Lower Steamboat Creek

Watershed Analysis

USFS UMPQUA NATIONAL FOREST
NORTH UMPQUA RANGER DISTRICT
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FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE

MIDDLE/LOWER STEAMBOAT CREEK WATERSHED ANALYSIS

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North Umpqua Ranger District
Umpqua National Forest

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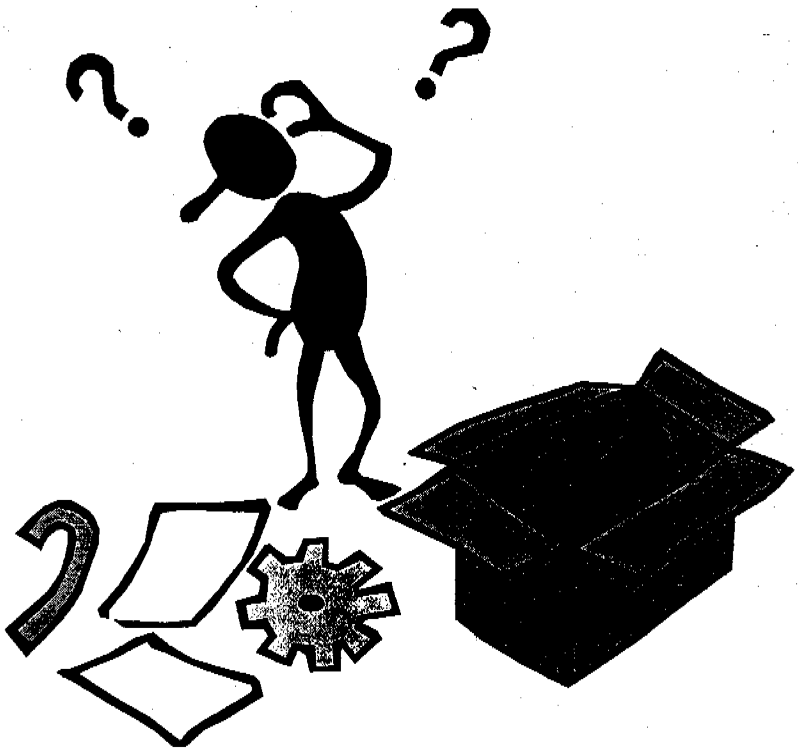

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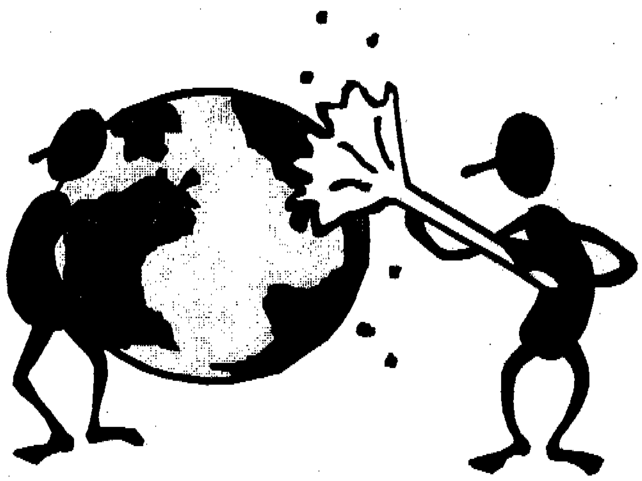


Watershed Characterization

Chapter 1 -Watershed Characterization

The Steamboat Creek watershed covers an area of roughly 104,632 acres and comprises approximately 3.5% of the Umpqua River basin (which drains into the Pacific Ocean at Reedsport). This analysis focuses on the lower portion of this watershed, beginning at the confluence of Little Rock and Steamboat Creek and ending at the confluence of Canton and Steamboat Creeks (Figure 1). The Lower Steamboat watershed analysis area (71,528 acres) is located on the west side of the Cascade Mountain range in southwestern Oregon. The mouth of Steamboat Creek is located approximately 38 road miles east of Roseburg, Oregon.

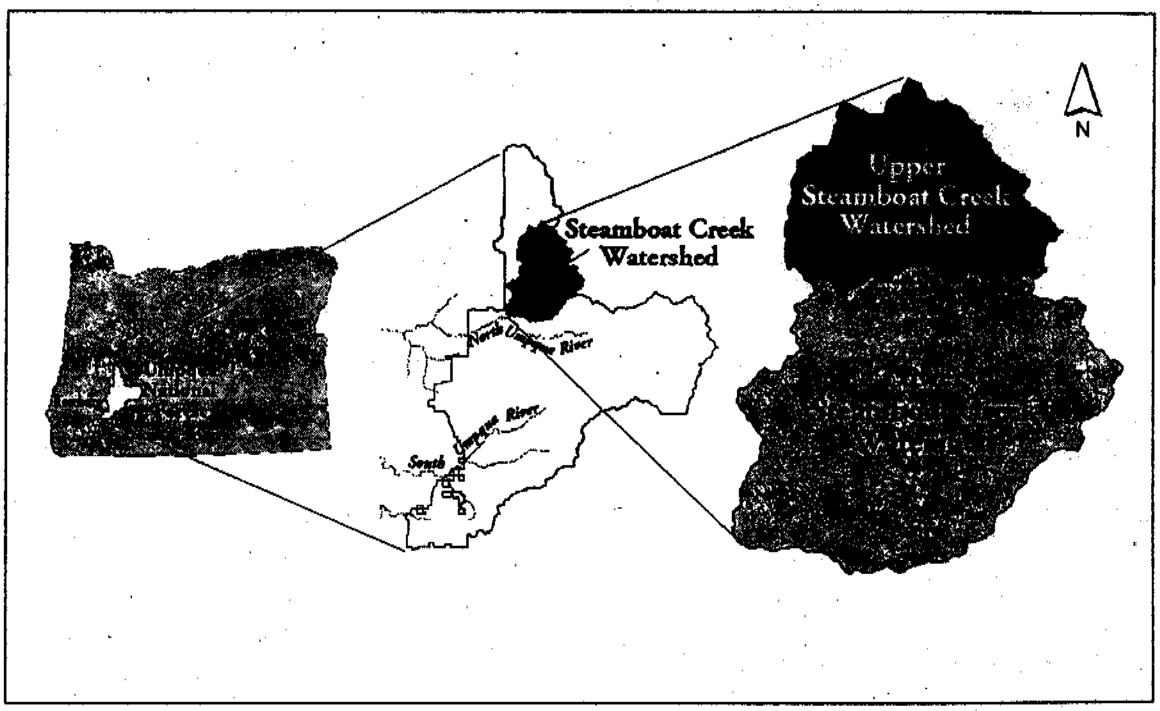


Figure 1. Location of the Lower Steamboat Creek watershed analysis area.

The analysis area was subdivided into nine subwatersheds based on logical divisions. There are 6 distinct subwatersheds, and 3 non-descript subwatersheds, or "face-drainages" (Figure 2). The nine subwatersheds are listed below:

- Upper Steamboat Face (05)
- Cedar Creek (06)
- Big Bend Creek (07)
- Middle Steamboat Face (08)
- Reynolds Creek (09)
- Singe Creek (10)
- Deep Creek (11)
- Steelhead Creek (12)
- Lower Steamboat Face (13)

Discussions of the key components and processes within the analysis area are divided into three broad areas: Human uses, terrestrial and aquatic resources.

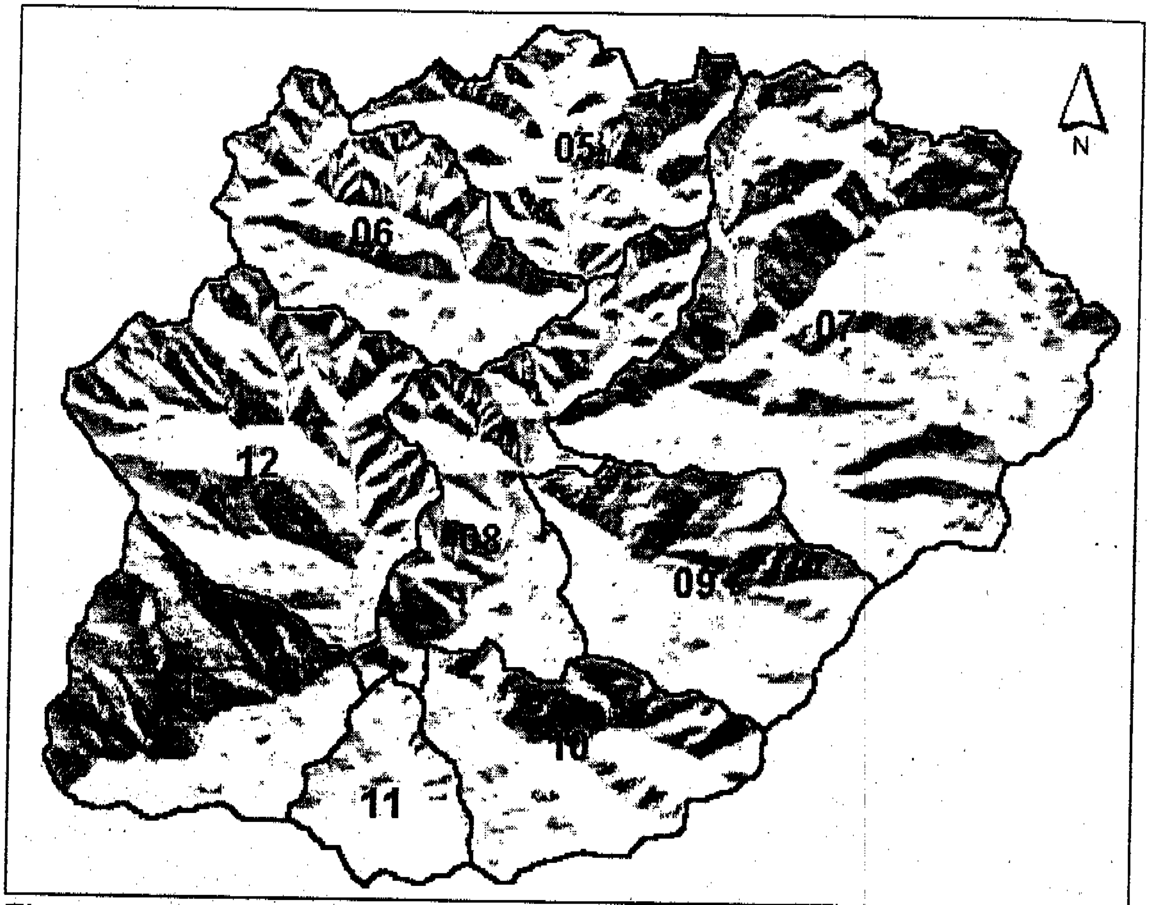


Figure 2. The nine subwatersheds of the watershed analysis area.

HUMAN USES

The earliest known human use of the watershed dates back to 10,000-12,000 B.C. when aboriginals hunted, fished, and gathered in this area. The ridgetops are believed to have been trade and contact routes between the Willamette Valley, the Umpqua region, the Southern Plateau, and the northwestern Great Basin.

Due to the extensive use by early humans, "prehistoric resources" was identified as an outstandingly remarkable value (ORV) in the Eligibility Determination of the Wild and Scenic River Suitability Study for Steamboat Creek (Umpqua National Forest 1991).

Mining

Mining in the Steamboat watershed dates back to the late 1850s when gold was first discovered. The Bohemia Mining District was formed in 1867 and access trails were established between the Upper Steamboat watershed and the communities of Oakland and Drain during these early years. The majority of this early mining activity consisted of hard-rock mining in the vicinity of Fairview Peak. In addition to the hard-rock mining, there were numerous placer mines along the main stem of Steamboat Creek in the early 1900s.

Currently there are 6 unpatented mining claims totaling approximately 120 acres in the Lower Steamboat Creek watershed. These mines are located in the Big Bend Creek subwatershed (07).

Water Withdrawals

In the entire Steamboat Creek watershed there are no public facilities that require domestic water withdrawals. Some domestic water use occurs on the patented mining claims and from seasonal campsites on the unpatented mining claims. Some domestic water use also occurs at the dispersed recreational camping sites.

Timber Harvest and Roads

Within the Lower Steamboat analysis area, the primary land uses in recent decades have been timber harvest and associated road construction. Timber harvest and road construction on public lands began in earnest in 1959. To date, approximately 34% of the land area (24,603 acres) has been logged with a regeneration harvest prescription (clearcut or shelterwood). Partial harvest logging has occurred on approximately 2,683 acres (4% of the watershed). The extent of timber harvest on public land has varied over the past several decades, but ceased in this watershed in 1994 with the implementation of the Northwest Forest Plan.

There are approximately 450 miles of road (an overall average of 4 miles/sq. mile) in the analysis area. Approximately 66% of the watershed has road densities in excess of 4 miles/sq. mile. Roadless areas or areas with less than one road mile per square mile make up approximately 3% of the analysis area.

Special Forest Products

Special forest products uses of the watershed include collecting firewood, conifer boughs, mushrooms, and beargrass. Pacific yew bark was collected for derivation of taxol, a cancer-fighting drug, in the late 1980s and early 1990s in active timber sale areas. This practice ceased with the advent of laboratory production of taxol.

Recreation

There is a relatively high level of recreational activity in Lower Steamboat Creek compared to other areas on the North Umpqua Ranger District. The lower portion of the Steamboat Creek watershed, including nearby Canton Creek, is used for swimming, kayaking, hiking, driving for pleasure, viewing scenery, bicycling, berry picking, All Terrain Vehicle (ATV) use, hunting and camping.

The majority of the water-based recreational activity occurs in the lower reaches of the Steamboat Creek, where warmer water temperatures, deeper pools, and higher summer stream flows sustain use. The heaviest recreation activity is believed to occur during the many hunting seasons, when hunters use numerous roads and dispersed campsites. In addition, some limited fishing use occurs at several of the small ponds and lakes within the eastern portion of the watershed; however, all streams within the Steamboat basin are closed to fishing.

Land Management Direction

In 1959, the Forest Service and the Oregon Department of Fish and Wildlife recognized the importance of the Steamboat Creek watershed to anadromous fish. This led to a mineral and fishing withdrawal along Steamboat Creek proper. In 1976, this mineral withdrawal was extended to include portions of fifteen tributaries to Steamboat Creek, including portions of streams within the Lower Steamboat watershed analysis area (Figure 3).

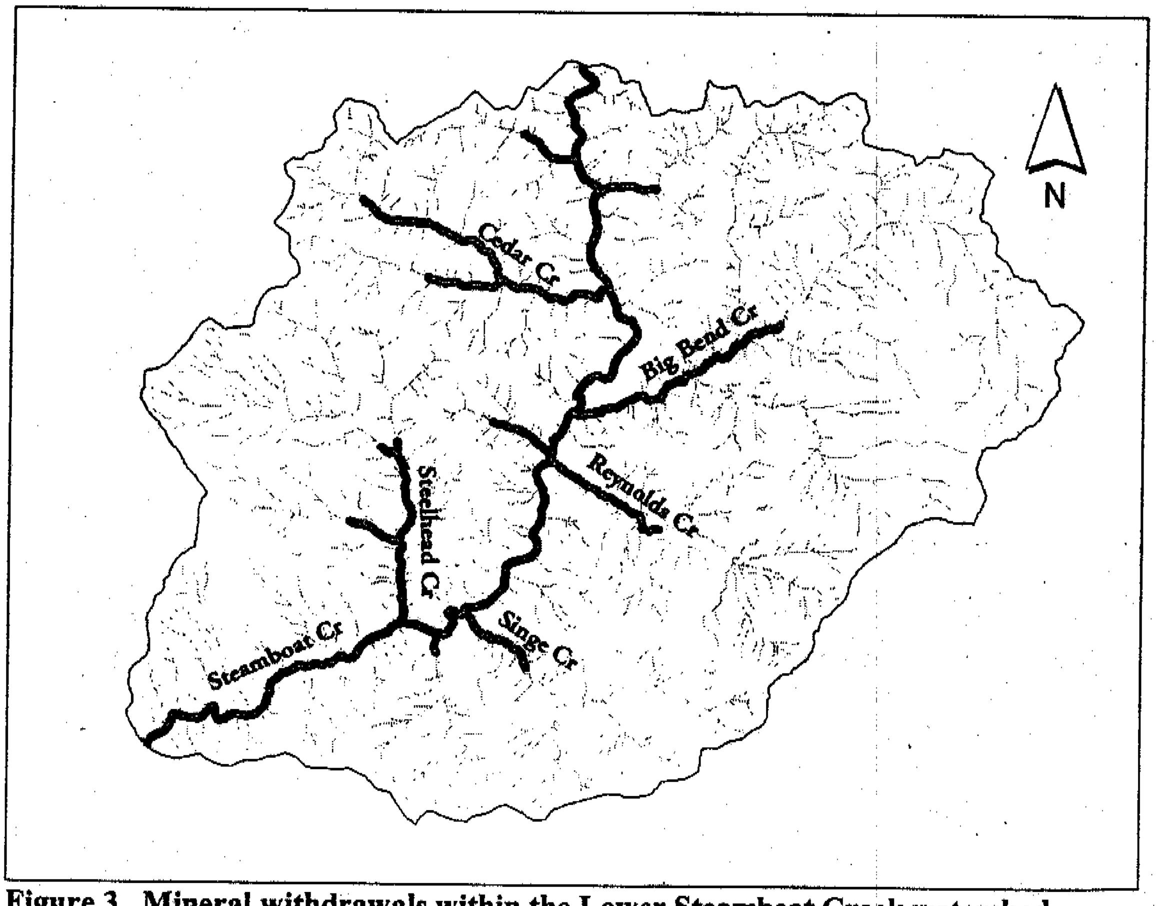


Figure 3. Mineral withdrawals within the Lower Steamboat Creek watershed.

In 1984, Congress gave direction to manage Steamboat Creek and its environment with an emphasis on enhancing fishery values and water quality. The 1988 Omnibus Oregon

Wild and Scenic Rivers Act identified Steamboat Creek as a study river to determine whether wild and scenic river designation would offer management tools to better protect fisheries values.

The Northwest Forest Plan of 1994 created a network of various public land allocations throughout the Pacific Northwest Region. The Lower Steamboat analysis area lies within a Late Successional Reserve (LSR-222) and Tier-1 Key Watershed as designated under this plan. In addition, approximately 19,510 acres of Riparian Reserves associated with streams occur within the analysis area.

Management Direction for Late Successional Reserves

> *Late Successional Reserves are to be managed to protect and enhance conditions of late-successional and old-growth forest ecosystems, which serve as habitat for late-successional and old-growth related species including the northern spotted owl* (ROD, page C-11).
>
> *There is no [timber] harvest allowed in stands over 80 years old. Thinning may occur in stands up to 80 years old regardless of the origin of the stands. The purpose of these silvicultural treatments is to benefit the creation and maintenance of late-successional forest conditions* (ROD, page C-12).
>
> *Salvage guidelines in LSRs are intended to prevent negative effects on late-successional habitat and should not diminish habitat suitability now or in the future.... In all cases, planning for salvage should focus on long-range objectives, which are based on a desired future condition of the forest* (ROD, pages C-13&14).

Management Direction for Key Watersheds

> *A system of Key Watersheds that serve as refugia is crucial for maintaining and recovering habitat for at-risk stocks of anadromous salmonids and resident fish species* (ROD, page B-18).
>
> *Tier-1 Key Watersheds were selected for directly contributing to anadromous salmonid and bull trout conservation* (ROD, page B-19).
>
> *Key Watersheds are highest priority for watershed restoration* (ROD, page B-19).
>
> *Reduce existing system and nonsystem road mileage outside roadless areas. If funding is insufficient to implement reductions, there will be no net increase in the amount of roads in Key Watersheds* (ROD, page B-19).
>
> *The amount of existing system and nonsystem roads within Key Watersheds should be reduced through decommissioning of roads. ...Priority [should be] given to roads that pose the greatest risks to riparian and aquatic ecosystems* (ROD, page B-19).

This watershed analysis is focused toward identifying opportunities that best meet objectives and management direction for the Late Successional Reserve and Key Watershed allocations of the Lower Steamboat Creek watershed.

TERRESTRIAL RESOURCES

Geology

Lower Steamboat Creek is underlain by a broad collection of consolidated volcanic dust, ash and rock fragments belonging to the Little Butte Volcanic Group (of the Western Cascades geologic province). These rocks originated from intermittent volcanic events that occurred between 17-35 million years ago. During this time period, rock layers were laid down by concentrated slurries of volcanic debris mobilized by water and deposited into slowly subsiding basins or troughs. This process allowed for the accumulation of over 3,000 feet (1,000 meters) of material. There is also evidence that pyroclastic flows and dilute muddy slurries played a role in rock formation within the watershed.

After the rock was deposited, the area experienced several sequences of uplifts which eventually raised the watershed and gave it a gentle tilt of approximately five degrees to the east. Most of the rocks were later subject to some degree of alteration by burial metamorphism (a change in the composition due to pressure, heat, chemical action, etc.) and hydrothermal activity related to volcanic activity between 10-17 million years ago. This alteration of the original minerals has affected the method and likely increased the rate of weathering during later geologic periods.

Over the last 12-600 thousand years, glaciers have affected the higher elevations of the watershed, especially along the Calapooya Mountains. Glacial activity in this area created the cirques and valleys that form the headwaters of Bulldog, Big Bend, and Reynolds Creeks. Glacially derived soils have been identified along Big Bend Creek, but have not been found in the Reynolds or Singe Creek areas.

Physiography

Elevations within the Lower Steamboat Creek analysis area range from 1,200 feet at the confluence with Canton Creek, to 5,898 feet near Fuller Lake. Roughly 85% of the analysis area is located within the 2,000-5,000 foot elevation band (the "transient snow zone").

The average annual precipitation ranges from 50-80 inches, with approximately 90% of this falling between October and June. The higher elevations receive more precipitation during fall and winter than do lower elevations. A rain gauge on Steamboat Creek near the upper edge of the analysis area boundary averages 56 inches of precipitation annually. Precipitation occurs as a combination of rain and snowfall with warm "rain-on-snow" events being common. Weather is generally considered temperate. The winters are relatively mild with temperatures averaging between 30-40°F in the higher elevations. July maximum temperatures average between 80-90°F at higher elevations.

The topography within areas of the Little Butte volcanics can be highly variable, as noted between the Upper and Lower Steamboat areas (Sherod 1986). Landforms can be characterized as a "sea of rolling hills and mountains" in a moderate erosional state. The terrain is deeply weathered, which has resulted in deeper soils. Streams in this area have relatively gentle gradients and appear to be well incised into their respective gorges. Large areas of earthflow terrain and areas of instability occur throughout the watershed.

Wildfire

The watershed has a moderate severity fire regime, but is showing signs of transitioning to a high severity regime. Fire regimes are a generalized description of the role fire plays in an ecosystem. A moderate severity fire regime is described as one where low to moderate intensity fires occur with pockets of stand replacement fire activity. Fires in a high severity regime would be infrequent and would have stand replacing activity to a greater extent.

Steamboat Watershed is located in the southern portion of the western hemlock forest zone where fire severity becomes patchier (Agee 1993). Low to moderate severity fires are characteristic of this zone; however, high severity fires remain an important disturbance process in the mesic to dry portion of the forests (Morrison and Swanson 1990).

Vegetation

Vegetation has responded to the fire regime, elevation differences and dissected landforms to create a diverse mix of coniferous forest types. Forests below the 4,000 foot elevation band are primarily western hemlock with Douglas-fir associations occurring on steeper, drier areas. These forests begin grading into the true fir forests of the higher elevations where white fir and Pacific silver fir become more prominent. Mountain hemlock and Shasta red fir forests are found near the highest elevations.

The dominant overstory tree species throughout the watershed is Douglas-fir. Other common conifer species include sugar pine, incense-cedar, western hemlock, western redcedar and Pacific yew. Broad-leaved trees such as red alder, vine maple and bigleaf maple are more common within the riparian areas, while Pacific madrone and golden chinquapin occur more commonly on drier sites. Shrub species include vine maple, salal, dwarf Oregon-grape and Pacific rhododendron.

White fir, Pacific silver fir and mountain hemlock become more prominent in the higher elevation stands. Mountain hemlock is often found on the coldest sites. Other tree species found in the higher elevations include Shasta red fir, western white pine and occasionally Alaska yellow-cedar. The shrub layer includes thin-leaved huckleberry and slender salal.

Landscape Patterns

The forest patterns were historically moderately fragmented with moderate landscape patch diversity. In general, the watershed was covered with a contiguous late-successional forest. This forested landscape constantly changed due to fire disturbances, which created openings from stand replacing forest fires. Although fire is common throughout the watershed, the moister areas are less prone to high severity fires and therefore historically maintained late-successional/old growth forest stand conditions for longer periods than the surrounding areas. Today, the overall forest landscape within the watershed is highly fragmented with a significant shift as to where the most intact late-successional habitat occurs spatially.

Wildlife

The Lower Steamboat watershed occurs mostly within the humid division of the Oregon Transition Zone (Bailey 1936) and has one of the western-most extensions of the Canadian Zone along the higher elevations of the Calapooya Mountains on its eastern margin. There are an estimated 190 terrestrial species of vertebrates known or suspected of occurring within this watershed. Of these, approximately 41% are closely associated with and dependent upon late-successional forest habitats.

Two federally listed wildlife species occur within the watershed (bald eagle and northern spotted owl), the most common being the "Threatened" northern spotted owl. There are 32 known spotted owl activity centers within the watershed. Peregrine falcons (recently delisted from federally Endangered to regionally Sensitive) occur and reproduce within the watershed. Bald eagles (federally Threatened) are occasionally spotted soaring above the watershed, but there are no known nest or roost sites. The watershed contains the largest known maternal colony of Townsend's big-eared bats (regionally Sensitive) in the State. Five more regionally listed Sensitive wildlife species are suspected of occurring within the watershed. They are the Canada lynx (federally Proposed for listing as Threatened), the red-legged frog, California mountain kingsnake, California wolverine and the harlequin duck.

AQUATIC RESOURCES

Fisheries

Fisheries values in Steamboat Creek have long been recognized, dating back to 1932 when Steamboat Creek and its tributaries were closed to fishing due to their importance to the North Umpqua River summer steelhead trout fishery. "Fisheries" was designated as an Outstandingly Remarkable Value (ORV) in the Steamboat Creek Wild and Scenic River Eligibility Determination. "Fisheries" and "water quality" are two ORV's for the North Umpqua River, a Wild and Scenic River.

There are approximately 244 miles of stream in the Lower Steamboat Creek watershed. Of these streams, approximately 64 miles support anadromous and/or resident salmonids (see Figure x). Various drainages in Lower Steamboat Creek are known to support populations of winter and summer steelhead, migratory cutthroat trout (sea-run and/or fluvial), resident cutthroat trout, and resident rainbow trout. In addition to salmonids, there are also several non-game species including sculpin, dace, and redside shiner found in these areas. It is also likely that brook lamprey or Pacific lamprey utilize these areas, but to date, their presence has not been documented. All life history forms of Umpqua cutthroat trout below natural migration barriers are federally listed together as an "endangered" species. Oregon coastal coho salmon are currently listed as "threatened", although critical habitat has not yet been designated. Additionally, Oregon coastal steelhead trout (which includes all Umpqua steelhead) were proposed for a federal "threatened" listing. A recent ruling on this proposal found that the status of the Oregon coastal steelhead populations did not warrant a Federal listing.

Water Quality

Section 303(d) of the Clean Water Act (CWA) requires states to identify waterbodies that do not meet water quality standards and thus require intensive management approaches, beyond the typical, to protect the beneficial uses. These waterbodies are referred to as "water quality limited" (WQL) and remain in this category as long as intensive management approaches are required to protect the beneficial uses. A sub-set to WQL waters is the 303(d) List. The waterbodies that do not have a completed pollutant evaluation and restoration plan would be placed on the state 303(d) List. In 1996, the Oregon Department of Environmental Quality (ODEQ) listed the main stem of Steamboat Creek and two tributaries within this analysis area as water quality limited. Summer temperature was the most common parameter listed while selected segments were listed for pH and habitat modification.

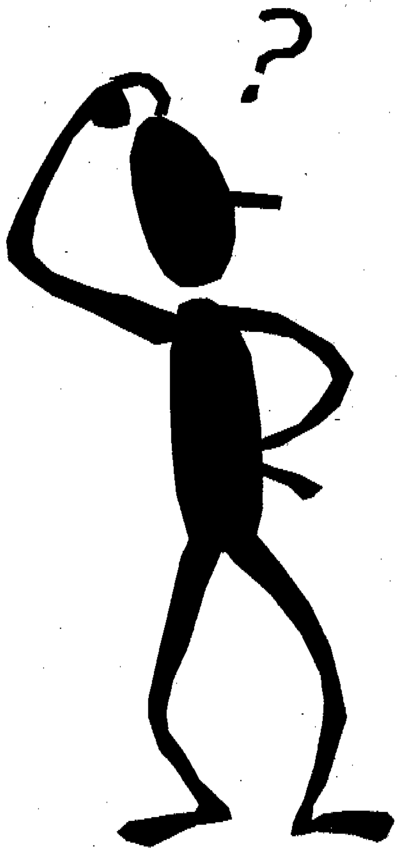
Unusual water quality conditions within the analysis area were found in Singe Creek during a US Geological Survey water and sediment investigation. Singe Creek was determined to be a calcium sulfate system while other tributaries were primarily calcium bicarbonate systems. High sulfate concentration and low alkalinity suggests that Singe Creek has naturally occurring acidic water with low buffering ability.

Streamflow from the Lower Steamboat watershed varies widely through the year. Because of the predominantly shallow and rocky soils with limited groundwater storage capability in the watershed, winter runoff events tend to be rapid in nature and summer base flow tends to be very small. The largest recorded winter runoff event at the mouth of Steamboat Creek occurred on December 22, 1964 at 51,000 cubic feet per second (cfs); in contrast, the lowest summer base flow was 27 cfs on September 24-28, 1994 (USDA 1997). A summer flow exception was found in the Big Bend Creek subwatershed where cooler and higher flows locally mitigate the warm and lower flow condition of Steamboat Creek at their confluence.

Erosional Processes

Landslides are a dominant erosive process in the Lower Steamboat Creek watershed. Debris flows stemming from landslides play a major role in shaping stream channels. Based on aerial photo interpretation with some field verification, a total of 258 landslides were identified in the analysis area dating back to 1946. Human activities have altered natural landslide rates. Of the 258 landslides, 196 of them (77%) were associated with roads or timber harvest units. Much of the watershed (35%) occurs in high to moderate landslide risk terrain. Thirty-seven percent of the landslides have occurred on the high to moderate risk terrain.

CHAPTER 2



Key Questions

Chapter 2 - Key Questions

This chapter displays the questions that the Lower Steamboat Creek Watershed Analysis Interdisciplinary Team determined to be most important given the land allocations and current management directions. These questions are summarized by the three areas of discussion – Human Use, Terrestrial, and Aquatic. Answers can be found throughout the document or appendices and are noted in parentheses after the question.

HUMAN USE QUESTIONS

Access and Travel Management

Forest Service road maintenance budgets have been steadily declining over the last several years. Currently, there is enough money to maintain roughly 1/4 to 1/3 of the roads on the Forest. Watershed analysis is the proper context to evaluate this road network, and develop ideas on a road network for the future. The questions below will help guide the analysis and make recommendations for future road management.

- *What percentage of roads in the watershed are inadequately maintained due to lack of funding? (To be answered in Iteration 2 of the Watershed Analysis)*
- *Which roads are required to achieve our land management objectives? (To be answered in Iteration 2 of the Watershed Analysis)*
- *Which roads are necessary to provide access for density management, forest health, recreation or fire management concerns? (Appendix C, D)*
- *Which roads are required for access to private lands or access to other Districts or Forests? (To be answered in Iteration 2 of the Watershed Analysis)*
- *How are roads negatively affecting aquatic, riparian, and late successional habitat, and which ones are highest priority for reconstruction or decommissioning? (To be answered in Iteration 2 of the Watershed Analysis)*
- *Which roads should be or are classified as primary or secondary routes? (Refer to forest direction and definition). (Chapter 3 page 33, Appendix D)*

Heritage Resources

Some of the earliest humans may have inhabited the Lower Steamboat Creek watershed as early as 10,000 - 12,000 B.C. (Honey, 1980). In addition, gold miners entered the basin in the late 1800s. Information pertaining to these historic and prehistoric uses is considered to be a valuable resource.

- *What are the prehistoric and historic human uses in the watershed? How will these resources be preserved? (Chapter 3 pages 19-23)*

Mining

The lower portions of Steamboat Creek experienced significant prospecting and placer mining activities during the late 1800s and early 1900s. Some limited hardrock mining claims still exist in the lower Steamboat area today.

- *What are the historic and current mining activities in the watershed? (Chapter 3 pages 23-26)*

- *How will this activity be preserved in harmony with other resources in the watershed? (Chapter 3 page 25)*

- *How have mining activities affected ecological processes in the watershed? (Chapter 3 pages 24-25 and Chapter 5 pages 122-125)*

Timber Harvest and Special Forest Products

Since the 1950s, timber production has been a major focus of land use on public lands in the Lower Steamboat watershed. To date, approximately 38% (27,286 acres) of the Lower Steamboat watershed has been clearcut or shelterwood harvested. Timber production expectations dropped to zero when the 1994 Northwest Forest Plan allocated all of Steamboat Creek as a late-successional reserve. Any timber harvest that occurs in the watershed will be a by-product of manipulating stand density for late-successional purposes and/or reduction of severe fire risk.

- *What are the potential timber resources or special forest products that would be available and/or appropriate for harvest from this watershed? (Chapter 6 pages 138-144)*

- *For stands under 80 years of age, are there areas of concentrated young stands in the watershed (between ridges, between late seral blocks, between ridges and riparian areas) that are candidates for density management? (Chapter 6 pages 143-144)*

- *For stands over 80 years of age, are there candidates for density management in order to speed the development of late-successional forest conditions?*

- *Considering other issues in the watershed (i.e. water quality, TES fish and wildlife), should we treat these stands? (Note: These two questions were not answered as part of this analysis. The interdisciplinary team came to a consensus decision to not analyze older stands given the land allocation of a Late-Successional Reserve and Tier 1 Key Watershed. A brief discussion of stand over 80 years old is included in Appendix C, page 44).*

Recreational Uses

According to recent studies, recreation is the fastest growing use of National Forests and Grasslands across the country.

- *What recreational activities occur in the watershed? Where do they occur? (Chapter 3 pages 26-30)*

- *What additional recreation facilities may be planned in the watershed? (Chapter 6 pages 137-138)*

- *Which roads are most heavily used for recreation activity? (Chapter 3 pages 31-34)*

TERRESTRIAL RESOURCES

Landscape patterns and vegetation have been shaped by natural disturbances throughout time. More recently, human influences (including timber harvest and road building and the exclusion of fire) have altered natural disturbance processes and created changes that have affected flora and fauna residing in the watershed.

Natural Disturbance

- *What is the characteristic fire regime (reference and current) for the watershed? (Chapter 4 pages 36-41)*

- *What are the current and reference condition fuel models on the landscape? Has there been a change? If so, why? (Chapter 4 pages 41-44)*

- *Where are the stands (mid and late seral) that are prone to fire? (Chapter 4 pages 43-44 and Chapter 6 pages 138-139)*

- *Where are the forest health activity centers (insect and diseases) and what risk category are they in? (Chapter 4 pages 46-48)*

Forest Vegetation

- *Where are areas of unique botanical habitat in the watershed? (Chapter 4 pages 63-66)*
- *What Threatened, Endangered and Sensitive plant species are present in the watershed and what activities would affect them? (Chapter 4 pages 66-68)*
- *What Survey and Manage plant species are present in the watershed and what activities would affect them? (Chapter 4 pages 66-68)*
- *Where in the watershed are noxious weeds found? (Chapter 4 pages 68-71)*
- *What are the key components of a noxious weed strategy? (Appendix H)*
- *What are the priorities and key components of a revegetation strategy in the watershed? (Appendix H)*
- *Where are the pine stands located and what condition are they in? What age ranges are present (<80 and >80)? Is any treatment recommended for these stands? (Chapter 4 pages 46-48, Appendix C)*
- *In young stands, are there areas of compaction affecting stand development? (Appendix C)*
- *Have changes to the terrestrial disturbance regime affected wildlife populations (emphasis on late-successional, TES and big game)? If so, how? (Chapter 4 pages 73-81)*

Landscape Patterns

- *How have forest landscape patterns changed from pre-management to post-management conditions? Where are the important landscape components within the watershed (e.g., refugia, riparian habitats)? (Chapter 4 pages 48-63)*
- *What types of landscape scale disturbances shaped the historic forest? What types of disturbances shape today's forest? (Chapter 4 pages 36-48)*
- *Where and when can we achieve the most benefits with silvicultural prescriptions designed to accelerate the development of late-successional habitat? (Chapter 6 pages 143-144)*

Riparian Areas

- *Are there any previously harvested riparian areas currently developing an even-aged structure that would not have done so historically? If so, do these areas warrant some kind of restorative treatment? (Chapter 4 pages 61-63, Chapter 6 pages 149-150)*

AQUATIC QUESTIONS

In addition to its LSR status, Steamboat Creek is also designated as a Tier 1 Key Watershed. Key Watersheds are areas that either provide, or are expected to provide, high quality aquatic habitat. In addition, they are crucial for maintaining and recovering habitat for "at-risk" stocks of anadromous salmonids and resident fish species. Fisheries resources were also identified as an Outstandingly Remarkable Value in the eligibility determination of Steamboat Creek for Wild and Scenic River status. Questions that pertain to fish and other aquatic organisms are listed below.

Erosional Processes

- *How have erosional processes affected channel morphology, water quality, runoff, and riparian and aquatic habitat conditions? (Chapter 5 pages 90-109)*

- *What and where are the dominant erosional and sedimentation processes occurring in the basin? (Chapter 5 pages 101-102)*

- *Has the channel morphology of Steamboat Creek changed from the reference condition to the current condition? If so, how? (Chapter 5 pages 101-102)*

Water Quality and Streamflow

- *What, where, and why are water quality conditions of concern in the watershed? (Chapter 5 pages 111-122)*

- *What are the current water quality conditions in the watershed? How have they been affected by land management activities? (Chapter 5 pages 111-122)*

- *Where are unique (positive or negative) water quality conditions occurring in the watershed? What are these specific conditions and why are they occurring? (Chapter 5 pages 119-122)*

- *Where and why is stream heating occurring in the watershed? What is the stream temperature profile? What are the influencing factors? (Chapter 5 pages 115-117)*

- *Are streamflow regimes influencing water quality and aquatic habitat in the basin? If so, where is this occurring and why? (Chapter 5 pages 112-114)*

- *Have streamflow responses changed from the reference to the current watershed condition? If so, what are the likely causes and potential magnitude of these changes? (Chapter 5 pages 112-114)*

- *How and where have riparian functions been influencing water quality and habitat? (Chapter 5 pages 125-129)*

Fish and Aquatic Wildlife

- *What is the condition of at risk fish stocks? (Chapter 5 pages 83-90)*

- *Are recreational activities along Steamboat Creek affecting summer steelhead trout and Umpqua cutthroat trout? (Chapter 5 pages 122-123)*

- *What is the condition of aquatic habitat in the watershed? (Chapter 5 pages 90-111)*

- *Has the aquatic ecosystem (stream, pond and wetland) changed from pre-management to post-management conditions? If so, what are the primary reasons for this change? (Chapter 5 pages 125-132)*

- *How have road construction and timber harvest affected aquatic conditions in the watershed? (Chapter 5 pages 125-132)*

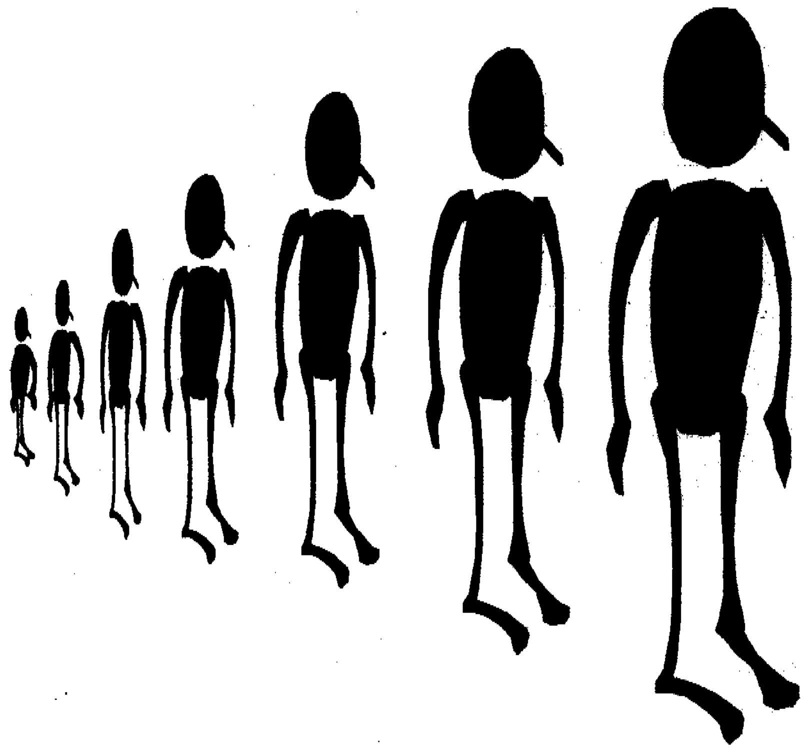
- *What types of disturbances shaped the aquatic ecosystem historically? Has the disturbance regime changed as a result of management? If so, how have these changes effected aquatic and riparian-dependent species? (Chapter 4 pages 36-41)*

- *What and where are the key linkages between the aquatic and terrestrial ecosystems? (Chapter 4 pages 61-63 and Chapter 5 pages 110-111)*

Restoration

- *What are the priorities and key components of an aquatic restoration strategy in the watershed? (Chapter 6 pages 151-153)*

CHAPTER 3



Human Uses

Chapter 3 - Human Uses

For the sake of this analysis, reference conditions are generally considered to be conditions in the watershed prior to 1950. Although Euro-Americans had occupied the watershed and exerted some degree of influence on the landscape since the 1860s, this influence became much more pronounced after 1950, more specifically in the late 1950s. Exceptions to this timeframe will be discussed where appropriate.

PREHISTORIC PERIOD

In 1991, pre-history was identified as an Outstandingly Remarkable Value (ORV) in the Wild and Scenic River eligibility determination for Steamboat Creek.

Entrance of the earliest humans into the Steamboat Creek watershed may have occurred as early as 10,000-12,000 BC (Honey 1980). The limited amount of ethnographic information available for the upper North Umpqua region attributes use of the area to the Southern Molalla (Berreman 1937; Beckham 1986). The principal homeland of the Southern Molalla was the Western Cascades and the main Cascade Range. They resided along the North Umpqua, Little River, and the South Umpqua deep into the Western Cascades (Beckham and Minor 1992). At contact with Euro-Americans, the population was limited. However, this small population estimate may merely have been due the wide range in their home territory.

Population size has been variously described. In 1854 Indian Agent William J. Martin described 15 bands in the Umpqua watershed. The "Mountain Band" is assumed to be Southern Molalla with a population of 54 people. In 1856 during the signing of the treaty with the United States Joel Palmer numbered 28 Southern Molalla and estimated 30 resided in the mountains (Beckham and Minor 1992). The total Southern and Northern Molalla population was reduced to less than forty people in 1891 (Powell 1891; Toepel 1987). This decline in population is reflected in archaeological sites known to contain items of Euro-American manufacture. Of the 115 sites in the Umpqua Basin that have some level of archaeological evaluation only two sites, the Tiller site (Draper 1996) and South Umpqua Falls (Minor 1987) have items of Euro-American manufacture (trade beads) identified. Possible trade beads have been recovered from the Glide Ranger Station site. However, these were obtained during surface collection or during construction activities and no positive identification has been completed.

Very little is known about the settlement/subsistence pattern practiced by the Southern Molallas. However, it may have been similar to that of the Kalapuya. Throughout the summer and fall, wild camas, various seeds and insects were probably collected. In the fall, acorns and hazelnuts were harvested (Toepel 1987). During the winter months, deer and elk were hunted intensively. Ethnographic information indicates that fishing may not have played a major role in subsistence for the Molalla; however, non-anadromous fish and lampreys would have been available in the upper reaches of larger streams. The Molalla traditionally joined the Klamath at a favorite camping place fifteen miles southwest of Crater Lake for huckleberry picking (Spier 1930, Toepel 1987). The Molallas wintered in sites located along streams in the lower elevations usually west of the Cascades. Houses were constructed large enough to hold a small family group. These may have been similar to the semi-subterranean earth lodges constructed by the Klamath. These were circular houses with conical roofs and radiating poles, measuring 12 to 30 feet or more in diameter (Toepel 1987). There are no descriptions for summer houses, but brush huts may have been constructed during this season.

This type of settlement/subsistence pattern has been generally substantiated by archaeological investigations in the area. Task specific sites and hunting base camps are found in the uplands. However, recent excavations at a site located on a terrace above the North Umpqua have discovered salmonid remains and bone fishing implements. This discovery suggests use of the anadromous fish runs might have been more intense than represented in the ethnographic literature. While no village site has been excavated or recorded for the Molalla, Baxter (1989) suggests that "for the Molalla, the area above the Narrows would have been attractive" for a winter village locality. He suggests that the area could have been utilized year round, by the Molalla in the fall and winter, and by the Umpqua in the spring and summer.

Archaeological investigations in the lower Steamboat drainage have been the result of federally mandated measures designed to reduce project impacts on National Forest lands and, as such, have not been focused in one drainage or on a single archaeological research topic. Over fifty prehistoric archaeological sites have been recorded. Five types of archaeological sites have been recorded including cairn, rock-shelter, rock-shelter with rock art, lithic scatter, and lithic groundstone scatters. Characteristics of the sites include the following:

Cairn sites - usually a pile or mound of piled rocks. Cairns may have been built for a number of reasons. Trail markers or spirit quests are considered common reasons. These sites are usually associated with a ridge crest or vista. In the Lower Steamboat Watershed, four cairn sites have been recorded.

Rock shelters - overhangs or shallow caves, which served as shelters. The openings may have been covered with woven mats, bark, or boughs. Stone tools, flakes, and faunal remains are often found within the cultural deposits. Rock-shelters often provide faunal information that is generally lacking in open lithic scatters. Two rock shelter sites have been recorded within the watershed. One rock-shelter, with pictographs recorded as an associated feature, is located on a rock bluff above Steamboat Creek. The shelter is small and may have been used only as a temporary campsite. Data recovery excavations at one site containing three rock shelters showed that the larger shelter served as a seasonal base camp approximately 400 years ago. Deer was the primary target of hunters from the base camp; however, bear, rabbit, mountain beaver, dog, porcupine, rodents, and a small number of fish and bird were exploited as well.

