10	N
38	3E	27	LP	4.9	10	N
38	3E	29	LP	5.4	10	N
38	3E	32	LP	4.7	4	N
38	3E	33	LP	6.5	9	N
38	4E	2	LP	5.0	4	N
38	4E	3	LP	6.3	11	N
38	4E	4	LP	7.0	18	N
38	4E	5	LP	4.3	8	N
38	4E	6	LP	6.4	4	N
38	4E	11	LP	5.7	6	N
38	4E	15	LP	6.2	11	N
38	5E	18	LP	5.1	11	N

SOURCE: Medford District BLM and Rogue River National Forest GIS

1/ Where there are two or more landforms in a section, the landforms are listed in order of area covered.
AB = alluvial bottom, ST = stream terrace, VF = valley floor, CS = canyon sideslope, LP = lava plateau, VP = volcanic peak

Rogue River Basin Temperature Study
1995

Little Butte Creek Subbasin
230,000 acres

Site Name	Map I.D.	Agency	Max. 7-Day High (F) 1993	Max. 7-Day High (F) 1994	Max. 7-Day High (F) 1995	1995 Diurnal range on the warmest day of 7-day high.	1995 Date of warmest temp. during maximum 7-day average	1995 Number of times 7-day average temperature exceeds DEQ standard	Site elevation
Little Butte Creek @ Eagle Point	LB18	BLM	~	82.3	79.7	69.8 - 82.4	Aug-05	96	1285
Little Butte Creek @ Hwy 62	LB19	MWC	~	~	77.7	69.6 - 80.7	Aug-05	55	1260
Little Butte N. Fork above confl with S. Fork	LB20	BLM	~	72.5	72.5	60.8 - 76.1	Aug-04	52	1655
Little Butte S. Fork above confl with N. Fork	LB21	BLM	~	77.9	74.8	58.1 - 76.1	Jul-05	21	1655
Lost Creek abv Coon Creek (Little Butte S. Fork)	LB22	BLM	~	~	64.8	59.9 - 66.2	Aug-05	15	2235
N. Fork of Little Butte Creek #1	LB23	RRNF	62.3	67.9	59.9	52.9 - 60.6	Aug-04	0	2720
North Fork Little Butte @ Lake Creek	LB24	MWC	~	~	~	~	~	~	1680
Salt Creek @ Mouth	LB25	MWC	~	~	71.6	68.2 - 73.2	Jul-18	63	1560
Soda Ck near confl with Little Butte Ck S. Fork	LB26	BLM	~	68.9	63.6	60.8 - 65.3	Aug-05	0	2235
Soda Cr. @ RM 5.0	LB27	ODFW	~	~	63.5	50.5 - 65.8	Jul-17	0	4280
Soda Cr. near Mouth	LB28	ODFW	~	~	62.8	59.8 - 64.4	Aug-05	0	2160
South Fork Little Butte Creek above Deer Cr.	LB29	ODFW	~	74.8	68.0	57.6 - 69.1	Jul-20	35	2060
South Fork Little Butte Creek below Lost Creek	LB30	ODFW	~	80.4	71.0	59.3 - 72.1	Jul-20	86	1830
South Fork Little Butte Creek below MID bypass	LB31	ODFW	~	68.0	66.8	57.3 - 68.8	Jun-28	35	1700
South Fork Little Butte Creek Side Channel 4	LB32	RRNF	~	~	56.7	56.5 - 57.3	Aug-05	0	2600
South Fork Little Butte Creek near Soda Creek	LB33	ODFW	~	72.9	67.0	57.0 - 67.9	Jul-24	25	2150
South Fork Little Butte Creek side channel 1B	LB34	RRNF	~	~	61.1	57.9 - 61.5	Jul-21	0	2520

Rogue River Basin Temperature Study
1995

APPENDIX G

Little Butte Creek Subbasin
230,000 acres

Site Name	Map I.D.	Agency	Max. 7-Day High (F) 1993	1994	1995	1995 Diurnal range on the warmest day of 7-day high.	Date of warmest temp. during maximum 7-day average	Number of times 7-day average temperature exceeds DEQ standard	Site elevation
Antelope Creek @ Bridge	LB01	MWC	~	~	80.1	63.8 - 82.0	Aug-05	59	1950
Antelope Creek @ Climax	LB02	MWC	~	~	59.6	56.7 - 61.5	Aug-05	0	2480
Antelope Creek @ Hwy 62	LB03	MWC	~	~	75.8	66.7 - 78.2	Aug-05	58	1260
Antelope Creek @ Yank Creek Road	LB04	MWC	~	~	70.0	63.2 - 72.9	Aug-05	52	1480
Antelope Creek above Burnt Canyon Creek	LB05	BLM	~	70.6	76.5	62.6 - 77.9	Aug-05	55	2075
Burnt Canyon Creek @ confl. with Antelope Ck.	LB06	BLM	~	63.5	81.8	63.5 - 85.1	Aug-05	51	2075
Conde Creek above TID Diversion Sec.8/9 line	LB07	BLM	~	74.0	69.2	52.7 - 70.7	Aug-05	57	4590
Dead Indian Creek above Conde Creek	LB08	BLM	~	72.5	74.6	56.3 - 74.3	Jun-28	64	4490
Deer Ck abv confl with Little Butte Creek S. Fork	LB09	BLM	~	66.6	61.2	58.1 - 62.6	Aug-05	0	2120
Deer Cr. @ RM 1.5	LB10	ODFW	~	~	60.0	56.8 - 61.3	Aug-05	0	2560
Deer Cr. near Mouth	LB11	ODFW	~	~	62.0	59.0 - 63.5	Aug-05	0	2065
Lake Creek @ confluence with Little Butte Creek	LB12	BLM	~	~	74.1	61.2 - 76.1	Jun-26	90	1640
Lake Creek @ Mouth	LB13	MWC	~	~	73.6	61.8 - 75.4	Jun-26	100	1680
Little Butte @ Agate Road	LB14	MWC	~	~	80.2	69.0 - 81.3	Aug-05	105	1180
Little Butte Ck N. Fk @ Heppsie Mtn. Rd. Bridge	LB15	BLM	~	67.9	60.2	53.4 - 60.8	Aug-04	0	2475
Little Butte Ck S. Fk abv Soda Ck, Sec 17/18 line	LB16	BLM	~	74.3	66.7	57.2 - 68.0	Jul-22	16	2190
Little Butte Creek @ Eagle Point	LB17	MWC	~	~	76.7	69.0 - 78.8	Aug-05	55	1300

