Slate Creek Watershed Assessment

Prepared for:

The Residents of the Applegate Valley
Oregon Watershed Enhancement Board
U.S. Bureau of Land Management – Grants Pass Resource Area
U.S. Forest Service – Siskiyou National Forest
Oregon Department of Fish and Wildlife – Rogue River District

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1.0 INTRODUCTION

The purpose of this analysis is to develop a scientifically based understanding of the processes and interactions occurring in the Slate Creek Watershed. Specific goals and objectives of the analysis are to:

1. Gather and analyze information to guide future management activities
2. Create an educational tool to increase awareness and understanding of the Slate Creek Watershed
3. Integrate federal and private land ownership to provide a complete picture of the watershed
4. Identify and prioritize management opportunities

1.1 Analysis Process

The analysis was jointly conducted by the Applegate River Watershed Council (ARWC), Bureau of Land Management (BLM), and the Siskiyou National Forest. Accordingly, the assessment method was designed to fulfill obligations for the Oregon Watershed Enhancement Board and the Federal Guide to Watershed Analysis. Issues and key questions, developed by the federal agencies, ARWC, and landowners guide the content of this analysis. Key issues focus the assessment on the principle concerns of the Slate Creek Watershed.

Slate Creek Watershed was divided into seven subbasins or analysis areas (Figure 1). Information used in the analysis consisted of Geographic information System (GIS) maps and associated databases, aerial photographs, field sampling and interviews with landowners. Considering the mixed ownership, amount and availability of data is variable across the watershed. However, attempts were made to consistently assess the watershed conditions across all ownerships.

This watershed assessment is grouped into three main categories: Cultural and Social environment, Terrestrial environment, and the Aquatic environment. The cultural and social environment examines the historic and current human uses in the watershed. The terrestrial environment focuses on vegetation patterns, wildlife habitat and fire/fuel conditions. Fish habitat conditions, water quality and riparian zone function are discussed in the aquatic environment.

An interdisciplinary team consisting of a hydrologist, geologist, fisheries/wildlife biologist, and silviculturalist conducted the analysis. Numerous landowners provided valuable input and insights to the history and trends in the watershed (Appendix A).

2.0 CULTURAL AND PHYSICAL FEATURES

Slate Creek is a tributary of the Applegate River located in the Rogue River Basin approximately 5 miles southwest of Grants Pass. The 28,412 acre watershed is the third largest tributary in the Applegate Basin and extends from the confluence of Slate Creek and the Applegate River to its headwaters located in T37S, R 8W (Figure 1).

Two small settlements, Wonder and Wilderville, are located within the watershed. U.S. Highway 199 runs through the lower third of the watershed for approximately 5 miles on its way to the Pacific coast. Land use in the watershed is predominantly rural residential and timber (ODFW 1996). Other land uses include farming, ranching, gravel mining, dispersed recreation, and conventional mining.

2.1 Land Management and Zoning

Lands managed by the forest products industry, private citizens, U.S. Forest Service (USFS), and U.S. Bureau of Land Management (BLM) create a mosaic of ownership (Figure 2). The BLM and Forest Service manage nearly 60 % of the watershed at 16,374 acres. Private landholdings, account for 11,976 acres. Forest Service management lies in a contiguous tract, occupying the upper half of the watershed. Private land and USBLM create a checkerboard pattern of ownership.

Josephine County designated land use zoning in Slate Creek is presented in Table 1. Approximately 75% of the watershed is designated as Forest and Woodlot Resources. Rural residential is the second largest designation at 13 % of the watershed.

Table 1. County Zoning and Acres in the Slate Creek Watershed.

Zoning Category	Acres	Percent of Area
EF - Exclusive Farm	62.3	0.2
FC - Forest Commercial	8,692.4	30.5
FR - Farm Resource	33.4	0.13
RC - Rural Commercial	9.8	0.03
RI - Rural Residential ≤1acre	15.1	0.05
RR2 - Rural Residential ≤ 2 acres	1,865.1	6.5
RR5 - Rural Residential ≤ 5 acres	1,792.9	6.3
S - Serpentine	8,046.2	28.2
TC - Tourist Commercial	40.5	0.14
WR - Woodlot Resources	4,334.2	15.2
Unknown or undesignated	256.8	0.9
No data	3,395.3	11.9
Totals	**28,544.00**	**100.05**

2.2 Physical Setting

The Slate Creek Watershed drains primarily from the west/northwest to the east. Waters Creek and Round Prairie Creek comprise the major tributaries draining north-facing sub-basins; Elliot

Creek, and some smaller tributaries drain south-facing slopes. The basin is characterized by moderate to large floodplains dominating the valleys along the lower gradient reaches contrasted by the ruggedness of the mountains in the headwaters. Elevations range in the watershed from 900 ft at the mouth, to maximum 4,385 ft in the headwaters of Slate Creek. Notable mountain peaks in the watershed include Wonder Mountain (2,560 ft) and Sloan Mountain (2,095 ft).

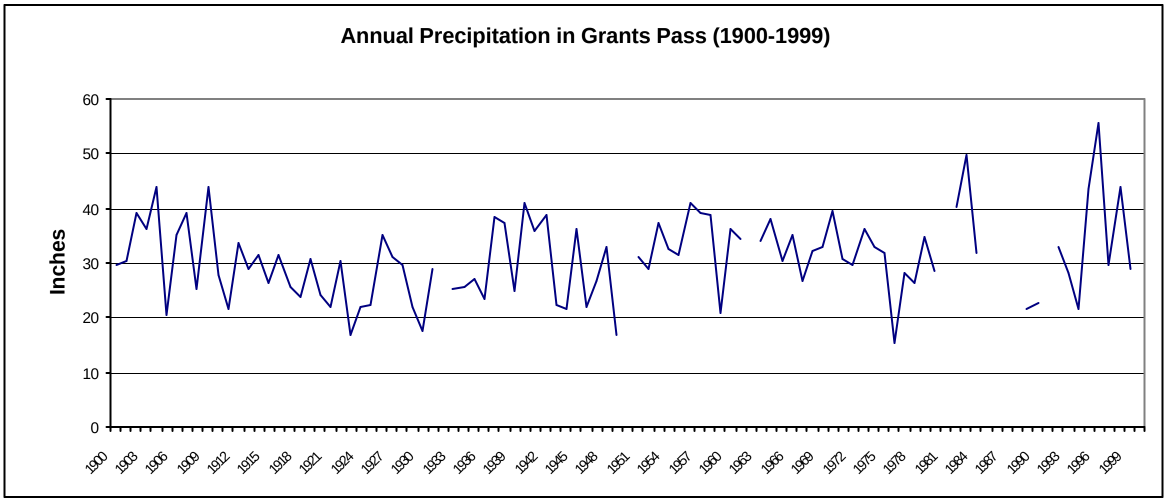
Slate Creek drains a rugged, mountainous area, and slopes throughout the watershed are steep. At higher elevations, among first-order headwater streams, gradients of over 75 % are found. Generally, slopes range from 35-60% throughout the majority of the watershed.

2.2.1 Climate

Precipitation

Annual precipitation in the Slate Creek Watershed ranges from 35 inches in the lower elevations, 35-50 inches in mid-elevations, and 50-60 inches at the uppermost elevations. For nearly 100 years precipitation was recorded in Grants Pass (Figure 3). Annual precipitation is highest in December and lowest during the summer months.

Figure 3. Annual Precipitation in Grants Pass, Oregon.



A graph of annual precipitation for Grants Pass illustrates the potential variability in precipitation for the Slate Creek area. The precipitation record displays decadal trends and annual variation. Annual precipitation in Grants Pass differs annually by as much as 28.5". Furthermore, drought periods appear frequently in the climatic record of Southern Oregon, and numerous dry and wet cycles typify the precipitation record of this region.

2.3 Cultural Setting

Introduction

Little documented historical information exists pertaining to the Slate Creek area. However this is not an indication that the area lacks notable events and occurrences. The area's predominance as a travel corridor from the interior to the coast was the catalyst for settlement and development of the area. Utilizing the abundant natural resources of the area, Slate Creek mirrors many communities in the Applegate Valley as an area influenced by ever changing customs and values.

Indigenous People

For approximately 10,000 years, southern Oregon's landscape has experienced human habitation (McKinley and Frank 1996). The Dakubetede tribe was the first recognized settlers in the Applegate watershed. A subsistent lifestyle of hunting, fishing and gathering made the Dakubetede's presence ubiquitous across the Applegate Basin.

Although no documentation exists of natives inhabiting the Slate Creek Watershed, the tan oak and its valued acorns and Slate Creek's proximity to the confluence of the Applegate River and Rogue River (which supported settlements) suggests that the Dakubetede utilized this area.

The most profound impact the Dakubetede had upon the landscape is the use of fire. The Dakubetedes used fire to manage the landscape for a board range of food uses. Frequent and low intensity fire on south facing slopes, such as those north of Highway 199 created an open expanse of forests and meadows. These expanses supported a diverse habitat for edible vegetation, along with enhanced foraging for game.

First Settlers

The natural bounty that attracted and sustained the Dakubetede was undoubtedly appealing to the frontier's men that passed through this region in the early 1880's. Peter Skene Ogden and his company of men from the Hudson Bay Company were among the first Euro-Americans to lay foot in the Applegate Basin.

In a political conquest of retaining the Pacific Northwest under British control, the goal to create a "fur desert" of the region was undertaken by trappers and fur trading companies (McKinley and Frank 1996). The rationale for removing beaver from the region was two fold: to feed the growing fashion demand of beaver skins in Europe as well to discourage and reduce the presence of American trappers and potential settlers in the Northwest; thereby the region would remain under British ownership.

Although Ogden laments about the low number of beaver in the Applegate River in his journal he writes "I now feel more than ever anxious to leave this Country being of opinion that it is not a Beaver one nor was it ever intended it should have one"(McKinley and Frank 1996). The reduction and/or removal of the small population of beaver from the Applegate and its tributaries such as Slate Creek reduced the complexity of riparian and channel habitat diversity in low-gradient reaches.

Mining

The finding of gold near Jacksonville was the catalyst for development and latter settlement in the Applegate Basin. With the announcement of gold found in the area in 1852, thousands of individuals converged upon the region. The severe disturbances associated with mining as witnessed in many sub-basins in the Applegate watershed were minimized to prospecting in the Slate Creek Watershed. Although the watershed lacks essential gold bearing geology, the area was found to contain valuable minerals. The copper and chromite rich serpentine bedrock found at the headwaters of Slate Creek supported two mines, the Ramsey and Buckeye, now both defunct. Mining still has a presence in the Slate Creek area today. Although the emphasis is no longer on metals, there are two proposed aggregate mining sites — the headwaters of Waters Creek and at the mouth of Slate Creek.

Agriculture

As quick as the population swelled in the Applegate area due to "gold fever", it vanished equally as fast. Many young men left as rumors of the next big strike circulated. Some men thou, traded the pickaxe for the plow. The Donation Land Claim Act (DLC), passed in 1850 by Congress to encourage settlement of the Oregon territory, was the catalyst for the second wave of settlement in the Applegate Valley. The DLC stated goals to settle Oregon and to foster a community of self-sufficient farmers led settlers to the fertile valley bottoms of the Applegate Valley who cleared the land for agriculture (McKinley and Frank 1996).

The other profound effect of settlement was the displacement of local natives to the coast and to eastern Oregon by 1856. Along with the natives, the once frequent prescribed fires vanished. The combination of removing native's fires with growing emphasis by new settlers to suppress all fires has continued effects to forest health and management.

Transportation

The remoteness and rugged terrain of southwest Oregon made it difficult for transporting provisions and material to miners and early settlers. An overland trail from Crescent City to the Rogue Valley provided an inland passage. The trail utilized the lower portion of the Applegate River, with a ferry crossing at the mouth of Slate Creek. By 1858, a stage road following present day Route 199 provided quicker and easier passage to the coast. As a result, of the new travel corridor, Wilderville was established. The road was the catalyst for development and growth in the Slate Creek area with an opening of a post office and the Junction House, a place for rest and food for weary and hungry travelers.

With advancements in technology and increasing population density on the West coast, a railroad line was constructed from Portland to Sacramento in 1887. Grants Pass and Medford became major thoroughfares, and consequently population in the Rogue Valley increased. As a result, the need for a safe and efficient route from Grants Pass to the coast necessitated a rail line between the areas. The railroad reached as far west as the town of Wonder where it prematurely terminated with the onset of World War I in 1911.

Undaunted by the failed railroad, John T. Robertson persisted as founder and owner of the Wonder General Store. Opened in 1902, Robertson's neighbors often joked where his customers would come from to patronize his store, hence the area's name, Wonder. With the completion of Route 199 in the early 1920's, John T. Robertson no longer wondered where his customer base would stem from; Highway 199 would become the major thoroughfare to the coast from the inland valleys' of southern Oregon.

Timber

As the earliest miners dug for precious metals and settlers cleared the land for farming, logging provided much needed building material. Large ponderosa and sugar pines were selectively targeted, as they were the favored building materials. Logging was localized and selective in the area. Small scale logging would continue to occur in the Applegate valley until the late 1940's. The reason for the lack of large commercial timber cuts in the area stemmed from the scattered distribution of trees, the inaccessibility of the stands due to rugged conditions, along with the notion that timber in this area was considered of poor quality (McKinley and Frank 1996).

The nation-wide housing boom fueled by solders returning from the second War World placed an unprecedented demand on timber production on public lands. This demand coupled with an improved road infrastructure and the application of new technology capable of logging the steep Siskiyou Mountains, southern Oregon was primed to become a major timber-producing region (McKinley and Frank 1995). Siskiyou National Forest timber records show that by 1947 three large commercial sales on federal lands had already occurred in the Slate Creek watershed (Cheney/Slate WSA 2002). The first, in 1940 was of one hundred and twenty acres in the Ramsey drainage. The following year, 1941, eighty acres were harvested in the Elliott Creek watershed. In1946 one hundred and twenty acres were cut in the headwaters of Newt Gulch. These first commercial cuts in the Slate Creek Watershed were the beginning of the large-scale timber harvesting in the area.

With the onset of the fifties and sixties clear cutting became the preferred method in harvesting timber on public lands (McKinley and Frank 1996). Clear cuts provided a convenient and inexpensive means of harvesting large volumes of timber. By 1970, the BLM's Medford district's (which manages BLM land in the Slate Creek Watershed) allowable cut reached a high of 274 billion board feet, one-quarter of the allowable cut for the entire state of Oregon (McKinley and Frank 1996). Timber harvests on this scale necessitated a massive increase of the road network. The ambitious development of the region's timber resources was demonstrated by the construction of 184 miles of logging roads in the Slate Creek Watershed by 1980.

As the 80's came to a close, the effects of liquidated commercial-sized timber, increased influence of global markets, listing of the northern spotted owl and the rise of public input on federal lands severely curtailed timber production on public lands in the Pacific Northwest.