<u>**Lithic scatters and ground stones**</u> – Lithic scatter refers to chipped stone tools and waste flakes. Ground stone includes manos, metates, bowls, hopper mortars, pestles, and grinding slabs. These sites may be temporary campsites associated with hunting and processing of game. Lithic scatters associated with ground stone indicate a broader range of activities. Activities include manufacture and repair of chipped stone tools and food processing. Forty-four lithic scatter and lithic scatter ground stone sites have been recorded within the Lower Steamboat Watershed. These sites are found in a variety of elevations and settings. Those sites found on stream terraces and benches often contain denser deposits then those associated with ridges. Many of these sites are recorded as having ground stone associated with the deposits. These sites may have been occupied as seasonal base camps or even winter villages. The sites identified on ridges in the uplands appear to represent short term hunting camps and are often located along travel routes.

HISTORIC PERIOD

Explorers and Hudson's Bay trappers entered the interior of southwestern Oregon around the 1820s through the 1840s. Little information was written on the conditions of forest lands during this period. Hudson's Bay policy during this time was to "trap out" beaver in the remote streams of southwestern Oregon on the edge of their territory. A number of French-Canadian and Meti ("mixed blood") trappers working for the Hudson's Bay Company took Indian women as wives. The fur trade lost impetus in the 1840s as Euro-American settlers began to filter into the lower valleys of the Umpqua Basin. However, there was little impact to areas such as Steamboat Creek until after the 1850s.

Human Use of Fisheries

Reference Conditions

Euro-American exploitation of the Umpqua fisheries resources began in the mid 19th century, before land management practices in the Steamboat Creek watershed began to influence habitat conditions. The commercial use of Umpqua basin salmon fisheries began in the 1850s and 1860s (Beckham 1986). Commercial operations expanded substantially in the 1870s and were an important element in the economy of Douglas County from this point into the mid 1940s. From 1923-1946 approximately 1.5 million coho salmon (approximately 65,000 fish per year) were caught in the Umpqua River (Beckham 1986). By the late 1940s the fishery had declined considerably to the point where commercial operations ceased.

Current Conditions

In 1988 the economic value associated with consumptive uses of fishery resources on the Umpqua National Forest was estimated to be $35,285,720 (Tripp and Rockland 1990). Estimated value of non-consumptive fishery resource use was $650,000 (Tripp and Rockland 1990). These estimates were based on people's "willingness to pay" for use of the resource and therefore did not include economic effects of commercial fishery contributions. These estimates ranked fishery values on the Umpqua National Forest third out of the 19 national forests in Region 6.

The spring chinook salmon and summer and winter steelhead sport fisheries in the North Umpqua River make a substantial contribution to these economic values. Steamboat Creek contributes substantially to these values by providing an important spawning and rearing area for these stocks, as well as providing fish viewing as a non-consumptive recreational use. ODFW (1986) has long identified the Steamboat Creek watershed as the primary stronghold for spawning and rearing of summer steelhead in the North Umpqua River sub-basin.

Spring Chinook Salmon - The estimated average annual in-river recreational catch of spring chinook salmon from 1977-1985 was 1,948 fish in the Umpqua basin (Nicholas and Hankin 1988). From 1984-1996 an average of 1,101 spring chinook salmon were caught annually by sport fishermen in the North Umpqua River alone (ODFW, unpublished data). The range over this period was from 411 to 2,022 fish per year. This is an average of 12.5% of the total population and represents about 6.5% of all sport-caught spring chinook salmon in Oregon coastal basins for this period.

Coho Salmon - Average annual in-river catch for North Umpqua coho salmon from 1984-1996 was 326 fish with a range of 102-757 fish over that time (ODFW, unpublished data). This is an average of 7% of the total in-river escapement and represents about 2% of the total coho catch in Oregon coastal basins for this period.

Summer Steelhead Trout - Over the 13 year period from 1984-1996, an annual average of 4,078 North Umpqua River summer steelhead were caught in in-river sport fisheries in the Umpqua basin (ODFW, unpublished data). The range over this period was 1,420-7,655 fish caught annually. Over the last six years of data, the average annual catch dropped to 2,046 fish due to reduced escapements and subsequent reduction of allowable annual take to fishermen. Nevertheless, this represents about 74% of all summer steelhead caught in Oregon coastal basin sport fisheries over this 13 year period and 15.5% of all in-river sport-caught summer steelhead in Oregon. As people come from literally all over the world to fish for North Umpqua River summer steelhead, this fishery is culturally and economically significant for the state of Oregon and is culturally important at the national level.

While the in-river sport fishery on North Umpqua summer steelhead is heavily relied upon as a human use, it also represents a significant impact to the spawning escapement. From 1984-1996 an average of 38% of the summer steelhead passing over Winchester Dam were caught and therefore removed from the spawning population by fishermen.

Winter Steelhead Trout - From 1984-1996 the annual average in-river catch of winter steelhead in the North Umpqua River was 1,122 fish with a range of 87-1,749 fish per year (ODFW, unpublished data). This average represents 19% of the winter steelhead being caught and removed from the potential spawning population. As with summer steelhead, the catch over the last six years of data dropped dramatically due to reduced escapements and changing fishing regulations. This average represents 2.5% of the total winter steelhead catch in Oregon coastal basins over this time.

Mining

Mining within the Steamboat Creek watershed began in the 1850s and continues today. In the analysis area, mining entails hard rock and placer mining. Many of the old mining sites along Steamboat Creek are used by today's recreationist. These sites provide the opportunity to imagine ones self in that earlier time period, when life was simpler.

Reference Condition

Miners entered the Grouse Mountain area in the Upper Steamboat Creek watershed in 1859 in search of placer gold mining opportunities. Finding none, they returned north to Sharps Creek. Gold was discovered in a quartz ledge on Grouse Mountain in the spring of 1863. Robert Easton and several others were engaged in mining on Steamboat Creek in 1860 where they were recorded as having earnings of $2-$4 per day. Placer mining was again recorded on Steamboat Creek, although the exact location is not known in either case (Walling 1884).

Evidence of early placer mining is still evident along Steamboat Creek in the form of cabin remains, ditches and tailing rock piles. The earliest mining activity consisted of exploration using picks, shovels and dynamite. The placer mines along Steamboat Creek required water to separate gold from soil and rocks. Miners built small dams and diverted water from streams into ditches to wash the soil across the riffle-boards in the sluice boxes. Ultimately, the soil that washed away ended up in Steamboat Creek. The tailing piles left behind by placer mining are composed of river worn rocks removed from the stream channel and adjacent floodplain terraces. In some of the areas where tailing piles are present, the large trees would have been removed during the process of washing the soil away. This altered the tree composition in the riparian zone at these sites.

A major network of ditch works began at the side of Little Rock Creek several hundred feet upstream from Steamboat Creek. This system was probably constructed during the 1890-1910 time period and grew to 1.5 miles in length. It had secondary ditches leading off to various workings and in one case a flume constructed across Steamboat Creek. This network continued down stream ending near Longs Creek. The most impressive evidence of this back breaking work are the ditches and approximately one acre of rock tailings left behind near the rain gauge. A smaller ditch system is located on the east side of Steamboat Creek upstream of road 3824. It ends in some small workings seen from Steamboat road just above the bridge.

Another mining operation is documented near Buster Creek. This activity is estimated to have occurred during two time periods, 1891-1908 and 1925-1937. A 0.34 mile ditch was constructed leading from Buster Creek to a flat bench along Steamboat Creek. Two cabins were constructed on this bench to house the miners.

The Moffit claim on Steamboat Creek, located approximately 0.5 miles upstream from the mouth of Cedar Creek, was active during the mid-1930s. A log cabin was built on a stream-side bench to house Moffit and his family during the summer months. Photographs show him shoveling gravel into his sluice box, located in the stream channel. No evidence of this activity can be found in the stream channel today.

Between Cedar and Big Bend Creeks, there were at least six placer claims filed in the late 1950s (before the mineral withdrawal went into effect). Several cabins were built and eventually removed, but little evidence remains of their mining work other than an occasional hole in the ground. Three other placer claims were located at the confluence of Steamboat and Big Bend Creeks. Today, cabin remains are the only evidence of any activity at this site in the early 1900s.

In contrast, evidence of the Olive Placer claim located at Steamboat Falls is still visible today. This claim was located in 1902 by A. M. Hammer of Albany, Oregon and was surveyed by U.S. Deputy Mineral Surveyors C.M. Collier, A.H. Steele, Lewis Groves and Cy J. Bingham. At the time of the survey, Hammer had constructed a 12' X 20' house and had built 13.5 miles of six-foot wide trail from the claim to the mouth of City Creek. This claim was patented, became private property and subsequently transferred to Douglas County (the present owner) presumably for back taxes. Today, a portion of the old claim lies within Steamboat Falls Campground. The 1902 survey includes: references to the 27 ft. high falls (then called Hammer Falls); a description of an old trail that predated the one constructed by Hammer; notes on the population of Bohemia City (a total of 100 people); and, a notation that Steamboat Creek had an estimated flow of 30 cubic feet per second (cfs) during the dry season.

Several other miner-created potholes have been found on the flat floodplain terraces adjacent to Steamboat Creek below Steelhead Creek. County records indicate that the brother of Aaron Rose and several other men had filed over twelve claims at the mouth of Steamboat Creek in the late 1800s. No evidence remains of activity on these claims.

All of the material used in construction of buildings and flumes was secured from the surrounding forest for those claims filed prior to the late 1950s. The buildings constructed in the later time period were of dimensional lumber hauled in from outside the National Forest. Very little underground mining that would require mine timbers has been conducted in the analysis area. This means very few trees have been felled and removed for mining purposes other than for housing. A six-foot wide trail/wagon road was used by miners to access some of these claims. The construction of this trail was reported in the 1902 Mineral Survey as not involving much tread construction, only cutting of brush and logs to clear a path along Steamboat Creek. This would have modified the riparian structure and understory composition. Stream crossings would have been placed at shallow-water ford areas.

Current Condition

On May 28, 1959 Public Land Order (PLO) #1867 withdrew 3,270 acres of land in legal subdivisions from mineral entry under the mining laws along Steamboat Creek. In 1976, the Forest Service submitted a withdrawal application, which included an additional 75 acres along tributaries of Steamboat Creek (Figure 3). These withdrawals were implemented for the protection of anadromous fish habitat in streams where surveys documented fish use (early 1970s).

The remaining land within the Lower Steamboat watershed is open to mineral exploration and acquisition under the 1872 Mining Law. The 1990 Umpqua National Forest Land and Resource Management Plan fosters and encourages the prospecting, discovery, exploration, development and extraction of locatable minerals, gas, oil and geothermal leases, and common variety minerals within the limits of applicable laws (LRMP Chapter IV 74-78).

In the last twenty-five years, 15 claims (300 acres) have been filed. All of these claims were located in the upper Big Bend Creek area. Currently, six of these claims are active, totaling 120 acres in the Bulldog Creek area. These claims are owned by one person and are hard rock lode claims. No placer claims, which are located in streams, have been filed. Current mining operations occurring on these hard rock claims are conducted under an approved Plan of Operation, amended in 1998 to more closely reflect the objectives of the Northwest Forest Plan.

Activities are exploratory in nature and involve moving topsoil in search of a mineralized vein containing gold. This soil movement is accomplished primarily with shovel and small explosive charges. A backhoe was used on a claim located adjacent to road 3850-300 several years ago. Steep terrain on the six claims limits machinery access and use. Use of a backpack core drill is approved on the claims to retrieve two-inch diameter bedrock cores. Tree cutting activity on the claims has been limited to clearing logs out of roads for vehicular access. The Plan of Operation was amended to restrict cutting of trees in the Riparian Reserves (without prior Forest Service approval) and restrict the detonation of near-surface explosive charges (within 3 feet of the surface) from April 30 to July 16 in order to protect wildlife.

Exploratory mining has been conducted at a low level of activity. If gold is not discovered, it is likely that the level of activity will remain the same for the next ten years. It is conceivable that additional mining claims could be located within the watershed, depending upon the fluctuating price of gold. Any future mining activity requiring a Plan of Operation will be guided by decisions of an Environmental Analysis in concert with the 1872 Mining Law. The addition of mitigation measures and reclamation requirements will help reduce long-term impacts to other resources in the watershed.

Recreation

Recreation is an important human use in the watershed. Recreation activities within the Lower Steamboat Creek watershed include camping, picnicking, driving for pleasure, viewing scenery, wildlife viewing, wildflower viewing, hiking, biking, horseback riding, motorcycling, ATV riding, berry picking, hunting, fishing, swimming at multiple holes along the length of the creek, and kayaking. All of these activities require a road system to provide access. In the case of viewing scenery and driving for pleasure, a higher number of open roads is needed. Additionally, some hunters prefer higher open road densities, while others prefer a more primitive experience with lower road densities. Camping occurs throughout the summer and is heavier during hunting seasons.

Reference Condition

Recreation has a long history in the watershed. A Douglas County map from 1914 identifies one trail along the full length of Steamboat Creek, a trail on the Calapooya Divide and a trail from Illahee Flat to the Calapooya Divide trail by way of Reynolds Ridge. This map does not show any camps, shelters or lookouts and in fact mislabels Steamboat Creek as the North Umpqua River. Early photos and stories from the mid 1930s document families spending the summer along Steamboat Creek. Some of these families had mining interests, while others were simply enjoying the recreational opportunities found along Steamboat Creek.

Early indications of recreational use in the Lower Steamboat Creek watershed are evident in two brochures, "*Steamboat-Little River Recreation Area*" and "*Bohemia Recreation Area*" published in 1936. These two brochures extolled the wonderful recreation opportunities of camping, fishing, hunting and hiking on the two districts, which includes the Lower Steamboat Creek area. Recreation activity highlighted on the map included six lookouts, seven camps, three shelters, two Guard Stations and nine trails. Steamboat Creek had been closed to fishing in 1932 in order to protect fisheries resources. Fishing opportunities in the watershed were limited to lakes and ponds.

A Civilian Conservation Corps (CCC) camp was located near Steamboat Creek above Little Falls from 1933 to 1941. Canton Creek Campground was one of the many facilities constructed by the Steamboat CCC crew. It is safe to assume that the many enrollees spent their idle hours recreating in this watershed.

The 1947 district map indicates twenty-one trails, six camps, six shelters, six lookouts and two Guard Stations. On this map, Steamboat road ended at Steelhead Creek. By 1959, development was blossoming in the Lower Steamboat Creek watershed. Ten trails appeared on the map, along with five camps, three shelters and four lookouts. Steamboat Falls Campground had been constructed in 1958 and Steamboat road was extended up to

Little Rock Creek, for a total distance of 17 miles. Following this development the road mileage in the Lower Steamboat watershed totaled 28 miles.

Current Condition

By the 1960s, recreation was beginning to take on importance for the Forest Service in response to an increasing public demand. A National Forest Recreation System inventory of potential recreation sites was completed on the Forest in 1962. This inventory identified eleven campsites, one hunter camp, two observation sites and twelve swimming sites in the Lower Steamboat Creek watershed. In addition, roadside and streamside corridors were identified. Some of the swimming sites were given a separate number even though they were co-located with a camp site.

A design was completed in 1961 for the City Creek Campground located at the mouth of Little Rock Creek. This site was designed for five campsites and two vault toilets to be located between Steamboat Creek and the road. In 1971 the decision was made to survey and design another campground along Steamboat Creek. This site was located on a large flat across from the mouth of Buster Creek. The site was labeled Buster Creek and was designed to have sixteen campsites and four toilets between Steamboat Creek and the road. To date, neither of these two campgrounds has been constructed.

In the 1978 Umpqua National Forest Land Management Plan, the Bulldog Rock Un-roaded Dispersed Recreation Area was created on the eastern edge of the watershed. This area was given that designation to preserve the unique characteristics of the area and "to provide a wider range of recreational use and management prerogatives than are possible in a wilderness". The intent was carried forward into the 1990 Umpqua National Forest Land and Resource Management Plan where the name was changed to the Bulldog Rock Un-roaded Recreation Management Area (URMA). Its focus remained providing opportunities for un-roaded recreation primarily in semi-primitive settings. Camps with shelters at Fuller and Bullpup Lakes, dispersed recreation sites at various trailheads and along several roads, and three separate trails totaling 8.1 miles provide opportunities for hiking, bicycling, motorcycle riding, horseback riding, viewing wildlife, viewing wildflowers, fishing, camping, picnicking, communing with nature and hunting. In addition, two trails totaling 8.0 miles may be proposed for construction. Refer to Appendix D for a map of these sites.

An inventory in 1979 of dispersed recreation sites mapped areas used by the public for camping, swimming, hunting and fishing. Twenty-six sites were documented in the Lower Steamboat Creek watershed, with most of these located along Steamboat Creek. A recent inventory of recreation areas in the analysis area documented 37 dispersed recreation spots, 13 forest camps/trailheads and two campgrounds. Eleven Forest Camps/Trailheads and thirteen Dispersed Recreation Sites are located on the eastern side of the watershed. A high percentage of these are located close to the Bulldog Rock URMA or the Boulder Creek Wilderness. Five trails remain on the system, while the rest have been replaced by roads. A map of the trails and recreation use sites can be found in

Maintenance levels (ML) of 1 through 4 are assigned to most roads and reflect maintenance standards necessary to meet documented management objectives for each road or road segment. Categorizing roads within the watershed by maintenance level is one way to develop an understanding of the character, function and use of the transportation system. About 325 miles, or 73% of roads are maintained as open for public use, designated as ML 2, 3 or 4. Maintenance Level 3 and higher roads are maintained as driveable by a standard passenger car during those times of the year when not closed by snow accumulations.

Most of the important roads linking the analysis area with adjacent watersheds and linking internal subwatersheds together are ML 3 or 4. Approximately 100 miles of road are designated ML 3 or higher. ML 2 roads (225 miles) are typically dead end roads or short side routes between larger road systems, built to access timber harvest units and provide shortened haul routes. Approximately 70 miles (16%) are designated ML 1, physically closed to traffic year-round. These closed roads, typically less than one mile in length and without rock surfacing, are well distributed and do not significantly restrict vehicle access to most areas of the watershed. The remaining 45 miles (10%) of the roads are temporary roads (as described above) that are not maintained as part of the managed road system.

Steamboat road (Road 3800) has been identified by the Forest Service as part of the "Regional Network", a system of government roads that provides primary access to large areas of National Forest lands. Steamboat road serves as a transportation link between the North Umpqua and Middle Fork Willamette river basins. The portion within the analysis area is 16 miles long, and closely parallels (mainly within) the Riparian Reserve of Steamboat Creek. Refer to Appendix E for road distribution maps and further characterization of the road system.

Recreational Road Use - The recreating public takes advantage of the existing roads for hunting, driving for pleasure, viewing scenery, swimming, and for access to fishing, hiking or camping sites. This long-term use by the public has created an expectation that those roads will be available for them and future generations of recreational users.

To better address this public expectation, a letter was sent in May 1998 to over 300 individuals and organizations on the District mailing list and published in the local newspaper requesting input regarding roads needed for recreational use. As a result of this request for input, eight responses were received (less than 3%) from the recreating public. In these responses, the continuous theme was to keep the main roads open (the roads currently referred to as primary and secondary). The public identified hiking, hunting, wildlife viewing, photography, wildflower viewing, fall leaves viewing, scenery viewing, berry picking, horseback riding, fishing and Christmas tree cutting as recreation activities that require the roads to be open to enjoy the activities. The roads specifically mentioned by the respondents are listed in Table 1. A map of these roads can also be found in Appendix D.

In addition to public outreach, a road prioritization effort was conducted by the Ranger District engineering staff in 1996 to select those roads considered necessary as a core road network that would provide for a base level of access to various areas within the watershed. These roads received a primary, major secondary, or minor secondary classification based upon their perceived importance. In total, 140 miles of road were selected for the primary and secondary designations (Table 1).

District recreation personnel also identified those roads that have high recreational value and use, including those that provide access to dispersed recreation spots, or historically have received use for hunting, viewing scenery or driving for pleasure. These roads were considered to be important, and were added to the list of roads developed from public comments. Together, these two sources identified a total of 145 miles of road that are considered important for recreational uses (Table 1).

While some overlap exists between the list of primary/secondary roads and those considered as important for recreation, they are not a list of the same roads. After eliminating overlap, roads identified to meet the minimum transportation needs (primary and secondary), along with those considered necessary for recreation needs total 201 miles. A map in Appendix D displays the various classifications.

Table 1. Primary and Secondary Roads, along with roads considered by the public and District staff to be important for recreational uses.

PRIMARY & MAJOR SECONDARY	MINOR SECONDARY	PUBLIC COMMENT AND RECREATION USE	PUBLIC COMMENT AND RECREATION USE
#38	Portions of #3803	All of #3803	#3816-200
Portions of #3810	#3806	#3806	All of #3817
Portions of #3816	#3809	#3806-100	#3818
Portions of #3817	Added more of #3810	#3806-200	#3824
#3818	#3810-360	#3806-300	#3850
#3850	#3810-380	#3809	#3850-100
Portions of #3850-300	#3811	#3809-151	#3850-200
	#3815	All of #3810	#3850-300
	Rest of #3816	#3810-100	#3850-317
	Portions of #3816-200	#3810-200	#3850-350
	#3821	#3810-360	#3850-370
	Rest of #3850-300	#3810-380	#4713-200
	#3850-366	#3811	

PRIMARY & MAJOR SECONDARY	MINOR SECONDARY	PUBLIC COMMENT AND RECREATION USE	PUBLIC COMMENT AND RECREATION USE
	#3824	#3815	
	#3825	#3816	
	#4713	#3816-001	
	Portions of #4713-100	#3816-002	
	#4760	#3816-005	
	#4760-100	#3816-100	

For more information on roads that were determined to be important to recreation in the Lower Steamboat Watershed, refer to Appendix D.

Administrative Uses

Weather and Stream Monitoring

Within the analysis area, the Forest has identified sites for long term data gathering. These include a rain gauge, river level gauge, fire weather station, and stream temperature and turbidity sites. Some of these sites have been in place since the late 1950s. The Forest Service has six identified locations where stream temperature and turbidity are monitored on a long-term basis. These sites are located at the mouth of Canton Creek; on Steamboat Creek above the confluence with Canton Creek; at the mouth of Steelhead Creek; at the mouth of Big Bend Creek; at the mouth of Cedar Creek; and in Steamboat Creek proper. Only the site on Canton Creek has a permanent facility installed. This installation is located under the Steamboat Road bridge over Canton Creek and no vegetation cutting is necessary to maintain the facility.

Douglas County has a special use permit for the rain gauge, which is located on a flat floodplain terrace alongside Steamboat Creek. The County also has a permit to maintain the river gauge station located at the upstream edge of Canton Creek Campground. Both of these installations require cutting riparian vegetation periodically to maintain clearance around their facilities. They are also structures, either buildings or steel towers, within the riparian zone. The Forest Service Remote Weather Station is also located in the vicinity of Grandad Butte. This installation has a small steel tower and requires cutting vegetation to maintain clearance for rainfall and temperature monitoring equipment.

Other Property

The only parcel of non-federally owned property within the analysis area is located at Steamboat Falls, owned by Douglas County. They do not conduct any activity on this parcel and are in the process of trading or selling the property to the Forest Service. A fish ladder was installed on this property by the Oregon Department of Fish and Wildlife.

This facility is located within the stream channel, and occasional maintenance activity is required to keep the ladder in operation. In the past this has included the placement of motorized equipment in the stream channel. Additional repairs may be required as the concrete deteriorates.

Some roads within the analysis area are used for access to private parcels, which are located outside the analysis area. Private parcels are located in the Bohemia Mining District in the Steamboat headwaters, on the eastern side of the Calapooya Divide and in the Canton Creek watershed.

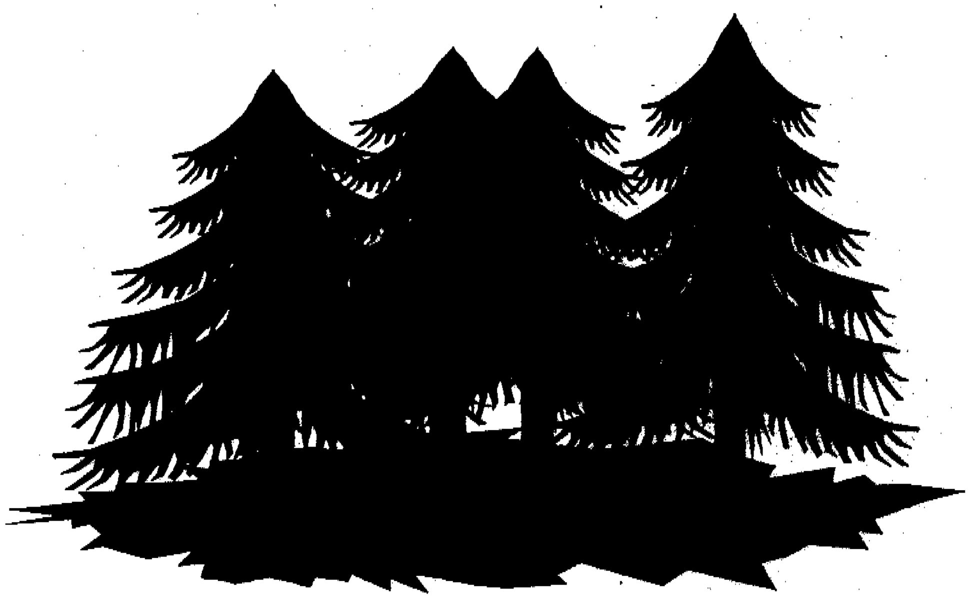
Building Stone Quarries

Common variety building stone sources have been identified throughout the watershed. These are locations where building stone can be removed under permit for commercial or private use. The stone is used for walkways, retaining walls, fireplaces or building accent. Two quarries are located within the analysis area and access is provided to another quarry just outside of the analysis area. The first quarry is located on road 3850 in T.25S., R.2E., Sec.13. The second quarry is located on road 3803 in T.25S., R.1E., Sec. 31. Access to the quarry located outside the analysis area is provided by road 3803.

Communication Sites

Two radio communication sites are located on the analysis area boundary or just outside of the boundary. Roads within the analysis area provide access to both sites. One communication site is located on Steamboat Point at the end of road 4713-308 and has powerline access to the site. The Oregon Department of Transportation has facilities at this site. The second communication site, Chilcoot Mountain, is located outside the watershed boundary. It contains facilities for the Forest Service, Bureau of Land Management, State Police and private industry. Vegetation is cut from around the towers and structures at infrequent cycles. Impacts in the Lower Steamboat Creek watershed would be from access to the sites. Chilcoot Mountain does require wintertime access over the snow in order to repair equipment as needed.

CHAPTER 4



Terrestrial Resources and Processes

Chapter 4 - Terrestrial Resources and Processes

GEOLOGY

Lower Steamboat Creek is underlain by a broad collection of consolidated volcanic dust, ash and rock fragments belonging to the Little Butte Volcanic Group (of the Western Cascades geologic province). These rocks (defined as tuffs, lapilli, breccias, and ash flows) originated from intermittent volcanic events that occurred between 17-35 million years ago. During this time period, rock layers were laid down by concentrated slurries of volcanic debris mobilized by water and deposited into slowly subsiding basins or troughs. This process allowed for the accumulation of over 3,000 feet (1,000 meters) of material. There is also evidence that pyroclastic flows and dilute muddy slurries played a role in rock formation within the watershed.

After the rock was deposited, the area experienced several sequences of uplifts which eventually raised the watershed and gave it a gentle tilt of approximately five degrees to the east. Most of the rocks were later subject to some degree of alteration by burial metamorphism (a change in the composition due to pressure, heat, chemical action, etc.) and hydrothermal activity related to volcanic activity between 10-17 million years ago. This alteration of the original minerals has affected the method and likely increased the rate of weathering during later geologic periods.

Over the last 12-600 thousand years, glaciers have affected the higher elevations of the watershed, especially along the Calapooya Mountains. Glacial activity in this area created the cirques and valleys that form the headwaters of Bulldog, Big Bend, and Reynolds Creeks. Glacially derived soils have been identified along Big Bend Creek, but have not been found in the Reynolds or Singe Creek areas.

PHYSIOGRAPHY

The topography within areas of the Little Butte volcanics can be highly variable, as can be seen by the differences between the Upper and Middle/Lower Steamboat areas (Sherod 1986). Landforms can generally be characterized as a sea of rolling hills and mountains, in a moderate erosional state. Streams have relatively gentle gradients and appear to be well incised into their respective gorges.

The geomorphic features identified within the watershed appear to be primarily based on slope and geologic structure and do not appear to be directly related to geologic rock type. The following geomorphic features were identified during the watershed analysis process:

Debris Slide Basins - Fan-shaped basins occupying the headwaters of many of the streams in the analysis area. Generally, they range in size from about 25 to 300 acres, and are strongly concave. They appear to have formed in areas where active erosion and small-scale landslides have occurred in shallow soils in steep terrain. Debris flows are common mechanisms of mass wasting within debris slide basins.

Earth Flows – Land types associated with ancient landslide complexes. They are typically characterized by gently sloping, convergent topography; deep, fine-textured soils; and an abundance of surface and groundwater. Stream channels flowing through earth flow areas are highly susceptible to bank erosion and channel downcutting. This is due to the presence of fine textured soils that generally lack larger particles that would provide some form of armoring and resistance to erosion.

Glacial Cirques – The uppermost slopes in glacial basins, generally at elevations above 4,200 feet (1,300 m). They are similar to debris slide basins, but have been modified by the actions of snow and ice during periods of alpine glaciation. The lower portions of these basins are often modified by annual snow avalanches.

Inner Canyon Gorges - The lower portions of canyon sideslopes, directly above the stream and alluvial valley floor. These areas are marked by an increase in slope to 65 percent or greater, as valley walls angle down into the stream bottom.

High-Relief Mountain Slopes -These are areas characterized by steep valley walls capped with sharp-crested drainage divides.

In general, the watershed contains large areas of earthflow terrain as well as large areas of steep and dissected country.

NATURAL DISTURBANCE

Natural disturbance is an important process within late-successional forest ecosystems, but humans have altered the disturbance regimes. Disturbance processes change stand and landscape-scale structure by killing trees, changing amounts of coarse woody debris (CWD), and changing stand size and shape (Morrison and Swanson 1990). These changes, even though they may occur within the terrestrial portions of the watershed, usually influence changes in the aquatic ecosystems. Examples of natural disturbances include wildfire, wind, insect and diseases. Management may be required to reintroduce natural disturbance, such as fire, or to minimize socially unacceptable impacts (FEMAT).

Wildfire

Prior to fire suppression and intensive timber harvesting, wildfire was the major disturbance shaping the forests of the western Oregon Cascades (Agee 1993, Morrison and Swanson 1990, Teensma 1987). The role wildfire plays in an ecosystem is described in terms of a fire regime. Fire regimes are classified at various scales often encompassing specific mountain ranges or similar climatic areas. They are a function of the frequency of fire occurrence and fire intensity (Irving 1971). Fire regimes are often based in terms of fire severity. As such, high severity fire regimes are defined as having infrequent high intensity fires (greater than 100 years between fires) that often kill most trees in a forest stand (Agee 1990). Moderate severity fire regimes have infrequent fires (25-100 years) that are often partial stand-replacement fires and include areas of high and low intensity.

Reference Condition

The fire regimes within the watershed were largely based on historical fire records and mapping of fire patterns from the 1946 aerial photos. Fire effects were highly variable and usually related to site specific vegetation and topographic characteristics. From this data, fire extent, frequency, severity and patch size distribution were estimated and correlated to topographical modeling of slope, aspect, landform and elevation. As a result, two distinct fire behavior areas were mapped within the watershed (Figure 4).

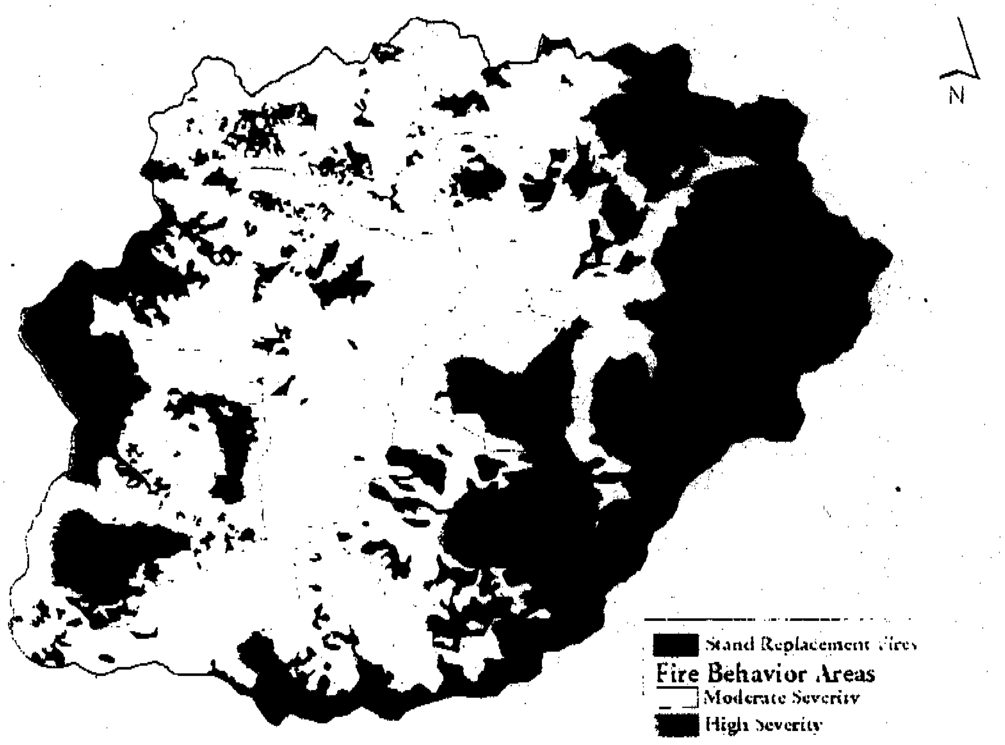


Figure 4. High intensity fire patterns from the 1946 aerial photographs. These fire patterns represent the extent of stand replacement fire within the watershed over the last 150 years.

Historical fire patterns seen in the 1946 photos were similar to those described in other Western Cascades studies (Morrison and Swanson 1990 and VanNorman 1998). Fires within the moderate severity behavior areas (steeper, more dissected, lower elevation landscapes) experienced more frequent wildfires (17 to 30 year return intervals) that were normally low to moderate in severity and occasionally crowned out to create patches of even-aged stands (Table 2). The average large fire event experienced a mix of intensities and burned approximately 5,000 acres. Stand replacement patches ranged from 2-570 acres in size, with an average patch size of 51 acres. These patches usually occurred in the mid to upper slopes, ridge tops and tops of steep draws. Forest canopies along larger order streams were more intact and experienced mostly low to moderate severity fires.

Table 2. Fire behavior areas within the Lower Steamboat Creek watershed.

Fire Behavior	Large Fire Characteristics (last 100 years)				
	Frequency (# fires/100yr)	Acres burned per fire	Acres Stand Replacement	Avg. Patch Size (acres)	Patch Size Range (acres)
Moderate Severity	≅3	≅5,000	600-1,000	51	2-570
High Severity	≅1	≅12,500	1,500-3,000	350	2-3,000

In the high severity behavior areas (higher elevation landscapes with cooler, moister conditions and gentler topography) large wildfires were less frequent (50 to 120 years return intervals). However, this portion of the watershed did interact with fire on a regular basis. Due to the moist, gentle slopes and higher elevation forest types, conditions were not conducive to large high intensity fire events unless combined with hot, dry climactic conditions such as drought or wind. When this combination occurred, wildfires usually burned extensive areas (approx. 12,500 acres). These fires experienced a greater amount of high intensity fire, and patch sizes ranged from 2-3,000 acres in size with an average patch size of 350 acres. These intense fires would commonly stand replace large sections of watersheds including large sections of riparian forest.

The reference condition can be described as one where large fires would occur periodically within a matrix of late-successional forest producing pulses of stand replacement patches into the forest ecosystem. Overall, this combination of fire behaviors produces a landscape typical of a moderate severity fire regime as defined by Agee (1993).

Studies for the central western Cascades (just north of the watershed) show that wildfires burn more area at low-moderate intensity than at high intensities, but that high intensity fire patches provide an important disturbance process in the forests (Morrison and Swanson 1990). They also show that the fire return intervals become shorter with a southerly progression along the Cascades. Teensma (1987) calculated a mean fire return interval for stand replacement fires (high severity only) of 130-150 years for the H.J. Andrews experimental forest. The overall mean fire return interval for the watershed is estimated at 30 years, based on fire history data collected on 40 plots within the Siwash, Steelhead and Cedar Creek subbasins (Appendix F). Out of the 1000 stumps tallied, 87 fire events in the form of a fire scar were recorded. Fire episodes were supported by pitch ring data, stand and cohort age classes. Analysis of the data shows that years between fires ranged from 15 to 131 years.

The time it takes for the entire watershed to experience some level of interaction with fire is expressed as the natural fire rotation (NFR). It is a function of the fire return interval and the portion of the area burned within this interval (see Appendix F). This concept is useful in the context that the frequency, extent and severity of the fires historically were extremely variable. Analysis of the 1946 aerial photos showed that approximately 16,723 acres (23% of the watershed) experienced moderate to high severity fire activity occurring over an approximate 100 year time period. If one assumes that for each fire event that approximately 25% is of stand replacement severity, then and estimated 50,169 additional acres burned at low severity over this same time period. This equates to approximately 93% of the watershed having experienced fire over the 100 year time period. Based on these numbers, it is estimated that the natural fire rotation for the watershed is 106 years.

Current Condition

Today, there are and have been a number of human influences affecting fire's role within the watershed. Some of these include:

Fire Suppression	- Limits the acres burned within the watershed - Converts stands from fire tolerant to fire intolerant species - Increases fuels within late-successional/old growth stands
Harvest Activity	- Breaks up stand continuity throughout the landscape - Changes stand structure and plant communities
Road System	- To some degree provides natural barriers for fire spread - Provides direct access to fire starts - Provides access to public increasing human ignitions

Other fire management activities include wildfire hazard reduction and prescribed fire application. Fire suppression for the watershed is based on suppression guidelines identified under Chapter 6 of the LSR Assessment (LSRA 1998). In the course of implementing the guidelines contained in a fire management plan to achieve ecosystem management objectives within the Late Successional Reserves, it is critical that wildfire suppression and prescribed burning activities do not compromise the safety of firefighters or the public. Safety is the highest priority for all fire activities conducted in the LSRs (LSR assessment 1998).

Fire suppression has been in effect for approximately 80 years. However, it has only been effective since the late 1940's. In 1996 the North Umpqua Ranger District experienced 51 fire starts, six of which occurred within the Steamboat Watershed. Due to effective fire suppression efforts only two fires within the Steamboat watershed exceeded 100 acres, the largest being the Black Gorge fire that reached a final size of 375 acres.

The lack of fire's interaction with the environment causes direct and indirect effects on the vegetation, forest structure, landscape patterns and alters many ecological processes which once occurred. One example of this can be seen in the decline of the relatively short-lived knobcone pine which occurs in the watershed. Knobcone pine trees have been found in isolated groups along the ridges near Dog Mountain above Deep Creek and along the Lemon Butte area between Cedar Ridge and Longs Creek. Knobcone pine populations depend upon fire as a primary agent to open cones, create suitable seed beds and regenerate new cohorts of seedlings. Fire suppression has led to a decline in the number and spatial extent of stand replacement fires in the watershed. This has had a negative impact on knobcone pine populations, which are in the process of being eliminated from the watershed, and has reduced the range available to knobcone pine regeneration from what existed during the reference period.

In 1996, the 16,480-acre Spring Fire occurred just southeast of the watershed boundary. This fire best represents what can be expected for fire intensities on a landscape scale under current conditions (Appendix F). The last recorded significant fire that occurred in the area of the Spring Fire was taken from the 1946 aerial photos. These photos indicate that there was a high severity fire in the late 1890s or early 1900s and there are no records of large scale fires in that area since then. The mean fire return interval for that area based on fire history stump data is estimated at 30 years. The Spring Fire occurred 90-100 years after the last high severity fire, suggesting that this area may have missed 1-2 burning cycles, perhaps due to fire suppression. Approximately 37% of the Spring Fire area burned at moderate to high intensities. This percentage of severe fire is slightly higher than that expected under normal moderate severity fire regimes. This increase in severity may be indicative of fuel loading increases at a landscape scale due to fire suppression (see Appendix F for map).

Fire frequency for the watershed is based on fire occurrence records from 1970-1996. During this time period, the North Umpqua Ranger District recorded 545 fires (an average of 20 fires per year). Thirty-two percent of these fires occurred in the Lower Steamboat watershed (for a watershed average of 6.4 fires per year). This occurrence information is used to calculate the watershed's fire occurrence rate (FOR) which is defined as the probability of a fire occurring on any 1000-acre area of land in any given year. Based on the above data, the FOR of the District is a 7 percent. In comparison, there is 9% probability of a fire occurring on any 1000-acre parcel on any given year for the analysis area. This implies that the watershed is a high priority for attention based on fire occurrence rates.

The same fire occurrence records were also used to conduct another probability analysis using the PROBACRE model. Fire starts for this time period are shown in the following table.

Table 3. Wildfires within the watershed between 1970 and 1996.

Acres Burned	Number of Wildfires
≤ 0.25	121
0.25 – 10	39
10 – 100	10
100 – 1000	2

According to this model, there is a 24% probability of at least two 100-1000 acre fires occurring over a 20 year period. This estimate is consistent with the fire records shown above. The significance of this probability estimate is that, as time passes, the probability of one or more large fires occurring also increases (Table 4).

Table 4. **PROBACRE results for small fires. Percentages indicate the probability of a fire occurring.**

Fire Size In acres	Next 10 Years		Next 20 Years		Next 30 Years		Next 40 Years		Next 50 Years	
	>2 fires	>4 fires	>2 fires	>4 fires	>2 fires	>4 fires	>2 fires	>4 fires	>2 fires	>4 fires
≤.25	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
0.25-10	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
10-100	16%	31%	99%	86%	100%	98%	100%	99%	100%	100%
100-1000	13%	0.10%	24%	2%	26%	7%	23%	18%	31%	31%

Long range probabilities for how much of the watershed may burn over the next few decades was derived using the same prediction model. Predictions were based on an aggregate of acres burning within a given time period. These probabilities are displayed in Figure 5.

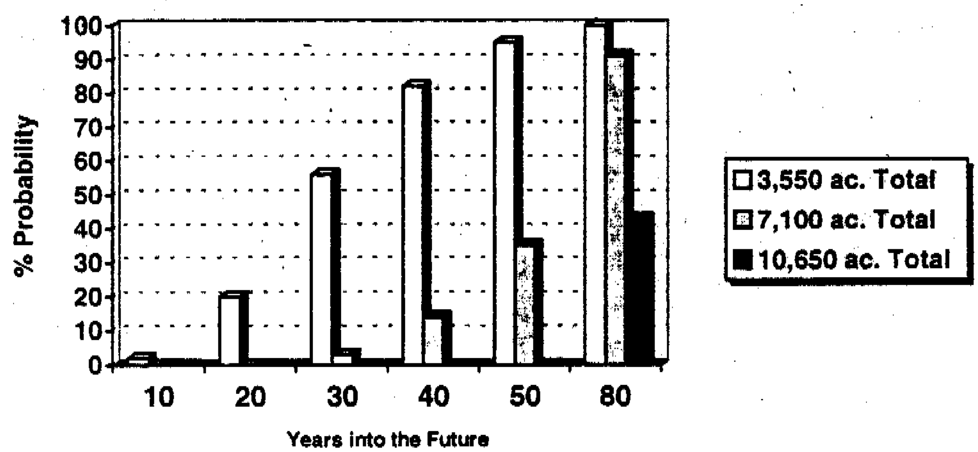


Figure 5. Probability of acres burned within the watershed over the next eight decades.

There is a 35% probability of a fire occurring, which will burn approximately 10% of the watershed over the next 50 years. This number is significant in that there has not been a recorded fire of this size in the past 50 years. Since this probability analysis is based on number of fire starts over a period of time, it is important to remember that it does not take into consideration at what severity these fires may burn at. Overall, the Steamboat watershed is showing signs of transitioning to a high severity regime with ample opportunities for fire ignitions.

Fuels

The fuel models descriptions that are relevant to the Lower Steamboat watershed were broken into four distinct fuel groups as defined by Anderson (1982). They consist of grass and grass-dominated, chaparral and shrub field, timber litter, and slash fuels (see Appendix F for specific fuel descriptions).

Reference Condition

Fuel models for the reference period consisted primarily of fuel models 8 and 10 which fall into the timber fuel models. Fuel models 1 and 5, grass and brush respectively, totaled approximately 1,757 acres or 2% of the watershed. The composition of fuel models within the watershed is displayed in Figure 6. It is important to remember that a single fuel model rarely occurs in huge continuous blocks. Instead, they are often intermixed throughout the watershed.

Fire behavior within the fuel model 8 for the reference condition consisted of slow-burning ground fires with low flame lengths (low intensity). The fire may have encountered an occasional "jackpot" of heavy fuel contributing to a periodic flare up and torching of a single or clump of trees. The fuels in the less than 3" size class were light and played a significant role in contributing to a low intensity burn. Fuel model 8 was most predominant in areas that supported frequent fires. Fuels accumulation was kept in check by periodic fire disturbance. Once the fuel levels reach a loading to support fire spread, the fire would creep through the ground litter. Fire spread occurred until the fuel loading became too light to sustain fire.

Fuel model 10 was the primary contributor to the moderate and high severity burn patterns found in the watershed. The dead-down fuels include greater quantities of 0-3" and >3-inch material. Larger limbs resulted from older trees or natural events that created a large load of dead material on the forest floor. Crowning out, spotting, and torching of individual trees was frequent. Once these areas burned, areas of high severity would convert to an early seral stand.

Current Condition

Fuel models present in the watershed today are primarily due to the heavy amount of harvest activity and successful fire suppression. Fuel model 1 shows an increase from reference condition which is attributed to clearcuts that have not reestablished after logging and are presently a grass meadow type.

