CHAPTER 5 - PAST AND CURRENT CONDITIONS OF WOLF CREEK WATERSHED

HUMAN HISTORY AND USE

Prehistoric Period - A single site located in the headwaters portion of the Wolf Creek watershed constitutes the only recorded evidence for human use of the Wolf Creek watershed during the prehistoric period. The Wolf Head site (35LA876) has been assigned to the Early Archaic period (6000 - 4000 B.C.) based on the presence of leaf-shaped lanceolate projectile points.[1] Leaf-shaped lanceolate projectile points are the hallmark of the Early Archaic period in western Oregon.[2] Located just west of the low divide between the Upper Willamette Basin and the Middle Coast Basin, it seems much more logical to attribute the occupation of this site to inhabitants of the adjacent Willamette Basin than to suppose that inhabitants of the coastal or intertidal portion of the Middle Coast Basin had penetrated some 100 river miles inland to the headwaters of Wolf Creek. Indeed, analysis of the material recovered from the excavation of the Siuslaw Falls site led to a similar conclusion regarding that site; it was occupied by peoples culturally affiliated with the Willamette Valley.[3]

The frequency and distribution of prehistoric sites within the Wolf Creek drainage mirrors the situation throughout much of the Coast Range province. With few exceptions, prehistoric sites tend to be located either on the estuarine portions of the rivers draining the Coast Range or on the upper reaches of those rivers in areas adjacent to the inland valley provinces.[4]

Ethnograp hic Period - The Wolf Creek drainage, and the remainder of the Siuslaw watershed, is within the historic territory of the Siuslaw Tribe.[5] [6] Today the members of the Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians retain an interest in the entire Siuslaw watershed for ancestral and cultural reasons. Evidence, both historic and archaeological, supporting the Confederated Tribes' claim for the occupation of the lower river by Siuslawan peoples is abundant. Maps and travelers accounts from the third through the sixth decades of the Eighteenth Century identify a number of village locations along the lower river.[7] [8] [9] Ethnographic work undertaken with members of the Siuslaw Tribe conducted during the Twentieth Century has provided information that also corroborate the tribal claims to occupation of the North Fork of the Siuslaw and the lower reaches of the main stem of the Siuslaw River. These same sources have provided statements regarding use of land along the river corridor for resource extractive purposes at least as far upstream as the confluences of Wildcat Creek and Wolf Creek with the Siuslaw River. Frank Drew, a Coos who had lived in the Florence area since the closure of the Alsea agency in 1875 and was familiar with the post-agency culture of the Indians living along the Siuslaw, told J.P. Harrington during the course of an interview in 1942 that canoes were used to travel up the main river during the winter to trap for furs. Drew himself had accompanied one such expedition to the Wildcat country.[10] Martha Harney Johnson, a Siuslaw woman who worked with the linguist Morris Swadesh in the early 1950s, indicated in one of the taped interviews that her parents had gone to an unspecified point on Wildcat Creek to catch eels.[11] This must have occurred during the major Pacific lamprey migration in the Siuslaw watershed between the beginning of April and the end of June.

The ethnographic evidence supports the contention that the Siuslaw Indians utilized the lands along the main stem of the river upstream as far as the mouths of Wildcat Creek and Wolf Creek and perhaps up those streams for an unknown distance. However, this evidence appears to relate to practices associated with the fur trade and the post-agency (post-1875) lifeway. To date, the only archaeological evidence supporting claims of use of the Wolf Creek drainage by aboriginal peoples during the prehistoric period is limited to the single site in the headwaters portion of the drainage.

Aboriginal land management practices, namely burning, conducted in the valleys of Coyote Creek and the N. Fork of the Siuslaw immediately to the east during the prehistoric period did have some effect on the upper portion of the Wolf Creek drainage; however, the level and extent of this effect is difficult to ascertain. A forest condition map published in 1900, apparently incorporating some information reflecting conditions in the 40 to 50 years preceding the publication of the map, indicates much of the upper end of the watershed as nonforested.[12] However, notes compiled by Deputy Surveyor Harvey Gordon during 1853 and 1854 while running the interior lines for Township 19 S., Range 5 W., Willamette Meridian indicate that the "prairie" did not extend westward beyond the middle of the township. Timber in Secs. 7, 17, and 20 is referred to as "scattering fir" or "scattering fir and oak." There is one reference to a "valley of about 80 acres mostly north of the line and partly prairie" at 10 chains from the east corner common to Sections 17 and 20 in the notes compiled for the line between Sections 17 and 20.[13]

Evidence gathered by counting growth rings on a sample of 100 stumps in a clear cut unit in Sec. 17, T. 19 S., R. 5 W. seems to refute the data on the map and to substantiate Gordon's observations concerning timber conditions. Counts of growth rings on the 100 stumps indicate that 65 percent of the sample trees had birth dates prior to 1840. The growth rings on all but the 3 oldest trees sampled also displayed a pattern of alternating periods of rapid growth (widely spaced rings) with periods of slower growth (closely spaced rings). One possible explanation for the observed pattern is periodic low intensity ground fires that killed shrubs and pole to sapling size conifers and released the larger conifers. Fire scars observed at the base of some stumps in the clear cut unit as well as at the base of trees comprising the "oldest" cohort(s) in an immediately adjacent stand are interpreted as indicative of low intensity fires burning through Sec. 17 at some time(s) in the past. Fire scars were not found on all stumps in the clear cut unit and are absent from the bases of trees comprising the younger cohort(s) in the adjacent stand.

Euro-American Settlement - Euro-American settlement in the southern Willamette Valley began in 1846 when Elijah Bristow, Eugene Skinner and Felix Scott, and William Dodson filed for claims in what are now Pleasant Hill and Eugene.[14] During the succeeding 10 to 15 years much of the arable land on the main valley floor, the valley floors of major tributaries and lands along the trail to California through the valleys of Coyote Creek and the North Fork of the Siuslaw was claimed. Land along the main stem of the upper Siuslaw River and Wolf Creek was in less demand because transportation infrastructure in these drainages was poor or nonexistent.

The claim in the Wolf Creek drainage was a cash entry for 80 acres in the SE¼SE¼, Sec. 17 and the NE¼NE¼, Sec. 20, T. 19 S., R. 5 W. filed by Joseph W. Arbuckle and patented in 1866. It was not until some 20 to 30 years later that settlers began moving into the watershed. Beginning in 1896 homestead entries and cash entries were patented on parcels as far west as Sec. 5, T. 19 S., R. 7 W. Homestead entries that were later relinquished along the same stretch of Wolf Creek suggest this initial wave of settlers began around 1890. The records indicate a slow but steady settlement of the lands along Wolf Creek continued through the first decade of the Twentieth Century. A final surge of settlement followed the revestiture of the O & C Railroad lands in 1916. Some of these lands were classified as suitable for agriculture and offered for homestead entry in 1920. It was this last action that accounted for the cash entries and homestead entries in the Wolf Creek watershed patented between 1925 and 1940.[15] The fortunes of the inhabitants of the dispersed settlement along Wolf Creek flourished or declined between 1890 and 1940 depending upon national and international factors. World War I drew population from the farms as men left to serve in the armed forces or to work in factories or mills stimulated to increased production by demands for war materials. Although some returned to the farm after the war, many others remained in the towns and cities where the burgeoning post-war economy created well paying jobs. This ended with the Great Depression of the 1930s that saw many families returning to the land as legitimate homesteaders or squatters seeking to eke out a living as subsistence farmers. The economic recovery stimulated by the onset of World War II was the beginning of the end for most of the small farmsteads along Wolf Creek. As the economy improved, jobs in factories and mills or on logging crews offered opportunities to earn wages that far exceeded the income possible from a small back-country farmstead. As families began to leave the watershed, large timber companies began to buy up the now abandoned homesteads. By 1952 the only occupied homestead on Wolf Creek west of the mouth of Swamp Creek was located at the mouth of Wolf Creek.

Euro-American settlement in the Wolf Creek watershed introduced 3 factors that changed conditions within the watershed. Each settler cleared land on the flats along the stream for crops or pasture. The amount varied from a large garden plot of an acre or so prepared by families eking out a subsistence living during the economic depression of the 1930s to genuine farmsteads with between 40 and 80 acres of cleared land, sizeable orchards, a house, barn, and smaller outbuildings. Farming on more than a subsistence scale required a means of transporting agricultural products to market. In the Wolf Creek watershed this need was answered, albeit imperfectly, by the construction of a wagon road along the stream to connect with the Territorial Road in the valley of Coyote Creek via a low pass on the divide between the Siuslaw and Willamette basins. Sometime before 1914 a wagon road was completed following the present route of the Wolf Creek Road (Lane County Road No. 4078) and connecting with the Territorial Road just south of Crow. Although the sediment from the land cleared for agricultural purposes and the unpaved wagon road must have had some adverse effect on the riparian zone vegetation along Wolf Creek, these effects were minuscule when compared to the effects of anthrogenic (native peoples) fire on conditions in the watershed during the wet season.

Homesteads, Settlements, and Agriculture - Development started in the eastern portion of the watershed in the late 1800s and early 1900s. Homesteading and agriculture have had a minimum influence on the streams and channels in the drainage. The only instance of streams being severely impacted is along a small section of Panther Creek and a 1/4-mile segment of a 3rd order tributary; there the streambed has been completely channelized and straightened as it flows through a pasture.

Timber Harvest and Roads - No significant logging occurred until the 1930s or 1940s. Early logging practices (1930s-1950s) included ground yarding and extremely high road and skid trail densities. In the late 1940s and early 1950s much of the area east of the Wolf Creek-Panther Creek junction was logged. Landings, skid trails, and roads were placed directly in Wolf Creek and many tributaries. Vast amounts of logging slash were left in the streams. Examination of 1953 photos shows what appears to be large amounts of sediment in Wolf Creek down to the mouth. The sediment formed point bars and islands. Although much damage was done to stream channels on site, the logging debris added structure to the streams. Upper Wolf Creek and Salmon Creek had landings in the creek; however, neither has had much downcutting, and stream beds may be at the same or higher levels than prelogging. Beaver in Wolf Creek may be another explanation for the condition of the channels. There is no record of splash damming having occurred in the Wolf Creek watershed. As late as 1953 the Wolf Creek Road only extended to Oat Creek. During the 1960s and 1970s logging practices improved and roads were not built in streambeds. During this time it was common practice to remove all organic debris along with logging slash from the creeks. It was during this time that the area from Eames Creek downstream was harvested. Recently at least 95 percent of the watershed has been managed for timber production.

Fishing - Early cannery records document the relationship between fish abundance and habitat conditions. It was estimated that between 1889 and 1896, approximately 11,000 chinook salmon and 87,500 coho salmon were harvested per year from the Siuslaw River. With a catch efficiency assumed to be 40 percent at that time, runs of chinook and coho salmon in the Siuslaw River in the 1890s would have been about 27,500 and 218,750, respectively. By 1960 virtually no chinook salmon were caught off the mouth of the river and only 7,000 coho were caught.[16] Again assuming a catch efficiency of 40 percent, the total coho salmon population would be approximately 17,500 during that year, and the number of chinook in the basin would be relatively small.

Rock Quarrys and Mineral Potential - The Wolf Creek watershed is within an area considered to have moderate potential for the leasable minerals of oil and gas. This classification is based on the indirect evidence of geologic inference. According to Niem and Niem (1990), a sample was collected from within T. 19 S., R. 6 W., W.M., Sec. 7, on BLM land by Mobil Oil Company as shown on Map 1, Geological Features Map. The sampling indicated that the rock had a porosity of 22.3 percent (by volume) and a permeability of 3.0 millidarcies. This data, along with many other data, suggest that within the Tyee Basin, the porosities and permeabilities are highest in the Flournoy Formation as compared to the other rock units.

The watershed is considered to have low potential for locatable minerals. The geology does not appear favorable for the occurrence of locatable minerals; however, there could be a slight chance that such minerals could occur as vein deposits in the vicinity of the intrusive rocks mentioned earlier. There is no surface indication of such deposits and no subsurface exploratory work has been conducted. According to current (and past) records, no mining claims have been filed in this watershed.

Salable minerals in western Oregon are often located in areas where volcanic rock was deposited as dikes, sills, flows, etc. Sand and gravel are also considered salable minerals. The large basaltic intrusion in T. 19 S., R. 6 W., Secs. 7, 8, 9, 16, 17, 18 is a known salable resource, since it has been quarried at 4 locations. Elsewhere in the watershed, there is high potential for salable resources in the areas mapped as being underlain by similar volcanic intrusive rock. GIS mapping of the volcanic intrusives calculated the acreage of these high and known salable mineral potential areas at approximately 465 acres. The alluvium along Wolf Creek has not been sampled so, based on the indirect evidence of geologic inference, those areas are considered to have moderate potential for sand and gravel, and the acreage has not been estimated. All other lands in the watershed are considered to have low potential for salable minerals.

Recreation - In some watersheds recreation use is a dominant or codominant human interest or value, and can constrain or direct land management activities in specific places or throughout an area. Recreation uses rarely contribute directly to the health or natural functioning of ecosystems. However, the human values that become associated with places often indirectly contribute (albeit accidentally) to their protection from potentially disruptive human activities. This does not appear to be the case in the Wolf Creek watershed because it appears to be valued primarily for consumptive/extractive uses.

Existing Recreation Opportunities - Recreation Opportunities Spectrum Classification - Roaded Modified/Roaded Natural

Setting: The watershed is characterized by a generally natural environment with moderate evidence of human activity, predominantly in the form of recent timber harvests. Resource modification and utilization are evident, but harmonize with the natural environment and, over time, becomes less evident. Concentrations of users is low, but there is often evidence of other users in the area. On-site controls and restrictions may be present, but are subtle. Facilities are provided primarily for the protection of resource values and user safety. Motorized use is permitted.

Experience Opportunity : There is some opportunity for isolation from the sights and sounds of people, and there is an opportunity for a high degree of interaction with the natural environment. There are moderate opportunities for challenge and risk and to use outdoor skills. Opportunities for motorized and nonmotorized recreation are present. Opportunities for direct contact with agency management personnel are low to nonexistent. There are opportunities to exercise a high degree of self-reliance and independence in using most of the watershed.

Activity Opportunities : Activity opportunities within the watershed include a wide range of resource dependent pursuits, including, but not limited to, fishing, crawfish collecting, swimming, hiking, pleasure driving, wildlife observation, hunting, camping, ATV riding, horseback riding, shooting (plinking), and collecting. Seasonally (during big game hunting seasons) hunters use the area so heavily that most other activity opportunities are displaced, unless they are directly associated with or in support of hunting, such as camping. Due to fire restrictions in summer or inclement weather over the rest of the year, the watershed is marginally attractive for most recreational uses. Alternative places or areas for the activities that could be pursued in the Wolf Creek watershed are readily available elsewhere. No unique recreational features have been identified within the watershed.

Local residents have noted there can be relatively high volumes of vehicle traffic along Panther Creek Road at night. This indicates that the Panther Creek area may be especially suitable for some nighttime activity that has yet to be identified by BLM.

Recreational Use Estimate - No survey of recreational use exists for the watershed. Based on the area's physical characteristics under the ROS system (that equate to a Roaded Natural setting with substantial Semi-Primitive Motorized setting characteristics), a theoretical maximum use level or carrying capacity of 3,146 PAOT (0.083 persons at one time/acre x 37,900 acres[17]) would be possible if those people were fairly evenly distributed throughout the area. This is not actually a realistic figure for this watershed because of several factors, including the steepness of the terrain, the tendency for visitors to stay fairly close to their vehicles, the expectation of visitors for the traditionally low frequency of contact with other visitors, and the concentration of vehicle traffic along the primary roads within and around the edge of the watershed. For these reasons, a more acceptable use level is probably closer to 500 PAOT or 0.013 PAOT/acre. If not evenly distributed, even this number of visitors would seem excessive to many of the area's traditional users.

Recreation Facilities - The Eugene District Management Framework Plan of 1983 (MFP) identified 2 potential recreation development sites within the Wolf Creek watershed. These are located at Wolf Creek Falls (T. 18 N., R. 7 W., Section 33) and Saleratus (T. 18 N., R. 7 W., Section 31). The Wolf Creek Falls site shows evidence of light use and has a well- worn access trail. The existing site is small and has no facilities. The Saleratus site shows no evidence of regular public use. There are no trails or other indications that this site receives recreational use. Both sites originally identified in the MFP were carried forward with the Eugene District RMP as potential day use sites. There are no plans for developing or actively managing these sites for recreational use.

Management Actions that Could Impact Recreational Experience Opportunities - The management activities associated with creation or enhancement of Late-Successional Reserves and Connectivity Blocks would not generally affect existing recreation experience opportunities within the watershed. Watershed restoration activities could have an affect, however, if they incorporate projects that would substantially increase public awareness of the watershed and/or public access into and through it. For example, paving the C-Line road could make visitation to the watershed more attractive to a greater population because conventional passenger vehicles could use the area without the existing risk of tire damage. Because this road parallels Wolf Creek, numerous small pullouts, picnic spots, and camps might be created, enhancing the area's recreational utility for activities not formerly pursued. The benefits of reducing fugitive dust might be obviated by streambank erosion resulting from increased recreational use.

Recreation Activity Impacts - With the exception of big game hunting, there do not appear to be any impacts directly attributable to recreational use of the watershed. Big game hunting impacts appear to be limited to a minor amount of stream sedimentation resulting from the casual operation of motor vehicle on the area's unsurfaced or graveled roads.

Unique Recreational Values - No evidence indicates that the Wolf Creek watershed contains unique recreational values or places considered especially important for their recreation attributes. Settings and opportunities found within the watershed are readily available elsewhere.

Special Forest Products - A number of special forest products exist within the watershed. These products include firewood, posts and poles, floral greenery, pharmaceuticals, Christmas decorations, and food. Special forest products are estimated to employ an estimated 10,000 people in Washington and Oregon and generate over $60 million per year.[18] Many of these products are not fully utilized. The potential for commercial uses/values are unknown and the harvest rates are poorly tracked.

These products require authorization for harvest or collection, but many of the products are harvested illegally without permits. The Wolf Creek drainage, especially the upper portion, provides an excellent opportunity for the sale and management of these products due to its close proximity to the Eugene-Springfield area, the large amount of public access, and the markets created and accessible in a larger urban area.

Small Wood Products - Firewood is utilized by the families living in the upper end of the Wolf Creek drainage and the surrounding area. Much of the firewood harvested is for personal use or sold within the Eugene-Springfield area. Posts and corral poles are also harvested. Over the past couple of years permits have been issued for approximately 80 cords of fuel wood and over 16,800 individual posts and poles.[19]

Floral Greenery - Floral products include ferns, salal, mosses, lichens, and huckleberry. These are used in floral arrangements and are utilized locally and by international markets. The actual amount of floral greenery harvested within the Wolf Creek watershed is not known but, based upon records, permits for 400 pounds of "greenery" have been issued[19]. No permits were issued for moss collection[19] although there has been illegal gathering. There is some concern over the harvesting of mosses and lichens as there are several species listed in the ROD on the Survey and Manage lists[20] (see Appendix 2).

Christmas decorations, primarily Christmas trees and cedar boughs, are also harvested within the watershed. The BLM has designated public harvest areas in the upper reaches of Wolf Creek in the past. The close proximity to the Eugene-Springfield area make this a desirable location for these products. Recent permits were issued for approximately 500 pounds of cedar boughs and over 250 Christmas trees[19].

Pharmaceuticals - The primary pharmaceutical located within Wolf Creek watershed is Pacific yew (*Taxus brevifolia*). Yew bark produces the cancer fighting drug Taxol. Yew bark was harvested from all active BLM timber sales within the watershed during 1991 and 1992. A total of 54 pounds of yew bark was collected from one timber sale.[21] Due to synthetic production of Taxol, widespread collection of yew bark has declined.

In the early to mid-1980s there was widespread collection of cascara bark throughout the watershed and the Coast Range. There are no estimates of the amount of cascara collected in the past and no recent permits have been issued within the Wolf Creek watershed. Past harvest may be the reason why there has been little collection in the past few years.

Foods - Foods are primarily mushrooms and berries. The berries available in the Wolf Creek drainage include creeping blackberry, black raspberry, Himalayan blackberry, and elderberry with huckleberry, thimbleberry, and salmonberry to a lesser degree. The majority of the harvest is for personal use, although a market exists for selling these products in the Eugene area. No estimates can be made on the amount of berries harvested within the drainage.

Mushrooms are harvested within the area although the amount of harvest is unknown. No permits have been issued for mushroom harvest within the Wolf Creek watershed[19]. Generally mushrooms are hand collected, sold to established buyers, and shipped to both domestic and international markets. The primary species known to be harvested within the drainage[22] are shown in Table 5-1. This is not intended to be an exhaustive listing, but represents the major mushrooms species harvested within the watershed and/or Coast Range area.

Table 5-1 - Mushrooms Collected Within the Coast Range and Wolf Creek

Common Name	**Scientific Name**	**Type of Collection**
chanterelle	*Cantharellus cibarius*	commercial and recreational
king bolete	*Boletus edulis*	commercial and recreational
milk caps	*Lactarius delicosus*	recreational
milk caps	*Lactarius sanguifluus*	recreational
Russula	*Russula*	recreational
oyster mushroom	*Pleurotus ostreatus*	recreational
fried chicken	*Lyophyllum decastes*	recreational
angel wings	*Pleurocybella porrigens*	recreational
Gomphidius	*Gomphidius*	recreational
shaggy mane	*Coprinus comatus*	recreational
pig's ear	*Gomphus clavatus*	recreational
coral mushrooms	*Ramaria*	recreational
cauliflower mushrooms	*Sparassis radicata*	recreational
admirable bolete	*Boletus mirabilis*	recreational
chicken of the woods	*Laetiporus sulphureus*	recreational
puffball	*Lycoperdon perlatum*	recreational
hedgehog mushroom	*Dentium repandum*	recreational

Some concern for harvesting of mushrooms exists because of the current lack of inventory and harvest information and the potential for some species to occur on the Survey and Manage list in the ROD[21] (see Appendix 2).

THE AQUATIC ECOSYSTEM

Discussion and analysis of the aquatic system related "components of concern" for the Wolf Creek watershed are focused on the 3 major issues identified in Chapter 4 of this document. Erosion (mass wasting, hillslope surface, and road related), sediment routing, stream channel condition, stream flow, water quality, and fisheries will be discussed in this section.

Erosion and Sediment Production

Mass Wasting Erosion Assessment - Mass wasting, or the downslope movement of soil and rock material through a variety of landslide movement types (shallow rapid translational failures, debris avalanches, and torrents), is a dominant physical process that created the landforms, which currently make up the Wolf Creek watershed. Mass wasting is a natural process within the watershed, although the natural frequencies and magnitudes can be influenced by human activity. The volume of mass wasting events can range from a few cubic feet to thousands of cubic yards. Mass wasting is an integral supplier of essential materials to downstream ecosystems, but it can also scour stream channels free of needed structure to the detriment of downstream ecosystems. Major concerns and impacts of mass wasting are off-site, i.e., public safety, private property, roads, bridges, water quality, and fisheries.

Some of the more important factors that contribute to soil/slope instability are steep gradient; low soil strength; declining root strength; ground water accumulation and alteration of natural water routing; and a high frequency, duration, and intensity of precipitation.

Field experience by BLM soil scientists and an aerial photo review indicated that shallow translational failures are the predominant type of mass wasting activity in the Wolf Creek watershed, and that they are most prevalent in the western half of the watershed. These translational failures often create fast moving, water charged debris torrents composed of soil, rock, and organic material that flow down the steeper drainages and end on gentler gradients as debris deposits. These failures are the predominant process that scour the steeper, upper reaches of streams and deliver sediment (and structure) to the gentler lower reaches.

Table 5-2 shows the acreages of each category of mass wasting potential for the Wolf Creek watershed. When compared to the eastern half, the western half of the Wolf Creek watershed has greater storm intensities, frequency of storm events, and total annual precipitation. Also, the slopes generally are steeper, the drainage density is greater, and the change from soil to bedrock is more abrupt in the western half. The mass wasting potential map (Map 2) indicates that most of the area rated as High occurs on the western half of the watershed; the eastern half of the watershed has the majority of area rated as Low. Gravel and larger boulder material was supplied to the stream system by landslides in the western half. The eastern half has supplied very minimal amounts of gravel and larger boulder materials to the system because mass movements are very infrequent to nonexistent in this area.

Table 5-2 - Mass Wasting Potential

Mass Wasting Potential	Acres	Percent of Watershed
Low	31,491	83
Moderate	4,337	12
High	2,063	5

A few igneous intrusions occur in the watershed. The aerial photo review revealed no deep rotational type failures associated with the contact areas between the intrusions and Flournoy Formation (sandstone).

Landslide erosion affects less than 1 percent of the land base in western Oregon. This percentage seems appropriate for Wolf Creek. Although landslides impact a small percentage of the land base, they can have significant impacts on water quality and fish habitat. Ninety percent of the landslides originate on slopes of 75 to 100 percent. This is because the slope angle is what determines the partitioning of the force of gravity in the weight of the soil mantle into a downslope component that promotes stability through its effect on frictional resistance. Slides can only occur when slopes are steep enough for other factors to combine and produce a stress that exceeds the resistance to sliding.

Soils developing in the eastern half of the Wolf Creek watershed are generally finer (more clay) textured and exhibit more cohesion than soils occurring in the western half of the watershed. Therefore, soils in the eastern half have more strength and resistance to landslides. The soils in the western half of the watershed are often referred to as cohesionless soils, which are predominantly silt, sand, and gravel-size fractions with minimal amounts of clay. Individual particles are influenced primarily by gravitational forces (which are partitioned into failure promoting or stability promoting forces by slope angle) and forces due to the movement of water into and through the soil profile. In cohesionless soils the resistance to sliding, other than that which results from gravitational forces in combination with slope angle, is almost exclusively the result of intergranular friction and the interlocking of soil grains. Particle size distribution and the angularity of soil grains controls the amount and effectiveness of interlocking within a soil mass. The greater the angularity and the wider the range of particle sizes, the greater the interlocking forces. The "angle of internal friction" is simply an index of the intergranular friction and interlocking of soil grains. It is an index that represents the frictional resistance to sliding, and it is primarily a function of the arrangement, angularity, effective size, and surface roughness of the soil grains as well as the gradation.[23] [24] [25] This angle generally varies from 30 to 34 degrees for soils in the western half of the watershed.