Rogue River Basin Temperature Study
1995

Little Butte Creek Subbasin
230,000 acres

Site Name	Map I.D.	Agency	Max. 7-Day High (F) 1993	1994	1995	1995 Diurnal range on the warmest day of 7-day high.	Date of warmest temp. during maximum 7-day average	Number of times 7-day average temperature exceeds DEQ standard	Site elevation
South Fork Little Butte Creek Trib. #1	LB35	RRNF	~	~	~	~	~	0	4800
South Fork Little Butte Creek Trib. #2	LB36	RRNF	~	63.1	58.4	55.0 - 59.8	Aug-05	9	4500
South Fork Little Butte Creek Trib. #3	LB37	RRNF	~	~	63.7	57.9 - 65.0	Jul-28	0	2600
South Fork of Little Butte Creek #1	LB38	RRNF	38.6	73.2	39.1	38.4 - 39.6	Aug-04	0	4800
South Fork of Little Butte Creek #2	LB39	RRNF	~	64.2	64.4	60.3 - 66.0	Jul-21	5	4600
South Fork of Little Butte Creek #3	LB40	RRNF	61.7	68.8	60.1	55.4 - 60.6	Jul-17	0	2680
South Fork of Little Butte Creek #5	LB41	RRNF	~	~	60.8	54.8 - 61.3	Jul-24	0	2600
South Fork of Little Butte Creek #6	LB42	RRNF	~	~	62.8	56.7 - 63.2	Jul-21	0	2560
South Fork of Little Butte Creek #7	LB43	RRNF	65.6	~	63.1	56.1 - 63.7	Jul-21	0	2520
South Fork of Little Butte Creek #8	LB44	RRNF	~	73.0	65.3	56.7 - 66.1	Jul-22	13	2520
South Fork of Little Butte Creek #9	LB45	RRNF	~	~	66.7	57.0 - 67.9	Jul-24	25	2520

APPENDIX H
Fifteen Percent (15%) Late-Successional Retention Areas

The Northwest Forest Plan (NFP) recognizes the value of remnant patches of old-growth forest and states that "Loss of old-growth stands may result in local extirpation of an array of species. It is prudent to retain what little remains of this age class within landscape areas where it is currently very limited" (USDA and USDI 1994, p.C-44). The Regional Ecosystem Office (REO) draft memorandum (dated March 7, 1997) on this Standard and Guideline (S&G) recognizes that stands in the transition and shifting gap stages of development generally have the characteristics required by late-successional and old-growth related species. The Forest Ecosystem Management Assessment Team (FEMAT) established that the transition phase begins between 150 and 250 years on the westside of the Cascades.

The Watershed Analysis Team concluded that stands in the transition and old-growth phases in the Little Butte Creek Watershed average greater than 21 inches in diameter, have two or more canopy layers, and have greater than or equal to 60 percent canopy closure and, therefore, qualified for the 15 percent retention S&G. A map of these stands was made using Western Oregon Digital Image Processing (WODIP) data. WODIP tracks the canopy cover of forest stands in blocks of 10 percent (e.g., 45, 55, & 65 percents...). This method provided consistency across the entire watershed, but changed the criteria from 60 to 65 percent for mapping and tracking purposes. It should be noted that satellite imagery interpretation errors may have been made and these late-successional stands need to be ground-truthed. If errors are detected, an equal area of suitable late-successional forest will be substituted from another part of the watershed.

The amount of stands that presently meet these criteria equals 14.6 percent of the federally-owned forest lands in the watershed; 75 percent of which is on Forest Service lands. For the BLM lands, the data from the satellite map was transferred to a map of the watershed's Operations Inventory (OI) data base, which represents the BLM's stand exam tracking system. Those OI stands that contain a majority of late-successional forest, as defined above, were incorporated into the 15 percent late-successional (LS)/old-growth (OG) retention provision. For tracking purposes, using the OI stands is the only way the BLM can designate the 15 percent retention areas. However, many small patches that qualify for retention may not be included in the OI stands because they comprise less than 50 percent of an OI unit. Since it is the intent of the Watershed Analysis team to retain 100 percent of the existing stands that are greater than or equal to 21 inches in diameter and have greater than or equal to 65 percent canopy closure with multiple canopy layers within the 15 percent retention areas, the OI 15 percent LS/OG retention map should be used for BLM tracking purposes only. The satellite data map (Map 12) represents the actual stands which are to be retained before ground-truthing.

The OI retention units may be entered for a variety of management reasons. The value of retaining LS/OG forest patches increases by distributing the retention areas across the watershed in a variety of plant series. Those stands in the pine series have large ponderosa pines, but are overstocked with invading Douglas-firs that need to be removed to restore the sites. Those parts of the OI stands that do not meet the retention criteria may also be entered for thinnings. Where dwarf mistletoe infestations have killed moderately sized patches of trees within the retention areas, these trees may be selectively harvested. The patch of dead trees will no longer meet the retention criteria and all harvested acres will be subtracted from the watershed's total retained acreage. The silvicultural activities related to any of these three situations may take the canopy closure of the stand below 60 percent, but will be sensitive to preserving other LS/OG components such as downed wood and snags.

On Forest Service lands, a GIS layer of the stands identified for retention was created and entered into the Ashland Ranger District's tracking system. This layer identifies retained stands to the detail of the satellite generated map.

APPENDIX I

UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
Oregon State Office
P.O. Box 2965 (1300 N.E. 44th Ave.)
Portland, Oregon 97208

In Reply Refer to:
5400(931)

November 29, 1994

Instruction Memorandum No. OR-95- 028
Expires 09/30/96

To: District Managers: Salem, Eugene, Roseburg, Coos Bay, Medford, and Lakeview

From: State Director

Subject: Implementation of Coarse Woody Debris Standards and Guidelines

The Regional Ecosystem Office (REO) has provided guidance from the Research and Monitoring Committee (RMC) for implementation of the Coarse Woody Debris (CWD) Standards and Guidelines (S&G). These guidelines apply for regeneration harvest and partial harvests (Record of Decision, C-40).

The Special Provision for regeneration harvest should read as follows:

> "A minimum of (120) (240) linear feet of logs per acre, averaged over the cutting area and reflecting the species mix of the unit, will be retained in the cutting area as shown on Exhibit A. All logs shall have bark intact, be at least (16) (20) inches diameter at the large end, and be at least (16) (20) feet in length. Logs shall be distributed throughout the cutting area, and not piled or concentrated in a few areas. Where logs are available and safety considerations permit, a minimum of (based on ID Team recommendation) linear feet of logs shall be retained on each acre of the cutting unit as directed by the Authorized Officer."