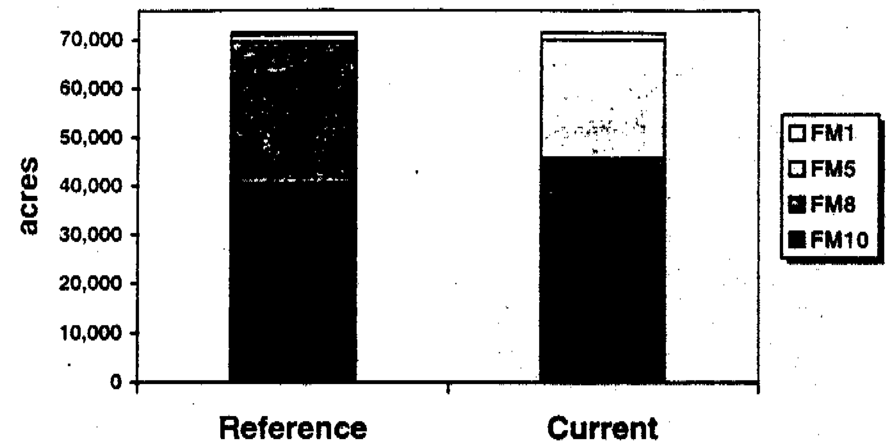


Figure 6. A comparison of reference and current fuel models within the watershed.

Significant changes have occurred primarily within the fuel models 5 and 8. Fuel model 8 has decreased from approximately 29,000 acres in the reference condition to 9,300 in the current condition. This decrease is attributed to conversion to a fuel model 5 via timber harvest or conversion to a fuel model 10 due to fire exclusion and accumulation of additional fuels. This change is significant in that this fuel model is the primary supporter for low intensity fires, such as were more common during the reference condition.

Fuel model 5 has increased by 94% from its reference condition. This encompasses all of the clearcut units within the watershed boundary. A fuel model 5 contains characteristics of a green regeneration shrub land after fire. Fire behavior in these stands is expected to be surface fires through the litter cast from shrubs and grass component, and would not generally be intense due to light fuels.

Fuel model 10 has shown a slight decrease in acreage due to timber harvest of old-growth stands within the watershed. However, this decrease has been offset somewhat by conversion of fuel model 8 stands through fire suppression. In addition, fuel model 10 stands that were present during the reference period and still exist today have been compounded by additional accumulations of fuels in all size classes.

The most significant change in fuel model 10 stands is not in quantity, but in the shift in their spatial arrangement from that during the reference condition. The reference condition fuel model 10 stands predominately occurred in the moist, gentle slopes that were highly productive and produced large amounts of biomass. In this landscape position these stands experienced fire, however the topography and microclimate of the area, along with normal weather conditions did not sustain high severity, stand replacement fire. The late seral stands positioned on the steep southerly slopes were dry sites with low productivity. These stand historically burned with low to moderate intensity ground fires with some torching in the upper slope positions. The mortality in these stands would have been focused in the shrub layer and the vegetation in the upper 1/3 of the slope. The mortality in the upper slope area would have been caused by convective heating. The mortality in the shrub layer would have kept the stand in a more open condition with a mosaic of age classes present in between fire events.

To date, most harvesting has occurred in areas where the historically stable late seral stands were present. This is where most of the conversion from fuel model 10 to fuel models1 and 5 has occurred. Presently, 50% of the remaining late seral stands occur on steep southerly slopes that historically had lower fuel loads and a greater level of interaction with fire. This spatial shift has set much of the remaining late seral habitat up for high intensity, stand replacement fire. This has been compounded due to increased stand densities that now provide higher fuel loads during a time of active and successful fire suppression. Agee (1993) states, "Fire protection has created homogeneous high fuel conditions across the entire landscape, a condition that was once associated only with…small pockets of these forests surrounded by cooler moisture types".

High risk is associated with heavy fuel loads in the 0-9" size class that exceed 21 tons per acre. This type of fuel load will burn with fire behavior that will be resistant to suppression efforts. Flame lengths will exceed four feet, making direct attack with ground crews unsuccessful and unsafe. The stands themselves will experience mortality in the shrub, intermediate and canopy layers. This mortality may be patchy or continuous over large blocks. The weather, topography and continuity of the fuels will determine if mortality is a result of isolated torching or a running-dependent crown fire.

Desired Future Condition

The desired future condition is to have late seral stands that can be maintained on a landscape scale. Until then, late seral stands that are resilient to stand replacement fire should be maintained in order to provide habitat for dependant species. Opportunities exist to treat some of these late seral stands (approximately 10% of the late seral habitat) to lessen the risk of high intensity fires. The desired fuel profile in stands determined to be at risk to stand replacement fire activity would be 7 to 21 tons per acre of material in the 0-9 inch size class. When an area or areas are looked at for potential fuels reduction treatment, multiple watershed analysis recommendations should be considered. This will allow for a holistic approach to terrestrial restoration with prescribed fire used as one of many tools needed to complete the work.

Wind

Wind is an important disturbance agent that provides both small and large scale changes to forest structure. Windstorms can cause stem breakage and windthrow, which increases stem decay in wounded trees and leads to bark beetle buildups in windthrown trees (Campbell et al. 1996).

Reference Condition

The majority of the destructive surface winds in Oregon are from the southwest and are associated with storms moving onto the coast from the Pacific Ocean. When the winds are from the west, they are often stronger on the coast than in the interior valleys due to the north-south orientation of the Coast Range and Cascades. These mountain ranges obstruct and slow down the westerly surface winds. The most destructive winds are those that blow from the south, parallel to the major mountain ranges. The Columbus Day Storm of 1962 was a classic example of a south wind storm. Other historical records of windstorms are shown in the Table 5.

Table 5. Historical records of windstorms in western Oregon (NOAA data).

DATE	DESCRIPTION
Jan. 1880	In Portland, wind speeds of 60 mph were observed., elsewhere, as high as 65 mph with gusts to 80 mph. Thousands of large trees, were toppled and buildings in the Willamette Valley were destroyed or damaged. At Coos Bay, a 3-masted schooner, dragging its anchor, was blown on to the beach and split in half. Widespread areas of wind-felled trees across railroad tracks halted rail traffic.
Jan. 1921	Hurricane-force winds were reported along the entire Oregon and Washington coasts. Very strong winds were also reported in the Willamette Valley. There was widespread damage to buildings and standing timber.
Apr. 1931	Very strong northeast winds caused widespread damage, particularly across northern Oregon. Officially recorded wind speeds were not extreme, sustained wind speeds were: 36 mph at Medford, 32 mph at Portland, and 27 mph at Roseburg. Damage was heavy to standing timber and fruit orchards. Dust was reported by ships as far as 600 miles from shore.
Nov. 1951	Sustained southerly to southwesterly winds of 40 to 60 mph occurred over nearly the entire state, with gusts of 75 to 80 mph at many locations. There was extensive damage to power lines, buildings, and standing timber.
Dec. 1951	This storm reached its greatest intensity along the coast, where unofficial observations reported sustained wind speeds between 60 and 100 mph, while inland valley locations reported sustained wind speeds up to 75 mph. The fastest mile at Portland airport was 57 mph, Baker at 42 mph, and Roseburg with 40 mph. Serious damage to buildings and widespread power losses occurred throughout the state.
Dec. 1955	High winds were felt across most of the state. North Bend reported sustained wind speeds of 70 mph with gusts to 90 mph. Most regular observing stations recorded sustained wind speeds of 55 to 65 mph, with gusts considerably higher. In addition to the extensive damage to buildings, power and telephone lines, heavy destruction occurred in the Willamette Valley orchards and standing timber across the state.
Oct. 1962	This was the most destructive wind storm to ever occur in Oregon, both in loss of life and property damage. Damage was most severe in the Willamette Valley. Monetary losses in the state were 175 to 200 million dollars. There were 38 fatalities and many more injuries. Roseburg recorded peak wind gusts of 62 mph.
Mar. 1963	This storm was the most intense along the coast, where wind gusts from several observations made on unofficial instruments were in excess of 100 mph. Wind speeds were diminished as the storm moved inland, but they were still capable of causing widespread destruction. Portland had a fastest mile of 57 mph with a peak gust of 63 mph. Salem had a fastest mile of 39 mph with a peak wind gust of 68 mph. Eugene recorded a fastest mile of 48 mph with a peak wind gust of 75 mph.
Oct. 1967	Wind speeds of 100 to 115 mph were unofficially recorded along the Oregon coast. There was one fatality and about 15 persons were seriously injured. Significant widespread damage occurred to agriculture, timber, power and telephone utilities, and homes.
Mar. 1971	An intense Pacific storm moved into northwestern Washington, bringing damaging winds across most of Oregon as the front marched east during the early part of the 26th. Damage was scattered along the coast, but was more widespread in the Willamette Valley, and the counties along the Columbia River. Considerable destruction occurred to standing timber in southern Lane County and northern Douglas County. Eugene Weather Service Office recorded winds of 49 mph.
Nov. 1981	Strong winds spread into the Pacific Northwest from the south. Wind gusts as high as 75 mph and 62 mph were observed at Brookings and Medford, respectively. North Bend recorded gusts to 92 mph, the strongest official wind gust of the storm. Other significant recorded wind gusts were: Coos Bay with 40 mph, Eugene 58 mph. Damage to standing timber was extensive from Washington to northern California. In northern California, winds toppled a dozen five-feet thick redwood trees across U.S. 101, blocking traffic for hours.
Dec. 1996	Winter windstorms, saturated soils and heavy wet snow accumulation caused hundreds of acres of blowdown/snowdown across the Umpqua National Forest, mostly between the 3-4,000 ft. elevation band.

Current Condition

Large windstorms appear to be relatively common and have occurred at least once in each of the last five decades. This trend can be expected to continue. The amount of windthrow that occurs today is influenced by the amount of abrupt forest stand edges. Past clearcut harvesting and road building have created several hundreds of miles of high contrast edges (well above what occurred naturally). It is common to see blowdown along these man-made edges.

Desired Future Condition

Wind disturbance is a part of the natural disturbance regime within this watershed. It provides recruitment of coarse woody debris and influences stand structure diversity. In the next few decades, the amount of high contrast forest edge will decrease and be within a more natural range as conifer plantations mature. This should reduce blowdown to some extent.

Insects and Disease

Historically, insects and disease played a small, but important role in creating disturbance.

Reference Condition

Insects like the mountain pine beetle, western pine beetle, the pine and fir engravers, and the Douglas-fir beetle were found in endemic populations through time across the Steamboat landscape. Incidences of significant outbreaks were rare except following infrequent large storm fronts, which created significant blowdown areas.

Similarly, root disease impacts have been generally small with pockets of laminated root rot and black stain root rot the most prevalent disease disturbance agents on Douglas-fir and western redcedar. Available evidence suggests that root disease centers probably contribute materially to maintaining populations of Douglas-fir bark beetles between outbreak years. Other important root disease agents include the annosus root disease in true fir, Douglas-fir and hemlock stands; the armillaria root disease; and, the velvet top fungus. Butt and stem rots were present as important stem rots and decomposers and included the brown cubical rot, the red-brown butt rot, the red ring rot and the brown crumbly rot.

Additional diseases prevalent within the watershed include white pine blister rust, which impacts five-needle pine trees. This disease was introduced into western North America in 1910 and spread rapidly in natural stands where there was little resistance to the fungus. This disease has had a significant impact on the regeneration of new young stands of 5-needle pine around the watershed. The pathogen girdles and kills branches, tops and stems. Saplings and poles are frequently killed outright by the blister rust; larger trees are damaged and in some cases predisposed to attack by mountain pine beetles. The seedling and sapling size classes typically experienced the most severe stress from the disease. Finally, dwarf mistletoe concentrations affected populations of Douglas-fir and hemlock within the basin by creating small areas of characteristic brooms throughout the watershed.

In reference times, fire helped control the spread of root disease and insect activity in a variety of ways. Historically, fire disturbance has been the main disturbance agent affecting pine health by removing ingrowth and small tree competition from around mature and old-growth pine trees. Sugar pine, western white pine, ponderosa and knobcone pine all exist within the drainage. Although pine composition in forest stands is generally a smaller subset of the total number of trees (2-20%), the function and role of these trees is important to the ecological health of the ecosystem where they occur. During drought cycles, insect activity would grow as the drought lengthened and the resultant mortality created snags that helped influence the fire behavior. Root rot pockets that carried concentrations of slash from downed trees would burn and possibly reburn. Fire influenced the species of trees left for regeneration and thus influenced the extent of spread or contraction of these root disease pockets.

Current Condition

The winter storms of 1996-1997 created the most measurable amount of blowdown in any single event since 1962. As a result, an increase in bark beetle activity has been apparent in 1998 and 1999. Small pockets of beetle-killed trees are scattered throughout the watershed is groups of 3-12 trees.

Timber management practices of repeated planting and interplanting of Douglas-fir in root disease pockets have helped expand some root disease areas. This is particularly true in the Reynolds Basin where laminated root rot has expanded and shaped stand development. Certain portions of the Steamboat landscape have higher projected root disease incidence than was thought to exist in reference periods. One example is black stain root rot, which has expanded in association with road system development.

White pine blister rust is causing mortality to seedling, sapling and pole sized sugar and white pine trees across their native ranges within the Steamboat basin. Effective fire suppression over the past 50 years has significantly increased understory stocking densities of seedling, sapling, pole and sawlog-size trees around the larger pine trees creating stress for site resources, especially water. This additional stress has led to an increase in the mountain pine beetle populations and increased mortality on this older component of pine within the watershed. In regeneration units, established young pine trees are not growing well due to excessive tree stocking. Both the increase in understory stocking densities and the impact from white pine blister rust has led to a decrease in both the older and younger cohorts (age classes) of the 5-needle pine in the watershed. Without intervention, the prognosis for maintaining this important cover type in the Steamboat watershed is poor. Currently, western white pine is found in the upper portions of the main tributaries generally above 3,000 feet in elevation. There is one major sugar pine group in the lower Steamboat subwatershed surrounding the Part, Grass, Spring and Siwash Creek areas. Another strong area for sugar pine is in the Reynolds Creek and Washboard ridge area above Homestead Creek.

Ponderosa pine has been found from the Black Gorge, Deep and Singe Creek area up towards Wild Rose Point above Reynolds Creek. Ponderosa pine populations are affected by mountain pine beetles, but also by western pine beetle and pine engraver beetles which cause mortality in drier portions of the landscape. Increased understory tree stocking due to the exclusion of fire in the pine habitats has led to increased levels of stress on ponderosa pine. Populations of older and younger cohorts are down from levels that historically existed within the watershed.

Moderate to severe amounts of hemlock dwarf mistletoe is noted in both the moderate and moist hemlock land stratifications. This amount is believed to have increased from reference conditions due to the lack of low intensity fire, which eliminated hemlock in understory areas. Today, hemlock continues to regenerate and grow as an understory component of the stand, perpetuating the lifecycle of mistletoe.

Desired Future Condition

Given the watershed's designation as a Late-Successional Reserve, the area should be allowed to function naturally with a range of insect and disease activity levels present within the basin throughout time. The discontinuation of clearcut harvesting and artificial regeneration should slow root disease expansion. However, it will still occupy portions of current and future forest stands. Insects and disease cycles create mortality, provide important stand structure, wildlife habitats and influence decomposition. There are many benefits to this flow of energy within the ecosystem. Over time, insect populations will ebb and flow with natural disturbance patterns.

Pine species would have early, mid and late-seral pine populations throughout its natural range. This would be achieved by regulating stand understory density, structure and species cover through the use of managed prescribed fire and thinning. Mature pine trees would experience less stress from competition due to less ingrowth.

LANDSCAPE PATTERNS AND STRUCTURE STAGES

The landscape within the watershed is naturally dynamic. It constantly changes, at large and small scales, in response to disturbances described above.

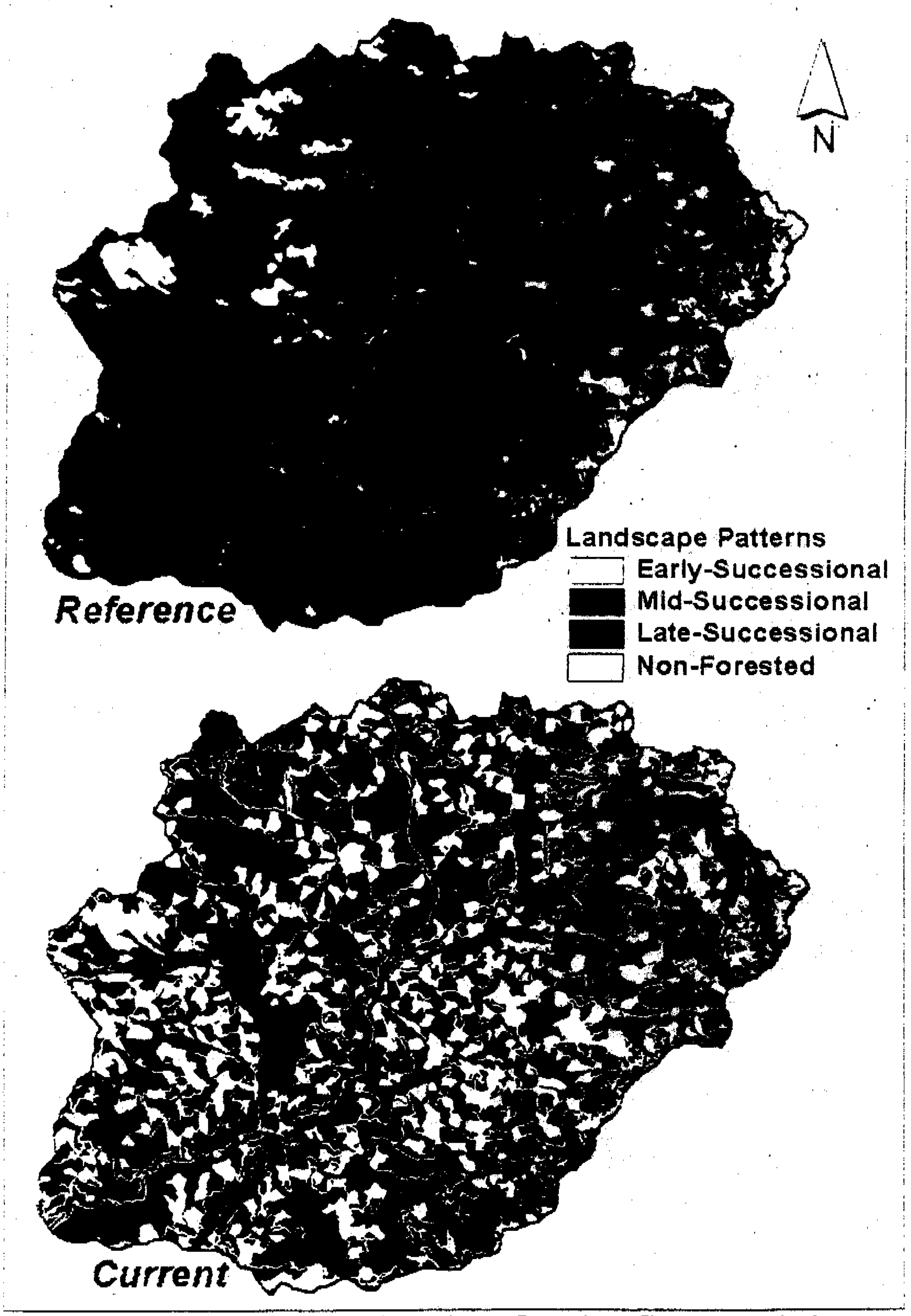


Figure 7. Landscape patterns within the lower Steamboat Creek watershed.

Changes in landscape patterns were analyzed by comparing the current patterns with historic patterns of the 1940s (Figure 7). Landscape patterns for the current conditions were developed through interpretation of aerial photos taken in 1997. Patterns for the reference period were obtained from historical vegetation mapping done in 1914, 1932 and 1946. The reference map was refined with mapping of unique habitats (non-forested patterns).

The landscape was divided into four broad classifications which are roughly equivalent to seral (or successional) stages (Table 6 defines these landscape patterns). Most of the patterns on the landscape are relicts of large stand replacement fires. Some smaller patches, which were created by debris torrents and landslides, were also mapped. Other common disturbances such as blowdown, and insect and disease mortality tended to create a "finer grained" pattern of small patches (<1/2 acre) and are an integral structural component of late-successional forests.

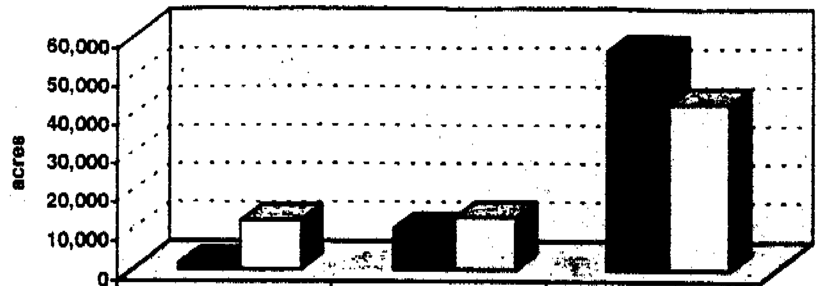
Table 6. Landscape pattern definitions.

Structure	Reference	Current
Non Forested	Water, rock, meadows and other unique habitats	Water, rock, meadows and other unique habitats
Early Successional	Stand replacement fire resulting in young conifers (<25 yr. old)	Clearcuts (0-25 yr. old)
Mid Successional	Conifers (25-80 yr. old)	Clearcuts (>25 yr. old) Conifers (25-80 yr. old)
Late Successional	Mature/Old growth conifers (80+ yr. old)	Mature/Old growth conifers (80+ yr. old)*

****includes some partially harvested and salvaged stands***

Reference Condition

During the reference period, the watershed was comprised of late-successional forest with scattered patches of early to mid-successional forests that resulted from stand replacement fire (Figure 8). The patch pattern within the western half of the watershed consisted of many smaller patches in the upper slopes. Riparian forest patterns were well defined in this portion of the watershed. The eastern portion of the watershed was characterized by larger patches that were indicative of a higher severity fire regime. These burned patches included large sections of riparian forests. However, the overall pattern of late-successional forest was mostly contiguous and concentrated around more gentler and moister terrain.



	Early-Successional	Mid-Successional	Late-Successional
■ Reference	1,522	10,226	56,263
□ Current	12,323	13,064	42,624

Figure 8. Reference and current acreages of late-successional forest types within the Lower Steamboat Creek watershed.

Current Condition

Clearcut timber harvesting and road construction have significantly changed the forest landscape patterns over the last five decades. These activities began in the 1950s in response to a reported Douglas-fir bark beetle outbreak. The earliest harvest units were focused on readily accessible old-growth forest stands. These units were large and did not have riparian protection buffers. Over the next three decades, the unit sizes gradually became smaller, but still focused on the "best" old-growth (Figure 9). Riparian buffering began in the 1980s and continued into the 1990s.

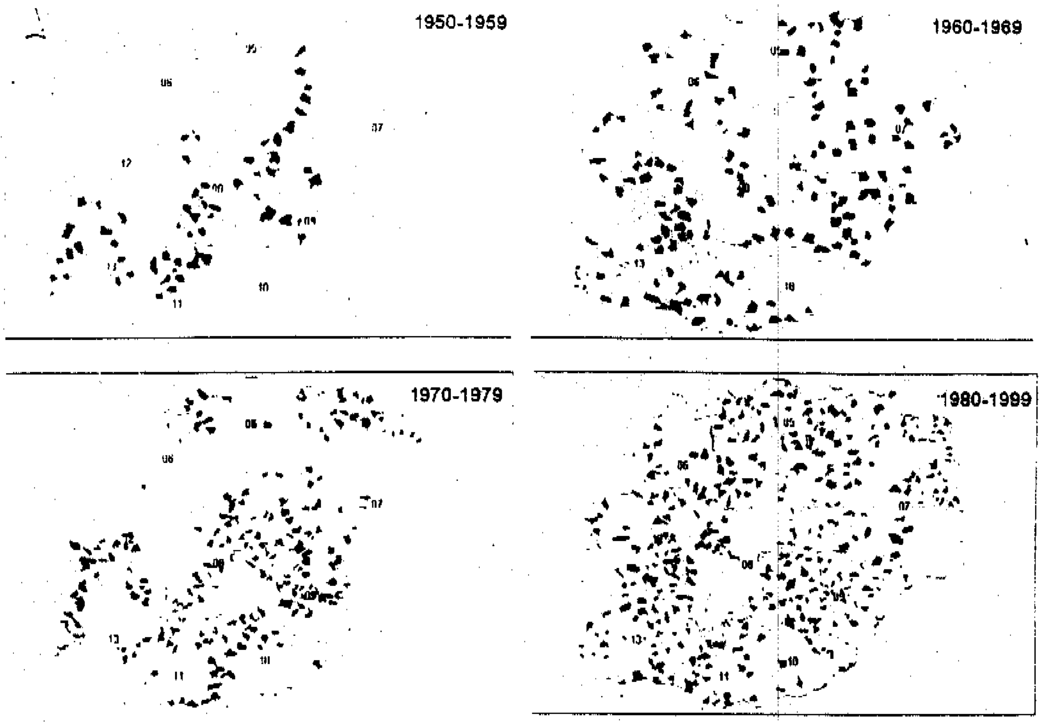


Figure 9. A decade-by-decade view of clearcut timber harvesting within the watershed.

The majority of the timber harvest was done with tractor, highlead and skyline cable systems. Harvesting was followed by an aggressive reforestation program that involved broadcast burning, planting and fertilizing. As a result, many of the plantations are monocultures of Douglas-fir, have compacted soils on the gentler slopes and are lacking a significant component of coarse woody debris. Some of the older harvest units contain cull material which is now in the later stages of decay, but these stands still lack remnant large trees and snags that will provide large wood in the future. However, some of the forest stands which were harvested as shelterwoods or retention units do have some remnant large trees and snags.

Although there has been a significant reduction in the amount of late-successional forest within the watershed, the largest impact has been from the fragmentation of the remaining late-successional habitat. The amount of edge habitat has increased dramatically due to clearcuts and road corridors, resulting in smaller, disjunct stands of late-successional forest. These remaining fragments of forest are more exposed to microclimate changes and other edge-related effects that decrease their ability to function as late-successional habitat for many species, including interior forest species. This shift in forest landscape patterns has resulted in a highly fragmented forest with a shift in the largest patches of late-successional forest occurring in the drier, less productive and more fire prone portions of the watershed.

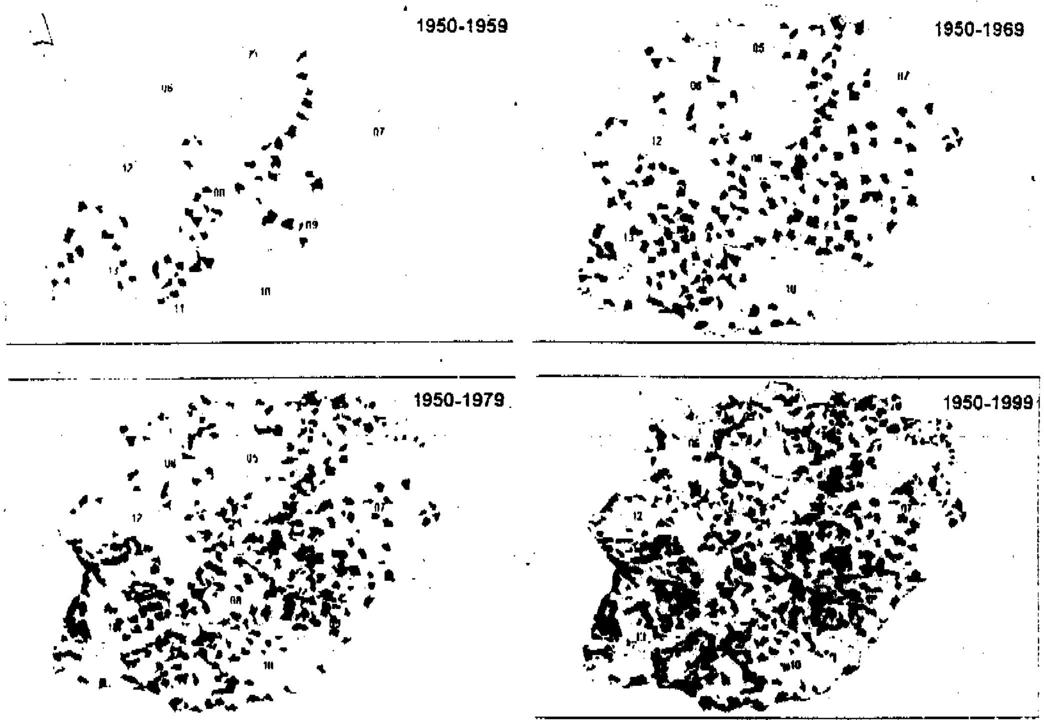


Figure 10. A cumulative view of clearcut timber harvesting within the watershed.

Another significant change has been the almost complete loss of early-successional patches with natural high amounts of coarse woody debris. In the reference condition, this landscape pattern was found as stand replacement patches that resulted from high intensity fires. This landscape component occurred in "pulses" through time and shifted across the landscape spatially. The temporal duration of this pattern was brief, lasting about three to five decades, before the snags and other coarse woody debris began to diminish to pre-fire levels. Today, the percentage of early-successional habitat has increased significantly and is different from the reference period in structure and function because of the almost total removal of large wood through timber harvesting and salvage of fire mortality. There is only 44 acres of early seral with ample CWD scattered in small patches resulting from the 1996 and 1998 wildfires. Clearcutting, fire exclusion and fire salvage are the main reasons for the loss of this landscape structure.

Desired Future Condition

The watershed is a designated Late-Successional Reserve (LSR-222) under the Northwest Forest Plan. As such, the desired future condition is to restore landscape patterns similar to those created by fire in the past. Future landscape structures would include large.

contiguous blocks of late-successional forest which form the majority of the watershed. The core areas from which these blocks would originate are the late-successional refugia areas (see following section). Within this late-successional forest, episodic events (natural or human-induced) of fire will create patches of early-successional forest with high levels of CWD. These patches will eventually redevelop into late-successional forest and new patches will occur elsewhere.

Silviculture and fire (both natural and prescribed) would be primary tools used to maintain the landscape-scale and stand-scale structure important to a functional late-successional forest ecosystem.

Late-Successional Refugia

The term "late-successional refugia" refers to areas on a landscape that are most suitable for the development and maintenance of late-successional forest habitat through time. Refugia is a relatively stable landscape feature which has disturbance regimes that differ from the surrounding landscape (Camp 1995). These areas have a low frequency of large fires, but a high severity fire disturbance pattern. Late-successional refugia can have patch sizes that can cover a large, continuous landscape. Complex vegetation interactions within the moist regime develop multi-strata structure and allow for long-term stable areas of interior forest habitat. Refugia have a close relationship to riparian forests and contain high densities of wetland habitat. Because of this, they represent the closest connection between the aquatic and terrestrial ecosystem and are important in addressing the "connectivity" aspect of functioning late-successional forests. They are also important in providing long-term maintenance of late-successional ecosystem functions such as flow regimes, water quality, and biodiversity.

Intact, functioning late-successional refugia within a watershed is important for achieving the Aquatic Conservation Strategy (ACS) objectives as outlined in the Northwest Forest Plan. Specifically, refugia relate to objectives 1, 2, 4, 6, 8 and 9 and they are a critical landscape-scale component to achieve an overall watershed restoration strategy.

Reference Condition

Approximately 38% of the watershed is capable of developing late-successional refugia. Of this, approximately 85% was forested with contiguous late-successional habitat during the reference period. The remaining 15% was a mix of early to mid-successional forest and non-forested habitats. Over time, there was a shift in the amount and continuity of late-successional refugia, with periodic large-scale decreases in acreage due to large stand replacement fires within the eastern portions of the watershed. It is estimated that when these large fires occurred, they set back succession on an estimated 3,000 acres within the refugia network.

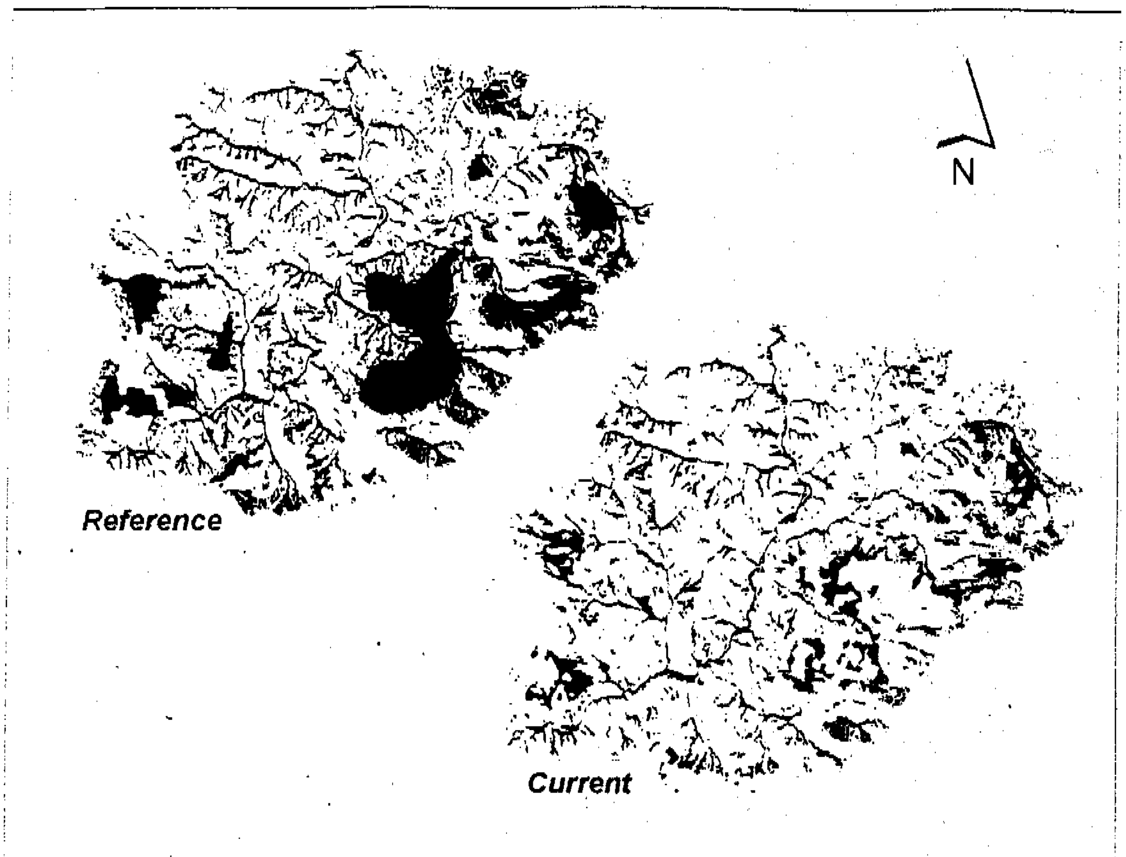


Figure 11. Reference and current conditions for late-successional refugia within the lower Steamboat Creek watershed.

Due to the infrequent occurrence of these events, these burned over stands eventually redeveloped into late-successional forests.

Current Condition

Past timber harvest has reduced the amount of late-successional refugia in the watershed over the past four decades (Table 7). The functioning network has been reduced by approximately 39% in total area and has several miles of road within it. These management-created features break up the continuity of the refugia and reduce its ability to function as interior forest habitat for terrestrial late-successional species. Much of the remaining refugia (Figure 11) is surrounded by high contrast edges which alter the microclimate within the network.

Table 7. Summary of late-successional refugia forest acreage within the watershed.

Subwatershed Name (#)	Reference Acreage of Late-Successional Refugia	Current Acreage of Late-Successional Refugia
Upper Steamboat Face (5)	1,296	905
Cedar (6)	1,472	1,100
Big Bend (7)	6,997	4,552

Subwatershed Name (#)	Reference Acreage of Late-Successional Refugia	Current Acreage of Late-Successional Refugia
Mid. Steamboat Face (8)	1,786	1,197
Reynolds (9)	4,141	1,612
Singe (10)	1,597	1,070
Deep (11)	890	385
Steelhead (12)	2,590	1,840
Low. Steamboat Face (13)	2,126	1,353
Analysis Area Totals	**22,895**	**14,014**

Desired Future Condition

The desired future condition is a late-successional refugia which extends throughout the watershed in a network similar to that in the 1940s. This network of refugia would include large contiguous blocks of late-successional forest with connection corridors devoid of dispersal barriers (e.g., even-age harvest units, roads and culverts) for late-successional dependent species.

The forest within the refugia network has multi-layered stand structure with higher amounts of coarse woody debris, large size overstory trees with dominants over 45" dbh common. Stands have a variable age class representation from 1-350+ years with high species diversity indices for tree, shrub and forb components. Overstory layers have approximately 70% crown closure and make up 70% of the basal area of the stand. These refugia forests will provide long-term maintenance of late-successional ecosystem functions such as hydrologic flow regimes, water quality, and biodiversity (e.g., amphibians). They also provide recolonization pathways for late-successional, riparian-dependent species after disturbances (human-caused or natural).

VEGETATION

The watershed is vegetated with a diverse assemblage of plants. At the broadest scale the vegetation was divided into forest zones (types, Plant Association Groups (PAGs)).

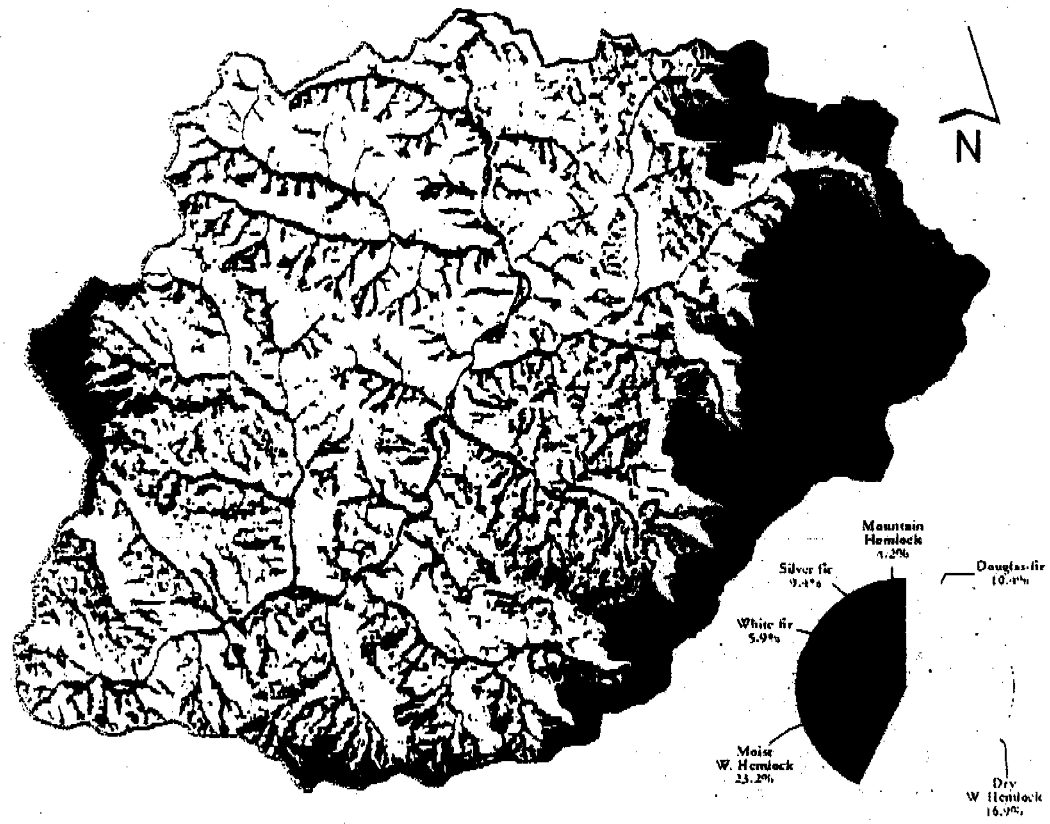


Figure 12. Map of forest zones within the watershed.

These zones were modeled and refined with plot data. The next division is along riparian corridors (streams and wetlands). Unique habitats constitute the finest scale of vegetation delineation.

Forest Zones

The watershed was mapped into six distinctly different forest zones with different ecological and management values (Figure 12). Differences between the zones are tied to abiotic and topographic variations across the landscape resulting in different assemblages of plant species and stand structure. The differences are created by growth and decay patterns and the natural disturbance regime associated with the underlying abiotic conditions of each zone such as climate, soils and topography.

Reference Conditions

Forest zones were mapped using a topographic moisture model, elevation and plot data. Refer to Appendix B for a description of the mapping process.

Douglas-fir - Occurs on the upper slopes, ridges and convex land forms usually with steep gradients and southerly aspects. Plant association diversity is relatively low.

Most of the plants that occur are adapted to drier conditions. Douglas-fir dominates the stands. Common associates are incense cedar, sugar pine and less commonly, white fir. Western hemlock and western redcedar are uncommon and mostly absent. Madrone and chinquapin are the dominant hardwood species. Other hardwoods found in this zone include live oak and isolated pockets of Oregon white oak. The shrub layer is usually sparse.

This zone is closely tied to fire disturbances. Fire occurs frequently but is normally of low to moderate severity with small pockets of high severity fire occurring in areas with high fuel loading. Because of harsher growing conditions, these areas are slower to revegetate after disturbances. This lack of ground cover exposes the soil to more erosion through time. The result is a zone with shallow, "young" and relatively unproductive soils that produce less biomass and smaller diameter trees.

Based on a summary of old-growth characteristics from Douglas-fir plots (Fierst et al. 1992), the average old-growth stand in these zones is two-storied and about 200 years in age with approximately 8-10 trees/acre ranging in diameter from 24-37 inches. High quality late-successional habitat characteristics can be achieved in this zone similar to those found in moister forest zones; however, they are usually achieved more slowly by as much as 50 years (Agee and Edmonds 1991).

<u>Dry Western Hemlock Zone</u> - The most common zone within the watershed. Douglas-fir is the dominant tree species with scattered incense cedar, sugar pine, western white pine, Pacific yew and western redcedar. Western hemlock dominates the understory tree layers and is the climax tree species. Fire occurs frequently in this zone and behaves similarly to that in the Douglas-fir zone. Fuel concentrations are more common in this zone however, due to less harsh growing conditions and may result in more widespread stand replacement patches. Ground fires occur with enough frequency to usually prevent western hemlock from becoming the dominant overstory tree. Thus, it is more common for mature stands to be dominated by large, old Douglas-fir that can persist for centuries. However, overstory dominance is sometimes shared between Douglas-fir and western hemlock (Huff 1984). This zone has the highest plant diversity, exhibiting hardwood species seen in both the Douglas-fir and moist western hemlock zones.

Based on a summary of old-growth characteristics from site class 3-5 western hemlock plots (Fierst et al. 1992), the average stand is two-storied and about 200 years in age with approximately eight trees/acre ranging in diameter from 21-31 inches.

<u>Moist Western Hemlock Zone</u> - These portions of the watershed encompass the moister, low elevation environments. There is a strong association with riparian influences, earth flow terrain and late-successional refugia. The topography is mostly gentle, with northerly aspects and undulating to concave in form. In this zone, western hemlock is expected to become the dominant tree species, given the opportunity to achieve a long-term stable state. The major conifer species in this zone are Douglas-fir, western hemlock and western redcedar. Minor conifer species include Pacific yew, white fir and sugar pine. Hardwoods include the bigleaf maple and red alder. The shrub and herbaceous layers are diverse with species such as vine maple, willow, dogwood, rushes, sedges and grasses. The zone is highly productive and produces a considerable amount of biomass, including large diameter trees.

The productive nature of this zone also creates high amounts of fuel, and fire is common in this zone, however it usually is of low severity. Ground fires are the norm. However, during periods of extreme dry and/or windy weather, this zone can experience high severity fires over large areas.

Based on a summary of old-growth characteristics from high site class (1-2) western hemlock plots (Fierst et al. 1992), the average stand is multi-storied and about 200 years in age with approximately eight trees/acre ranging in diameter from 35-42 inches.

True Fir Zone - Occurs above 4,000 feet. White fir seems to be more common in the cooler, drier areas. Under a natural fire disturbance regime, Douglas-fir will usually dominate the overstory, however with the lack of fire, white fir will become the climax species. The major conifer species in this zone are Douglas-fir and white fir (especially in the understory). Minor conifer species include western hemlock, incense-cedar, western white pine, Pacific silver fir, Shasta red fir and mountain hemlock. Hardwoods include golden chinquapin in the drier areas, with alder and bigleaf maple in the moister sites. The shrub and herbaceous layers include species like vine maple, dwarf Oregon-grape and commons prince's-pine.

In the more humid areas with moderate temperatures, short growing seasons and a late summer dry season the dominant climax tree species is Pacific silver fir, but it commonly shares dominance with western hemlock, mountain hemlock, Shasta red fir and white fir. It can produce pure stands in moister localities. Other associates include western white pine, Douglas-fir, incense-cedar and western redcedar. The true fir is generally a very diverse zone for tree species. Shrub and forb species include thin-leaf huckleberry, dwarf Oregon-grape, Pacific blackberry and common prince's pine. Snow accumulation is high in this zone and provides moisture well in to the dry season. The zone is characterized by a high occurrence of lightning started fires that commonly burn as low intensity ground fires. Infrequent higher intensity fires can occur in this zone during extended hot and dry climatic conditions.

Based on a summary of old-growth characteristics from white fir plots taken in Central Oregon (Fierst et al. 1992), the average old-growth stand is two-storied and about 150 years in age with approximately 10-20 trees/acre averaging in a diameter of 21 inches. For Pacific silver fir, the average old-growth stand is two-storied and about 190 years in age with approximately 6-7 trees/acre averaging in a diameter of 25 inches.

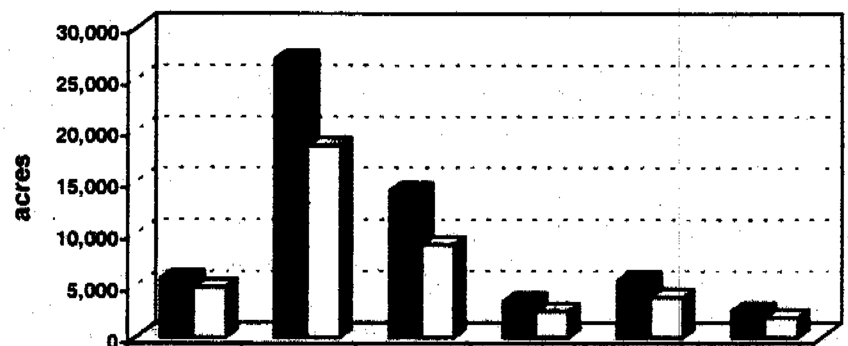
Mountain Hemlock Zone - This zone occurs in the eastern portions of the watershed along the Calapooya Mountain ridge, which extends from the Cascade crest to Bohemia Mountain. It occurs in scattered pockets in the highest elevations of the watershed in cold/moist-wet areas. It is a small, but unique component of the watershed (approximately 4.2% of the total area). Mountain hemlock is considered a late-successional or climax species (Atzet and McCrimmon 1990); however, the vegetative structure differs significantly enough to make it less suitable for some late-successional species found in the lower elevations (e.g., the northern spotted owl).