Soils in the Wolf Creek watershed form and rest at angles or percent slopes beyond this angle of internal friction because of factors that lend additional resistance strength to the soil mantle, such as the root masses of trees and brush. Soils in this watershed also fail at percent slopes or angles below the angle of internal friction due to factors that reduce the resistance to sliding, such as exceptionally high subsurface water flow. Pore water pressure within the soil profile is the primary force that lowers this angle of repose for soil materials. This is why more then 80 percent of the landslides in the Coast Range, including the Wolf Creek watershed, occur or originate in landform positions where the concentration of subsurface water is the greatest.

Studies in the Coast Range on the Mapleton Ranger District have shown that headwalls (26%), channels and incipient channels (31%), and oversteepened stream-adjacent side slopes (26%) account for 83 percent of the slope failures. Headwalls produced all failures over 100 cubic yards. These data are applicable for the western half of the Wolf Creek watershed. All of these landform positions are segments of the landscape that receive and transport water through and over the land to the stream system. These are the landform positions receiving the greatest concentration of subsurface flow and subsequent pore water pressure. What little cohesion that the soils in the western half of the Wolf Creek watershed initially have is due to capillary tension. As water enters the soil and fills the pores, capillary tension is reduced. Seepage pressures of percolating ground water result from viscous drag between liquid and solid grains. If the rate by which water infiltrates into the soil exceeds the rate by which the water can percolate through the soil, then a free water surface develops (piezometric surface). Pressure at the free water surface equals zero. It is thus free of downslope gravitational pressures and capillary tension. As this free water surface rises it is able to exert pressure of its own. These new pressures are upward and also against the interlocking grains of the soil. Positive pore water pressure resulting from saturated flow can significantly decrease a soil's shear resistance by reducing the portion of the soil mass weight that is holding the mass against the slope and contributing the frictional resistance to sliding. The smaller the slope angle, the more of this weight that is contributing to stability and the less likely that pore water pressure will be destabilizing.[26] This smaller slope angle is part of the reason that mass wasting is not a significant process in the eastern half of the Wolf Creek watershed; also, the eastern half has less frequent, less intense storms that contribute to positive pore water pressures.

Reduction in root strength following timber harvest and site preparation activities is possibly a significant cause of landsliding outside the area of road construction. This change matches the high frequency of landslides the first few years following timber harvest on slopes with high potential for failure in western Oregon.[27] Areas most sensitive to loss of root strength and subsequent landsliding usually are steep (75+ percent) slopes in concave positions over hard bedrock in areas of high rainfall. These areas are mapped in the "High" category for mass wasting potential (see Map 2?, Mass Wasting Potential). The natural rate of landsliding in Wolf Creek was probably influenced by fire. Translational failures most likely were triggered when a stand replacement fire removed vegetation from areas susceptible to landsliding, then an intense storm provided enough water to create positive pore water pressures at the period of time (3 to 10 years after vegetation removal) when root strength was lowest. Resource management practices have created similar situations, although these practices have been greatly curtailed in the last 10 years.

The nearest data on mass wasting frequency and volumes is from the Mapleton Ranger District inventories on the Siuslaw National Forest. This data is not relevant to the Wolf Creek watershed as it is from a zone of substantially greater storm intensity, frequency of storm events, and total annual precipitation. That data is also reflective of management practices of a couple of decades ago that included side casting of road construction materials on steep slopes, including into headwall zones of concentrated subsurface flow; inclusion of headwall zones and steep stream side slopes in timber harvesting; and hot intense burns to rid the sale units of logging slash and to kill the roots of brush species. Almost all of the private land within this watershed is owned by a single timber company that, as a practice, does not burn logging slash and replants leaving the woody debris and the root strength of brush species. Side casting was abandoned by private industry and the public agencies on steep land in the mid-1970s. The BLM does not cut timber within or adjacent to potentially unstable slopes within headwalls or on over steepened stream adjacent side slopes. Private industry is required by the State of Oregon to avoid potentially unstable areas as well. There has not been a storm year sufficient to test current management practices since the mid-1970s. Conditions on the ground are not analogous to that previous era, and it is unlikely that a major storm event similar to the mid-1960s or mid-1970s would produce remotely similar results.

An inventory identifying segments of roads likely to create slope instability was conducted for BLM controlled roads in the early 1980s. Corrective action was accomplished for the segments that were identified as suspected to create instability. No road segments identified during the 1980 inventory remain for corrective action. No road segments were identified as unstable during the extensive field work conducted in July and August 1994 for assessing the sediment contribution of roads in the Wolf Creek watershed. Therefore, it is concluded that slope instability created by roads is minimal in the watershed.

Surface Erosion Asses sment - "Surface erosion occurs when detachable soils on sufficiently steep slopes are exposed to overland flow and/or the impact of rainfall. Sediments introduced to streams from surface erosion processes are generally fine-grained and can influence water quality and aquatic habitat.

Raindrop splash, freeze/thaw, dry ravel, and biogenic processes such as windthrow and animal burrowing are natural causes of soil detachment. Gravity and overland flow of water are natural transport mechanisms of the detached soil particles. Overland flow of water rarely occurs under natural forest conditions because the soil is usually protected by an absorbent, protective layer of organic material. Soil compaction can lead to overland flow and serious erosion consequences. Vegetative cover, hillslope angle, soil texture as it affects how well the soil holds together, soil infiltration rates, and climate are important influences on the inherent erosion hazard of a site."[28]

Table 5-3 shows the acreage of each K factor category in the Wolf Creek watershed. Soils on approximately 35,963 acres (95%) of the watershed have low K factors indicating that they have a low susceptiblity to erosion, even in a bare, tilled condition. About 1,828 acres (5%) of watershed have intermediate K factors, and 101 acres (<1%) of watershed have high K factors. Soils with high K factors (most susceptible to erosion in a bare, tilled condition) occur on terraces along Log and Panther creeks in the eastern third of the watershed. Soils with intermediate K factors occur along Wolf (sporadic over entire length), Panther, Swamp, Eames, and Oat creeks. See figure 4 for a map illustrating the location and distribution of these K factor classes within the watershed.

Table 5-3 - Summary of Wolf Creek Watershed by Soil K Factor

Soil K Factor Category	Acres	Percent of Watershed
Low (K <.25)	35,963	95
Moderate (K= .25-.40)	1,828	5
High (K >.40)	101	<1

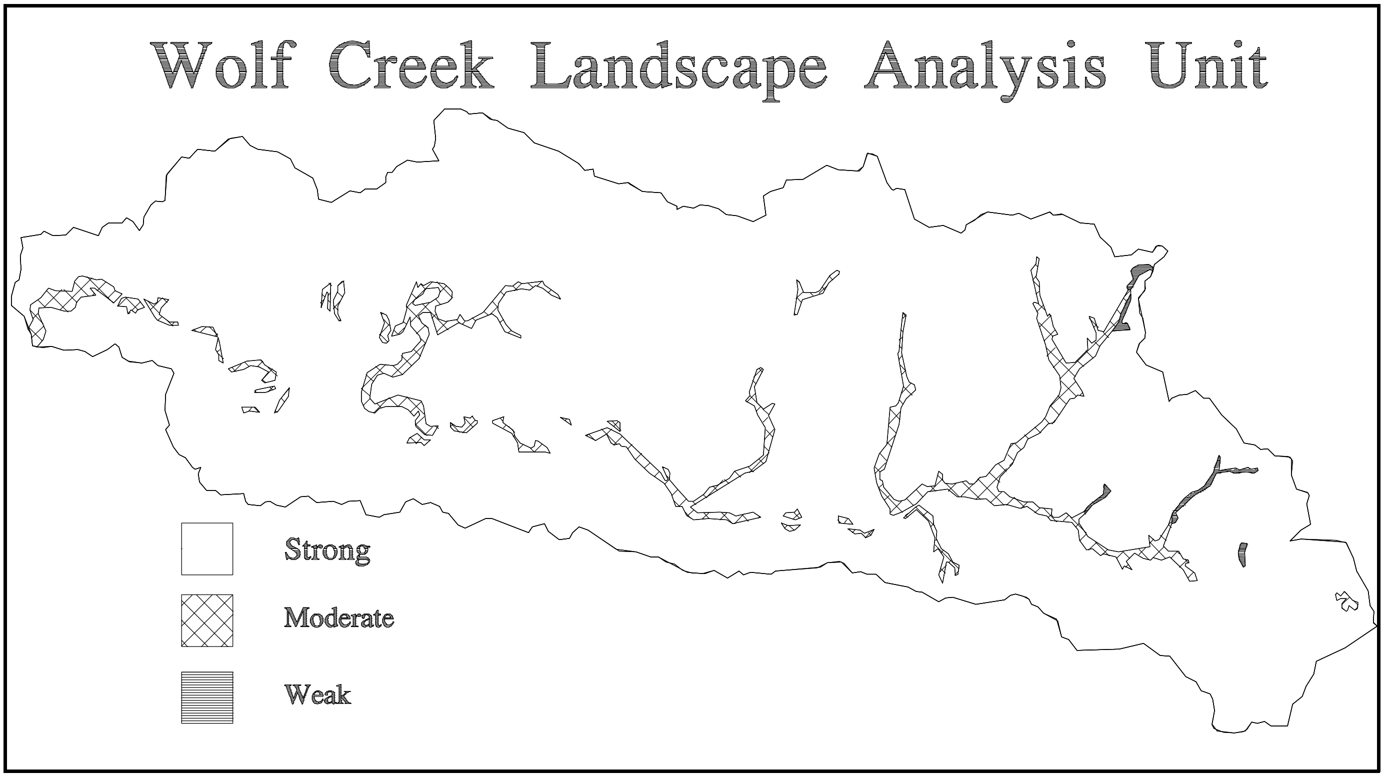

Figure 4: Soil K Values - Wolf Creek Watershed

Acreages of the 3 slope classes are shown in Table 5-4. Slopes of greater than 65 percent occur on 4,304 acres (11%) of the watershed; slopes between 30-65 percent occur on 14,794 acres (39%) of the watershed; slopes less than 30 percent occur on 18,794 acres (50%) of the watershed. The western half of the watershed has the majority of slopes greater than 65 percent (see Map 3, Slope Class). The eastern third of the watershed and areas along major streams contain the majority of the <30 percent slope class.

Table 5-4 - Slope Class Summary for Wolf Creek Watershed

Slope Class	Acres	Percent of Watershed
Gentle (< 30%)	18,794	50
Moderate (30-65%)	14,794	39
Steep (> 65%)	4,304	11

Using the 3 soil erosion potential categories defined in (see Appendix 6, Surface Erosion Module), 23 acres (<1%) of the Wolf Creek watershed are in the High category, 4,541 acres (12%) of the watershed are in the Moderate category, and 33,301 acres (88%) of the watershed are in the Low category (Table 5-5). These erosion potential categories (Map 4) are based on erodibility of bare, freshly tilled soil (K factor) and slope steepness; they do not include cover (vegetation, duff, rock armoring, etc.). The majority of areas in the Moderate category occur in the western two-thirds of the watershed and are in that category due to steepness of slope (>65%).

Table 5-5 - Soil Erosion Potential Classes for Wolf Creek Watershed

Soil Erosion Potential	Acres	Percent of Watershed
Low	33,301	88
Moderate	4,541	12
High	23	<1

Evidence of significant hillslope surface erosion, such as gullies or rills, was not observed in the field for any of the erosion potential categories, nor was there evidence of fine sediment delivery from surface erosion of either natural or disturbed hillslopes to the stream channels.

Confidence in this assessment is moderate because no erosion measurements were collected. Obtaining reliable erosion data is demanding in both the spatial and temporal contexts. Field site visits indicated that hillslope surface erosion was insignificant but no measurements were collected. The variable with the least confidence is the K factor as part of the prediction model for potential surface erosion. This factor is regularly used for agricultural soils and is calculated using bare, freshly tilled soil. Seldomly do significant areas of forest soils reach this level of disturbance through normal forest management practices. Therefore, the Hillside Erosion Risk Class (Map 4) indicates a "worst case" scenario.

Road Related Erosion and Sediment Production Assessment - Roads can be a significant source of sediment to streams in forests, and this sediment can be detrimental to stream ecosystems. Traffic and maintenance grading rejuvenate the supply of fine sediments and thus make roads a potential long-term source of sediment to streams. The costs of total road erosion control or capture of all road derived sediment is prohibitive and, in most locations, unnecessary because the forested slopes below the road capture and store much of the sediment.[29] [30] Key to predicting if road segments provide significant sources of sediment to streams is determining the "connectedness" of road drainage to stream channels.

"The delivery of road erosion products to the stream system is key to understanding the influence of roads on the stream system . . . Although all roads generate erosion, only a portion of the road system drains into the stream system . . . It is important to determine what proportion of the sediment from a road system is delivered to streams in order to evaluate the contribution of road surface erosion to downstream resources" [29].

GIS was used to identify approximately 333 miles of road located in the Wolf Creek watershed. Of this total, approximately 80 percent are rock surfaced, and 17 percent are natural surfaced. Approximately 41 miles of roads are within 75 feet of ridgetops, 111 miles are within 200 feet of streams, and 181 miles are on midslopes (see Map 5, Topographic Road Position Map). A comprehensive field inventory indicated that over 80 percent (269 miles) of the road network in the Wolf Creek drainage does not have the potential to deliver sediment to stream channels. However, it was determined that 19 percent (64 miles) of this road network does have the potential to deliver sediment to streams.

The Washington State methodology[29] partitions road sediment by origin with 20 percent coming from fill slopes, 40 percent from cut slopes and ditches, and 40 percent from the road surface. Fill slopes without total vegetative cover are rare in the Wolf Creek drainage. Only 19 percent (64 miles) of the road network in the Wolf Creek watershed has the opportunity to deliver sediment to a stream channel, and less than 2 percent (6.2 miles) of this has cut banks that have less than 80 percent vegetative cover. Thus, fill slopes play a negligible role, cut banks contribute on 6.2 miles of the road network, while the road surface is a significant factor on 64 miles of the road network. Understanding road sediment in the Wolf Creek drainage requires that the road system be stratified by its ability to deliver sediment to a stream, by the quality of its surfacing, and by traffic levels impacting the road surfacing.[31]

Overall, traffic levels within the Wolf Creek watershed were low but over half (33 miles) of the road segments capable of delivering sediment are mainline haul routes paralleling streams with the road surface subjected to moderate or heavy traffic.

Most roads in the Wolf Creek drainage and 96.5 percent of the road segments with sediment delivery potential are rock surfaced. Typically this includes a lift (approximately 6-8 inches) of pit run (larger stone fragments) and a lift (4-6 inches) of crushed gravel with high aggregate quality. This is a significant factor working on behalf of water quality in this drainage. Kochenderfer and Helvey (1987)[32] showed an 88 percent reduction in sediment with a 6-inch lift of 1.5 to 3.3 inch rock, and a 79 percent reduction in sediment with a 6-inch lift of gravel smaller than 1.5 inches. Swift (1984a) showed a 97 percent sediment reduction with an 8-inch lift of large stone and a 92 percent sediment reduction with a 6-inch lift of crushed 1.5 inch minus gravel. Swift (1984)[33] found sediment production reduced by 84 percent with a combination of rock surfacing and established grass cover up to the road edge. Burroughs et al. (1985)[34] had similar results with a reduction of 79 percent from rock surfacing.[35]

Table 5-6 lists the distribution of the 64 miles of the Wolf Creek drainage with the capability of delivering sediment to stream channels by surface type, cut bank condition, and traffic levels. Annual sediment yield (listed in Table 5-6) from each of these road categories was calculated using the methodology given in the Washington State Watershed Analysis Manual[28].

Table 5-6 - Summary of Sediment Yield by Road Conditions and Surface Type for Wolf Creek Watershed

Road Surface	**Cutbank Vegetative Cover (%)**	**Traffic Level**	**Road Length Capable of Delivering Sediment (miles)**	**Annual Sediment Yield (tons/year**	**Percent of Annual Sediment Yield From Roads**
Native	<80	Light	0.5	15.6	1
Native	>80	Light	1.7	40.9	2
Rock	<80	Light	5.7	84.9	5
Rock	>80	Light	23.0	178.2	10
Rock	>80	Moderate	14.7	455.7	26
Rock	>80	High	18.3	1,000.0	56

Total sediment delivered to streams in the Wolf Creek watershed from roads is estimated to be 1,775 tons per year. Assuming a sediment density of 1.25 tons per cubic yard (based on bulk density of typical soils), this estimated sediment delivery is equivalent to 1,420 cubic yards.

The background sedimentation yield for the Wolf Creek watershed is estimated to be 19,000 tons per year (see Sediment Routing section). Therefore, the estimated delivered sediment related to road erosion is equivalent to 9 percent of the background level. Due to the winter flows, most of the sediment is flushed from the Wolf Creek channel system. Overall, road sediment delivery can be considered to be low and have no significant impact to the Wolf Creek stream channel system (see Channel Morphology and Fisheries sections).

Confidence in the determination of sediment contributing road segments is high because almost all roads were field inventoried. Through GIS, a comprehensive road map showing location of all roads in the watershed was created using satellite imagery, aerial photos, and existing road maps. GIS road attributes and field inventory were used to determine surface types.

The variables with the least confidence are actual traffic use levels, sediment delivery rates, and estimation of background sediment levels. The mainline gravel roads that are assumed to have "heavy" traffic may at times drop to a "moderate" level. Therefore, the estimates provided in the above analysis depicts sediment amounts on the high side of possible estimated amounts. The other roads were assigned "light" or "moderate" ratings; decreases in use categories of these roads should not significantly decrease the estimated overall sediment delivery rates. Cross culverts or lead-off ditches that are located within 200 feet of a stream channel were identified as providing 100 percent of their sediment to the channel. This distance may be too great based on several field observations of general slopes below cross culverts. The distance that sediment was observed deposited on the ground surface varied between 20 and 100 feet. With the vegetation cover, duff layer presence, and soil infiltration and percolation rates, the 200 foot distance may represent a maximum for "worst case" analysis.

Sediment Routing - "Watershed conditions dictate the rate of materials transfer to the stream system, and changes in their input rates raise many of the concerns associated with forest management activities. As these materials and energy are processed, stored, or transported downstream, they influence channel morphology and the suitability of streams for fish habitat and water quality."[28]

Natural Background Sediment Production - ". . . Average bedrock lowering rates of about 0.07 mm. $year^{-1}$ for the last 4,000 to 15,000 yrs. Those rates are consistent with maximum bedrock exfoliation rates of about 0.09 mm. $year^{-1}$ . . . Sediment yield measurements from 9 Coast Range streams provide similar basin wide denudation rates of between 0.05 and 0.08 mm. $year^{-1}$, suggesting an approximate steady state between sediment production on hill slopes and sediment yield. In addition, modern sediment yields are similar in basins varying in size from 1 to 1500 km^2, suggesting that erosion rates are spatially uniform and providing additional evidence for an approximate equilibrium on the landscape."[36]

Utilizing the work of Reneau and Dietrich (1991)[36], a natural sediment yield for the Wolf Creek watershed was determined to be approximately 19,000 tons per year. Surface erosion is not a significant factor under natural conditions given the lush vegetation and porous soils of the Coast Range and the almost total lack of surface runoff outside of stream channels. Roads are obviously not a factor in natural, presettlement yields either. It is assumed that this natural background sediment yield is made up almost entirely from soil creep and mass soil movement. Soil creep was estimated (utilizing Washington State Forest Practices Board: Standard Methodology for Conducting Watershed Analysis) to be in the range of 2,000 to 3,000 tons per year, which leaves mass wasting accounting for 16,000 to 17,000 tons per year of the natural background sediment yield. Mass wasting or the downslope movement of soil and rock material through a variety of landslide movement types is widely recognized as the dominant physical process creating the landforms of the Coast Range including the Wolf Creek watershed. However, the above estimates are probably excessively high as only the western one-third of the Wolf Creek watershed is a close approximation of the soils, geology, climate, and topography that was represented by the work of Reneau and Dietrich (1991). The eastern two-thirds of the Wolf Creek watershed is characterized by significantly lower dissection density, more rounded topography, lower total annual precipitation, less frequent storms capable of triggering landslides, deeper weathering, and finer textured soils. Not only is there a significantly lower likelihood of shallow, rapid slope failures and debris torrents, but there is virtually nothing to indicate any recent deep-seated failures. However, lacking better data, we will rely on the above estimates to characterize this watershed.

Current Sediment Production Above Natural Rates - Total road sediment delivered to Wolf Creek was estimated to be 1,800 tons per year, or approximately a 9 percent increase over natural background levels. This approximation is probably excessively high as Washington State Methodology[28] was used that assumes an average road gradient on forest roads. One thousand tons per year of the 1,800 tons included in our analysis is from a high traffic, wide, mainline parallelling Wolf Creek with road gradients in the 0 to 1 percent range. Research scientists involved in the development of the Washington State Methodology were consulted and advised that our mainline rates would be significantly and exponentially lower but data was lacking to allow this to be adequately quantified. We would conclude, however, that road derived sediment in the Wolf Creek Basin is in the range of 5 to 10 percent of total natural background sediment yield.

Evidence of significant hillslope surface erosion, such as gullies or rills, is virtually absent in this watershed, and there was no indication of fine sediment delivery from surface erosion of either natural or disturbed hillslopes to stream channels.

Homesteading and agriculture have had very little influence on the stream channels and sediment yield of the Wolf Creek Basin. At least 95 percent of the watershed is forested and managed for forest related resources. Homesites are a very minor part of this watershed, occurring in relatively small numbers at the fringes of the upper end of Wolf Creek.

Proportionately, mass soil movement is still the most significant erosion process. There is no data or methodology capable of arriving at even a remotely reasonable approximation of current mass soil movement rates as compared to natural rates. Mass soil movement is predominantly an episodic event correlated with major storm years. Existing inventories in the Coast Range document landslide rates associated with road building and logging practices of the 1960s and early 1970s. These practices have changed dramatically since the mid-1970s. Much has been done by public agencies and private industry to correct past mistakes (sidecast pullback, improved road design and maintenance, endhaul of construction materials, leave areas in hydrologically sensitive areas, spring burning, directional yarding, etc.). As significant, or perhaps much more significant than the change in management practices, is that most of the road network was established in those earlier periods. It has had a couple of decades to mature in terms of settling of fills, slumping of cut banks, and establishment of cut and fill slope vegetation. There has yet to be a storm year of sufficient significance to test these significantly different sets of conditions, from which to compare current conditions with natural background for mass soil movement.

Overall, the Wolf Creek watershed is lacking in sediment necessary for fish habitat. The Wolf Creek watershed lacks an adequate supply of gravel, cobbles, and boulders, and the channel substrate generally consists of sands. There are no indications of fine sediment being a negative factor in fish habitat.

Hydrology and Channel Morphology

This assessment describes the physical attributes and processes of stream related resources in the Wolf Creek watershed. It is designed to understand interrelationships between these attributes and the rest of the ecosystem. Specifically it is designed to look at relationships with the biologic communities and other physical properties, e.g., geomorphology. It can also be used to relate the Wolf Creek watershed to the Siuslaw Basin as a whole, e.g., downstream effects. The descriptions include stream flow, water quality, and channel morphology. Ground water was not listed as an issue for the Wolf Creek watershed. An understanding of the climate, mass wasting erosion, road related erosion, and hill slope related erosion assessments would be useful in understanding this assessment.

Water resources are important only as they relate to beneficial uses. There are 17 water rights at the upper end of the Wolf Creek watershed: primarily on Panther, Wolf, and Swamp creeks. Seven of these are on springs and small, unnamed creeks, and 7 are for domestic use only. There are no water rights on the rest of Wolf Creek, and there are none on the Siuslaw River for a number of miles below Wolf Creek. See Appendix 7, Table 1 for a list of water rights in the Wolf Creek watershed.

Downstream beneficial uses for Wolf Creek are primarily fishing, salmonid fish rearing, and recreation. Wolf Creek feeds into the Siuslaw River and eventually contributes in some minor way to the estuaries at the mouth of the Siuslaw River. Small fishing boats are a common sight on the Siuslaw River, and there is some recreational and commercial boating on the lower end.

Stream Flow - A summary of the stream flow data for Wolf Creek is given in Table 5-7. In addition, data for the Siuslaw River is given to put Wolf Creek in context with the larger basin.

Table 5-7 - Stream Flow Data for Wolf Creek Watershed

	Wolf Creek Flows [1]				SIUSLAW RIVER Near Mapleton [2]	
	Lake Creek [3] Regression		USGS Formula [4]			
	(cfs) [5]	(cfsm) [6]	(cfs)	(cfsm)	(cfs)	(cfsm)
Average Flow	162.85	2.75			2,141	3.64
Maximum Flow	4,547.39	76.81			49,400	84.01
Minimum Flow	5.57	0.09			45	0.08
Return Period [7]						
1.25 YR 80%	1,486.54	25.11			18,900	32.14
2 YR 50%	2,150.39	36.32	2,526.13	42.67	27,000	45.92
5 YR 20%	3,077.11	51.97	3,482.97	58.83	38,200	64.97
10 YR 10%	3,700.87	62.51	4,002.68	67.61	45,500	77.38
25 YR 4%	4,502.83	76.05	4,688.30	79.19	54,700	93.03
50 YR 2%	5,104.31	86.21	5,370.21	90.70	61,500	104.59
100 YR 1%			5,740.89	96.96		

1. Basin size = 59Mi^2.
2. Basin Size = 588Mi^2.
3. Calculated from empirical data (see methods).
4. Calculated from USGS Formula (see methods).
5. Cubic Feet per Second.
6. Cubic Feet per Second per Square Mile.
7. Return Period is the average number of years until a storm of equal or greater magnitude occurs. A better way to express return period is the probability that a storm of equal or greater magnitude will occur in a given year. The probability is given in percent.