Slate Creek Today

These days, the majority of individuals experience Slate Creek via Highway 199. Beyond the hum of the freeway, is a rural community set in a pastoral and woodland setting. The tranquil setting attracts retirees, daily commuters and small business owners. The original post office still exists at Wilderville and the Wonder General Store still sells refreshments to travelers on the Redwood (US 199) Highway.

3.0 TERRESTRIAL ENVIRONMENT

Assessment of the terrestrial environment begins with the historic and current vegetation patterns in the watershed. This includes vegetation series, acres of old growth, and current forest structure. Following the forest vegetation condition, the assessment presents wildlife species of concern and habitat requirements.

3.1 Vegetation Characterization

Method

The Bureau of Land Management (BLM) provided existing vegetation classes for the Slate Creek Watershed, encompassing BLM, U.S. Forest Service (USFS) and privately managed land. Data were derived from 1996 satellite images. The BLM condition classes, used to classify BLM and privately managed land, were grouped by dominant form (i.e., grass, shrub, tree form, etc.) and tree size. The ten classes are non-vegetated, grass/forb, shrub, hardwood, hardwood/conifer, early (stand replacement disturbance 0 to 5 years previous), seedling/sapling (0 to 4.9" in diameter), poles (5to 10.9" in diameter), large poles (11 to 20.9" in diameter), and mature (21" and greater in diameter). The hardwood/conifer class was used when a mix of both kinds of trees was present and insufficient information exists to distinguish the dominant life form. Sites such as these have generally been harvested in the past, resulting in a size class of 8" or less. Such sites generally function ecologically as early seral stands.

The two sources of data (BLM/private and USFS) used different protocols and definitions for collecting and classifying information. In order to standardize, the data were categorized into rough seral stages. Table 2 displays the vegetation classes defined by the USFS and BLM and the resulting combined classification. Table 3 defines the vegetation categories.

It is important to note that the success ional stage descriptors employed by the BLM and Forest Service for the purpose of the Slate Watershed analysis, as well as those presented in Tables 1 and 2 are not ecologically based. Consequently, the vegetation classes are not indicative of developmental processes leading to current structural attributes. Additionally, total acreages for each of the current condition classes are approximate due to inconsistencies in data, and errors associated with data interpretation.

The term "mature" has been used here in place of the term "old growth" due to the lack of consistency with which the term old growth is applied. Structural and other characteristics that define old growth were not addressed in the data provided, and therefore the term mature is favored.

Table 2. Combined BLM and USFS Condition Classes.

Combined Class	BLM	USFS
Non-Vegetated	Non-Vegetated	Non-Vegetated
Grass/Shrub	Grass or Forb Dominated/Shrub Dominated	Grass/Shrub
Hardwood	Hardwood Dominated	Hardwood
Early	Early/Seedlings/Sapling	NA
Early/Mid	Poles	Poles
Mid	Mid	Large Poles
Mature	Mature/Old Growth	Mature

Table 3. Vegetative Condition Classes and Descriptions.

Non-Vegetated	Never vegetated or never will be
Grass/Shrub	Grass/ shrub-dominated, no tree association
Hardwood	Dominated by hardwoods
Early	Conifers 0 - 5 years old or > 5 years old and 1 - 4.9" DBH
Early/Mid	Conifers 5 - 11" DBH*
Mid	Conifers 11 - 21" DBH
Mature	Conifers > 21" DBH

*DBH- diameter at breast height

The percent of each category represented were calculated and existing vegetation conditions were compared, when possible, with reference conditions. Reference conditions provide a sketch of forest vegetation that existed prior to significant Euro-American modification. The reference conditions presented by BLM were developed from the Oregon and California (O&C) revestment notes, which characterized vegetation in every other section in the watershed. The reference conditions within the rest of the watershed are assumed to be similar to those represented by the vegetation notes. The revestment notes provide inventories undertaken circa 1920 in order to determine the economic worth of the land, timber volume and how the land should be used.

The revestment notes provide sufficient data to approximate major plant series and to estimate the extent of fire occurrence. The survey notes described conifers present in the overstory and understory, the amount of board feet present at that time, the major hardwood species (madrone, tanoak, etc.), the dominant shrub species such as *Ceanothus* or manzanita, and whether or not there were any recent signs of fire events. The notes provide little information on seral stages.

Major Plant Series

Basal area is used as a relative measure of site productivity. For example, an area that can support 200 ft^2/acre of basal area is more productive than an area that can support 100 ft^2/acre of basal area. Differences in site productivity, in turn, occur as a result of local geology, soils, hydrology, aspect and microclimate variations. Basal area in plant series is derived using all vegetative species. It is not limited to the tree species for which that series is named. The following descriptions indicate the relative productivity of each series in the watershed.

Douglas-fir is the most common tree species in southwestern Oregon. Sites within the Douglas-fir series average 254 ft^2/acre (Atzet and Wheeler 1984). Douglas-fir tends to produce conditions that promote fire within the range of the series. The species is self-pruning and often sheds its needles, characteristics that tend to increase the rate of fuel buildup (Atzet and Wheeler 1982).

The **Jeffrey pine** series is confined to areas where ultramafic rock (serpentine, etc.) has directly influenced the mineral makeup of the soils (Atzet and Wheeler 1982). Serpentine areas dominated by Jeffrey pine may have the lowest productivity of any conifer series in the Klamath Province with an average basal area of 83 ft^2/acre (Atzet and Wheeler 1984). Although these areas are not considered important in terms of timber production, they are floristically diverse, supporting many special status plants. Jeffrey pine-dominated sites also offer unique habitats for a variety of wildlife species.

Forests in the **ponderosa pine** series average approximately 170 ft^2/acre of basal area. This series is relatively rare because ponderosa pine does not often play the role of a climax dominant (Atzet and Wheeler 1984), although in the presence of a natural fire regime the species may dominate the canopy indefinitely. The ponderosa pine series tends to occur on hot, dry aspects that burn frequently. Ponderosa pine regeneration is restricted via a reduction in the number of low intensity fire events. Due to the success of fire suppression over the last 70 years, overall occurrence of this series has decreased in the watershed (Atzet and Wheeler 1982).

In general **tanoak** sites are considered productive. Average total basal area for this series is 262 ft^2/acre (Atzet and Wheeler 1984). The tanoak series occurs where both soil and atmospheric moisture are plentiful. The series occurs most frequently on cooler aspects with fine textured soils (Atzet and Wheeler 1984). Fire is the principal inhibitor of dominance of individual tanoak trees (Tappeiner et al.1990). Due to the success of fire suppression efforts over the last 70 years, overall presence of this species has increased in the watershed.

The **Port-Orford cedar** (POC) series basal area averages about 166 ft^2/acre on utramafic soils compared to 401 ft^2/acre on non-ultramafic soils (Atzet and Wheeler 1984). Although not formally mapped, individual Port-Orford cedar or small groups of trees are found in the upper reaches of the Slate Creek Watershed. Port-Orford cedar requires high daytime humidity and is associated with stream channels and lower slope positions. The species is able to tolerate the chemical composition of ulramafic soils and can compete well in such areas as long as the humidity criteria are met. Species productivity associated with ultramafic soils is lower than that associated with non-ultramafics. Port-Orford cedar is susceptible to an exotic pathogen, *Phytophthora lateralis* (PL), which is not known to be present in the Slate Creek Watershed. POC downstream from or adjacent to PL infestations are at risk.

3.1.1 Reference Conditions

Composition

Historically, the most common plant series in the Slate Creek Watershed was Douglas-fir, which occupied 82% of the watershed (approximately 10,800 acres) (Figure 4). The Jeffrey pine series was the next most common at 10% of the inventoried acres (approximately 1,400 acres). The Jeffrey pine series was found in the western portions of the watershed in the upper reaches of Slate Creek and in the Cedar Log and Ramsey Creek drainages. The ponderosa pine series was found on 4% of the acres surveyed (approximately 600 acres). The series was found primarily along the northern boundary of the drainage, however small amounts (less than 80-acre parcels) were found along the valley bottom within a mile of Slate Creek. Non-forest areas were small, generally less than 80 acres, located primarily in the eastern portion of the watershed. There was one occurrence of the tanoak series in the watershed, which occupied about 0.3% of the inventoried acres (Figure 4).

Forest Structure

In 1920, approximately 12% of the Slate Creek Watershed supported forest with late-successional (mature) attributes. All late successional forest surveyed was associated with the Douglas-fir plant series.

It is uncertain how much of the drainage was in the early/mid and mid successional stages in 1920, but it is believed that the amount of acres in these stages was less in 1920 than what exists today. This is based on the effects of fire exclusion and the regeneration, growth, and development characteristics of the tree species in question. Data pertinent to early, hardwood, grass/shrub and non-vegetated areas were not available. However, based on plant series data, the decrease in the percentage of mature forest and probable encroachment of forest vegetation into non-forested areas, it is assumed that early and hardwood categories have increased while the grass/shrub and non-vegetated areas have decreased.

3.1.2 Current Conditions

Composition

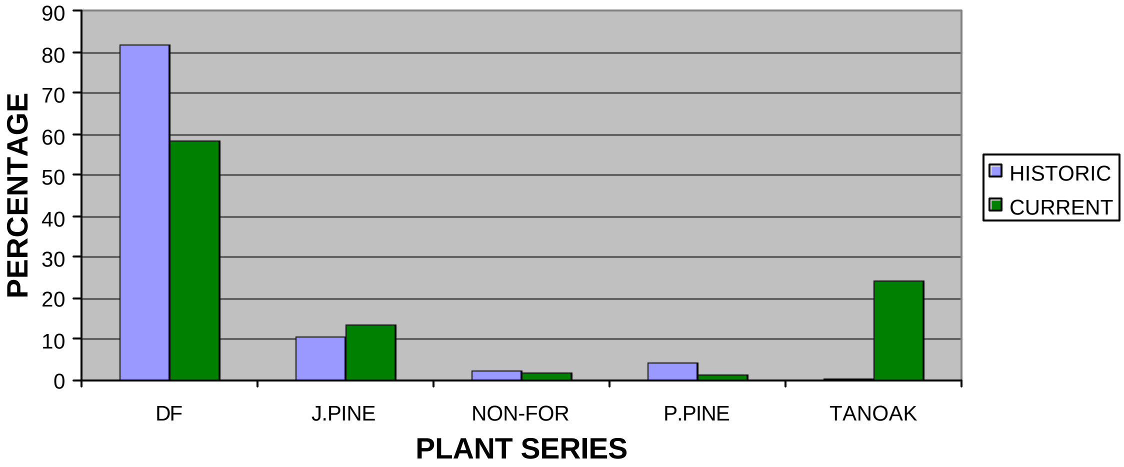
Presently, the most common plant series in the Slate Creek Watershed is still the Douglas-fir series, which occurs on approximately 58% of the landscape. Although Douglas-fir is still the most common series, its presence has declined since the 1920s (Figure 4). Decline in Douglas-fir due to fire exclusion and harvest practices has allowed understory species such as tanoak to prosper. Accordingly, acres of tanoak have increased significantly. The series has increased from approximately 0.3% to approximately 24%.

The Jeffrey pine series has increased slightly from approximately 10% historically to approximately 13% currently. Jeffrey pine continues to dominate a somewhat consistent amount of acres on the landscape due to the species' ability to compete and survive on serpentine soils.

The reason for the decrease in land deemed non-forested is not clear. The percent of non-vegetated land decreased from approximately 2% to approximately 1% (Figure 4).

The ponderosa pine series has nearly disappeared from the Slate Creek Watershed. Historically, the series occupied about 4% of the drainage. Today that number has decreased to approximately 1% (Figure 4). Ponderosa pine requires frequent low intensity fire in order to compete successfully. Because ponderosa pine occurs naturally in areas that receive little precipitation and water. Lack of sunlight, is the factor most likely to limit growth and development. Frequent, low intensity fires historically burned understory vegetation, which allowed for ample growing space for established trees. In addition, when gaps were created due to windthrow, frequent low intensity fires would keep rapidly regenerating species at bay until ponderosa seedlings were established. Once in place, the ponderosa pine seedlings grew quickly during the fire-free interval, and became well established, able to survive the next fire. Many areas in which ponderosa pine has occurred in the past have shifted to Douglas-fir with the advent of fire exclusion.

Figure 4. Comparison of 1920 to 1996 Forest Plant Series.

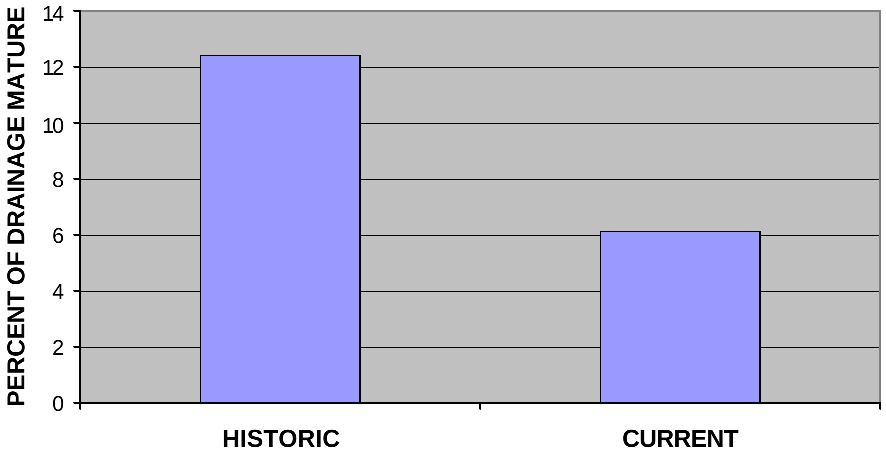


Forest Structure

The vegetative and structural conditions of the forests in the Slate Creek Watershed have changed frequently in synchrony with historic disturbance patterns. Disturbance has played a vital role in providing a diversity of plant series and seral stages both spatially and temporally. The presence of fire, insects, disease and periods of drought has resulted in tree mortality, a crucial part of the forest ecosystem.

In 1920, approximately 15% of the Slate Creek Watershed supported forest stands with late successional (mature) characteristics. Currently, late successional forest covers about 6% of the drainage (Figure 5). Most mature forest stands are found within the boundaries of BLM managed land, although small patches of mature forest are present on USFS land.