Stands are dominated by mountain hemlock, while Shasta red fir, Pacific silver fir and western white pine are common. Douglas-fir, western hemlock, white fir and incense-cedar are scattered throughout. Stand structure and vegetative diversity is low in this zone. The shrub layer is minor in many places and includes common prince's pine and thin-leaf huckleberry. Snow accumulation is high in this zone providing a very moist and cool environment.

Lightning caused fire occurs relatively frequently in this zone, but fire intensity and extent is limited by low fuel loading, high moisture and cool temperatures during the fire season. However, periodic high severity fires of large extents do occur and tend to be stand replacing when the climatic conditions are extremely hot, dry or windy (Atzet 1990).

Current Conditions

Clearcut timber harvesting and road construction have changed the spatial distribution of forest zones over the last five decades (Figure 13). The biggest change has been the reduction of the amount of late-successional forest in the western hemlock zones. Late-successional habitat within the other forest zones has decreased to a lesser degree.



	Douglas-fir	Dry W. Hemlock	Moist W. Hemlock	White fir	Silver Fir	Mountain Hemlock
■ Reference	5,681	27,051	14,143	3,488	5,522	2,555
□ Current	4,844	18,514	8,918	2,474	3,885	1,896

Figure 13. Reference and current acreages of late-successional forest types within the Lower Steamboat Creek watershed.

This shift in forest vegetation patterns has reduced the amount of forest which experiences less frequent high intensity fires, while leaving the more fire-prone drier forest zones (e.g., Douglas-fir zone) more intact. This, combined with the effects of fire exclusion, has likely put the watershed at a higher risk for high intensity fires. Effects to species that require moist, late-successional habitat has been greater compared to the effects on species that can survive in the hotter, drier forest environments.

As a result of intensive forestry practices, the forest stand composition has been skewed predominantly towards Douglas-fir in areas that historically supported multi-species mixing of conifers and hardwoods. Stand density records indicate that a high percentage of plantations have uniformly overstocked areas which will impact future growth and the development of late-successional tree and stand characteristics. Structurally unstable conifers are developing in densely-stocked, even-aged stands of Douglas-fir where precommercial thinning has been delayed.

Riparian Forests

Riparian areas are particularly dynamic portions of the landscape. They are shaped by disturbances characteristic of upland terrestrial systems, such as fire, insect and disease and windthrow, but also affected by disturbance processes unique to stream systems such as lateral channel erosion, peak flows, deposition by floods and debris flows. These disturbances provide important ecological processes and maintain the riparian forest in a variety of conditions.

Riparian forests contribute to the health of the aquatic ecosystem by stabilizing stream banks, providing large woody material for complexity and cover for aquatic organisms, providing shade, flow of nutrients, leaf and litter fall and delivering sediment to the stream channel (LSRA 1998). These functions are related to riparian vegetation, soil type, water quantity, and natural disturbances (LSRA 1998). Riparian forests provide an important linkage between the terrestrial and aquatic environments.

Reference Condition

During the reference period, the riparian forest was an all-aged forest of conifers and hardwoods that supported a complex and diverse structure and composition of tree types and sizes. The composition of cover included coniferous species such as Douglas-fir, western hemlock, western redcedar, Pacific yew and true firs, along with deciduous species such as bigleaf maple, western dogwood, red alder, and Oregon-ash. Historically, a large portion of the riparian area supported late-successional forests with conifers comprising 70-80% of the cover, while hardwoods provided 20-30% of the riparian canopy cover. Headwall areas within intermittent streams may have had 85-95% conifer cover and 5-15% hardwood cover.

Fire along the larger Class I and II streams was infrequent and usually of low intensities. This resulted in contiguous stringers of riparian forests in a late-successional condition. These contiguous late-successional riparian forests served as dispersal corridors of the late-successional refugia network and are important for long term survival of many plant and animal species. Riparian forests along class III and IV streams burned with more frequency and intensity than those along the larger streams. Wildfires occasionally burned large portions of riparian forests at high, stand replacement intensities. These wildfires often occurred during an abnormal period of dryness, although not necessarily under drought conditions.

After the fire, riparian vegetation was able to respond through fire induced epicormic sprouting. This occurs when the dormant buds that are located on trunks and large branches are stimulated to grow as a result of fire-induced mortality of existing foliage. This phenomenon exists for many broad-leaved shrubs and hardwoods in the Pacific Northwest (Walstad 1990). Fire in the reference condition acted as an agent to promote new growth in these hardwoods. Similar results occur within the conifer stands where ecosystems are characterized by low intensity fires and often require mineral seedbeds in which to germinate. In pine and mixed-conifer forests of the Pacific Northwest, frequent fires create openings with bare mineral soil exposed that facilitate establishment of species such as ponderosa pine, sugar pine, and Douglas-fir (Walstad 1990). Fire suppression or infrequent fires will decrease the abundance of pines and favor species such as true firs and incense-cedar (Hall 1977; Thomas and Agee 1986).

Current Condition

Riparian forests were clearcut harvested without reserve trees from the 1950s up until the 1980s. Since that time, buffer strips of trees have been left next to many of the perennial streams in the watershed. However, the buffer strips were generally only 1-2 trees wide along the length the stream. Full riparian buffers were not supported or utilized until the Northwest Forest Plan was developed (e.g., Riparian Reserves). Road construction has also fragmented Riparian Reserves, impacting the flow of animals and plants across the landscape.

Thirty-two percent of the riparian areas within the watershed support early to mid seral stands as a result of harvesting through the riparian areas. Currently, Riparian Reserves are fragmented throughout the landscape with large blocks of late-seral forest removed from the lower and middle reaches of main tributaries. Clearcut harvesting created young plantations along stream reaches that are now growing even-aged stands of Douglas-fir. These stands are on trajectories for growth and yield and not diversity and function.

Changes in forest structure and species diversity have occurred over the landscape. Plant composition has been altered within the high fire frequency Riparian Reserves to more fire intolerant species. Class III and IV streams that currently support late seral stands prone to fire can be expected to burn with moderate to high intensities. Diversity of conifer, hardwood and shrub cover is lacking in many stream reaches and structural diversity of age classes will be delayed for 60-80 years without a disturbance event.

Fuel loadings after harvest were extremely high (> 70 tons per acre). Until the 1980s, cull logs were left in the unit. Prescribed fire for site preparation and hazard reduction was complete with little regard to retaining down woody material and cull logs were burned on site. The result is levels of coarse wood in Riparian Reserves below the range of natural variability and snags are missing from young stands. In addition, the high fuel loading created very high intensity burns and extended residence time for flames. This often increased soil temperatures to a point of sterilization.

Wildfire has played a significant role in the shaping of riparian forests through history. Exclusion of fire from these areas, particularly in the steeper tributaries is unnatural. Sedell and Swanson (1984) suggest that even where fires did burn across riparian areas, the remaining structural influence of the forest from snags and large woody debris in the stream served to minimize sedimentation and hasten recovery of disturbed stream areas. Compared to historic or modern-day wildfires, prescribed burns are generally much less severe and much smaller in aerial extent; hence, the impacts on fish populations can be expected to be much less severe as well (Walstad 1990).

Desired Future Condition

The desired future condition would be restored corridors of healthy riparian forests both in species composition and structural diversity of plant communities. These riparian areas would provide adequate summer and winter thermal regulation, nutrient filtering, more natural rates of surface erosion, bank erosion, and channel migration.

Prescribed fire would be used to supply amounts and distributions of coarse woody debris and snags sufficient to sustain physical complexity and stability. Fire or mechanical treatments would be used to place young managed stands on a trajectory where large size overstory trees with dominants over 36"dbh are common and age class representation is from 1-450+ years. Early seral vegetation along stream reaches would be limited to less than 15% of any given tributary length.

Unique Habitats

Unique habitats refer to natural meadows, wetlands, ponds, rock outcrops, cliffs and caves (Figure 14). These habitats are usually small inclusions within the forest. They provide ecological diversity and are important forest components that contribute to the diversity and productivity of the ecosystem. In spite of their small size, unique habitats are heavily utilized by many species and are home to many rare and sensitive plant species.

Reference Condition

There are numerous unique habitats within the watershed. The highest density seems to occur within the eastern portion of the watershed near the Calapooya Divide, a main travel corridor for the aboriginal inhabitants. The ethnographic information within the watershed suggests that the Klamath, Mollala, and Umpqua tribes used unique habitats for campsites, hunting and gathering. It is highly probable that these people utilized fire to maintain and enhance their gathering and foraging grounds.

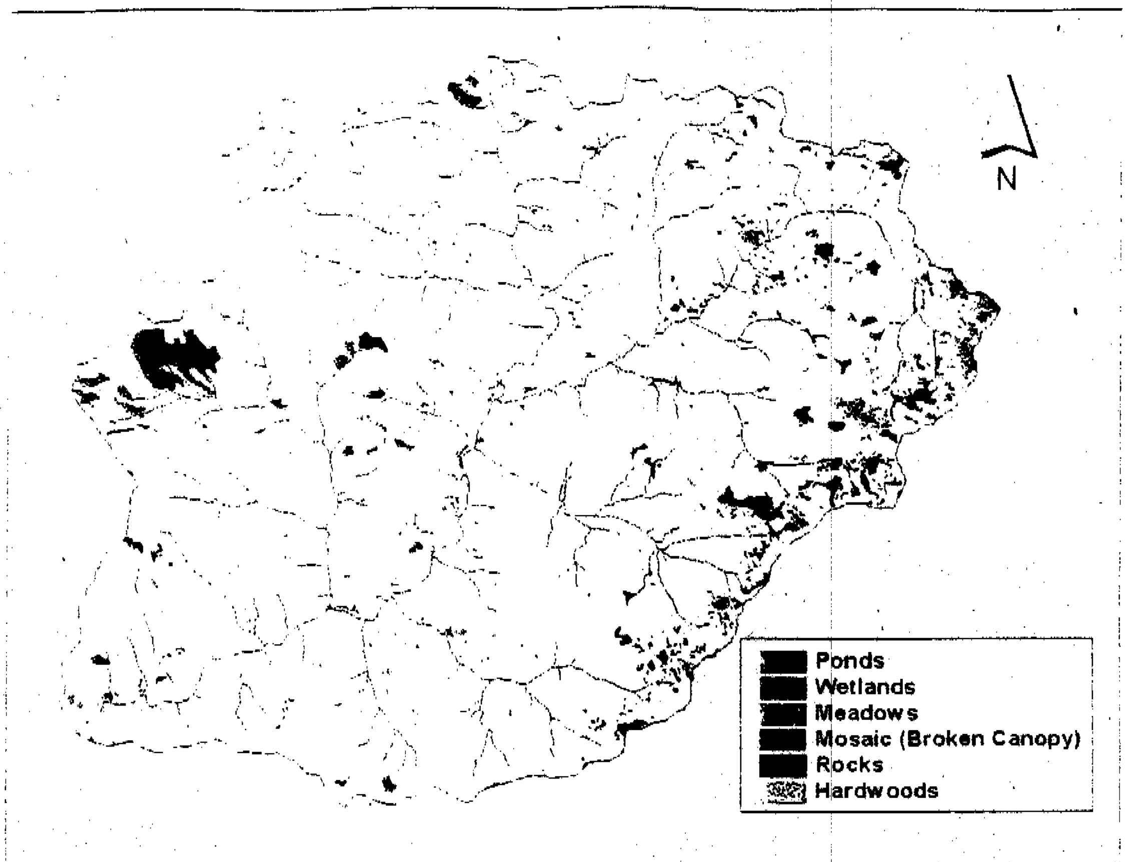


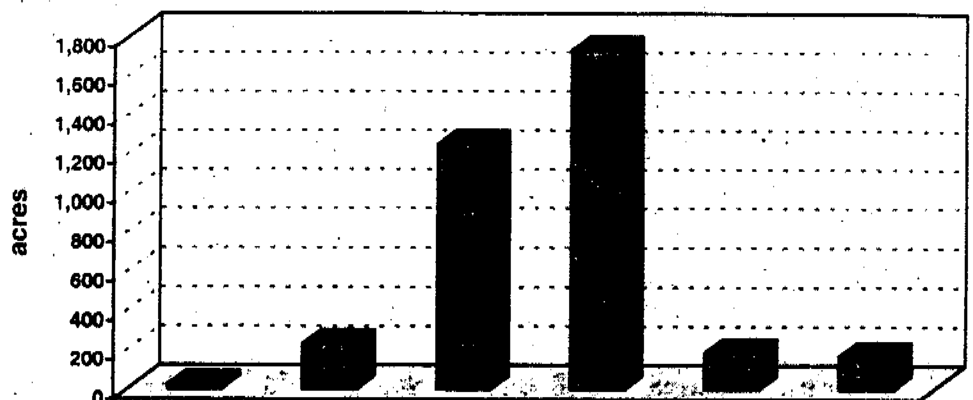
Figure 14. Unique habitats within the lower Steamboat Creek watershed.

The interaction and dependence on fire within these ecosystems varied. As mentioned before, fire-induced epicormic sprouting served to promote new growth of hardwoods, especially white oak. Meadows have predominately three environmental factors affecting their vegetation composition and size: fire interaction, water table level and geology. The dry meadows carried predominately brush and grass species with a mix of forbs. Fire is more important to these areas for maintenance of opening size. Wetlands (including wet meadows) historically were home for numerous species. Fire played a minor role in maintaining their size with low to moderate intensity burns sporadically interacting when dry climactic conditions persisted.

The presence of livestock grazing began as early as 1902. Sheep grazing was intense in the general vicinity during the early part of the century. Cows were grazed in the area as early as the 1920's. This activity aided in maintaining openings, however, species composition may have been limited because of introduction of non-natives or noxious species. Many species of sensitive plants are found in unique habitats. Of the thirty-seven sensitive plant species suspected to occur on the North Umpqua Ranger District, most are likely to be found on unique habitats.

Current Condition

There are a total of 1,880 mapped unique habitats within the watershed analysis area for a total of 3,602 acres (Figure 15). The majority of these unique habitats are meadows and mosaic areas of large trees and meadows. Wetlands and rocky outcrops are also important unique habitats.



	Ponds	Wetlands	Meadows	Mosaic	Rocks	Hardwood
Total Acres	21	234	1,252	1,734	190	171

Figure 15. Acres of Unique Habitats in the Lower Steamboat Creek watershed.

The highest density of unique habitat occurs in the true-fir and mountain hemlock zones in the eastern portions of the watershed.

There are a total of 100 inventoried wetlands (National Wetlands Inventory – USFWS) within the watershed. Most of these wetlands (66%) also occur in the true fir and mountain hemlock zones. When compared to the topographic moisture model, most wetlands fall within the moist zones (87%) and all occur within moderate to moist zones.

A total of 22 ponds were mapped in the watershed, ranging from 0.1 to 5.3 acres in size. The largest ponds (≥ 3 acres surface area) are currently stocked with non-native fish for recreational use. These ponds include Bullpup, Fuller (which are natural ponds) and Beaver Pond (a man-made pond). Beaver pond was a wet marsh/meadow during the reference period and was dammed to create the pond. A species of pond snail, not found in smaller natural ponds, occurs in high densities within Beaver Pond. Pond snails have been documented as intermediate hosts for a parasitic trematode associated with deformities in amphibians.

Wet meadows occupy 141 acres and are exclusive to the eastern portion of the analysis area. The wet meadows still carry numerous willow species along with common camas, wild ginger, glacier lily and a wide variety of native orchids. The meadows are experiencing some encroachment from conifer species. This appears to be a slow successional process that historically may have been kept in check with fire interaction in conjunction with water table and soil conditions.

The watershed has 1251 acres of dry meadows. Most of these meadows (over 80%) are located along the eastern boundary of the watershed. The dry meadows are experiencing more aggressive encroachment from conifers in neighboring stands. The role fire played in maintaining these openings and species mix has been eliminated in the current condition. These are the unique habitats with the greatest potential for loss of opening size and species diversity due to a lack of fire. Species present in these sites include common camas, beargrass, wild iris, and a host of native grasses and forbs.

Rock outcrops are dispersed throughout the area. The rock outcrops are potential habitat for mosses, lichens and bryophytes. These sites are not dependent on disturbance and remain edaphic in nature.

Grazing allotments were established on what is now considered the unique habitats identified in the eastern portion of the watershed. The Bristow Prairie allotment ran three pastures at 150 AUMs and was active from the early 1960s to 1992. At that time the permittee ceased using the allotment. This allotment encompassed unique habitats as far south a Horse Prairie and north to Ranger Prairie. Grazing, along with timber harvest, may have played an important role in maintaining opening size by limiting tree encroachment. It is also very likely that non-native and noxious plant species were introduced to these habitat areas at the same time.

Harvest activity occurred on or near unique habitats from 1960 through 1990. The 1990 revision of the Umpqua National Forest Land and Resource Management Plan provided buffers for unique habitats. Fire suppression policies as they are implemented today limit fire's natural role in unique habitats.

Desired Future Condition

The reintroduction of fire through the use of management ignited prescribed fire is desired in the future. Prescribed fire will be applied in the future based on acquired knowledge that certain species and habitats are at risk due to the lack of fire. Wildfires will be managed to take advantage of fire's ecological role in certain unique habitats.

Native, Sensitive and Survey and Manage Plants

Reference Condition

In the reference condition, native species (including those that are presently listed as threatened, endangered, sensitive, survey and manage, or protection buffer) would have been represented across the landscape and had populations that were considered stable. Impacts to plant species prior to European settlement were likely caused by changes in habitat influenced by events such as fire, flood, or climate fluctuations. These natural events prepared seed beds for native species, with dispersal likely occurring through wind, water or animals.

European settlement brought with it the loss of habitat due to establishment of farms and communities. Clearing land to plant crops and cutting timber to build structures had the greatest impacts to plant habitats. The settlers also brought non-native plant materials into the watershed, either as crops, ornamentals or incidentally (seed sources that occurred in or on other plant materials). Over time, some of these plant species displaced native vegetation. These non-native plant species usually lacked predators and natural pathogens, easily filled their habitat needs, and had an unrestricted ability to reproduce.

Current Condition

The watershed remains relatively unexplored for threatened, endangered, and sensitive plants. Currently, eleven sites representing six sensitive plant species are known to occur within the watershed (Table 8).

Table 8. Sensitive plant species and their suspected habitats.

Common Name	Scientific Name	Suspected Habitat
Grass-fern or Forked Spleenwort	*Asplenium septentrionale*	General Forest, Rocky Openings
Woodland Milkvetch	*Astragalus umbraticus*	General Forest
Mount Mazama Collomia	*Collomia mazama*	General Forest
Siskiyou Fritillaria	*Fritillaria glauca*	Rocky Openings, Alpine/Sub-alpine
Thompson's Mistmaiden	*Romanzoffia thompsonii*	Rocky Openings
Columbia Lewisia	*Lewisia columbiana* var. *columbiana*	Rocky Openings
Umpqua Kalmiopsis	*Kalmiopsis fragrens*	Rocky Openings

No federally Threatened or Endangered plant species are known to occur in the area. Prior to 1990, records were not kept on surveys for sensitive plants. Since 1990, less than one percent of the watershed has been surveyed. The staff of the Douglas County Museum Herbarium (with the assistance of the Roseburg chapter of the Native Plant Society of Oregon) have conducted plant surveys in the lower Steamboat Creek watershed for many years. They have kept a composite list of vascular plant species for ten survey sites in the area.

The Northwest Forest Plan requires protection of certain vascular and non-vascular species that may not be protected by other standards and guidelines. The objective in performing Survey and Manage (SM) and Protection Buffer (PB) surveys is to acquire additional information about habitat, abundance, and distribution of the identified species. These species are most commonly associated with late-successional, old-growth and riparian habitats. Information is essential to determine the level of protection necessary for these plants and their habitats.

Five survey strategies were outlined in the Northwest Forest Plan with guidelines for doing surveys (ROD page C-49). Implementation of these strategies has been in affect for less than a year. Roseburg Bureau of Land Management (BLM) personnel have been surveying on lands adjacent to the Steamboat watershed and have found 10 different species at 20 sites (Table 9). It can be assumed that some of these species also exist in the watershed.

Table 9. Survey and Manage and Protection Buffer species known to occur within or adjacent to analysis area.

Scientific Name	Within the Watershed	Adjacent Watersheds
Buxbaumia piperi	0	1
Buxbaumia viridis	1	3
Lobaria oregana	1	2
Lobaria pulmonaria	3	0
Lobaria scrobiculata	1	0
Nephroma helveticum	0	1
Nephroma occultum	0	4
Allotropa virgata	3	4
Pannaria saubinetii	2	0
Peltigera collina	2	0
Psuedocyphellaria anthrapsis	2	3
Psuedocyphellaria anomala	3	0
Psuedocyphellaria rainerensis	0	1
Ptilidium californicum	2	1
Ulota megalospora	2	1

Protocols for fungi have not been completed, so no surveys have been conducted. A schedule to begin fungi surveys needs to be considered for the near future.

Desired Future Condition

Known populations of TES species within the watershed are found primarily in general forest areas. In the future, more knowledge will exist on population trends and habitat requirements of rare species. Plant populations and their habitats will be managed to maintain stable populations across the watershed.

Non-Native Plants and Revegetation

Reference Condition

The introduction of non-native species has been going on at a rapid rate on the North American continent since European people began to arrive. These non-native plant species have been removed from their natural environment and are lacking predators and natural pathogens. Some of the non-native plants introduced during the reference period are considered "noxious weeds". The Oregon Department of Agriculture (ODA) defines these as plants that are "injurious to public health, agriculture, recreation, wildlife, or any public or private property". The ODA determines which species will legally be considered "noxious" in the state of Oregon

Current Condition

Many non-native species thrive in areas disturbed by management activities such as timber harvest, rock pits, road stormproofing and road decommissioning. Fire suppression has reduced introduction of non-natives into large tracts that may have once burned. Very little of the watershed has not been invaded by one or more aggressive non-native species. Non-native species spread rapidly, easily displacing native plants and organisms that depend on them. The exact extent of such species in the watershed is unknown. Non-native plants impact native and rare plants by causing physical displacement, changes in microclimates, out competing native species for nutrients, water and light and by interrupting crucial relationships with other species. The extent of damage to the native and rare plant populations is not known. However, based on observed situations, it is reasonable to assume the trend has been negative.

Noxious weed species that are known to occur in the watershed are listed in Table 10. They are spreading rapidly. Even with repeated treatment of known sites, occurrences are expected to increase due to the movement of seed into the area from outside sources and by perpetuation of seed production on private land. Meadow knapweed, widely used in the early 1960's by the Forest Service for roadside erosion control, is a slow moving, but aggressive colonizer that has become so widespread that eradication of the population is unlikely.

Table 10. Noxious weeds known to occur in the analysis area.

Common Name	Scientific Name	ODA Noxious Weed List
Bull Thistle	*Cirsium vulgare*	B
Canada Thistle	*Cirsium arvense*	B
Meadow Knapweed	*Centaurea pratensis*	B
Tansy Ragwort	*Senecio jacobaea*	B
Gorse	*Ulex europaeus*	B
Scotch Broom	*Cytisus scoparius*	B

From May - August of 1998, Forest Service roads within portions of the watershed were surveyed for the presence of populations of Scotch broom. Areas of infestations were mapped and small populations were pulled. This plant has demonstrated an ability to change patterns of succession. It dominates disturbed sites and forms dense thickets that exclude other species from becoming established. It contains highly flammable oils, is very fire prone, and burns intensely. The plants produce copious amounts of seed that can lay dormant in the soil for decades, then sprout quickly after fire, producing yet another brush field and precluding the establishment of native species.

Legal mandates are provided to deal with noxious weeds (Appendix H). Policy on public lands toward these species is consistent with State regulations. The Umpqua National Forest has issued a list of noxious species of concern and provided direction to help prevent the introduction and establishment of new infestations. A Draft Integrated Weed Management Environmental Assessment exists that addresses efforts to manage noxious weeds on the Forest. This draft includes the Forest noxious weed list, prevention measures, and recommendations for specific sites on the Forest (Appendix H). At the Regional level, the Forest Service and BLM have a Memorandum of Understanding with the Oregon Department of Agriculture (ODA) to work jointly to prevent the spread of noxious weeds.

Besides those plants listed as "noxious", there are many other aggressive non-native species that are compromising the ecology of the area and may threaten native communities. For the most part, they are pioneer species that occupy disturbed areas in great numbers. In some cases the invasive ability of these plants rivals those listed as noxious, but they are either so firmly established that eradication efforts have not been useful, or their ecological threat has not been recognized. Three of the species of particular concern on the North Umpqua Ranger District are cat's ear, dogtail hedgehog grass, and ox-eye daisy. All of these species spread by windborne seeds, easily dominating disturbed sites. They are commonly transported in surface gravel for roads. Ox-eye daisy also increases itself by rooting from the stems. Dogtail hedgehog grass is quite likely the most common grass species in the watershed. None of these species is easily eradicated.

Other indirect impacts have likely occurred from the non-native plant invasion. For example, impacts to insects involved in pollination. Native plant species have established varied and particular relationships with native pollinators. Non-native encroachment may cause displacement or loss of pollinators. Orchids may be particularly at risk, since they often are dependent on single pollinators. Another example of an indirect effect is the affect non-natives have on vegetation structure and food production for wildlife. These changes are not necessarily all negative. For example, Himalayan blackberry provides extensive habitat and food for certain species. The net loss or gain to wildlife from occupation of non-native species in the Lower Steamboat watershed has not been determined, but there is potential for the impact to be negative.

While not currently found in the watershed analysis area, another species that have the potential to impact wildlife is purple loosestrife, which rapidly colonizes wet areas through both seed dispersal and rooting stems. It forms dense thickets crowding out native plants and animals. Purple loosestrife does not provide food, nesting structure or useful cover for wildlife; it displaces many species; and it disrupts the ecological functions of the area it invades.

Past and current revegetation efforts are designed to control erosion and to prevent colonization by highly aggressive, non-desirable plant species where soil has been disturbed. However, aggressive non-native plant species were used in past revegetation efforts. While the immediate benefit of stabilizing the soil is obvious, no long term monitoring has been conducted to determine the effects of the introduction of these species. Planting of herbaceous vegetation has also been undertaken for big game forage production. As long as large populations of elk are desired in the forested areas of Lower Steamboat, this will continue. However, native species may be capable of filling this need.

Arguments are often made that non-native species will die out over time as the vegetation moves from open clearcuts to forested conditions. To some extent this is true. Pioneer plant population's decline in shaded conditions provided by tightly growing trees. How this disruption of early seral processes effects the long-term viability of native pioneer plants and the creatures that depend on them is unknown. The extent of the detrimental effect on the composition of later seral herbaceous communities is, for the most part, also unknown.

Desired Future Condition

In the future, management will limit further spread of non-native plant species. By far the simplest and least expensive means of control will be prevention. An increased awareness and emphasis on the part of land managers will exist, allowing the public and agency personnel to identify and avoid spreading weeds.

Coarse Woody Debris

The term "coarse woody debris" (CWD) refers to snags, fallen trees, large limbs and branches that occur naturally in all forests. It is a major structural component, provides habitat for many species and is necessary for the proper functioning of the forest ecosystem. Levels of CWD across a watershed are affected by several processes including tree growth, tree mortality, fire, wind, insects, disease and decomposition. Site productivity, or the ability of the ground to produce biomass, is also a critical factor which influences watershed levels of CWD through time. Understanding the role of fire within the watershed is crucial for understanding the dynamics of CWD both within the stand as well as at the landscape scale.

Recent forest management in the Pacific Northwest has focused on late-successional and old-growth forest habitat, of which CWD is a critical structural component. Where CWD dominates the forest structure immediately after a stand replacement fire may be as important to the functioning of a healthy forest ecosystem as a large, contiguous stand of old-growth.

Reference Condition

For this analysis, the reference condition of CWD will be defined in the broad terms of the reference fire regime within the watershed and site conditions relating to site productivity as referenced in previous discussions. Large pulses of dead trees were created by wildfire at varying frequencies and spatial extent through time (Table 11).

Table 11. Estimated ranges by percentage of land area for landscape structures within the analysis area during the reference period.

Structure Stage	Percent of Wshd	CWD Component
Late Successional	60-80%	*Most Diversity* – Spatially heterogeneous based on topographic location and disturbance history.
Mid Successional	10-15%	*Low Levels* - Most of the CWD recruited by the fire has decomposed and the stand is not incurring much mortality
Early Successional (High CWD)	2-6%	*Highest Levels* - Most or all of the trees have been killed by fire and remain as snags or logs
Early Successional (Low CWD)	5%	*Low Levels* - These are reburns of early to mid-successional habitat where most CWD is consumed or decomposes quickly

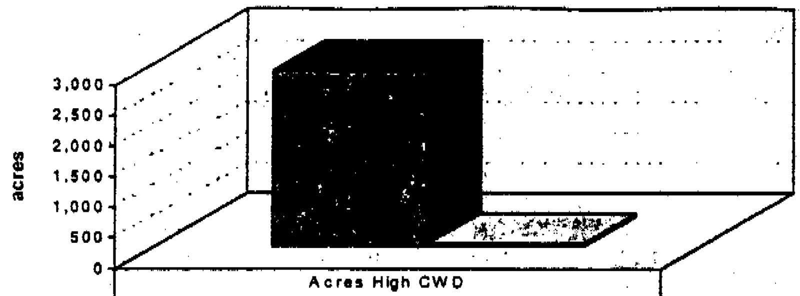
At a finer scale, levels of CWD within late-successional forest varied with the occurrence of blowdown or snowdown events, suppression mortality, natural tree mortality, insect and disease mortality and the more frequent occurrence of small fires. Plot inventory data (Appendix B) within current late-successional habitat was used to characterize CWD levels within late-successional forests.

Current Condition

Through landscape analyses, it has been shown that the remaining late-successional/old growth forest habitat within the watershed is below the reference range. What remains is highly fragmented. Thus, there are associated impacts on the spatial distribution of CWD across the watershed within this forest structure.

Today, the watershed contains less acreage of late-successional forest, more mid-successional forest and more early-successional forest (low CWD). The early-successional forests of today are very different from the reference conditions in that they are mostly devoid of dead trees as snags and down wood. Large woody material is largely absent from the forest floor in many of the units clearcut after 1970 and snags of all sizes and classes are missing from harvest units throughout the basin.

The watershed is highly deficit of the "early-successional (High CWD)" landscape-scale forest component. Today, a total of approximately 44 acres of this type of habitat occurs in small patches scattered throughout the watershed as a result of the 1996 and 1998 wildfires (Figure 16).



	Acres High CWD
■ Reference	2,860
□ Current	44

Figure 16. Reference and current conditions of early-successional landscape-scale features with high levels of CWD.

Managing pulses of CWD is critical. Areas with high densities of snags and logs are rare due to aggressive fire suppression. When pulses do occur, there is a high emphasis put on salvaging the dead or dying trees. In the past, most pulses were quickly eliminated through timber salvage sales. Having scattered periodic pulses of CWD within a watershed is necessary for maintaining proper forest ecosystem functioning.

Desired Future Condition

The desired future condition would be restored landscape-scale patterns caused by stand replacement fires within the watershed. These landscape components would occur as pulses through time. Patch sizes would reflect the size and spatial arrangement consistent with the underlying fire regimes. Within the late-successional forest, episodic small-scale disturbances would create smaller patches of CWD. Coarse woody debris deficits would be restored via recruitment through natural stand development processes.

Fire and post-fire management would be the primary tools used to achieve the desired future condition. Silviculture would also be used in shaping the development of future CWD at the stand-scale.

WILDLIFE

Northern Spotted Owl

The spotted owl is a Federally listed "Threatened" species and is protected by the Endangered Species Act. Spotted owls are strongly associated with late-successional and old-growth coniferous forests (Forsman et al. 1984, Hunter et al. 1995) below 5,000 feet elevation (on the Umpqua National Forest). The presence and amount of structural complexity within these forests is important to spotted owl occupancy. Key structural characteristics include the presence of large snags or live trees with broken tops, large branches or cavities for nesting. A multi-layered closed canopy is important to allow for thermal regulation and protection from predation during roosting and foraging. Adequate amounts of coarse woody material on the forest floor are also important to support populations of prey species.

Current research indicates that large contiguous blocks of this habitat are required for nesting success and survival (Thomas et al. 1990, Ripple et al. 1991). Within the southern Cascades, a circle with a 1.2 mile radius (2,895 acres) represents the average home range. The U.S. Fish and Wildlife Service established that a threshold of at least 40% of this home range (or 1,158 acres) is required to maintain a viable, reproductive owl site. The spatial arrangement of suitable owl habitat is a good predictor for spotted owl occupancy and nest site selection (Swindle 1997).

Reference Condition

The majority of the watershed was forested with suitable spotted owl nesting habitat during the reference period. An estimation of acreage was made using the historical vegetation mapping (1934 and 1946). Areas typed as subalpine were not included. From this map amount of suitable nesting habitat was 56,101 acres. Of this, approximately 76% was rated as "good" quality habitat (>75% habitat within a 0.5 mile radius circle).

No surveys for spotted owls were conducted prior to the 1970s, therefore an unknown number of nesting pairs occupied the watershed during the reference period. However, based on known home range sizes, overlap and nearest neighbor distance analyses, an estimation can be made based on the amount of suitable habitat. Owl abundance is directly proportional to the amount of suitable nesting habitat in a given area. In the southern Oregon Cascades, the average owl pair density is estimated at 21-31 pairs/100mi^2 in landscapes with greater than 60% suitable habitat (Bart and Forsman 1992). Based on this information, there may have been 24-35 pairs within the lower Steamboat Creek watershed during the reference period.

Current Condition

To compare reference and current spotted owl habitat conditions, a landscape analysis of the proportion of habitat within a 0.5 mile radius circle was used to rank habitat quality (Figure 17).

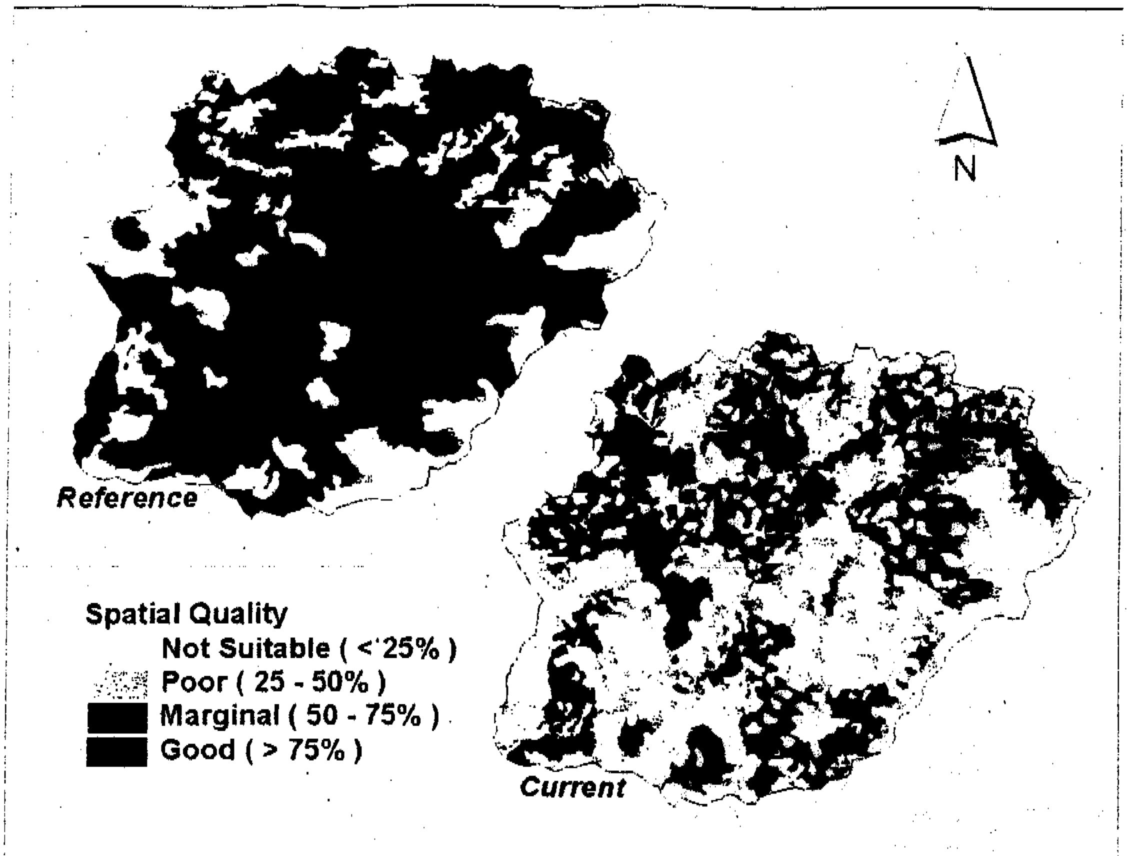


Figure 17. Reference and current conditions of spotted owl nesting, roosting and foraging habitat within the lower Steamboat Creek watershed. Spatial quality is based on the amount of suitable habitat within 0.5 mile radius circle.

The results of this analysis showed that 86% of all current spotted owl activity centers on the North Umpqua Ranger District (n=108) occur in areas which contain greater than 50% suitable nesting habitat within a 0.5 mile radius circle. As a result of clearcut timber harvesting, the amount of suitable spotted owl habitat has been reduced by approximately 32% in total area (Figure 18). The habitat remaining is highly fragmented and surrounded by road and clearcut edges.

	Non-Suitable	Poor	Marginal	Good
■ Reference	88	1,767	11,453	42,794
□ Current	263	9,366	20,846	8,138

Figure 18. Comparison of reference and current spotted owl habitat within the watershed.

When considering the spatial arrangement of the remaining habitat, a more accurate indication of the impacts of clearcut harvesting can be seen in the loss of "good" quality habitat. While there has been a 32% decrease in total suitable habitat, there has been an 81% decrease in the amount of good quality spotted owl habitat. The amount of marginal and poor quality habitat has increased.

In addition, there is approximately 3,166 acres of spotted owl habitat within the watershed that is below the 40% of home range threshold set forth by the US Fish and Wildlife Service.

The lower Steamboat Creek watershed contains approximately 33% of the remaining "marginal" to "good" quality habitat and 32 spotted owl activity centers, or 30% of the total spotted owl resource on the North Umpqua Ranger District. This is within the reference range for this watershed. Twenty-nine of these activity centers are documented as being occupied by pairs, and ten of these centers have produced juvenile owls since surveys begin in 1980. The majority of spotted owl activity centers (84%) occur in the western hemlock forest zones. The remaining centers occur in the true fir zone. No spotted owl activity centers occur within the drier Douglas-fir zones in this watershed.

The presence of barred owls is documented within the watershed with two activity areas being identified to date (Singe Creek and upper Steelhead Creek). Barred owl activity has been documented at four areas across the District. Interestingly, all of these areas center around the few remaining large blocks of "good" quality habitat. Barred owls are slightly larger and more aggressive than spotted owls. They also have been known to hybridize with spotted owls. The indications are that barred owls may focus in on the best remaining spotted owl nesting habitat and in the long run, may displace spotted owls from these areas.

Desired Future Condition

The desired future condition is to maintain the current 32 owl activity centers within the watershed and improve the spatial quality of their nesting, roosting and foraging habitat.

Forest Carnivores of Concern

Awareness has increased for a group of carnivores that are considered sensitive to forest management. This group is called "forest carnivores" and refers specifically to the Canadian Lynx, wolverines, fishers, and American martens. These animals occur in a wide band across the higher latitudes of North America (Kucera and Zielinski 1995). It is the southern extensions of these species that are of concern. These species have relatively large area requirements and are associated with wilderness, unfragmented late-successional forests and/or are thought to have a high sensitivity to human activity and man-caused disturbances (Figure 19).

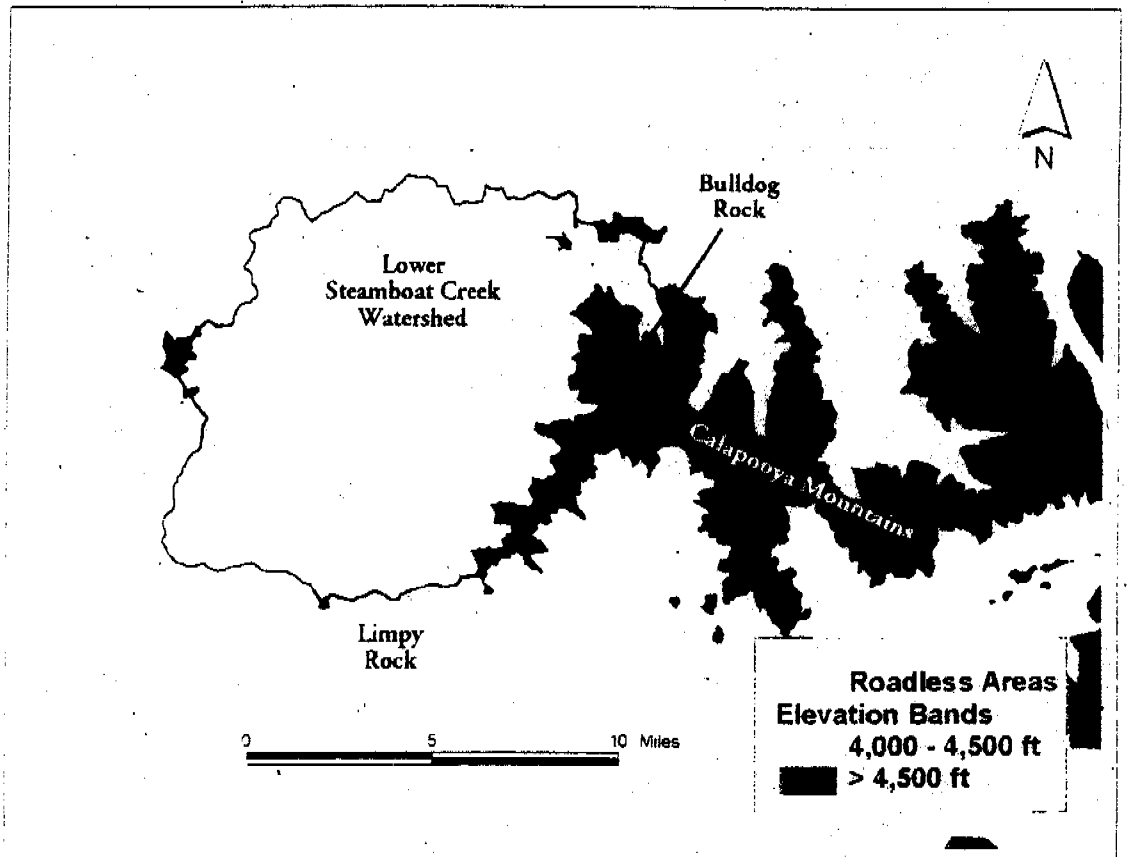


Figure 19. High elevation potential habitat for forest carnivores. An extension of high elevation forest from the Cascade crest runs along the Calapooya Mountains and into the lower Steamboat Creek watershed.

Reference Condition

The presence of these carnivores in the watershed was highly likely during the reference period. Canada lynx are closely associated with deep snow and the snowshoe hare, their primary prey. Wolverines typically exist in low-density populations and have notoriously large home ranges. They were extirpated from the upper Midwest in the early 1900s and were considered rare in Oregon in 1936 (Bailey). Wolverines extended southward in montane boreal habitats along the Rocky Mountains as far as New Mexico, and along the Cascade-Sierra Nevada axis to the southern Sierra Nevada of California. Wolverines require large-mammal carrion, particularly in winter. Fishers are a medium-sized carnivore and prey on small mammals and birds, most notably the snowshoe hare and porcupine, but also eat carrion and fruit. Before European settlement, fishers occurred down the West Coast to the southern Sierra Nevada's. In the late nineteenth and early twentieth centuries, fisher numbers plummeted nation-wide. They were extirpated from the southern tier of states they historically occupied in the East and Midwest. The American marten is the smallest of these four carnivores. They also feed on a variety of small mammals and birds. There have been substantial reductions in the distribution of American martens in the Pacific Northwest coast. A subspecies from the Coast Range of northern California, the Humboldt marten (*M. a. humboldtensis*), may be extinct, although American martens in other areas, such as the higher elevations of the Oregon Cascades, are relatively common.

In addition to the four forest carnivores mentioned above, two other large carnivores occurred within the watershed, but are now extirpated. These two species are the gray wolf and the grizzly bear. The grizzly was extirpated in the late 1800s through hunting and the wolf was extirpated in the early to mid 1900s through hunting, trapping and poisoning.

Current Condition

The combined effect of trapping, poisoning, roading and logging has caused the reduction or extirpation of these carnivores over much of their range. Until recently, little was known of their occurrence and distribution in the southwestern Cascades. Camera-bait stations (1994-1997), aerial surveys (1997-1998) and hair sampling stations (1998) have been used to document occurrence of forest carnivores on the Umpqua National Forest and the surrounding public lands.

American marten, fisher and wolverine have been documented on the Forest. Lynx have been documented nearby and periodic wolverine sightings occur within the immediate vicinity of the watershed. The majority of these sites occur above 4,500 feet in elevation in the more remote areas of the forest. The Lower Steamboat Creek watershed contains suitable habitat for forest carnivores within its eastern portions. The low road-densities, large blocks of unfragmented forest and high density of wetlands and meadows give this area of the watershed a higher likelihood for occupancy by one or more of these forest carnivores.

High road densities, human use and fragmented landscapes decrease habitat suitability for these carnivores. Current plans for decommissioning portions of road 3817 will increase the portion of the watershed that contains less than 1 mile/sq. mile of road from 3% to approximately 7%. The presence of wilderness and roadless areas, as well as current forest landscapes give the eastern portion of the watershed a highly likelihood for occupancy by forest carnivores. Currently, the best habitat occurs in the Bulldog Rock roadless area located in the eastern portion of the watershed.

Desired Future Condition

The watershed will contain large blocks of unfragmented forest with low road densities (Figure 20). Forest carnivores would reoccupy the eastern portion of the watershed where prey populations would be healthy and human use minimal.