Apply the first set of specifications (120 linear feet; 16 inches; 16 feet) to sales south of the Willamette National Forest and the Eugene BLM District, or east of the Cascades. Apply the second set of specifications (240 linear feet; 20 inches; 20 feet) to sales north of and including the Willamette National Forest and Eugene BLM District.

The RMC recommended that the minimum linear feet to be retained on each acre be established by an interdisciplinary team (ID Team) based on the availability of CWD and the site conditions. This approach was identified as consistent with the objectives of the S&G and several related S&Gs. We recommend that steepness of slopes and stand density be considered in arriving at a reasonable and attainable minimum.

The Special Provision for partial harvest should apply the same basic principles, but they should be modified to reflect the timing of the stand development cycles where partial harvest is practiced. The RMC specified that:

1. The application is difficult in stands being thinned or in density management prescription implementation when harvest trees are generally less than 18-20 inches DBH.

2. The ID Team should modify the guidelines based on the timing of stand development and site conditions, including current CWD, availability of logs, and future production of CWD.

3. It is not necessary to fall reserve trees to provide down logs. Reserve trees provide opportunities to meet snag and CWD objectives later in the rotation.

A copy of the REO correspondence, which is the basis for our guidance, is attached for your reference.

Daryl L. Albiston
Acting Associate State Director

1 Attachment
1 - REO memo to BLM dated 10/13/94 (4 pp)

Distribution
WO-230 (Room 204 LS) - 1
OR-930 - 1
OR-931 - 1

REGIONAL ECOSYSTEM OFFICE

P.O. Box 3623
Portland, Oregon 97208
(503) 326-6265
FAX: (503) 326-6282

MEMORANDUM

DATE: October 11, 1994

TO: Don Knowles, Executive Director

FROM: Dan McKenzie, Research and Monitoring Committee

SUBJECT: Review of BLM's Interpretation of Standards and Guidelines for Retention of Coarse Woody Debris.

As requested in your letter of September 6, 1994, the RMC has reviewed BLM's interpretation and suggests an alternative contract provision that is consistent with BLM's proposal and the intent of the Coarse Woody Debris (CWD) Standards and Guidelines (S&G) for regeneration harvests (ROD, C-40). We intend that this example contract provision for retention of 120 linear ft. per acre is applied to sales south of the Willamette National Forest and the Eugene BLM District, or east of the Cascades. For areas north of and including the Willamette National Forests and Eugene BLM District, the length (240 ft.) and diameter (20 in.) requirements remain the standard and would modify the contract provision when applied to those areas. Further, the RMC noted that no distinction was made (in the August 23, 1994 letter) between the contract provision for regeneration harvest and partial harvests. The RMC interpreted the sample contract provision as proposed to be applied only to regeneration harvest related sales and that appropriate modifications would be made for partial harvests. A short note appears at the end of this letter that provides additional material for consideration when implementing the CWD S&G to partial harvests.

The objective of the coarse woody debris standard is to assure that minimum levels of CWD are retained "well distributed across the landscape" and "for maintaining populations of ... organisms that use this habitat structure" (ROD, C-40). The linear feet of logs standard was not meant to apply as an exact amount on each individual acre (Starkey and Tappeiner, pers. comm. 9/94). It is recognized that site characteristics will result in more coarse woody debris in some areas of the cutting unit than others, which is not inconsistent with the intent of the S&G. However, the intent is that logs will be well distributed and it will not be appropriate to concentrate material in a few locations within the cutting unit.

We propose the following alternative to your proposed example contract provision for a 10-acre regeneration harvest sale:

> "A minimum of 120 linear feet of logs per acre, averaged over the cutting area and reflecting the species mix of the unit, will be retained in the cutting area as shown on Exhibit A. All logs shall have bark intact, be at least 16 inches diameter at the large end, and be at least 16 feet in length. Logs shall be distributed throughout the cutting area, and not piled or concentrated in a few areas. Where logs are available and safety considerations permit, a minimum of 50 linear feet of logs shall be retained on each acre of the cutting unit as directed by the Authorized Officer."

Our recommendation is based on examination of three aspects of the CWD S&G: 1) average over cutting unit versus amount per individual acre, 2) minimum diameter of logs, and 3) minimum linear feet on any individual acre.

1. Use of an average per acre over the unit, or total across the unit, as the measurement to determine compliance with the S&G for CWD is consistent with the scientific author's intent (Starkey and Tappeiner, pers. comm. 9/94). In addition, it is consistent with the CWD S&G's for northern California National Forests as prescribed in the ROD C-40, and described in the Draft Forest Plans. As an example, the Mendocino NF Plan is: "Maintain a minimum of three recently-downed logs per acre, averaged over 40 acres." (IV-37) Further, the average per-acre measurement is consistent with the closely associated Standard and Guide for snag retention: "with per-acre requirements met on average areas no larger than 40 acres" (ROD, C42).

2. The proposal to measure the log diameter at the small end, while consistent with the CWD S&G, is a more restrictive requirement than measurements at the large end. Measurements at the large end are designated for the northern California National Forests, draft Forest Plans: "greater than 20 inches in diameter (large end)" (Mendocino NF Draft Plan IV-37). The RMC concluded that the log diameter requirements of the S&G could be met by a uniform approach of measuring the CWD logs at the large end.

3. The RMC recommends that the "minimum ... on each acre," be established by the interdisciplinary team to reflect availability of CWD and site conditions. While not explicitly required by the CWD S&G, providing a minimum per acre is consistent with the objectives of the S&G and several related S&G's. Examples of related S&G's are: "maintain 5 to 20 pieces of coarse woody material per acre," (Klamath NF Draft Plan, 4-19) and "4 to 6 logs," (Shasta-Trinity National Forest Draft Plan, 4-45). The RMC does not consider the current proposal of "a minimum of fifty(50)" to be a recommendation to establish a new minimum CWD S&G.

REGIONAL ECOSYSTEM OFFICE

P.O. Box 3623
Portland, Oregon 97208
(503) 326-6265
FAX: (503) 326-6282

MEMORANDUM

DATE: October 13, 1994

TO: Elaine Zielinski, BLM State Director OR/WA

FROM: Donald R. Knowles, Executive Director

SUBJECT: Interpretation of Coarse Woody Debris Requirements in the Record of Decision (letter of August 23, 1994)

By letter of August 23, 1994, you requested concurrence by the Regional Ecosystem Office (REO) with the Bureau of Land Management's interpretation of the Coarse Woody Debris (CWD) requirements in the Record of Decision.