Average Flows (Water Yield) - The total or average amount of water that leaves the Wolf Creek drainage is not an issue because there are no downstream water users that store the water. The average flow per square mile for the Siuslaw River is 32 percent higher than it is for Wolf Creek. This is because Wolf Creek has less precipitation than the average for the Siuslaw River Basin. There may be other reasons that are unknown and would require further analysis. Wolf Creek contributes 8 percent of the flow of the Siuslaw Basin at Mapleton (from Table 5-7).

Minimum Flows (Base Flow) - In western Oregon, base flows often last from late spring through fall. This makes the impact of any change in base flow very important. Base flow directly affects all beneficial uses including aquatic and riparian organisms (flora and fauna). Any changes in base flow will change the area that is under water in the summer; a change that directly affects the survival of macro and micro aquatic organisms. Indirectly, base flows determine the ground water regimes and, therefore, the communities of riparian areas. The size, shape and number of pools, riffles, and other fish habitat features are determined by the base flows in the summer. The base flow affects physical properties of the water including temperature, dissolved oxygen, and concentrations of dissolved and suspended solids (see water quality module). Between 1968 and 1973 base flows in Wolf Creek ranged between 9.5 and 13.5 cfs. The calculated minimum flow from 1967-1987 was 5.5[1] cfs in 1977 (see Appendix-7; Hydrology methods).

Many natural occurrences and land management practices can affect base flows. Removal of vegetation will increase base flows by decreasing evapotransporation. Increases of 100 percent have been reported in the Coast Range during the first year after clear cutting 100 percent of a drainage; however, these increases are short lived.[37] Large fires are expected to have similar effects. Compaction and very hot fire can decrease base flows especially at the end of the summer. This decrease happens because the water runs off faster in the spring leaving less water available for base flows.

Changes in riparian vegetation and channel morphology from natural conditions can also decrease base flows. There have not been any studies in this region on the effects of riparian vegetation on flows. However, in more arid areas, studies[38] have shown significant decreases in base flow after removal of riparian vegetation, even the drying up of creeks. Although these studies do not apply on the "westside", some processes do happen here. Of most significance is the property of riparian areas to act like a sponge, holding water in winter and releasing it in summer. When channels downcut they become disconnected from the riparian area. This drains the riparian area earlier in the season. Because streams in the Wolf Creek watershed can only downcut a few feet before reaching bedrock (see channel morphology section), the magnitude of of any decrease in base flow cannot be calculated.

Streams that downcut and straighten have another effect. These streams are more efficient moving water out of the basin, leaving less water for base flow.[39] This amount could be calculated; however, it would be extremely expensive. Decreases in base flows cannot be calculated; however, changes in riparian condition and channel morphology can give an indirect indication of the likelihood of decreases (see channel morphology section). The present base flow in Wolf Creek includes an increase of 3 percent or 0.16 cfs, due to timber harvest activities. Increases from timber harvest in 1956 were in the range of ½ percent or 0.03 cfs. (see Appendix 7, Hydrology Assessment Methodology).

The minimum recorded per square mile flow of the Siuslaw River at Mapleton was 1 percent higher than that of Wolf Creek. This is due to the relatively low precipitation in the Wolf Creek Basin. There may be other reasons for this variance that are unknown and would require further analysis. Wolf Creek contributes 12 percent of the minimum flow of the Siuslaw Basin at Mapleton (from Table 5-7).

Peak Flows (Floods) - Because the natural variation in peak flow is several orders of magnitude, this analysis will discuss peak flows in terms of the return period or the likelihood of a certain size flood occurring during any given year. The impacts of peak flows on beneficial uses can be positive or negative. On the negative side, peak flows can destroy property and structures, cause loss of life, cause accelerated erosion, cause massive siltation, straighten and downcut stream channels, kill riparian vegetation and animals, and make channel restoration more difficult. The positive effects of peak flows are: improves movement of material through the channel system that creates downstream structure, connects the stream with the flood plain (riparian area), creates point bars and islands, increases sinuosity, cleans gravels, digs pools, and cleans out the system.

Whether peak flows have positive or negative effects depends on the magnitude and duration of the flow, the location in the watershed, the spatial and temporal context, and the beneficial uses being considered.

Large Flows--Greater Than or Equal to a 25-Year Flood - (This is an arbitrary but often used break). There is a 4 percent chance of one of these floods in any year. Presently greater than or equal to 20,200 cfs.

- Most of the fines (sand, silt, and clay) in the channels may be flushed out of the watershed and may be deposited in the Siuslaw as far down as the estuary.
- New fines may be eroded and deposited in the flood plain and around structures.
- Gravels may be added to the system from bank erosion and mass wasting. They may be moved to the Siuslaw or redeposited in the larger channels.

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1 May be revised

- Cobbles and boulders (what there are of them) may be made available to the system.
- Spawning gravels may be moved or destroyed.
- New pools may be created where large structures exists and destroyed in other places.
- Riparian vegetation may be washed away or buried in silt. Large trees will probably stand.
- Channels may be straightened and downcut with a loss of sinuosity.
- Roads and bridges may be damaged or washed out. Potential flood damage to structures in the flood plain.

Smaller Flows--Greater Than 1.25-Year and Less Than 25-Year - There is an 80 percent chance of one of these floods in any year. Presently greater than or equal to 6,660 cfs.

- Fines may be washed out of reaches with no structure and deposited in areas of greater structure. Many may enter the Siuslaw to be deposited there.
- Most gravels (what there are of them) may be deposited throughout the system.
- Cobbles and boulders may remain in place (depending on size).
- Spawning gravels may be cleaned.
- New pools may be created.
- Riparian vegetation may receive a new layer of silt.
- Channels may be agraded with an increase in sinuosity.
- Minor impact to man-made structures.

The present return periods for peak flows are given in Table 5-8.

Almost all land use practices increase the magnitude and duration of peak flows. Removal of vegetation will increase peak flows especially in the fall and spring by decreasing evapotransporation. Clear cutting an entire watershed will increase peak flows an average of 50 percent.[40]

Roads have two effects on peak flows. First, compaction decreases the amount of infiltration and delivers more water to the channels sooner. There is a direct exponential relationship between the percent of a watershed compacted and the magnitude of peak flows.[41] Second, roads intercept ground water and route it directly to the channels. Sidehill roads, in effect, become new streams. In the Wolf Creek drainage, 333 miles of road or 1.5 percent of the watershed is adding to compaction. In addition, approximately 181 miles of road are acting as new channels. The effects of logging and road building have a synergistic effect on peak flows. Increases in peak flows of between 10 and 52 percent have been reported in the Cascade Range with as little as 5 percent of the watershed harvested[40]. These increases were for all peaks. The percent for larger midwinter storms were far less.

The same processes that lower base flows, when riparian areas and stream channels are modified, increase the magnitude and duration of peak flows. There are no methods to calculate the magnitude of these changes. Increases in one-year flows due to timber management activities for the Wolf Creek Basin are between 30 and 53 percent (see methods). The calculated increase from logging activities is 1,108 cfs. Assuming this increase, Table 5-8 gives the change in probability of a particular flood. These increases are only accurate within an order of magnitude (see Appendix-7, Hydrology Methodology).

Table 5-8 - Probability of a Flood Event for Wolf Creek Watershed

Return Period	Present Conditions Flow (cfs)	Prelogging Flow (cfs)	Probability of Exceeding Present Flows	Probability of Exceeding Prelogging Flows
1.25 YR	1,486.54	378	80%	>99%
2 YR	2,150.39	1,042	50%	78%
5 YR	3,077.11	1,969	20%	57%
10 YR	3,700.87	2,593	10%	30%
25 YR	4,502.83	3,395	4%	14%
50 YR	5,104.31	3,996	2%	7%

Channel Morphology - Stream channels in the Wolf Creek drainage have a lower gradient than those in other parts of the Coast Range. Table 5-9 gives the miles of stream by order and Table 5-10 provides the miles of stream by gradient in the watershed. Stream gradients are shown on Map 6. Slope classes for the watershed as a whole are shown on Map 3.

Table 5-9 - Miles of Stream by Order - Wolf Creek Watershed

Stream Order	Stream Length (in miles)	Percent of Total
1st order	202.1	57.0
2nd order	69.8	19.7
3rd order	35.5	10.0
4th order	18.7	5.3
5th order	8.1	2.3
6th order	20.4	5.7
Totals	354.6	

Unlike other watersheds, the upper (eastern) portion of Wolf Creek has gentler slopes than the lower (western) portion. This has implications for channel morphology and sediment routing. The watershed has been divided into 6 geomorphic units (see Chapter 2, geomorphology section, Table 2-2 and Figure 3).

Table 5-10: Miles of Stream by Gradient for Wolf Creek Watershed

MILES OF STREAM BY GRADIENT											
<1%		**1%-2%**		**2%-4%**		**4%-8%**		**8%-20%**		**>20%**	
MI	%	MI	%	MI	%	MI	%	MI	%	MI	%
43	12	9	2.5	18	5	37	10	126	36	120	34

Small samples of streams were surveyed for channel characteristics. Each stream was rated for confinement, channel bed morphology, bank condition, point bars, and the proper functioning condition of the riparian area. This information plus soil resilience, mass movement, and channel slope is given in Table 5-11.

Smaller Streams - The smaller streams are shown on Figure 5. They include all streams except for the less than 1 percent gradient portions of Wolf, Panther, Swamp, Eames, and Oat creeks.

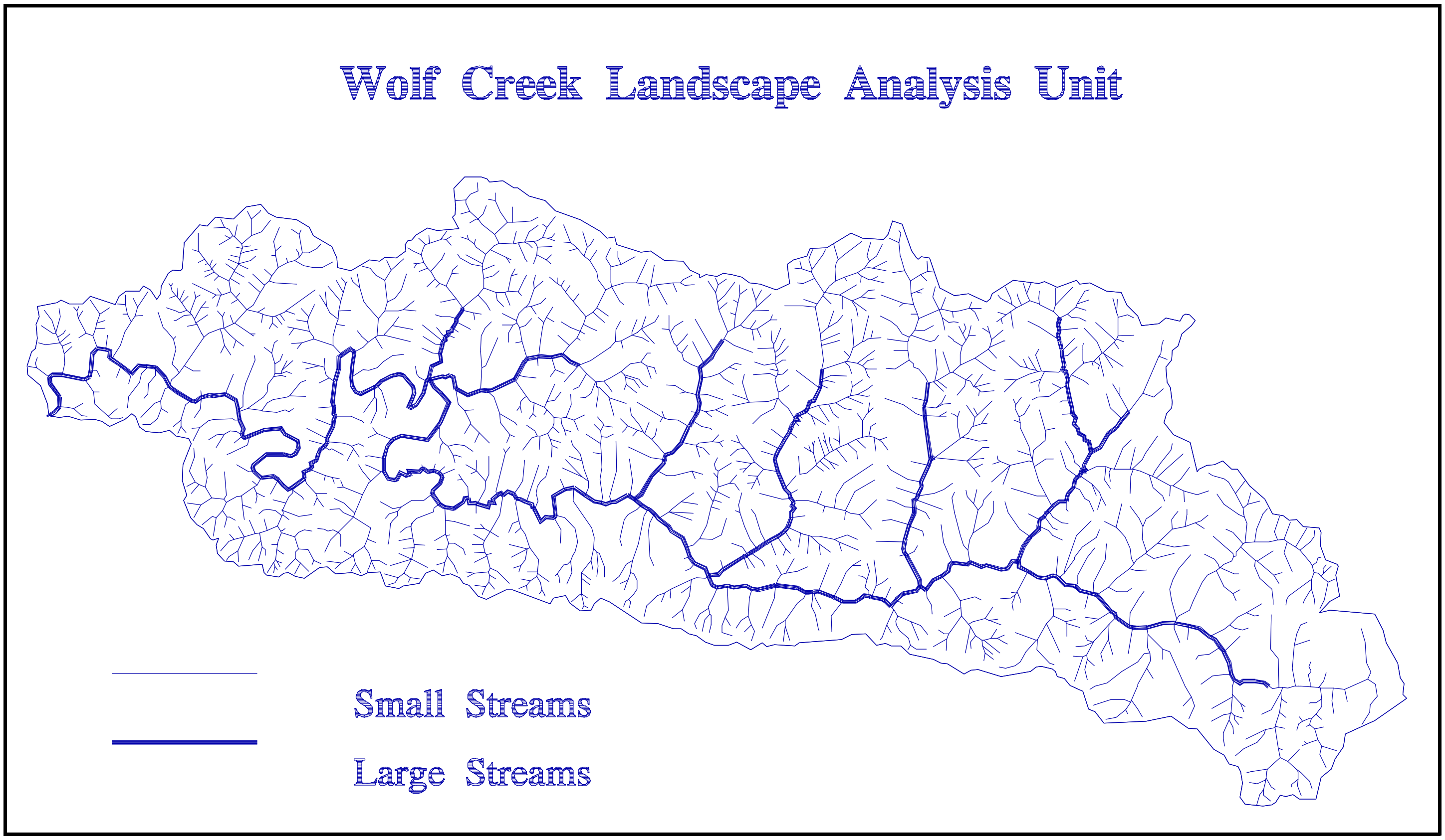

Figure 5: Map of small and large streams within Wolf Creek watershed

Hydrologic Processes - The hydrologic processes in these streams appear to be functioning well. They have adequate structure comprised of large and small woody debris that prevent severe downcutting. The small debris is adequate to supply structure. The streams do not have enough flow to move this material. In the upper two-thirds of the watershed, the headwater streams (1st and 2nd order) are often underground. They are covered by 5-10 feet of organic and colluvial material that is held in place by coarse woody debris however, these streams are often perennial.

Entrenchment - There was evidence of downcutting (up to 5 feet) on several of the streams. These streams are able to reach their flood plains, but less frequently. The evidence of raw cutbanks is an indication of downcutting. Of the reaches sampled[2], there were 7 good ratings (very few raw banks), 6 fair ratings (some raw banks), and 3 poor ratings (mostly raw banks).

Another indication of entrenchment is the lack of point bars in channels large enough to have them. Of the 11 streams that would be expected to have point bars, 5 had none, 4 had a few, and 2 had the expected amount.

[2]Some reaches had more than 1 rating.

Confinement - Our survey found that only confined streams had a gradient of greater then 8 percent. Only two streams were found to be confined due to downcutting. These were both short reaches caused by road crossing. For all other streams confinement was consistent with the surrounding topography.

Channel Morphology - Five of thirteen reaches had bed plane morphology in all or part of the reach. The rest had pool-riffle or step pool morphologies. The bed plane indicates a lack of structure, complexity, and/or habitat.

Stream Bed Material - Although bedrock was evident on many reaches, all streams had some fluvial material except for 1st order streams which had colluvial material. Fines (sand and silt) were the dominant material in the upper 2/3 of the watershed and were found in all but 2 of the streams sampled. Saleratus Creek and a unnamed tributary located about 1/2 mile from the mouth had gravel-cobble substrate. These streams were in drainages with basaltic intrusions (see Map 1, Geological Features).

Larger Streams - Larger streams are shown on Figure 5. They include streams considered 4th order and larger.

Function and Entrenchment - Few of the larger creeks have adequate hydrologic functioning channels or riparian areas. These streams have been downcut to bedrock with the exception of the upper portion of Wolf Creek. Here, beaver activity and logging debris have brought the channel closer to natural levels. In most cases, the downcutting is not so severe that the stream does not reach the flood plain, but flooding happens far less often. For example, if Wolf Creek has downcut 3.3 feet at the mouth, it would take a 2-year flood to reach the flood plain in 1950 and a 5-year flood today. The degraded channels route water more efficiently and may cause larger floods downstream, lower summer flows, and higher velocities that can prevent new structure from becoming established. The 1953 photos show lower Wolf Creek having more islands and point bars than today. Sinuosity was not measured but photos indicate that it may have decreased as the creek became more entrenched.

Confinement - Assuming that the streams are still able to reach their flood plain, most reaches of the larger creeks are unconfined.

Stream Bed Material and Channel Morphology - Wolf Creek, below Swamp Creek, and most of the larger tributaries have bedrock bottoms. Starting about Pittenger Creek, more and more reaches have accumulations of cobbles. There are increasing amounts of structural material that trap gravels and fines in the form of bed material, point bars, and islands. These reaches are still rated as bedrock.

Man-Made Structures - Many structures have been built for fish habitat (see Map 7, Man Made Structures). These structures appear to be raising the stream bed and improving hydrologic function. There are no measurements of the effectiveness of these structures.

Summary - The Wolf Creek watershed lacks an adequate supply of gravels, cobbles, and boulders. Consequently, the channel substrate generally consists of sands. The channels of smaller streams are almost always able to reach their flood plain on a regular basis (2-year storm). The channels of smaller streams can be grouped into 3 groups. Four of the 14 reaches examined were in healthy condition. They had the appropriate structure, sinuosity, and morphology for their location. Two channels were not healthy; they were seriously downcut and channelized that functions was impaired. Eight reaches were moderately healthy; they had some downcutting, but not to bedrock, lacked structure, lacked habitat, and were not fully utilizing their flood plain.

The channels of the larger streams have been downcut, often to bedrock. A lack of structure is the cause of this problem. Man-made structures have been constructed on several reaches of these larger streams. These structures look promising. They appear to be replacing some of the structure that has been lost. Man made structures have a relatively short life and will not replace natural structure. They may need to be maintained until natural course woody debris sources have matured and begin to supply the system.

Table 5-11 - Summary of Major Stream Characteristics

REACH	SOIL RESILIENCY UNIT		MASS MOVEMENT POTENTIAL		STREAM ORDER	P-I-C	CONFINEMENT	CHAN SLOPE	CHAN BED MORPH	BANK CONDT	POINT BARS	PFC
	CHAN	BASIN	CHAN	BASIN								
PANTHER 1	9/10	8/9	L	L	3	P	UNCONF	<1	PB-PR	F	NONE	R-U
PANTHER 2	10	6/9	L	L	4	P	UNCONF	1-2	PB	P	NONE	NON
PANTHER 3	6	9	L	L	3	P	UN-MOD	1-2	PB-PR	G	NONE	PFC
SALMON 1	6	6	L	L-H	3	I	CONF	8-20	SP	G	NONE	PFC
SALMON 2	6	9	L	L	3	P	UN-MOD	4-8	PR	G	NONE	PFC
EAMES	9	9	L	L-H	4	P	UNCONF	<1	PB	G-F	FEW	R-S
GRENSHAW	9	9/3	L	L-M	3	P	UNCONF	2-4	PB-SP	G	FEW	PFC
VAN CUREN	9	9/3	L	L-H	2	P	UNCONF	4-8	PB	F-P	NONE	R-S
PITT 1	6	9	M-H	M-H	1	C	CONF	>20	NA	NA	NA	PFC
PITT 2	9	9	L	M-H	4	P	UNCONF	1-2	SP	G	PLENTY	PFC
SALERATUS 1	6	6	L	L-H	4	P	MOD	1-2	PR	G	ENOUGH	R
SALERATUS 2	6	6	M-H	M-H	4	P	CONF	<1	PR	G-F	FEW	R
LOWERTRIB 1	3	3	L	L	2	I	UNCONF	4-8	PR	FAIR	FEW	R-U
LOWERTRIB 2	9	9	M	M-H	2	I	C-MOD	8-20	PB	F-P	NONE	R-S
WOLF 1	9	8/9	L		4	P		<1	PB	FAIR	NONE	R-U
WOLF 2	6	9	L		6	P		<1	BR	POOR	NONE	R-S
WOLF 3	6	6/9	L-H		6	P		<1	BR	FAIR	FEW	R-U
WOLF 5	6	6/9	L		6	P		>1	BR-PR	GOOD	NEW	R-U
WOLF 6	6	6/9	L	H	6	P		<1	BR-PR	G-F	NEW	R-U

Table 5-1 Columns - This table contains the field information used for the channel morphology assessment.

Soil Resiliency Unit: Descriptions of the soil resiliency units are found in Appendix 6. The most common Soil Resiliency Units occurring:
a. along the channel (CHAN)
b. within the drainage area (BASIN) of the reach surveyed.

Mass Movement Potential: Low - Moderate - High. Descriptions are found in Appendix 6 under Mass Wasting. This information was used to determine possible source as well as sediment delivery.

Stream Order: The stream order of the segment surveyed using Horton's system where the smallest channels are 1st order streams, two 1st order streams joining create a 2nd order stream, etc. This is used to compare streams by size.

P-I-C: Classification of channels as permanently flowing, intermittent or channel, using the ROD definitions.

Confinement: The relationship of the width of the stream channel to the width of the flood plain. The categories are explained in the TFW handbook[28]. The confinement is used to help determine the potential of streams to downcut, and to meander in their flood plains.

Channel Bed Morphology: PB = Plane-bed, PR = Pool-riffle, SP = Step-pool, BR = Bedrock
These classifications are explained in the TFW handbook[28].

Bank Condition: Streambanks were rated as Good-Fair-Poor, according to the amount of raw banks present (see Appendix 7).

Point Bars: A subjective estimate of the number and size of point bars compared to a healthy stream of the same size.

PFC: This is a riparian not a channel classification. PFC = Proper Functioning Condition, R = Functioning at Risk, U = Upward Trend, S = Stable
Non = Nonfunctional. Proper Functioning Condition is a description of the hydrologic function of riparian areas.

Water Quality

Wolf Creek waters are of very high quality for all parameters with the possible exception of temperature, dissolved oxygen and sediment - turbidity. There is no numerical State Water Quality Standard[42] that is being exceeded in the Wolf Creek Basin. State Water Quality Standards for temperature and turbidity are written for management actions and generally do not apply to watersheds. The following standards[42] could apply depending on the interpretation:

> "Existing high quality waters, which exceed those levels necessary to support propagation of fish, shellfish, and wildlife and recreation in and on the water shall be maintained and protected unless . . . 340-41-026 (1)(a).
>
> "Logging and forest management activities shall be conducted in accordance with the Oregon Forest Practices Act so as to minimize adverse effects on water quality. 340-41-026 (b)(7)
>
> "Road building and maintenance activities shall be conducted in a manner so to keep waste materials out of public water and minimize erosion of cutbanks, fills and road surfaces 340-41-026 (b)(8).
>
> ". . . federal, state and local resource management agencies will be encouraged to assist and coordinate planning and implementation . . . 340-41-026 (b)(8).
>
> <u>Mid Coast Basin Standard</u>
>
> "Notwithstanding the water quality standards contained below, the highest and best practicable treatment and/or control of wastes, activities, and flows shall in every case be provided so as to maintain dissolved oxygen and overall water quality at the highest possible levels and water temperature, coliform, bacteria concentrations, dissolved chemical substances, toxic materials, radioactivity, turbidities, color, odor, and other deleterious factors at the lowest possible levels. 340-41-245 (1)"

<u>Sediment</u> - There are no State standards for suspended or bedload sediment. It is assumed (incorrectly) that Jackson Turbidity Units have a direct relationship to suspended sediment. The standard for turbidity in the Mid-Coast Basin is "No more than 10 percent cumulative increase in natural stream turbidities shall be allowed, as measured relative to a control point immediately up stream of the turbidity causing activity." Although this standard does not apply to a watershed scale, the analysis of suspended sediment, that was done for the sediment routing section of this chapter, estimates that present rates are less than 10 percent greater than natural rates.

It is doubtful that any beneficial use is adversely impacted by sediment in the Wolf Creek watershed. There may be a problem caused by the large amount of fine sediments, compared to cobbles and gravels. As structure is added to the streams the small amount of gravels may be filled by fine sediments, decreasing there usefulness as habitat for aquatic organisms.

<u>Temperature</u> - State Water Quality Standards designate allowable increases from management activities of up to 2º F. for water that is less than 64º F. The standards do not give any numerical standard.

Salmonid fish spawning and rearing is the most critical beneficial use affected by water temperature. A temperature of 64º F. is a good bench mark temperature for salmonids (see Aquatic section in Chapter 6).

Historically summer water temperatures have been near or above 64º F. Table 5-12 gives temperatures for various streams in the watershed. Except for those temperatures marked with an asterisk the temperatures are calculated[43].

Table 5-12 - Water Temperatures for Various Stream Reaches - Wolf Creek Watershed

Date	Location	Temperature (ºF)
1987	Wolf Creek below Oat Creek	68*
1971	Grenshaw Creek above clear cut	59*
1971	Grenshaw Creek below clear cut	68*
1971	Grenshaw Creek at mouth	59*
1985	Oat Creek at mouth	64*
	Wolf Creek at mouth	78
	Wolf Creek below Eames Creek	70
	Wolf Creek at Panther Creek	67
	Saleratus Creek	64
	Pittenger Creek	63
	Panther Creek	64

Forestry practices can influence stream temperature. Increases in flow decrease temperature by providing more water to be heated. Larger surface area increases temperature by providing a larger area to be heated. Bedrock channel bottoms increase temperatures by absorbing heat that is reradiated later. The amount of shade is by far the greatest factor affecting instream water temperatures making the other factors almost insignificant.

Fisheries

The Wolf Creek watershed contains 10 major streams that are tributaries to Wolf Creek. There are no lakes in the basin and the average stream gradient is low in the mainstems of the major tributaries (<1.0 to 2.5%). Stream channels in the basin were once dominated by large woody material that, together with beaver dams, created extended reaches of pools and slow flowing water. As a result of past activities in the basin, most of the woody structures in the streams have been removed or lost. Harvesting of streamside trees left too few large trees that could fall into the stream channel and replace the stream structure. As a result of this loss, many of the stream channels in the basin have incised into the valley substrate, secondarily confining the channels and reducing the availability and quality of habitat. This is most evident along portions of Wolf Creek.

Riparian communities within the watershed are dominated by hardwoods, primarily red alder and bigleaf maple, and only remnant older conifer trees or patches of trees are present. Buffers along the streams have been left after harvest; however, most have suffered up to 90 percent mortality, and many are now dominated by brush species[44].