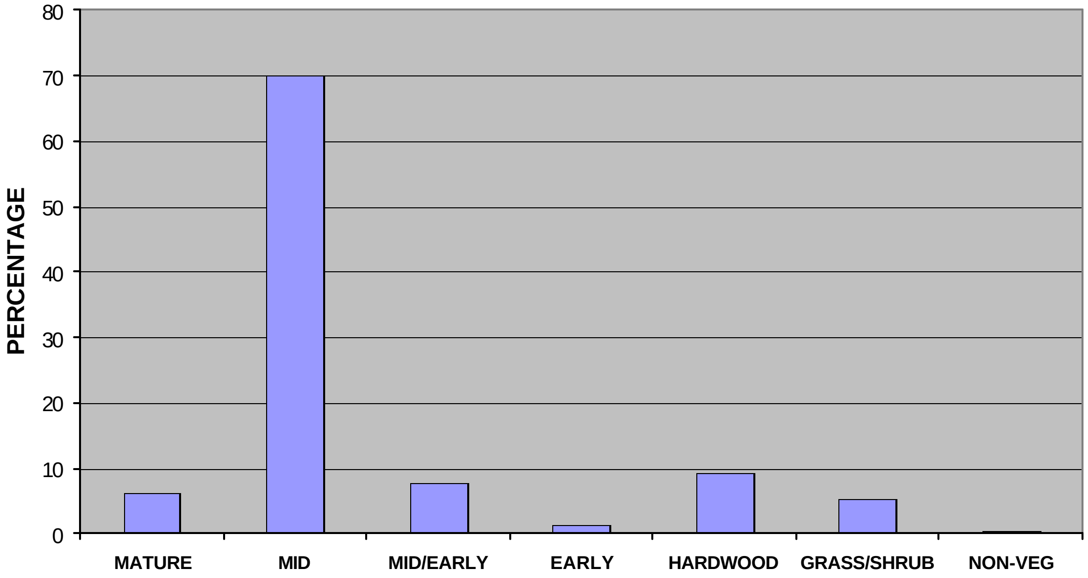
Figure 5. 1920 and 1996 Comparison of Late Successional Forest.



The great majority of the Slate Creek Watershed (approximately 69%) is occupied by forest stands in the mid-successional stage. As previously mentioned, forest stands in mid or pole stages were not recorded during the 1920 surveys, but the belief is that the acreage was less historically than what exists today. This is partial due to the removal of mature stands and the encroachment of hardwoods. Fire exclusion during the last century has permitted dense pole stands to develop in parts of the watershed. Subsequently, ecologically important shade intolerant early and mid-seral species, such as ponderosa pine, pacific madrone, and California black oak have crowded out in many areas. When the stands become too dense, forest health wanes.

Early and early/mid seral stages (hardwood or grass/shrub and non-vegetated areas) were not documented during the surveys of 1920. However, 1996 surveys indicated that approximately 7% of the drainage supports mid/early seral stands, 1% supports early seral stands, 9% supports hardwood stands, 5% is grass/shrub, and 0.4% is non-vegetated (Figure 6).

Figure 6. Percent of Successional Forest Stages in the Slate Creek Watershed.



Fire Suppression and Timber Harvest

Timber extraction and fire exclusion are the primary factors influencing the current vegetation mosaic. Traditional timber harvesting tends to simplify forest structure. Clearcutting and selective harvesting often lead to the regeneration of even-aged or single species stands, which lack the heterogeneity of natural stands. While timber harvest often decreases the complexity of forest stands, fire exclusion has provided increased complexity. The forest ecosystems of the Slate Creek watershed rely on regular fire disturbance to maintain species composition and structure. Fire suppression allows fire intolerant and shades tolerant species to reach the upper canopy at the expense of fire tolerant, shade intolerant species, such as ponderosa pine. Once shade tolerant species have established dominance in the upper canopy, their progeny may acquire growing space in the lower and mid stories. This crowds out shade intolerant species and creates vertical complexity of the stand.

Shifting stands toward less frequent but more intense disturbances has contributed to the severely overstocked conditions. Subsequent impacts on growth and vigor have increased the potential for damage or mortality from bark beetles and the likelihood of killing of mature conifers from below due to unchecked encroachment by understory vegetation. In addition, fire suppression creates conditions conducive to the development of stands with high percentage of hardwoods. This suppression decreases the likelihood of establishment and growth of shade-intolerant but otherwise well-adapted species such as ponderosa pine (Main and Amaranthus 1996).

In the Slate Creek Watershed the most dramatic shifts away from the historical landscape patterns include a decline in the amount of mature (late successional) forest cover, a dramatic increase in the area occupied by tanoak at the expense of coniferous species, (particularly ponderosa pine), a general shift away from more open forest structure and toward much greater tree per acre densities. The changes have also manifested in the substantial increase in the amount of potential fuel for future wildfires.

Fire History

Based on 1920 notes, approximately 14% of the inventoried acres (1,840 acres) had some signs of a fire event. In the Slate Creek Watershed, all fire events except one in the ponderosa pine series were within the western 25% of the drainage. The burn in the ponderosa pine series was along the valley bottom, within a half-mile of Slate Creek. All other fire events were located within the upper reaches of Slate Creek, Cedar Log Creek, and Ramsey Creek. Overall, the Douglas-fir series experienced the greatest amount of acreage burned (1,080 acres). The burns were divided into four types: stand-replacing fires (440 acres), mosaic burns in serpentine-influenced soils (400 acres), mosaic burns (360 acres) and an underburn on one 40-acre parcel. The stand-replacing fire took place along the western ridgetop at the top of the Ramsey and Cedar Log Creek drainages. The mosaic burn in the serpentine-influenced Douglas-fir and the Jeffrey pine series and other burns in the non-serpentine-influenced Douglas-fir series occurred throughout the upper Slate Creek Watershed. The underburn occurred in the southwest quarter of the southwest quarter in a 40-acre parcel that retained late-success ional habitat after the burn. This 40-acre parcel was the only late-success ional habitat inventoried in the watershed.

Timber Harvest

Refer to section 2.3 (Timber) for a summary of historic logging activities in the Slate Creek Watershed.

3.2 Wildlife Habitat and Species

Upland

The upper Slate Creek Watershed is predominately federally managed coniferous forest with a large hardwood component (BLM 1996). Hardwoods such as: California black oak (*Quercus kelloggii*), Oregon white ash (*Quercus garryana*), tanoak (*Lithocarpus densiflorus*), and California hazel (*Corylus cornuta*) supply food for a variety of wildlife species.

Prior to landscape scale disturbances such as mining and timber harvest, old-growth forests within the upper Slate Creek Watershed occupied 12 % of the watershed, offering abundant habitat for species such as the Northern spotted owl (*Strix occidentlis*) and Pacific Fisher (*Martes pennanti*). Remaining stands of old-growth still present in the watershed are located in the Waters, Round Prairie, Elliot and Upper Slate Watersheds (BLM 1996).

Due to timber harvest, road building and mining, older contiguous habitats have shifted into younger early and mid seral dominated habitats. Less than 10% of the watershed is currently composed of old growth/mature stages; 70% is in mid (poles/saplings and young forest stages) successional stage (see Vegetation section 3.1)

Valley Bottom

Habitats on the valley floor include grasslands, oak savannahs, pine forest, chaparral, and riparian (BLM 1996). The majority of the native habitats associated with these valleys were replaced by agricultural lands and rural residential properties.

Riparian areas located within these valley floors are a main source of habitat for many species such as the beaver (*Castor Canadensis*), river otter (*Ultra Canadensis*), and muskrat (*Encarta bioethical*), which were historically prevalent through out the watershed (BLM 1996). Active beaver sign was discovered in the first 4.5 miles during the 1996 ODFW Habitat Survey. Up to River Mile (RM) 5 beaver activity was noted by the surveyors. Residents during the assessment process have reported active beaver presence in Newt Gulch and Upper Slate Creek.

3.2.1 Special Protection Species

The Northern spotted owl (*Strix occidentlis*) is the only species listed under the Endangered Species Act (ESA) known to inhabit the watershed. Since the mid 1970s, Northern spotted owl surveys have occurred within the watershed (BLM 1996). Within the Elliot and Knight Creek drainages 100-acre core habitats were established in order to protect active owl sites (BLM 1996). Elliot and Round Prairie Creek drainages support Northern spotted owl roosting and foraging habitats (BLM 1996). Waters Creek and Upper Slate drainages provide suitable owl dispersal habitat (canopy of 40 % of greater) (BLM 1996).

Other ESA listed species such as the marbled murrelet (*Brachyramphus marmoratus*) may exist but have not been documented (BLM1996). Surveys for the marbled murrelet have detected no birds since surveys began in 1993 (BLM 2001). No lands within the Slate Creek Watershed were identified as critical habitat, but agencies are still required to survey within 50 miles of the coast (BLM 1996). The BLM Medford District and the Siskiyou National Forest are currently in the development and validation of a landscape-scale sampling effort to determine if marbled murrelet surveys are necessary farther than 25 miles inland (BLM 2001).

Other special status species that historically and presently inhabit the Slate Creek Watershed are listed in the Appendix B.

Before any ground disturbing activities within proposed timber sales on federal lands, many surveys are conducted. Presently, Red Tree Vole (*Aborimus longicaudus*), salamander, and mollusk (snails and slugs) surveys are conducted according to protocol standards (BLM 2001).

4.0 AQUATIC ENVIRONMENT

This section describes the past and current condition of the aquatic resources in the Slate Creek Watershed. The intent of this analysis is to establish linkages between current aquatic, hillslope and riparian conditions. The assessment starts with the upslope processes of runoff and erosion. Riparian zone conditions and functions are then presented, followed by water quality conditions. The channel condition assessment describes stream processes and integrates findings from the upslope and riparian assessments.

Following the physical description of the aquatic environment, section 4.6 (aquatic species) provides the fisheries communities found in Slate Creek and their habitat requirements. All information presented is then synthesized to conclude how channel structure and water quality influence aquatic habitat and salmonid use in the Slate Creek Watershed.

4.1 Geology and Soils

Regional Geologic Setting

The Slate Creek Watershed lies within the northwest portion of the Klamath Geological Province. The Klamath Province encompasses the region from Roseburg, OR to Redding, CA and from the Pacific coast east to the Bear Creek Valley (Figure 7). This province formed between 345 and 160 million years ago. During this period the oceanic plate was being forced under the continental plate, a process referred as subduction. Small slices of the oceanic plate were scraped off and added to the overriding continental plate. These slices are called accreted terrain and decrease in age westward. These slices formed four distinct rock belts. The two western belts run through Josephine County, including Slate Creek.

The Klamath Geologic Province has experienced a high degree of metamorphism and intense structural deformation as a result of compressional and extentional faulting. While the Klamath Province was forming compressional pressure caused the continental rocks west of the oceanic plate to buckle and fold. The compressional pressure also caused the rock formation to break and fracture. These breaks and fractures caused by compressional stress are known as thrust faults. The ultramafic serpentinite was injected along these thrust faults, forming the ultramafic terrain of upper Slate Creek. As the compressional pressure decreased the oceanic plate began to recede from the continental plate. During the recession liquid rock (magma) was forced into the cracks due to the decrease in pressure. This magma solidified, forming the coarse grained intrusive rocks found in Slate Creek.

Subsequently, the entire region underwent a 23,000-ft uplift. The uplift created high gradient terrains resulting in high erosion rates. Stream and rivers down cut through the elevated formation creating the steep rugged terrain in Slate Creek and surrounding areas.

Local Geologic Setting

Figure 8 shows the local geology of the Slate Creek area. The Slate Creek Watershed is primarily composed of 200 million year old metasedimentay rocks consisting of slatey siltstone, sandstone, and shale. At one point in geologic history these rocks were unconsolidated sand and mudstone lying at the bottom of the ocean.

During compressional plate tectonics as the oceanic plate subducted beneath the continental plate these sediments were heated and pressurized enough to adjust the minerological, chemical and structural makeup of these sediments (metamorphism). Metasedimentary rocks occupy ¾ of the Slate Creek Watershed and define the eastern border of the Slate Creek Watershed. Metatsedimentary rocks define the hillslopes of Round Prairie, Elliott Creek, Middle and Lower Slate.

Westward in the watershed, ultramafic and gabbroic rocks define the geology. Mafic means dark and ultramafic describes rocks that are composed of dark minerals. These rocks are dark because they are created from the oceanic crust, which is primarily primitive basalt. The predominant ultramafic rocks in Slate Creek Watershed are peridotite and serpentine. Peridotite is a coarse grained rock that cooled beneath the earth's surface. Because peridotite forms underground at depth, it is not stable at the earth's surface. Once peridotite is exposed to surface conditions it weathers into serpentine. The ultramafic serpentinite is found along highly sheared and dissected fault zones. Consequently, the serpentinite and serpeninized peridotite are distributed as narrow, highly sheared stringers and are found in Upper Slate and in Slate headwater areas. The primary mineral in peridotite is olivene with accessory pyroxene, plagioclase or chromite. These minerals often leach into the groundwater.

The intrusive gabbroic rocks formed after the serpentinite. Gabbro refers a group of dark colored rocks that never reached the earth's surface, thus cooled at some depth underground. Basalt has the same chemical composition as Gabbro. The difference is that basalt forms above ground thus cool at much faster rate. The rate of cooling determines the crystal size. Since Gabbro cools underground it has much slower cooling rate and has more time to form large crystals. Gabbro is a basic rock, meaning it has relatively low silica content. Basic rocks are relatively rich in iron, magnesium, and/or calcium. Similar to peridotite, these minerals leach into the groundwater as the rocks weather and dissolve.

As the uplifted terrain eroded bench deposits consisting of gravel silt and poorly sorted sand formed terraces along Slate Creek. These deposits can be thicker than 40 meters. More recently, erosion and flooding deposited sand and silt in low gradient areas, creating floodplains.

Soils

Soil types and associated characteristics for Josephine County are documented in the Soil Survey of Josephine County Oregon (1983). The soils found in the Slate Creek Watershed are highly dependent on the parent rock from which they weathered. The soils are a direct reflection of the geology and often define the subsurface groundwater availability and quality.

Slope Stability and Erosion Potential

Slope stability is defined as the resistance of a slope to fail. Failures can occur gradually, as earth flows or rapidly as landslides or debris flows. Failure can be a result of natural processes under the force of gravity assisted by running water, or by modification of the slope due to road building and mining. Erosion potential refers to the soil resistance by mechanical processes such as flooding or high precipitation.

Figure 9 is a map of the natural soil erosion and landslides potential. Natural potential was defined by the soil type and slope. Areas prone to extreme erosion within Slate Creek are soils derived from the ultramafic serpentinite forming on slopes greater than 55 %. Soils forming from serpentinte have a low infiltration rate and tend to hold water once saturated. Due to the increased weight and liquidification of the soils there is a higher risk of mass wastage and slope failure. Additionally, the high chromite content and low calcium greatly reduces vegetation establishment. Consequently, vegetation offers little protection against erosion. Most of ultramafic soils are found in the upper west portion of Slate Creek. Areas at high risk for erosion were defined by ultramafic soils on slopes ranging from 35-55 %, and metamorphic rock on slopes greater than 55 %. The moderate erosion potential areas were defined by metamorphic rock on slopes ranging from 35-55 %.