The REO referred your request to the Research and Monitoring Committee (RMC) for review of the CWD Standards and Guidelines (S&G). The RMC has completed it's review of the proposed contracts provision and their report is enclosed.

The RMC report provides a clarification of the method of measurement for complying with the Standards and Guides. The RMC also directs your attention to the differences in the CWD S&G for regeneration harvests and partial harvests.

Should you desire further assistance on this matter, please feel free to call either myself or Dan McKenzie (503-326-6350).

Enclosure

cc:
Mike Crouse

OR910 ROUTING:
(10/17/94 - ...)
OR910-SD
OR910.1-ASD
OR912-PA
OR913-EEO
OR914-RP/LE
OR920-MIN
OR930-LRR
OR940-OPS
OR950-ADM
OR955-RMU IT30
W. DISTRICTS
E. DISTRICTS
OTHER:

X–Action / C–Copy

Attachment 1-

Coarse Woody Debris Standards and Guidelines for partial harvest.

> "In areas of partial harvest, the same basic guidelines should be applied, but they should be modified to reflect the timing of the stand development cycles where partial harvest is practiced" (ROD, C-40).

We recognize that interpretation of these guidelines is difficult for stands which are being thinned or in which density management prescriptions are being implemented, especially when the harvested trees are generally less than 18 to 20 inches DBH. In partial harvest situations, the interdisciplinary team should modify the guidelines based on timing of the stand development and site conditions, including current CWD, availability of logs, and future production of CWD.

During partial harvests early in the rotational cycle, it is not necessary to fall the larger dominant or codominant trees to provide logs. These trees will provide opportunities for CWD later in the rotational cycle, plus as these larger trees die from natural mortality, some can be retained to provide snags and future CWD.

UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
Oregon State Office
P.O. Box 2965
Portland, Oregon 97208

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In Reply Refer to:
5400 (OR-931)

November 19, 1996

EMS TRANSMISSION 11/20/96
Information Bulletin No. OR-97-064

To: District Managers: Coos Bay, Eugene, Lakeview, Medford, Roseburg, and Salem

From: State Director

Subject: Implementation of Coarse Woody Debris Standards and Guidelines

Instruction Memorandum No. OR-95-028 dated November 29, 1994, provided guidance for the implementation within Matrix management lands of coarse woody debris (CWD) Standards and Guidelines (S&Gs) (pp. C-40 and 41 of the Northwest Forest Plan). As we continue to gain experience working with CWD on the ground, various prescriptions have been developed and clarifications requested for their use.

This Information Bulletin discusses options and clarification for the following CWD features:

- Retention of existing CWD:
- Crediting linear feet of logs;
- Crediting of large diameter short piece (less than 16/20 feet) logs by using a cubic foot equivalency alternative;
- Standing tree CWD retention versus felling to provide CWD substrate:
- Application of the basic guideline in areas of partial harvest.

The information contained in this bulletin may be used for the design and layout of Matrix harvest sales: however, proposed timber sales where layout has been completed need not be modified. Resource Management Plans may limit the implementation of some of these recommendations. This Information Bulletin has been shared widely with other agency specialists and a copy has been provided to the Regional Ecosystem Office (REO). We are forwarding the attached discussion paper for information and detail on how various resource areas have dealt with CWD issues.

The development of models for groups of plant associations and stand types to be used as a baseline for prescriptions within specific geographic areas is encouraged (S&Gs at C-40.

Part A, and C-41, Part E). The desired conditions should address both sustainable ecological and biological conditions, even providing habitat beyond natural conditions. Some working "CWD" and "desirable condition" definitions are given in the Appendix: historical ecological condition, species-specific biological condition, and desired future condition. Taking advantage of opportunities "to provide coarse woody debris well-distributed across the landscape in a manner which meets the needs of species and provides for ecological functions" should be captured in your local prescriptions.

If you have any additional questions, please contact Larry Larsen at 503-952-6080 or Nancy Anderson at 503-952-6072.

Signed by
A. Barron Bail
Acting Deputy State Director for
Resource Planning, Use & Protection

Authenicatedby
Maggie Weaver
Management Asst.

1 Attachment
1 - Questions & discussion re S&Gs
for coarse woody debris (8 pp)

Distribution
WO-330 (Room 204 LS) - 1
OR-930 - 1
REO (Knowles, Pietrzak) - 2

Questions and Discussion Regarding Standards and Guidelines to *Provide specified amounts of coarse woody debris in matrix management.*

This paper discusses the implementation of the Standard and Guideline (S&G) titled *"Provide specified amounts of coarse woody debris [CWD] in matrix management"* (S&G C-40 and C-41). The S&G prescribed specific measures (S&G C-40, Part B) which need to be used until geographic guidelines are developed (S&G C-40, Parts A and E). As local knowledge on how best to design timber sales continues to increase, the ways to achieve adequate quantities of CWD are also developing. We have drafted a question-and-answer discussion paper which we believe will be helpful in your implementation of this S&G.

1. **QUESTION:** Retention and protection of CWD already on the ground was not addressed in Instruction Memorandum No. OR-95-028. Standard and Guideline C-40, Part C, states: "Coarse woody debris already on the ground should be retained and protected to the greatest extent possible from disturbance during treatment which might destroy the integrity of the substrate." Is the priority "to provide" CWD or "to retain" existing CWD? Is it appropriate to remove decay classes 1 and 2 and replace them? How limiting is "protect to the greatest extent possible?" Is the presence or absence of bark, post-logging, the critical indicator of functioning decay class 1 or 2 logs?

> DISCUSSION: Logs present on the forest floor prior to harvest generally are providing habitat benefits that will likely continue after harvest. Where practicable, pre-harvest CWD decay class 1 and 2 logs should be reserved (e.g., painted with the reserve color) in adequate quantities to provide the baseline feet requirement; other decay class logs are to be protected to the extent possible. Specified amounts of decay class 1 and 2 logs to be retained is given in C-40, Part B; and suggested locations of retention areas is given in C-41, Part D.
>
> The phrase "protected to the greatest extent possible" recognizes felling, yarding, slash treatments, and forest canopy openings will disturb CWD substrate and their dependent organisms. These disturbances should not cause substrates to be removed from the logging area nor should they curtail treatments. Appropriate protective practices should be addressed during logging design such as locating forest patches to retain logs, use of site preparation techniques, and attention to CWD during contract administration to minimize damage and protect substrate integrity. As a general rule, a reserve clause would be used in the timber sale contract and site preparation activities would be designed to minimize disturbance for all decay classes. During contract administration, our desire to protect these logs to the greatest extent possible should be conveyed to the purchaser.
>
> Following harvest, coarse woody debris should be retained both for the current forest habitat and for the development and function of the next forest. Prescriptions should account for current habitat conditions and the timing and development of subsequent snags and CWD until the next stand once again begins to contribute CWD. Decay

substrates as a group generally persist for hundreds of years. Some CWD last up to 500 years within some forest ecosystems, while in others the life span is as short as 60 years. Advanced decayed material often holds large amounts of water and nutrients and contains the majority of soil horizon ectomycorrhizae. Prescriptions are to provide CWD to a full array of late-successional related species and to ensure soil organic material replacement over the next 100 years.