Aquatic Habitat Conditions - The habitat conditions within the Wolf Creek watershed are well below potential. The lack of deeper pools, high water temperatures, and lack of off-channel rearing areas are probably the major limiting factors for native fish in the watershed. As a general indicator, the following values can be used as an approximation of the quality of aquatic habitat:

Percentage of habitat as pools varies by gradient:
- <2.5% gradient, pools should be ≥70% of habitats
- 2.5-6% gradient, pools should be 30-50% of habitats
- >6% gradient, pool percentage depends on canyon width

Pool Depth to Width ratio indicates quality of pools: (for pools other than beaver dams)
- 30% or higher, excellent pools
- 20-30%, good
- 10-20%, fair
- <10%, poor

Each of the following tributaries to Wolf Creek are key streams that provide habitat for aquatic species (primarily fish) located within the watershed. The following is a discussion related to the habitat conditions for each of those tributaries. The discussion follows the length of Wolf Creek starting from its confluence with the Siuslaw River (see Map 8, Fish Distribution for location of streams).

Unnamed tributary (1) - This is a 3rd order stream that had its adjoining slopes logged in about 1980. Silt and slash collected in the creek and severe erosion occurred following a storm event. Boulders were deposited into Wolf Creek following this storm event. Red alder have since become established along the banks of the creek, contributing to its stabilization. The slash was removed from Wolf Creek out of concern for the bridge downstream. The boulders remain in place in Wolf Creek, creating a large pond. The culvert on this tributary at Wolf Creek has a drop of over 6 feet, blocking any fish migration into the creek. The channel on this tributary has stabilized and habitat is recovering.

Saleratus Creek (2) - This 4th order stream is dominated by shallow, flowing water, with 47 percent of the substrate as bedrock (see Appendix 4, Table 7). Most of the spawning gravel in the system has been deposited on private land below Wolf Creek road during periods of high water or in association with earlier BLM restoration projects. Particularly lacking are deeper pools and off-channel areas as rearing habitat. One-third of the existing pools are rated as poor and over half are rated poor to fair (Table 5-13, Appendix 4, Table 2). Although temperatures have not been measured in this stream, the extensive bedrock areas and limited shading are probably contributing to elevated temperatures, which in turn contribute to high temperatures in Wolf Creek.

Aquatic habitat restoration projects have been built in Saleratus Creek (see Appendix 4, Table 13). Most of these structures of small fir and small rocks have remained and are functioning as intended. In addition, beavers have built dams upon a couple of the remaining structures, enhancing the structures' functions.

Bill Lewis Creek (3) - This is a 4th order stream with the lower portion being flat and dominated by shallow pools and glides. The substrate is mostly gravel, sand, and silt (see Appendix 4, Table 7). There are some good spawning areas, but rearing habitat is limited. Upstream, Bill Lewis Creek flows through a mature/old growth forest that provides considerable amounts of woody structure in the stream channel, making aquatic habitat along this reach generally good.

Pittenger Creek (4) - This is a 3rd order stream that is low in gradient along most of its length with mostly pool-glide-riffle habitat (see Appendix 4, Table 1). Spawning habitat is adequate in the stream; however, rearing habitat is limited, as most of the basin was harvested in recent years. There are limited areas for recruitment of woody structure into the channel. Near the mouth of the creek is an open forest of older conifer and bigleaf maple.

Four log sills were placed above a replaced culvert to maintain the channel integrity, and to provide aquatic habitat. The logs were placed to prevent channel downcutting because the culvert was lowered to remove a barrier to fish; however, this created a gradient discontinuity.

Gall Creek (5) - This is a 4th order stream with a flat gradient, particularly along the lower half-mile of the stream that empties into Oat Creek just above its confluence with Wolf Creek. The substrate is mostly silt and sand, with habitat consisting of mostly shallow pools (see Appendix 4, Tables 7 and 2). A culvert at a road crossing above the Wolf Creek road was plugged by debris, creating a series of ponds and wetlands. Although the debris at the culvert has been cleaned out, beaver activity has maintained most of the wetlands. The riparian area in this portion of the stream lacks stream-side trees and is dominated by brush species. Above this area the stream is predominantly pool-riffle habitat and the vegetation is dominated by red alder.

Gall Creek is one of the better streams in the basin for fish habitat. There are adequate upstream spawning areas to seed the good rearing habitat in the lower half-mile of the stream. In addition to beaver using the stream, otters have been observed on many occasions.

Oat Creek (6) - This is a 5th order stream that is dominated by long glides and riffles, with extensive bedrock areas along the lower portion of the stream. Near the mouth of the stream are several large, deep pools that provide excellent habitat. Further up the stream the gradient becomes somewhat steeper and the size of the aquatic habitats becomes smaller. There are areas of bedrock, but some good spawning areas as well. Beaver activity has been extensive, particularly in the lower portions and one of the forks.

Limited aquatic habitat enhancement work has been done in Oat Creek. Early efforts have been washed out or have had minimal sucess. However, recent efforts have provided adequate habitat enhancement in one short reach of Oat Creek.

Van Curen Creek (7) - This is a 3rd order stream with a confined stream channel and predominantly riffle and shallow pool habitats. There is habitat suitable for resident trout, steelhead, and cutthroat; however, the culvert on the Wolf Creek road has a drop that creates a permanent barrier for movement of fish into the creek. Private lands along the stream were harvested during the past decade and only narrow buffers along the streams were left. Most of these private land buffers have since fallen down and only remnant trees remain along the stream. The riparian areas along the public lands are more complete with conifers, red alder, and bigleaf maple.

Grenshaw Creek (8) - This is a 4th order stream with predominantly pool-riffle habitat. The substrate has extensive areas of bedrock and finer particle size materials (see Appendix 4, Tables 1 and 7). In 1973, the Eugene District created a spawning channel in the Grenshaw Basin. It was built at a bend in the creek, with an upstream headgate to control flows into the channel. Gravel was placed in the channel and held in place with boards at the lower end of the channel. A series of structures were built below the channel to create stair-step pools leading to the channel (see Appendix 4, Table 13). Fish used the spawning channel for several years, but then stopped, and use of the channel was abandoned. A contributing factor was that there were no discontinuities in the channel. As a result, silt probably built up and percolation of water through the gravel was inadequate to support fish use. In addition, a large beaver dam was built above the mouth of Grenshaw Creek that blocked all access for anadromous fish for several years. Eventually the BLM removed the dam. The spawning channel was reopened by BLM, modified to facilitate fish passage past a beaver dam that was built in the original stream channel above the lower entrance to the spawning channel. Fish began to use the channel for spawning and were able to reach spawning areas in Grenshaw Creek above the spawning channel. However, the beaver dam has recently blown out and the gabions below the spawning channel placed to create jump pools broke apart. The channel is usable but not accessible to fish.

Gabions, boulder weirs, and log structures have been placed in Grenshaw Creek above and below the spawning channel beginning 20 years ago. Some of these structures are still functioning, but others have broken up. Beavers have built dams on several of the structures, some of which have since broken apart.

Grenshaw Creek has some good habitat but is lacking instream structure. Where projects have been built, the response has been good. With the exception of boulders placed in the lower reach, the projects have not provided long-term channel improvements.

Eames Creek (9) - This is a 4th order stream that begins with steep headwater areas but is primarily a low-gradient stream with an unconfined valley floor. Aquatic habitat consists primarily of pool-riffle-glide, with over 50 percent of the substrate as bedrock (see Appendix 4, Tables 1 and 7). Spawning and rearing areas are quite limited with the best pools, and the best habitat overall, associated with beaver activity. Extensive reaches of the channel have downcut due to the lack of instream structure, creating secondary confinement of the channel and some bank instability.

Extensive timber harvesting has occurred in the basin, with nearly all of the basin in various stages of second growth forest. Narrow buffers were retained after harvest activities, and large conifers are scarce.

Early habitat enhancement efforts used gabions and high explosives to blast pools in the bedrock. The gabions have broken through, but the blasted pools remain functional. A large beaver dam near the mouth effectively blocked access for several years in the 1980s, except during flood flows. Recent habitat enhancement efforts have been done, placing boulders and logs along a mile of the stream where early efforts were done. Habitat changes following the initial placements includes increased depth of pools, increased rearing habitat, and increased spawning areas.

Swamp Creek (10) - This creek is a 4th order stream, generally low gradient and unconfined along the portions of the stream passing through BLM lands, although there are some steeper areas in the headwaters. Habitat is almost entirely pool and riffle, with insignificant amounts of glide habitat (see Appendix 4, Table 1). Fifty-six percent of the substrate is composed of silt, with bedrock and sand being the other common substrates (see Appendix 4, Table 7). Much of the pool habitat is formed by beavers, which are common throughout the basin. There are a number of wetland areas as well. Instream structure is variable, being absent in many reaches.

The basin has been extensively harvested in recent years, especially on private lands. Riparian buffers have generally been narrow. There are some older mature stands on BLM lands. Over 50 percent of the riparian vegetation is composed of red alder, with Douglas-fir being the only other abundant overstory species. Beaver activity and natural wetlands also create a number of open, marshy areas dominated by grasses, sedges, and brush species.

Several gabions have been placed in the stream on private lands by the Izaack Walton League (Appendix 4 Table 13).

Panther Creek (11) - This is a 4th order stream with generally low gradient flowing in a mostly unconfined valley. Most of the basin is in private lands, with public ownership mainly in its tributaries. Except for the lower end, the valley in private lands is managed for farming and residential uses, with the upslopes managed for timber.

There have been no habitat inventories on this creek; however, the habitat in the main channel is similar to Swamp Creek and is dominated by pools, glides and riffles, with extensive silt deposits. There are several large beaver dams in the basin that contribute to rearing habitat.

A series of gabions have been placed on private land in Panther Creek by the Izaack Walton League (see Appendix 4 Table 13), but because of the low gradient, silt loads, and lack of adequate percolation, they have been unproductive.

Salmon Creek (12) - This is a 3rd order stream that is relatively steep with predominantly stair-step pool-riffle habitats (see Appendix 4, Table 1). Timber harvesting activities have been recent in the basin, both on private and public lands. Riparian buffers vary in width, dependent upon the ownership.

Swing Log Creek (13) - This is a 4th order stream with generally low gradient flowing in an unconfined valley. Pool habitats compose 87 percent of the stream, with some glides and riffles (see Appendix 4, Table 1). Substrates are dominated by silt, organic matter, and bedrock (see Appendix 4, Table 7). Beaver activity was once very high in the basin, creating open, wet, grassy areas. However, the beaver dams have since broken out and the stream has become incised into the valley floor, lowering the water table, and drying out the wetlands. Brush has begun growing in the formerly marshy areas and large trees are still absent. Some beaver activity continues in the headwaters, creating new wetlands.

Habitat restoration projects were initiated in 1994 to increase instream woody structure, raise the water table, restore the wetland areas, and create spawning and rearing habitat (Appendix 4, Table 13).

Wolf Creek (14) - Wolf Creek flows generally east to west, with most of the larger tributaries flowing into Wolf Creek from the north. Wolf Creek can be divided into 3 segments based on stream conditions and size.

The first segment runs from the headwaters to the junction with Panther Creek. The headwaters begin as a series of smaller streams with relatively low gradients. This segment is marked by low gradients, and substrates dominated by silt and sand. The headwaters lack a source of gravel, and have infrequent material movement due to low gradients. In addition, previously accumulated sediments were lost when in-channel structure was lost. Fish habitat is limited, being mostly suitable for coho salmon and cutthroat trout, although some steelhead use may occur. Chinook salmon can use the area, but probably do not except in high flow years. Spawning habitat is limited, while rearing habitat is patchy. Several large beaver dams with extensive wetlands occur in this portion of Wolf Creek.

The second segment runs from the junction with Panther Creek to Eames Creek. This segment flows through a reach bordered by magma intrusions, now being used as rock quarries, that constrict the channel and introduce larger, harder rocks into the channel. The intrusion provides a source of hard rock for boulder habitat and spawning gravel. Boulder accumulations are common through this segment, creating some rapid and cascade habitats not common elsewhere in the basin. Because of the boulder intrusions in this segment, the area has a greater diversity of habitats than elsewhere in the basin, including boulder rapids and cascades, and a number of large pools. This segment has some of the best steelhead habitat in the basin, and is also used by coho and chinook salmon, and cutthroat trout (see Map 8, Fish Distribution Map).

The third segment of Wolf Creek runs from Eames Creek to the mouth. From Eames to Oat Creek is considered a transitional zone. It has a broader, unconfined valley, but has more boulders and associated rocky habitat than is found downstream. A common feature of the segment is the incision of the channel, creating secondary confinement and lowering the water table.

This segment is characterized by extensive bedrock, and sediments dominated by fine particles. Large in-channel woody structure is lacking. Pools are the dominant habitat type but are often shallow. The best pools are associated with beaver activity, which is occurring throughout the segment. One pool was created near the mouth by boulders accumulating after a landslide from a 2nd order stream in 1980. This created an extended deep pool upstream. The incised channel and lack of woody debris in this segment prevent creation of additional larger pools. Prior to the incision of the channel, Wolf Creek probably had extensive wetlands and off-channel habitat, both of these are currently limited in the lower segment.

Riparian vegetation and buffer widths along the entire length of Wolf Creek varies with the amount and intensity of timber management activities that have occurred in the past. The availability of large woody structure along the creek is limited to those areas that have adequate streamside buffers or where the stream channel runs through old growth or mature forest stands (see Map 15?, Riparian Vegetation).

Coho and chinook salmon, steelhead, and cutthroat trout use Wolf Creek along with a number of nongame species. Temperatures in the mainstem of Wolf Creek often exceed 68° F., the upper limit for salmonid use. This limits the suitability of Wolf Creek for rearing habitat during peak summer periods.

Habitat Comparisons - The following discussion relates the more important habitat features in the watershed by comparing streams within the watershed. There are considerably more habitat characteristics and features that were measured and recorded for streams within the Wolf Creek watershed. These characteristics and features are listed in the tables in Appendix 4, Fisheries Habitat Data.

Generally, the amount of habitat in the Wolf Creek watershed is good, with an average of 60 percent of the habitats within the watershed as pools. However, the size and depth to width ratio of these pools is the ultimate distinction between a "good" pool, providing conditions for rearing of fish, and a "bad" pool. The anadromous fish-bearing streams within the watershed are a low gradient (average 1.5%) with a range of <1.0 percent to 2.5 percent. There are short reaches in each of the tributaries to Wolf Creek that are greater than 2.5 percent gradient, but on the average the stream is less than that. As indicated earlier, a stream system with low gradient should have at least 70 percent of the fish habitat within the system as pools to be considered good conditions for fish spawning and rearing. Another consideration when classifying streams as suitable for fish spawning and rearing is the depth to width ratio of the pools in the stream as well as the size or surface area of a pools.

As indicated in Table 5-13, Bill Lewis Creek, Swamp Creek, Swing Log Creek, and that portion of Wolf Creek surveyed in 1985, have pool habitat greater than 70 percent. For Bill Lewis, Swamp, and Swing Log creeks, the depth to width ratio for the majority of the pools falls into the category of fair quality, and only a few are considered to be excellent. Most of the pools in Bill Lewis and Swing Log creeks are small pools, with a surface area of up to 300 square feet. The surface area of most of the pools in Wolf Creek are large, being 700 square feet or greater. Most of these larger pools have been created by beaver dams. Approximately 50 percent of the pools in Swamp Creek are 600 square feet and smaller and approximately 50 percent of the pools are greater than 700 square feet.

Streams like Eames Creek, Gall Creek, Oat Creek, Grenshaw Creek, Swamp Creek, and that portion of Wolf Creek surveyed in 1986, have pool habitat amounts nearer to the Wolf Creek Basin average of 60 percent. The majority of the pools in these creeks, except for Oat Creek and Wolf Creek, have a depth-to-width ratio of 11 to 20 percent in the fair quality category. For the majority of the pools in Wolf Creek, the depth-to-width ratio is up to 10 percent or poor quality, and 80 percent of the pools in Oat Creek fall into the poor to fair ranges. The sizes of the pools in these creeks show that Eames Creek has a larger portion of the pools in the larger size class, ranging from 800 square feet and greater. The sizes of the pools in Wolf Creek are generally split evenly, with 46 percent being in the smaller sizes (<600 square feet) and 54 percent in the larger sizes (>700 square feet). The majority of the pools in remaining creeks are in the smaller category, ranging up to 300 square feet.

The remaining creeks along Wolf Creek, including that portion of Wolf Creek surveyed in 1993, have less than 42 percent of the habitats as pools . The depth-to-width ratio for the majority of those pools falls into the fair quality category (11-20%), though this ratio for the pools in Wolf Creek are in the small range (0-10%). The sizes for the majority of the pools in these stream are in the lower range of 0-300 square feet, except for Saleratus Creek that shows the greater portion of the pools in the larger range (800 square feet and greater).

Table 5-13 - Comparison of Pool Habitat for Each Stream in Wolf Creek Watershed.

Stream	**% Pool Habitat**	**Depth:Width Ratio [1]**				**Pool Size (ft 2)**			
		Poor 0-10%	**Fair 11-20%**	**Good 21-30%**	**Excel > 30%**	**0-300**	**400-600**	**700-5,000**	**> 5,100**
Bill Lewis	86	32	47	15	6	83	8	8	1
Eames	49.5	42	57	4	0	16	12	64	8
Gall	69.8	24	52	20	4	76	13	9	2
Oat	48.2	40	40	20	0	60	20	20	0
Grenshaw	54	19	48	24	9	85	8	6	1
Pittenger	41	18	57	24	0	87	6	6	0
Saleratus	20.7	39	46	15	0	31	8	54	7
Salmon	18.9	0	100	0	0	100	0	0	0
Swamp	78.3	32	50	17	0	33	16	24	24
Wolf Swamp	66.8	25	59	13	3	59	19	19	3
Swing Log	87.2	29	44	19	7	57	7	28	4
Van Curen	35.9	34	47	13	6	100	0	0	0
Wolf 1985	70.8	62	34	0	3	10	13	47	30
Wolf 1986	61.5	70	27	1	1	30	16	36	18
Wolf 1993	17.7	54	44	2	0	52	28	20	0

[1] Values are Percent of Pools in listed condition from BLM Computerized Aquatic Resources Program (CARP) Database

Following the condition guidelines indicated above, there are few if any streams in the watershed that meet all of the requirements for quality fish habitat. The streams with the greater amount of habitat as pools, have pools that reach only the fair condition for depth to width ratio ratings, and an average of 13.7 percent of the pools in the watershed reach the larger size conditions ($\geq$ 800 square feet). With low stream gradients in the major anadromous fish bearing streams within the watershed, more fish habitat should be as pools. The condition of the existing pools in the watershed should be of better quality. The current conditions of these streams in the watershed indicate that spawning and rearing habitat is a potentially limiting factor to fish colonization and recruitment in the watershed.

Fish Distribution and Status - The Siuslaw River Basin is an integral portion of the inland habitats for the entire run of native mid-Oregon Coast coho salmon. With essentially 3 river systems providing habitat for this run of fish, the Siuslaw River system, which includes Wolf Creek, is important to the long-term survival of the coho salmon. This system plays an even more important role with the mid-Oregon Coast coho salmon run now in status review as a threatened species under the Endangered Species Act, 1973.

Wolf Creek has been considered a classic coho salmon stream. Low gradients, extensive wetlands, off-channel areas, and beaver dams provided suitable habitat for coho salmon in Wolf Creek and most of the larger tributaries to Wolf Creek. However, because of the loss of structure, subsequent downcutting, and low water tables, Wolf Creek has failed to provide habitat essential for the rearing of young salmon. The areas not used by coho salmon are streams with higher gradients, primarily the upper headwater streams in the watershed.

Chinook salmon are found in the main stem of Wolf Creek, with the distance upstream varying by the flow levels. Steelhead have been seen in the main stem and in most of the tributaries.

Cutthroat trout are found throughout the Wolf Creek Basin. In addition to resident trout, Wolf Creek is used by sea run cutthroat. No information is available on the past or current cutthroat populations. See Map 8 for current fish distribution within the watershed.

One other anadromous fish, the Pacific lamprey, also spawns in Wolf Creek and its tributaries. Its numbers have declined since about 1990. The lamprey spawns at about the same time as steelhead, and its decline has mirrored the steelhead decline. This suggests that ocean conditions may be a factor in its decline. The brook lamprey, which spends its full life in freshwater, is found in much of the basin, although it numbers are unknown.

Sculpins remain fairly abundant throughout the basin. Their distribution is similar to that of resident cutthroat trout. Other nonsalmonid fish are found primarily in the mainstem of Wolf Creek, especially below Oat Creek. Dace, and shiners, are the species most likely to move into smaller streams. While the non-salmonids have been noted while doing salmonid collections, no effort has been made to characterize the community. Table 5-14 lists the fish species occurring within the Wolf Creek watershed.

Table 5-14 - Fish Species Found Within Wolf Creek Watershed

Salmonids	**Scientific name**	**Status**
coho salmon	*Oncorhynchus kisutch*	Proposed Threatened
chinook salmon	*Oncorhynchus tshawytscha*	
steelhead trout	*Oncorhynchus mykiss*	At risk; Status under review
cutthroat trout	*Oncorhynchus clarki*	At risk; Status under review
Non-Salmonids		
brook lamprey	*Lampetra richardsoni*	
Pacific lamprey	*Lampetra tridentata*	

squawfish	*Ptychocheilus oregonensis*	
speckled dace	*Rhinichthys osculus*	
blackside dace	*Rhinichthys osculus nubilis*	
redside shiner	*Richardsonius balteatus*	
largescale sucker	*Catostomus macrocheilus*	
three-spine stickleback	*Gasterosteus aculaeatus*	
coast range sculpin	*Cottus aleuticus*	
prickly sculpin	*Cottus asper*	
riffle sculpin	*Cottus gulosus*	

THE TERRESTRIAL ECOSYSTEM

This section will focus on the terrestrial and upland components of the watershed. Historic disturbances, soil productivity, plant succession, historic and current vegetation, botanical resources, noxious weeds, and wildlife will be discussed in this section. Not all of these areas were issues of concern to the manager so a cursory discussion is included to provide minimal background on the subject for future expansion.

Soil Productivity and Resiliency

Long-term soil productivity is the capability of soil to sustain inherent, natural growth potential of plants and plant communities over time. Most forest uses ultimately depend on a productive soil resource. Maintenance of long-term soil productivity is widely recognized as a basic requirement of forest management.

Soil (e.g., organic matter content, structure, porosity, etc.) and nonsoil (e.g., climate, geology) factors influence soil productivity. Soils in the Wolf Creek watershed have different natural productivity capabilities and behave differently to various management practices. Determining the soils' inherent, natural productivity and their degree of sensitivity/suitability to resource management practices is an important first step to maintaining their productivity. The use of Soil Resiliency Units is one method to accomplish this first step.

The Resiliency Unit concept is a stratification of watersheds according to physical properties and processes that have evolved for hundreds and thousands of years in response to climate, geologic and geomorphic processes, time, and in conjunction with the biotic community. It is a measure of the sustainable range of response to natural and human caused disturbance in that soils and landforms have evolved in conjunction with the biotic community and with natural disturbance regimes (e.g., landslides, wildfire, climate).

The Wolf Creek watershed has 8 of the 11 Resiliency Units occurring on the Eugene District. Map 9 shows the location of these 8 units in the watershed. As indicated by Resiliency Units 2, 5, and 8, the eastern quarter of the watershed contains all the xeric moisture regime sites (3,946 acres, 10% of watershed); the remainder of the watershed has a udic moisture regime (Units 3, 6, and 9 = 33,554 acres). The xeric sites are drier in the summer and have plant communities with drier site indicators (e.g., incense cedar, poison oak, hazel). Since elevations are below 2,000 feet and the watershed is not adjacent to the coast, the temperature regime is mesic for all soils occurring in the watershed.

Table 5-15 shows the acreages of each Resiliency Unit. The areas with low resiliency (Resiliency Units 2 and 3 = 2,381 acres, 6% of the watershed) usually occur on steep slopes and have shallow, gravelly soils with sporadic rock outcroppings. These areas have the lowest productivity potential in the watershed, and are drought prone; soil nutrition and water are limiting factors for these sites. These areas probably did in the past, and probably will in the future, remain in the forb/grass and brush succession stages longer following disturbances of the forest canopy. Old growth forest structure will take longer to develop on these low productive areas.

Table 5-15 - Soil Resiliency Unit Summary for Wolf Creek Watershed

Resiliency Unit	Acres	Percent of Wolf Creek Watershed
Unit 1	17	<1
Unit 2	60	<1
Unit 3	2,321	6
Unit 5	139	<1
Unit 6	11,024	29
Unit 8	3,747	10
Unit 9	20,209	53
Unit 10	373	<1

The soils with high resiliency (Units 8 and 9, Map 9) represent the most productive areas and occupy 63 percent of the watershed. Characteristically, slopes for these areas are gentle to moderate (<65%), and the soils are greater than 3 feet deep, reddish-brown clay loams with relatively high levels of nutrients and plant available water. Old growth forest structure will develop fastest on sites with these soils.

The moderately resilient soils (Units 5 and 6, Map 9) occupy 29 percent of the watershed and typically occur on moderate to steep slopes (>30%) and are moderately deep to deep with coarse fragments ranging from 20-50 percent of the volume.

Aerial photo investigation showed that some areas of timber on the upper part of the watershed (above Swamp Creek) have been harvested twice. The remainder of the harvested portion of the watershed appears to have been harvested once. The portion that has been harvested twice is comprised mostly of highly productive and resilient sites. Other than land occupied by roads, buildings, and rock quarries, it is assumed that human disturbance has had insignificant effects on the inherent, natural soil productivity.

Confidence in this assessment is moderate because the Resiliency Units were constructed using the Order 3 SCS Lane County Survey. Order 3 surveys, by definition, have fairly broad mapping units with numerous inclusions. However, for the level of detail of this watershed analysis, this order of mapping is thought to be acceptable.