Human activities can accelerate hillslope erosion. Activities that reduce vegetative cover, expose and/or compact soil, reduce soil depth, or concentrate water can increase erosion rates. Furniss et al. (1991) concluded that roads contribute more sediment than all other forest activities combined. Amaranthus et al. (1985) found, on the Siskiyou National Forest, that erosion rates from roads was 100 times higher than in undisturbed areas. The study also found 98 % of landslides occurred on slopes greater than 50 %. Figure 9 highlights roads in the extreme and high erosion potential areas. These locations are considered the most sensitive to increased erosion.

In Slate Creek, aerial photographs from the 1940's to present provide information on hillslope stability and erosion processes. The photographs did not display landslides, indicating that landslide potential is low in the basin. Conversely, debris flows (rapid transport of soil and water) were common in the 1950's and 60's. The debris flows occurred in the moderate to high gradient stream reaches. In nearly all cases, debris flows were associated with riparian timber harvest and road building. Streams used as a yarding corridor or streams with roads within the riparian area destabilized during flood events, initiating debris flows. During these events large volumes of sediment entered the channel network and scoured the stream channel carrying the debris flow. With the reduction in road building and riparian harvest, incidence of debris flows has greatly decreased in the Slate Creek Watershed.

4.2 Hydrology

The hydrology section addresses the dominant hydrologic characteristics in the watershed. Specifically, road densities, vegetation patterns, irrigation uses, and historic flow records were examined to characterize condition of winter peak flows and summer low flows, a.k.a baseflow. Each factor will be discussed individually, and then combined to determine any possible cumulative effects.

Dominant Hydrologic Characteristics

The Slate Creek Watershed receives an average annual precipitation ranging from 35 inches near the mouth to 60 inches near the headwaters. Most of the watershed is within the rain-dominated zone, 6% lies in the transient snow zone (elevation 3500-5000 feet).

Accordingly, Slate Creek is a rain dominated hydrologic regime; snow melt runoff accounts for very little flow. Examining the ratio of January to June flow for the years of record (1944-1966) confirms this assertion. On the Applegate River at the Wilderville gage, the June flow was 32 % of the January flow, while the June flow in Slate Creek was 6 % of the January flow. Snow melt accounts for the higher percent in the mainstem Applegate. Additionally, according to the soil survey of Josephine County, soils in nearly 75 % of the watershed have very slow infiltration. The combination of rain dominated hydrologic regime and low infiltration rates results in a "flashy hydrologic regime". This regime more closely resembles a coastal basin than other streams in the Applegate.

Peak flows of record (1955, 1964, 1974, and 1997) generated from rain on snow events (warm intense winter rains on an existing snow pack). Contrary to high winter flows, early autumn brings low flows at the end of a dry summer. Many of the upper slope streams do not have surface flow during this time. Small springs are scattered across the watershed but do not provide enough surface flow during the dry season to be significant at the watershed scale. However, where they occur they provide significant local relief from the otherwise dry summer environment.

United States Geologic Survey (USGS) maintained a stream gage on Slate Creek near Wilderville from 1944 to 1967. The gage recorded daily flows providing statistics on peak and base flows (Table 4). Return interval is the average number of years within which a given event will be equaled or exceeded. For example 4000 cubic feet per second (cfs) recorded in 1946 is expected to occur every 5 years.

Table 4. Slate Creek Peak and Low Flows at Wilderville Gauging Station.

Water Year & Date of Annual Peak Flow	Peak Flow (cfs)	Return Interval	Annual Low Mean Daily Flow (cfs)	Month of Annual Low Mean Daily Flow
1944 10/24/43	865	1.1	0.7	Aug. & Sept.
1945 2/8/45	1530	1.2	1.1	Aug. & Sept.
1946 12/28/45	4000	5.0	0.6	September
1947 11/22/46	2080	1.5	0.8	September
1948 1/6/48	2940	1.8	1.5	September
1949 2/22/49	1810	1.4	0.8	Aug. & Sept.
1950 1/21/50	1810	1.3	0.9	September
1951 10/29/50	4020	6.7	0.7	September
1952 2/1/52	2230	1.7	1	Aug. & Sept.
1953 1/18/53	3820	2.9	1.8	October, 1952
1954 1/27/54	3580	2.5	1.6	September
1955 12/31/54	714	1.1	0.9	September
1956 12/21/55	3920	3.3	1.1	Aug. & Sept.
1957 2/26/57	3200	2.0	0.3	August
1958 1/29/58	3410	2.2		
1959 1/12/59	3940	4.0		
1960 2/8/60	1800	1.3		
1965 12/22/64	4650	20.0		
1966 1/3/66	4450	10.0		

Note on [1]: Data provided by USGS via the internet
Note: Calculations of the recurrence intervals was based on Gumbel Extreme Value Distribution

4.2.1 Peak Flows

The Slate Creek Watershed was divided into seven subwatersheds (Figure 1) for the evaluation of peak flow alteration. The assessment focuses on the effects of road building, vegetation management, and agriculture use.

Roads and Vegetation

Vegetation recovery of harvest units and road acres were assessed to describe hillslope runoff conditions. Recovery in this analysis is considered “hydrologically recovered.” Harvest units are hydrologically recovered when transpiration rates and canopy cover returns to near preharvest levels. Please refer to Appendix C for a description and calculations involved in determining hydrologic recovery.

Table 5 displays the subwatersheds, unrecovered vegetative acres and road acres. All road acres were considered unrecovered. The final column “percent of watershed unrecovered” is sorted from the subwatersheds with the highest unrecovered acres to the least.

Table 5. Road and Vegetative Recovery.

Subwatershed	Total Acres	Road Acres	Road Density[1]	Vegetative Unrecovered Acres	Acres of Road and Unrecovered Vegetation	% Watershed Unrecovered
Lower Slate	3701	52	4	666	717	19
Upper Slate	8810	134	4	1344	1478	17
Middle Slate	3296	83	7	371	454	14
Elliot Creek	2147	51	6	221	271	13
Waters Creek	4426	73	4	467	540	12
Slate Headwaters	3900	34	2	422	456	12
Round Prairie Creek	2142	20	3	207	227	11
Total	**28421**	**447**		**3698**	**4145**	**15**

[1] Miles of road per square mile of drainage

Interpretation

In a rain dominated hydrologic regime, soil moisture recharge begins in the fall and becomes complete through the winter season. Subbasins with high unrecovered acres attributed to harvest management and roads are likely to experience increases in runoff early in the wet season, during the first storms of the year. Timber harvesting reduces evapotranspiration, increasing prior soil moisture so that soil recharge occurs earlier in the year. Keppler et al. (1990) state, " soil on a logged watershed has a relatively high moisture content at the onset of the rainy season, requiring less rainfall to recharge moisture levels, thus allowing more precipitation to become available for runoff." Additionally, increases in peak flow are more likely to occur in the smaller (<2 yr. return interval) storm events. Harr et al. (1975) found that with increasing storm size differences between harvested and non-harvested watersheds became less significant, responding nearly alike hydrologically. Wright et al. (1990) further states, "For larger storms, interception would be less significant because the canopy quickly reaches water holding capacity."

Research suggests that flow alteration begins when 20-30 % of the watershed is in unrecovered condition. All subbasins are below 20 % unrecovered. Lower Slate ranks the highest at 19 percent. In upper Slate and Slate headwaters aerial photographs and geologic maps indicates that ultramafic soils are responsible for a significant percentage of early seral vegetation. Since early seral vegetation represents reference conditions, these acres are considered recovered. Hence, the percent unrecovered acres for Slate Headwaters and Upper Slate is overestimated.

Research has also documented that watersheds with road acres in excess of 12 % of the watershed area can show impacts to peak flows (OWEB 1997). Furthermore, the National Marine Fisheries Service (NMFS) (1996) established a criteria of 2 miles of road per square mile of drainage or less to be properly functioning. Based on the road density information, roads comprise less than 3 % of the subbasins. However, all subbasins exceed the NMFS criteria. Middle Slate and Elliot Creeks maintain the highest road densities at 7 and 6 miles of road per square mile of drainage.

Agriculture and Rural Development

Agricultural practices and rural development have the potential to increase peak flows. The water conveyance due to road development, compaction and ditching of drainages can increase flows. Channelization or ditching of small streams, to drain the land surface for crop production, carries the water away from the land at an accelerated rate. Compaction and development directly alter the surface water conveyance network and infiltration rates. When an area is compacted, the immediate hydrologic effect is to increase the area of low or zero infiltration capacity and to increase the efficiency or speed of water transmission (Dunne and Leopold 1978).

Both loss of infiltration and increasing water conveyance can increase the runoff volume produced by a storm event. Increased peak flows have a collateral effect of bank erosion and channel enlargement.

Agriculture and rural development represent a fraction of the watershed area, limited to narrow bands along lower Slate Creek, lower Waters Creek, lower Elliot Creek and Slate Creek above Highway 199. In these areas, channelization has occurred in both the mainstem creeks and tributaries flowing through the agricultural land (see Section 3.1.2). Channelization has led to poor channel conditions and loss of floodplain features which function to store water and reduce stream velocities.

Cumulative effects

Increases in peak flow or alterations to the hydrograph due to forest removal are unlikely. Vegetative root mass and canopy cover is sufficient to prevent significant increases to soil moisture or loss of interception.

The combination of agricultural practices leading to channelization and compaction, and high road densities has increased the conveyance of water to and through the channel network. These disturbances have likely led to localized increased flow concentration and peak flows. Lower Elliot Creek, Middle Slate, and Upper Slate were identified as the areas most prone to increased flow routing and peak flows. These locations have the highest road densities in the watershed and nearly all floodplain areas area channeled and compacted. Given the hydrologic regime of Slate Creek and disturbances, flow events associated with high intensity short duration winter rains, are the most susceptible to peak flow augmentation. In larger events, change detection is difficult due to the large runoff volumes.

Cumulative effects at the Slate River Watershed scale are uncertain but unlikely. Necessary long-term stream gage data is unavailable to support definitive conclusions. However, existing data indicates that there are no cumulative hydrologic effects. The transient snow zone, typically the most sensitive to disturbances, represents less than 5 % of the watershed. Except for ultramafic areas the transient snow zone is vegetated. Additionally, roaded acres represent less than 2 % of the watershed area.

4.2.2 Baseflows

The most influential management activity on baseflows in Slate Creek is irrigation consumptive uses. OWRD provides information on expected streamflows, water rights, and allocated instream flows. Instream flow rights are water rights dedicated to maintaining instream beneficial uses, namely fisheries.

OWRD used this information to determine water availability; water availability is the expected amount of streamflow available for future consumptive uses. OWRD calculated water availability at three locations in Slate Creek — Slate Creek above Butcherknife Creek, Slate Creek at mouth, Waters Creek. Tables 6 -8 display streamflow, water allocation, instream flow rights, and water availability statistics.

Table 6. Slate Creek at Mouth Water Availability.

Month	Natural Streamflow (cfs) [1]	Appropriated Streamflow (cfs)	Expected Stream Flow (cfs)	Instream Water Rights	Net Water Available
January	38.2	0.43	37.80	85.00	-47.20
February	62.1	0.43	61.70	85.00	-23.30
March	59.1	0.43	58.70	85.00	-26.30
April	32.1	0.89	31.20	55.80	-24.60
May	13.8	1.18	12.60	19.70	-7.08
June	5.0	1.49	3.49	10.40	-6.91
July	2.3	1.86	0.46	3.92	-3.46
August	1.5	1.61	-0.08	2.00	-2.08
September	1.1	1.19	-0.11	1.35	-1.46
October	1.2	0.66	0.56	2.06	-1.50
November	3.7	0.42	3.29	13.20	-9.91
December	18.0	0.43	17.60	71.80	-54.20

[1] Natural streamflow model based on regional equations and local gage station statistics

Table 7. Slate Creek above Butcherknife Water Availability.

Month	Natural Streamflow (cfs)	Appropriated Streamflow (cfs)	Expected Stream Flow (cfs)	Instream Water Rights	Net Water Available
January	15.4	0.11	15.30	42.00	-26.70
February	25.4	0.11	25.30	42.00	-16.70
March	24.1	0.11	24.00	40.70	-16.70
April	12.8	0.32	12.50	23.90	-11.40
May	5.3	0.45	4.89	8.81	-3.92
June	1.8	0.59	1.23	3.20	-1.97
July	0.7	0.76	-0.09	1.03	-1.12
August	0.4	0.64	-0.26	0.48	-0.74
September	0.3	0.46	-0.20	0.37	-0.57
October	0.4	0.22	0.14	0.68	-0.54
November	1.4	0.11	1.29	5.51	-4.22
December	7.6	0.11	7.49	29.30	-21.80

Table 8. Waters Creek Water Availability.

Month	Natural Streamflow (cfs)	Appropriated Streamflow (cfs)	Expected Stream Flow (cfs)	Instream Water Rights	Net Water Available
January	5.44	0.06	5.38	12.00	-6.63
February	9.08	0.07	9.01	12.00	-2.99
March	8.54	0.06	8.48	12.00	-3.52
April	4.43	0.06	4.37	7.85	-3.48
May	1.83	0.07	1.76	2.60	-0.84
June	0.66	0.08	0.58	1.70	-1.12
July	0.31	0.08	0.23	0.64	-0.41
August	0.20	0.08	0.12	0.31	-0.19
September	0.14	0.07	0.07	0.18	-0.11
October	0.15	0.06	0.09	0.27	-0.18
November	0.49	0.06	0.43	1.80	-1.37
December	2.50	0.06	2.44	10.40	-7.96

The tables display very low flow (column expected streamflow) conditions in Slate Creek in July, August and September. A negative entry indicates over appropriation of water. That is, more water rights were allocated then available stream flows. Negative values were calculated for July, August, and September at Slate Creek above Butcherknife and for August and September at Slate Creek at mouth.

Flow measurements by OWRD and ARWC confirm very low flow conditions at both Slate Creek at Butcherknife and at the mouth. Flows averaged 1 cfs at Slate Creek near Butcherknife Creek and 0.5 cfs near the mouth of Slate Creek. In Waters Creek, field observations and discussions with residents indicate that water in Waters Creek is often limited to deep pools. The tables also display that instream flows were allocated for all sites throughout the year. While instream flow rights are intended to improve and/or protect aquatic habitats, the priority date for instream flows is 1987. Water rights for consumptive uses were established prior to 1987 and, therefore, have priority over instream water rights.

Of particular interest to landowners is the observed reduction in streamflow over the last 10 years. These observations appear to be a result of higher precipitation in the 1980's compared to the 1990's (see Figure 3). Flows measured in 1999-2001 near the mouth of Slate Creek are consistent with those measured by USGS in the 40's, '50's and 60's.

4.2.3 Hydrogeology

Groundwater availability and quality is a very important issue to the residents in the Slate Creek Watershed. Groundwater data in Slate Creek Watershed is limited to well logs, created during initial well emplacement.