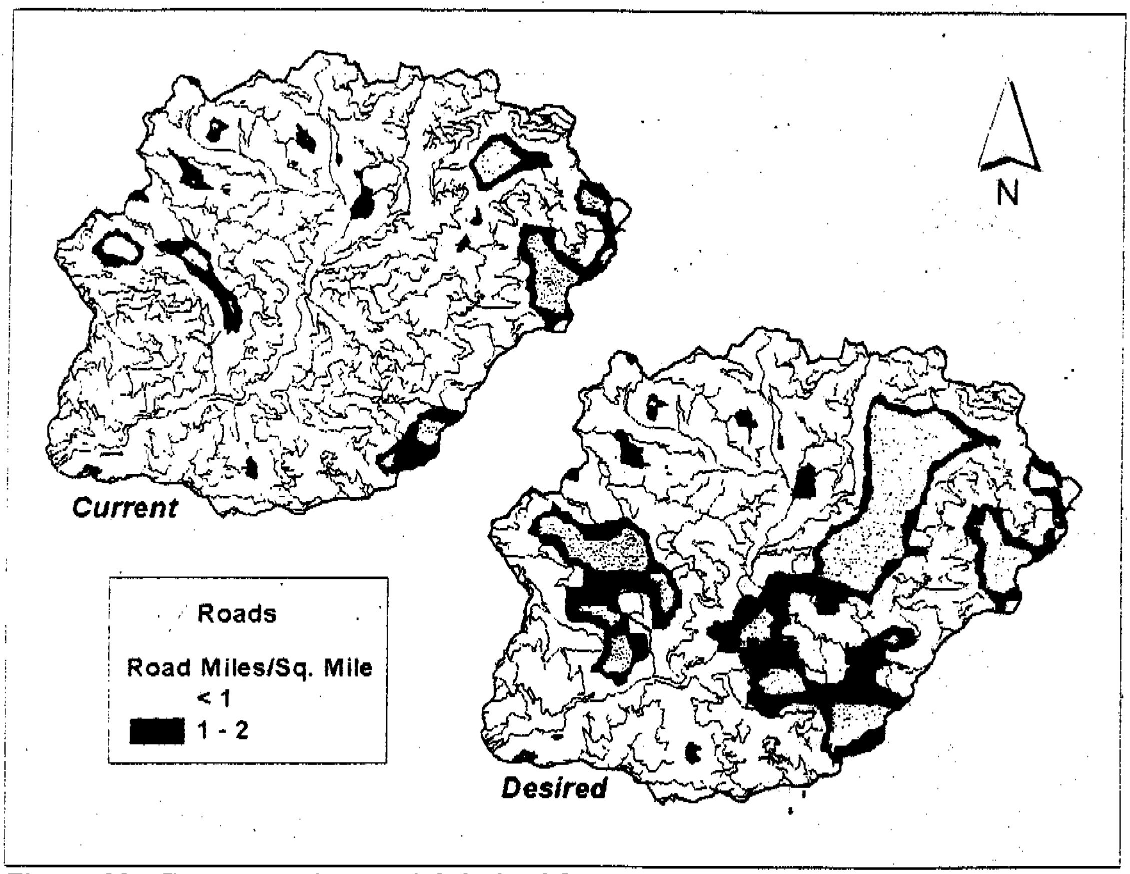


Figure 20. Current and potential desired future conditions for low density road areas.

Roosevelt Elk

Roosevelt elk are a native big game species to this watershed. They were almost extirpated in the late 1800s. Translocations, hunting regulations and ample forage resulting from decades of clearcut timber harvesting, forage seeding and fertilization have resulted in the re-establishment of large herds of Roosevelt elk within the watershed (Figure 21).

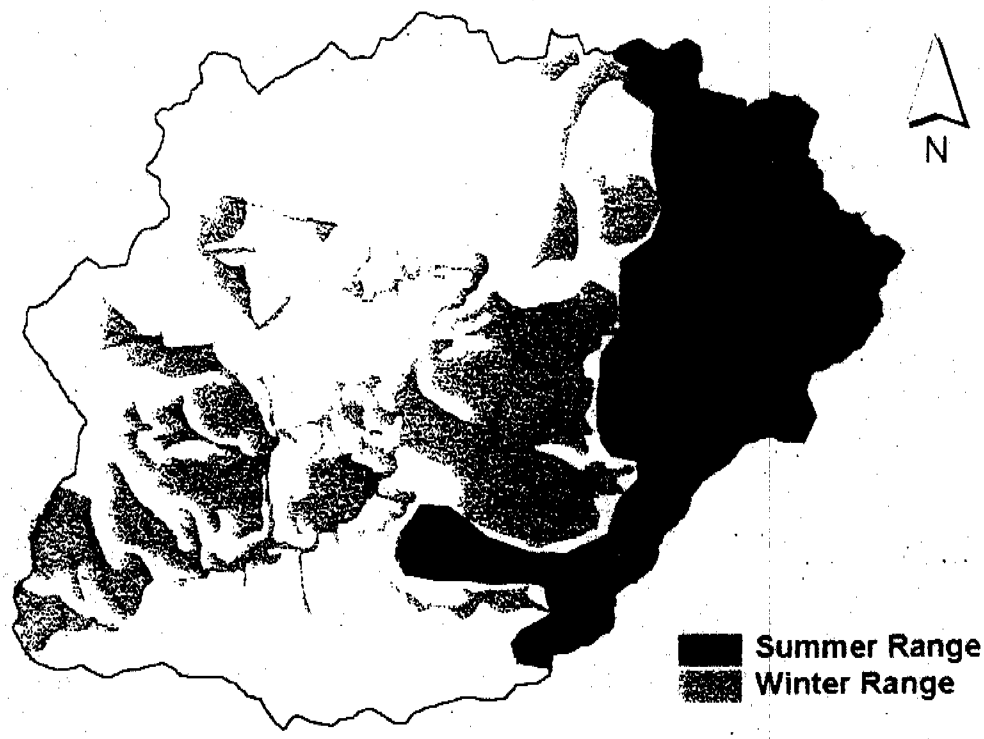


Figure 21. Elk range within the watershed. Winter range is commonly used throughout all seasons. Portions of the summer range will be used during mild winters.

Reference Condition

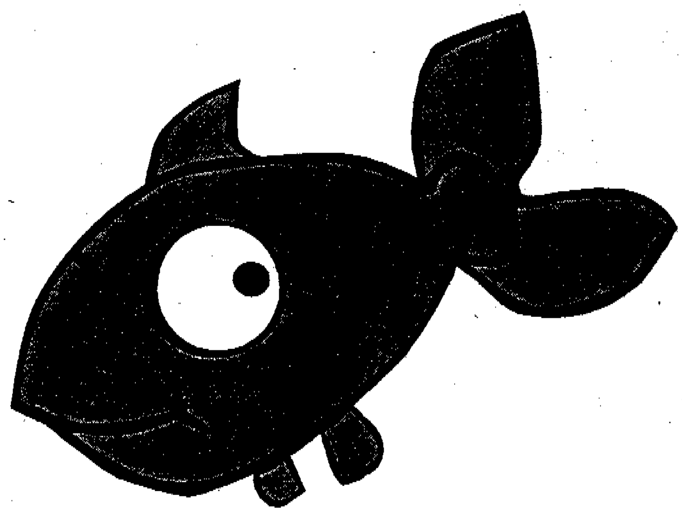
Roosevelt elk browse or graze opportunistically but when available, grass and forbs make up a large portion of their diet, especially during the winter and spring months. During the reference period, grass and forb forage occurred in pulses as a result of stand replacement fires. A more stable network of meadows occur in the higher elevations of the true fir and mountain hemlock zones. This portion of the watershed along the Calapooya Mountains also had a high density of wetland areas and small ponds scattered throughout the forest. It provided good summer range for elk, but was usually buried by snow during the winter months.

In 1910, Forest Service officials reported Roosevelt elk as "formerly abundant" on the Umpqua National Forest. By the mid-1920s, herd numbers were reported as increasing, but statewide populations were still estimated at below 1000 head.

Current Condition

The Lower Steamboat Creek watershed is located within the southern portion of the State's Indigo Wildlife Unit where bull harvests have fluctuated between 125-225 bull/year over the last decade. Hunting and wildlife viewing are increasing as popular recreational activities within Douglas and Lane Counties. Both rifle and bow elk hunter numbers have almost doubled for the South Indigo Unit in the last 10 years (ODFW data). Roosevelt elk herd counts for the Indigo Unit reported between 1990-95 ranged from 773-1,200 head and peaked at 1,588 in 1996. Lower Steamboat Creek contains the largest herds of elk on the North Umpqua Ranger District.

CHAPTER 5



Aquatic Resources and Processes

Chapter 5: Aquatic Resources and Processes

FISH POPULATIONS

Reference Condition

The reference period for fish populations would best be characterized as the period prior to post-industrial human influence on exploitation of the fisheries resource and resources associated with fish habitat in the Umpqua River Basin (prior to 1850). The decline was attributed to over-fishing, logging practices (including splash-damming), and possibly egg harvesting for fish stocking in other river basins (Beckham 1986). The fact that fish stocks had declined considerably by the mid to late 1940s is important because the modern record of fish counts in the North Umpqua River (Winchester Dam fish counts) began in 1945, **after** fish stocks had already declined to the point that commercial operations in the river were no longer viable.

Some information on the condition of Umpqua basin fish stocks in the mid 20th century is available in a report put together by the Fish Commission of Oregon and Oregon State Game Commission in 1946. Much of the following information is based on that report. While this report does not provide specific information regarding fish abundance, it does provide a context of the relative numbers of fish in the Umpqua basin at the time of its writing and remains the best account available on what the trends have been for Umpqua fish stocks.

Spring chinook salmon

It has long been recognized that spring chinook salmon populations have been declining in the Umpqua basin. Historically, spring chinook were harvested commercially both in the ocean by trollers and in the main stem of the Umpqua River by gill-netters. Estimated numbers of spring chinook harvested in-river from 1923 to 1946 decreased from as high as 11,500 fish down to as low as 100 fish annually (Fish Commission of Oregon and Oregon State Game Commission 1946). The in-river commercial fishery ceased in 1946. Declining catch rates led the state Fish and Game Commissions to recommend that *"additional study be conducted for at least one complete life cycle (five years) of the spring chinook salmon, to attempt to further identify and correct all the factors contributing to the declines of the fishery."* The commissions further recommended:

> *"It is recommended that the Umpqua River and its tributaries be closed to fishing for spring chinook salmon, insofar as practicable, by the commercial and sport fisheries for a period of at least five years."*

The Commissions also suggested that under proper management, the Umpqua River should be capable of a sustained average annual yield of at least 50,000 pounds of spring chinook salmon (about 2,500 fish) to the commercial and sport fisheries.

In spite of this concern expressed by state agencies in 1946, Umpqua basin spring chinook have continued to be harvested commercially and recreationally in ocean fisheries off the Oregon coast as well as in-river in the main stem Umpqua, North Umpqua, and South Umpqua Rivers. However, commercial in-river fisheries ceased after the 1946 season due to lack of fish.

Coho Salmon

Coho salmon populations in the Umpqua basin have been declining since at least the 1920s. Commercial landings of coho salmon in the Umpqua River indicate a trend of decline in the fishery that mimicked the decline seen with spring chinook salmon. From 1923 to 1946 the coho catch dropped from over 240,000 fish to less than 10,000 fish (Fish Commission of Oregon and Oregon State Game Commission 1946). This trend prompted the Fish and Game Commissions to recommend that *"fishing intensity on the silver [coho salmon] runs should be curtailed."* It is not possible to speculate on how many fish in the historic coho catch in the main stem Umpqua River were destined to spawn in the North Umpqua River or its tributaries. However, like spring chinook salmon, coho salmon have continued to be fished in ocean sport and commercial fisheries as well as in-river sport fisheries since the 1940s.

Summer Steelhead Trout

Relatively little historic information is available on steelhead trout. It has long been noted that summer steelhead "appear to run only in the North Umpqua River" (Fish Commission of Oregon and Oregon State Game Commission 1946). Summer steelhead were historically harvested as by-catch in the in-river shad fishery down in the main stem Umpqua River. Approximately 18,000 pounds of summer steelhead were landed in the commercial in-river fishery in 1926 (Fish Commission of Oregon and Oregon State Game Commission 1946). Based on other data in this report, the average fish weighed approximately 7 pounds during the commercial catch in 1946. Assuming the same average fish size for the 1926 harvest, approximately 2,571 fish were harvested in 1926. This catch declined to 97 fish in 1946 when all commercial in-river fisheries ceased due to the lack of fish.

Winter Steelhead Trout

Like summer steelhead, relatively little specific information is available on the historic abundance of winter steelhead. Some winter steelhead were formerly caught incidentally in commercial coho salmon fisheries in the main stem Umpqua River. In 1946 approximately 1,244 winter steelhead were taken as part of the coho salmon catch (Fish Commission of Oregon and Oregon State Game Commission 1946). As with summer steelhead, there was no specific commercial fishery for them although there was a sport fishery for them.

Umpqua Cutthroat Trout

There is little historical information available on Umpqua cutthroat trout. The Oregon state fish and game commissions recognized cutthroat as their "problem children" because of the lack of information on them (Fish Commission of Oregon and Oregon State Game Commission 1946). In the past there were specific sport fisheries within the Umpqua basin targeting large cutthroat trout (either sea-run or fluvial life history) typically 12 inches to 16 inches in length (Oregon Sportsman 1913, Chenoweth 1972).

Current Condition

Current trends in abundance of North Umpqua River anadromous fish stocks can be identified based on a long record of annual fish counts at Winchester Dam dating back to 1946. Winchester Dam is located at approximately River Mile 7 of the North Umpqua River. Data are available from 1946 to the present for spring chinook salmon, coho salmon, summer steelhead, winter steelhead, and migratory cutthroat trout.

One important aspect of the Winchester Dam fish counts is that these counts did not begin until in-river commercial fisheries had collapsed and salmon and steelhead stocks were considered depressed by 1946 as discussed in Chapter 3. Current data are discussed for each salmonid fish stock below.

Spring Chinook Salmon

A recent survey of fisheries professionals throughout the Pacific Northwest to assess stock status concluded that the North Umpqua River spring chinook population level is currently between one tenth and two thirds of its historic level prior to Euro-American cultural influence (Huntington et al. 1994). Although this represents a reduction of the population, the authors identified North Umpqua River spring chinook salmon as one of two "healthy" spring chinook salmon populations in the state of Oregon (Huntington et al. 1994).

ODFW fish counts over Winchester Dam dating back to 1946 suggest that the spring chinook salmon population in the North Umpqua River is on a downswing since a relatively strong period in the1970s and 1980s (Table 12). As similar trends are observed for steelhead trout stocks, this trend is often partially attributed to poor ocean conditions for growth and survival of salmonids in the 1990s.

Table 12. Average annual escapements of spring chinook salmon into the North Umpqua River by decade or period including proportions of wild and hatchery fish.

Period	# Wild Fish	# Hatchery Fish	Total	% Hatchery
1946-1950	2,745	–	2,745	0%
1951-1960	4,304	920	5,132	18%
1961-1970	6,810	3,158	9,968	32%
1971-1980	6,553	5,026	11,579	43%
1981-1990	6,375	3,796	10,171	37%
1991-1996	3,617	2,458	6,075	40%

The North Umpqua River is the primary producer of spring chinook salmon in the Umpqua basin. Since 1945 the average annual number of wild spring chinook salmon returning to the North Umpqua River is approximately 5,374 fish. Assuming that a large proportion of the up to 11.500 spring chinook salmon historically harvested from in-river commercial fisheries alone (excluding in-river sport fisheries) were destined for the North Umpqua River, it appears that the North Umpqua spring chinook population size has been considerably reduced. In spite of the fact that some fisheries professionals consider this stock as relatively healthy, it is still important to recognize that it is currently reduced in numbers.

Spring chinook salmon use the lower 10 miles of Steamboat Creek (Figure 22). Their primary area of use is the lower 1.3 miles of Steamboat Creek, where up to 19 redds (nests) per mile are seen in spawning ground surveys (Table 13). Their use of areas farther upstream is more sporadic, but spring chinook adults have been observed spawning as high as 10 miles up the creek in 4 out of 8 years in the 1990s.

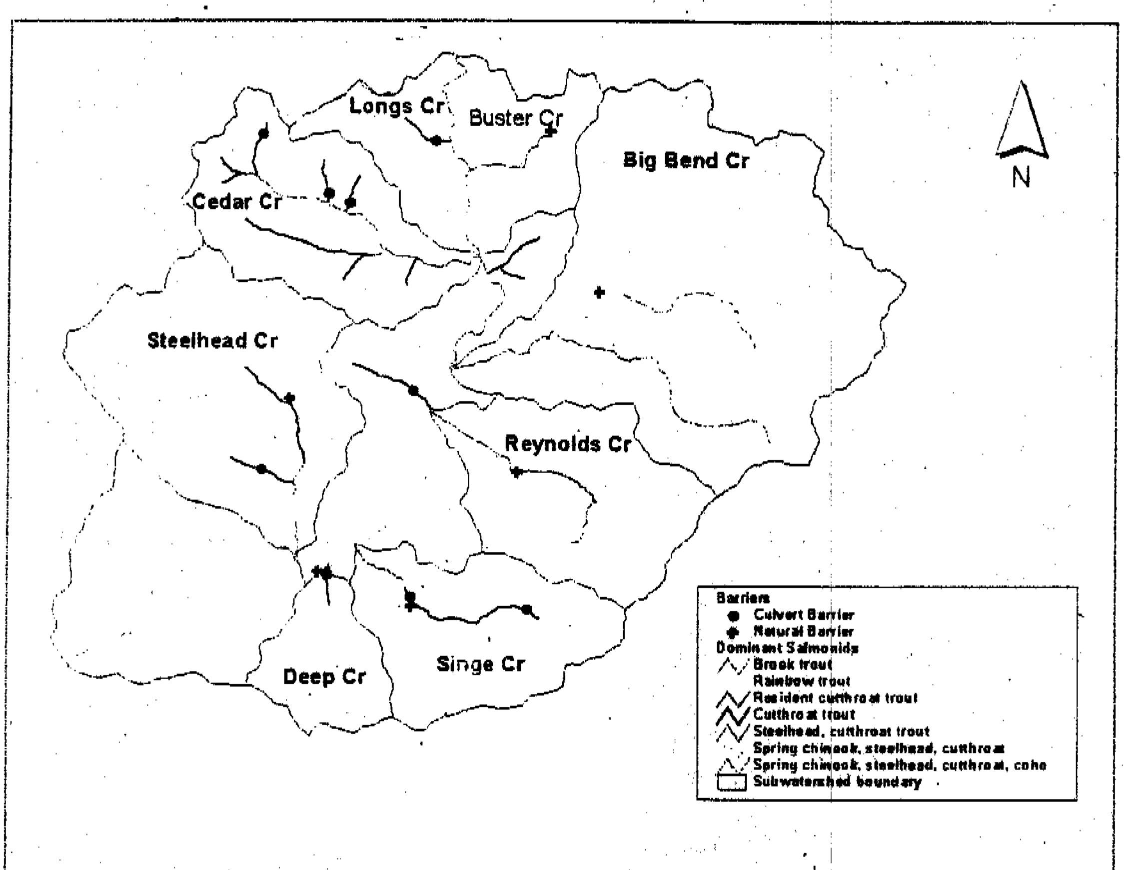


Figure 22. Salmonid distribution in the Lower Steamboat Watershed.

Juvenile spring chinook salmon were observed in Black Gorge (approximately 4 miles upstream from the mouth of Steamboat Creek) during summer 1998 indicating that spring chinook spawned at least that far up the creek during fall 1997.

Table 13. Spring chinook salmon redd counts in reach 1 of Steamboat Creek (from the mouth of Steamboat Creek up to Little Falls) by year.

Year	# of Surveys	Total # Redds	# Redds/Mile	Live Fish	Carcasses
1990	5	18	13.8	32	19
1992	3	7	5.4	8	7
1998	3	24	18.5	19	16

Coho Salmon

Based on information on coho salmon fisheries presented in Chapter 3, coho salmon populations in the Umpqua basin on the whole are down one to two orders of magnitude from their historic levels. Coho salmon in the Umpqua basin were considered at "moderate risk of extinction" by Nehlsen et al. (1991) due to habitat degradation and hatchery influences of Rock Creek fish hatchery. Since 1945, an average of approximately 70% of coho adults returning to the North Umpqua River have originated from the Rock Creek fish hatchery located approximately 20 river miles downstream from the mouth of Steamboat Creek (Table 14). While this hatchery program undoubtedly contributed to commercial and sport coho harvests over this period, it has also undoubtedly affected the genetic makeup of any wild remnants of the population, thus leading to the concerns about hatchery practices identified by Nehlsen et al. (1991). Huntington et al. (1994) did not identify North Umpqua River coho salmon as a healthy stock. Oregon Coast coho salmon (which includes Umpqua River coho stocks) are currently listed as "threatened" under the federal Endangered Species Act.

Table 14. Average annual escapements of coho salmon into the North Umpqua River by decade or period including proportions of wild and hatchery fish.

Period	# Wild Fish	# Hatchery Fish	Total	% Hatchery
1946-1949	1,170	--	1,170	0%
1950-1959	1,736	--	1,736	0%
1960-1969	1,050	--	1,050	0%
1970-1979	446	120	518	23%
1980-1989	899	3,094	3,684	84%
1990-1996	1,323	3,629	4,952	73%

Coho salmon use the lower end of Steamboat Creek but their exact distribution is unknown and probably varies from year to year. They are suspected of using the lower approximately 2.5 miles of the main stem (Figure 22). Coho are not abundant in Steamboat Creek as they have been found only sporadically during summer snorkel surveys and may be completely absent in some years.

Summer Steelhead Trout

A recent survey of fisheries professionals throughout the Pacific Northwest to assess stock status concluded that the North Umpqua River summer steelhead population is currently between one tenth and two thirds of its historic level prior to Euro-American cultural influence (Huntington et al. 1994). Although this represents a reduction of the population consistent with the discussion in chapter 3, the authors identified North Umpqua River summer steelhead trout as one of six "healthy" summer steelhead populations in the state of Oregon (Huntington et al. 1994).

Oregon Department of Fish and Wildlife counts of summer steelhead over Winchester Dam suggest that since the crash of commercial fisheries in the 1940s, numbers of wild summer steelhead in the North Umpqua River are somewhat steady (Table 15). Escapements have been averaging over 50% hatchery fish in most years for the past four decades thus resulting in concerns about the genetic integrity of this stock.

Table 15. Average annual escapements of summer steelhead trout into the North Umpqua River by decade or period including proportions of wild and hatchery fish.

Period	# Wild Fish	# Hatchery Fish	Total	% Hatchery
1946-1950	3,149	--	3,149	0%
1951-1960	2,753	822	2,917	28%
1961-1970	2,599	3,951	6,549	60%
1971-1980	3,927	6,439	10,366	62%
1981-1990	5,032	7,400	12,432	60%
1991-1996	2,795	2,623	5,418	48%

Winter Steelhead Trout

The North Umpqua winter steelhead stock was also identified as a relatively healthy stock by Huntington et al. (1994) with its current population being between one tenth and two thirds of its historic level. Although this represents a reduction of the population, the authors identified North Umpqua River winter steelhead trout as one of seven "healthy" winter steelhead trout populations in the state of Oregon (Huntington et al. 1994).

Table 16. Average annual escapements of winter steelhead trout into the North Umpqua River by decade or period including proportions of wild and hatchery fish.

Period	# Wild Fish	# Hatchery Fish	Total	% Hatchery
1946-1950	8,743	--	8,743	0%
1951-1960	7,147	323	7,470	4%
1961-1970	7,511	948	8,459	11%
1971-1980	6,738	735	7,473	10%
1981-1990	7,401	94	7,495	1%
1991-1996	4,862	--	4,862	0%

As with spring chinook salmon and summer steelhead trout, numbers of returning adult winter steelhead have declined in the North Umpqua River in the 1990s (Table 16).

These trends are attributed in part to poor ocean survival conditions in the 1990s including a very strong El Nino weather pattern that resulted in several years of poor upwelling off the coast of Oregon.

Summer and winter steelhead occupy approximately 30 miles of habitat in the analysis area (Figure 22). It is unknown whether there is spatial segregation between the summer and winter steelhead stocks so they must be lumped together for any discussions of their distribution and abundance. Steelhead spawning ground surveys have been conducted in a number of areas in Steamboat Creek since 1991. Results of this work will be discussed in the habitat section of this analysis.

Umpqua Cutthroat Trout

Currently Umpqua cutthroat trout are listed as "endangered" under the Endangered Species Act. One major contributing reason for the listing is that counts of adult cutthroat trout migrating upstream past Winchester Dam on the North Umpqua River have declined from an average of 950 adults from 1946-1956 to an average of 90 fish from 1957-1960 (Johnson et al. 1994). From 1961-1976 the counts increased to an average of 940 fish due to hatchery supplementation (Table 17). As the hatchery program ceased in the late 1970s the counts have averaged 62 fish annually since 1977 (Johnson et al. 1994).

Table 17. Average annual escapements of migratory cutthroat trout into the North Umpqua River by decade or time period.

Period	Total Number of Fish
1946-1950	761
1951-1960	766
1961-1970	862
1971-1980	282
1981-1990	72
1991-1996	33

Fishing for cutthroat trout was closed in 1996; so, although there was formerly a fishery for them, it no longer exists.

Within this watershed analysis area, cutthroat trout are distributed throughout approximately 42 stream miles (Figure 22). At least three different life histories of cutthroat trout are assumed to use the Steamboat watershed: sea-run, fluvial, and resident. Sea-run and fluvial fish have a similar life history in that their adult forms go on spawning runs into small tributaries. After eggs hatch, the young reside in natal streams for 1-3 years prior to emigrating downstream. In the sea-run life history the young emigrate to the ocean where they reside for several months before beginning their run back up-river. In the fluvial life history the young emigrate to main stem rivers but do not go all the way to the ocean. They grow to adult size in the main stem river or large creek prior to going on spawning runs back up into small tributaries. Steamboat Creek serves as habitat for adult as well as juvenile fluvial cutthroat trout. The resident life history form spends its entire life cycle within its natal stream with minimal migration.

Cutthroat trout spawning has been identified in some streams. Large migratory cutthroat trout (either sea-run or fluvial) have been seen spawning in Cedar Creek, North Fork Cedar Creek, South Fork Cedar Creek, Steelhead Creek, and Reynolds Creek within the analysis area as well as Little Rock Creek, Horse Heaven Creek and upper Steamboat Creek outside the analysis area. Within the analysis area Big Bend Creek, and main stem Steamboat Creek from Big Bend Creek up to Cedar Creek have been surveyed over the years with no cutthroat spawning observed. Spawning surveys have never been done in Singe Creek, Deep Creek, Johnson Creek, Longs Creek, Little Bend Creek, and Buster Creek. Juvenile anadromous fish abundance (young of the year fish) has been found to be very low in these tributaries during summer suggesting that few adult migratory fish spawn in these streams. Many of these streams also have arduous migratory conditions such as small waterfalls and steep chutes that likely limit the number of adult migratory fish that access them.

Brook Trout

Brook trout have been introduced into several human-made impoundments in the analysis area. Fuller Lake and Bullpup Lake in the Big Bend Creek subwatershed are regularly stocked with brook trout to provide recreational fisheries. Summer 1997 snorkeling of the streams draining these two lakes did not identify any brook trout in downstream areas. Beaver Pond, located in the Reynolds Creek subwatershed is another impoundment that has historically been stocked with brook trout but is currently stocked with rainbow trout. There are 2-3 unnamed ponds up on Chilcoot Ridge in the Lower Steamboat face subwatershed that have also historically been stocked with brook trout. Concerns associated with stocking this exotic species focus on their potential to introduce disease to native aquatic habitats, invade native aquatic habitats and outcompete native fishes, and prey upon salamanders and other native fauna.

WATER QUALITY AND AQUATIC HABITAT

Reference Condition

In general the reference condition for water quality and aquatic habitat is considered to be the period prior to when the Euro-American dominated culture affected conditions in the watershed. For most of the tributaries this period can be defined as prior to the 1950s. However, for main stem Steamboat Creek this period would best be described as prior to the turn of the last century because placer mining activities did occur in main stem Steamboat Creek just after the turn of the century.

The reference condition for water quality can be described by comparison to the relatively undisturbed condition of Boulder Creek in the adjacent wilderness and City Creek. Boulder Creek Wilderness is a 5th field watershed that is about 22,400 acres with a similar watershed aspect and shares a common watershed boundary. City Creek is a 6th field subwatershed in upper Steamboat (Upper Steamboat Creek Watershed Analysis 1997) where only 5% of the riparian and 15% of the total subwatershed have been harvested over a 40-year period. The most likely changed stream attributes to contrast are temperature, longitudinal distribution of pH and dissolved oxygen, sediment delivery and transport, and winter peak flow response.

Stream channels in the Steamboat Creek watershed are generally considered to be geomorphically "constrained". In the Steamboat Creek watershed, bedrock outcrops and colluvial slopes laterally limit floodplain development on either side of most creeks. One partial exception to this is Cedar Creek whose main stem and north fork have more floodplain development than is seen in the other tributaries of Steamboat Creek. For the sake of this discussion, descriptions of stream conditions are subdivided into the main stem of Steamboat Creek itself (a 6th order stream), and tributaries of Steamboat Creek (generally 3rd to 5th order streams).

Main Stem Steamboat Creek

In their watershed analysis of the North Umpqua River above Rock Creek, Stillwater Sciences Inc. (1998) suggest that the bedrock-dominated morphology of Steamboat Creek that we see today has not likely been significantly altered from the reference condition. Bedrock-dominated reaches make up approximately one third of the channel length of Steamboat Creek (Stillwater Sciences Inc. 1998). The contention of historic and prehistoric bedrock dominance is supported by evidence of prehistoric Native American uses along the stream. Many of the bedrock trench and lateral scour pools used today for oversummering by adult summer steelhead have evidence of Native American use as fishing areas, suggesting that these very pools have been used by adult summer steelhead for thousands of years. This in turn suggests that the morphology of these pools has probably changed very little over thousands of years.

While Steamboat Creek may have historically been nearly as bedrock dominated as it is today, conditions in Steamboat Creek above Buster Creek may have been substantially altered by placer mining in the early 1900s. For their analysis, Stillwater Sciences Inc. (1998) identified the period "prior to the 1950s" as their reference period and used the 1946 aerial photo series to characterize reference stream conditions in Steamboat Creek: Extensive placer mining in the main stem of Steamboat Creek, particularly above Buster Creek, had occurred just after the turn of the century, prior to the reference period used by Stillwater Sciences in their analysis. Therefore, some of Stillwater Sciences Inc. (1998) findings may be inaccurate, especially for the portion of Steamboat Creek above Buster Creek.

One result of the generally constrained morphology of Steamboat Creek is that during large storms, stream flows cannot spread out into floodplain areas. Flows are instead contained primarily within the main channel where water velocities are very high. There are very few calm water areas necessary for aquatic organisms to survive during these winter flows. This means that high quality overwinter habitat for aquatic organisms is inherently in short supply within Steamboat Creek due to its channel morphology.

In the reference condition, calm water areas during winter flows in main stem Steamboat Creek would have been inherently lacking due to the relative lack of floodplain areas. Presence of calm water areas in the main stem would have been heavily dependent on the few side channels that are present as well as the presence of large wood jams along the margins of the creek, at heads of islands and point bars, and at outcurves of meanders.

Large Wood

Large wood is highly renowned as a critical aquatic habitat component in streams on the west side of the Cascade mountains (Maser and Sedell 1994, Naiman et al. 1992, Gregory et al. 1991, Bisson et al. 1987). Large wood is critical as a building block for streams and for sediment routing/storage, nutrient processing, nutrient storage, high flow velocity refugia, flood attenuation, high flow energy dissipation, hiding cover, and living space for aquatic organisms. In the larger main stem of Steamboat Creek, large wood was likely present at heads of point bars, along main channel margins, at outcurves of meander bends, in secondary (side) channels, and along margins and heads of islands (Bisson et al. 1987). Wood was likely configured in a combination of clumps and single logs, none of which were channel-spanning because Steamboat Creek is so large that it routinely transports whole fallen trees out of its watershed if trees fall entirely into the main stem. There was probably less large wood in the active channel of main stem Steamboat Creek in the reference condition than there was in tributary streams. However, large wood accumulations were likely more frequent under reference conditions than today, especially along channel margins where the channel is relatively wide so that high flow water velocities would be relatively low (Stillwater Sciences Inc. 1998).

Riparian Vegetation

Lands designated as riparian reserves for this watershed analysis encompass corridors 180' in width (the equivalent of one tree height) on either side of all intermittent and perennial non-fish bearing streams, as well as 360' in width (the equivalent of two tree heights) on either side of all fish-bearing streams. Riparian vegetation along main stem Steamboat Creek was historically dominated by late seral conditions with approximately 90% of the lower 18 miles of the main stem having vegetation greater than 80 years old.

Water Temperature

The daily water temperature fluctuation within a stream (minimum to maximum) reflects the overall riparian thermal buffering ability along that stream. Where riparian shade is removed, summer stream temperatures of smaller tributaries are elevated because of direct sunlight exposure or short-wave energy heating during the day (Brown 1980). The potential heat loss at night to the atmosphere through outgoing long-wave energy would contribute to greater daily fluctuations. Therefore, small to moderate size streams with smaller daily water temperature fluctuations usually reflect near reference stream temperature condition where the riparian vegetation is undisturbed and cold ground water input is not dominating.

In reference conditions, the diurnal temperature fluctuations in the main stem were probably similar to those seen under current conditions. Holaday (1992) found that diurnal fluctuations in main stem Steamboat Creek have not significantly changed over a twenty-year period. This unchanged condition has been historically influenced by channel width. Little information is available to determine overall main stem width for the reference condition. From a 1902 surveyor's field notes for a placer claim at Steamboat Falls (Collier 1902), the channel was described as a " bedrock channel" and "the stream is shallow and does not occupy much of said channel except in time of flood". This channel description is true today for this single site. However, other main stem segments have been manipulated by early placer mining activity.

In the reference condition, the maximum and minimum temperatures of the main stem were likely cooler in the upper reaches above Cedar Creek. However, temperatures in the lower reaches (below the confluences of most large tributaries) were probably similar to those found there currently. In support of this, Holaday (1992) found a cooling trend in the upper reach, but did not see this same trend in the lower reaches of main stem Steamboat Creek. This appears to reflect maximum and minimum temperature recovery in upstream tributaries towards reference conditions. However, with increasing main stem flow in the downstream direction and a dominant wide channel, noticeable tributary influence on water temperature becomes limited in the lower reaches. The limited cooling influences of tributaries in the lower main stem reaches likely occurred near the confluences of the larger tributaries, and would quickly be lost in the downstream direction as those cooler waters mixed with the larger, warmer volume of water in the main stem. Since tributary flow would regulate the extent of this cool water influence, Cedar Creek, Steelhead Creek, and Big Bend Creek would have had the greatest cooling potential at their respective confluences.

These confluence areas may serve as small, cool-water refuges, providing localized areas where fish and other aquatic organisms can survive during the warmest portions of the summer.

Main Stem Steamboat Creek

Current Condition

Steamboat Creek has long been recognized as an extremely important spawning and rearing area for summer and winter steelhead trout. The creek and its tributaries have been closed to fishing since 1932. A placer mining withdrawal was placed on Steamboat Creek and its major tributaries in 1959. The Oregon Department of Fish and Wildlife has recognized Steamboat Creek as an important fish production area where the majority of the North Umpqua's wild summer steelhead are produced (Anderson et al. 1986).

One unique characteristic about Steamboat Creek is that adult summer steelhead migrate up into the main stem and hold up in pools throughout the summer prior to their fall dispersal in preparation for spawning. Approximately 30 pools dispersed throughout the lower approximately 18 miles of Steamboat Creek are used by adult summer steelhead* trout for oversummering. These fish use the same pools year after year. Virtually all of these pools are associated with bedrock features so their morphology is not highly susceptible to change. Therefore these pools have likely persisted for hundreds to thousands of years in a form similar to what they are today. Indeed, many of the pools used today by adult summer steelhead show evidence of prehistoric native American use as fishing areas indicating that summer steelhead have used these same pools for thousands of years.

In 1959 a fish ladder was installed at Steamboat Falls at approximately River Mile 6.25. While this ladder has likely made access to the upper basin easier for summer steelhead and spring chinook salmon, the upper basin has long been accessible to these fish even before construction of the ladder as evidenced by the presence of prehistoric Native American fishing artifacts at many adult holding pools upstream of the ladder.

Habitat Conditions

Summer 1997 stream surveys of Steamboat Creek indicate that the main stem is a bedrock dominated stream with a profound lack of large wood but with a relatively high proportion of pool habitat by area and normal pool frequencies (Table 18).

Table 18. Descriptions and physical characteristics of main stem Steamboat Creek reaches.

Main Stem Steamboat Creek Habitat Characteristics								
Reach	**Reach Description**	**Reach Length**	**Reach Gradient**	**% Pools**	**Dominant Substrate**	**# Pieces Wood/Mi**	**# Pools per Mile**	**Expected # Pools/Mile**
1	From mouth up to Steamboat Falls	6.4 mi	1%	54%	Boulders	0.8	10	12 - 17
2	From Stmbt Falls to mouth of Big Bend Ck.	4.7 mi	0.76%	39%	Bedrock	0.6	11.5	9.5 - 13
3	From mouth of Big Bend Ck. To mouth of Little Rock Ck.	6.6 mi	0.78%	69%	Bedrock	1.7	14.9	11 - 15

The ranges of "Expected # Pools/Mile" in Table 18 were derived per reach on the basis of normal pool frequency being every 5-7 channel widths for mid to high order channels such as Steamboat Creek (Leopold et al. 1964 as cited by Rosgen 1996). Reach 1 of Steamboat Creek falls slightly below the expected pool frequency but reaches 2 and 3 fall within the expected range. Reach 1 may fall below the expected range because this reach contains Black Gorge, an approximately 3 mile stretch of the creek where channel morphology differs from the majority of main stem Steamboat Creek in which pools occur every 5-7 channel widths. Some portions of Black Gorge have higher than average pool frequency due to a localized large boulder stair-step nature of the channel. Other portions of Black Gorge have lower than average pool frequency due to the presence of extremely long bedrock trench pools created by bedrock confinement for prolonged lengths of the stream. This variability may manifest itself in the form of slightly lower than expected pool frequency for reach 1 overall. The fact that adult summer steelhead have been using many of the same pools for oversummering for thousands of years suggests that these pools are stable through time and resistant to pool filling.

The entire 17.7 miles of main stem Steamboat Creek lacks large wood (Table 18). The entire main stem averages 1.1 pieces of large wood/mile ("large wood" is defined as wood ≥24 inches diameter at small end and ≥50 feet in length).

The lack of large wood is an important shortcoming of aquatic habitat in Steamboat Creek. Since Steamboat Creek is a confined 6th order channel, we would expect large wood loading within the active channel to be less than that in 3rd to 5th order tributaries. However, even in large streams such as Steamboat Creek large wood is an important component to add channel complexity along channel margins, in side channels, at heads of point bars, and at heads and margins of islands. This wood plays a critical role in providing overwintering habitat for salmonids as well as spring and summer habitat for salmonid fry. Large wood is crucial to retaining fine organic matter and thereby trapping nutrients and providing substrate for aquatic macroinvertebrate communities.

Knowing exactly how much large wood "should" be present in main stem Steamboat Creek is nearly impossible to ascertain because pristine stream and river systems of this size on which to base a comparison are rare to nonexistent along the Pacific coast (Bisson et al. 1987). Primary processes of large wood input to a 6th order stream like main stem Steamboat Creek include transport from upstream, bank cutting, blow down, streamside debris avalanches, earthflows, or debris torrents from tributaries (Bisson et al. 1987). In main stem Steamboat Creek several of these processes have been reduced or arrested by management activities. See the later discussion on human impacts to aquatic habitats for more details.

Side Channel Habitats

Side channels are very important aquatic habitats. They tend to be areas of sediment and large wood deposition, fine organic matter and nutrient retention, aquatic insect production, and overwintering for fish and other vertebrates (Bustard and Narver 1975, Swales et al. 1986, Gregory et al. 1991).

During summer 1998 the 18 mile portion of main stem Steamboat Creek in the analysis area was inventoried to identify large side channel habitats. Side channels greater than 600 feet in length were categorized as "large" due to their inherent depositional features and potential to provide significant amounts of overwintering habitat for aquatic vertebrate species including fish and salamanders. Over the entire 18 mile main stem, ten large side channel sites were identified based on a combination of field and air photo inventory. A cumulative total of approximately 1.7 miles (10% of total stream length) of the main stem has large side channel habitats associated with it (Figure 23, Table 19).

Virtually all these side channels were formed by localized wide stretches of Steamboat Creek controlled at the downstream ends by bedrock nick points. These are places where bedrock outcrops or sideslopes on both sides of the creek converge to "back up" water into the wider upstream areas. This backing up of water combined with the relatively lower water velocities at high flows going through the wider areas allows deposition of sediments to form bars and islands.

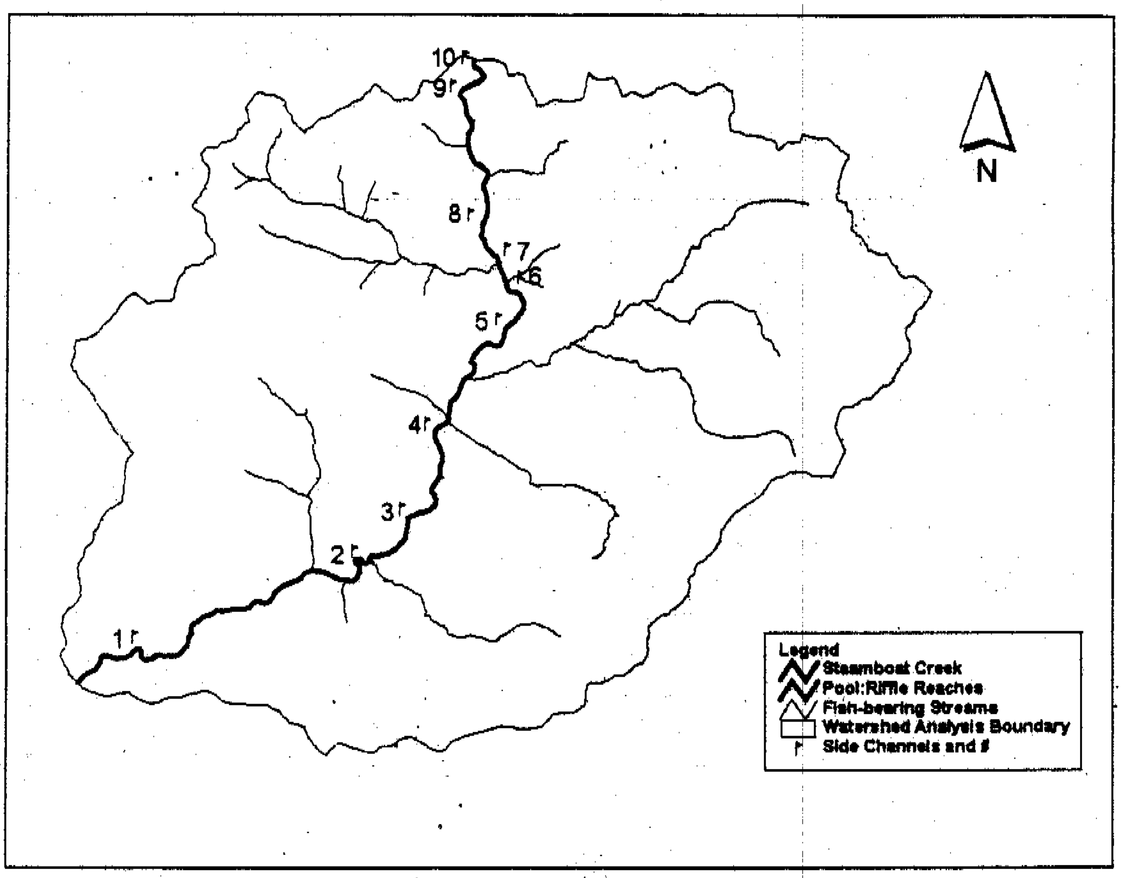


Figure 23. Side channels of the Mainstem Steamboat Creek.

Smaller side channels ranging from approximately 150-300 feet in length were observed but not documented on the inventory. While these shorter areas have some potential to provide high flow velocity refugia and sediment/nutrient retention, the channel tends to be more constrained in these shorter sites so their potential was judged to be minor compared to large side channels.

Table 19. Characteristics of large side channels in the lower approximately 18 miles of Steamboat Creek.

Site	River Mile	Length	Active Width	Active Width Above/Below	Comments	Treatment Priority
1	1.5	690 feet	250 feet	150 feet	Depositional area, no island	Low
2	6	1230 feet	375 feet	80-100 feet	Island w/old growth trees	High
3	7	975 feet	165 feet	105 feet	Island with hardwoods	Mod.
4	9.2	630 feet	150 feet	95 feet	Weak island w/hardwoods	Low
5	11.2	660 feet	156 feet	90 feet	Island w/hardwoods	Mod.
6	12	1500 feet	180 feet	90 feet	Large deposits, SC w/wood jams in margins	High
7	13	780 feet	260 feet	50-60 feet	Island w/old growth trees and wood jams	High
8	13.2	925 feet	162 feet	75 feet	Island w/hardwoods	Mod.
9	16	725 feet	145 feet	80 feet	Bedrock side channel	Low
10	17.8	790 feet	200 feet	75-100 feet	Bedrock side channel, island w/hardwoods	Mod.

Side channel sites 2, 6, and 7 were judged to make the greatest contribution to habitat diversity. Sites 2 and 7 both have islands with late seral vegetation on them. The area of these islands inhabited by late seral vegetation appears to have reduced by approximately 50% since the 1946 aerial photos were taken. This is consistent with the scouring effects of the 1964 flood combined with the chronic large wood removal which has occurred throughout the length of Steamboat Creek since the 1960s. The absence of large wood along the margins of these islands would reduce protection of their streambanks and therefore promote their erosion and loss of late seral vegetation. Presence of late seral vegetation on these islands would tend to promote their stability due to the extensive rootmasses provided by large trees compared to shrub-sized hardwoods which inhabit many islands in Steamboat Creek. Site 6 is also in relatively good condition relative to the other sites by virtue of its extensive gravel and cobble bars, relatively well established hardwood vegetation, and presence of large wood in jams along the channel margin on the east side of Steamboat Creek.

Another interesting aspect of these side channel areas is that they appear to be areas of vegetative diversity. Black cottonwood, while sparsely present in the riparian area of Steamboat Creek, tends to be more dense on the larger depositional areas associated with the larger side channels. Shrub diversity appears to be higher than in more constrained areas. This relative diversity may be because the large side channels have more wide open spaces than the majority of the riparian area of Steamboat Creek. These larger openings are locally unique habitats that may promote localized plant and wildlife species diversity relative to the more typical closed in riparian areas.

Channel Morphology Trends

Stillwater Sciences Inc. (1998) indicated that much of the channel morphology of main stem Steamboat Creek consists of bedrock, forced pool-riffle, and plane-bed morphologies as defined by Montgomery and Buffington (1993). Pool-riffle channels have an undulating streambed that occurs as a sequence of gravel/cobble bars, pools, and riffles (Leopold et al., 1964, as cited by Montgomery and Buffington, 1993). This morphology manifests itself as a rhythmic series of laterally alternating pools and riffles. Forced pool-riffle channels are those whose features are forced by the presence of large wood such as if a log jam in a channel margin facilitates development of a gravel bar and forces the channel to move laterally off the bar.