Botanical Resources

Special Status and SEIS Special Attention Species - Currently, 1,653 acres have been surveyed for vascular plants in conjunction with various management activities (timber sales, silvicultural projects, roads, etc.). This is approximately 10 percent of the BLM lands within the watershed and 4 percent of the total watershed. Based on this limited inventory, the following sensitive vascular plant species have been located (none are considered Special Status Plant Species, but they are being tracked for consideration into this category): *Poa laxiflora* (loose-flowered bluegrass; BLM Tracking); *Montia diffusa* (branching montia; BLM Tracking); and Eugene District Review Species, *Carex interupta* (green-fruited sedge).

Several Sensitive and Special Status plant species have been located directly outside of the watershed including: Federal Candidate Species, *Cimicifuga elata* (tall bugbane); BLM Tracking species, *Poa laxiflora* (loose-flowered bluegrass) and Eugene District Review Species, *Pityopus californica* (pinefoot). There is potential habitat within the Wolf Creek watershed for several Special Status plant species (see Appendix 2).

No systematic inventories have occurred for vascular plant species listed under SEIS Special Attention Species (Survey and Manage) within the watershed until 1994. *Allotropa virgata* (sugar stick) was part of the 1994 survey efforts for vascular plants. No *Allotropa* have been located in the watershed; however, sites outside of the watershed have been identified. There is potential habitat within the Wolf Creek watershed for this species.

No surveys have been implemented for SEIS Special Attention or Special Status lichens or fungi. See Appendix 2 for a list of SEIS species likely to occur within the watershed. Inventories were started in the fall of 1994 for rare bryophyte species. No information is available. There is potential habitat within the watershed for several SEIS Special Attention and Special Status lichens, bryophytes, and fungi (see Appendix 3).

Threatened and Endanger ed Plant Species - No federally listed threatened or endangered vascular plants are known to occur within the watershed, nor has there been any likely habitat identified for such species.

Noxious and Exotic Weeds - Noxious weeds are present within the watershed. Species selected for this survey were based on their perceived threat to sensitive plant species and habitats or their legal definition as noxious weeds. Other survey criteria were significant population density of species with existing bio-control programs and species in the early stage of infestation that might be targeted for a containment program.

The noxious and exotic weed survey covered 93 miles of forest roadside equaling approximately 452 acres. This represents about 1.2 percent of the total watershed. These areas are considered high probability weed infestation areas. Table 5-16 is a listing of the noxious weed species known to occur within the Wolf Creek watershed. The density within the watershed is based upon the percent weed occurance within the surveyed road miles.

Table 5-16 - Noxious and Exotic Weeds within Wolf Creek Watershed

Noxious/Exotic Weed	Scientific Name	Density within Watershed Area Surveyed
Scotch broom	*Cytisus scoparius*	≈5.65%
tansy ragwort	*Senecio jacobea*	≈4.75%
meadow napweed	*Centauria pratensis*	‹ 1%
spotted napweed	*Centauria maculosa*	‹ 1%
St. John's-wort	*Hypericum perforatum*	1.50%
foxglove	*Digitalis purpurea*	‹ 1%
burnweed	*Erechtites minima*	‹ 1%
everlasting Sweet-pea	*Lathyrus latifolius*	‹ 1%
Robert's geranium	*Geranium robertianum*	‹ 1%
policeman's helmet	*Impatiens glandulifera*	‹ 1%
many-flowered rose	*Rosa multiflora*	‹ 1%

Forest roads act as conduits for weed invasion within the watershed. Weed habitat may be created by hydrological changes and canopy openings resulting from road construction. Weed seed can be spread in contaminated construction materials. Road maintenance activities may also contribute to the spread of weeds through continued ground and canopy disturbance, spread of seed on mowers and graders, and contaminated rock and fill.

Tansy ragwort is the only noxious weed located within the watershed that have a control program currently. The BLM in cooperation with Oregon Department of Agriculture have been identifying release sites for biological control agents for over ten years. These agents, the flea beetle and Cinnabar moth, are effective in controlling tansy. As a result of these past efforts and the expectation of continued releases in the future, tansy is the only weed in Wolf Creek that can be considered under control. The other weeds listed in Table 5-16 have no on-going control programs, nor have there been any concentrated efforts. A strategy needs to be developed cooperatively among the landowners in order to effectively limit and/or control the invsion and spread of noxious weeds within the basin.

Vegetation

Successional S tages - Succession is the replacement of vegetative communities following events that change or alter the original community. Eventually the original community is restored and remains reasonably stable and constant until the next disturbance event. In the Pacific Northwest, the dominant species are so long-lived that the probability of succession restoring the original community before another disturbance event happens is low.

The following is a general description of the various successional stages. The ages are somewhat different then that utilized in the vegetation class and patch type descriptions, but the overall stand level dynamics and interactions are well documented.

Early Seral Stage - This seral stage occurs from the time of disturbance that exposes bare ground to the time when the site is revegetated with conifer or hardwood saplings. Domination of the site with hardwood and/or conifer saplings typically occurs before 15 years after disturbance. The first 2 to 5 years are usually dominated by grass, forbs, and herbaceous vegetation followed by a dominance of shrubs and/or hardwoods. Species diversity is highest in this seral stage and biomass is relatively low, but increases rapidly throughout this stage. The conifers develop slowly at first but gradually become dominant. Once conifer dominance occurs and the crowns close to fully occupy the site, then the early seral stage is concluded.[45] These descriptions assume that **all** stands currently in this seral stage have developed as a result of man-caused disturbance (forest management) and there are no stands in this seral stage that have resulted from natural disturbances.

There are 3 separate stand conditions that exist during the early seral stage:[46]
- grass-forb stand condition
- shrub stand condition
- open sapling-pole stand condition

Grass-Forb Stand Condition - This stand condition usually lasts 2 to 5 years and occasionally as long as 10 years. After timber harvest or disturbance, the area is usually devoid of vegetation for the first growing season. Resident herbs and new plants quickly dominate the site. Some shrubs and sprouting hardwoods may be present, but not yet dominant. This stage can be bypassed if residual overstory tree cover does not create openings, e.g., a shelterwood harvest.

This stage can be defined as: "Shrubs less than 40 percent crown cover and less than 5 feet tall; areas may range from mainly devoid of vegetation to dominance by herbaceous species (grasses and forbs); tree regeneration generally is less then 5 feet tall and 40 percent crown cover."[47] Stands in the grass-forb stand condition are classified as clear cut patch types for this analysis.

Shrub Stand Condition - The shrub condition typically lasts from 3 to 10 years, but can remain for 20 or more years if tree regeneration fails or is delayed. Shrubs become the dominant vegetation and provide some habitat for wildlife that is different from the grass-forb condition. Tree regeneration is common, but the trees are generally less then 10 feet tall and provide less then 30 percent of the crown cover.

This stage can be defined as: "Shrubs greater than 40 percent crown canopy; they can be any height; trees less than 40 percent crown canopy and less than 1 inch dbh. When trees exceed 1 inch dbh for the stand average, they should be classified in the "open sapling" or "closed sapling" category."[46] Stands in the shrub stand condition are classified as clear cut patch types for this analysis.

Open Sapling-Pole Stand Condition - This stand condition exists when the trees reach 10 feet in height, but still have less then 60 percent crown cover. The trees generally average less then 1 inch in dbh. A dominant shrub understory is common and generally consist of vine maple, hazel, oceanspray, thimbleberry, salal, and Oregon grape. This stage may be bypassed if initial stocking densities exceed 400 to 500 trees per acre. This stage can also be reinitiated or prolonged through precommercial thinning. This stage may last from 8 to 20 years depending upon tree crown closure and subsequent stand treatments.

This stand condition is defined as: "Average stand diameter greater than 1 inch dbh and tree crown canopy less than 60 percent. Saplings are 1 to 4 inches in dbh; poles 4 to 9 inches."[46] Stands in the open sapling pole condition are classified into the sapling-pole patch type for this analysis.

Mid Seral Stage - This stage is characterized by dominance of conifers (from the time of crown closure to the time of first merchantability). This stand condition can also be called closed sapling-pole sawtimber[45] or stem exclusion stage[49]. These sites are characterized by a dense conifer stand, a closed canopy with crown cover ranging from 60 to 100 percent, and a relatively low occurrence of understory vegetation. Stands typically exhibit these characteristics between 16 and 45 years of age.[45]

The overstory trees are growing very rapidly and begin to lose the lower, deeply shaded foliage and branches. Stem growth slows down and the stem form becomes more tapered. As individual trees within the stand differ in growth rates and occupy different amounts of growing space, some trees gain a competitive advantage. Since the overstory is growing very rapidly, the larger more dominant trees begin to overtake the growing space of the smaller less competitive individuals. This process is called stand differentiation and is generally manifested first in diameter differences, and then later in height differences. Stand differentiation creates a stand with individual trees of different crown sizes and positions, as well as different heights and diameters. This allows for a classification of individual trees by canopy position or crown class -- dominants, codominants, intermediates, and overtopped or suppressed.

Species diversity decreases in most cases. These stands can change to large sawtimber and eventually old growth if thinning treatments and long rotations are used. The size and number of snags and coarse woody debris is dependant upon the stand origin. Managed stands created by forest management during the past decades tend to be devoid of large snags and downed logs. However a large number of small snags are present. These snags are created by stand differentiation and competition mortality; which tends to be the smaller sized trees in the intermediate and overtopped crown classes. Natural stands may have a greater number of snags and large downed logs that are legacies from the original forest as well as the high amounts of small snags and downed logs created by competition mortality. These existing natural stands tend to be limited in the number of large snags as a result of past fire management policies, but still have some levels of downed logs. These snags and downed logs currently present tend to be in the more advanced decay classes; classes 3, 4, and 5.[48]

This stand condition can be defined as: "average stand diameters between 1 and 21 inches in dbh and crown cover exceeding 60 percent."[46] The average stand diameter range used can overlap into the late seral stage, depending upon stand management treatments applied and the site productivity. Stands in the mid seral stage are classed in the pole-young patch type for this analysis.

Late Seral Stage - This stage typically is characterized by openings in the canopy with a corresponding increase in forbs and shrubs or the understory reinitiation stage.[49] Species diversity, although minimal, is once again beginning to increase but at a slower rate than what occurred in the early seral stage. For conifer growth, it is the time of first merchantability to the time of culmination of mean annual increment (CMAI). During this period, stand diversity is low but increasing. Stands generally exhibit these characteristics between 46 and 80 years[45]. Stands in the late seral stage are classified as pole-young patch types.

These stands typically have large numbers of small diameter snags and downed logs resulting from stand density and competition related mortality. The large diameter snags and downed logs, legacies from the previous forest, tend to be few in number, limited in distribution, and those present are typically in the more advanced decay classes. The number of legacy and small diameter snags and downed logs tends to be greater in naturally regenerated stands. Past management activities and silvicultural treatments like precommercial and commercial thinning tend to decrease the number of small snags and downed logs present in these stands .

Mature Seral Stage - This stage typically occurs between ages 81 and 195. Stand diversity is gradually increasing in response to openings in the canopy created by windthrow, disease, insects, and stand mortality. Biomass is still increasing but at a relatively slow rate. For conifers it is the time from CMAI to an old growth state.

This stage could also be called the large sawtimber stand condition[46] that is characterized by trees with an average dbh of 21 inches or larger. The conifers usually exceed 100 feet in height with crown cover generally less than 100 percent, permitting the development of ground vegetation. Stands in the mature seral stage generally have a more open canopy than the mid seral aged stands. These stands create different wildlife habitat than smaller sized stands. Natural stands in this condition can have nearly as much standing and downed woody material as old growth stands. Stands that have had silvicultural treatments are generally lacking in standing and downed woody material. These stands also tend to lack the more tolerant, successional understory species required for the old growth stage. For this analysis the stands in the late seral stage are classified as mature or mature over young if a 2-storied stand condition is present.

Old Growth Seral Stage - This stage typically occurs after 195 years and represents climax and subclimax plant communities. The subclimax condition may persist for centuries depending on the frequency of natural disturbances. Whether in the climax or subclimax condition, old growth is characterized by 2 or more tree species with a wide range of size and age including long-lived seral dominants, decadence of the long lived dominants, a deep, multi-layered canopy, significant amounts of snags and downed logs, and openings or gaps in the canopy. More tolerant conifers (western hemlock and western red cedar) and/or shrub species occur in the understory or in the gaps and openings caused by windthrow or other disturbance. Old growth stands are optimal habitat for saprophytic plants, lichens, mosses, and liverworts. Biomass reaches a maximum and species diversity approaches the level found in the early seral stages. Forest stands in the old growth seral stage are classed as old forest or old over young if a 2-storied stand condition exists.

Natural Disturbance - Disturbance and succession are 2 sides to the change phenomenon in landscapes. Disturbances are events that drastically change the vegetation communities and characteristics within the landscape, often in short time periods. Disturbances can be characterized by type, intensity, frequency, duration, and effects. There are four major types of natural disturbance known to exist and/or occur within the Wolf Creek Basin: wind, floods, landslides, and fire. Examples of each of these has occurred in the watershed to differing degrees since the late 1950s and early 1960s.

Wind - One of the major disturbance events in recent times within the Wolf Creek Basin was the Columbus Day Storm. The event occurred October 12, 1962 and affected the entire Pacific Northwest. According to Oliver and Larson[49] this regional disturbance was classed as a cyclone and caused over $150 million in estimated property damage. Information gathered from local sources[50] indicate that this storm produced winds in excess of 75-90 mph and caused widespread windthrow damage throughout the Eugene District. The year following the storm the Eugene District's entire allowable cut was salvage volume which totalled between 500 MMBF and 520 MMBF. Based upon the selling price of timber at the time, over $12.5 million in salvage was recovered from this storm. This event and the salvage that followed were the major factors producing two storied stands currently present in Wolf Creek.

Floods - One of the last major floods in recent times was termed the "Christmas Flood" that happened in late December, 1964. A review of several nearby gauging station within the region indicate that this flood was a regional event.[51] The Alsea River to the north and the Umpqua River to the south list the peak as December 22 or 23, 1964. The peak flows generated by this flood exceeded the 100-year event calculated flow rates. This flood was triggered by a "rain on snow" situation and based upon anecdotal information,[50] the impact of this flood was more severe in the Cascades, Willamette Valley and the Willamette River system than in coastal streams because of the lack of snow pack. No information is available for Wolf Creek or the Siuslaw River. Another flood event, according to local BLM sources[50], that caused more damage and higher water in the upper Siuslaw system was the 1972 flood. Based upon the gauging station located on the Siuslaw near Mapleton this flood was less than a 25-year event.

Landslides - There has been at least one landslide within the watershed in the recent past. In 1979-80, an unnamed tributary west of Saleratus Creek, approximately in Sections 25 and 36 of T. 18 S., R 8 W., experienced a landslide that began in the headwaters and traveled down to main Wolf Creek. This slide temporarily closed Wolf Creek road and removed the majority of the vegetation along the stream channel. Significant amounts of wood, sediment, and rocks/boulders were deposited into Wolf Creek.

Fire - Fire has played a minor role within the Wolf Creek watershed during the recent past. There are several points within the basin that are somewhat lightning prone: Stony Point, High Point, and Wolf Point. All 3 of these points are along the southern ridgeline of the watershed at 1,900 foot elevation. There have been lightning strikes in and around those areas with the passing of lightning producing storms. Lightning strikes as recently as July 1994 caused small fires that were quickly suppressed.

Forest condition maps published in 1914 and 1936 contain records of fires evident at the time the map was compiled. Both of these maps show areas classified as "burned, not restocking" within the boundaries of the Wolf Creek watershed. The major cause of these fire events is unknown but is probably linked to settlement and development. The natural fire interval in the watershed can only be estimated. Based upon the stand birth dates of old BLM timber type maps, a large portion of the Wolf Creek watershed had stand origin dates from the 1850s through the 1890s. This would imply that the last major stand replacement wildfire in the basin was in pre-1850s. The early mapping also substantiates this in that the majority of the Wolf Creek watershed is mapped as merchantable timber or older forest. The mapping done by Teensma[52] also verifies this characterization of historical vegetation conditons. Work performed by Ripple[53] suggests that from a regional scale, 80 percent of the forested area was in large size class and occured in one huge connected patch that extended throughout most of western Oregon. The average patch size for these large-sized forests was 29,486 acres within the Willamette River unit. Ripple also determined the average size of deforested burn patches to be about 7,138 acres in the Willamette unit. This suggests that examination of fire as a disturbance agent in the Coast Range needs to be done at a scale larger than the watershed to obtain meaningful results.

Work published by Agee[54] suggests a regional fire return interval of 230 years for the Douglas-fir zone with considerable spatial variability associated with this estimate. Teensma (1991) suggests a 150 to 350 year return interval. Ripple also suggests a stand replacement fire cycle of between 237 and 242 years. Episodic is a better descriptor of the fire return interval for these forests. Agee describes the current old growth forests as the first generation postfire forests and suggests that short-term, extreme shifts in the climatic patterns of the region play the dominant role in determining the fire return interval for these forests. Also see Swetnam (1993)[55] for an examination of the role of climate in a regional fire history. There is no available information that describes the spatial extent, duration, intensity, or effects of natural fires within the Wolf Creek watershed at a scale suitable for reliable interpretation.

Unique Communities and Special Habitats - There are 3 major groups of special habitats/unique communities identified within the Wolf Creek Basin: rock outcrops and dry rock gardens, ponds, and bogs. These were identified from photo interpretation based upon instructions developed within the Eugene District.[56] A total of 250 acres, approximately 0.06 percent of the watershed, are identified as special/unique habitats, with the majority of these habitats being rock outcrops. Table 5-17 summarizes the information on the special habitats.

Table 5-17 - Special Habitats in Wolf Creek Basin - All Lands

Special Habitat Type	Total Acres	Number of Patches	Avg. Patch Size
Rock Outcrops	200	29	6.9
Dry Rock Gardens	12	3	3.9
Ponds	21	17	1.3
Bogs	17	7	2.5
Totals	**250**	**56**	**4.5**

The distribution of each of these types of unique habitats is different. The vast majority of the rock outcrops are located along the northwest watershed boundary. The dry rock gardens tend to be located in the far eastern part of the basin, with

Wolf Point being one of the major areas identified. The ponds and bogs are all in the east half of the watershed and are associated with the upper reaches of Wolf Creek or its tributaries. Some of these wetland areas are the result of beaver activity in the headwaters of Wolf Creek.

Historical Conditions - The past vegetation conditions and patterns were shaped by Euro-American settlement and the natural processes of disturbances and succession. Euro-American settlement began in the mid-1860s.[57] The oldest record of vegetation patterns and conditions available for the area is the 1900 Land and Forest map.[58] Information shown on the map appears to reflect the forest conditions in the 40 to 50 years preceding the compilation of the map. This map is depicted at a scale that makes reliable interpretation at the watershed scale difficult. The 1900 map depicts the majority of the Wolf Creek watershed as merchantable timber, with the upper end (far eastern portion) as nonforested. Information available from the original land survey notes circa 1854[13, 59] indicate that "prairie" type conditions did not extend west into the watershed beyond the middle of Township 19 S., Range 5 W., Willamette Meridian. According to these notes, the timber in Sections 7, 17, and 20 is referred to as "scattering fir" or "scattering fir and oak." Based upon these early records, the upper end of the watershed, which is immediately adjacent to the Willamette Valley fringe, appears to be a mixture of woodland, prairie, and older forests. The locations, agents of change, and vegetation conditions can only be inferred with little confidence in the interpreted results.

The forest map compiled in 1914 by F.A. Elliott[60] also depicts the majority of the basin as merchantable timber with scattered islands called "cutover, not restocking" and "burned areas, not restocking." There is an increase in the number of areas noted as "burned" between the 1900 and 1914 maps. About 14 separate locations are mapped as burned whereas there were none indicated on the 1900 map. This is believed to be primarily human-caused and almost entirely related to settlement. This is because the "burned areas" largely coincide with areas where settlements and homesteads were known to exist. The size, character, and exact locations of these burned areas cannot be accurately determined from the maps due to mapping scale and resolution. The area noted as "cutover, not restocking" occurred in the far eastern half of the watershed, in the vicinity of Township 19 S., Range 6 W., Sections 2 and 11. This also coincides where settlement and travel routes into the Wolf Creek Basin occurred.

Examination of the 1936 Forest Type Map for the State of Oregon[61] reveals a similar pattern. The eastern quarter of the basin was a mixture of forest conditions, with the majority of the watershed as old forest. The eastern half of the area includes 5 different forest types: nonrestocked; cutover (cut prior to 1920); Douglas-fir, small second growth (6" to 20" in diameter); Douglas-fir, large second growth (20" to 40" in diameter); deforested, burn areas; and nonforested, agricultural lands. The eastern quarter contains the second growth types, cutover lands, and the nonforested, agricultural lands.

There are 13 locations noted as burned areas and 5 locations typed as nonforested agricultural lands. The burned areas do not overlap with locations identified on the 1914 map except for 4 areas. These locations seem to indicate a reburn of some portion of the previously mapped areas. These reburns are located in the vicinity of middle Eames Creek (Section 32, Township 19 S., Range 6 W.), Eames and Wolf Creek confluence (Sections 7 and 17, Township 19 S., Range 6 W.), and Pittenger Creek (Section 32, Township 18 S., Range 7 W.). Some of the 1914 burned areas are typed as nonforested agricultural land on the 1936 map and represent known homesteads and settlement locations. The nonforested agricultural lands appear to coincide with locations of known settlements and homesteads. There are 2 areas that were harvested between 1920 and 1936. These are in the vicinity of Township 18 S., Range 7 W., Section 22 and Township 18 S., Range 6 W., Sections 26, 27, 34, 35 plus Township 19 S., Range 6 W., Section 2. The logging in 18S-6W and 19S-6W is adjacent to settlements and travel routes and represents some of the earliest commercial logging . The logging in 18S-7W, Section 22 is part of a major railroad logging area harvested in the mid-1930s. The majority of this harvested block is outside of the watershed in the Bulmer Creek drainage, but the south half of Section 22 lies within the Wolf Creek Basin and was cut at the same time.

Logging started in the watershed in the mid-1930s based upon timber patent records issued by Eugene District and confirmed for non-BLM lands by examining these historical forest maps. Review of early 1950s aerial photos[62] for the watershed confirm that a significant amount of the clear cut and sapling pole classes are from earlier logging in the watershed. The vegetation pattern within the watershed as of 1956 is mapped[63] and can be analyzed. This vegetation pattern reflects the results of logging and settlement in the eastern half of the area. Table 5-18 is a summary of the 1956 vegetation conditions for the watershed. Figure 6 displays of the 1956 vegetation classes for all lands within the Wolf Creek watershed (see Map 10, 1956 Vegetation Classes).

Table 5-18 - Vegetation Classes as of 1956 - All Lands

Vegetation Classes	Total Acres	Percent of Total Acres	Number of Patches *	Percent of Total Patches	Avg. Patch Size
Nonforest	492	1.3	15	6.6	32.8
Hardwoods	363	1.0	10	4.4	36.3
Mixed Conifer/Hardwoods	324	0.9	2	0.9	162.2
Clear cut	1,495	3.9	21	9.2	71.2
Sapling-Pole	10,053	26.5	33	14.4	304.6
Pole-Young	4,319	11.4	57	24.9	75.8
Mature over Young	750	2.0	12	5.2%	62.5
Mature	8,871	23.4	58	25.3	153.0
Old Forest	11,224	29.6	21	9.2	534.5
Totals	**37,892**		**229**		**165.5**

* patch numbers generated by FRAGSTATS[64]

In 1956 the majority (53%) of the Wolf Creek watershed was mature and old forest. Another 25 percent of the watershed was in the sapling pole stand condition, and the balance of the area was composed of the remaining vegetation classes, with the pole-young forest condition the dominant class.

The average patch size for the old forest was 534 acres and the mature forest areas averaged 153 acres in size. The overall average patch size for the watershed was 165 acres. The old forest was almost all located in the western half of the watershed, whereas the mature forest type was located throughout the entire basin. The largest single patch of old forest was 2,719 acres in size, and the largest patch of mature forest was 1,131 acres based upon FRAGSTATS. The pole-young vegetation class was largely the result of regrowth in abandoned homesteads and natural restocking of the earlier logging sites.

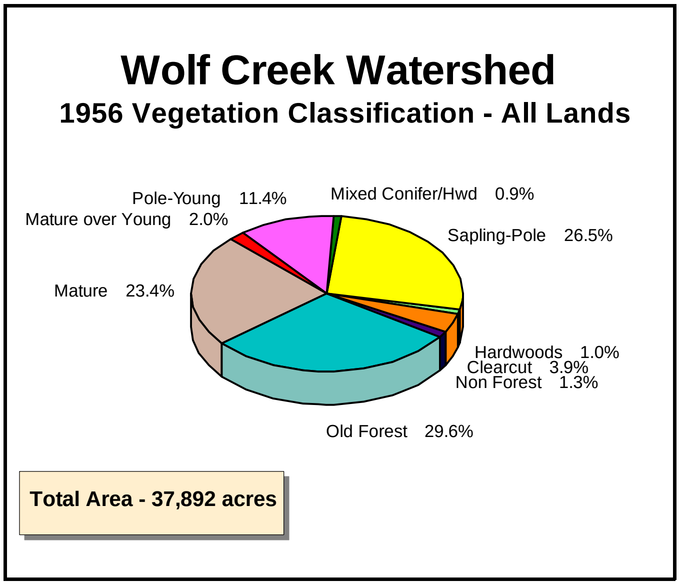

Figure 6: 1956 Vegetation Classes - All Lands

The distribution of vegetation classes between BLM lands and other owners as of 1956 is displayed in Table 5-19 and Figure 7. The ownership within the Wolf Creek watershed as of 1956 is undetermined; therefore, the current ownership was used to compare vegetation distribution differences. Figure 8 displays the major landowners in the Wolf Creek watershed.