Groundwater in the Slate Creek Watershed is controlled by fractures found in the slate bedrock. Consequently, the orientation and frequency of fractures determine the water quantity. Water is often found within the quartz veins that occupy the fractured zones. The highest yielding wells are drilled into extremely fractured shale bedrock. Groundwater has also been found in old river deposits of sand and gravel at the contact with the bedrock. The bedrock is shale, which acts as a barrier for water travel. As water travels down through the old river deposits, it accumulates on top of the bedrock.

Robison (1972) identified specific groundwater properties such as well depth, static water level, and first water. These properties were divided into Township, Range, and Section. Robison's data for T37W, R7W, Section 9 (Wilderville), was compared to recent well log data and results are in Table 9.

The most obvious change in groundwater properties since Robison's data is the increase in well depth. This increase is due to new wells being drilled farther away from Slate Creek, higher up in the hillslope. The increase in variability of water depth is a result of well drilling further away from the creek. While average static water level has decreased by 10 feet, well yield has increased. According to Quinn's Well Drilling (a Murphey based business), as well depth increases so does the probability of finding small aquifers.

Table 9. Groundwater Comparison from 1970's to Present in Wilderville.

1970's		**Current Data**	
Median Well Depth	74 ft	Median Well Depth	138 ft
Median Water Depth	16 ft	Median Water Depth	26 ft
Variability in Water Depth	3-16 ft	Variability in Water Depth	1-95 ft
Median Yield	4 gal/min	Median Yield	9 gal/min

To further define groundwater resources and availability, the sections were divided into quarter sections for the towns of Wonder and Wilderville (Tables 10 and 11).

Table 10. Wonder Water Availability Delineated into Quadrants T37S, R7W, Sec. 1.

NW Section	NE Section
Average 1st Water 55 ft	Average 1st Water 63 ft
Average Well Depth 141 ft	Average Well Depth 131 ft
Average Water Depth 21 ft	Average Water Depth 24 ft
Variability in Water Depth 6-95 ft	Variability in Water Depth 8-54 ft
Average Yield 7.2 gal/min	Average Yield 7.0 gal/min
SW Section	**SE Section**
Average 1st Water 75 ft	Average 1st Water 102 ft
Average Well Depth 145 ft	Average Well Depth 145 ft
Average Water Depth 24 ft	Average Water Depth 33 ft
Variability in Water Depth 8-40 ft	Variability in Water Depth 1-90 ft
Average Yield 9.0 gal/min	Average Yield 14.0 gal/min

Table 11. Wilderville Water Availability Delineated into Quadrants T37S, R7W, Sec. 9.

NW Section	NE Section
Average 1st Water 63 ft	Average 1st Water 53 ft
Average Well Depth 155 ft	Average Well Depth 140 ft
Average Water Depth 39 ft	Average Water Depth 26 ft
Variability in Water Depth	Variability in Water Depth
Average Yield 6.6 gal/min	Average Yield 5.5 gal/min
SW Section	**SE Section**
Average 1st Water 30 ft	Average 1st Water 79 ft
Average Well Depth 140 ft	Average Well Depth 154 ft
Average Water Depth 20 ft	Average Water Depth 33 ft
Variability in Water Depth	Variability in Water Depth 1-90 ft
Average Yield 2.5 gal/min	Average Yield 14.6 gal/min

In Wonder and Wilderville, the groundwater is primarily controlled by the fracture patterns in the shale bedrock. The highest yielding wells are in the SE quadrant of T37S R7W Sec.1. Yields ranged from 4 to 55 gal/min. The groundwater in this section behaves as an artesian system, where there is an overlying confining layer. Once this layer is punctured, static water levels rise to around 32 ft. In high yielding wells the first water depth is commonly between 35 and 69 ft within the shales.

The highest yielding wells were found in the SE quadrant of T37S, R7W Sect.9. Average well yield was 14.6 gal/min. The groundwater in Wilderville is also defined as an artesian system. The average static water level was 26ft and well depth averaded154 feet.

In the Slate Creek area mineralization of wells is common and can cause well yield to decrease. Recirculation of chlorine or vacuuming wells has proven an effective method to decrease mineralization.

Geochemistry of Streams and Groundwater

Samples of stream sediments in the Slate Creek Watershed have shown high levels of heavy metals and arsenic. Samples taken from Cheney Creek had 60 ppm Arsenic and 150 ppm of Lead (Whittington et al. 1983). High levels of arsenic are associated with of silver and other metals. This suggests the possibility of mineralization in the southeastern portion of Slate Creek. Two samples taken from Butcherknife Creek had anomoulously high levels of Chromium >5000 ppm and Nickel, (Table 9). Additionally, Whittington et al. 1983, found high levels of arsenic, lead, molybdenum, and zinc. Tables 12 and 13 show metal analysis of stream sediment samples from Cheney and Butcherknife Creek. These studies have shown that there are areas of mineralization in the Slate and Cheney vicinity.

These elements and heavy metals naturally occur in the rock formations in and around Slate Creek. As these rocks break down and weather, the elements are mobilized and can travel either in surface water or groundwater. All of the water in Slate Creek is derived from groundwater (Gall personal conv. 2002). Due to the geology and soil composition in Slate Creek groundwater movement is slow, allowing more time to accumulate heavy metals and arsenic.

Table 12. Metal Analysis of Butcherknife Creek.

Chromium	Cobalt	Copper	Zinc	Nickel
>5000 ppm	50 ppm	20 ppm	200 ppm	1,000 ppm

Table 13. Metal Analysis of Cheney Creek.

Maganese	Lead	Copper	Silver	Arsenic
10,000 ppm	150 ppm	70 ppm	1 ppm	60 ppm

Although the stream sediments show high levels of heavy metal and arsenic, it is very important to note that stream sediments hold higher levels than the groundwater. For example, arsenic in soil samples is estimated to be 10 to 200 times higher than in the interstitial water (water in pore spaces between particles) (US Dept. of Energy 2001). The high levels found in the stream sediments are indicators that groundwater also contains heavy metals and arsenic. Depending on the concentration in well water, these elements can present human health problems.

4.3 Riparian Environment

The riparian zone functions as the interface between the aquatic and terrestrial environments. This corridor, comprised of plant communities varying in composition and size classes, influences the rate of transport of sediment, water, wood, and energy into and out of the steam (Washington Forest Practices Watershed Analysis Version 4.0 1997). The composition and size of these communities are controlled by climatic, geologic, topographic, vegetative, natural disturbances along with land use practices (Washington Forest Practices Watershed Analysis Version 4.0 1997).

The assessment focuses on the condition of the riparian zone in terms of providing potential near-term (10-20 years) instream large wood and stream canopy cover. Riparian vegetation in the Slate Creek Watershed was classified and assessed using a combination of methodologies. These methods include the *Washington Forest Practices Watershed Analysis Version 4.0*, *Oregon Watershed Enhancement Board, Watershed Analysis Manual 1997*, and the Applegate River Watershed Council; *Little Applegate River Watershed Analysis 2002.*

Riparian vegetation communities were delineated using 1996 (1:12,000) color aerial photos. The mainstem and major tributaries with slopes less than 20% were evaluated in each subbasin. The dominant riparian vegetation communities were delineated into polygons. The dimensions of the polygons were determined by the extent of the vegetation community in the longitudinal direction; with no polygon being less than a 1000’ in length while extending a 100’ on both sides of the stream. Field sampling and was used to ensure accuracy and verify photo interpretation results.

The riparian community types include:

No Vegetation/Barren (**NV**)- includes denuded areas (gravel bars, bedrock, recent flood scour roads, mining, and cleared land for development).
Grass/Shrub (**GS**)- includes agriculture lands as well.
Immature Deciduous (**IMD**)- deciduous <10” tree Diameter at Breast Height (DBH).
Immature Conifer (**IMC**)- conifer <20” DBH.
Immature Mixed (**IMM**)- mixed deciduous and conifer <10 and <20” DBH, respectively.
Immature Deciduous w/ Mature Conifer (**IDMC**)- deciduous <10” DBH, w/ mature conifer 20-32” DBH.

Mature Deciduous (**MAD**)- deciduous >10” DBH.
Mature Conifer (**MAC**)- conifer 20-32” DBH.
Mature Mix (**MAM**)- mixed deciduous and conifer >10 and 20-32” DBH, respectively.
Old Growth Conifer (**OGC**)- conifer >32” DBH.

Each vegetative community was assigned a large wood recruitment potential rating of either low or high. Immature deciduous/mature conifer communities were not assessed for potential woody debris. The uncertain probability of these communities contributing large woody debris coupled with occupying an area less than five acres in the watershed deemed these communities as non-applicable in the large woody debris assessment. Each community was also assigned a low, medium, or high streamside shade value (Table 14).

Shade value was derived from the amount of canopy cover associated with individual vegetation communities. Shade values are dependent on stream size; the smaller the stream width the more effective immature vegetative becomes to provide shade. Nearly all stream reaches have stream widths less than 25 feet. Therefore, immature vegetative communities were assigned a moderate shade value.

Table 14. Riparian communities associated large wood recruitment and shade potential.

Riparian Community	Large Wood Potential	Shade
Grass/Shrub	Low	Low
Immature Deciduous	Low	Moderate
Immature Conifer	Low	Moderate
Immature Mixed	Low	Moderate
Mature Deciduous	High	High
Mature Conifer	High	High
Mature Mixed	High	High
Old Growth	High	High

4.3.1 Large Wood Debris Recruitment Potential and Shade

Large Wood Recruitment

Table 15 provides riparian vegetation acres by 6th field watershed. Table 16 display Large Wood Debris (LWD) recruitment potential and streamside shade summaries at the 6th field watershed level.

Table 15. Riparian Vegetation Types and Acres by Subbasin.

Subbasin	Non Vegetated	Grass/ Shrub	Immature Conifer	Immature Deciduous	Immature Mixed	Mature Conifer	Old Growth
Slate Headwaters	37		68	12	39	10	
Upper Slate	1	70	153	16	40	89	
Waters Creek		42	82	30	38	10	10
Round Prairie Creek	2	17	60	31	9	0	
Middle Slate	0	60	32	20	31	5	
Lower Slate	5	45	47	19	5	12	
Elliot Creek		24	43	5	16		

Potential near-term LWD recruitment for the entire Slate Creek watershed is very low (Table 16). For the entire Slate Creek Watershed, only 12% of the current riparian vegetation ranks high to provide large wood to the channel environment.

All sub-watersheds possess low percentages of riparian vegetation with a high large wood recruitment potential. Upper Slate Creek sub-basin contains the greatest percentage of riparian vegetation with high large wood recruitment potential at 24 %. Lower Slate Creek and Elliott Creek subbasins do not contain vegetation stands with high recruitment potential.

Table 16. Subbasins and Large Wood Debris Recruitment Potential.

Subbasin	Potential	Percentage of subbasin
Lower Slate Creek	Low	100.0
Middle Slate Creek	Low	94.6
	High	3.6
	N/A	1.8
Upper Slate Creek	Low	75.8
	High	24.2
Slate Creek Headwaters	Low	94.0
	High	6.0
Elliott Creek	Low	100.0
Round Prairie Creek	Low	92.2
	High	7.8
Waters Creek	Low	90.6
	High	9.4
Slate Creek Watershed - Total	**Low**	**88**
	High	**12**

Shade

Table 17 displays subbasins and shade values. In examining shade values, Upper Slate Creek has the largest percentage (24.2%) of high canopy cover of all sub-basins.

The Middle and Lower Slate Creek sub-basins possess the highest percentage of low canopy cover with 39.9 and 37.6% respectively. While the headwaters of the Slate sub-basin have the greatest percentage of no-canopy cover (22.4%).

Table 17. Subbasins and Shade Values.

Subbasin	Shade Value	*% of Subbasin*
Elliot Creek	Low	0
	Moderate	100
	High	0
Lower Slate	Low	37
	Moderate	53
	High	10
Middle Slate	Low	40
	Moderate	54
	High	6
Upper Slate	Low	19
	Moderate	57
	High	24
Slate Headwaters	Low	23
	Moderate	72
	High	5
Round Prairie	Low	16
	Moderate	76
	High	8
	Low	20
Waters Creek	Moderate	70
	High	10

Discussion

In Slate Creek, the riparian zone functions as the primary source of in-stream LWD. Large woody debris, including tree boles, root wads, and large branches are important structural and biological components of stream systems (Harmon 1986, Bisson 1987). Only 12 % of the riparian area has high potential to input instream large wood.

The low potential of LWD in the Slate Creek riparian zone is the cumulative effects of residential and agricultural land uses in the lower elevations, along with forest management and natural limiting factors in the mid-higher elevations of the watershed.

Rural-residential, agriculture and roads in the floodplains in the lower elevations reduced the availability of near-future LWD. In the middle and higher elevation reaches of Slate Creek, historic timber harvest is the causal mechanism for the low large wood recruitment potential. Upper Slate Creek, namely Ramsey Creek, possesses the highest LWD recruitment potential. The high potential of this sub-basin, is a result of intact and relatively undisturbed mature riparian communities. Although Slate Headwaters offers minimal potential for future LWD, the presence of ultra-mafic bedrock and nutrient poor soils are responsible for low LWD recruitment potential.

Resulting from the low potential of LWD, channel and ecological functions are hindered in the Slate Creek Watershed. The lack of near-term LWD will result in the reduction or absences of critical stream habitat complexity in the Slate Creek basin. Furthermore, low recruitment of in-stream LWD will disrupt stream nutrient dynamics by the reduction of available organic material to the Slate Creek Watershed (Bilby and Likens 1980).

Warm water temperatures continue to be a major impairment in the aquatic health and bio-diversity of the Slate Creek Basin. Stream temperatures in Lower Slate Creek exceed 20°C for part or all of the summer (see section 4.4.1). Stream temperature is controlled by the amount and density of canopy cover (Brown and Krigier 1970). The canopy cover offered in the Slate Creek Watershed is moderate. The predominance of moderate levels of canopy cover in Slate Creek is a combination of the effects of residential and agricultural development, timber harvest and natural disturbance events in the Slate Creek riparian zone.

It must be noted that, moderate canopy cover on smaller tributaries and in the headwaters of the Slate Creek basin can potentially provide high shade values due to narrow channel widths. Further monitoring of canopy cover associated with deciduous and immature conifer communities is needed to verify shade values.

4.4 Water Quality

The water quality assessment compares measured water quality values to Oregon Department of Environmental Quality (DEQ) standards. Water quality standards are based on the established beneficial uses for Slate Creek. The beneficial uses established in Slate Creek are:

- Public Domestic Water Supply
- Private Domestic Water Supply
- Industrial Water Supply
- Irrigation
- Livestock Watering
- Anadromous Fish Passage
- Salmonid Fish Passage
- Salmonid Fish Rearing
- Resident Fish & Aquatic Life
- Wildlife & Hunting
- Fishing
- Boating
- Water Contact Recreation
- Aesthetic Quality
- Hydropower

Of the beneficial uses, salmonids are the most sensitive fish species to changes in water quality. Accordingly, DEQ uses the criteria of cold-water fisheries for water quality standards in Slate Creek.