Prior to removal of any decay class 1 or 2 logs, the Interdisciplinary Team should evaluate the "appropriate coarse woody debris quantity, quality (such as species, decay stage and size) and distribution." Down logs should reflect the species composition of the original stand in order to retain the habitat conditions which would have occurred without harvest. The removal of excess decay class 1 and 2 logs is contingent upon the evidence of appropriately retained or provided amounts of decay class 1 and 2 logs. Large amounts of CWD are naturally and periodically infused into the forest following fires, blowdown, and snow/rain events and provide benefits to late-successional species. "Salvage" of these materials must provide for adequate levels of desirable biological substrates.

The presence or absence of bark has been used as a method to help logging crews distinguish between decay class 2 and 3 logs. Experience has indicated that some surface bark will be dislodged from CWD during felling, yarding, and site preparation. The presence or absence of bark is an important indicator, but not the sole critical indicator. (See structural features associated with decay class logs as given in the Forest Survey Handbook H-5250-1, "A five-class system of log decomposition based on fallen Douglas-fir trees," pp. IV-13/-16. In discussing site preparation, Graham et al. (1994) concluded that fire which charred bark and wood did not interfere substantially with the decomposition or function of CWD.) (Graham, et al., Managing Coarse Woody Debris in Forests of the Rocky Mountains. USDA Res Paper INT-RP-477. 1994.)

Cedar logs, whose wood texture remains decay class 2 for extended periods, tend to accumulate over time. They also tend to lose their bark when, as substrate, they still exhibit decay class 1 or 2 habitat features of structure and texture (i.e., buckskin logs); and their function is that of a decay class 1 or 2 log although bark retention is analogous to that of decay class 3 logs. Post-logging retention, or the removal, of some of these barkless logs is not expected to be critical to the overall function of CWD within a sale unit.

2. **QUESTION:** Specific amounts of decay class 1 and 2 logs are required following regeneration harvest (S&G C-40, Part B); and in crediting linear feet per acre, Instruction Memorandum No. OR-95-028 stated minimum diameter logs may be measured at the large end. For minimum diameter logs, what length can be credited as a piece to meet the linear feet CWD requirement?

<u>DISCUSSION</u>: In the case of minimum diameter-sized logs (16 or 20 inches at the large end), one minimum piece length (16 or 20-foot section) beyond the minimum diameter may be credited. Bucking tree lengths into sections is not the intent of this clarification or the S&G; long log lengths are preferable.

3. **QUESTION:** Large diameter, short piece length decay class 1 and 2 logs are being removed from units; and small diameter, adequate length logs are being retained. Can a volume equivalent to 20 inches x 20 feet, (i.e., logs greater than 40 cubic feet) be used to retain large diameter piece logs by crediting their footage toward meeting the linear feet of logs per acre requirement? (See Table 1)

<u>DISCUSSION</u>: An appropriate quantity and quality of CWD must be provided, and the specific measure states "Logs less than 20 [or 16] feet cannot be credited toward this [required minimum] total" (S&G C-40, Part B). Lacking those logs, the general rule is to retain the best material available.

We believe the specific measures are a baseline. We can use the specific measure to develop prescriptions for the retention of CWD. Larger CWD is important for the development and function of both the current and next forest; and because large diameter pieces of CWD have more durable heartwood than small pieces, they last longer. Large logs are a key habitat component for many forms of wildlife; and by disrupting air flow and providing shade, they insulate and protect various forest species.

In many cases, large diameter logs which are the result of felling breakage during logging are removed, and then much smaller diameter logs are left on the unit to meet CWD requirements. Large diameter log sections often possess desirable CWD characteristics such as having more heartwood than smaller pieces. Yet, under the S&Gs, these pieces would not "count" because they are less than 16/20 feet long. Based on field examination, some biologists recommend the retention of these large diameter, shorter length logs. If these segments provide the desired CWD form and function despite the fact that their length is shorter than the specified minimum, they may be counted towards the linear requirement when:

- the large end diameters are greater than 30 inches and log length is greater than 10 feet:
- log diameters are in excess of 20 inches <u>and</u> volume is in excess of 40 cubic feet; (see attached table)
- they are the largest material available for that site.

4. **QUESTION:** When adequate amounts of pre-logging CWD are lacking, is it okay to provide standing green trees versus immediately felling trees during the regeneration harvest to meet the decay class 1 and 2 log specific measures, at least in the short term?

DISCUSSION: The standard is "[m]anage to provide a renewable supply of large down logs well distributed across the matrix landscape in a manner that meets the needs of species and provides for ecological functions." It is also recognized that "scattered green trees will provide a future supply of down woody material . . . " The specific measures are to provide a supply of decay class 1 and 2 logs at the time of regeneration (and partial) harvest.

It is essential that at the time of regeneration harvest (and partial harvest) provisions be in place to ensure the supply of adequate amounts of CWD. In most cases, the required CWD amounts should be either reserved existing CWD or retained felled logs. (The original memorandum contained a special provision to be used for sales where the purchaser would "select" CWD to be left.) The strategy for CWD should be clearly documented during the planning process.

Experience suggests when tree sizes, disturbance history, and regeneration-harvest stand scheduling does not provide adequate down woody debris, the deficiency, including total absence, of decay class 1 and 2 logs could be corrected by marking additional standing trees and leaving them standing for a period following harvest. This could be accomplished by augmenting the Bureau of Land Management's scattered green tree retention (C-41) requirements. The additional trees would initially be left standing.

If the S&Gs require that 6-8 green trees per acre be retained, prescriptions would require that additional green trees be marked for retention and protection during sale preparation. Adequate potential trees would be retained whether these trees are to be felled or left as green trees for future down woody debris. By reserving all or a portion of decay class 1 and 2 logs, and additional standing trees as described above to correct any deficit, new contract language would not be needed. Operationally, some reserved green trees will be knocked down or felled during the course of logging operations.