Table 5-19 - 1956 Vegetation Class Distribution Between Owners

Vegetation Class	Total Area	BLM Acres	Percent of Total	Other Owners Acres	Percent of Total
Nonforest	492	79	16.0	414	84.0
Hardwoods	363	244	67.3	119	32.7
Mixed Conifer/Hardwoods	324	123	37.8	202	62.2
Clear cut	1,495	560	37.5	935	62.5
Sapling-Pole	10,053	3,081	30.6	6,972	69.4
Pole-Young	4,319	1,521	35.2	2,798	64.8
Mature Over Young	750	33	4.4	717	95.6
Mature	8,871	5,025	56.6	3,847	43.4
Old Forest	11,224	6,022	53.7	5,202	46.3
Totals	**37,892**	**16,688**		**21,204**	

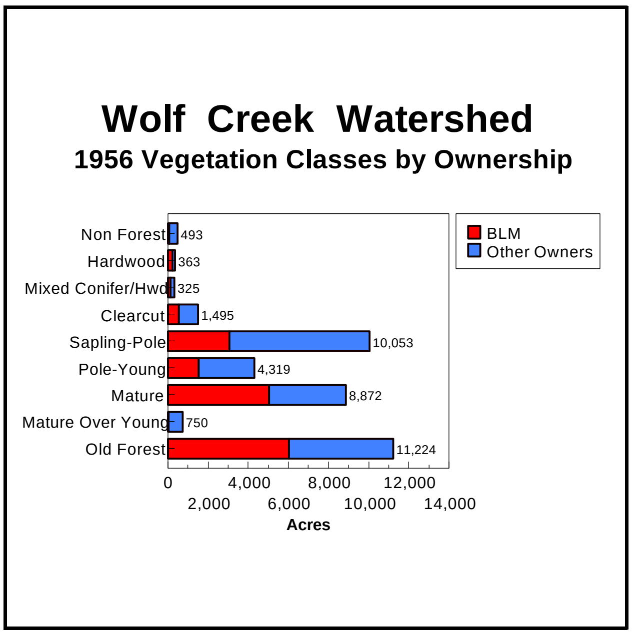

Figure 7: 1956 Vegetation Distribution between Current Owners

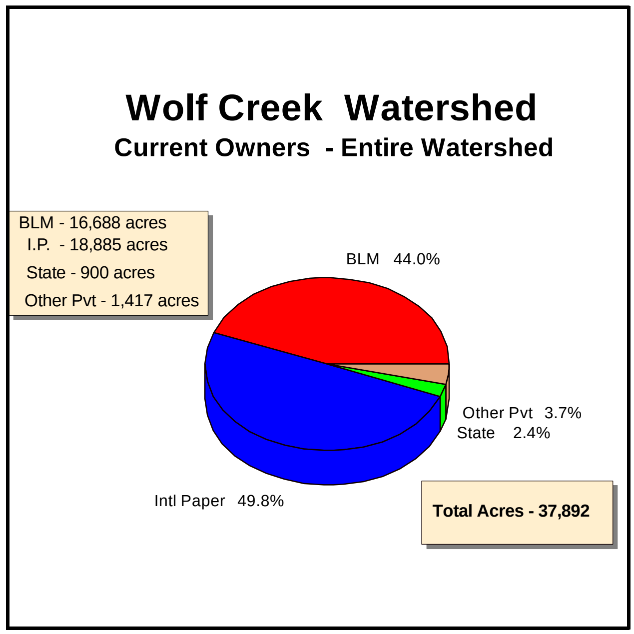

Figure 8: Current Ownership Within Wolf Creek

The mix of vegetation classes in 1956 between ownerships does not reflect the current ownership pattern of the watershed. The older forest types, mature and old forest, are almost evenly split between BLM and the other landowners with the difference being that the other landowners, primarily private timber companies at the time, had already began harvesting some of the mature and old forests on their holdings. The younger forest types, clear cut, sapling-pole, pole-young, and the mixed conifer/hardwoods, are more in the other landowners holding than current ownership. This reflects the initiation of logging and redistribution of vegetation classes in the basin. The mature over young forest type is almost exclusively in other ownership. It may reflect some of the earliest logging practices and/or some of the burned or cutover, not restocking classifications noted on the earlier forest condition maps.

Current Conditions - The vegetation pattern that currently (as of 1990) exists within the Wolf Creek watershed has largely been the result of several decades of timber management and the checkerboard ownership pattern. Table 5-20 is a summary of the current vegetation classification (see Appendix-1, Vegetation Classification) for the entire watershed by acres and number of patches of that type within the Wolf Creek watershed. Figure 9 depicts the current vegetation distribution by class (see Map 11, Current Vegetation Distribution).

Table 5-20 - Current Vegetation Classes - All Lands

Vegetation Classes	Total Acres	Percent of Total Acres	Number of Patches *	Percent of Total Patches	Avg. Patch Size
Unclassified	35	0.1	1	0.1	35.0
Nonforest	379	1.0	21	2.6	18.0
Hardwoods	2,348	6.2	56	6.8	41.9
Mixed Conifer/Hardwoods	1,837	4.8	99	12.1	18.6
Clear cut	9,157	24.2	159	19.4	57.6
Sapling-Pole	4,171	11.0	97	11.8	43.0
Pole-Young	10,294	27.2	119	14.5	86.5
Mature over Young	2,628	6.9	85	10.4	30.9
Mature	349	0.9	30	3.7	11.6
Old over Young	1,851	4.9	71	8.7	26.1
Old Forest	4,842	12.8	81	9.9	59.8
Totals	**37,891**		**819**		**46.3**

* patch numbers generated by FRAGSTATS

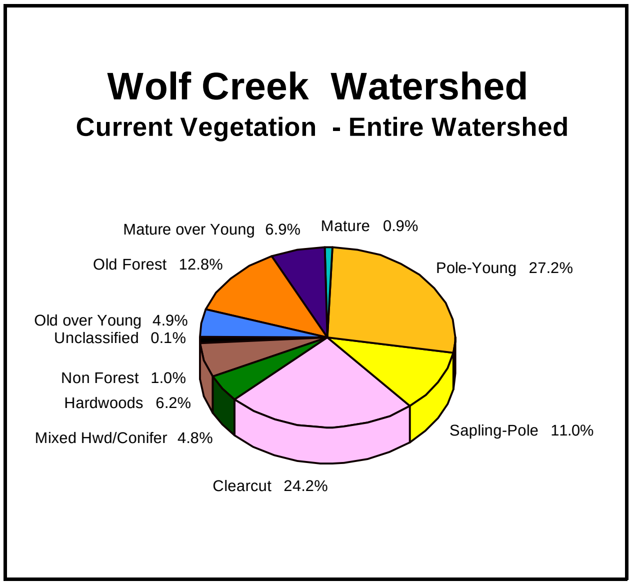

Figure 9: Current Vegetation Classes - All Lands

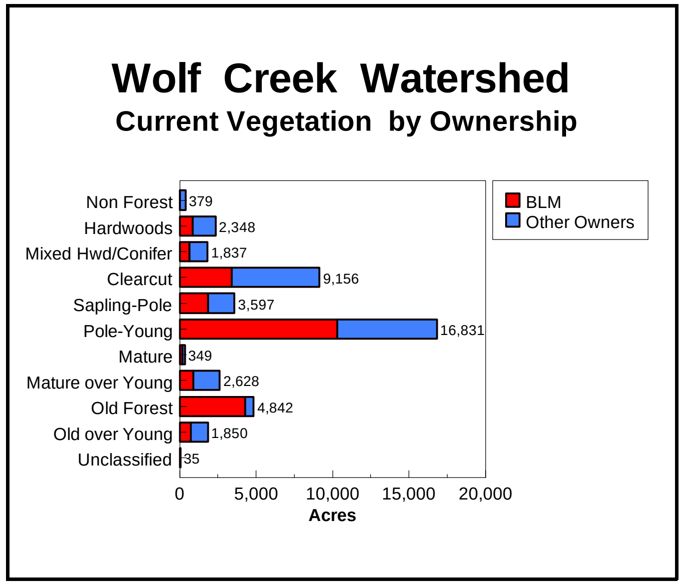

Figure 10: Current Vegetation Distribution by Ownership

The Wolf Creek watershed is approximately one quarter recently harvested; one quarter in the pole-young stand condition; one quarter in old forest or "uneven" aged stands with structural features trending toward old forest; and one quarter is young forest, hardwood and mixed conifer, and nonforested agricultural and pasture lands. The majority of the nonforested agricultural lands are in the eastern half of the watershed.

The following statistics are based upon FRAGSTATS results. The average unit or patch size is 46 acres. The recently harvested areas average 57 acres in size; approximately 25 percent larger than the watershed average. The largest single clear cut patch currently in the watershed is 793 acres. The areas classified as pole-young average 86 acres; about 87 percent greater than the average for Wolf Creek, with 1,441 acres being the largest patch in the basin. Mature forest areas are scarce, small isolated remnants scattered throughout the watershed. The largest mature forest patch in Wolf Creek Basin is 57 acres. Patches classified as old forest (≥ 200 years old) average 59 acres in size and most likely represent planned future harvest units since this is almost exactly the current harvested unit size for the watershed. The largest single patch of old forest currently is 300 acres. The hardwood areas are generally associated with streams and riparian areas of 3rd order and larger streams. Some hardwoods occur as scattered stands in the western half of the watershed. The nonforested agricultural and pasture areas are generally located in the eastern half of the Wolf Creek watershed in close proximity to the more heavily developed and populated Willamette Valley. Several large rock quarries are also classified as nonforested.

The mix of vegetation classes between landowners more closely approximates the ownership percentage with the exception of the nonforested areas and the old forest. The nonforested lands are mostly on nonfederal lands while 88 percent of the old forest occurs on federal (BLM) lands. This represents a major shift in distribution of vegetation classes between BLM and private ownership from the 1956 vegetation classification. The younger vegetation classes, clear cut, sapling-pole, and pole-young, are in very similar proportions to that found in the 1956 vegetation distribution. The mature forest type has remained relatively stable between 1956 and 1990, although it is a small percent of the vegetation watershed wide. Figure 8 depicts the ownership breakdown by major landowners within the watershed and Figure 10 displays the current vegetation classes by ownership. Table 5-21 summarizes the current distribution and percent by owner of each vegetation class.

Table 5-21 - Current Vegetation Class Distribution Between Owners

Vegetation Classes	Total Area	BLM Acres	Percent of Total	Other Owners Acres	Percent of Total
Unclassified	35	0	0.0	35	100.0
Nonforest	379	21	5.6	358	94.5
Hardwoods	2,348	857	36.5	1,491	63.5
Clear cut	9,157	3,418	37.3	5,739	62.7
Sapling-Pole	4,171	1,879	45.0	2,292	55.0
Pole-Young	10,294	3,755	36.5	6,539	63.5
Mature over Young	2,628	909	34.6	1,719	65.4
Old over Young	1,851	744	40.2	1,107	59.8
Mature	349	193	55.2	157	45.0
Old Forest	4,842	4,276	88.3	566	11.7
Mixed Conifer/Hardwoods	1,837	636	34.6	1,201	65.4
Totals	**37,891**	**16,687**		**21,204**	

Land Use Allo cations - There are 6 different land use allocations (LUA) within the Wolf Creek watershed: Late-Successional Reserves (LSR), Connectivity (CON), Marbled Murrelet Reserves (MMR), Residual Habitat Areas (RHA), Riparian Reserves, and General Forest Management Areas (GFMA) as described in the Eugene District's Proposed Resource Management Plan (PRMP)[65] and the SEIS Record of Decision (see Map 12, Land Use Allocations). Late-Successional Reserves account for approximately 60 percent of the BLM holdings within the watershed. BLM lands managed for old forest characteristics and late successional species also include the Residual Habitat areas and Marbled Murrelet Reserves. Including these LUAs with the Late-Successional Reserves increases the amount of Wolf Creek watershed managed for late successional/old forest characteristics to over 85 percent of the total area. The following summarizes the acreage and percent of the watershed for each land use allocation (see Table 5-22 and Figure 11). The sum of these acres will exceed BLM's ownership because some of the LUAs are nested within another LUA. For example, the Riparian Reserves are included within each of the other allocations so some acres are counted twice - once as Riparian Reserve and again as LSR, CON, General Forest, etc. Therefore, the Riparian Reserve acres are not shown in Figure 11.

Table 5-22 - Land Use Allocations in Wolf Creek Watershed (***BLM Lands***)

Land Use Allocation	Total Acres	Percent of Watershed
Late-Successional Reserves (LSR)	10,888	65.2
Riparian Reserves	8,306	49.8
Connectivity (CON)	271	1.6
Marbled Murrelet Reserves (MMR)	2,689	16.1
Residual Habitat Areas (RHA)	704	4.2
General Forest (GFMA)	2,843	17.0

Table 5-23 is a breakdown of the acres by vegetation classes for each Land Use Allocation on BLM lands within the Wolf Creek watershed. Figure 11 illustrates the land use allocations for BLM lands. Residual Habitat Areas and Riparian Reserves are not shown in Figure 11 as they overlap with some or all of the other allocations.

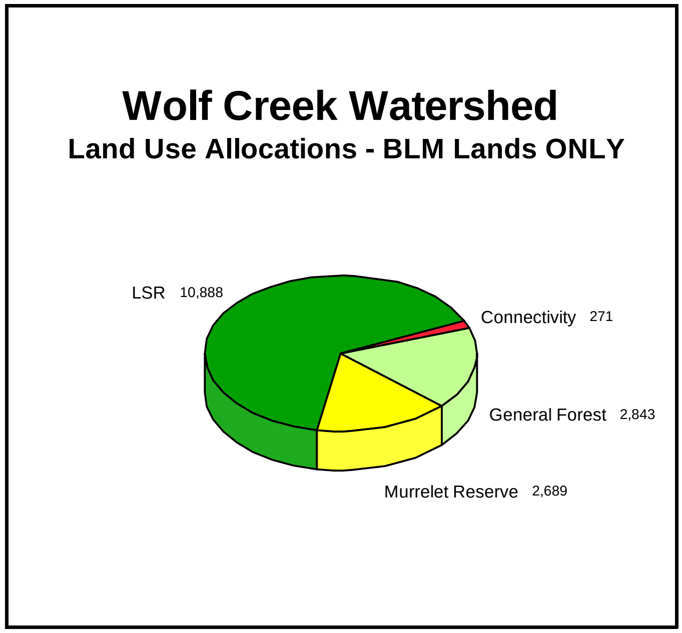

Figure 11: Land Use Allocations for BLM Lands

Table 5-23 - Acres by Vegetation Class for Each Land Use Allocation (***BLM Lands ONLY***)

Vegetation Class	LSR	MMR	CON	GFMA
Clear cut	2,188	907	47	278
Sapling-Pole	1,580	162	1	135
Pole-Young	1,254	848	41	1,613
Mature over Young	292	214	6	397
Mature	119	14	0	60
Old over Young	523	73	20	128
Old Forest	3,838	283	153	1
Hardwood	703	92	1	61
Mixed Conifer/Hwd	388	86	0	162
Nonforest	3	10	0	9
Totals	10,888	2,688	271	2,844

<u>Late Successional Reserves</u> - Over 10,000 acres of the Wolf Creek watershed are designated as Late-Successional Reserves (LSR). This is approximately one third of the total watershed area and over 65 percent of the BLM ownership in the

watershed. The vegetation is composed of approximately one third old forest, 20 percent clear cut, and 25 percent in sapling-pole-young stands. Table 5-24 is a summary of the vegetation classification for the Late-Successional Reserves LUA. Figure 12 illustrates the vegetation classes within the Late-Successional Reserves for BLM lands in the Wolf Creek watershed.

Table 5-24 - Vegetation Classification of Late-Successional Reserves - ***BLM Lands Only***

Vegetation Class	Acres	Percent of LUA	No. of Patches	Average Patch Size
Clear cut	2,188	20.1	97	22.6
Sapling-Pole	1,580	14.5	75	21.1
Pole-Young	1,254	11.5	88	14.3
Mature over Young	292	2.7	35	8.3
Mature	119	1.1	14	8.5
Old over Young	523	4.8	40	13.1
Old Forest	3,838	35.3	81	47.4
Hardwood	703	6.5	48	14.6
Mixed Conifer/Hwd	388	3.6	42	9.2
Nonforest	3	0.0	1	3.3
Totals	10,888	100.0	521	16.2

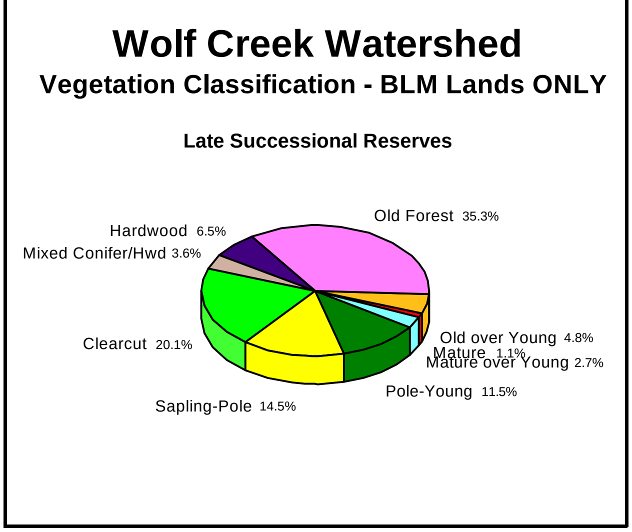

Figure 12: Vegetation Classes within the Late Successional Reserve LUA

Marbled Murrelet Reserves - Marbled Murrelet Reserves (MMR) total 2,689 acres of BLM lands in the Wolf Creek watershed. This amounts to about 16 percent of BLM ownership and about 7 percent of the total watershed. This LUA is primarily designed to protect potential marbled murrelet habitat areas. Murrelet Reserves are managed like Late- Successional Reserves in the SEIS ROD and are subject to the same standards and guidelines. The vegetation is comprised of about one third clear cut, one-third pole-young stands, 10 percent old forest, and the balance is a mixture of the other classes.

Table 5-25 is a summary of the vegetation information for these reserves. Figure 13 illustrates the vegetation classification with the murrelet reserves for BLM lands within the watershed.

Table 5-25 - Vegetation Classification for Marbled Murrelet Reserves - ***BLM Lands Only***

Vegetation Class	**Acres**	**Percent of LUA**	**No. of Patches**	**Average Patch size**
Clear cut	907	33.7	29	31.3
Sapling-Pole	162	6.0	7	23.2
Pole-Young	848	31.5	40	21.2
Mature over Young	214	8.0	17	12.6
Mature	14	0.5	2	6.8
Old over Young	73	2.7	13	5.6
Old Forest	283	10.5	21	13.5
Hardwood	92	3.4	8	11.5
Mixed Conifer/Hwd	86	3.2	9	9.5
Nonforest	10	0.4	6	1.6
Totals	2,688	100.0	152	13.7

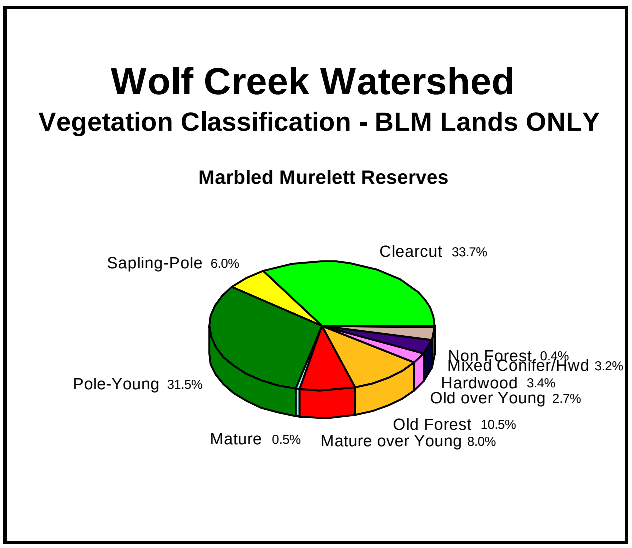

Figure 13: Vegetation Classes within Marbled Murrelet Reserves LUA

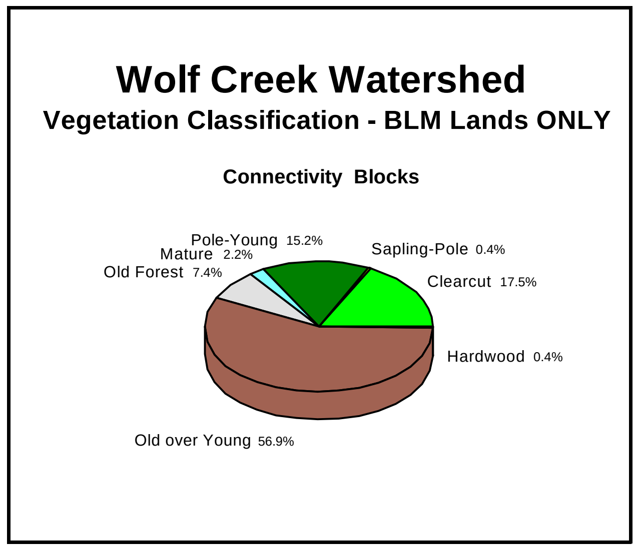

Figure 14: Vegetation Classes within the Connectivity LUA

Connectivity Blocks - The Connectivity LUA at 271 acres is the smallest allocation in the Wolf Creek watershed. The connectivity blocks are about 2 percent of the total BLM ownership and about 0.5 percent of the total watershed. These blocks are designed to provide a bridge of late successional forest from the Coast Range to the Cascades across the southern Willamette Valley where other LUAs and reserves do not provide for adequate connectivity. This LUA is to be managed differently from both LSRs and General Forest in that the best 25 percent of current habitat for late successional dependant species is reserved from timber harvest. The Connectivity Blocks will be available for harvest using an area control approach.

The Connectivity Blocks contain over 50 percent old forest and old over young forest, 17 percent cut over stands, and 15 percent in a pole-young stand condition. Table 5-26 displays the summary information on the Connectivity Block vegetation classification and Figure 14 illustrates the vegetation composition for BLM lands allocated to Connectivity Blocks.

Table 5-26 - Vegetation Classification for Connectivity Blocks - ***BLM Lands Only***

Vegetation Class	**Acres**	**Percent of LUA**	**No. of Patches**	**Average Patch Size**
Clear cut	47	17.5	15	3.2
Sapling-Pole	1	0.4	1	1.1
Pole-Young	41	15.2	13	3.2
Mature over Young	6	2.4	2	3.2
Mature	0	0.0	0	0.0
Old over Young	20	7.5	4	5.1
Old Forest	153	56.7	4	38.4
Hardwood	1	0.4	2	0.5
Mixed Conifer/Hwd	0	0.0%	2	0.0
Nonforest	0	0.0	0	0.0
Totals	271	100.0	43	5.5

General Forest Management Area - The GFMA or "matrix" lands are approximately 17 percent of the BLM lands within the Wolf Creek watershed and about 7 percent of the total watershed. This LUA consists of lands not designated as other allocations and most timber harvest and other silvicultural activities would be conducted on lands with this allocation using the SEIS ROD Standards and Guidelines. Over 50 percent of the area allocated as general forest lands is in the pole-young condition with forest stands between 30 and 79 years old. About 15 percent is in young stands classified as clear cut and sapling-pole, and about 20 percent is mature, mature over young, and old over young. These older aged stands are available for harvest only if the federal lands exceed the 15 percent old forest retention stand as specified in the ROD (see Figure 16).

Table 5-27 displays the summary information on the vegetation classification within the matrix or General Forest LUA and Figure 15 illustrates the vegetation composition for BLM lands within the Wolf Creek watershed.

Table 5-27 - Vegetation Classification for General Forest Lands - ***BLM Lands Only***

Vegetation Class	Acres	Percent of LUA	No. of Patches	Average Patch Size
Clear cut	278	9.8	22	12.6
Sapling-Pole	135	4.8	6	22.6
Pole-Young	1,613	56.7	28	57.6
Mature over Young	397	13.9	26	15.3
Mature	60	2.1	4	15.1
Old over Young	128	4.5	11	11.6
Old Forest	1	0.0	4	0.2
Hardwood	61	2.2	10	6.1
Mixed Conifer/Hwd	162	5.7	9	18.0
Nonforest	9	0.3	8	1.1
Totals	2,844	100.0	128	16.0

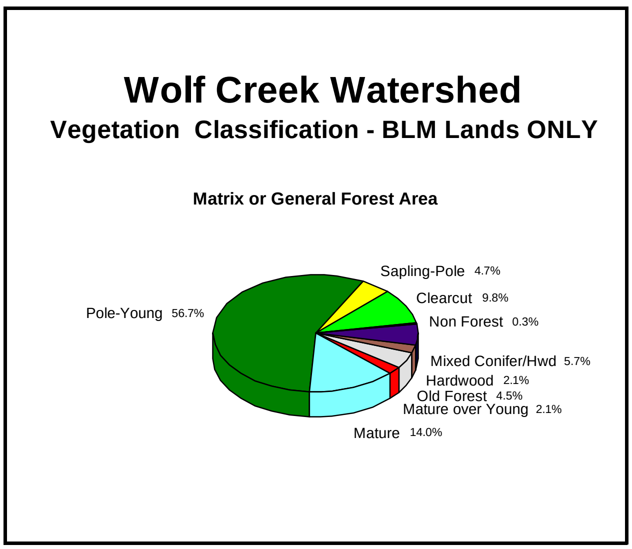

Figure 15: Vegetation Classes within the General Forest LUA

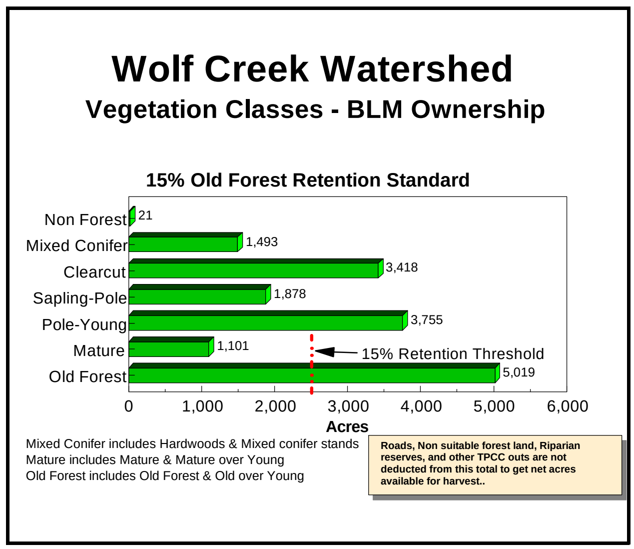

Figure 16: Old Forest Retention Standards and Vegetation Classes for Federal Lands in Wolf Creek

Riparian Reserves - Riparian Reserves are lands adjacent to streams where the riparian dependent resources receive the primary emphasis and specific standards and guidelines from the SEIS Record of Decision (ROD)[66]. Riparian Reserves include that part of the watershed directly coupled to streams and rivers and that part of the watershed required for maintenance of hydrologic, geomorphic, and ecological processes that affect the standing and flowing waters. The SEIS sets interim widths for Riparian Reserves based upon 5 categories of streams and waterbodies. The Wolf Creek watershed has 3 of these categories: fish bearing streams; permanently flowing, nonfish bearing streams; and seasonally flowing or intermittent streams, wetlands less than 1 acre, and unstable and potentially unstable areas. These reserve widths apply across all LUAs. According to Table 5-22 there are 8,306 acres within the watershed identified as Riparian Reserves based upon the standards and guides in the SEIS ROD and the Forest Practices Act requirements. This acreage is based upon using a site-potential tree height of 210 feet rather then the distances specified in the ROD because the site tree height is greater. The site tree height is based upon "Draft" internal guidance.[67] The state forest practices utilizes a 25 foot streamside protection buffer. See Map 13 for a pictorial representation of the Riparian Reserve.