The Applegate River Watershed Council (ARWC) collected and assessed water quality at three sites in Slate Creek since 1996. The monitoring consists of testing the basic chemical properties relevant to aquatic biota, specifically water temperature, dissolved oxygen, pH, turbidity, and conductivity. Sampling locations are:

- Slate Creek at Mouth-River Mile 0.2
- Slate Creek above Waters Creek-River Mile 5.5
- Slate Creek at Slate Creek Road Mile 1.6-River Mile 7.5

Bacteria levels in Slate Creek and heavy metal concentration in domestic wells are important issues to residents. Comprehensive testing for these parameters has not been conducted in Slate Creek. Testing for bacteria and metals are recommended in the action plan.

Since 1996, the ARWC has used continuous recorders to obtain water quality information. Temperatures were recorded every half-hour from June 15th to September 15th. In 1998 a Forward Looking Infrared (FLIR) flight was flown along Slate Creek. FLIR records water surface temperatures for a single day along the stream corridor. The results delineated cool and warm water reaches in Slate Creek.

Dissolved oxygen was determined using the Winkler Titration method. pH determinations were established using an *Orion model 210A* and/or a *Cole Parmer Model 59002-00*. Meters were calibrated daily before measuring samples. Turbidity was measured with a *Hach 2100P Portable Turbidimeter*. The meter is calibrated in accordance to manufactures specifications. The *YSI (Yellow Springs Instruments) 30 Salinity, Conductivity and Temperature* meter measured conductivity and water temperature.

Slate Creek water quality data, was evaluated in terms of level of impairment. Impairment level is a measure of how the water quality condition impairs the beneficial uses. The percentage of water quality values violating established DEQ or regional standards was calculated for all parameters. The impairment level was assessed using the following criteria outlined in the Oregon Watershed Assessment Manual (1997).

Percent of Values Exceeding Water Quality Standards	Impairment Level
<15%	No Impairment. No or few exceedences of criteria
15-50%	Moderately Impaired. Criteria exceedence occurs on a regular basis.
> 50%	Impaired. Exceedence occurs majority of the time.
Insufficient or no data	Data lacking or insufficient

(Oregon Watershed Assessment Manual 1997).

4.4.1 Water Quality Standards

Water Temperature

Studies have shown that an increase of water temperature reduces growth and survival rates of juvenile fish, reduces survival of eggs, increases competition for food and habitat from warm-water tolerant species, and a greater incidences of disease occurs (Boyd and Strudrvant 1996). Furthermore, increased water temperature can directly affect other water quality parameters, such as dissolved oxygen (Washington Method 1997).

The standards for water temperature are based on native-resident and anadromous fish's life cycles. The Oregon Department of Environmental Quality (DEQ) states that the seven-day moving average of the daily maximum temperature should not exceed 64°F (17.8°C) during rearing of juvenile and adult salmonids (June 1-September 30). During the duration of spawning to fry emergence (October 1- May 31), the seven-day average of the daily maximum temperature should not exceed 55°F (12.8°C).

Dissolved Oxygen

The concentration of dissolved oxygen is imperative for all aquatic organisms. The implications of degradation to the biological community occur when the demand for dissolved oxygen is greater than the amount in solution (EPA 1991). The early life stages of fish are most sensitive to low levels of dissolved oxygen. Development in the embryo and larval stages can be impaired when dissolved oxygen levels drop below 9 mg/L, and mortality can result when levels reach 6 mg/L (EPA 1991). Likewise, macro-invertebrates are impaired when levels of dissolved oxygen fall below 8 mg/L and death can occur if concentrations reach 4 mg/L (EPA 1991).

DEQ standards for dissolved oxygen vary in accordance to salmonid life cycle. During spawning to fry emergence (October 1-May 31) dissolved oxygen levels are not be less than 11 mg/l or 95% saturation. During rearing of juveniles and adults (June 1- September 30), dissolved oxygen shall not fall below 8.0 mg/L or 90% saturation.

pH

The pH of water is the measurement of the logramithic amount of reactable hydrogen ions in solution. pH levels extending beyond the range of 6.5-8.5 are detrimental to fish and other aquatic organisms.

Turbidity

Turbidity is the measurement of the amount of suspended solids, or fine sediment, in the water column. Increases in turbidity reduce visibility, affecting aquatic organisms by reducing foraging ability. In addition, high levels of sedimentation can increase streambed scour, thereby removing essential food sources for higher level organisms. Increased fine sediment can also abrade organs in aquatic organisms. Turbidity levels greater than 25 NTU adversely affect salmonids and other fish species (EPA 1991).

Conductivity

Conductivity is the ability of an aqueous solution to carry an electric current. The ability of the solution to carry a current is dependent on the concentration of minerals or salts. Conductivity can be used to detect the intrusion of ground water into a stream. Likewise it can be used to detect faulty septic systems, due to the high concentrations of salts in leaking effluent. DEQ has not established a standard for conductivity.

4.4.2 Current Condition

Since 1996 , ARWC conducts water quality monitoring during the summer months (June-September). The statistical summaries for the past four years are displayed in Appendices

Temperature

Elevated water temperature is a severe impairment in Slate Creek. During the summer, all three monitoring sites exceeded the standard established by DEQ.

A downstream warming trend is evident. The monitoring sites at River Mile (RM) 5.5 and 7.5 exceeded the 17.8°C criteria from approximately early-mid July until mid-late August. At the confluence with the Applegate River, Slate Creek exceeded the water temperature standard the entire duration of the monitoring season (see Figure 10). Additionally, a Forward Looking Infrared (FLIR) flight captured the temperature profile along the mainstem of Slate Creek. The recordings represent the temperature profile on a single day in July 1999.

All sites consistently exceeded 20°C— the lethal limit for salmonids. At RM 5.5 and 7.5 water temperatures exceeded 20°C during July and August for all years. Likewise, water temperatures at the mouth have reached or exceeded 20°C from June to late August in all years of monitoring (see Figure 11).

Figure 10. Number of Days Exceeding 17.8 ºC.

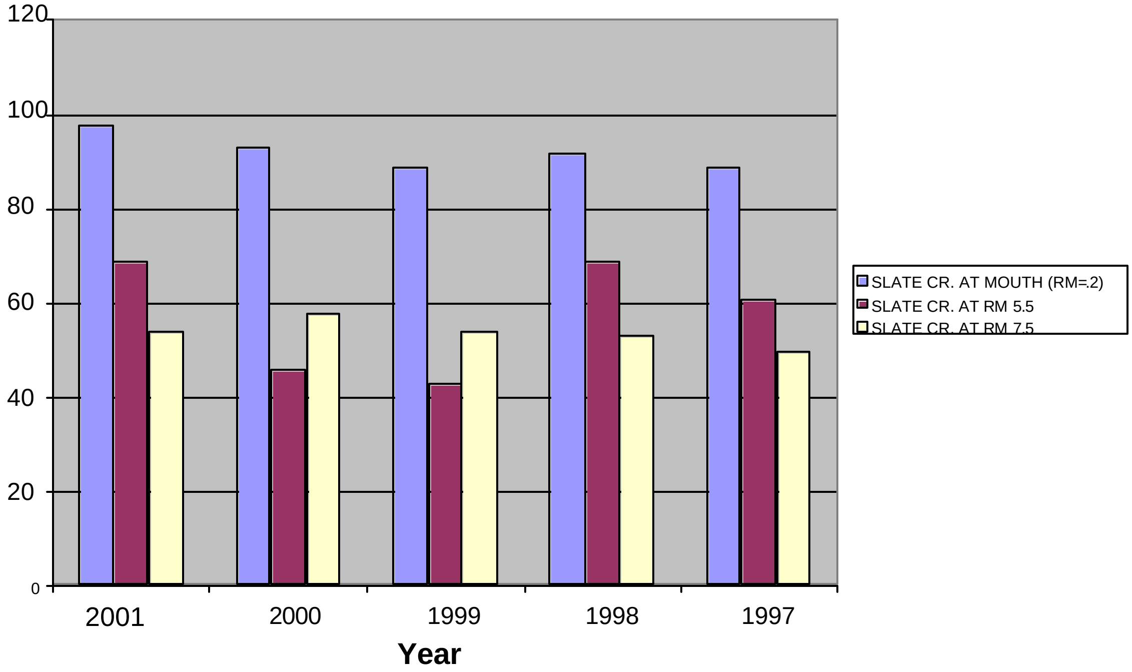
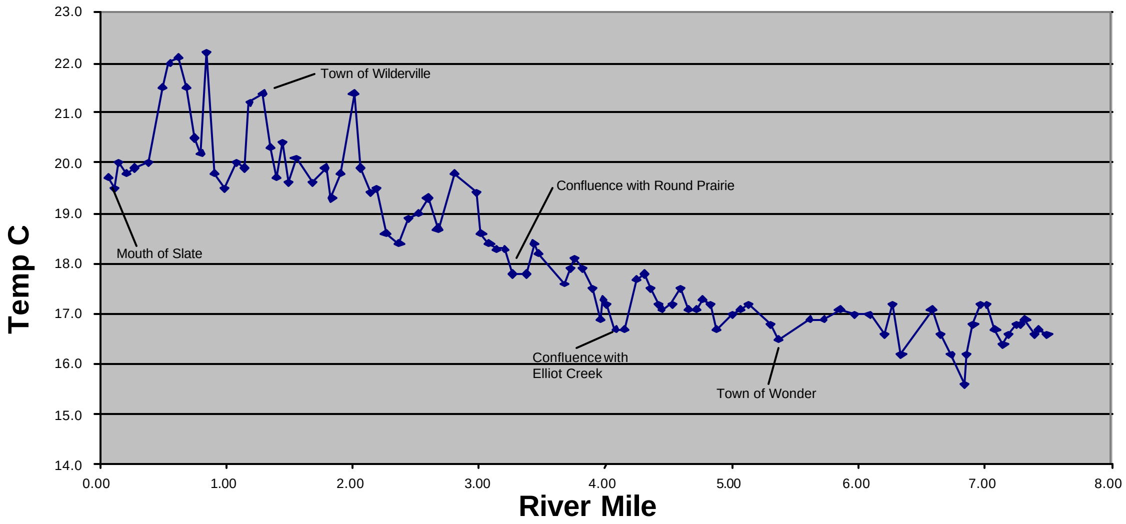


Figure 11. 1998 Temperature Profile of Slate Creek.



Macro-invertebrate sampling in Slate Creek has shown that "Summer water temperatures are high enough to be lethal to nearly all cold-water invertebrates. The near absence of cold-water invertebrate biota indicates water temperatures are non-supportive of salmonids" (Aquatic Biology Associates 1998). Less understood and documented are the sub-lethal effects of elevated water temperatures on cold-water fish populations. With elevated water temperatures in Slate Creek, it is likely that many of these non-lethal effects are occurring.

The high water temperatures are symptomatic of a degraded riparian zone, simplified channel structure and reduced summer flows. A combination of timber harvests, road construction, and residential and agricultural development within the riparian zone has reduced the amount of canopy cover in the Slate Creek Watershed. The loss of riparian vegetation is directly related to the increase in sunlight reaching the surface of Slate Creek. The warming trends in Lower Slate, below RM 3.0, obtained in the FLIR flight is attributed to a lack of shade and presence of exposed bedrock.

Another significant component affecting stream temperature is flow volume. Quantity of stream flow is potentially the most significant parameter leading to increased stream temperatures (Boyd and Sturdrvant 1996). Due to very low streamflow downstream of Waters Creek, Slate Creek is extremely susceptible to increases in water temperature.

Degraded channel morphology has also contributed to poor water temperature conditions. Widening of the stream channel near Round Prairie allows sunlight to penetrate the water column and strike the streambed. The predominance of large cobble, boulder and bedrock in Slate Creek, absorbs and retains some of the incoming solar radiation. This energy, in the form of heat is released in the evening when water temperatures are declining, thereby maintaining an elevated water temperature.

Loss of floodplain connectivity has resulted in a loss of potential cold water refugia for salmonids. Loss of floodplain connectivity (see Section 4.5.1) leads to losses of side channels, alcoves, and off channel wetland formation. These floodplain features function to provide cold water refugia during the summer months by slowly releasing cool water into the stream.

Dissolved Oxygen

Levels of impairment for dissolved oxygen increased from no impairment at RM 7.5 and 5.5 to moderately impaired near the confluence with the Applegate River.

Table 18. Level of Impairment for Percentage of Dissolved Oxygen in Slate Creek.

Year	**# Samples**	**# Samples below 8 mg/L**	**% Samples below 8 mg/L**	**Impairment Level**
1997				
Slate Creek at mouth	5	3	60	Impaired
Slate Creek at RM 5.5	6	0	0	None
Slate Creek at RM 7.5	6	0	0	None
1998				
Slate Creek at mouth	9	6	67	Impaired
Slate Creek at RM 5.5	9	0	0	None
Slate Creek at RM 7.5	9	0	0	None
1999				
Slate Creek at mouth	7	3	43	Moderate
Slate Creek at RM 5.5	7	0	0	None
Slate Creek at RM 7.5	7	0	0	None
2000				
Slate Creek at mouth	5	2	40	Moderate
Slate Creek at RM 5.5	6	0	0	None
Slate Creek at RM 7.5	5	0	0	None

During August 2001, a very dry year, a continuous dissolved oxygen (DO) recorder was placed in Slate Creek. The instrument recorded DO values every half hour for 12 days. Approximately 80 % of the values fell below 3 mg/L. It is speculated that late July through mid September values were similar to those recorded in August. Clearly the low DO levels did not support salmonid fish through most of the summer.

Factors that contribute to the low levels of dissolved oxygen in lower Slate Creek at the confluence with the Applegate River are water temperature, aquatic vegetation, and volume of in-stream water. Water temperature and DO are inversely proportional. Specifically, cold water has a greater dissolved oxygen carrying capacity than warm water; as water warms the ability to transport dissolved oxygen decreases. In the lower reaches of Slate Creek, from Round Prairie to the mouth, aquatic plant respiration-transpiration cycles greatly depress DO levels. During sunlight hours algae transpires, releasing DO; at night algae respires, consuming oxygen and releasing carbon dioxide. During the respiration cycle, DO values fell below lethal levels. Also contributing to the depression of dissolved oxygen levels is the low amount of flow that characterizes Slate Creek in the summer. The reduced volume of water in Slate Creek is more prone to increases in temperature, and therefore susceptible to low dissolved oxygen concentrations.

pH

The standard for pH, as established by the Department of Environmental Quality, is in the range of 6.5-8.5. Slate Creek pH values consistently display no impairment to beneficial uses. A moderate impairment was detected at the RM 7.5 in 1998.