Four scenarios have been proposed and recommended to provide the decay class 1 and 2 material by utilizing standing CWD trees:

Scenario 1. Blowdown commonly occurs and wind normally fells retention trees, providing both snags and down CWD immediately following regeneration harvest. After two winter seasons, wind-firm trees may still be standing; top snap occurs providing both snags and CWD; and blowdowns include total tree length, often with the root wad attached. A third year assessment would monitor for CWD and determine if the need exists to fell trees to meet the required linear feet.

Scenario 2. In small diameter regeneration harvest stands, the largest sized green trees are selected as CWD trees and felled following harvest. The alternative is to allow these trees to remain standing and potentially to grow into larger sized diameter CWD substrate after a reasonable period of time. The treatment is similar to partial harvest or commercially thinned units (see Question 5). To date, green tree CWD retention prescriptions have included some or all of the following elements:

- retain the largest sized diameter trees for required green leave trees;
- immediately post-harvest, ensure that enough logs are on the ground to meet one-half the CWD requirement;
- designate additional standing green trees to grow larger diameter trees;
- CWD green trees would be left standing for a period of time; 5-15 years, until they attained the desired larger size or succumbed to natural mortality. The necessary window to grow and provide the specified amount of CWD could be as long as 30 years.

Scenario 3. The strategy is to meet the decay class 1 and 2 log level required post-harvest immediately following logging or the site preparation treatment period. This strategy assumes that an adequate number of reserve trees are retained to meet the requirement. Upon completion of harvest, the existing linear feet of decay class 1 and 2 logs for each sale unit are tallied; and then the reserve trees are felled to meet the 120/240 linear foot requirement. Knockdowns, trees felled to alleviate a logging concern, and blowdowns are counted toward the total linear feet so long as they meet the decay class, diameter, and length requirements. The minimum amount of CWD linear feet are ensured, and excess trees continue to grow.

Scenario 4. Provide the full requirement of CWD logs in reserve trees. There is no need to measure linear feet since the decay class 1 and 2 requirements will be met from the standing, reserved trees. Accept whatever linear feet of decay class 1 and 2 logs is present on the unit post-harvest. It may range from zero to several hundred linear feet. The management action will be to allow natural forces (primarily, windthrow) to provide infusions of trees into CWD decay classes 1 and 2 over time from the population of marked retention trees and snag replacement trees. The option remains to revisit the site over time to monitor decay class 1 and 2 conditions and consider whether elective felling of selected retention trees is warranted. Note that any trees marked as replacement trees to correct snag deficiencies in the short term (three decades) may not count toward the standing retention tree requirements and may not be felled to account for the decay class 1 and 2 logs.

5. QUESTION: "In areas of partial harvest the same basic guidelines are to be applied, but they should be modified to reflect the timing [of] stand development cycles where partial harvesting is practiced" (S&G C-40, Part B). Does this mean we should be felling trees to provide CWD in selection and commercial thinning areas?

> <u>DISCUSSION</u>: An accumulation of CWD should be designed into partial harvest prescriptions to provide a natural or biologically desired condition. The timing of stand development cycles providing snags and subsequent CWD from natural suppression and overstocking mortality should be accounted for, the desired conditions estimated, and then the advantages of treatment to improve habitat conditions beyond natural conditions should be assessed. The amounts of CWD should be specifically provided, including felling trees, to meet the desired conditions for late-successional forest related species. CWD trees are not normally required to be felled during harvest, especially trees with broken tops, advanced decay, or other deformities contributing habitat structural features. Leaving naturally dense clumps around snags to provide suppression mortality, scattering "structural" green trees, and allowing individual trees to grow into larger sized CWD materials should be considered in partial harvest plans. Leaving green trees and felling to provide a source for CWD should be part of the partial harvest prescription. The intent is to provide a source of "coarse woody debris well distributed across the landscape in a manner which meets the needs of species and provides for ecological functions."

Appendix
Working Definitions

Coarse Woody Debris (CWD):

The portion of a tree that has fallen or been cut and left in the woods. Usually refers to pieces at least 20 inches in diameter (ROD Glossary F-4).

Coarse Woody Debris (CWD) or Down Woody Debris (DWD):

Any large piece of woody material having a diameter greater than 10 cm (4 inches) and a length greater than 1.0 meter (39 inches)[1]. Fifteen to twenty percent ground cover of DWD or 4.5-10 tons of fresh DWD would be adequate after timber harvesting for optimal amounts of small mammal habitat and organic matter[2].

Desired Condition (DC):

Structural characteristics of late-successional forest vary with vegetation type, disturbance regime, and developmental stage. The desired condition also varies whether the target is a "natural" desired condition or a "biological" desired condition.

Historic Ecological Conditions (HEC):

This term is used to describe a set of ecological conditions that were likely present prior to European influence on the landscape. One of the assumptions was that during this time period natural processes and functions were occurring under inherent disturbance regimes, and thus these represent sustainable conditions. A description of these conditions is usually synonymous with the natural or historic range of variability and focuses on maintaining ecosystem processes and functions, not necessarily the viability of a particular species.

Species-Specific Biological Conditions (SBC):

This term is used to described a set of biological conditions specific to the viability of a particular species. In particular, this term was used to describe habitat conditions for the northern spotted owl or other late-successional/old-growth forest-related species that may address short-term (up to 50 years) viability concerns. These habitat conditions are not necessarily the DEC and may not be sustainable in the long term (greater than 50 years) due to a variety of potential disturbances.

Desired Future Conditions (DFC):

This term is used to describe the interaction between HEC, SBC, and any other social issues that may result in deviation from the HEC. For example, the HEC is described for a particular vegetation type and due to the viability concern for northern spotted owl or other late-successional/old-growth forest-related species, the SBC requires a deviation from the HEC. By overlaying the two conditions, the DFC for that vegetation type is then described. In cases where there were no overriding viability issues with any species, the HEC was synonymous with the DFC.

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[1] Society of American Foresters. Forest Ecology Working Group Terms. 1996.

[2] Carey, A. and M. Johnson: Small Mammals in Managed, Naturally Young and Old-Growth Forests. Ecological Application 5(2): 336-351, 1995; Nakamura, F. And F. Swanson: Distribution of Coarse Woody Debris in a Mountain Stream, Western Cascades Range, Oregon. Canadian Journal of Forestry Research 24: 2395-2403, 1994.