The following table summarizes the amount of Riparian Reserve by each of the major LUAs, including other lands subject to the provisions of the Forest Practices Act provisions. The acres shown in Table 5-28 reflect the "best case" scenario. This is because the hydrology layer used to develop this has not been fully field verified. It may also include streams that are predicted to occur based upon drainage area but do not actually occur on the ground. Site-specific analysis will be necessary prior to establishing Riparian Reserves for any management activity.

Table 5-28 - Riparian Reserves by LUA - All Lands

Land Use Allocation	**Acres of Riparian Reserves**	**Percent of Watershed**
Late-Successional Reserves (LSR)	5,494.8	66.2
Connectivity (CON)	86.9	1.0
Marbled Murrelet Reserves (MMR)	1,139.4	13.7
General Forest Mgmt. (GFMA)	1,338.3	16.1
Private Lands (subject to Oregon Forest Practices provisions)	245.9	2.9

<u>Other Land Use Allocations</u> - There is an additional LUA from the SEIS that is included in the watershed, Residual Habitat Areas (RHA). The RHAs are BLM's nomenclature for the Known Spotted Owl Activity Centers.[68] The intent of RHAs is to preserve approximately 100 acres of the best northern spotted owl habitat as close to nest sites or owl activity centers as possible. These areas are to be managed under the standards and guidelines for LSRs regardless of the LUA they are located within. There are 7 separate RHAs totalling 704 acres located in the basin. The RHAs range from 73 acres to 127 acres in size and represent the best currently available habitat. Since the RHA are basically a subset of the LSR allocation, no specific vegetation information will be presented as it is already represented within the LSR acreage.

<u>Old Forest Retention</u> - The SEIS Record of Decision[69] states that 15 percent of the federal lands with existing old growth fragments (old growth defined as 80 plus years of age in the ROD) will be retained within watersheds where little remain. Federal lands (BLM) within the Wolf Creek watershed total 16,688 acres; therefore, 2,503 acres of old forest must be retained within the Wolf Creek watershed area to meet the ROD. Currently 5,019 acres are classified as Old Forest/Old over Young, plus 1,101 acres of Mature/Mature over Young on BLM lands in the Wolf Creek watershed using the vegetation classification shown in Appendix 1. Therefore, the watershed exceeds the 15 percent retention standard by 2,516 acres of Old Forest and all 1,101 acres of Mature/Mature over Young stands. Figure 16 illustrates this. This is based strictly on the stands that are over age 80 and not necessarily on these stands over age 80 functioning as older successional forests. The actual available acres are less than depicted in Figure 16 as Riparian Reserves, TPCC, roads, and other nonsuitable lands have not been deducted from these acreage figures.

Based upon BLM's actual inventory, there are 4,200 acres age 80 plus. There are several reasons for the differences in acres. One of the differences is the basic vegetation layer used in this analysis is a different source than the inventory layer and was done for a different purpose. The vegetation layer used in the Wolf Creek watershed tended to split out the small inclusions of older forest types, and the 2-storied stands as separate classes. The inventory layer generally lumped the inclusions into the dominant type. Another reason is the inventory figures are based upon net forest acres, with acreage for roads, unsuitable lands, and other withdrawals removed from the acreage calculation. The vegetation layer used in this analysis did not remove any of these from the calculations. The net result of the inventory calculation is 985 acres are in excess of the 15 percent retention standard whereas our analysis indicates about 2,500 acres are in excess of the standard. The official inventory calculations will be the actual numbers utilized by all projects and management actions.

Wildlife

<u>Special Statu s Species</u> - Besides inventories for the northern spotted owl and the marbled murrelet, there have been few inventories conducted for special status species within the Wolf Creek watershed. Table 5-30 lists those species known or suspected to occur in the watershed.

<u>Northern Spotted Owl</u> - There are 10 known northern spotted owl site centers located within the boundaries of the watershed. Four more sites are located outside the boundary of the watershed, within 1.5 miles. The amount of habitat suitable for spotted owls within the watershed is 24,150 acres or 64 percent of the watershed, with 5,192 acres (14% of suitable habitat) considered suitable for nesting. The remaining suitable habitat is considered roosting, foraging, or dispersal habitat (see Map 14, Northern Spotted Owl Habitat).

A portion of two Critical Habitat Units (CHU) for spotted owls are located within the Wolf Creek watershed. The total amount of habitat suitable for nesting on federal land in both CHUs is 5,007 acres or 35 percent of the total federal land within the CHUs. There are approximately 8,611 acres of federally owned land within that portion of CHU OR-52 located within the watershed. Of those acres, approximately 3,493 acres (41%) is considered suitable habitat. Within that portion of CHU OR-53 in the watershed, there are approximately 5,880 acres of federally owned land. Of those acres, approximately 1,514 (26%) are considered suitable habitat (see Table 5-29 and Figure 17).

Table 5-29 - Acres of Suitable Habitat and Federal Lands in Critical Habitat Units within Wolf Creek Watershed

Critical Habitat Unit #	CHU OR-52	CHU OR-53
Acres Federal Land	8,611	5,880
Acres of Suitable Habitat (%)	3,493 (41)	1,514 (26)

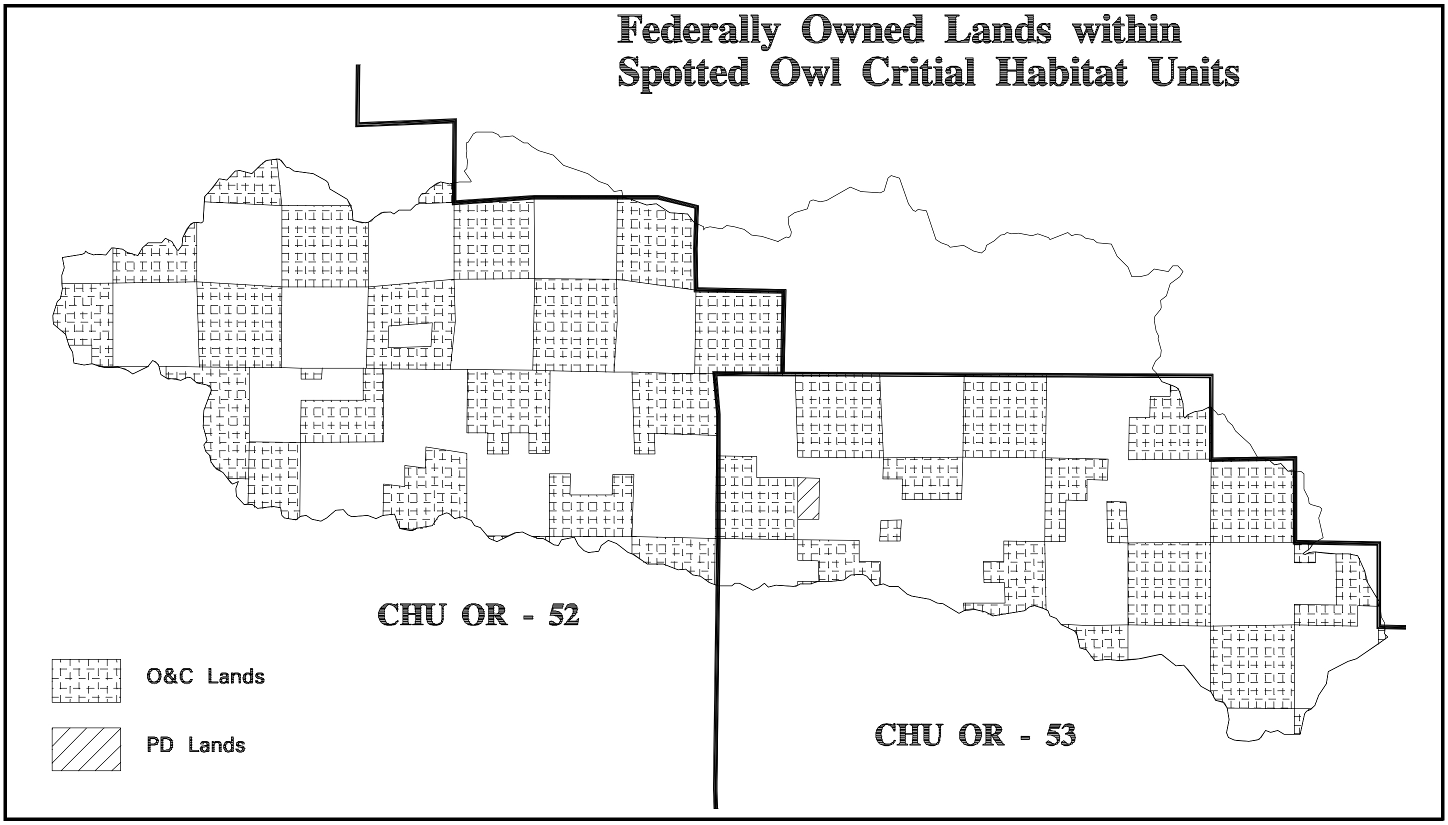

Figure 17: BLM Lands Within Spotted Owl Critical Habitat Units - Wolf Creek Watershed

Marbled Murrelet - The Wolf Creek watershed lies within the 35-mile line designated as the inland nesting range for the marbled murrelet. Marbled murrelets generally nest in old forest stands on large, moss-covered limbs. There are approximately 5,192 acres of habitat suitable for marbled murrelet nest sites within the watershed. These acres of habitat have not been surveyed for marbled murrelets.

Bureau of Land Management surveys for marbled murrelets have been conducted near the Wolf Creek watershed. These surveys have discovered 3 marbled murrelet nest sites, and an additional 6 sites have been classified as occupied, located 2 miles outside of the watershed boundary. No known marbled murrelet sites have been located within the boundary of the watershed.

Table 5-30 - Sensitive Wildlife Species Known or Suspected Within Wolf Creek Watershed

Species (common name)	Scientific Name	Status	Presence	Inventory
Invertebrates (earthworms, insects, and mollusks)				
Lillianis moss bug	*Acalypta lillianis*	BT	U	N
Prairie Peak blind carabid beetle	*Anillodes sp.*	RV	U	N
Vaughn Creek earthworm	*Argilophilus sp.*	RV	S	N
Siskiyou chloealtis grasshopper	*Chloealtis aspasma*	FC2	U	N
Foliaceous lace bug	*Derephysia foliacea*	BA	U	N
Evening fieldslug	*Deroceras hesperium*	ROD	U	N
Oregon giant earthworm	*Driloleirus macelfreshi*	FC2	U	N
Oregon micro-slug	*Gliabates oregonia*	RV	U	N
Astaneous lepidostoman caddisfly	*Lepidostoma astaneum*	RV	U	N
Oregon megomphix (land snail)	*Megomphix hemphilli*	ROD	U	N
Mulsant's water treader	*Mesovelis mulsanti*	BT	U	N
Alsea ochrotrichian micro-caddisfly	*Ochrotrichia alsea*	BT	S	N
Vertrees's ochrotrichian micro-caddisfly	*Ochrotrichia vertreesi*	FC2	U	N
True fir pinalitus	*Pinalitus solivagus*	BT	U	N
Douglas-fir platylygus	*Platylygus pseudotsugae*	BT	U	N
Reticulate tail-dropper (slug)	*Prophysaon andersoni*	RV	S	N
Blue-gray tail-dropper (slug)	*Prophysaon coeruleum*	ROD	U	N
Papillose tail-dropper (slug)	*Prophysaon dubium*	ROD	S	N
Roth's blind carabid beetle	*Pterostichus rothi*	FC2	U	N
Fender's rhyacophilan caddisfly	*Rhyacophila fenderi*	BT	U	N
Montane bog dragonfly	*Tanypteryx hageni*	BT	U	N
Siskiyou caddisfly	*Tinodes siskiyou*	FC2	U	N
Amphibians (salamanders and frogs)				
Clouded salamander	*Aneides ferreus*	BA, SU	S	1
Tailed frog	*Ascaphus truei*	FC2, SV	S	N
Western red-backed salamander	*Plethodon vehiculum*	RV	S	1
Northern red-legged frog	*Rana aurora aurora*	FC2, SU	K	1
Foothill yellow-legged frog	*Rana boylii*	FC2, SV	U	N
Bullfrog	*Rana catesbeiana*	EX	U	1
Variegated salamander	*Rhyacotriton variegatus*	FC2, SV	K	2

Species (common name)	Scientific Name	Status	Presence	Inventory
Birds				
Northern goshawk	*Accipiter gentilis*	FC2, SC	S	N
Marbled murrelet	*Brachyramphus marmoratus*	FT, SC	S	N
Bufflehead	*Bucephala albeola*	BA, SP	S	N
Barrow's goldeneye	*Bucephala islandica*	BT, SP	S	N
Pileated woodpecker	*Dryocopus pileatus*	BT, SV	K	2
American peregrine falcon	*Falco peregrinus anatum*	FE, SE	S	N
Bald eagle	*Haliaeetus leucocephalus*	FT, ST	S	N
Harlequin duck	*Histrionicus histrionicus*	FC2, SP	S	N
Loggerhead shrike	*Lanius ludovicianus*	SU	U	N
Lewis' woodpecker	*Melanerpes lewis*	BT, SC	S	N
Mountain quail	*Oreortys pictus*	BT	S	N
Purple martin	*Progne subis*	BT, SC	S	N
Western bluebird	*Sialia mexicana*	BT, SV	S	N
Northern spotted owl	*Strix occidentalis caurina*	FT, ST	K	4
Mammals				
American marten	*Martes americana*	BT, SC	U	N
Fringed myotis	*Myotis thysanoides*	FC2, SV	S	N
Columbian white-tailed deer	*Odocoileus virginianus leucurus*	FE, SE	U	N
White-footed vole	*Phenacomys albipes*	FC2, SP	S	N
Red tree vole	*Phenacomys longicaudus*	ROD	S	N
Pacific western big-eared bat	*Plecotus townsendii townsendii*	FC2, SC	S	1

Status:
FE - Federal Endangered
ROD - Record of Decision species
FT - Federal Threatened
FP - Federal Proposed
FC2 - Federal Candidate category 2
BS - Bureau Sensitive
BA - Bureau Assessment species
BT - Bureau Tracking species
SE - State Endangered
ST - State Threatened
SC - State Critical
SU - State Undetermined
SV - State Vulnerable
SP - State Peripheral or naturally rare
EX - Exotic species
RV - Rare or Vulnerable (no legal status)

Presence:
K - Known to be present
S - Suspected
U - Uncertain

Inventory:
N - No surveys done
1 - Casual, unstructured surveys
2 - Structured spot surveys
3 - Structured surveys not to protocol
4 - Surveys to protocol

General Wildlife - There are many wildlife species that could potentially occur within the Wolf Creek watershed based on geographical ranges or habitat availability. Appendix 5 lists those species of wildlife.

Other high interest species of wildlife observed in the watershed include: mountain lion, bobcat, black bear, and other species of raptors. The majority of the wildlife observation reports, especially elk, that have been recorded for the watershed, have occurred in the west half of the watershed. These observations are in the general area that has had the least intensive amount of management. The majority of the habitat remaining is older forests that have not been altered as intensively as the areas in the eastern half of the watershed. The eastern half of the watershed has residential areas, whereas, the western half of the watershed has no residential dwellings.

Roosevelt Elk - The Wolf Creek watershed lies within the Oregon Department of Fish and Wildlife (ODFW) Siuslaw Big Game Management Unit, and elk are hunted in this area each year. Elk in Oregon were hunted almost to extinction during the 1800s. It was not until 1899 that the State Legislature gave complete protection to elk, making it illegal to sell the meat from wild animals. The range of Roosevelt elk in Oregon had been reduced to a few small herds along the coast and in the Cascade Range. In 1917 the Fish and Game Commission (now ODFW) reported ". . . it is not considered possible to reestablish elk as a game animal in the State of Oregon." The taking of elk remained unlawful until 1938, but protection was granted a few years at a time. The 1903-1904 annual report from the Game and Forestry Warden indicated that the law protecting the elk should be reenacted, or ". . . the elk of Oregon will be an animal of the past." (ODFW, 1987)

With concern rising about the status of elk in Oregon, transplanting efforts were explored more seriously. In 1917 the first successful transplant of elk in Oregon occurred. A small group of Rocky Mountain elk, originating in Yellowstone and kept at Billy Meadows in Wallowa County, were used for some stocking efforts in western Oregon. Stocking continued throughout Oregon, and finally in 1938 the first legal Roosevelt elk hunting season was opened (ODFW, 1987).

Transplanting occurs throughout the range of the Roosevelt elk now, as elk deemed as nuisances are captured and moved to areas with less concentrations of humans. Many elk transplants have occurred within or near the Wolf Creek watershed. The Siuslaw Big Game Management Unit has had 229 elk transplanted within its boundaries from 1967 through 1979.

The Oregon Department of Fish and Wildlife has indicated that the Siuslaw Big Game Management Unit has the lowest bull:cow ratio of all units in western Oregon (B. Castillo, ODFW, pers. comm.). With a target level of 10:100 bulls:cows ratio, the Siuslaw unit is averaging 6:100 bulls:cows (60% of target) for the past several years. The latest counts put the ratio at 2:100. Additionally, ODFW indicates that the Siuslaw unit is the slowest area for recovery of elk numbers, citing increased road densities and poaching as the major factors.

The Wolf Creek watershed is partially located within two BLM/ODFW Elk Management Areas. These areas were identified by the ODFW and the BLM due to a concern for Roosevelt elk on the Eugene District. District management activities designed to enhance or create habitat for elk would first be planned in these areas. Additionally, any forest management activities planned by the District in these areas would attempt to implement measures to mitigate impacts to elk.

The 2 Elk Management Areas (EMA) that are associated with the Wolf Creek watershed are the Wolf Creek EMA and the Siuslaw River EMA. The Wolf Creek EMA encompasses approximately 87,693 acres of land with 39,615 acres managed by the BLM. Of the BLM owned acres 11,803 acres are located within the Wolf Creek watershed. The Siuslaw River EMA encompasses 40,074 acres, with 20,224 acres managed by the BLM. Of the BLM acres, 455 acres are within the Wolf Creek watershed (see Figure 18).

Elk Habitat - Habitat effectiveness was analyzed for the EMAs within the District for the Draft RMP. These analyses were conducted following the habitat effectiveness model developed by Wisdom et al. (1986). The model was modified for this analysis by dropping the spacing index (HE_S) because of the confounding nature of the checkerboard ownership pattern of BLM lands in the EMAs. This modification was agreed to by the ODFW.

The Wisdom Elk Habitat Effectiveness Model rates the effectiveness of habitat based on four indexes: (1) habitat effectiveness index derived from size and spacing of forage and cover areas (HE_S), (2) habitat effectiveness index derived from the density of roads open to vehicular traffic (HE_R), (3) habitat effectiveness index derived from the quality of cover (HE_C), and (4) habitat effectiveness index derived from the quality of forage (HE_F). The overall habitat effectiveness for a given area is calculated using the following equation: $HE_{SRCF} = (HE_S \times HE_R \times HE_C \times HE_F)^{1/N}$, where HE_{SRCF} = the habitat effectiveness index considering the interaciton of HE_S, HE_R, HE_C, and HE_F, and, 1/N = Nth root of the product taken to obtain the geometric mean where N = the number of habitat variables (see Wisdom et al. 1986 for explanation of derivation of indices).

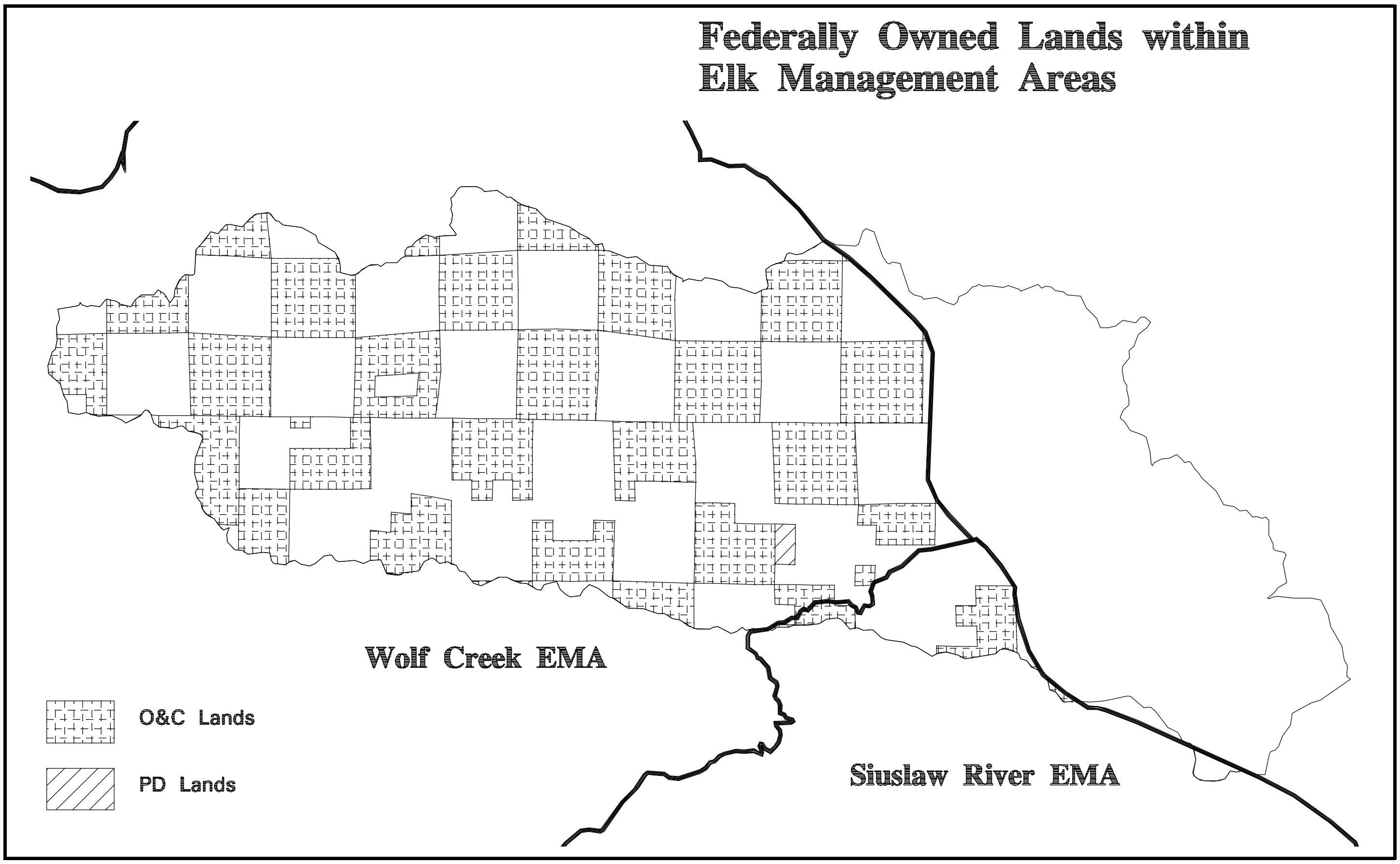

Figure 18: BLM Lands Within the Elk Management Areas - Wolf Creek Watershed

Habitat effectiveness analysis completed during the Draft RMP analysis indicated the following scores for each Elk Management Area:

Wolf Creek EMA

Siuslaw River EMA

$HE_R = 0.25$
$HE_R = 0.24$
$HE_C = 0.31$
$HE_C = 0.60$

$HE_F = 0.20$
$HE_F = 0.19$

$HE_{RCF} = 0.25$
$HE_{RCF} = 0.30$

Habitat effectiveness scores were calculated for Wolf Creek using the habitat existing on the landscape in 1990 and 1956. The 1993 habitat showed an excellent score on the Spacing Index of 0.84. Cover and Forage Indices were on the low scale of 0.29 and 0.12, respectively. The lowest score was the Road Index, which was determined to be 0.10. This gave and overall Habitat Effectivenes Index of 0.23.

The Habitat Effectiveness Index score for the 1956 habitat data is as follows: Spacing Index = 0.40, Cover Index = 0.59, Forage Index = 0.03, and Road Index = 0.55. The overall Habitat Effectiveness Index for the 1956 habitat is 0.24.

The scores generated by the Wisdom model evaluate the quality of each habitat feature. Scores near 1.0 are considered optimum and scores near zero identify nonviable population parameters. Scores above 0.6 are considered highly viable population parameters, whereas scores below 0.5 are considered viable to marginal. By increasing the effectiveness score of any of the parameters, the overall score increases. The easiest parameter to manage for and increase is the roads parameter. By implementing a road closure plan for an area the habitat effectiveness for roads increases, thus increasing the overall habitat effectiveness.