Table 19. Level of pH Impairment in Slate Creek.

Year	# Samples	# of Samples outside 6.5-8.5 Range	% of Samples outside 6.5-8.5 Range	Impairment Level
1997				
Slate Creek at mouth	5	0	0	None
Slate Creek at RM 5.5	6	0	0	None
Slate Creek at RM 7.5	6	0	0	None
1998				
Slate Creek at mouth	8	0	0	None
Slate Creek at RM 5.5	8	0	0	None
Slate Creek at RM 7.5	8	3	37.5	Moderate
1999				
Slate Creek at mouth	6	0	0	None
Slate Creek at RM 5.5	6	0	0	None
Slate Creek at RM 7.5	6	0	0	None
2000				
Slate Creek at mouth	5	0	0	None
Slate Creek at RM 5.5	6	0	0	None
Slate Creek at RM 7.5	5	0	0	None

Turbidity

Turbidity in Slate Creek did not impair beneficial uses during the summer months of 1998-2000. Turbidity values in Slate Creek indicate that suspended solids are not a problem during the summer months. However, there is a strong relationship between turbidity and discharge (EPA 1991). Therefore, turbidity values during high flow events are expected to be much higher. Winter turbidity values have not been recorded to date.

Table 20. Level of Turbidity Impairment in Slate Creek.

Year	Samples	Exceedences	% Exceedences	Impairment Level
1998				
Slate Creek at mouth	8	0	0	None
Slate Creek at RM 5.5	8	0	0	None
Slate Creek at RM 7.5	8	0	0	None
1999				
Slate Creek at mouth	7	0	0	None
Slate Creek at RM 5.5	7	0	0	None
Slate Creek at RM 7.5	7	0	0	None
2000				
Slate Creek at mouth	4	0	0	None
Slate Creek at RM 5.5	5	0	0	None
Slate Creek at RM 7.5	4	0	0	None

4.5 Channel Environment

Introduction

The objective of this assessment is to generate information sufficient to establish:

- Channel segments likely to respond similarly to changes in water, sediment, and wood recruitment
- Hhistorical changes
- Current channel condition
- Interpretation of habitat-forming processes

Channel morphology, or channel structure, is influenced by a number of variables including: width, depth, velocity, discharge, channel slope, roughness of channel materials, sediment load and sediment size (Leopold 1964). Although a number of variables determine channel structure, examining channel gradient and confinement provides a method to delineate between channel processes and response potential. Channel slope, gravity as the energy driver, determines sediment transport and deposition patters. Channel confinement, defined as the ratio of valley floor width to channel width, is the dominant structure determining channel width and floodplain development.

Based on slope and confinement streams are classified at two scales. The channel network is delineated into reaches; the reaches are then delineated into channel habitat types. The larger reach-scale delineation describes general sediment supply and transport capacities. At a finer scale, stream reaches were further delineated into channel types. The channel type classification system was designed to help identify which portions of the watershed have the highest potential for fish use and how different channel types respond to land use impacts or restoration efforts. Both scales are provided to facilitate an understanding of how larger scale processes and disturbances influence local channel conditions.

To verify habitat types and channel conditions aerial photograph sequencing, habitat surveys, and representative sampling were used. Tools and materials used for the assessment include:

- USGS topographic maps
- Geographic Information System (GIS)
- Aerial photographs (1939/40, 1959, 1965, 1969, 1996, and 1997)

- BLM/FS/ODFW Aquatic Inventory Habitat Surveys (1974, 1990-92, and 1996-99)
- Field sampling at representative locations
- Interviews with land owners

4.5.1 Reach descriptions and Historic Disturbances

Channel reaches were classified as *source, transport* and *response* reaches. Identification of potential source, transport, and response reaches provides a first step for assessing potential channel responses and recovery times (Montgomery and Buffington 1993). Source reaches with their steep position in the watershed are susceptible to scouring, providing a sediment source to the channel environment. Transport reaches are high gradient confined channels capable of transporting sediment downstream. Response reaches occupy the lower watershed and have the lowest gradients. Commensurate with low gradients is low sediment transport capacities. These reaches respond to elevated sediment loads and other disturbances.

Figure 12 displays the distribution of source, transport and response reaches.
Source reaches have slopes greater than 30%, occupying the upper most reaches of the watershed. They are often called colluvial hollows. Source reaches are sediment storage sites and considered vulnerable to scouring events such as debris flows and shallow landslides. Changes in root strength or runoff concentration from roads tend to accelerate landslides (Montgomery and Buffington 1993).

Most source reaches are not identified on the map, but several were identified in the field and in aerial photographs. Specifically, channels were investigated to determine current stability and historic scouring patterns.

The highest incidence of scouring and debris flows in source reaches occurred in the 1950's due to harvesting and related activities. Identified watershed locations include:
Love Creek, Knight Creek, Elliot Creek, Newt Gulch, and Squaw Creek.
Use of source reaches as skidding trails and the 1955 flood was the causal mechanism for several scouring events. Yarding up the channels destabilized the streambed. Concurrently, riparian vegetation was removed. The combination of disturbing the streambed and riparian vegetation created an unstable environment. The flood of 1955, one of the largest on record, mobilized the channel bed and scoured stream banks. The event essentially flushed all sediments and wood from these channels, delivering them to the transport and response reaches of the watershed. Past harvesting outside the riparian areas and roads crossing perpendicular to streams appear to have minimally affected source reach stability. Nearly all debris flows were associated with roads in or closely paralleling the creek.

Occurrence of source reach scouring prior to 1950 and after 1970 is very low. This information indicates that source reaches are naturally stable and that historically they were not a dominant source of sediment into Slate Creek.

Transport reaches generally occupy the mid elevation reaches of Slate Creek. Slopes range from 3 to 20%. As displayed on Figure 12 Slate Creek is dominated by sediment transport processes. During the 1950's, similar to source reaches, channel yarding, riparian harvest, and the 1955 flood created widespread scouring of transport reaches. By 1959, approximately 40% of streams in Elliott, Butcherknife, Waters, Love, Knight, and Welter creeks display some level of channel widening caused by scouring. In many cases, 50% of the channel length was exposed due to scouring.

As observed in source reaches, in the absence of close channel-road proximity and riparian harvest there was little evidence of stream scouring. Presently, nearly all channel segments scoured in the 1950's maintain a full canopy of alders; channel exposure has returned to pre-disturbance levels.

Response reaches have gradients of 3 percent or less and are typically unconfined. Response reaches are considered susceptible to changes in sediment and/or flow regime due to low sediment transport capacity.
Theses reaches are associated with floodplains, built and developed through time as the creek migrated back and forth within the valley floor. The process of channel migration deposited fertile soil, building floodplains.

Slate Creek mainstem represents the largest contiguous response reach in the watershed. The lower reaches of Elliott, Waters, Round Prairie and Butcherknife also classify as response reaches. As observed in 1940 and 1939 aerial photographs nearly all response reaches became developed agricultural land prior to 1940. Floodplains were reclaimed via vegetation removal, channelization and mining. Streams were also straightened to provide road right of ways. Highway 199 parallels the mainstem and intersects the response reaches of Elliott, Waters, Round Prairie, and Butcherknife Creeks. The streams responded by downcutting into the alluvium, reducing lateral migration and connectivity with the floodplain.
Floodplains reduce stream velocity, and store sediment as it moves through the drainage (Knighton 1984); thus, the floodplain reduces sediment transport downstream. The same sediment provides a nursery for developing riparian vegetation. Channel interaction with the floodplain raises water table elevations adjacent to the channel providing moisture for wetland habitats and a variety of riparian species.

Loss of floodplain interaction or channelization increases water conveyance. Straightening a stream reach increases slope, decreases roughness and increases water depth at flood stage. This leads to greater flow velocities and higher erosive forces.

The hydrologic storage function of floodplains is lost following channelization. Bed degradation lowers local water tables leading to a reduction of marshes, wetlands, and flood attenuation. Loss of storage also leads to a decrease in summer base flows because of a reduction in local groundwater tables (Wyrick 1968).

In terms of biological habitat, channelization reduces the structural diversity of streams through the elimination of meanders, side channels, and removal of wood and snags. Fish no longer have backwaters, pools or low velocity for refugia during high flows, and fish eggs may be swept downstream by the higher velocities (Lewis and Williams 1984). Additionally, Statzer and Higler (1986) found that channelization reduced shelter provided by overhanging vegetation and undercut banks.

4.5.2 Channel Habitat Types

Channel types, also known as habitat types, develop from natural channel processes. Natural processes interact with current and past disturbances to shape stream channel conditions. As previously stated, different processes are at work for different channel types. Naturally, each channel type responds uniquely to a given disturbance. This section builds on the reach level characteristics to define specific habitat forming processes and current channel conditions.

Habitat Unit Descriptions

Pool-riffle

Pool-riffle channels classify as a response reach. Having the lowest stream gradients (1-3%); they have the lowest sediment transport capacity.

Pool-Riffle channels have an undulating bed defined by pools as topographic low points and bars as topographic high points. The bar and pool topography may be either freely formed by building point bars and scouring banks, or forced by flow around in-channel obstructions such as large wood debris (LWD) or boulders (Montgomery and Buffington 1993).

Forced pool-riffle channels rely on large wood material to form pools and riffles. A reduction in the supply of large wood may result in a conversion to plane bed morphology (Montgomery and Buffington 1993). Montgomery et al. (1995) discovered that LWD was the dominant pool-forming mechanism, accounting for 82% of the observed pools.

Plane-bed Channels

Plane-bed channels are characterized by long stretches of relatively flat channel bed. Plane-bed morphologies encompass channel units classified as glides and riffles. They lack the rhythmic bed undulations created by scour and fill sequences seen in pool-riffle or step pool morphologies. Plane bed channels are usually armored by a bed surface layer that is courser than the subsurface, and are threshold channels (Lane 1953, Henderson 1963, and Li et al. 1976). The courser layer of the channel prevents sediment movement of smaller particles as they are trapped under and between the larger particles. Sediment transport remains static until a flow capable of mobilizing the larger particles occurs, at which point all bed material mobilizes. This flow is termed the threshold flow.

Step-pool Channels

Step-pool channels classify as transport reaches. Steep gradients, course bed material and confined valleys characterize step-pool morphology. Step-pool channels are very resilient to changes in sediment or water supply due to the combination of stable banks and high transport capacity.

Step pools form by large roughness elements organized into discrete channel spanning accumulations that form a series of steps (Whittaker and Davies 1982, Grant et al. 1990 in Montgomery and Buffington 1993). Chen 1(989), Whittaker (1987) and Grant et al (1990) found pool spacing in step pool channels to be 1 to 4 channel widths.

Cascade Channels

Similar to step-pool channels cascade channels are classified as transport channels. Observationally, deposition of gravel and/or sand is very limited. Due to the gradient, stream flow velocities at nearly all flows is competent in transporting finer sediment downstream. Cascade channels have the highest rate of energy dissipation. Flow over, between, and into large material such as boulders and cobbles dissipates much of the energy. Cascade channels are characterized by disorganized bed material. This disorganization prevents the rhythmic pool-riffle sequencing observed in other channel types. Pools are often isolated pocket pools adjacent to large obstructions such as wood and boulders.

Colluvial Channels

Colluvial channels occupy the highest gradients in the watershed and are classified as source channels. Due to their steep positioning colluvial channels are considered vulnerable to scouring events such as debris flows and shallow landslides
They maintain a soil layer, typically sitting atop bedrock. During intense infrequent rainstorms the soil becomes saturated, increasing soil weight. When their weight increases above the shear friction created by the bedrock, debris flows and landslides result.

4.5.3 Current Conditions

Table 21 displays the miles channel habitat type in each subbasin.

Table 21. Miles of Channel Type.

Subbasin	Pool_rif Plane_bed	Forced Pool_rif	Step_Pool	Cascade	Colluvial
Lower Slate	4.4	1.3	0.7	5.8	4.8
Middle Slate	3.6	1.2	0	5.2	3.4
Elliott	1.4	1	.35	4.5	5.5
Round Prairie	0.29	1.39	2.08	2.8	4.4
Waters	2.1	2.5	1.1	7.1	7.8
Upper Slate	2.4	4.8	3.1	12.5	14.8
Slate Headwaters	0	0	1.8	5.7	14.3

Lower Slate Subbasin

Lower Slate Creek is a response reach and is furthered classified as a pool-riffle system. In the lower mainstem there are two distinct reaches, defined by confinement. Oregon Department of Fish and Wildlife (ODFW) surveyed Slate Creek in 1996. The survey information provides summary data corresponding to each reach.

Reach Summary:

Reach 1

- Geomorphology: Very low gradient - 0.5%; Unconfined Valley with a Valley width index of 20.
- Channel is constrained by terraces.
- % Pool habitat: 29
- % Fines: 41
- Large Wood Debris: Rated as low volume — 16 pieces per mile of stream
- Complex pools: 0

Reach 2

- Geomorphology: Low gradient - 1%; Unconfined Valley with a Valley width index of 11.
- Channel is constrained by terraces.
- % Pool habitat: 50
- % Fines: 18
- Large Wood Debris: Rated as very low volume —1.5 pieces per mile of stream
- Complex pools: 0

Interpretation

Reach one of Lower Slate has the lowest gradient in the watershed. Commensurate with low gradients is low sediment transport capacity. Accordingly, Reach 1 has the highest level of percent fine sediment in the watershed at 40%. Bank erosion in Reach 1 and 2 and sediment input from the mainstem Applegate River are the dominant sources of fine sediment (see below). As noted in section 4.5.1 many source and transport reaches scoured in the 1950's and '60's. These events input high levels of fine sediment. However, aerial photographs from 1970 to 1990 display that these upslope reaches have stabilized with developing riparian vegetation and that sediment input has greatly decreased over the last 30 years.

From field visits and ODFW surveys it is evident that Lower Slate is a degraded system. The wide valley is suitable for agriculture development and road building; both are present in these reaches. The floodplain has been reclaimed for agriculture and rural development. Highway 199 parallels Slate Creek. Additionally, large wood volume in Lower Slate is rated low. Typically, channelization and low wood volumes reduce complexity and pool forming processes. However, pool habitat is rated good at 29% and 50% in Reach 1 and 2, respectively. Proximity to the mainstem Applegate River accounts for the pools observed in Reach 1 and 2. These reaches are within the Applegate River floodplain. During floods, as observed in 1997, flood waters carrying sediment and organic debris enters lower Slate Creek from the north bank. Residents described the processes as a wall of water from the Applegate discharging into the lower two miles of Slate Creek. This process lead to residential flooding, widespread bank erosion, large wood deposition, and fine sediment input.

Complex pools (pools with multiple pieces of large wood) were not observed. Wood removal is assumed, accounting for the absence of pool complexity.