Plane-bed channels are characterized by long stretches of relatively planar channel bed that may have occasional channel spanning rapids or boulder steps (Montgomery and Buffington 1993). Plane-bed channel reaches generally lack pools and obstructions in the channel thus making them generally less complex aquatic habitat. Plane-bed channel reaches occur naturally in Steamboat Creek in some unknown proportion. However, Montgomery and Buffington (1993) describe that pool-riffle reaches forced by the presence of large wood could metamorphose into plane-bed reaches upon removal of large wood. Chronic riparian timber harvest and stream cleanout along Steamboat Creek and its tributaries have left the lower 17.8 miles of Steamboat Creek averaging 1.1 pieces of large wood/mile. This low amount of wood indicates that much of the large wood has been removed from Steamboat Creek over the past 40 years of management (see later discussion on human impacts to aquatic habitats). Given this management history, it seems likely that there are currently some plane-bed channel reaches in main stem Steamboat Creek that were formerly pool-riffle reaches forced by the presence of large wood.

In summer 1998 several areas with tendencies toward pool-riffle morphology were identified in main stem Steamboat Creek (Figure 23). These were plane-bed areas that did not have distinctly formed pools and riffles in an alternating fashion, but did appear to have gravel/cobble point bars weakly forming in a laterally alternating rhythmic fashion. These are areas where replenishing large wood at the heads of the forming bars may help facilitate development of pool-riffle reaches and restore channel complexity. Like the side channels described above, these areas are high priority areas for large wood additions to Steamboat Creek.

Tributary Streams

Reference Condition

One suite of processes that has played a large role in shaping aquatic habitats in tributary streams of the Steamboat Creek watershed is that of debris flows/dam break floods. Debris flows are rapid movements of large volumes of water charged with soil, rock, and organic debris down steep stream channels (Swanston 1991). They can travel down steep channels (>12% gradient) at up to 35 mph scouring out habitats before they lose energy and deposit in lower gradient stream reaches (often <12% gradient). Debris flows are initiated by a landslide or slope failure that enters a stream. Dam break floods occur when organic debris dams in streams mobilize during high discharge events (Johnson 1991 as cited by Montgomery and Buffington 1993). Failure of these log jams releases water and sediment as a large flood wave that may propagate downstream much like a debris flow. The results are similar to those of a debris flow where the path of the event leaves a highly scoured channel until the depositional area is reached, where there is considerable large wood and sediment.

Debris flows and dam break floods occur at some natural rate to act as profound regulators of aquatic habitat conditions. Swanson et al. 1982 (as cited by Naiman et al. 1992) estimated the natural recurrence interval of debris flows in first-order channels in the central Oregon Cascades as once every 500 years. On the 1946 aerial photos approximately 9 miles of stream appeared to be scoured out by dam break floods or debris flows. This represents approximately 3% of all streams in the watershed. Of these, 1.3 miles were in fish-bearing tributary reaches. This represents approximately 3% of the fish-bearing tributary stream miles that had been scoured out by debris flows or dam break floods under the natural disturbance regime at the time the 1946 aerial photos were taken. These streams were likely scoured down to a highly simplified bedrock condition due to natural processes prior to the onset of industrial-age management of the watershed. The actual number of miles affected by debris flows and dam break floods may have been higher but the 3% was what was visible on the 1946 air photos. While this 3% only represents a snapshot in time, it is likely that under natural conditions an even greater proportion of streams would be expected to undergo debris flows or dam break floods during severe storm events (i.e. 100 year recurrence interval storms).

Large Wood

Large wood is a major component of aquatic habitat conditions and stream channel morphology in tributaries of Steamboat Creek. The streams are made of trees. Large wood in 3rd to 5th order tributary streams (Buster, Longs, Johnson, Reynolds, Big Bend, Little Bend, Deep, Singe, Steelhead, and Cedar Creeks) would naturally tend to be configured as channel spanning log jams, angle logs, "stilted" logs, channel-spanning sill logs, as well as wood in secondary channel and floodplain areas (Bisson et al. 1987).

Stream survey data from roadless area stream reaches represent the best available information available today about what aquatic habitat conditions likely were in

Steamboat Creek tributaries in the reference period. Based on recent stream surveys in relatively unmanaged streams as a reference, large wood (>24 inches diameter, >50 feet in length) quantities probably averaged 50-80 pieces per mile in streams of the Steamboat Creek watershed. Stream reaches in less fire-prone areas (late-seral refugia – upper portions of Steelhead Creek, upper portions of Reynolds Creek) would likely have large wood amounts approaching the upper end of this range. Streams that had undergone natural debris flows or dam break floods likely averaged less than 10 pieces of large wood per mile.

Riparian Vegetation

In the reference condition, riparian vegetation was predominantly in the late seral stage in all sub-watersheds of the analysis area prior to land management activities. Over the entire analysis area 84% of riparian reserve acres were estimated to be in a late seral forest condition (stands greater than approximately 80 years of age). At the sub-watershed scale the proportion of late seral riparian vegetation varied from a low of 66% in the Singe Creek sub-watershed to highs of 92% in the Reynolds, Cedar, and Middle Steamboat Face sub-watersheds (Table 20).

Table 20. Reference and current acreages of riparian reserve in late seral forest condition for each subwatershed of the Steamboat watershed analysis area.

Subwatershed Name (#)	Reference Acreage of Late Seral Riparian Veg (%)	Current Acreage of Late Seral Riparian Veg (%)
Upper Steamboat Face (#5)	1541 (87%)	1207 (68%)
Cedar (#6)	1878 (92%)	1404 (69%)
Big Bend (#7)	3815 (84%)	3035 (67%)
Middle Steamboat Face (#8)	2063 (92%)	1615 (72%)
Reynolds (#9)	1850 (92%)	816 (41%)
Singe (#10)	1072 (66%)	910 (56%)
Deep (#11)	586 (75%)	385 (49%)
Steelhead (#12)	2112 (78%)	1740 (64%)
Lower Steamboat Face (#13)	1548 (81%)	1085 (57%)
Analysis Area Total	**16,465 (84%)**	**12,197 (62%)**

Water Temperature

The diurnal water temperature fluctuations in most tributaries were probably smaller under the reference condition in response to relatively undisturbed riparian vegetation and lower maximum temperatures. The undisturbed condition of Boulder Creek averaged 4° F fluctuation during the warmest week of 1990 while the tributaries in Steamboat Watershed ranged from 5° to 9° F for the same period. Holaday (1992) found decreasing trends in diurnal fluctuations and maximum temperatures for Steamboat tributaries over the 1969-1990 period. Air temperature and streamflow did not account for these trends. Therefore, the apparent regrowth of riparian vegetation appeared to be the major influence. The undisturbed riparian condition of Boulder Creek showed little change for the same period. Natural disturbances would have impacted the riparian shade and channel dimensions, but channel complexity would have likely mitigated the potential effects on water temperature.

Stream pH

The pH distribution was closely related to upslope and channel disturbance. Where debris flows had simplified and widened tributary segments, algae would have had the opportunity to establish, especially following wildfire and the natural release of nutrients. Since debris flows have been a natural channel forming process in this watershed, elevated pH probably occurred below stream segments directly impacted. As seen in City Creek (Powell 1996), the longitudinal distribution of pH would have included localized sites of elevated pH followed by downstream recovery with improving channel and riparian condition until the next disturbed segment. Because of the close relation that dissolved oxygen has to pH as a by-product of photosynthesis, a similar pattern would have occurred for dissolved oxygen.

Streamflow

The peak flow events that historically developed the current stream system probably varied over time with changes in vegetative patterns and climate. Under the reference condition, peak flow increases would have potentially occurred after a catastrophic change in the stand structure, combined with a climatic condition that would have provided large winter storms. For example, a large wildfire that would have reduced the continuous stands of mature trees would have provided such a situation. However, the channels receiving the additional runoff water were more complex than they are today with greater abundance of large channel and riparian wood (Sedell 1981). This former channel complexity would have had an offsetting effect, essentially reducing the peak flow movement downstream because of greater channel roughness and storage of water, while also causing floodwaters to spread out onto adjacent floodplain areas.

Erosional Processes

In the reference condition, mass wasting and surficial (fluvial) forms of erosion were naturally occurring geomorphic processes within the mountainous terrain of the Middle and Lower Steamboat watershed. These erosional processes can have a dramatic influence on aquatic habitat conditions. Sediment production within the watershed is derived from three primary sources: 1) small and widely dispersed mass-wasting events (landslides) that occur upon steep mountain sideslopes and within stream channels; 2) chronic fluvial erosion relating to stream down-cutting and associated lateral bank erosion; and 3) sheet wash, rill, gully, and ravel mechanisms that take place in areas where the vegetative cover has been removed and the soil mass has been disrupted (i.e. from fires, landslides, etc).

Ecosystem function and the majority of riparian habitats remain largely unimpaired as long as erosional processes occur within the range of natural variability or frequency. Severe episodic disturbance patterns, such as stand-replacement fire or rain-on-snow storm events, can yield large volumes of sediment. However, the frequencies, magnitudes, and spatial distribution of such events is poorly known and thus rates of natural erosion are not well understood within the context of large watersheds (Neiman, et al. 1993).

The intensity and distribution of mass wasting or surficial erosional processes that occur throughout the watershed is dictated by an array of factors including: 1) resistance of underlying bedrock to mechanical and chemical weathering processes; 2) topographic profile of hillslope as expressed by steepness and form; 3) influence of surface and groundwater hydrology; 4) soil thickness and properties – cohesive or non-cohesive; and 5) presence of adverse, large-scale geologic structures and localized discontinuities such as flow layering, sedimentary bedding, and jointing patterns.

Landslide Rates and Sedimentation

Scientific literature suggests that sediment delivery to channels was less prior to road building, and sediment transport was likely less efficient. Landslides, as inventoried on aerial photos, have occurred in unmanaged settings within the analysis area at an average rate of 0.0009 landslides/acre. These slides were inventoried on four different air photo flights dating from 1946 to 1997.

A primary source of sedimentation under active forest management has been roads (MacDonald 1991). Roads have supplied episodic and chronic inputs from road fills, surfaces, and drainage. Road drainage has linked sediment sources to the channel. Since roads overall do not mimic natural disturbance processes, road sediment was absent for the reference setting. Once sediment is delivered to the channel today, its movement through the stream system is efficient because of limited amount of large in channel wood (Betscha 1979) in the tributaries and main stem. Historical records document that over a 100 years ago channels had more roughness from large wood (Sedell 1981) reducing sediment routing efficiency and providing sites for sediment storage.

Tributary Streams

Current Condition

The relative direct value of tributaries to anadromous salmonids is discussed in Appendix A, specifically the Bradbury Process (La Marr 1999) and the sub-watershed discussions, and summarized in Table 21.

Table 21. Miles of fish-bearing stream by subwatershed in the Lower Steamboat Watershed Analysis area.

* Miles are easily accessible to brook trout, but they are not necessarily present

** Bradbury Process included the entire Steamboat Creek watershed, so subwatershed rankings number up to 14 even though there are only 9 subwatersheds in this analysis area.

Subwatershed	Steelhead Miles	Cutthroat Miles	Resident Rainbow Miles	Brook Trout Potential Miles *	Bradbury Ranking **
Lower Steamboat Face	5	5	-	-	1
Deep Creek	0	1.5	-	-	14
Singe Creek	1	3.5	-	-	13
Steelhead Creek	1.5	5.5	-	-	8
Reynolds	2	4.1	2.1	1	12
Big Bend	2	2	6.3	7.5	7
Cedar	6	11	-	-	4
Middle Steamboat Face	7.8	11	-	-	6
Upper Steamboat Face	4	6.7	-	-	10

Based solely on fish-bearing stream miles, the most important subwatersheds in the analysis area for fish habitat are the Cedar Creek, Middle Steamboat face, and Upper Steamboat face subwatersheds. For its size, the Cedar Creek subwatershed contributes a disproportionately large amount of fish habitat. As previously described in the discussion on main stem Steamboat Creek, the Lower Steamboat face subwatershed contains an important summer rearing habitat refuge area for juvenile steelhead. Middle Steamboat Face is an important summer refuge for adult summer steelhead. Upper Steamboat Face and Steelhead Creek subwatersheds have considerable potential for fish habitat although both of these subwatersheds need considerable restoration to achieve this potential.

Big Bend Creek is a crucial subwatershed for regulation of summer water temperatures in the 10 miles of main stem Steamboat Creek below its confluence because Big Bend contributes disproportionately large amounts of relatively cold water to the main stem. See the water temperature discussion in this document and associated appendices for more details on this phenomenon.

Aquatic habitat conditions in tributary streams vary considerably. The sub-watershed discussions in Appendix A provide detailed discussions of tributary stream conditions in the analysis area. A detailed description of conditions in the Cedar Creek sub-watershed is documented in the Cedar Creek watershed analysis (Harkleroad 1995). One strong indicator of aquatic habitat complexity and resilience is the amount of large wood present in streams. Figure 24 shows a comparison of the range and average densities of large wood in analysis area streams to those of reference streams. Each reference bar in Figure 24 represents an individual reference stream or reach from elsewhere on the North Umpqua or Tiller Ranger Districts. These reference streams are either in wilderness areas, roadless areas, or relatively lightly managed areas.

The mean density of large wood in reference streams is 55 pieces/mile compared to 24 pieces/mile in analysis area streams. This points out the general lack of large wood in fish-bearing streams of the analysis area. None of the fish-bearing streams average as high as the average condition in reference streams. Reynolds Creek overall averages 45 pieces/mile thanks to one fish-bearing reach (1.7 miles long) that averages 87 pieces/mile. This reach has the single highest wood density of fish-bearing reaches in the analysis area and accompanies the lower 2.1 mile reach of Reynolds Creek which averages 29 pieces/mile. In stark contrast, the entire main stem of Steamboat Creek (17.8 miles), the single largest aquatic habitat in the analysis area, averages 1.1 pieces/mile.

The lack of large wood indicates that the bevy of functions associated with large wood in the "Reference Condition" section of this document are moderately to severely compromised in 3rd order and larger streams throughout the analysis area. Because winter flows are so high in this watershed, three of the most severely compromised functions are availability of overwintering habitat for aquatic fauna, lack of fine organic matter and nutrient retention to fuel aquatic insect communities, and lack of sediment retention to retain gravels for aquatic insect and salmonid spawning habitat. Stillwater Sciences Inc. (1998) suggested that the combination of large wood removal from streams and the 1964 flood eliminated sediment storage in 3rd and 4th order channels and caused scour of these channels to bedrock, a condition which persists today in many streams. See individual writeups of aquatic conditions by subwatershed for more specific conditions in specific tributaries (Appendix A, sub-watershed discussions).

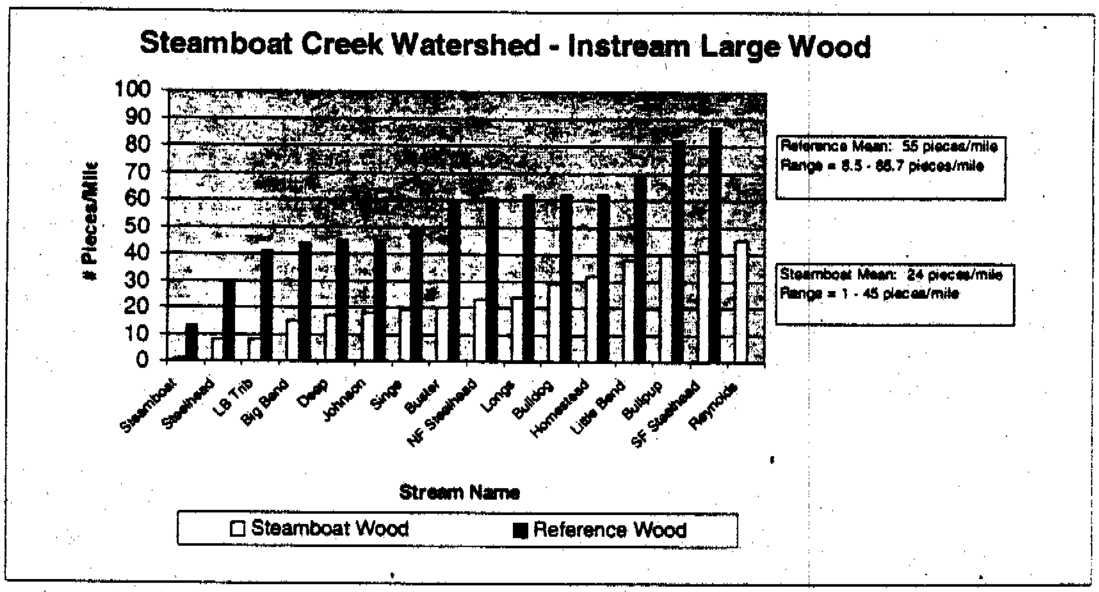


Figure 24. Comparison of large wood densities in analysis area streams with those found in reference streams.

Dambacher's Steelhead Study

Dambacher (1991) estimated summer juvenile steelhead populations, estimated overwinter survival for one year, and characterized habitat for steelhead in the Steamboat Creek watershed. Dambacher made a number of important findings about steelhead trout ecology in the Steamboat Creek watershed. These findings are summarized below in the context of the entire Steamboat Creek watershed including the Canton Creek and Upper Steamboat Creek subwatersheds.

Summer Habitat Utilization by Juvenile Steelhead

Relative abundance results of Dambacher's summer habitat characterization and juvenile steelhead population estimates (Figure 25) show that reach 1 of Steamboat Creek made up 20% of the habitat in the basin by surface area, but supported 33% of all the juvenile steelhead in the watershed during summer. This effect of disproportionately high fish densities was most pronounced in the 3 mile section of lower Steamboat Creek known as Black Gorge where a large number of juvenile steelhead resided during summer.

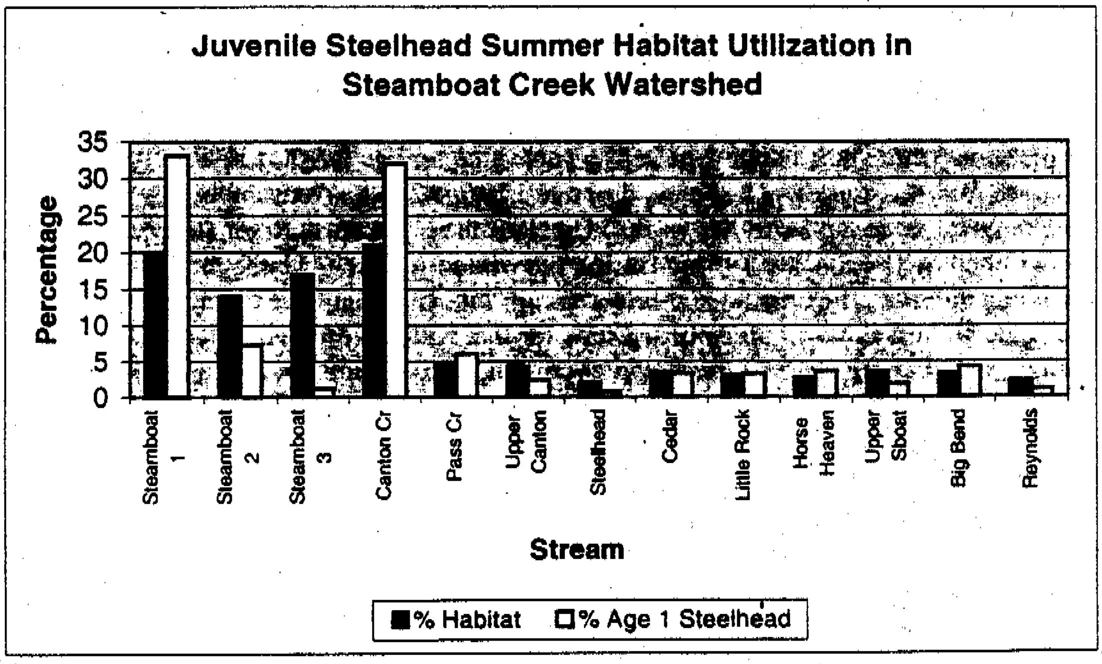


Figure 25. Summer habitat utilization of Steamboat Creek tributaries and reaches by age >1 steelhead trout, from Dambacher (1991).

In contrast, reach 3 of main stem Steamboat Creek (from Big Bend Creek up to Little Rock Creek) was nearly devoid of juvenile steelhead probably due in part to high water temperatures. This reach made up 17% of summer habitat but reared only 1% of steelhead juveniles in the basin. However, this reach was estimated to contain 23% of the spawning gravel in the entire watershed (Dambacher 1991). As described below in the

"Steelhead Spawning" section, this reach is relatively heavily used for steelhead spawning and may be an important node for the entire main stem of Steamboat Creek.

Although summer water temperatures are also high in reach 1 of Steamboat Creek, the large boulder riffles and plunge pools (especially in the Black Gorge area) seem to provide favorable habitat which allows juvenile steelhead to compensate for high temperatures by providing them with favorable feeding conditions. These favorable conditions appear to be widely distributed fast water areas which transport a lot of food in the drift, combined with calm water areas provided by the large boulders in close proximity (Dambacher 1991). This enables fish to hold in the calm water and have easy access to drifting food in the fast water.

In general age 1 juvenile steelhead prefer riffle habitats during summer in large streams such as main stem Steamboat Creek, the lower 2 miles of Big Bend Creek, and the main stem of Canton Creek. In smaller tributaries, summer low flows are so low that riffles are too shallow and virtually uninhabitable to age 1 steelhead. In these smaller tributaries (Cedar, Steelhead, Reynolds, Johnson, Buster, Little Bend, Longs, Singe Creeks), juvenile steelhead strongly prefer pool habitats during summer because these are the only habitats with enough space to physically support them.

Overwinter Survival of Juvenile Steelhead

Dambacher (1991) estimated overwinter survival of juvenile steelhead from age 0 to age 1 as 43% and from age 1 to age 2 as 36%. This value for age 0 fish is relatively high compared to other studies. The survival of age 1 to age 2 fish is extremely low compared to the range of 40 to 82% survival in Fish Creek of the Clackamas River (Everest et al. 1988 as cited by Dambacher 1991). During the winter in which Dambacher estimated overwinter survival, the climate and flow regimes in Steamboat Creek were extremely mild. The highest flows in Steamboat Creek for that winter were two separate 1.25 year storm events. During years of harsh winter conditions overwinter survival rates are likely dramatically lower than the 36% observed by Dambacher (1991). These results led Dambacher to identify winter habitat as a habitat deficiency in Steamboat Creek.

This finding of poor overwinter survival in age 1 steelhead is highly consistent with the lack of overwintering habitat complexity in the Steamboat Creek watershed. It is well documented that salmonids prefer calm water areas along channel margins, in side channels, in interstitial spaces between cobble and boulder substrates, and in pools with deep cover associated with large woody material (Naiman et al. 1992, Bisson et al. 1987, Bjornn and Reiser 1991). The dominance of bedrock in main stem Steamboat Creek and the lack of large wood indicate a relative lack of high quality overwinter habitat for salmonids.

Juvenile Steelhead Life History

Steelhead juveniles in Steamboat Creek use what is known as a "partial rearing" life history (Dambacher 1991). This means that the majority of juveniles (approximately 80%) leave Steamboat Creek as age 1 fish and reside within the North Umpqua River for an additional 1-2 years prior to emigrating to the ocean as smolts. This phenomenon has been documented in other streams of the Pacific Northwest including Calf Creek on the North Umpqua Ranger District where approximately 70% of juvenile steelhead emigrants are age 1 (Harkleroad and La Marr 1993). In contrast, only 50% of steelhead emigrants in Jackson Creek and the upper South Umpqua River are age 1 while the remainder are older smolts (Roper 1995). This difference in life history may be due to the fact that the North Umpqua River provides a hospitable location with good summer water quality for fish to reside an additional year or two after they leave their natal streams. In contrast, the South Umpqua River gets extremely warm with very high pH during summer and is therefore less hospitable for salmonids.

Key Conclusions from Dambacher (1991)

Important steelhead tributaries of Steamboat Creek identified by Dambacher include Canton Creek, Cedar Creek, Little Rock Creek, and Horse Heaven Creek. Of these, only Cedar Creek is within the analysis area. Big Bend Creek was identified as a strong summer water quality influence by virtue of its disproportionately large contribution of cold water to Steamboat Creek. This phenomenon is discussed under the "Water Quality" section in this analysis.

Steelhead Creek, City Creek, Singe Creek, Reynolds Creek, Deep Creek, Buster Creek, Longs Creek, and Little Bend Creek are believed to be less directly important to steelhead production. However, recent stream surveys in Steelhead Creek and City Creek suggest habitat conditions in these two tributaries may be improving since Dambacher's work in the late 1980s.

Other key findings from Dambacher (1991) are:

1) high summer water temperatures are likely a limiting factor to salmonids in the Steamboat Creek watershed, and

2) habitat for overwintering is poor in the Steamboat Creek watershed based on low overwinter survival of age 1 steelhead through a very mild winter in his study.

Steelhead Spawning

Comparative stream survey results from 1967 and 1987 suggest that considerable amounts of gravel substrate (from pea to grapefruit sized rock) has been lost from the Steamboat Creek watershed (Bauer 1967, Dambacher 1991). In 1967 stream surveys of Steamboat Creek and its tributaries were done in which spawning gravel was inventoried within the active channel and its surface area was estimated in each stream reach (Bauer 1967). These methods were repeated in 1987 for the same stream reaches (Dambacher 1991). Results show a large decrease in the amount of gravel present in main stem Steamboat Creek as well as most of its tributaries between 1967 and 1987 (Figure 26).

In 1967 a total of approximately 55,000 square meters of gravel were estimated to be available as spawning habitat compared to 4,900 square meters in 1987. This order of magnitude in reduction is consistent with the processes of large wood removal from streams and reduced large wood inputs due to riparian timber harvest. As noted previously, large wood is instrumental in retaining sediments in streams. It is also likely that during the 1967 stream surveys, channels were excessively loaded with sediment due to the large numbers of landslides and dam break floods which occurred during the 1964 flood just three years earlier.

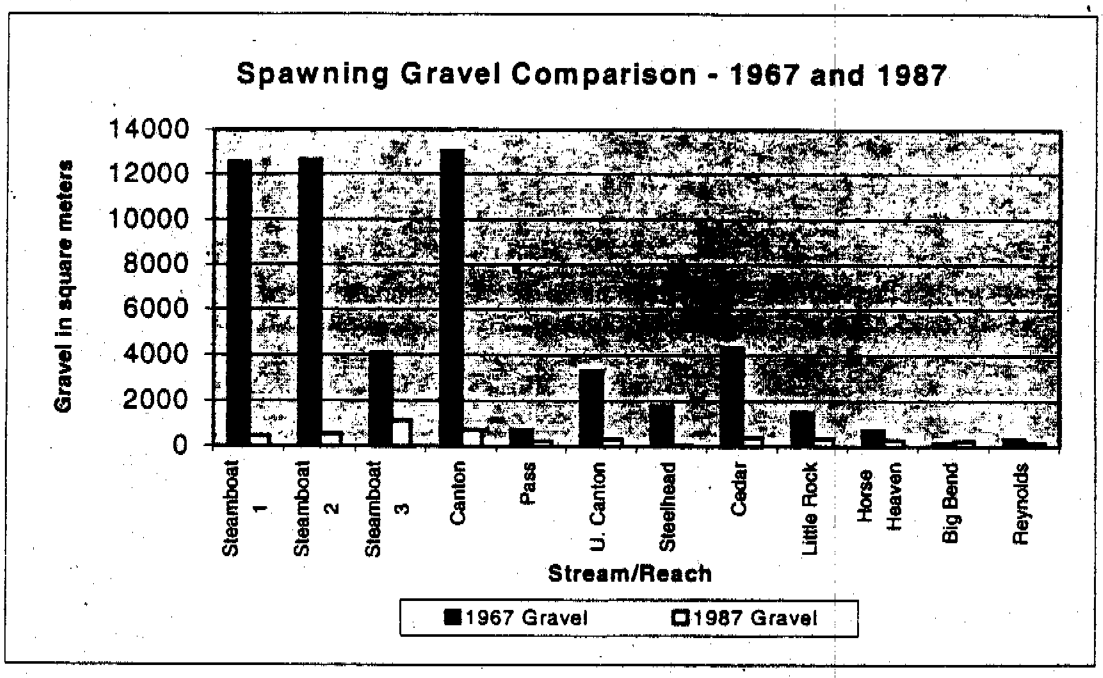


Figure 26. Comparison of spawning gravel inventoried in 1967 and 1987 in Steamboat Creek watershed.

Although this gravel was inventoried as spawning gravel, its loss does not necessarily indicate a shortage of spawning habitat for steelhead in the Steamboat Creek watershed. Dambacher (1991) concluded that the most limiting factor to steelhead production was juvenile rearing habitat rather than spawning habitat.

The implications of this gravel loss may be most important to overall aquatic productivity. The gravel loss represents a tremendous reduction of habitat complexity for aquatic macroinvertebrates. In habitats with substrates with interstitial spaces, such as gravel and cobble-bedded streams, macroinvertebrate communities are more diverse with greater biomass than what is seen in bedrock dominated streams (Gregory et al. 1991, Allan 1995). The loss of macroinvertebrate habitat may be the greatest ecological impact related to the lost gravel. With less gravel present there is simply less habitat for macroinvertebrates and therefore fewer of them to form the prey base for aquatic vertebrates and other species.

Spawning Surveys

Spawning surveys can be used as a means of assessing relative abundance of spawning anadromous fish between reaches or tributaries. In salmon streams, methodologies have been developed to estimate spawning escapements based on spawning ground surveys. This is practical in some streams for salmon because they die after spawning and populations can be estimated based on counts of carcasses and live fish.

Since steelhead do not die after spawning and live fish are not nearly as often seen on spawning grounds as are salmon, spawning ground surveys can only be used as an indicator of relative abundance for steelhead. The primary indicator of abundance for steelhead is redd (nest site) counts since adults are seen so infrequently.

Throughout the 1990s spawning ground surveys have been conducted sporadically in streams in the Steamboat Creek watershed (Table 22). Survey reaches and results in each of these streams are discussed more thoroughly in district progress reports (La Marr 1991, La Marr 1992, Scheurer and La Marr 1999).

Table 22. Summary of steelhead spawning survey data in Steamboat Creek streams for which complete data sets have been collected in at least one year. Survey years occurred between 1991-1998. **Note: The Steamboat Creek survey reach is from the mouth of Big Bend Creek to the mouth of Cedar Creek.**

Stream	Miles Surveyed	# Years of Data	Average Total # of Redds	Average # Redds/Mile
Steamboat	2.5	2	46.5	19
Cedar	4.7	5	119	25
Steelhead	1.3	1	31	24
Little Rock	3.5	2	61	17
Horse Heaven	3	2	58	19

In addition to the results documented above, "spot-check" surveys have been conducted in other tributaries within the analysis area in various years of the 1990s. During a survey of Big Bend Creek at a peak spawning time in 1992 a total of 35 redds were counted in the lower 2 miles of the stream, averaging out to 17.5 redds/mile. Spot checks in Big Bend Creek at peak spawning times in other years have never yielded such high redd counts. Three spot check surveys of the lower 1.3 miles of Reynolds Creek in 1998 revealed the presence of only two steelhead redds in spite of the fact that two of these surveys were conducted during peak spawning times. While relatively large numbers of redds were observed in Steelhead Creek in one year (1998), surveys at peak times in previous years have consistently revealed relatively little spawning there.

Overall, spawning surveys in the Steamboat Creek watershed have revealed that Cedar Creek, Little Rock Creek, Horse Heaven Creek, upper Canton Creek, and some portions of main stem Steamboat Creek are consistently used relatively heavily by steelhead spawners. Spawning utilization is less consistent in Big Bend Creek, Reynolds Creek, and Steelhead Creek. Smaller streams such as Buster, Longs, Little Bend, Singe, Johnson, and Deep Creeks have never been surveyed for steelhead spawning. These streams either have partial to full migration barriers on them or have been found to have very low juvenile steelhead densities in past years suggesting light use by steelhead spawners.

RIPARIAN RESERVES

Reference and Current Condition

The total stream length in the Steamboat Watershed Analysis Area is approximately 435 miles. This includes perennial and intermittent streams where evidence of definable channel and annual scour or deposition can be found. The stream coverage for this analysis area incorporates the mapping from Stillwater Sciences which was a part of the North Umpqua Cooperative Watershed Analysis (PacifiCorp 1998). This product (from 10-meter digital terrain model) appears to better represent the actual stream locations for most subwatersheds than the existing forest stream data layer. The only possible exception is the Reynolds Creek subwatershed, which includes a large proportion of gentle earthflow terrain within its drainage area. In general, stream densities found on gentle landforms are expected to be lower than those found in other steeper landforms. This was not the situation for the Reynolds Creek subwatershed. The Stillwater Sciences mapping identified relatively high drainage density for greater Reynolds Creek. Future stream investigations in Reynolds Creek will help to verify or correct possible mapping errors.

The riparian reserves in this analysis area cover approximately 19,493 acres, or about 27 % of the area. Of the total riparian reserve acreage, 6567 acres or 34 % has been harvested. Figure 27 summarizes the riparian reserve harvest along fish and non-fish bearing streams for each subwatershed.

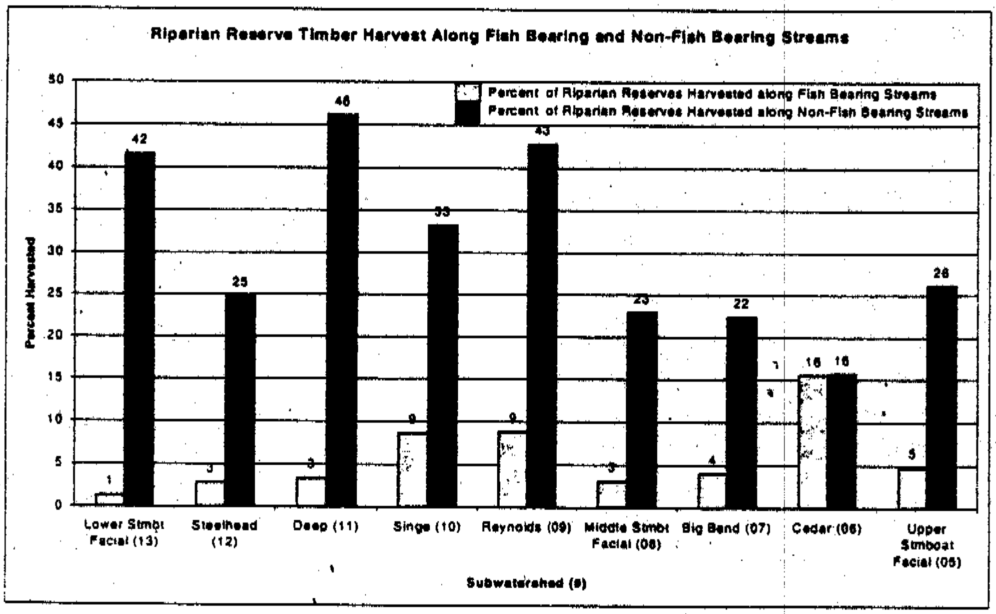


Figure 27. Percentages of riparian reserves harvested along fish and non-fish bearing streams by subwatersheds.

From the displayed results in Figure 27, riparian reserve harvest along fish bearing streams has been proportionately greater for Cedar Creek (16%) than the other streams. During the early 1960's, riparian reserve harvest along the main stem of Cedar Creek took place in association with a proposed hatchery by Oregon Department of Fish and Wildlife (Umpqua National Forest, 1995). However, this proposed hatchery was not built. The Lower Steamboat Facial subwatershed has the lowest proportion of riparian reserve harvest (1%). Most riparian reserve harvest has occurred along non-fish bearing streams across the analysis area. The riparian reserve acreage by fish and non-fish bearing is summarized in Appendix A.

Water Quality

Reference and Current Condition

The water quality in the Steamboat Watershed has been measured by various parameters. The Forest Service has measured summer stream temperature at five long-term and eleven occasional sites since 1969. The agency has also collected suspended sediment and turbidity samples in lower Steamboat. Dissolved oxygen, pH, specific conductivity, nutrients, and trace elements have been collected through contracts in more recent years.

Streamflow is also an important parameter that has been included in the discussion of water quality. Streamflow measurements help interpret many water quality parameters and characterize the watershed.

Water quality parameters of concern have been identified by Oregon Department of Environmental Quality (DEQ). As required in Section 303(d) of the Clean Water Act (1972), Oregon has recently finalized a 1998 update list of waterbodies exceeding water quality standards for the protection of beneficial uses under best management practices. Within the analysis area, those stream segments and parameters are listed in Table 23.

Table 23. Oregon's 1998 Water Quality Limited Streams - 303(d) List for Steamboat Watershed Analysis Area.

Stream Name	Segment	Parameter	Criteria
Main Stem Steamboat Creek	Mouth to Deep Creek	Dissolved Oxygen (summer)	below 8 mg/l or 90% saturation standard for cold water aquatic life
		pH (summer)	exceeded pH 8.5 standard
		Temperature spawning (June & Sept)	7-day average maximum exceeded 55° F standard.
		Temperature rearing (summer)	7-day average maximum exceeded 64° F standard.
	Deep Creek to Big Bend Creek	pH (summer)	exceeded pH 8.5 standard
		Temperature rearing (summer)	7-day average maximum exceeded 64° F standard.
	Big Bend Creek to headwaters	Habitat Modification	lack of LWD
		pH (summer)	exceeded pH 8.5 standard
		Sediment	invertebrate community moderately to severely truncated
		Temperature rearing (summer)	7-day average maximum exceeded 64° F standard.
Cedar Creek	Mouth to headwaters	Habitat Modification	lack of LWD
		Temperature rearing (summer)	7-day average maximum exceeded 64° F standard.
Steelhead Creek	Mouth to headwaters	Temperature rearing (summer)	7-day average maximum exceeded 64° F standard.

Flow Regimes

Streamflows in the Steamboat Creek Watershed exhibit a wide range of flows, from summer low flow to winter storm runoff. These flows have been measured by the U.S. Geological Survey at the stream-gaging station near the mouth of Steamboat Creek (station #14316700 - Steamboat Creek near Glide, OR). Since June 1956 to September 1997, the extremes of record are 27 cubic feet per second (cfs) on September 24-28, 1994 and 51,000 cfs on December 22, 1964 for the greater 145,280 acre (227 square mile) watershed which includes Canton Creek Watershed. The mean seasonal range of flow, which is defined by mean daily flow for the station record, is 78 cfs for the summer period (July - August) to 1,366 cfs for the winter period (November-February). Historical flow analysis and data by the U.S. Geological Survey are in Appendix A.

The summer flow is not equally distributed across this watershed. Holaday (1992) estimated the average daily summer flows for the larger tributaries and main stem sites for 1969 to 1990. Holaday referred to this summer low flow period as the "summer base flow" during July and August. This period does not include September when low flow also occurs. His results are displayed in Table 24.

Table 24. Summer flow (July- August) for Steamboat Creek, selected tributaries, and Boulder Creek, 1969-1990. Extremes are shaded.

Note: cfs = cubic feet per second; cfsm = cfs per square mile

Area	Ave Daily Flow (cfs)	Ave Daily Flow % of Steamboat	Area as % of Steamboat W's	Flow per Area (cfsm)
Steamboat Ck at gage	83.0	100	100	0.37
Canton Ck	26.0	31.0	27.0	0.42
Steamboat Ck above Canton	58	69.9	73	0.34
Steelhead Ck	6.8	8.2	6.9	0.44
Singe Ck	2.2	2.7	4.2	0.23
Reynolds Ck	3.3	4.0	4.9	0.31
Big Bend Ck	29.0	34.9	12.9	1.01
Cedar Ck	1.7	2.0	4.7	0.16
Steamboat Ck bl Little Rock	15.0	18.1	22.9	0.29
Boulder Ck (wilderness)	11.0	13.3	18.8	0.31

From Table 24, the lower average daily summer flows per area have been observed in Cedar Creek and Singe Creek. These two subwatersheds represent about 9% of the Steamboat Watershed, but only about 2.5% of the average daily summer watershed flow that was observed at the mouth of Steamboat Creek.

The most significant subwatershed summer flow is from Big Bend Creek. At the mouth of this tributary, the summer flow is about 35% of the flow observed at the mouth of Steamboat Creek, while representing 13% of the watershed. Brown et al. (1971) found that on July 27, 1969 the instantaneous flow from Big Bend Creek was 1.6 times greater than the flow in Steamboat upstream of this tributary confluence. Holaday (1992) also found a similar relationship for the 1969-1990 "summer base flow" period. However, a recent field investigation during the summer of 1998 found that the higher summer flows are not proportionately distributed across this subwatershed. Instantaneous streamflow was measured at the mouth of Bulldog Creek and Big Bend Creek upstream of this tributary confluence. Bulldog Creek was found to contribute about 74% (14 cfs on August 26, 1998) to the combined flow (19 cfs on August 26, 1998) in Bend Creek below this tributary confluence. Bulldog Creek represents about 28% of the Big Bend Creek subwatershed at this tributary confluence (see Appendix A).

The Bulldog Creek summer flow story becomes even more significant when contrasted to the flow in Steamboat Creek at the mouth. While Bulldog Creek was flowing 14 cfs on August 26, 1998 (max temp: 53° F), Steamboat Creek was flowing 57 cfs. The Bulldog Creek flow was 25% of the Steamboat flow and represents only 3% of the watershed area. In comparison to other tributaries in this analysis area, Bulldog Creek has the largest summer flow per area (1.82 cfsm on August 26, 1998). The higher sustained cool summer flow that comes from Bulldog Creek is an important contributor to summer water quality parameters.

The geology of the Bulldog Creek drainage helps to explain the sustaining cool summer flow. Alpine glaciation has created the features that are seen today. These features include U-shaped valleys, cirque basins, and tarns (e.g. Fuller Lake). Glacial erosion has created some surficial deposits that transmit water directly to subsurface areas, but do not actually retain substantial water. However, the drainage is underlain by young fractured volcanic rocks which tend to have higher porosity and permeability compared to typical Western Cascade rock types. This condition allows high groundwater recharge and conveyance from bedrock to streams. This type of streamflow response and geology is typical in the High Cascade of the Umpqua National Forest (Broeker 1999; Sherrod 1995; Ingebritsen 1994).

Winter flows have not been measured across the watershed because of the difficulty and potential safety concern. The Steamboat Creek gaging station provides the overall winter observation for the watershed. Winter storm runoff events are most likely to occur during November through February. From the gaging station history, 92% of the peak flows (greater than 8,000 cfs) occurred in this period. For the remaining record, the most atypical occurrence was a 5-year peak flow event (22,200 cfs) on March 2, 1972. The earliest in the water year that a peak flow has occurred was on October 30, 1956 and the latest was on April 24, 1996. Both of these peak flows were less than a 2-year event (see Appendix A).

The precipitation-runoff relation for the greater Steamboat Watershed was estimated from the Steamboat gauging station data and Upper Steamboat hourly precipitation station data (see Appendix A). From 1958 to 1990, the mean annual precipitation was 57 inches and the mean runoff was 44 inches. From this water input and output data, the estimated average annual evapotranspiration loss was 13 inches or 23% of the mean annual precipitation input. Most of this loss occurs during spring, summer, and early fall. In contrast, the mean runoff was 78% which reflects the shallow soils and limited soil moisture retention that is typical of most of the basin. The shallow soils contribute to a characteristic flashy winter runoff response and limited groundwater storage (with the exception being Big Bend Creek as described above). During the summer season of greatest potential evapotranspiration loss, both precipitation and runoff are seasonally lower.

Considering the Late-Successional Reserve allocation, the future vegetative structure will increase the potential evapotranspiration during the summer base flow period (resulting in lower summer base flows), but also reduce available winter soil moisture which contributes to storm runoff (resulting in potentially lower winter peak flows) (Jones and Grant 1996).

Water Temperature

Summer stream temperature has been evaluated in the Steamboat Watershed by a number of studies. In 1969, Brown et al. (1971) studied summer temperature at 17 stream sites, which included main stem and tributaries and demonstrated the importance of riparian shade. Hostetler (1991) analyzed the 1969 to 1989 data for the five long-term sites (see Appendix A) and found that most of the sites showed a decreasing temperature trend while air temperature showed no change and flow showed an increasing trend. Holaday (1992) revisited Brown's study during the summer of 1990 and also evaluated long-term trends (1969-1990) and found stream temperature decreases were more significant in some tributaries. Holaday also found that minimum stream temperatures had decreased for the long-term sites and the diurnal fluctuations for several tributaries decreased. Dambacher (1990) found that summer water temperature greatly affected juvenile steelhead distribution, abundance, and habitat utilization. He went on to state that "the single most important factor limiting juvenile steelhead production in Steamboat Creek basin is high summer water temperature."

The 1990 summer stream temperature from Holaday's study was used in this analysis for characterization of the analysis area. This is the most recent summer data that included both 5 long-term and 6 occasional monitoring sites. A complete data history of stream temperature monitoring for the long-term sites is in Appendix A.

The 1990 stream temperature data was reduced to the summer 7-day warmest period (Table 25). This level of data reduction allowed comparison to DEQ temperature standard. The standard for the protection of salmonid and resident fisheries during the summer rearing period follows:

> *"Seven (7) day moving average of the daily maximum shall not exceed .... 64° F (17.8° C) .... unless specifically allowed under a Department-approved basin surface water temperature management plan..."*

All of the temperature monitoring sites exceeded this temperature standard during the summer of 1990. Steamboat Creek from mouth to headwater has been listed as water quality limited for summer rearing temperature and also from mouth to Deep Creek for June and September spawning temperature (55° F).

The wide main stem channel condition with a southerly aspect and shallow summer streamflow greatly contributes to the warmer stream temperature. In contrast to lower Boulder Creek, the main stem Steamboat sites had 2-3 times greater diurnal fluctuation. This relationship between minimum to maximum stream temperature reflects the wide main stem condition where riparian trees can only partially shade the stream.

Table 25. 1990 stream temperature parameters during the warmest 7-day period for Steamboat main stem and tributaries, and Boulder Creek (below wilderness).