Because of the high road densities in the area, the Siuslaw Unit has not been designated as an area to encourage elk numbers. Instead, ODFW will attempt to maintain them until land management agencies and large private landowners begin a road closure program. Until such time, the road density targets for this area are 2.0 to 2.5 miles of open road per square mile. This figure allows the elk population in the area to maintain current numbers. The ODFW target for road densities for any given area where elk numbers are to be encouraged and elk populations are to increase in the area, is 1.0 to 1.5 mi/mi^2.

In the Wolf Creek watershed there are 332.9 miles of road, which equates to a road density of 5.6 mi/mi^2. This figure requires 188.9 to 215.9 miles of road be closed to bring the current density to the ODFW maintenance target levels of 117 to 147 miles of open road (2.0 to 2.5 mi/mi^2). To bring the current road densities to the elk encouragment level of 1.0 to 1.5 mi/mi^2, 244.9 to 273.9 miles of road need to be closed this will bring the number of miles of open road within the watershed to 59 to 88 miles. It is suggested that road closures be widespread, not concentrating the closures in any one given area. This promotes a less concentrated use of any one area by hunters, and enhances a road closure program (B. Castillo, ODFW, pers. comm.).

Habitat Components - Snags and Down Woody Debris

Snags - Snags are an important structural component in forest communities. In forests of western Oregon and Washington, snags are used by nearly 100 species of wildlife of which at least 53 species are cavity-dependent. On the Eugene District, at least 36 species require standing dead trees for one or more life needs (Eugene District RMP, 1994[65]). Wildlife species that use cavities in partially live or dead trees for various life functions are referred to as cavity users or nesters and include representatives from all classes of terrestrial animals. The absence of suitable snags can be the major limiting factor for some snag-dependent wildlife populations. From the 1940s through the early 1960s the Oregon Conservation Act of 1942 (repealed) inadvertently provided snags on managed young forests. This act required the replanting of harvested sites or the retention of seed trees. These old seed trees, many now dead or dying, often became snags (Brown et al. 1985). Marcot et al.[70] developed a model to estimate densities of snags by decay class and size classes over time based on desired population levels of primary cavity nesters (i.e., woodpeckers). These criteria indicated that 11 inches dbh is the minimum size class used as nesting habitat by cavity nesters.

The District Resource Management Plan will require snags and green trees, 15 inches dbh or greater, to be retained at levels sufficient to support cavity-nesting species at 40 percent of potential population levels. The species of primary cavity nesters located in the Wolf Creek watershed as well as the required snag numbers, sizes, and decay class to support 40 percent of potential population levels are listed in Table 5-31. This table indicates that 1.5 snags per acre are required to support 40 percent of the potential population numbers of the woodpecker species located within the Wolf Creek watershed. The numbers of snags in this analysis, reflect only those snags greater than or equal to 11 inches dbh.

Table 5-31 - Snag Requirements For Woodpeckers Found in the Wolf Creek Watershed[1]

Snag diameter class (inches dbh)	**Snag Decay Stage**		**Total snags by diameter class**
	Hard 2 - 3	**Soft 4 - 5**	
11 +	Downy Woodpecker (3)	Downy Woodpecker (3)	(6)
15 +	Red-breasted Sapsucker (18)	Hairy Woodpecker (77)	(95)
17 +	Northern Flicker (9.5) Red-Breasted Nuthatch (31)	Northern Flicker (9.5)	(50)
25+	Pileated Woodpecker (2)		(2)
Total snags by decay stage	(63.5)	(89.5)	(153)

[1] This table assumes 40 percent population levels. Numbers of snags per 100 acres are shown in parentheses. Note snag densities shown herre refer to densities through time. (Adapted from Brown et al. 1985)

The Wolf Creek watershed, like many other watersheds on the District, has areas with remnant seed trees remaining as snags, and other areas where there were no trees left after harvest and snags are absent from these developing stands.

To determine if snags are a limiting or scarce habitat component within the Wolf Creek basin, analysis was done on data collected from a spotted owl habitat study being conducted by Oregon State University's Cooperative Wildlife Research Unit, contracted by the Eugene District, BLM (Thrailkill et al.). Data was collected on trees that fell into a 40 Basal Area Factor (BAF) prism variable plot. Trees were tallied, and decay class and diameter at breast height (dbh) was determined for each tree. Only those trees that were determined to have a decay class of 3 or greater were considered to be snags. By isolating only those areas where data was collected within Wolf Creek, an approximation of the number of snags per acre for each habitat type was established. Table 5-32 depicts those approximations. In addition data collected throughout the spotted owl study area was analyzed to determine snags per acre on a larger scale (Table 5-33).

For comparison, the Resource Management Plan (RMP) for the Eugene District, BLM indicates that a minimum of 1.5 snags per acre will be maintained on lands after harvest (see Table 5-31). Additionally, all snags existing on the landscape will remain as long as they do not cause safety problems. Further analysis of Thrailkill et al. vegetation data indicates there are 5.6 snags per acres located in their study area (part of which is the Wolf Creek watershed). Table 5-34 lists the number of snags per 100 acres within each size class, and decay stage, and associated cavity nesting species.

Table 5-32 - Snags Per Acre for Wolf Creek Watershed, from Spotted Owl Habitat Analysis

Habitat Class	# Plots per habitat class	Total # of snags in plots 11+ in dbh	Avg. DBH of snags (in)	Stand Table Tree/Acre (for size class)	Snags per acre
Pole - Young	10	0	n/a	n/a	n/a
Mature - Young	20	6	30.5	7.9	2.4
Mature	10	3	18.9	20.7	6.2
Old - Young	19	12	36.8	5.4	3.4
Old Forest	10	8	37.8	5.2	4.1

Table 5-33 - Snags Per Acre for Entire Study Area, From Spotted Owl Habitat Analysis

Habitat Class	# Plots per habitat class	Total # of snags in plots 11+ in dbh	Avg. DBH of snags (in)	Stand Table Tree/Acre (for size class)	Snags per acre
Pole - Young	50	14	32.8	6.8	1.9
Mature - Young	50	18	30.2	8.1	2.9
Mature	50	33	28.7	9.0	5.9
Old - Young	50	34	47.6	3.2	2.2
Old Forest	50	49	41.7	4.2	4.1

Table 5-34 - Number of Snags Per 100 Acres in Study Area of OSU Owl Study, Central Coast Range[1]

Snag diameter class (inches dbh)	Snag Decay Stage		Total snags by diameter class
	Hard 2 - 3	Soft 4 - 5	
11 +	Downy Woodpecker 110 (8)	Downy Woodpecker 40 (8)	150 (16)
15 +	Red-breasted Sapsucker 20(45)	Hairy Woodpecker 30 (192) **	50 (**2**37)
17 +	Northern Flicker 140 (24) Red-breasted Nuthatch (76)	Northern Flicker 60 (24)	200 (124)
25+	Pileated Woodpecker 30 (6)	130	160 (6)
Total snags by decay stage	300 (159)	260 (224)	560 (**383**)

[1] Woodpecker species listed are categorized by nesting snag requirements as in Table 5-31. Numbers in parentheses indicate number required for the 100 percent population levels of the listed species. (Adapted from Marcot et al. 1989[70])

The number of snags present on the landscape now exceed most requirements to support 40 percent of potential population numbers of cavity-nesting birds. Furthermore, the number of snags within each size class and decay stage existing on the landscape indicate 100 percent of population levels of 4 of the 6 species can be supported. The species that are not supported 100 percent, however, are the red-breasted sapsucker and the hairy woodpecker. Furthermore, the hairy woodpeckeer would not be supported at the 40 percent population level with the number of snags existing on the landscape. This indicates that snags need to be provided that are within 15+ inches dbh and in decay stages 4 or 5 (soft). Snags at this size class deteriorate rather quickly lasting approximately 15 to 20 years before becoming too soft for use and falling down[70]. Therefore, efforts to create snags of this size class and in a soft decay class, would need to create approximately twice the number of hard snags as the number of soft snags desired. This effort should be spread out over time to allow for the hard snag decay rate to create the number of soft snags needed.

The snag numbers required for population levels in Table 5-31 and Table 5-34 are for nesting habitat only and do not reflect the number of snags needed for foraging and roosting habitat. Therefore, these numbers should be considered as extreme minimums when used for snag creation projects.

Down Woody Debris (DWD) - Dead and down woody material in the form of stumps, root wads, bark, limbs, and logs in various stages of decay occurs in most forest ecosystems. This is especially true of the temperate conifer forests west of the Cascade Range where highly productive forest sites are capable of producing large volumes of wood fiber[48]. This is the case for unmanaged forests where suppression mortality occurs naturally and provides large amounts of down woody material.

Dead and down material serves many important functions that should be recognized. Not only is this material important in mineral cycling, nutrient mobilization, and natural forest regeneration, it also creates a structure and diversity of habitat that is valuable to a great many wildlife species, terrestrial and aquatic.[48]

Dead and down woody materials are important components of wildlife habitats in western forests. These materials provide cover and serve as sites for feeding, reproducing, and nesting for many wildlife species. In forests west of the Cascade crest in Oregon and Washington, 150 terrestrial wildlife species are known to utilize dead and down woody materials as either a primary or a secondary component of their habitat requirements. Just as snags can be a limiting factor for some wildlife populations in western forests, so can down woody material[48].

Within the Wolf Creek watershed are areas that have naturally developed the amounts of down woody material necessary for the proper function of the ecosystem. These areas are primarily unmanaged old growth forests. In many managed stands most of the down woody material has been removed in amounts relative to the demand in the forest products industry. Most forest stands that have been recently harvested are devoid of any down woody material.

To determine if the amount of down woody material within the Watershed is a limiting or scarce habitat type for wildlife species, Thrailkill's owl habitat data were analyzed further. In the data, set down logs were tallied during transects from fixed plots. The logs had to be bisected by the transect, and the diameter of each log had to be 4 inches or greater. Lengths of the down woody material bisected for the data set were not measured.

To determine amounts of down woody material present in the Watershed, a few assumptions had to be made for the analysis from these data sets. These assumptions are as follows:

- Average log length is 23 feet. This was calculated from log data gathered on over 6,000 logs for a spotted owl habitat study conducted on the McKenzie Resource Area, Eugene District, BLM, in cooperation with the National

- Council of Air and Stream Improvement.[71]

- Average diameter of the logs measured in the McKenzie Resource Area spotted owl habitat study was 13.5 inches.

- Transect width was 46 feet, twice the average length of a log.

From these assumptions, analysis was conducted to determine linear feet per acre of down woody material as well as tons/acre within each habitat class. Table 5-35 shows the result from the analyses done for the spotted owl habitat data within the Wolf Creek watershed and Table 5-36 shows the results from the analyses done for data collected throughout the study area.

In addition to all logs being analyzed, an analysis was conducted on logs that were at least 20 inches in diameter with the assumption that these logs were also at least 23 feet long. This was done to determine the amount of down woody material meeting specifications. The results are shown in Table 5-37 for the entire study area and Table 5-38 for the watershed.

In unmanaged old growth forests in western Oregon, the amount of down woody material ranged from 25 to 259 tons/acre, depending on the position on the landscape the measurements were taken. The highest amounts of down woody material were found on lower slope, streamside areas; whereas, the lighter amounts were found on dry ridgetops (Brown et al. 1985). Standards and Guidelines outlined in the ROD require only 240 linear feet per acre to be left after harvest, which equates to 7.8 tons per acre.

Table 5-35 - Down Woody Material From Spotted Owl Habitat Data Within Wolf Creek Watershed

Habitat Class	**# Logs Bisected**	**Avg. Dia.**	**Approximate # of Acres**	**Linear feet of DWD per Acre**	**Tons per Acre**
Pole - Young	23	9	0.55	961.8	**6.27**
Mature - Young	50	15	1.11	1036.0	**18.92**
Mature	46	12	0.55	1923.6	**22.58**
Old - Young	92	14	1.05	2015.2	**32.42**
Old Forest	32	16	0.55	1338.2	**27.93**

Table 5-36 - Down Woody Material From Spotted Owl Habitat Data, Entire Study Area

Habitat Class	**# Logs Bisected**	**Avg. Dia.**	**Approximate # of Acres**	**Linear feet of DWD per Acre**	**Tons per Acre**
Pole - Young	138	14	2.77	1,145.8	**18.43**
Mature - Young	134	15	2.77	1,112.6	**20.32**
Mature	153	13	2.77	1,270.4	**17.68**
Old - Young	261	11	2.77	2,167.1	**21.67**
Old Forest	202	16	2.77	1,677.3	**35.00**

Table 5-37 - Down Woody Material (≥20" in dia.) from Spotted Owl Habitat Data, Entire Study Area

Habitat Class	# Logs Bisected	Avg. Dia.	Approximate # of Acres	Linear feet of DWD per Acre	Tons per Acre
Pole - Young	22	40	2.77	187.4	**29.31**
Mature - Young	30	36	2.77	249.1	**31.30**
Mature	22	32	2.77	182.7	**17.31**
Old - Young	35	33	2.77	290.6	**29.06**
Old Forest	50	36	2.77	415.2	**51.99**

Table 5-38 - Down Woody Material (≥20" in dia.) from Spotted Owl Habitat Data, Wolf Creek Watershed

Habitat Class	# Logs Bisected	Avg. Dia.	Approximate # of Acres	Linear feet of DWD per Acre	Tons per Acre
Pole - Young	2	31	0.55	83.6	**6.65**
Mature - Young	13	38	1.11	269.4	**37.83**
Mature	9	31	0.55	376.4	**32.24**
Old - Young	23	32	1.05	503.8	**45.78**
Old Forest	9	32	0.55	376.4	**35.35**

Except for the amount of down wood in the pole-young habitat class, the amount of down woody material in the watershed indicate that there is an adequate amount to meet the requirements of the ROD see Table 5-35. The amounts shown here are probably near the lower values of down wood found in other studies. It is important to note how this habitat component is functioning in the ecosystem and what is considered a natural range of variability. As indicated in Brown et al., the amount of woody material falls within that range. However, Standards and Guidelines in the ROD fall well below this range and what is seen within the Wolf Creek watershed. This is further corroborated with the analysis of only those logs ≥ 20 inches in diameter, as shown in Tables 5-37 and 5-38. All of the habitat types, within the watershed, except for the pole-young habitat class, exceed that which is required by the ROD. Within the entire study area the ROD requirements are exceeded by the mature over young, old over young, and old forest habitat types. This points to the importance of the Wolf Creek watershed in providing this habitat component across a larger landscape (i.e. river basin). The amount of down wood material in the watershed exceeds the ROD standards by 264 ft/ac, at the most, and as little as 29 ft/ac. The importance of down woody material on the landscape has not fully been realized.

Riparian Areas and Conditions

Riparian areas are an interface between the aquatic and terrestrial ecosystems and provide major travel corridors and habitats for a variety of species. Riparian areas are a major source of inputs into the aquatic system in the form of wood, food sources, and nutrients. To understand the role of riparian areas and develop criteria for establishing Riparian Reserves, it is necessary to map the riparian areas, characterize the vegetation composition, and identify interactions between the riparian areas and the stream network. This is the first step in meeting the Aquatic Conservation Strategy objectives developed in the ROD.

To characterize the riparian vegetation, the stream adjacent vegetation for main stem of Wolf Creek and the major tributaries 4th order and greater was photo interpreted from 1990 photos. Wolf Creek proper was divided into 3 sections: upper Wolf Creek, middle Wolf Creek, and lower Wolf Creek. Upper Wolf Creek runs from the headwaters to the junction of Swamp Creek. The middle Wolf Creek segment is from Swamp Creek juncture to the Oat Creek-Pittenger Creek confluence. Lower Wolf Creek runs from Oat-Pittenger Creek to the junction of Wolf Creek with the Siuslaw River. The riparian width was identified and scaled from these photos as well as classifying the dominant overstory vegetation. This information was mapped and summarized for the 200 to 300 feet closest to the stream (see Map 15, Riparian Vegetation Map). Table 5-39 lists the 3 segments of main Wolf Creek, the length of the segment, the vegetation type of that segment as well as for the entire main stem of Wolf Creek. Figure 19 displays the same information graphically.

Main Stem Wolf Creek

Table 5-39 - Summary of Overstory Riparian Vegetation for Main Stem Wolf Creek

	Upper Wolf Ck.	**Mid Wolf Ck.**	**Lower Wolf Ck.**	**Total**
Total length: feet	29,193	52,499	49,958	131,650
Total length: miles	5.53	9.94	9.46	24.9
% of Total Main Stem	22.2	39.9	37.9	
Overstory Composition: as a percent of the total 4th order stream length				
Pasture	17.5			3.9
Residential	3.9			0.9
Marsh	12.4			2.7
Disturbed areas		2.9		1.2
Clear cut-Sapling		4.0	12.3	6.3
Pole-Young	19.6		8.3	7.5
Mature	7.7			1.7
Old Growth			3.0	1.2
Young Hardwood			10.7	4.1
Mixed Hardwood/Conifer	38.9	81.9	38.3	55.8
Old Hardwood		11.2	27.4	14.9

One of the major questions concerning the current riparian areas is the ability to supply structural materials; logs and wood to Wolf Creek now and into the future. From this classification 6 percent (7,779 feet or 1.47 miles) of the riparian vegetation along main Wolf Creek have been permanently altered and are in pasture, residential, or disturbed areas. Almost all of the permanently altered stream-side vegetation occurs in the upper Wolf Creek segment, primarily because this is where the houses, farms, and inhabitants are located. The disturbed area is principally the rock quarry that is located in the upper reaches of the middle Wolf Creek segment just below the Swamp Creek junction.

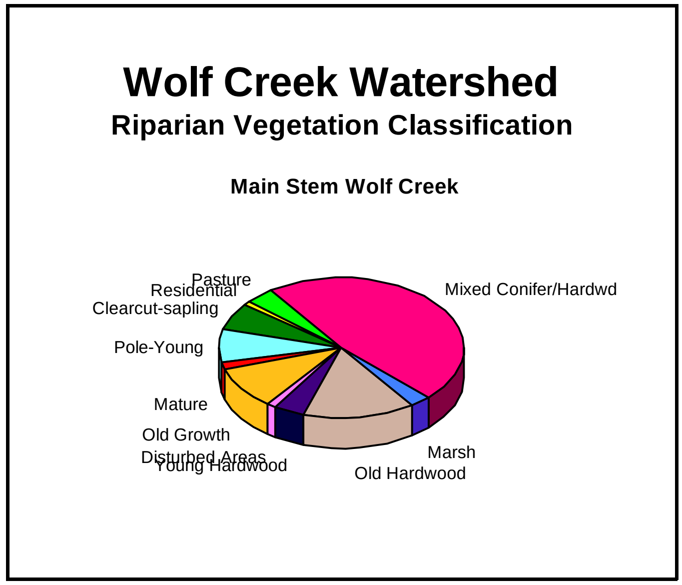

Figure 19: Overstory Riparian Vegetation Classes for Main Stem Wolf Creek

The vegetation classes expected to produce wood of the size and species desired for structural inputs are the old growth, old hardwood, and mature forest types. These classes total 17.8 percent (6.5 miles) of main stem Wolf Creek's riparian vegetation. The remaining two-thirds of the main stem has some form of younger vegetation and is not able to supply the structural materials of sufficient size to the aquatic system. Lower Wolf Creek contains all of the old growth, 70 percent of the old hardwood type, and none of the mature forest type. Middle Wolf contains the remaining 30 percent of the old hardwood type, and no mature or old growth forest types; and upper Wolf Creek contains one stretch of mature forest and none of the other structurally important forest types.

The distribution pattern of these vegetation classes along the main stem Wolf Creek varies (see Map 15, Riparian Vegetation). The lower reach of Wolf Creek has 55 percent in mixed hardwood-conifer and old hardwood types. The mixed harwood-conifer type occurs in 3 separate areas and as such is discontinuous along this part of Wolf Creek. The old hardwood type is one patch located about in the middle of this reach. There is only one area of old forest that covers about 1,500 feet near the confluence with Saleratus Creek with no mature forest type along the lower reaches of Wolf Creek. About 30 percent of this stretch of Wolf Creek has riparian vegetation types capable of producing structural materials to the stream.

Over 80 percent of the middle Wolf Creek reach is dominated by the mixed hardwood-conifer forest type. This forest type is almost continuous with 5 places where other vegetation classes intrude. These other vegetation types include old hardwood in 3 places, and sapling conifers and disturbed area in one specific location. The old hardwood type is located in 2 small stretches and 1 large area upstream of Grenshaw Creek that is close to 5,000 feet long. The Swamp Creek quarry is also located within this stretch of Wolf Creek and influences about 1,500 feet of the upper part of this reach. The middle Wolf Creek segment has the most continuous riparian vegetation of any of the 3 segments, but about 10 percent of this reach has a forest type capable of producing structural materials to Wolf Creek.

Riparian vegetation types on the upper Wolf Creek are discontinuous. The mixed hardwood-confier type occupies the largest single type, about 39 percent of the length of this segment. All of the pasture and residential vegetation classes occur in this reach and occupy 21 percent of the reach length. Of particular interest is the presence of marshes and bogs. About 12 percent of this reach has marshes and wetlands as the dominant vegetation. Only 7 percent of this part of Wolf Creek has mature forest. It is the only vegetation class at present capable of contributing structural material to the Wolf Creek system.

Major Tributaries - There are 7 major tributaries to Wolf Creek within the basin. The major tributaries are considered 4th order and larger streams. There are several other important tributaries within the basin, but available information and time precluded fully developing the riparian vegetation conditions for them. The vegetation classification was done for the 4th order and greater portions of these major tributary streams. These 7 tributaries total 97,698 feet (18.5 miles) of 4th order stream within the basin. This is approximately 5 percent of the total perennial stream miles within Wolf Creek watershed (see Table 5-9). Table 5-40 summaries stream length and vegetation classes for the 4th order segment of each of the 7 major tributaries analyzed in the watershed.

Table 5-40 - 4th Order Stream Length and Overstory Vegetation Classification for Major Tributaries

	Swing Log Ck.	**Panther Creek**	**Swamp Creek**	**Eames Creek**	**Grenshaw Creek**	**Oat Creek**	**Gall Creek**	**Saleratus Creek**
Stream length: ft	6,279	14,461	17,308	21,652	9,348	11,486	10,370	6,794
Stream length: mi	1.19	2.74	3.28	4.10	1.77	2.17	1.96	1.29
Vegetation Class								
Agricultural		31.9%						
Pasture		23.0%						
Residential								
Marsh			6.0%					
Disturbed Areas								
Clear cut-Sapling				1.9%		14.2%		
Pole-Young	100.0%	40.7%	33.7%	20.1%				
Mature								
Old Growth				4.6%	35.2%			15.5%
Young Hardwood				8.6%			7.4%	26.2%
Mixed Conifer/Hardwood		4.5%	53.8%	60.1%	64.8%	85.8%	92.6%	58.3%
Old Hardwood			6.6%	4.6%				

The majority of the tributaries are dominated by mixed conifer-hardwood or pole-young vegetation classes. Panther Creek is the only major tributary with agricultural and pasture lands as a part of the riparian vegetation and Swamp Creek is the only tributary with marshes identified within the riparian area, although upper Wolf Creek does have some marsh identified near the headwaters. Eames and Swamp creeks have small reaches where old hardwood is the dominant riparian vegetation that may provide some source for large wood for the tributary. However, given the stream gradient of these creeks and the location of the old hardwood vegetation, it is doubtful that any larger wood contributed by this patch would reach Wolf Creek without a major flood event. However, a wood supply for the lower portions of the 4th order reaches is probably in the short-term.

Old growth vegetation classes are found on the upper end of the 4th order reaches of Eames and Grenshaw creeks and at the confluence of Saleratus Creek and Wolf Creek. One unnamed tributary on the south side of Wolf Creek between Eames and Swamp creeks also has old forest riparian vegetation and Eames Creek has a very small reach of mature forest. The other 4th order tributaries do not have riparian vegetation conditions that are favorable to producing large woody material for the stream systems. On Eames and Swamp creeks, there is potential for near term structural materials to be provided to these creeks but, given stream gradients and flows, they are not likely to contribute much to the main stem of Wolf Creek.

There are 2 locations of old forest where major tributaries join with Wolf Creek: one is the unnamed tributary on the south side of Wolf Creek between Eames and Swamp creeks (approximate location of T. 19 S., R. 6 W., Section 7) and the other is upstream of the confluence with Saleratus Creek. These are the only sources of old forest along the entire main stem of Wolf Creek. The Saleratus Creek confluence is the only place within the watershed where old forest riparian vegetation exists along the lowest reaches of the tributary and along the main stem of Wolf Creek.

The dominant riparian vegetation for the 4th order tributaries is generally mixed conifer-hardwood or pole-young conifer forests. The supply for wood of suitable size for structural materials for the streams is extremely limited in the near term. However, as these forests age, the availability of larger sized wood to the stream systems increases. The riparian vegetation pattern is expected to be maintained in a fragmented pattern because of the ownership pattern in the basin. The amount of older aged forests existing in the riparian areas will increase with time on BLM lands.

Species Composition - There is no historical information available as to what the species composition of the riparian areas within the Wolf Creek Basin looked like; some current information is available from stream and fisheries surveys. Appendix 4, Tables 10, 11 and 12 list the species composition for the overstory species, understory species, and the ground cover for each of the major streams and 3 years worth of information from different reaches of main stem Wolf Creek. Given the lack of historical data, there is no way of knowing whether the species composition currently within the watershed reflects a "natural" or "managed" condition. The overstory species composition is generally 60 percent hardwoods (red alder and bigleaf maple), 25 percent Douglas-fir, and 10 percent other conifers (western hemlock and western red cedar). Information regarding snags and downed logs within the riparian stands is limited as the current collection of data has not been compiled and entered into a database, so this component of the stand composition cannot be addressed.

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