TABLE 1
VOLUME PER LOG SEGMENT
TAPER PER 16 FEET

Diameter Large End (inches)	Segment Length (feet)								
	20	18	16	14	12	10	8	6	4
20	38.5	35.1	31.6	28.0	24.3	20.5	16.6	12.6	8.5
22	47.1	42.9	38.6	34.1	29.6	24.9	20.2	15.3	10.3
24	56.6	51.5	46.3	40.9	35.4	29.8	24.1	18.3	12.3
26	67.0	60.9	54.6	48.3	41.8	35.1	28.4	21.5	14.5
28	78.2	71.0	63.7	56.2	48.6	40.9	33.0	25.0	16.8
30	90.3	82.0	73.5	64.8	56.0	47.1	38.0	28.7	19.3
32	103.3	93.7	84.0	74.0	64.0	53.7	43.3	32.7	22.0
34	117.2	106.2	95.1	83.8	72.4	60.8	49.0	37.0	24.9
36	131.9	119.5	107.0	94.3	81.4	68.3	55.0	41.5	27.9
38	147.5	133.6	119.6	105.3	90.9	76.2	61.4	46.3	31.1
40	164.0	148.5	132.8	116.9	100.9	84.6	68.1	51.4	34.5
42	181.3	164.2	146.8	129.2	111.4	93.4	75.2	56.7	38.0
44	199.5	180.6	161.4	142.1	122.5	102.6	82.6	62.3	41.8
46	218.6	197.8	176.8	155.5	134.0	112.3	90.3	68.1	45.7
48	238.6	215.8	192.9	169.6	146.2	122.4	98.5	74.2	49.7
50	259.4	234.6	209.6	184.3	158.8	133.0	106.9	80.6	54.0
52	281.1	254.2	227.1	199.6	171.9	144.0	115.7	87.2	58.4
54	303.7	274.6	245.2	215.6	185.6	155.4	124.9	94.1	63.0
56	327.2	295.8	264.1	232.1	199.8	167.3	134.4	101.3	67.8
58	351.5	317.7	283.6	249.2	214.6	179.6	144.3	108.7	72.8
60	376.7	340.4	303.9	267.0	229.8	192.3	154.5	116.3	77.9

APPENDIX K
Roads of Concern

BLM ROADS

Objectives: To reduce road density, compacted area, peak flows, sedimentation, and/or roads adjacent to or in Riparian Reserves.
Recommendation: Decommission the following roads.

Road Numbers	Road Numbers	Road Numbers
37-1E-11.1	38-2E-1.0	38-3E-7.2
37-1E-11.3	38-2E-1.2	38-3E-7.3
37-1E-11.5	38-2E-1.3	38-3E-8.1
37-1E-13.1	38-2E-1.4	38-3E-9.1
36-2E-35.0	38-2E-1.6	38-3E-9.2
37-2E-17.1	38-2E-3.3 (only last portion)	2 unnumbered roads (T.38S.,R.3E., Sec. 9, NE¼)
37-2E-19.0	38-2E-3.4	
37-2E-19.1	37-3E-5.2	
37-2E-19.2	37-3E-5.3	38-3E-15.3
37-2E-19.3	37-3E-5.4	38-3E-27.2
37-2E-19.4	38-3E-4.3	38-3E-27.3
37-2E-24.0 (only on BLM)	38-3E-4.4	38-3E-27.5
37-2E-25.2	38-3E-6.0	38-3E-29.4
37-2E-29.0	38-3E-6.1	38-3E-29.5
37-2E-33.3	38-3E-6.2	
37-2E-33.5	38-3E-6.3	

Objective: To reduce wildlife disturbance.
Recommendation: Block the following roads.

Road Numbers
37-1E-13 and all tributary roads
37-2E-25.4
37-2E-29.2
Unnumbered connecting road between roads 37-2E-7.2 and 37-2E-3.2
37-3E-6.2
37-3E-6.4
37-3E-6.6
37-3E-6.8
37-2E-1.2
38-3E-20.0

FOREST SERVICE ROADS

Objective: To avoid an earthflow.
Recommendation: Relocate road 3730800 in T.37S., R.3E., Sec. 22, SE¼ and upgrade the road from T.37S., R.3E., Sec. 21, SE¼ to Sec. 22, SW¼.

Objective: To reduce erosion or landslide problems.
Recommendation: Decommission the following roads.

Road in T.37S., R.3E., Sec. 14, SE¼
Road numbers 422, 423, 424, 425, and 426 in T.37S., R.3E., sections 10 and 11
Road number 250 in T.37S., R.3E., Sec. 3, NE¼
End of road number 100 in T.37S., R.3E., Sec. 25, NE¼
Road numbers 2800-045 and 047 in T.36S., R.3E., Sec. 33, SE¼
Road number 2800-104 in T.36S., R.3E., Sec. 35, N½
Road in T.37S., R.3E., sections 22 and 23

APPENDIX L
Matrix of Factors and Indicators

Table 1 was designed in conjunction with the Aquatic Conservation Strategy Objectives. This matrix provides a good approach for assessing existing environmental conditions relative to baseline conditions in the North and South forks of Little Butte Creek Watershed fish-bearing stream system and the tributary watersheds during the watershed analysis process.

Table 1. Little Butte Creek Watershed Analysis Area (North and South forks) - Matrix of Factors and Indicators: Existing Conditions for Instream and Riparian Habitat

Factors: Indicators	**Existing Conditons**		
	Properly Functioning[1]	**At Risk**	**Not Properly Functioning**
Water Quality			
Temperature (7-day max. average)	NF/H		SF/W,SF/H,NF/W
Sediment and Turbidity	NF/H	SF/W,SF/H,NF/W	
Hazardous Materials	All		
Habitat Access			
Physical Barriers		All	
Habitat Elements			
Large Woody Material	NF/H		SF/W,SF/H,NF/W
Substrate Embeddedness		NF/H,HF/W	SF/W,SF/H
Pool Character & Quality			SF/W,SFH,NF/H,NF/W
Off-Channel Habitat	NF/H	SF/H	SF/W,NF/W
Flow/Hydrology			
Changes in Peak/Base Flows		All	
Channel Conditions and Dynamics			
Width Depth Ratios by Channel Type	NF/H	SF/W,SF/H,NF/W	
Streambank Condition	NF/H	SF/H,NF/W	SF/W
Floodplain Connectivity		SF/H,NF/H	SF/W,NF/W