Stream	Warmest 7-Day Period	Average Maximum (°F)	Average Minimum (°F)	Diurnal Fluctuation (°F)
Steamboat Creek above Canton Creek	July 11-17	78	68	10
Steelhead Creek	Aug 5-11	68	61	7
Steamboat Creek above Steelhead Ck.	July 10-16	74	65	9
Singe Creek	Aug 7-13	66	61	5
Steamboat Creek above Singe Creek	July 10-16	75	63	12
Reynolds Creek	Aug 6-12	69	61	8
Big Bend Creek	July 12-18	65	56	9
Steamboat Creek above Big Bend Ck.	Aug 5-11	77	69	8
Cedar Creek	Aug 5-11	68	61	7
Steamboat Creek above Cedar Creek	July 10-16	76	64	12
Steamboat Creek below Little Rock Creek	July 12-18	73	61	12
Boulder Creek (below wilderness)	Aug 7-13	68	64	4

The Big Bend Creek/Bulldog Creek influence on the main stem stream temperature is a critical factor. The large amounts of cooler stream flow coming from Big Bend/Bulldog Creek, which has been discussed, provides significant main stem thermal recovery. The 1998 temperature monitoring results for Big Bend Creek and Bulldog Creek are summarized in Table 26. Bulldog Creek diurnal fluctuation was 8° F, which may seem to be larger than expected for a strongly groundwater-influenced system. However, 31% of the riparian reserves (including 7% of those along the main stem) within the Bulldog drainage have been harvested, which potentially has an influence on the current condition (see Appendix A).

Table 26. 1998 stream temperature average maximum, average minimum, and diurnal fluctuation for the warmest 7-day period.

Stream	Warmest 7-Day Period	Average Maximum (°F)	Average Minimum (°F)	Diurnal Fluctuation (°F)
Bulldog Creek	July 21-27	61	53	8
Big Bend Creek Above Bulldog	July 22-28	67	60	7

On July 27, 1990, Big Bend Creek maximum stream temperature was 10° F cooler then Steamboat Creek upstream of this tributary. The Steamboat Creek temperature down stream of Big Bend Creek declined 7° F (Holaday 1992). For the 1990 7-day average maximum temperature, Big Bend Creek was 12° F cooler than Steamboat Creek. Figure 28 displays the main stem maximum temperature profile for July 27 in 1969 and 1990 (Holaday 1992). Both profiles show the influence that Big Bend Creek/Bulldog Creeks have on the main stem.

Figure 28 also illustrates the decreasing maximum temperature trend from 1969 to 1990. For these two years, air temperature was 4° F warmer in 1990 and streamflow was 18cfs higher in 1969. Holaday (1992) did not find a trend in air temperature or streamflow for the 1969-1990 period. Therefore, the regrowth of riparian vegetation and its associated shade, was determined to be the primary influence on the decreasing maximum summer stream temperature. Holaday also found a decreasing minimum stream temperature trend for the long-term monitoring sites and decreasing diurnal fluctuation for some of the sites.

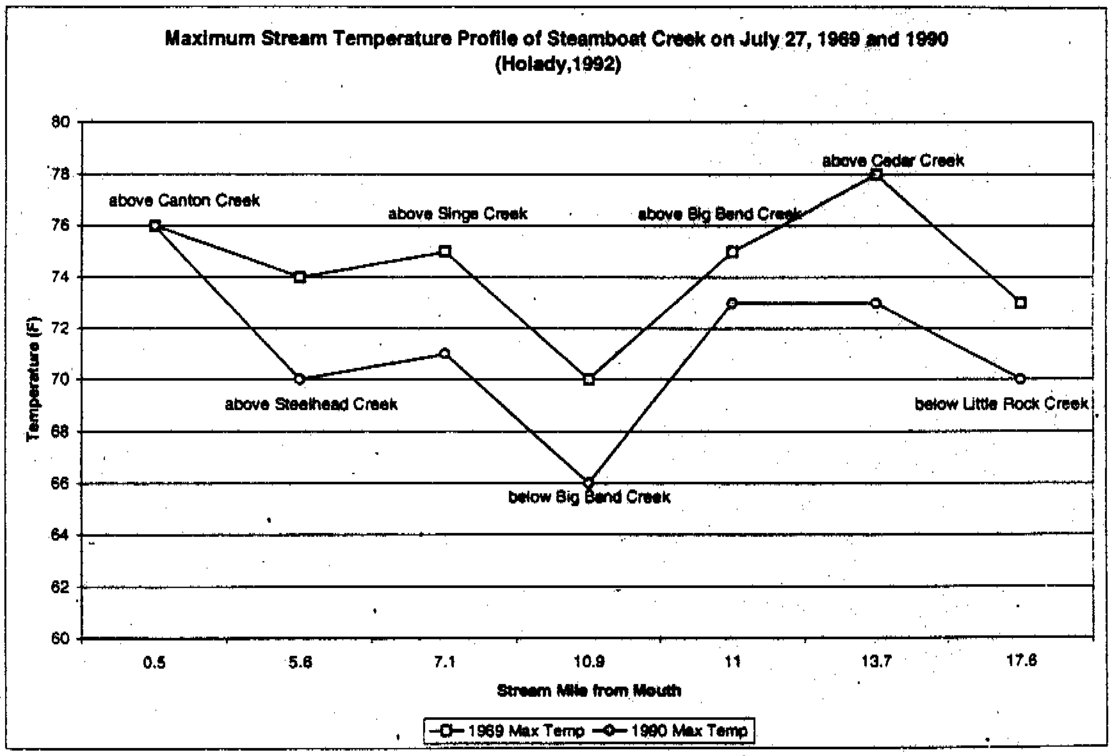


Figure 28. Steamboat Creek maximum stream temperature profile on July 27, 1969 and 1990.

Turbidity and Suspended Sediment

Turbidity monitoring began in Steamboat Creek in 1972 above the Canton Creek confluence. A turbidity/flow ratio analysis has been done on this data. This analysis characterizes the watershed response in terms of turbidity that is produced per unit of flow. Since fall and early winter flows generally flush a stream system of loose inorganic and organic particles that influence water clarity, this analysis uses the turbidity and flow that is generated after the flush period when turbidity response per unit of flow is relatively constant. Figure 29 displays the results of this analysis.

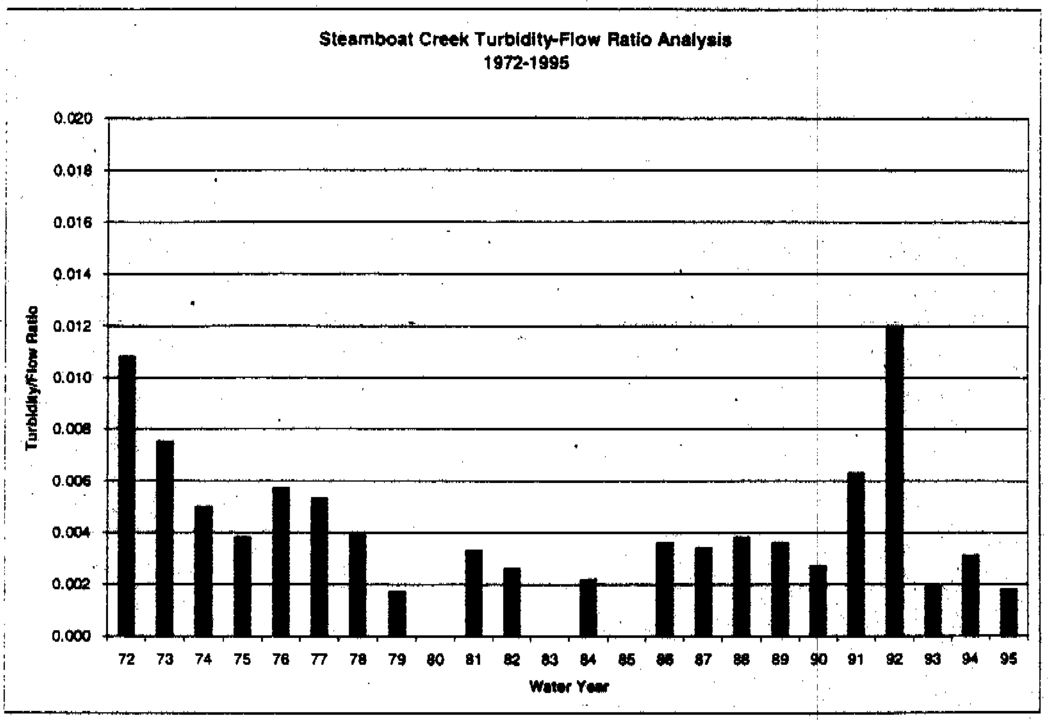


Figure 29. Turbidity /Flow Ratio Analysis for Steamboat, 1972-1995.

Since water year 1981, the turbidity/flow ratios have been relatively constant except for the slight rise in 1991 and 1992. It appears from the analysis that Steamboat Creek did not make as definable a transition from fall flush to winter flow generated turbidity in 1992. The antecedent fall sediment condition, which may have been influenced by the previous spring, may have also influenced this difference. This slight rise was not related to above average winter flow and resultant erosion. In fact, for the November to February period, the average monthly flow was about 35% less than the long-term average and only one peak flow (11,000 cfs; +1.25 year event) occurred above the 8,000 cfs base flow in water year 1992. In contrast, the average winter flow for water year 1995 was about 7% higher than the long-term average and two peak flows (12,100 cfs, +1.25-year event; 8,120 cfs, -1.25-year event) occurred, but the turbidity/flow ratio was less than 1991 and 1992.

The water samples have also been analyzed for suspended sediment since 1985. A similar relationship to flow will be evaluated in the future for suspended sediment. Turbidity is an optical measurement of water clarity and suspended sediment color can effect the results. The relationship of turbidity to suspended sediment can be variable. However, because of greater difficulty analyzing suspended sediment, turbidity has been used as a general indicator of erosion associated with winter runoff.

A study of suspended sediment in Southwest Oregon (Curtiss 1975) found that Steamboat Creek had higher annual suspended sediment yield in contrast to the South Umpqua River at Tiller (449 square mile area). For 18 years of record, Steamboat Creeks mean annual suspended sediment yield was 770 tons per square mile, while South Umpqua Rivers was 120 tons per square mile. The flashier runoff characteristic of Steamboat Creek probably contributes to the higher sediment yield. The bankfull flow or 1.25-year peak flow event for Steamboat Creek is 45 cfsm and South Umpqua River at Tiller is 25 cfsm (Wellman 1993).

Water Chemistry

In addition to temperature, other water quality parameters were monitored during the 1996 and 1998 summers and 1996 fall to better characterize the current watershed condition (Table 27).

Table 27. Water quality parameters sampled under contract and principal investigator.

Investigator	Parameters
Colliding Rivers Research, Inc. Summers 1996 and 1998	pH, dissolved oxygen, temperature
U.S. Geological Survey fall 1996	major inorganic ions, trace elements, nutrients ,specific conductance, dissolved oxygen, pH, alkalinity, temperature, and flow

The sampling done by Colliding Rivers Research, Inc. involved visiting many sites throughout the Steamboat Watershed. Within this analysis area, sites in the main stem and Cedar Creek were identified by stream mile allowing the 1998 sampling to repeat the 1996 sampling. Specific conductance and alkalinity were sampled at selected sites both years. The 1998 data and graphs from this contract are in Appendix A.

The U. S. Geological Survey sampling involved a single visit to Singe Creek. As part of this contract, three sites in upper Steamboat were also sampled. The information and discussion covering filtered water analysis for these sites are in the Upper Steamboat Creek Watershed Analysis (Umpqua NF 1997). The 1996 data for Singe Creek are in Appendix A.

Sampling by Colliding Rivers Research, Inc. showed a close relationship between dissolved oxygen (DO) and pH (Powell 1996 and 1998). The Steamboat main stem and Cedar Creek were longitudinally sampled morning and afternoon. The main stem was sampled on five dates. The overall results revealed that the diurnal fluctuation of DO and pH tracked closely together. High DO values coincide with high pH during the late afternoon while morning DO and pH values were the lowest. This suggests that photosynthesis and respiration of aquatic biota are influencing these DO and pH trends (Pogue and Anderson 1994; Powell 1996). Observations identified large accumulations of filamentous algae. Fresh water DO is typically a function of temperature and atmospheric pressure, but for the sampled sites the photosynthetic activity appears to offset this relationship.

Higher pH and DO were frequently measured immediately downstream of bedrock segments where algae tends to proliferate. In bedrock, algae grows unchecked, due in part to the lack of "grazing" aquatic insects. These "grazers" require gravel and cobble stream substrate as habitats. Some recovery was observed downstream when channel complexity improved, with more gravel/cobble in the streambed substrate, along with increased levels of large woody debris and riparian shade.

The DEQ water quality standard for pH to protect resident and salmonid fisheries, aquatic life, and water contact recreation states that:

> *"pH shall not fall outside the following range(s):*
> *Umpqua Basin: 6.5 to 8.5"*

Occurrences outside of the standard within the analysis area were found at most sites in the main stem, but not in Cedar Creek. For the seven main stem sites within the analysis area, maximum pH exceeded the standard 83% of the time for 35 samples. The pH diurnal fluctuation was largest in mid August when all afternoon samples for the seven sites exceeded the standard on two different dates. Since sampling was at select times and not continuous, these results characterize the high pH and large pH daily cycle that occurred and not necessarily the extremes. Steamboat Creek from mouth to headwater has been listed as water limited for pH.

The DEQ water quality standard for DO to protect resident and salmonid fisheries and aquatic life follows:

> *"For waters identified as providing cold-water aquatic resources, the dissolved oxygen shall not fall below 8.0mg/l..."* (for individual grab samples)

Occurrences less than the standard were observed only in the main stem. For these main stem sites, 14% of the 35 samples were less than 8.0 milligrams/liter (mg/l). For these samples, DO saturations were less than 90% and occurred in the morning. DO less than the standard was observed from above Canton Creek to above Cedar Creek, while the site above Big Bend Creek had the most occurrences below the DEQ standard for DO. Steamboat Creek from mouth to Deep Creek has been listed as water quality limited for summer DO.

Cedar Creek in 1996 had subsurface flow at stream mile 2.8 where large gravel and cobble deposits occurred above a debris jam. The result was depleted DO of less than 8.0

mg/l immediately downstream where the water was not exposed to air. The DO levels quickly recovered downstream. A 25-year flood occurred in Steamboat Watershed on November 18, 1996, which physically changed the channel and allowed surface flow to continue through this same site. The DO depletion observed at this site in 1996 was not observed in 1998.

The U.S. Geological Survey (USGS) sampled four streams in the fall of 1996, but only Singe Creek is within this analysis area. City Creek, Horse Heaven Creek, and Steamboat Headwaters were discussed in Upper Steamboat Watershed Analysis. The primary focus of this USGS investigation was to evaluate the major-ion, nutrient, and trace-element concentrations in these four streams (Rinella 1998).

Singe Creek was found to have primarily calcium sulfate water. Of the four streams sampled, Singe had the largest concentrations of most major-ion constituents, but smaller concentrations of most nutrients. Because of the calcium sulfate water environment along with low alkalinity concentration (3mg/l) and relatively lower pH, it appears that Singe Creek may be receiving naturally occurring acidic water. The thermally altered geology of Singe Creek potentially contributes to this condition.

Of the 18 trace elements used to analyzed filtered water, only six were detected in Singe Creek (Table 28). These element concentrations are below acute water quality criteria of concern. Iron and zinc are the only trace elements that have chronic toxicity criteria established by the U.S. Environmental Protection Agency (USEPA) for the protection of aquatic life. The iron and zinc concentrations did not exceed the USEPA criteria (Rinella 1998).

Table 28. Trace elements detected in Singe Creek and the concentrations.
Note: µg/l = micrograms/liter

Stream	Aluminum µg/l	Barium µg/l	Cobalt µg/l	Iron µg/l	Manganese µg/l	Zinc µg/l
Singe Creek	8	31	1	11	109	4

Bottom sediments were analyzed for 44 trace elements. Of this number, 13 are of interest because of the frequent association with human activity. These trace elements are antimony, arsenic, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel, selenium, silver, and zinc (Rinella 1998). All 13 trace elements were detected in Singe Creek. In comparison to the interim Canadian threshold effect level (TEL) for the protection of aquatic life, four trace elements in Singe Creek exceeded these guidelines. These trace elements were arsenic, chromium, copper, and nickel. The concentrations for these 4 trace elements are displayed in Table 29.

Table 29. Trace elements in bottom sediment that exceed the Canadian threshold effect level (TEL). Note: μg/l = micrograms/liter

Stream	Arsenic μg/l	Chromium μg/l	Copper μg/l	Nickel μg/l
Singe Creek	23	64	37	24
TEL	5.9	37.3	35.7	18

The TEL is based on bulk sediment samples and this investigation analyzed sediment less than 62 micrometer size fraction. Rinella cautioned the use of TEL concentrations "because the less than 62 micrometer size fraction tends to have higher concentrations than bulk sediment." Trace elements tend to be attached to the smaller particle size. Therefore, bulk samples tend to dilute the concentration.

Arsenic concentrations were also described as enriched for the Singe Creek site (Rinella 1998). From a similar investigation in the Willamette River Basin, a "break-point" concentration was defined as the point where below this level was considered background and above was considered enriched (naturally or because of human activities). The "break-point" level for arsenic was defined as 10 μg/l compared to the 23 μg/l found in Singe Creek.

Human Impacts to Fish and Aquatic Habitats

Humans can impact fisheries resources either directly or indirectly. Direct impacts can come from human activities such as fishing, swimming, or poaching. Indirect impacts come from activities that can alter aquatic habitats such as mining, riparian timber harvest, road construction and maintenance.

Direct Impacts

A number of recreational activities directly impact fisheries resources in Steamboat Creek. The actual fisheries previously described for coho salmon, spring chinook salmon, and summer and winter steelhead trout have the obvious direct impact of removing potential spawners from populations.

Activities associated with camping and swimming in Steamboat Creek can impact adult summer steelhead attempting to hold in their pools over summer. Of the approximately 30 adult holding pools within the analysis area, 17 of them have recreation sites (either developed or regularly used dispersed sites) on the streambanks adjacent to the pools. Human swimming within pools occupied by adult steelhead may force fish to evacuate pools and hold in less favorable pools. This phenomenon has been observed in Steamboat Creek in the past. Even if human swimming activity does not force fish to evacuate pools, it subjects them to physiological stress and may reduce their ability to survive and reproduce. Standards and guidelines from the 1990 Umpqua National Forest Land and Resource Management Plan discourage swimming in adult holding pools, but to date these standards and guidelines have never been explored and enforced in an interdisciplinary manner.

Poaching is another obvious direct impact of removing and killing individuals from the spawning population. Poachers target adult holding pools, many of which are associated with recreation sites located adjacent to holding pools. Poaching of adult steelhead trout from Steamboat Creek has long been a problem that has been greatly rectified in recent years with a cooperative law enforcement effort between the Forest Service and Oregon State Police.

Historic Mining Effects

Aquatic habitat in the main stem of Steamboat Creek has been affected by historic placer mining activity. We believe the most extensive placer mining in Steamboat Creek occurred after the turn of the 20^{th} century from approximately 1915-1940. An elaborate aqueduct system is evident today beginning near the mouth of Little Rock Creek and continuously working its way down to approximately Longs Creek. This aqueduct was used to pipe water from Little Rock Creek on a gravity-feed system downstream approximately 2.5 miles to near Longs Creek. Water from the system was piped down to Steamboat Creek where instream gravel and cobble bars as well as terrace deposits were hydraulically mined. While the larger cobble and boulder sediments (softball and larger-sized) were removed and stacked along streambanks and are still evident today, the finer sediments were run through sluiceboxes to find the gold. A smaller, less elaborate aqueduct system was developed from Buster Creek downstream approximately 0.5 mile to near Steamboat Creek.

We used our knowledge of the historic mining locations, combined with field reconnaissance in summer 1998 to identify portions of Steamboat Creek most impacted by historic placer mining (Figure 30). Evidence of past mining activity is present in the form of localized old mossy tailing piles along stream banks and in terrace areas.

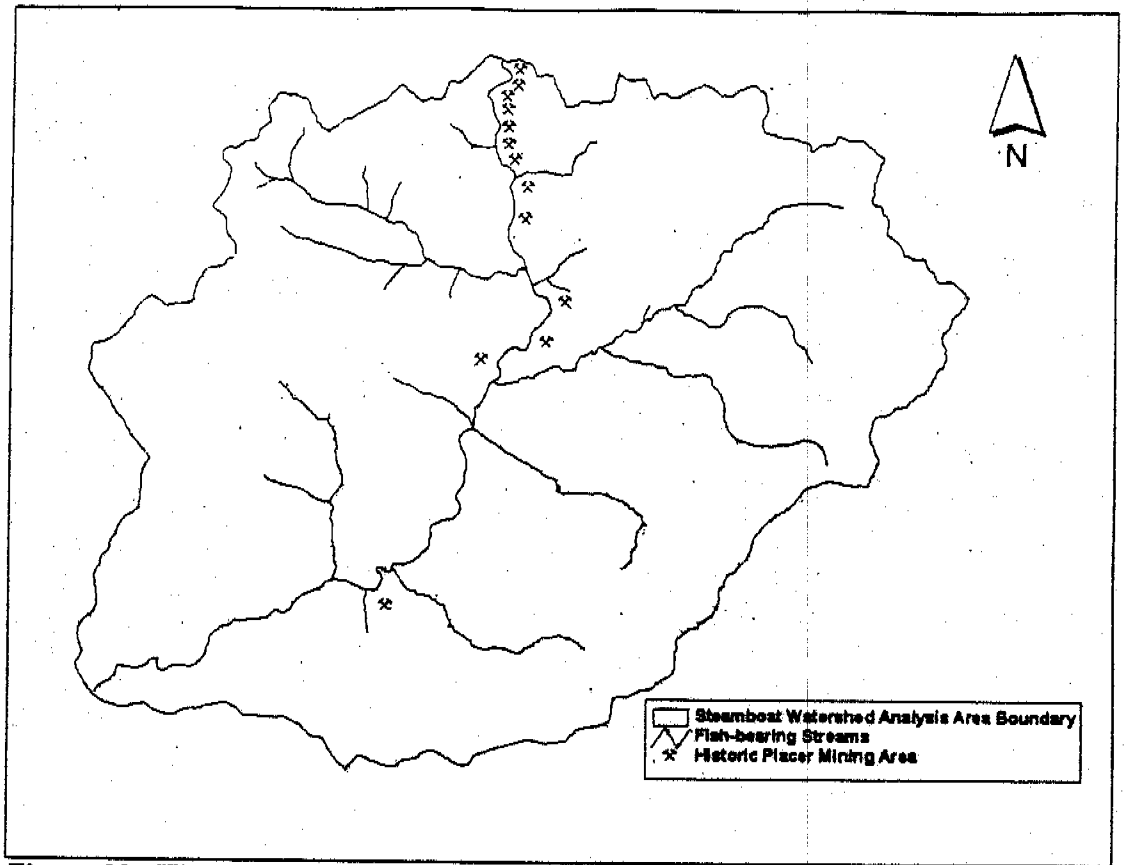


Figure 30. Historic placer mining areas along Steamboat Creek.

The portion of Steamboat Creek most impacted by this activity is the upper 3 miles in the analysis area from the mouth of Buster Creek up to the mouth of Little Rock Creek. While this area had the extensive aqueduct system, it also contained the highest concentrations of old tailing piles. It is likely that mining impacts were substantial throughout this portion of the stream. Most cobble/gravel bars present in the stream were likely mined out thus destabilizing them and promoting their subsequent erosion. Any down trees perched on gravel/cobble bars would likely have been cut up and either removed or used prior to mining the bars. The aquatic effects would be a loss of complex gravel and cobble substrates necessary for aquatic insect production, interstitial spaces for salamanders and frog larvae, and spawning habitat for salmonid fishes. Loss of large wood would have reduced the stability of bars, reduced nutrient and fine organic matter retention, and reduced the amount of low water refuge areas in channel margins necessary as overwintering habitat for aquatic organisms. These impacts were likely extensive in the upper 3 miles of Steamboat Creek in the analysis area but they also occurred to a lesser degree at a number of other isolated locations all the way down to Steamboat Falls (Figure 30).

Stillwater Sciences (1997) in their watershed analysis of the North Umpqua River suggested that the bedrock dominance of Steamboat Creek is primarily natural in origin. They based this finding in part on a comparative air photo inventory of depositional features in Steamboat Creek using the 1946 aerial photos as a "reference" condition and the 1989 photos as a "current" condition. One aspect of using the 1946 aerial photos as a "reference" condition is that by the time these photos were taken, there had already been significant amounts of placer mining in Steamboat Creek. It is likely that channel conditions had already been altered, particularly in the upper 3 miles of the main stem in the analysis area (see section on Mining below). Based on the placer mining history, it is likely that there had been a loss of some depositional areas due to mining prior to the taking of the 1946 aerial photos. Therefore, the conclusion made by Stillwater Sciences that the bedrock dominance is primarily natural needs to be tempered with the consideration that their reference condition did not consider previous placer mining impacts.

Riparian Timber Harvest and Stream Clean-out

The riparian reserves in the analysis area have long been subject to timber harvest, down wood removal, and log jam removal from streams. Examination of the North Umpqua Ranger District's timber sale records indicate that since 1953 there were no fewer than 30 timber sales that indicate riparian reserve timber harvest and stream clean-out in the fish-bearing stream reaches of the analysis area. Of these 30 sales, 18 of them occurred along the lower 23 miles of the main stem of Steamboat Creek. These numbers undoubtedly underestimate the amount of riparian harvest because there was a gap from approximately 1958-1969 within the timber sale records examined where there were no sale records whatsoever. Many other sales harvested timber in riparian areas of numerous headwater nonfish-bearing streams.

One past management activity that was particularly damaging to aquatic habitats was that of stream clean-out. From some time in the 1960s until some time in the 1980s large wood was actively removed from streams. This was thought to benefit fish passage and prevent damage to bridges and other facilities downstream due to log jam formation upon them. In fact, one goal of Steamboat Creek watershed stream surveys in the 1960s was to identify log jams that needed to be removed from streams to facilitate fish passage (Bauer 1967).

Fish-bearing streams that have undergone riparian timber harvest and/or stream clean-out have been mapped based on a combination of timber sale records and recent field identification of stream clean-out remnants (Figure 31). Approximately 38 miles of fish-bearing stream have undergone riparian timber harvest/stream clean-out out of the total of 53 stream miles of native fish habitat in the analysis area (excluding brook trout miles). In general, in areas where riparian timber harvest has previously occurred, evidence of past stream clean-out can often be found. In addition, stream clean-out has also been conducted in stream reaches that have not necessarily undergone riparian timber harvest.

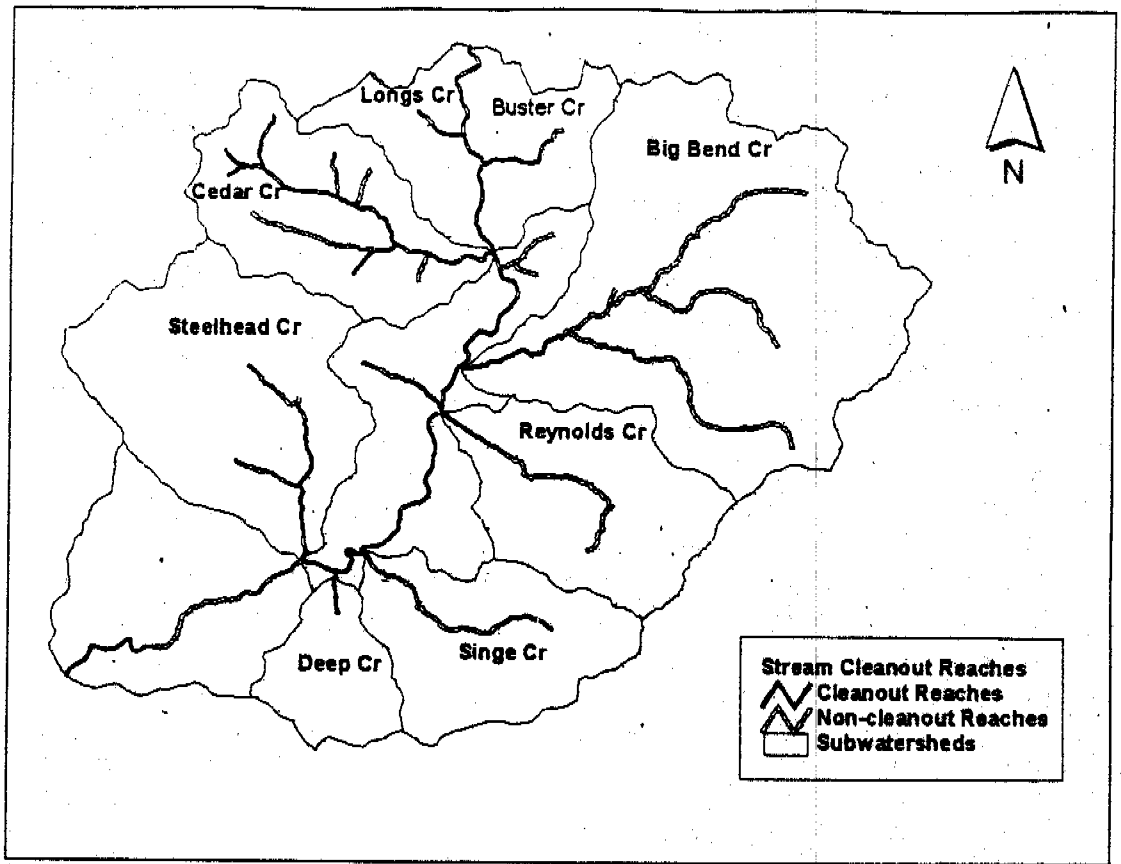


Figure 31. Stream clean-out reaches within the Lower Steamboat Watershed.

Fish-bearing stream reaches that have not undergone stream clean-out have more large wood in them than reaches that have been cleaned out (Figure 32). Partial clean-out reaches are those where a portion, generally between 1/3 and 2/3 of the reach has undergone stream clean-out. Partial clean-out reaches have intermediate levels of large wood in them (Figure 32). The data presented in Figure 32 for non-clean-out reaches is only an indication of reaches that, based on timber sale records, have never undergone stream clean-out. Given the apparent 11year gap in the timber sale record, some of these reaches may also have undergone clean-out.

One aspect of the riparian timber harvest/stream clean-out puzzle is the effect of chronic maintenance associated with riparian roads. From the time of road construction, road corridors are managed to minimize risk of trees falling onto roads and injuring people or damaging road facilities. This means that potential hazard trees have long been harvested along riparian roads, thus removing the trees with the highest potential to naturally fall into streams and riparian areas. In addition, any trees that have blown down onto roads have typically been bucked into small enough pieces to move them easily off the road (or into standard log lengths for salvage). While bucking down trees into smaller pieces may have few negative implications for wildlife species dependent on down wood, the reduction of size often makes such wood much more prone to transport by the adjacent stream and thereby less viable as aquatic habitat components.

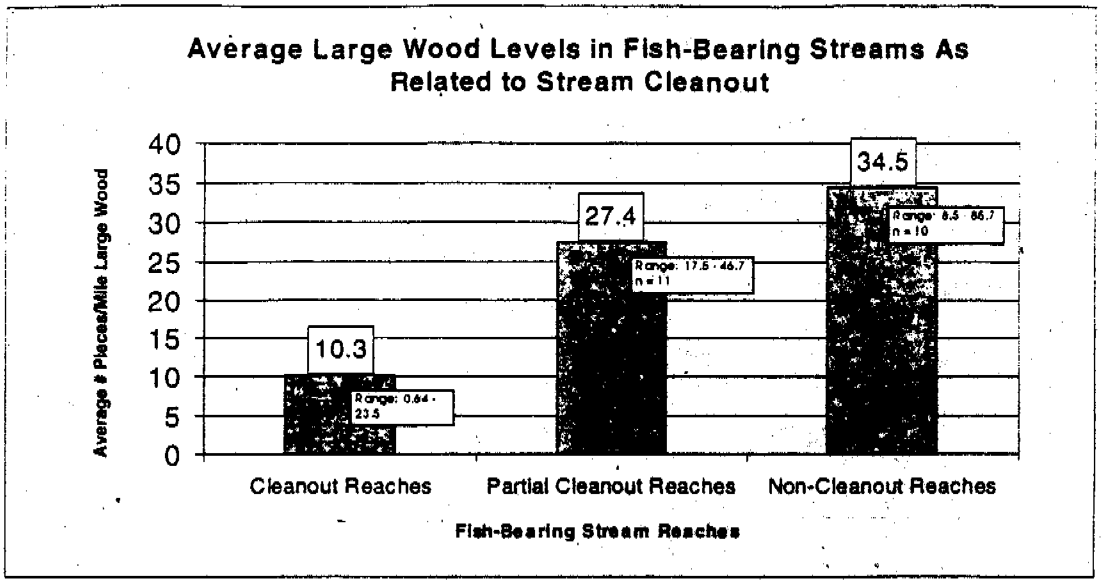


Figure 32. Comparison of large wood levels in fish-bearing streams in the Lower Steamboat Watershed Analysis area subject to differing levels of stream cleanout.

Stream clean-out in main stem Steamboat Creek as well as tributaries has reduced the source available to be transported to downstream reaches of Steamboat Creek. Extensive hazard tree removal and riparian timber harvest along Steamboat Road has substantially reduced inputs from blow down, bank cutting, and in some cases streamside debris avalanches. The mere presence of Steamboat Road has reduced wood inputs to the creek in that as large trees fall from upslope onto Steamboat Road they are virtually always cut into smaller pieces and either removed or pushed off the road. Over the past 45 years very few of these pieces have made it into the stream or floodplain area. At approximately River Mile 6.5 there is a large earthflow whose toe has been chronically cut by Steamboat Creek. In the 1980s the tow of this earthflow was heavily armored with riprap to prevent the creek from eroding it thereby preventing naturally concurrent inputs of sediment and large wood (Stillwater Sciences Inc. 1998).

The dominance of bedrock may be slightly more pronounced today than historically. Loss of large wood due to historic mining, riparian timber harvest, stream cleanout, combined with erosive effects of historic placer mining have likely led to a net loss of gravel/cobble bars in some portions of the main stem and a consequent increase in bedrock substrate.

Large wood has been chronically removed from Steamboat Creek over the past 45 years with activities such as riparian timber harvest, stream cleanout, and hazard tree removal along Steamboat Road. Although the large wood supply for Steamboat Creek has been chronically reduced since approximately 1950 with the construction of Steamboat Road, we were able to roughly compare large wood levels in the lower 6 miles of Steamboat Creek in 1967 compared to 1989 based on air photo interpretation. Relatively low elevation air photo sets of Steamboat Creek with stereo pairs were available from each of these years. Although large wood had already been depleted, on the 1967 photos a total of 43 pieces of large wood were observable from the mouth of Steamboat Creek up to Steamboat Falls. On the 1989 photos 15 pieces of wood were visible in this same stretch of stream. During this inventory, it is likely that wood in the 1967 photos was undercounted. The 1967 photos were taken from a higher elevation and had more severe shadow on the creek than the 1989 photos. While air photo interpretation is subject to error, this rough comparison does suggest that Steamboat Creek has lost large wood between even the late 1960s and today.

Human-Created Barriers to Fish Movement

There are nine stream crossing culverts that potentially affect fish movement in the analysis area (Table A-19). These culverts are all corrugated metal pipes located in small fish-bearing streams. The greatest amount of habitat impeded by any one culvert is 1.1 miles in Johnson Creek. Steelhead and cutthroat trout are the two salmonid species affected by these culverts. Based on criteria established by the Oregon Department of Fish and Wildlife, the target species and age class for fish passage is the age >1 salmonid (a trout about 3-4" long). In most cases corrugated metal pipes are barriers to passage of age >1 juvenile salmonids because water velocities flowing through them are frequently too high for these fish to overcome. Therefore any stream crossing with a corrugated metal pipe located within native fish distributions were assumed to be at least partial barriers. Undoubtedly, some of the culverts listed in Table 30 pass some fish (such as adult steelhead) during some flows so these culverts are not necessarily total barriers to fish passage.

Table 30. Characteristics of known stream crossing culverts within the fish distributions in the Lower Steamboat Watershed area. **St = steelhead; Ct = cutthroat trout; * = no information available; ? = indicates habitat is available but little-used by the species.**

Stream	Road #	Salmonid Species Affected	Miles of Habitat Affected	Culvert Dimensions			
				Length	Diameter	Grad.	Pool Depth
S.F. Steelhead	3809	St (?), Ct	0.5	80'	9'	4%	No pool
Singe	3810	St, Ct	0.05	104'	14'	11%	No pool
Singe	3810-100	Ct	0.3	*	*	*	*
N.F. Cedar	3821	St, Ct	0.7	*	*	*	*
N.F. Cedar	3821	St, Ct	0.8	*	*	*	*
N.F. Cedar	3821	Ct	0.2	*	*	*	*
Johnson	3815	St, Ct	1.1	80'	8'	2%	3.6'
Deep	3810	Ct	0.1	98'	12'	8%	No pool
Longs	38	St, Ct	0.8	67'	9'	5%	0.9'

Culverts affect access to a total of 3.9 miles of potential or only partially used steelhead habitat. Including these 3.9 miles, this total is 4.9 miles for cutthroat trout. All of the stream miles affected are small streams that serve fish primarily as spawning tributaries with limited potential for juvenile rearing due to their small size.

Parallel Riparian Roads

Roads parallel to streams in riparian reserves can have a number of detrimental impacts to aquatic habitats. These include truncation of large wood delivery to the stream via riparian timber harvest and hazard tree removal, stream cleanout, loss of floodplain function due to localized floodplain filling, and chronic reduction of large wood potential due to the road occupying potential riparian tree growing sites. These effects would vary with the extent to which the road follows along a stream and its proximity to the active channel. Stream cleanout and loss of late seral riparian vegetation along Steamboat Creek has likely contributed to localized channel widening in some areas; localized scouring out of gravel and cobble substrates; reduced nutrient and fine organic matter retention; and reduced overwinter survival of fish and other aquatic fauna due to loss of overwintering habitat. With the exception of an approximately 2-3 mile portion of Steamboat Creek where it flows through Black Gorge, these effects associated with the main Steamboat road are pronounced throughout the remaining 15.5 miles of the main stem in this analysis area.

Other streams in the analysis area profoundly affected by parallel riparian roads include Deep Creek (1 mile), Cedar Creek (6 miles), Steelhead Creek (approx. 0.5 mile), and Reynolds Creek (approx. 0.5 mile).

Altered Sediment Regimes

Excessive sediment that results from land use practices and disturbance activities may adversely affect beneficial uses and resource values. Sediment that originates as a consequence of road systems, or timber harvest is a core issue with respect to landscape analysis within the watershed.

Identifying the sources and causes of chronic sediment represents an important element of cumulative effects analysis for management practices and activities within the watershed. The road transportation network is an integral component influencing fluvial erosional processes within the watershed. Localized alteration of surface flow patterns by roads may create an imbalance in hydrologic function and response.

Increased landslide rates associated with roads and timber harvest have increased the amount of sediment entering stream channels. This effect, combined with the removal of large wood from streams has facilitated the rapid transport of large amounts of sediment from Steamboat Creek into the North Umpqua River. Based on aerial photo interpretation of 1946, 1966, 1988, and 1997 air photos, a total of 254 landslides were found in the analysis area. Of these slides, 117 (46%) were found in timber harvest units, 75 (30%) were associated with roads, and 62 (24%) were associated with unmanaged stands. Within the analysis area 23,057 acres (32%) of the area are in managed stands, approximately 2,475 acres (3.5%) are in roads, and the remaining approximately 45,996 acres (64.5%) are in unmanaged stands.

Stillwater Sciences Inc. (1998) found that as a result of road construction and timber harvesting, hillslope erosion in the Steamboat Creek watershed is estimated to be roughly 5-10 times greater than pre-1950 conditions. Stillwater Sciences Inc. (1998) estimated that 30% of the 700,000 tons of bedload delivered from Steamboat Creek to the North Umpqua River consisted of sediment that had been stored by large wood in tributary streams prior to large wood removal from streams.

Altered Peak Stream Flow Regimes

To date, approximately 32% of the watershed has been previously clearcut or shelterwood harvested. This has resulted in some unknown increase in rain-on-snow peak flows. In addition, the drainage network has been extended an estimated 13.5% by the road network. This is believed to have the effect of increasing peak flows, albeit to an unknown extent.

The factors influencing runoff include changes to the water balance from timber harvest, changes to forest stand structure including canopy, changes to potential flow routing from the existing road system, and changes to channel roughness, complexity, and connectivity to floodplains. Analysis of long-term hydrologic records has demonstrated detectable changes in the timing and magnitude of winter peak flows that may be associated with timber harvest and road construction. Jones and Grant (1996) suggested that timber harvest and road construction on the Willamette National Forest increased peak flows by as much as 50% in small basins (0.6-1.0 km^2) and as much as 100% in large basins (62-637 km^2).

A common conclusion from most research (Jones and Grant 1996; Thomas and Megahan 1998) has been that statistically significant increases in peak flows have occurred when at least 31% of smaller drainages have been harvested and roaded. The degree of increase of different peak flow events and the extent of time that the effect persists have been variable in the research. The increases were attributed to changes in both flow routing due to roads and in the water balance due to timber harvest. Changes in the size of peak flows can have important implications for the stability of the stream channels, size and quantity of the bed material, and sediment transport rates (MacDonald et al. 1991). Some of the current factors that potentially influence peak flow response for the analysis area are displayed in Table 31.

Table 31. Harvest, road density, and channel extension by subwatershed. ➊ = facial subwatersheds; others are true subwatersheds.

Subwatershed	Percent Harvested	Road Density (mile/square mile)	Percent Channel Extension
Lower Steamboat➊	36	4.8	18
Deep Creek	49	3.8	23
Singe Creek	28	4.5	20
Steelhead Creek	34	3.9	8
Rynolds Creek	47	4.5	16
Middle Steamboat➊	32	4.6	15
Big Bend Creek	26	3.6	10
Cedar Creek	21	3.5	na
Upper Steamboat➊	31	4.5	11

The current amounts of harvest and road construction in most subwatersheds appears to have potentially influenced peak flow responses to rain-on-snow events. Deep Creek and Reynolds Creek subwatersheds appear to have greater potential influence on peak flows based on the harvest history and road density. In comparison to the research, the similarity in management history indicates that at least near bankfull peak flows may have been increased in most subwatersheds (Thomas and Megahan 1998). However, the historic timing of harvest (over the past 30 years) has allowed some hydrologic recovery to occur, which may have also diminished the potential response.

Summer low flows may have increased at the smaller catchment scale (i.e.; less than subwatershed size) in response to timber harvest reducing evapotranspiration and increasing soil moisture. However, this type of response tends to diminish with vegetative growth and is often variable in the amount and duration (MacDonald 1991). The relative shallow soils in the overall watershed also tends to diminish any possible increase because of the limited potential for soil moisture storage. With increasing catchment size, any low flow increase becomes more difficult to detect because a smaller proportion of a catchment would be harvested and unrecovered.

Stream temperatures have been recovering throughout the watershed from 1969-1990. The loss of riparian shade because of timber harvest, debris torrents, or flooding has been recovering with riparian vegetative regrowth. Holaday (1992) found significant trends of decreasing maximum stream temperatures in Steamboat Creek and tributaries. However, main stem Steamboat above Canton Creek did not significantly change and appears to have been historically warm. Any cooling influences in lower Steamboat Creek "are largely negated by the large volume of water in the main channel" (Holaday 1992). In lower Steamboat Creek, riparian trees can only partially shade the wide main stem. In addition, Holaday found a decreasing minimum stream temperature trend for the long-term monitoring sites. Diurnal temperature fluctuations also decreased for several of the tributaries. Temperature graphs for the long-term sites are located in Appendix A.

Total sediment yield is more often used in discussion of watershed responses than suspended sediment. Stillwater Sciences (1998) stated in their watershed analysis for the

North Umpqua Hydroelectric Project that "sediment transport capacity is high, given the flashy hydrology of the (Steamboat) watershed". They also stated that "the combination of LWD removal and the 1964 flood eliminated sediment storage in third- and fourth-order channels such as Cedar Creek and caused scour of these channels to bedrock.." which is often the current condition throughout the watershed. Gravel deposition in the main stem can be seen in the 1966 aerial photos at locations where is it lacking today after LWD removal and timber salvage operations. The lack of roughness from LWD for sediment storage is a missing function from reference condition. However, sediment supply has increased in response to past forest management activities (Stillwater Sciences 1998), but little is retained in the Steamboat system.

Elevated pH with correlated DO is closely associated with channel condition. With removal of LWD and major floods like 1964, shift to bedrock dominance in most tributaries has likely extended the length of channel with elevated pH and DO. The opportunity for any recovery is limited because of the bedrock channel condition, lack of LWD, and impacted riparian shade. In contrast, the pH longitudinal distribution of City Creek, where only 5% of the riparian and 15% of the total subwatershed have been harvested over a 40-year period, has localized sites of elevated pH followed by downstream recovery with improving channel and riparian condition (Powell 1996). The daily cycles of pH and DO are not as pronounced in the unmanaged setting of the Boulder Creek wilderness area.

Altered Summer Water Temperature Regimes

Riparian timber harvest from the 1960s, 1970s, and 1980s has promoted increased water temperatures in many streams throughout the watershed. See the water temperature section for a more detailed discussion of this phenomenon.

Aquatic Desired Future Conditions

The following discussion represents a description of desired future conditions for aquatic ecosystems in Steamboat Creek. Some of this discussion is very general because the extent to which these conditions would be reached is highly dependent on decisions regarding human uses in the watershed. Given the late successional reserve and key watershed allocations of this watershed, it is expected that considerable progress would be made toward meeting these desired aquatic conditions. Desired conditions are described in two separate categories: main stem of Steamboat Creek and watershed-wide conditions.

Main Stem Steamboat Creek

Approximately 90% of stream length in the lower 17.8 miles would be bordered by late seral stage forest dominated by large conifers and including large amounts of down wood of various sizes.

Main stem Steamboat Creek would be well-connected with its adjacent floodplain and riparian areas. Large wood delivery and routing from the immediate riparian areas would be restored. Sediment and large wood flowing in from tributaries would be delivered unimpeded.

Large down wood would be common along channel margins as jams and single pieces, at outcurves of meanders, in side channel areas, and at heads of point bars and islands, and along margins of islands. These wood accumulations would be critical sites for trapping finer organic matter including pole-sized trees, tree limbs, and hardwood leaves. These areas would be important overwinter habitat sites for aquatic organisms and spring/early summer rearing habitat for juvenile fishes including coho salmon, spring chinook salmon, steelhead and cutthroat trout, and speckled dace.

With the restored role of large wood in Steamboat Creek more gravel and cobble substrates would accumulate in the stream margins and there would be localized narrowing of Steamboat Creek associated with hardwoods vegetating and stabilizing these new deposits in the margins. More point bars would be formed and stabilized in reaches tending toward a pool:riffle channel morphology.