Factors: Indicators	Existing Conditons		
	Properly Functioning[1]	At Risk	Not Properly Functioning
Watershed Conditions			
Road Density and Location		All	
Overall Conditions Rating (Human Disturbance History)		All	
Riparian Reserves		All	
Landslide and Erosion Rates	NF/H	SF/W,SF/H,NF/W	

1/ The three function categories ("properly functioning", "at risk", and "not properly functioning") are defined for each indicator in the "Matrix of Factors and Indicators" in Table 2.
SF/W: South Fork Little Butte Creek, Western Cascade geology
SF/H: South Fork Little Butte Creek, High Cascade geology
NF/W: North Fork Little Butte Creek, Western Cascade geology
NF/H: North Fork Little Butte Creek, High Cascade geology

Table 2. Little Butte Creek Watershed Analysis Area (North & South forks) - Matrix of Factors and Indicators: Baseline Conditions for Instream and Riparian Habitat

Factors: Indicators	**Baseline Conditions**		
	Properly Functioning	**At Risk**	**Not Properly Functioning**
Water Quality			
Temperature (7-day max. Average)	2nd - 4th order streams <62°F, >5th order stream <68°F	2nd - 4th order streams <64-68°F, >5th order stream 68-74°F	2nd - 4th order streams ≥ 69°F, > 5th order stream >74°F
Sediment and Turbidity	<20% fines (sand, silt, clay) in gravel, little cobble embeddedness. Fine sediment within range of expected natural streambed conditions		>20% fines (sand, silt, clay) in gravel, embedded cobbles. Fine sediment outside of expected natural streambed conditions
Habitat Access			
Physical Barriers	No human-made barriers to prevent passage of age 1+ salmonids		Human-made barriers prevent upstream and downstream passage of age 1+ salmonids
Habitat Elements (Focus on conditions in low gradient, fish-bearing stream segments {LGS}, usually alluviated canyons or alluvial valleys) (Frissell 1986 and 1987)			
Large Wood Material {LGS}	>25 pieces/mile; >24 inches in diameter and >50 ft. in length or 2 x bankfull width (BFW). Little evidence of stream clean out.	10-25 pieces per mile >24 inches in diameter and >50 ft. in length or 2 x BFW. Some stream clean out.	<10 pieces per mile >24 inches in diameter and >50 ft. in length or 2 x BFW. Evidence of stream clean out.
Substrate	Dominate substrate is gravel and cobble for <2% slope; interstitial spaces clear.	Gravel/cobble subdominant, moderate embeddedness for <2% slope.	Bedrock, sand, silt or small gravels dominant or embedded cobbles.
Pool Character and Quality ≥ 3rd Order Streams {LGS}	>30% pool habitat by area; little evidence of pool volume reduction and majority of pools >3 ft. in depth.	<30% pool habitat by area; some evidence of pool w/ fines and majority of pools <3 ft. in depth.	<30% pool habitat by area; widespread evidence of pool volume reduction and majority of pools <3 ft. in depth.
Off-Channel Habitat {LGS}	Active side channels relatively frequent; backwater areas present; related to large wood, nick point, etc. or within the expected range of natural conditions.	Relatively few side channels or backwater areas. Evidence of abandoned side channels due to past management activities.	Few or no active side channels or backwater areas. Entrenchment or evidence of abandonment of floodplain. Side channel frequency outside of range expected.
Flow/Hydrology			

Factors: Indicators	Baseline Conditions		
	Properly Functioning	**At Risk**	**Not Properly Functioning**
Changes in Peak/Base Flows (Watershed Risk Rating)	Timber harvest, roads and other human activities have not likely influenced the hydrologic regime of the watershed. Little extension of channel network.	Moderate amounts of timber harvest and roads have likely influenced the hydrologic regime of the watershed, some increase of channel network.	High levels of timber harvest and roads have likely effected the hydrologic regime of the watershed. Considerable increase in channel network.
Channel Conditions and Dynamics			
Width Depth Ratios by Channel Type	Width/depth ratios and channel types within natural ranges and site potential within watershed. Expected range of bankfull width/depth ratios by channel type: Rosgen Type W/D Ratio A,E,G <12 B,C,F 12-30 D >40	Width/depth ratios and channel types partially outside historic ranges site potential within watershed.	Width/depth ratios and channel types throughout the physiographic sub-provinces of the watershed are well outside of historic ranges and/or site potential.
Streambank Condition	Stable stream banks, little evidence of eroding banks or within range of expected conditions.	Moderately stable, some streambank erosion evident.	Unstable stream banks, numerous areas of exposed soil and cutting, outside of expected range.
Floodplain Connectivity {LGS}	Off channel areas frequently linked to main channel, floods frequently connect stream to floodplain and riparian zone.	Reduced floodplain connection to main channel, some evidence of lowering water tables on floodplain.	Greatly reduced connectivity between main channel and off channel habitats and riparian areas.
Watershed Conditions			
Road Density and Location	Greater or equal to 95% of watershed with low road densities <3 mi./sq.mi., valley bottom roads not restricting stream meanders or affecting riparian function.	Greater than 30% with road density 3.1-4.0 mi./sq. mi., some valley bottom roads restricting steam meander, riparian function.	Greater or equal to 5% of watershed with high road densities >4.0 mi./sq. mi., valley bottoms well-roaded, effects on stream channel and riparian function are evident.
Overall Condition Rating (Human Disturbance History) (utilized road density, % watershed in stands <30 yrs., temp., embeddedness)	Little harvest and road activity, with little or no activity in unstable areas, aquatic and riparian refugia or Riparian Reserves.	Moderate harvest and road activity, with moderate disturbance concentration in unstable areas.	Widespread harvest and road activity with disturbance in unstable areas, refugia or Riparian Reserves.

Factors: Indicators	Baseline Conditions		
	Properly Functioning	**At Risk**	**Not Properly Functioning**
Riparian Reserves	Riparian Reserves provide adequate shade, future large wood, habitat protection and connectivity for sensitive aquatic species. Little or no evidence of salvage, sufficient down wood or within expected range of conditions.	Altered Riparian Reserves, providing partial adequate shade, habitat protection and connectivity for sensitive aquatic species. Evidence of salvage and down wood deficient.	Substantially altered Riparian Reserves, not providing adequate shade, habitat protection and connectivity for sensitive aquatic species. Extensive salvage and down wood lacking or outside of expected range of conditions.
Landslide and Erosion Rates	Landslide rate and volume near natural rates. Stream conditions not altered by human-caused landslides.	Some landslide rate and volume related to management activities.	Landslides exceed natural rates and related to land management activities. Stream conditions obviously altered by human activities.