Adult summer steelhead would peacefully hold over the summer in large pools without the threat of being poached or harassed by humans conducting recreational or other activities within pools or along stream banks.

Pool habitats in main stem Steamboat Creek would be more complex due to the presence of down large wood in them to provide hiding cover for aquatic vertebrates, and living substrate for aquatic invertebrates.

The diversity of aquatic insect communities would increase from their current condition due to colonization by detritus-associated species, species intolerant of high water temperatures, and species intolerant of a high degree of scour. These changes in the aquatic insect community would be a reflection of decreasing water temperatures, decreasing peak flow response to rain-on-snow events, and decreasing bedload movement through the main stem of Steamboat Creek.

Watershed-Wide

Landslide rates would be reduced by approximately 75% as human-caused landslide rates would be near zero. Landslides would occur at a rate of approximately 0.0009 slides/acre/50 years as detected on aerial photos. At any given time this rate would vary to some degree pending the climatic patterns, namely the alternation of wet and dry weather periods. Naturally occurring landslides would occur from naturally slide-prone areas such as from headwalls of debris slide basins, toes of earthflows, high risk landslide terrain, and outcurves of stream channel meanders. The majority of landslides would be laden with late seral-sized large trees such that these large trees would be delivered as large wood to streams when landslides reach streams. Fewer landslides would reach streams because the large wood in them would get entangled with standing vegetation adjacent to landslide paths and stop downslope movement of slides. Fewer slides would propagate into debris flows in streams because the majority of streams would be festooned with large wood which would tend to "catch" landslide material entering streams, absorb the momentous energy of slides, and stop them before they would become debris flows.

Impacts to aquatic habitats from roads would be reduced considerably as road densities are reduced by 67% to match district road maintenance capabilities.

A large proportion of the time, approximately 3% of tributary stream miles would be in a scoured out condition due to naturally occurring debris flows and dam break floods as detectable on aerial photos. This percentage would be higher in the immediate decades after large storm events (i.e. 100 year recurrence interval).

Flow regimes would function within the range of natural variability because peak flow attenuation would be greater than today. For most any given storm event, peak flow process would be less efficient than today. Peak flow response would have been reduced by development of late seral forest canopy over a greater proportion of the watershed, reduction of drainage network extension due to road decommissioning and stormproofing efforts, and improved channel roughness and complexity with the recruitment of large wood and connectivity to floodplains.

The majority of 3rd to 5th order streams would have an average of 50-80 pieces of large wood/mile configured as channel spanning log jams, sill logs, angle logs, "stilted" logs, logs in floodplain areas, and logs in side channels. The recovery of large wood would also facilitate increased deposition of gravel and cobble substrates in tributaries which in turn would increase hiding cover for salmonid fishes and other aquatic organisms, increase habitat for aquatic insects, increase nutrient retention and processing, increase flood attenuation, and increase channel stability.

With the recovery of large wood, sediment regimes, and flow regimes, the majority of 3rd to 5th order streams would re-establish a step-pool morphology (stair-step nature) with increased storage of gravels and cobbles, localized lowering of the stream gradient upstream of steps, and reduction in the exposure of bedrock substrate in streams.

In localized stream reaches where the potential for well-developed floodplains exists, these floodplains would be well-connected to stream channels. Floodplain areas would be dominated by late seral forest vegetation with large amounts of down wood of various sizes. The Cedar Creek subwatershed and small localized portions of main stem Steamboat Creek and Big Bend Creek are the areas with the most potential for recovery of floodplain connectivity and function.

Watershed-wide, approximately 84% of riparian reserves would be dominated by forested stands greater 80 years of age. This dominance of riparian areas by late seral vegetation would facilitate recovery of large wood inputs to streams and riparian areas as well as recovery of stream shading.

Water quality would be improved over the current condition. Stream pH fluctuations during summer would be less than they are today. In most 3rd to 5th order tributaries it would be rare for pH to exceed 8.0 or drop below 7.0. In most streams, summer water temperatures would undergo smaller diurnal fluctuations than they do today. These reductions in pH and temperature fluctuations would likely be due to increased riparian shading over streams, increased recruitment of large wood into streams, and subsequent reduction of stream surface area in bedrock substrate due to aggradation.

Native fish populations watershed-wide would encounter no impassable culverts or other human-caused barriers. Connectivity between streams would be unimpeded by anthropogenically induced water quality barriers (i.e. extreme water temperatures) or channel morphology barriers (i.e. excessive presence of marginally passable bedrock chutes from past stream cleanout). Access of non-native fishes (i.e. brook trout), if still present in the watershed to natural aquatic habitats would be minimized by human-placed barriers.

CHAPTER 6

Recommendations

Chapter 6: Recommendations

HUMAN USE RECOMMENDATIONS

Existing Recreation Facilities

An interdisciplinary evaluation needs to occur to determine whether or not recreation activities (managed or dispersed) are affecting adult summer steelhead or cutthroat trout at summer resting pools. Of the 30 primary adult summer steelhead resting pools in Steamboat Creek, 17 have dispersed recreation sites associated with them. Fish may be subjected to disturbance from camping/swimming activities or perhaps even removal due to poaching. An evaluation will determine the appropriate action and activities for these resting pools.

Possible Recreation Facilities

The 1990 Umpqua National Forest Land and Resource Management Plan (LRMP) listed several trail improvements and proposed new construction of recreation facilities within the Steamboat watershed. Potential activities may include:

- Reconstruction of the 5.5-mile Bulldog Rock Trail #1534;
- Construction of facilities at the Bullpup Trailhead and Bear Camp Trailhead;
- Reconstruction/construction of a 2.0-mile long inactive trail from Fuller Lake to Bulldog Rock Trail;
- Reconstruction of the 3.8-mile Wild Rose Trail #1535 and construction of one trailhead;
- Construction of the 6.0-mile Bristow Loop Trail from Bulldog Rock Trail through the Bulldog Rock URMA to Bristow Prairie ponds and loop back to itself;
- Construction of the 0.5-mile North Steelhead Falls trail and construction of a trailhead off of road #3809-110;
- Reconstruction of the 2.4-mile High Divide Trail #1407.

All potential recreation projects will be evaluated by interdisciplinary teams to determine if the project is consistent with the Northwest Forest Plan (including compatibility with current land allocations, standards and guidelines, and the Aquatic Conservation Strategy). Any potential projects will undergo planning as required by the National Environmental Policy Act (NEPA).

Of the potential trails listed in the LRMP, the 0.3-mile Chilly Falls trail, on Steelhead Creek, is unlikely to be constructed because of limited recreation value. The locations of these sites are mapped in Appendix D.

Potential recreation site improvements would be concentrated at existing Forest Camps/Trailheads and Developed Recreation Sites. Improvements may include: gravel added to parking areas and access roads; barrier rocks installed; new toilets installed or replacement of old toilets; steel fire rings installed; facilities to improve wheelchair access; bulletin boards installed; or tent areas leveled and hardened. Not all sites will receive listed improvements. Sites where these improvements may occur include Canton Creek Campground, Steamboat Falls Campground, Reynolds Camp, Bullpup Trailhead, Bullpup Lake Forest Camp, Steelhead Forest Camp, Milepost 7 Forest Camp, Beaver Pond Forest Camp, Fuller Lake Trailhead, Fuller Lake Forest Camp, Wild Rose Trailhead (south), Illahee Rock Trailhead, Wild Rose Trailhead (north), and Illahee Lookout Rental. See Figure XX in Appendix D for details. Any improvements at the Dispersed Recreation Sites would involve addition of gravel to access roads and parking areas to reduce soil runoff and enhance the recreation experience. Although unlikely, if recreation use were to increase at these sites they could be designated as Forest Camps with additional improvements added as necessary.

Road Management

Manage hazard trees and road-related blow down as down wood in roadside and riparian areas. In riparian areas, particularly along Steamboat Road, leave down wood as large as possible so as to optimize its function as a floodplain component.

If large-scale blowdown occurs where substantial funding sources are required to clear roads, use watershed restoration funds or other available funds to collect and stockpile some of the blowdown for use in instream restoration projects. *(Note: At least 38 out of 56.7 fish-bearing stream miles (67%) in the analysis area have undergone stream cleanout and lack large wood).*

Continue following Forest Plan direction in key watersheds to pursue road decommissioning projects focusing on roads that pose a high risk or existing impact to aquatic resources. Use an integrated, interdisciplinary process that includes input from a journey level fisheries biologist and/or a journey level hydrologist to identify these opportunities.

As existing road miles continue to exceed road maintenance budget capabilities, maintain an opportunistic approach to reducing road miles in the event of extreme storms which cause road damage.

Decommission roads and refrain from building roads that would intercept groundwater in the Big Bend Creek subwatershed. This drainage is a summer water quality refuge, as well as a refuge for at least two sensitive aquatic invertebrate species.

TERRESTRIAL RECOMMENDATIONS

Fuels

Numerous opportunities for managing hazardous fuels exist within the watershed. The most important aspect of fuels management within the Lower Steamboat Creek watershed will be the development of a fire management plan for the use of management-ignited prescribed fire within the watershed. Within this plan, fire hazard areas will be identified in order to mitigate fire intensities and severities. Areas identified at the landscape scale for possible treatment are included in Figure 33. The methodologies for these recommendations are documented in Appendix F.

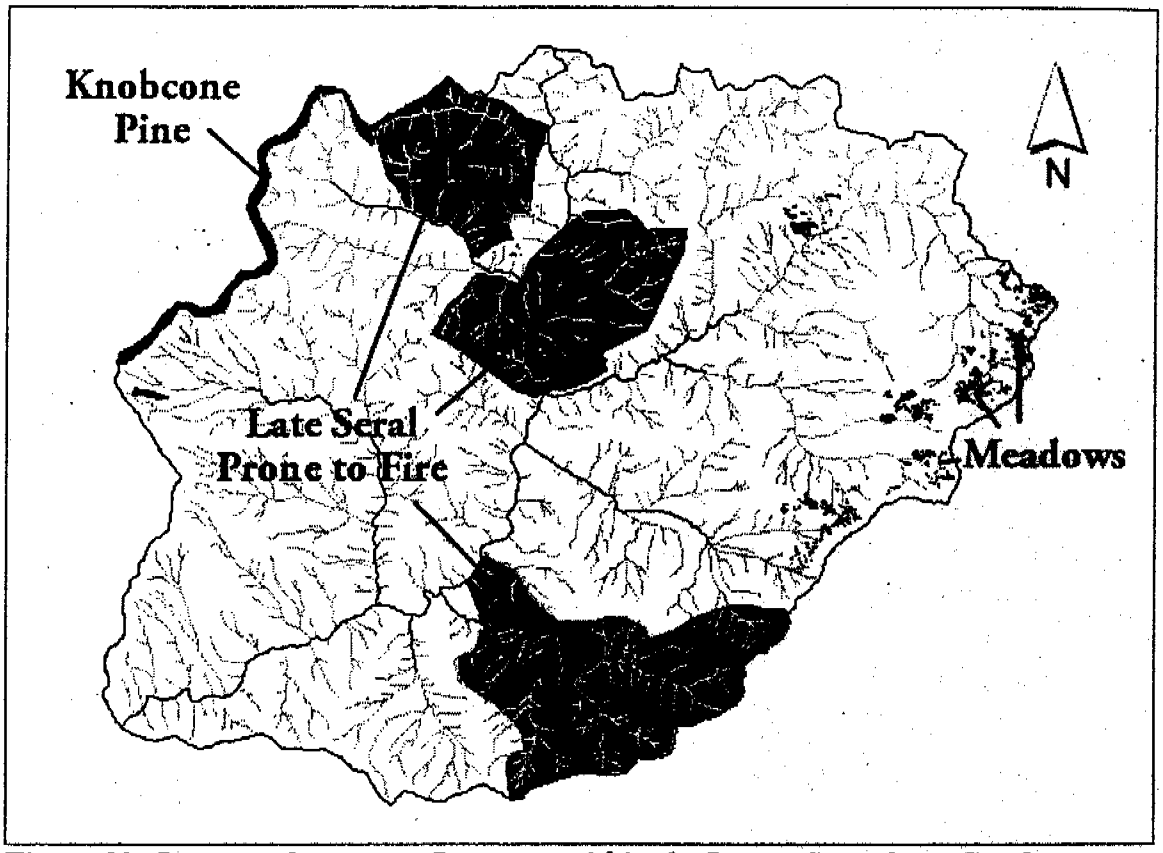


Figure 33. Late-seral prone to fire areas within the Lower Steamboat Creek watershed.

When working with blocks of late seral stands prone to high intensity fire, try to exclude the late-successional refugia core areas that have been identified in this watershed analysis. The refugia corridors may be included if it is not feasible to keep fire out of them. Efforts should be taken to avoid them unless it is operationally difficult. When considering areas to treat for fuels reduction, large blocks are the most effective way to treat landscape-scale hazardous fuels condition.

Management-ignited prescribed fire operations need to be designed to contribute to attainment of Aquatic Conservation Strategy objectives (FM-4, ROD page C-36). An important component of the ACS is to maintain adequate amounts of coarse wood and duff within the Riparian Reserves. As such, prescribed fire efforts will be conducted to minimize consumption of litter and coarse woody debris (ROD page D-11).

Fire Suppression

Wildfire suppression strategies should recognize the role of fire in the ecosystem and identify those instances where fire suppression or fuels management activities could be damaging to long-term ecosystem functions. However, for the next few decades, fire will likely continue to be suppressed to avoid loss of late-successional forest habitat. Important components of suppression strategies will be to:

1) Meet the Aquatic Conservation Strategy Objectives.
2) Design suppression strategies, practices and activities to minimize disturbance of riparian ground cover and vegetation. Strategies should recognize the role of fire in the ecosystem and identify instances where suppression activities could cause more damage than the fire itself.
3) Locate incident bases, fire camps, helibases, staging areas, and other facilities outside of Riparian Reserves.
4) Develop mechanized equipment guidelines for LSRs and Key Watersheds. This would involve mapping sensitive areas such as steep ground, high geohazard areas, and riparian reserves. Include alternative line construction methods in these guidelines (such as blasting).
5) Include 1/8" mesh for pump intakes, absorbent kits, and spill containment materials in district pump kits and initial attack engines.
6) Identify least toxic water additives for utilization and minimize delivery of chemical retardants to surface waters. An exception would be situations where overriding and immediate safety concerns exist.
7) Include a qualified Resource Advisor as a position filled during initial attack in the district lightning organization. This person should be familiar with the area, its resource values, and have a thorough knowledge of the standards and guidelines of the Northwest Forest Plan.

Regardless of whether fire activities are undertaken for wildfire suppression, wildfire hazard reduction, or for prescribed fire applications, it is critical that the safety of firefighting personnel and the public are not compromised.

Pine Health

In order to maintain a healthy component of pines in the watershed, competition from surrounding trees should be reduced. Management techniques, including underburning and thinning, should be used where appropriate.

1) For mature pine that are deemed healthy, thin trees away from the base, thereby removing all woody vegetation (up to 24" diameter) within 40 feet of the bole of the released pine.
2) Reintroduce fire into historic pine areas to control understory and intermediate layer stocking.
3) Take advantage of fire to restore knobcone pine along certain ridges.
4) Plant pine along certain decommission road segments (e.g., FS-3817)

5) Prune lower branches (up to 50% live crown) from infected pine under 6" dbh if prognosis is good for control of blister rust.
6) Plant resistant 5-needle pine (white or sugar) stock in strong pine areas within younger stands with current open early seral vegetation.
7) Maintain a clear, 20-foot spacing around selected pine in older plantations and prescribed pruning treatment to accomplish lift to 16 feet in identified high hazard areas for blister rust. Stands basal areas of no more than 140 sq.ft. per acre are considered optimal for maintaining pine.

Spatial prioritization for pine health management activities is as follows:

<u>Sugar Pine</u>	<u>Ponderosa Pine</u>	<u>Knobcone Pine</u>
1) Washboard Ridge	1) Singe Creek	1) Cedar Creek
2) Reynolds Creek	2) Deep Creek	2) Upper Steamboat Face
3)Lower Steamboat Face	3) Lower Steamboat Face	3) Deep Creek
4) Steelhead Creek	4) Reynolds Creek	4) Singe Creek

Insects and disease

It is important to realize that disturbances caused by insects and disease provide desirable structure and diversity to late-successional forest ecosystems. However, opportunities exist in areas designated as late-successional refugia to convert laminated root rot pockets into populations of resistant species such as five-needle pines. However, if areas are planted to pine, a healthy pine component should be maintained by utilizing techniques described above. Opportunities also exist to leave susceptible populations of Douglas-fir near identified root pockets to purposely maintain these areas as open early seral areas for wildlife forage benefits. These areas could be utilized to passively maintain small group openings within an area. Larger outbreaks of insect activity should be dealt with through the IDT process.

Landscape Pattern and Structure Stages

Young managed stands will form the backbone of opportunities to adjust stand development trajectories for various resource needs. Future management prescriptions within the watershed need to be designed to restore landscape patterns similar to those created in the past through fire. Out of the 9,887 acres of managed stands previously harvested before 1972, on the ground information supports a total of 3,726 acres that are outside of Riparian Reserves and stocked at high densities that would necessitate a density management treatment. This treatment should alter growing conditions to favor the development of late-successional stand characteristics. The stands identified contain dominant trees with an average diameter of 8 inches. A subset of this group averages approximately 10" in diameter and covers a total of 1,586 acres (Figure 34).

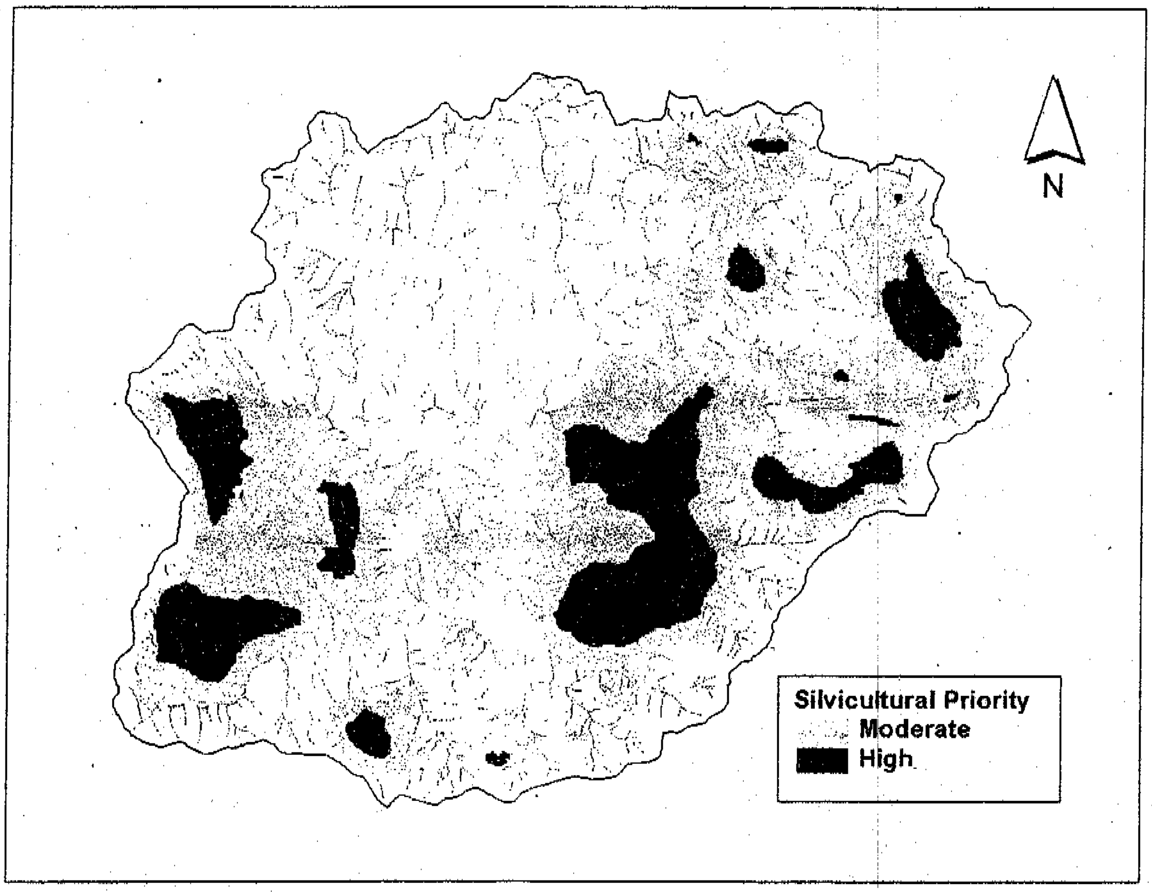


Figure 34. Prioritization of the watershed for silvicultural activities addressing landscape forest patterns.

Over the next 5-year period, it is reasonable to assume that approximately 1,000 acres of younger forest stands would need treatment in order to maintain stand vigor, adjust relative species composition rates, and promote deep tree crown development. On dry and warm environments, variable spacing and less dense stands are desired while on moist and cool sites, even spacing and areas of higher tree densities are prescribed. For further details on spacing and species strategies, see the section in the appendices called Silviculture by land unit. Silvicultural treatments that will move the ecosystem back towards the desired condition in the general landscape are summarized below:

1) Design density management treatments to release a variety of conifers, hardwoods, shrubs and forbs tailored to fit the site.
2) Place large wood within riparian and terrestrial portions of key areas identified with an interdisciplinary team.
3) Utilize precommercial thinning in the youngest managed stands in order to retain the highest amount of compositional and structural diversity possible through the use of uneven-spacing or spacing by species.

4) Interplant resistant stock in areas with root diseases or blister rust if maintenance of a closed canopy is desired. Balance this treatment with maintenance of open areas as described in the insects and disease recommendation.
5) Interplant riparian areas with native plants (including conifers) where cover of native species is lacking or where non-native species incursions are occurring.
6) Slowly reduce stocking in areas of structurally unstable conifers (height/diameter ratios >90).
7) Prioritize treatments in refugia areas to create large blocks of habitat where possible;
8) Treatments to enhance water infiltration are recommended in moderate to severely compacted harvest areas.
9) Schedule work on higher site potential land if possible before work is done on areas with lower site potential.
10) Reduce backlog of precommercial thinning needs by treating stands as needed within an area when density management is prescribed for the older managed stands in the same area.
11) Refer to the Silviculture by land unit appendices for more specific recommendations on general stand treatments.

Late-Successional Refugia

Management objectives should focus on maintenance of existing late-successional habitat, thinning plantations to accelerate the development of late-successional forests, removal of barriers (clearcuts, roads, culverts) and large diameter wood placement.

As far as silvicultural activities, the first priority should be on density management in plantations that have been clearcut harvested before 1972. Stands with greater than 275 trees per acre (tpa) are dense enough to prohibit or slow the development of characteristics associated with late-successional forests, such as large crowns and limbs and multi-layers of understory vegetation. Thinning should be focused on larger blocks of older plantations that can direct stand trajectories toward late-successional habitat over contiguous landscapes as opposed to scattered individual stands.

The second priority should be on density management in younger plantations to maintain the current diversity of conifers, hardwoods and shrubs that have established naturally on site following harvest. These stands include the verified precommercial thinning stands and other stands clearcut since 1985 (Table 32). A mix of species and ages of native conifers and hardwoods is desirable to facilitate the development of late-successional cover in refugia areas. Once diversified, these young stands can help in the recovery of the various cutover refugia areas.

Spatial prioritization of where to prescribe density management activities in late-successional refugia is as follows:

Older Stands	Younger Stands
1) Reynolds Creek	1) Reynolds Creek

2) Lower Steamboat Face/Deep Creek
3) Steelhead Creek
4) Big Bend Creek

2) Big Bend Creek
3) Steelhead Creek
4) Deep Creek

Table 32. Late-successional refugia treatment opportunities in acres.

Subwatershed	**Acres of older stands < 80 yrs**		**Acres of Precommercial thinning**	
Name (#)	**>170 tpa**	**>275 tpa**	**Verified**	**cut since 1985**
Upper Steamboat Face (5)	8	0	42	0
Cedar (6)	0	0	0	0
Big Bend (7)	169	49	81	276
Mid. Steamboat Face (8)	25	25	1	0
Reynolds (9)	677	221	144	255
Singe (10)	22	0	0	27
Deep (11)	305	148	20	135
Steelhead (12)	290	71	128	198
Low. Steamboat Face (13)	305	148	20	41
Analysis Area Totals	**1801**	**662**	**436**	**932**

Harvest opportunities in second growth stands with greater than 170 trees per acre can be used to help fund other resource projects identified as important restoration items. When planning density management with commercial opportunities, consider collecting KV funding to accomplish road decommissioning and large wood placement within the planning area.

The following list summarizes silvicultural treatments and other activities that will move the late-successional refugia ecosystem back towards the desired condition:

1) Thin plantations to accelerate the development of late-successional tree characteristics.
2) Use variable thinning spacing to accommodate complex vegetative needs, maintain full live crown ratios, develop large branch sizes as well as thick bark.
3) Release desirable hardwood and shrub components that exist in the stand;
4) Interplant shade-tolerant conifers such as western redcedar and hardwoods such as Oregon ash in riparian areas.
5) Maintain and/or develop intermediate layers.
6) Provide conditions to ensure success on natural regeneration of trees, shrubs and forbs.
7) Utilize variable spacing by species that prescribes different levels of retention between the riparian and the terrestrial environments.
8) Design soil treatments to reduce effects from compaction in key areas within harvested plantations.
9) Place large diameter wood within riparian zones.

Botanical Resources

Ideally, surveys need to be completed across the watershed analysis area for all management species (Threatened, Endangered, and Sensitive; Survey and Manage; and Protection Buffer); however, it is recognized that funding and personnel required to accomplish this is not currently available. Opportunities may exist to work with volunteers of local botanical groups and other government agencies to share data that is gathered. Information is lacking for most management species with regards to habitat needs and management requirements for continued viability. Knowledge obtained during surveys will be used to mange these species more effectively in the future.

Surveys need to be completed within the watershed in habitats where TES species are suspected to occur, both in riparian and upland areas. Following surveys, any TES species and their habitats should be managed to maintain stable populations across the watershed. Documentation of known sites and information collected at these sites will help identify management opportunities and threats to viability.

General surveys need to be done following survey strategies outlined by the Northwest Forest Plan Record of Decision. Late-successional habitat in the area needs to be inventoried in order to provide needed information. Information collected by BLM personnel should be utilized to determine areas to survey. Management activities for need to consider maintaining or enhancing existing late-successional and old-growth habitats until further information is available.

Prior to proposed activities in the watershed, a noxious weed management strategy will be prepared using the management recommendations outlined in the Draft Integrated Weed Management Plan for the Umpqua NF (Appendix H). An integrated weed management strategy includes planning, inventory, control (including mechanical, manual, chemical and biological), prevention, education, coordination, and monitoring/research. Some aggressive non-native species will be included in the strategy, but for the most part will not be treated due to the size of the populations. Prevention measures such as equipment cleaning prior to entering a project area, are outlined in the Draft Integrated Weed Management Plan for the Umpqua NF (Appendix H). Implementation of prevention measures will help curtail the continued spread of non-natives species (including noxious weeds).

Ongoing efforts, such as educating the public and agency personnel on how to identify and avoid spreading weeds, need to continue. Minimizing soil disturbing activities will help control the spread of noxious weeds. Current efforts are underway to limit the spread of Scotch broom through removing or pruning plants found along roadsides during routine road maintenance. Other efforts are aimed at using bio-control on Tansy ragwort and mechanically removing gorse within the area. As new gorse plants either germinate or sprout from residual roots, they should be dug up and removed.

Protecting or avoiding area where non-natives have not encroached will reduce further spread. The use of native plants for revegetation and restoration work will be common, but non-native plants may be used for site revegetation and erosion control. The non-native species to use in these cases are chosen for their ability to establish but not effect the recovery of native species (Table 33).

Table 33. Non-native revegetation species which may be used for revegetation work.

Common Name	Scientific Name
Alta fescue	*Festuca arundinaceae*
Annual rye	*Lolium multiflorum*
Colonial bentgrass	*Agrostis tenuis*
New Zealand white clover	*Trifolium repens*
Perennial rye	*Lolium perenne*

Legumes and grasses are commonly used for their nitrogen fixing qualities. This will aid in site productivity and plant establishment. Grass species that have the potential to be useful for revegetation efforts and that commonly occur throughout the area include blue wild rye, California fescue, California oatgrass, Columbia brome, and Letterman's needlegrass. Species appropriate for revegetation of wetlands include cattail, small-fruit bulrush, inflated sedge, coltsfoot, and several other species including slough sedge, common rush, and dagger-leaf rush. On sites where adequate soil moisture is available, salal, thimbleberry, beargrass, and trailing blackberry all may be worthy of particular attention for revegetation work.

Non-native species that are considered noxious weeds will be treated with biological controls. Some aggressive non-native species will be treated, but for the most part, no treatment will occur due to the size of the populations.

Prescribed fire will be considered to reduce fuel levels so that future fires will be less likely to open up large areas of potential seed beds for non-native species.

Where feasible, equipment used in any project area will be required to be cleaned prior to entering the project area and when leaving areas of high non-native plant populations. This will help curtail the continued spread of non-natives.

Unique habitats within the analysis area are experiencing encroachment and degradation due to present management policies. Surveys are needed in order to determine what habitat restoration activities need to be considered. Use of prescribed fire in areas of unique habitat (especially dry meadows) that are experiencing encroachment is a restoration activity that needs to be considered in the analysis area. Other meadows at risk of species diversity losses due to fire exclusion would be the second priority. The species that are currently present in these habitats would play an important role in determining if a site would benefit from treatment. Prior to use of prescribed fire, however, it will need to be determined if noxious weeds will be perpetuated by the activity. If noxious weeds are present and known to be prolific in the event of fire, steps to mitigate reproduction need to be taken. These may include eradicating known populations of weeds prior to burning (through manual methods if feasible); seeding after the burn with a native seed source; monitoring populations; burning at lower intensities or repetitive entries; or burning areas in a rotation or during certain seasons.

During wildfire suppression activities in or near unique habitats, a resource advisor should be used in order to mitigate impacts to the area. Actively pursue rehabilitation efforts after suppression activities. Identify acceptable staging and fire camp areas prior to fire suppression activity.

Access and Travel Management processes and Storm Repair efforts should continue to evaluate the need to eliminate roads that intersect or influence unique habitats.

When considering prescribed fire in late successional habitat, appropriate levels of coarse woody debris needs to be determined to maintain habitat for Survey and Manage species.

Coarse Woody Debris

Management of coarse woody debris (CWD) within the watershed should consider both the landscape and stand-scale conditions. Probable scenarios for management will arise from post-disturbance proposals for salvage timber sales or when designing silivicultural activities associated with younger stands. Current guidelines for salvaging within Late-Successional Reserves (LSRs) are intended to prevent negative impacts on late-successional habitat now and in the future. In all cases, planning for salvage should focus on long-range objectives based on a desired future condition (ROD C-14). Silvicultural activities within LSRs should focus on how the prescription will affect future development and recruitment of CWD.

In order to achieve the desired future condition for CWD within this watershed, patches of dead trees created by fire or insects are desirable landscape components. The size and distribution of these patches should be based on the appropriate underlying fire regime. Salvage should not be considered until at least 2% of the watershed has been restored to this condition. Patches of CWD should be mapped and managed through time and factored into the timing aspect of these fire events.

Salvage after disturbances that create smaller pockets of down wood within late-successional habitat are not recommended in this watershed. Small clumps or "jackpots" of fallen trees are a desirable structural component for this habitat. Field inventories of CWD indicate the "clumpy" nature of this resource across the landscape. Past proposals (in 1997) for salvaging along roadways within this watershed were dropped and windthrown trees within and immediately adjacent to the road corridors were either moved and left on site or collected and stockpiled for use in watershed restoration activities. Utilizing windthrown trees along roadways for restoration is considered appropriate management of the CWD resource within the watershed, until desired levels of late-successional habitat and early-successional habitat (with high CWD) are achieved.

Recommendations that will move the ecosystem back towards the desired condition in terms of CWD are summarized below:

1) Do not salvage stand replacement events, regardless of size and severity, until at least 2% (at least 1,430 acres) of the watershed is restored to a early-successional forest with high levels of CWD.
2) Do not salvage fallen trees within late-successional habitat until watershed levels of late-successional forest are restored. Once this is achieved, utilize CWD inventory data to base management recommendations.
3) Based on the fire regime, plan for 1-3 pulses of CWD per century. Track these pulses through time in GIS.
4) Utilize blowdown along open road corridors for large wood restoration activities.
5) Design silvicultural prescriptions to achieve future development and recruitment of CWD within treated stands. This may include uneven spacing and leaving some portions of the stand unthinned.
6) Consider the use of innoculants to create dead trees when thinning 30-40 year old plantations.
7) Consider placing large diameter CWD within previously clearcut harvest units/plantations. This activity should concentrate on the areas designated as late-successional refugia.

Northern Spotted Owls

Spatial habitat quality will need to be improved. This can be accomplished by protecting the existing "good" quality habitat cores from stand replacement fire, including the use of prescribed low intensity fire as a fuels reduction tool. Silviculture efforts to accelerate the development of owl habitat should focus on plantations within the late-successional refugia blocks and then within plantations located in the western hemlock forest zones.

Management prescriptions need to incorporate the maintenance or development of important owl habitat structure such as closed canopies (>60%), multiple layers of trees, trees with large limbs, large diameter snags or broken-topped trees, trees with hollows and high levels of down wood.

Periodic monitoring of barred owl activity within the watershed is also recommended.

Forest Carnivores

Conduct periodic monitoring for forest carnivores within the low-density road areas of the watershed. Use camera/bait stations, hair sampling stations and periodic aerial surveys for wolverine denning (conducted by the Oregon Department of Fish and Wildlife). Continue to consider carnivore habitat suitability in land management decisions, such as road decommissioning.

Roosevelt Elk

In order to manage for elk herds, it will be important to maintain forage habitat and reduce road densities within the watershed. Specific activities include:

1) Continue with the implementation of road decommissioning on 3817, a cooperative project with the Rocky Mountain Elk Foundation and Oregon Department of Fish and Wildlife (ODFW).
2) Maintain forage habitat in existing meadows through the use of prescribed burning in fall.
3) Take advantage of silvicultural activities to restore historical natural openings which have been planted to conifers.
4) Continue to look for opportunities to decommission roads within winter range.
5) Work with recreation to determine the need to create dispersed campsites and trail heads at decommissioned road segments.
6) Monitor elk herds through aerial surveys in winter (ODFW).

Riparian Stand Treatments

Use thinning as a tool in Riparian Reserves where needed to facilitate development of late seral forest conditions. This activity would only pertain to previously managed riparian stands, or other riparian stands under 80 years of age. Leave thinned material on-site as down wood to benefit overall riparian ecosystem function. Replant where necessary to achieve a natural composition of conifer and hardwood species in natural proportions. During thinning projects maintain stream shade to prevent summer water temperature increases.

In commercially thinned stands, leave thinned material in colluvial hollows, headwall areas, and other areas identified as being prone to landslides. Leaving thinned material on the ground would provide more wood available as structural components for streams in the event of a landslide that reaches a stream. Fire hazards from fuel build ups will need to be evaluated through an interdisciplinary process to determine the amount and extent (continuity) of thinned material left on the ground. General Riparian Reserve recommendations are as follows:

1) Limit the wildfire size and continue to minimize impact of suppression tactics according to the Aquatics Conservation Strategy Fire/Fuels Management Standards and Guidelines.
2) Utilize prescribed fire and mechanical treatment on a landscape scale in areas identified as late seral prone to fire;
3) Incorporate maintenance (low hazard fuels) burning with the late seral prone to fire stands if fire is frequent to the area. Where logistically appropriate, include late seral stands that: support fuel model 8's, and are in a high frequency area for management prescribed fire;

4) Utilize uneven-age management techniques in young stands that focus on individual tree and group selection harvest methods;
5) Place coarse woody material within riparian zones in managed stands;
6) Thin in early and mid-seral stands to accelerate the development of late-successional tree characteristics: i.e., vary thinning spacing to accommodate complex vegetative structure needs (wide spacing in some areas to maintain high growth rates to develop large diameter trees as soon as possible vs. areas of no thinning); maintain full live crown ratios; develop large branch sizes and thick bark, etc.;
7) Release desirable hardwoods and shrubs in early and mid-seral stands to maintain diversity;
8) Interplant shade tolerant conifers and hardwoods in riparian areas to represent the native species mix in riparian stand areas cut after 1985;
9) Provide small openings(<1/4 acre and <2% of stream reach) to reestablish shade-intolerant species such as pine and Douglas-fir;
10) Maintain or develop intermediate layers in managed stands by thinning;
11) Provide seedbed conditions with prescribed fire to ensure successful reliance on natural regeneration of trees, shrubs and forbs;
12) Establish and maintain effective shade cover over stream reaches (particularly south and west aspect streams) by utilizing hardwoods and conifers;
13) Reduce compaction where practical in former harvest areas within the riparian area.

Spatial prioritization for riparian density management activities is as follows:

Older Stands	**Younger Stands**
1) Reynolds Creek	1) Big Bend Creek
2) Lower Steamboat Face	2) Steelhead Creek
3) Steelhead Creek	3) Upper Steamboat Face
4) Big Bend Creek	4) Reynolds Creek

In Riparian Reserves, the goal of wildfire suppression is to limit the size of all fires. When watershed and/or landscape analysis, province-level plans, or prescribed natural fire plans are completed and approved, some natural fires may be allowed to burn under prescribed conditions. Rapidly extinguishing smoldering coarse woody debris and duff should be considered to preserve these ecosystem elements. In Riparian Reserves, water drafting sites should be located and managed to minimize adverse effects on riparian habitat and water quality, as consistent with Aquatic Conservation Strategy objectives. Consider allowing management prescribed fires to back through riparian areas where riparian protection may compromise the safety of personnel. These will need to be identified on a project basis.

AQUATIC RECOMMENDATIONS

Prioritization

Based on a re-working of the Bradbury Process for prioritizing watershed restoration in Steamboat Creek, the top priority subwatersheds (6th field HUC) for restoration in the entire Steamboat Creek watershed are grouped in Figure 3 of Appendix A. Based on these groupings of high, moderate-high, and low-moderate priority subwatersheds, the highest priority subwatersheds for restoration are Lower Steamboat Face, Canton Creek watershed (not w/in Steamboat 5th field), Cedar Creek, Little Rock Creek, and Horse Heaven Creek. The moderate-high priority subwatersheds include City Creek, Steamboat Headwaters, Upper Steamboat Face, Middle Steamboat Face, Big Bend, and Steelhead Creek. The lowest tier includes Deep Creek, Singe Creek, and Reynolds Creek.

To date, watershed restoration activities have been completed in Canton Creek and Cedar Creek, two of the top five priority subwatersheds. Restoration activities are currently planned in the Little Rock Creek subwatershed, another of the top five.

Maintenance and restoration of aquatic values in the Lower Steamboat Face subwatershed is truly cumulative in nature. Its ranking as a high priority for restoration in the Bradbury process is attributed to the higher species diversity found in the lower main stem habitats of this subwatershed. Since the primary aquatic habitat in this area is main stem Steamboat Creek, and the main stem in this subwatershed is at the downstream end of approximately 100,000 acres of watershed, the condition of aquatic habitat here is mostly a function of the cumulative effects of processes in the entire upstream watershed. Therefore, restoration activities within the Lower Steamboat Face subwatershed proper would not likely have a great effect on aquatic conditions there. There would likely be less "bang for the buck" with watershed restoration activities here since aquatic conditions are predominantly cumulative in nature relative to processes and conditions in the watershed upstream.

The final high priority subwatershed not yet discussed is Horse Heaven Creek. This is an important headwater refuge for steelhead trout spawning and rearing. Although this subwatershed was analyzed as part of the Upper Steamboat Creek watershed analysis, it remains the top priority subwatershed to continue watershed restoration once activities have been completed in Little Rock Creek.

Three of the five top priority subwatersheds are located in the upper half of the Steamboat watershed (Figure 3 of Appendix A). Given that water quality conditions in main stem Steamboat Creek are cumulative in nature, it stands to reason that employing a "top down" restoration strategy from the headwaters down to the mouth would stand the best chance of gradually improving water quality throughout main stem Steamboat Creek. This "top down" approach to water quality improvement should also include a component of securing conditions in the primary water quality refuge in the watershed, Big Bend Creek.

Based on the groupings of subwatersheds by priority in Figure 3 of Appendix A, watershed restoration in City Creek, Steamboat Headwaters, Big Bend, and Upper Steamboat Face subwatersheds would tend to group these subwatersheds together with Cedar Creek, Little Rock Creek, and Horse Heaven Creek to form one large refuge area. This area would encompass approximately the upper 1/3 of the entire watershed, and would also represent application of the "top down" philosophy of watershed restoration. This philosophy is based on the notion that it is not possible to restore conditions in a large main stem stream channel unless conditions in the upstream headwaters are restored first, due to the fact that cumulative effects from upstream areas drive conditions in the main stem.

Recommendation

Upon completion of watershed restoration work in Little Rock Creek, focus the watershed restoration program first in Horse Heaven Creek as per Upper Steamboat Creek watershed analysis recommendations. Follow that work up with restoration in Steamboat Headwaters, Upper Steamboat Face, Big Bend Creek, and City Creek subwatersheds as the next priorities. This would create a large headwaters aquatic refuge consisting of six key headwater subwatersheds. Work in Big Bend Creek, particularly pertaining to re-establishing riparian vegetation, would secure the primary summer low flow water quality refuge in the Steamboat Creek watershed.

After working in the subwatersheds listed above, we recommend Middle Steamboat Face, Steelhead Creek, and Lower Steamboat Face subwatersheds as the next set of areas for watershed restoration. We recommend watershed restoration work in Deep Creek, Singe Creek, and Reynolds Creek as the final tier of subwatersheds.

As per the ROD, we recommend addressing upslope erosional risks as well as riparian/floodplain impacts associated with roads as a high priority. This includes continuing to reduce road miles in this key watershed as per the Northwest Forest Plan. This would be followed by concurrent work with riparian thinning and additions of large wood to streams. We recommend using the map in this watershed analysis showing the fish-bearing stream reaches that have undergone stream cleanout as a starting point for proposed instream wood placement areas. In all, at least 38 of the 56.7 native fish-bearing stream miles (67%) have undergone stream cleanout in the analysis area. We recommend re-establishing large wood levels to 50-80 pieces/mile in tributaries.

Pilot Project Large Wood Placement – Main Stem Steamboat Creek

In addition to focusing on watershed restoration activities in the subwatersheds listed above, we recommend concurrent placement of large wood in main stem Steamboat Creek. The objective of this work would be to test approaches to increasing aquatic habitat complexity to the single largest aquatic habitat in the watershed. Most notably, overwintering habitat for aquatic vertebrates is poor in the Steamboat Creek watershed. We recommend adding large wood to the side channel sites in main stem Steamboat Creek identified in the watershed analysis as a means of improving overwintering habitat for aquatic vertebrates as well as increasing habitat complexity for riparian-dependent wildlife in these unique habitats. Use the prioritized list of sites in the watershed analysis to guide project site priorities.

During side channel large wood project design, we recommend configuring large wood as jams along channel margins, at heads of islands, at lateral margins of islands, at downstream nickpoints, and in floodplain areas to mimic natural wood accumulation tendencies. We recommend trying a variety of techniques involving the use of whole trees and large logs >50' in length and (preferably) >24" in diameter. Potential techniques would include:

1) Tree lining to pull "anchor" trees over followed by placement of smaller logs on upstream sides of "anchor" trees to form jams.
2) Tree blasting to fall "anchor" trees followed by placement of smaller logs on upstream sides of "anchor" trees to form jams.
3) Use of a combination of helicopters and ground-based systems from Steamboat Road to place large logs in associated with "anchor" trees. Avoid using ground equipment in riparian area of Steamboat Creek other than on Steamboat Road itself.

Another context for large wood placement in main stem Steamboat Creek is to re-establish stream channel morphology in reaches trending toward a pool:riffle morphology. These reaches are identified in the watershed analysis. Objectives of large wood placement would be to work with the trend of gravel/cobble bar re-establishment by placing log jams at heads of forming bars to facilitate further deposition downstream of wood jams along the lengths of the bars.

Monitoring/Data Collection

Establish a long-term outmigrant fish trapping program near the mouth of Steamboat Creek as a monitoring tool to determine long-term trends of migratory salmonid populations in Steamboat Creek watershed.

Continue existing Forest Plan monitoring data collection for stream inventories, aquatic macroinvertebrates, water temperature, and turbidity.

Continue exploratory sampling to determine whether R6 Sensitive aquatic macroinvertebrates are present in spring habitats in the watershed.

Note: The aquatic recommendations listed above are not intended to be set-in-stone direction. They were put forth by the aquatic subgroup of this watershed analysis team, and represent a blending of the best available peer reviewed science integrated with on-the-ground field knowledge. They merely serve as a starting point, and as suggested direction when approaching the task of aquatic restoration. In all cases, use common sense where appropriate.

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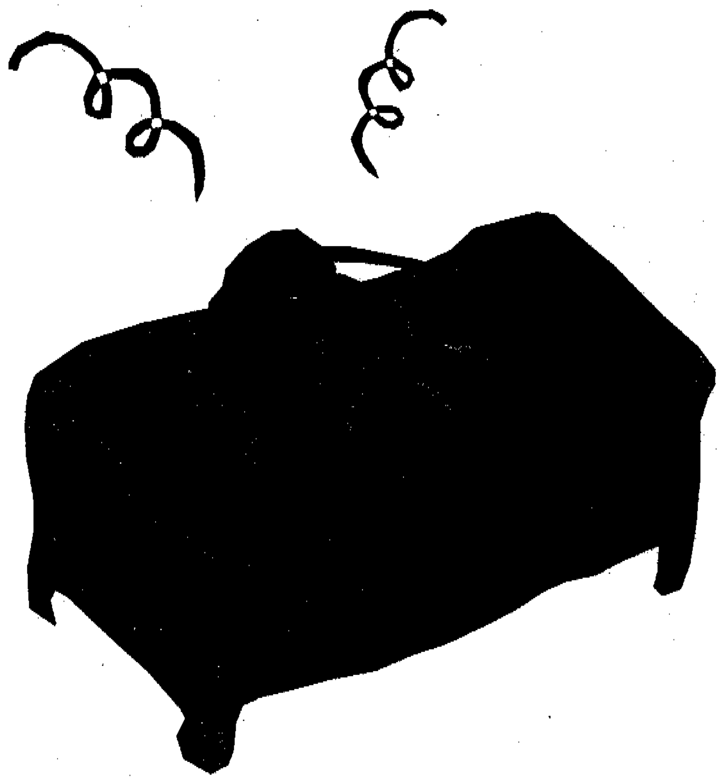

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