Middle Slate Subbasin

Middle Slate Creek is a response reach and is furthered classified as a pool-riffle system. ODFW surveyed Slate Creek in 1996. The survey information provides summary data.

Reach Summary:

- Geomorphology: Low gradient - 1%; Unconfined Valley with a Valley width index of 5.6. Channel is constrained by terraces.
- % Pool habitat: 23
- % Fines: 10
- Large Wood Debris: Rated as very low volume — 4.8 pieces per mile of stream
- Complex pools: 0

Interpretation

Despite a valley width of 5, indicating an unconfined valley bottom, terraces confine the channel. Confined by terraces in a wide valley bottom indicates channel incision and loss of floodplain connectivity. Rural residential development and Hwy 199 run along the creek throughout the reach. These activities led to channel straightening and incision into the floodplain. Less than 3 % of the stream banks were actively eroding, indicating lateral migration is not an active process. In the absence of lateral migration, the channel relies on large roughness elements for pool formation. Very low wood volumes were recorded during the survey. As a result, available pool habitat is also very low; complex pools were not observed.

However, within this reach exists a small (300 ft) segment with large wood debris, a 50-50 pool-riffle ratio, and complex pools. This channel segment flows through mature riparian forest located below the Hwy 199 crossing near the town of Wonder.

Waters Subbasin

The lower reach, Reach 1, is a response reach and is furthered classified as a pool-riffle system. Middle Waters Creek, Reach 2, is a response reach and is further classified as a forced pool-riffle system. ODFW surveyed Reach 1 and 2 in 1996. The survey information provides summary data.

Reach Summary:

Reach 1

- Geomorphology: Low gradient - 1%; Unconfined Valley with a Valley width index of 5. Channel is constrained by terraces.
- % Pool habitat: 20
- % Fines: 17
- Large Wood Debris: Rated as very low volume — 0 pieces per mile of stream
- Complex pools: 0

Reach 2

- Geomorphology: Low gradient – 1.5%; Confined Valley with a Valley width index of 1.6. Channel is constrained by hillslope.
- % Pool habitat: 21
- % Fines: 11
- Large Wood Debris: Rated as very low volume — 3.2 pieces per mile of stream
- Complex pools: 0

The upper reach (RM 4.5 to 6.3) was surveyed by the USFS in 1992. The reach includes the upper mile of mainstem, continuing up the left fork. Through this reach the channel becomes a step-pool system. The forest service survey provides summary data.
Reach Summary:

- Geomorphology: Moderate gradient – 10%; Confined valley with a valley width index of 1.5
- % Pool habitat: 6
- % Fines: < 10
- Large Wood Debris: Rated as low — less than1 piece per 330 feet of stream
- Complex pools: 0

Interpretation

Based on survey data and field observations, Waters Creek maintains very little pool habitat and channel complexity. Pool forming processes in the lower, middle and upper reaches have decreased.

A loss of sinuosity in Reach 1 reduced lateral migration. Lateral migration is necessary for pool formation in low gradient channels. The forced pool-riffle channel, Reach 2, relies on large roughness elements such as wood and boulders to create pools and channel complexity. Montgomery and Buffington (1993) state, “a reduction in the supply of large wood may result in a conversion to a plane bed morphology”. Montgomery et al. (1995) discovered that LWD was the dominate pool-forming mechanism, accounting for 82% of the pools. Low wood volumes in Reach 2 are responsible for channel simplification and low pool habitat.

Pool habitat and complexity in the left fork Waters Creek is very low. In the 1950’s riparian vegetation was completely removed from the lower mile of the left fork, fully exposing the channel. The exposure level indicates channel scour. It is speculated that removal of wood and subsequent channel scour created a high gradient riffle.

The Right Fork of Waters Creek was not formally surveyed but field visits recorded an average of 6 pieces of large wood per 330 feet of stream. Pools comprise 30-40 % of the habitat with most pools associated with large wood, creating complex habitat.

Upper Slate Subbasin

<u>Mainstem</u>

The mainstem channel transitions from a pool-riffle system in the lower half of the reach to a forced pool-riffle channel in the upper half. In 1996 Oregon Department of Fish and Wildlife surveyed the mainstem reach. The survey provides summary information.

<u>Reach Summary:</u>

- Geomorphology: low gradient – 1.5%; Unconfined valley with a valley width index of 6.
- % Pool habitat: 15
- % Fines: 9
- Large Wood Debris: Rated as Very low - 3 pieces per mile
- Complex pools: 0

<u>Interpretation</u>

Despite a valley width of 6, indicating an unconfined channel, terraces constrain the channel. Confined by terraces in a wide valley bottom indicates channel incision and loss of floodplain connectivity. Less than 1 % of banks were actively eroding, indicating lateral migration is not an active process. Additionally, Riparian harvest and agriculture development removed mature vegetation within the riparian zone. Presently, instream large wood volumes are very low. Consequently, both pool habitat and channel complexity rate as very low.

Butcherknife Creek

The lower and middle reaches of Butcherknife Creek classify as a pool-riffle and forced pool-riffle respectively. Riparian zones in these reaches were harvested; riparian vegetation consists of early seral stands. The lower reach lies in an unconfined valley bottom that has been cleared for agriculture and residential development. Consequently, sinuosity and input of large wood debris has decreased. Both are necessary for pool formation and channel complexity. As observed in similar channel types in the basin a reduction in LWD and sinuosity led to a plane bed channel dominated by riffles with little complexity.

Upper Butcherknife maintains mature riparian vegetation. Field inspection in the reach noted more than 40 pieces of LWD per mile. Pools comprised approximately 40% of the habitat. Nearly all pools resulted from flow convergence around large roughness materials (LWD, Bedrock). Complex pools were observed.

Ramsey Creek

Ramsey Creek is a forced-pool riffle channel in the lower reach and a step pool system in the middle to upper reaches. Both reaches were field inspected.

The upper reach maintains mature riparian vegetation. Over 50 pieces of LWD per mile was observed. Channel condition was very complex with a combination of plunge, dam, and lateral pools; pools comprised 40% of the channel habitat. Side channels were active and banks stable. Spawning gravels formed behind and around large roughness elements.

Downstream, riparian harvest created stands of early seral vegetation. The channel was scoured to bedrock in many sections. Bedrock and large cobble dominated stream substrate composition; very little medium to large gravel was present. No large wood debris was observed. Pools were generally 1-1.5 feet deep glides, which comprised 20% of the habitat.

Slate Headwater Subbasin

Channels in the Slate Headwaters subbasin classify as a transport reach, further classifying as a step-pool morphology. The Forest Service conducted a habitat survey of the channel. The survey provides summary information.

Reach Summary:

- Geomorphology: moderate gradient – 2-4%; Moderately confined to confined valley
- % Pool habitat: 50
- % Fines: 9
- Large Wood Debris: 19 pieces per mile; approximately 20% due to leaning vegetation rather than instream; 10% attributed to habitat structures
- Complex pools: Not available

Interpretation

Seventy percent of the riparian zone is in early seral condition; natural wood recruitment is low. However, percent pool habitat is high at 50 %. Step-pools are very resilient to changes in wood and sediment supply due to high sediment transport capacity and large bed material (cobbles to small boulder). Slate Headwater reaches maintain a high percentage of pool habitat despite riparian road building and harvest. This supports the assertion that step-pools are resilient to channel changes. Past habitat structures (LWD) has increased pools and stream complexity in upper Slate Creek. Salmonids were observed using the created pools during the low water months (ARWC 2001).

Elliot Creek Subbasin/Round Prairie Subbasin

Habitat surveys have not been conducted in Elliot Creek or Round Prairie subbasins. However, based on aerial photos, channel types, disturbance history, and observations in similar channel types, channel conditions can be surmised.

The lower reaches of both Elliot and Round Prairie are low gradient, classifying as a pool-riffle channel. The floodplains were reclaimed for agricultural development prior to 1940. Subsequently, the channel incised into the floodplain. Riparian vegetation consists of a narrow band of early seral vegetation.

The middle reaches classify as forced pool-riffle morphology. Riparian zones in these reaches were roaded and harvested in the 1950's, reducing large wood supply to the channel.
The upper mainstem of Elliott classifies as a cascade channel. Upper Round Prairie classifies as a step-pool channel.

Interpretation

Pool forming processes and complexity in the lower reaches of both Elliot and Round Prairie have decreased. A loss of sinuosity in the lower reach reduced lateral migration. Lateral migration is a necessary process for pool formation and complexity in low gradient channel types. Additionally, the presence of early seral vegetation indicates low levels of instream large wood debris. Large wood debris provides a roughness element leading to both pool formation and channel complexity.

Pool formation and complexity has also been reduced in the forced pool-riffle habitat types in Elliot and Round Prairie. Forced pool-riffle channels rely on large wood, acting as roughness elements, for pool formation.

Consequently, in the lower and middle reaches, the interaction of disturbances with channel types has led to a high riffle to pool ratio; a channel dominated by riffles and plane beds. Loss of wood input also decreased channel complexity and fish cover.

The step-pool system of Round Prairie and the cascade channel of Elliott are naturally resilient to disturbance. High sediment transport capacities and well armored banks of cobbles, boulders and bedrock account for their stability. Large substrate (large cobbles and boulders) generally provides structure creating backwater and plunge pools. Therefore, channel conditions are assumed to be relatively unaffected by past disturbances.

4.6 Aquatic Species

Native Fish Species

Figures 13-16 display the salmonid fish distribution in Slate Creek.
There are four known native salmonids (family *Salmonidae*) within the Slate Creek Watershed; the coho salmon (*Oncorhynchus kisutch*), chinook salmon (*Oncorhynchus tshawytscha*), steelhead/rainbow trout (*Oncorhynchus mykiss*), and cutthroat trout (*Oncorhynchus clarki*) (USFS 1995, BLM 1996).

Other native fish species present in the watershed include the reticulate sculpin (*Cottus perplexus*), speckled dace (*Rhinichthys osculus*), Klamath smallscale sucker (*Catostomus rimiculus*) and Pacific lamprey (*Lampetra tridentatus*) (ARWC 1999).
Of the native species present in the Slate Creek Watershed, steelhead, coho, chinook, and Pacific lamprey are the only anadromous (ocean-going) species. The cutthroat trout within Slate Creek is believed not to migrate to the ocean.

Special Protection Species

Of the native fish species presently within the Slate Creek Watershed, coho salmon are the only species listed under the Endangered Species Act. The Southern Oregon/Northern California coho salmon was listed as federally *threatened* on May 6, 1997 by the National Fisheries and Marine Service (NMFS) under the Endangered Species Act (ESA) (Fed. Reg./Vol. 62, No. 87). Slate Creek coho, in efforts to increase populations are protected under the ESA.

The Oregon Department of Fish and Wildlife (ODFW) has listed the Pacific lamprey as a *sensitive critical* species, due to the lack of data on the lamprey’s abundance. Table 22 lists the special status species present in the Slate Creek Watershed.

Table 22. Federal and State Listed Fishes Present in the Slate Creek Watershed (ONHP 2001).

Species	Status
Coho Salmon **S.Oregon/N. California Coho ESU***	· Federally Threatened for Southern OR/Northern CA Coasts · Oregon Natural Heritage Program (ONHP) Status List 1 · State of Oregon "Critical"
Steelhead Trout **Klamath Mountains Providence ESU**	· Federally Ruled Not Warranted for Listing · Oregon Natural Heritage Program* (ONHP) Status List 1 · State of Oregon "Vulnerable"
Chinook Salmon	· Federally Ruled Not Warranted for Listing · Oregon Natural Heritage Program (ONHP) Status List 2 · State of Oregon "Critical" · Critical Habitat Proposed
Cutthroat Trout	· Federally Ruled Not Warranted for Listing · Oregon Natural Heritage Program (ONHP) Status List 4 · State of Oregon "Vulnerable"
Pacific Lamprey	· Federal "Species of Concern" · State of Oregon "Vulnerable" · Oregon Natural Heritage Program (ONHP) Status List 2
Reticulate Sculpin	· Bureau Tracking in Washington

* **ESU**- Endangered Species Unit

Oregon Natural Heritage Program (ONHP) Status

List 1: Taxa that are threatened with extinction or presumed to be extinct throughout their entire range

List 2: Taxa that are threatened with extirpation or presumed to be extirpated from the state of Oregon.

List 3: Species for which more information is needed before status can be determined, but which may be threatened or endangered in Oregon or throughout their range.

List 4: Taxa which are of concern, but are not currently threatened or endangered.

Introduced Species

Thirteen non-native fish species are known to inhabit the Rogue Basin (ARWC 2000). Many fish were introduced to enhance the sport fishery opportunities, such as the brown trout (*Salmo trutta*) and largemouth bass (*Micropterus salmoides*). The introduction of these exotic species often severely disrupts the health of the system. There is competition for food and refuge among juvenile salmonids and introduced species. Large exotic predators like the largemouth bass can consume native juveniles. Extent of the distribution and impact of non-native species in the Slate Creek Watershed is not known. The only introduced species documented in the Slate Creek system is the redside shiner (*Richardsonius balteatus*) (ARWC 1999). Reeves et al. (1987) discovered that juvenile steelhead are out competed by redside shiners in warm water temperatures. During summer months when water temperatures are warm, Lower Slate Creek may provide an environment that benefits redside shiners more than salmonids.

4.6.1 Life History

Anadromous (ocean-going) salmonids migrate to the ocean as smolts and return to fresh water as adults to reproduce. Once a mystery, it is know believed adults return to their natal waters with the use of specialized olfactory senses. The timing of the run can vary, but increases in flows due to fall rains usually promote the start of the spawning run. Adult salmon do not feed while in fresh water, compared to steelhead that feed while migrating in the freshwater. Spawning males can be distinguished from females from the kipe, the pronounced curve on their mouth. This form of sexual dimorphism is present in most salmonids.

Female salmon excavate depressions in the gravel, called redds, 15 to 30 inches deep with her caudal (tail) fin. Following fertilization she will fan the eggs with her tail fin creating the perfect environment with adequate oxygen and protection. The location of salmon redds often appears random, but a few habitat requirements are needed to ensure successful spawning, such as water velocity, water depth, and gravel size.

The eggs hatch after a few months and the juvenile fish (fry) emerge from the gravel in search of food and cover habitat. The fish will consume aquatic and terrestrial insects as well as remnants of salmon carcasses. The adult salmon die after spawning, creating a valuable source of nutrients to the system. The decomposing carcasses filled with marine derived nutrients are extremely beneficial to aquatic insects, juvenile salmon, crayfish, as well as terrestrial animals such as bears and raccoons. Often pulled out of the streams for fear of dogs contracting salmon poisoning and foul odors, these carcasses are a key piece to the salmon life history.

On average feeding on insects and avoiding predators, the juveniles remain in the fresh water until their migration to ocean as smolts. While in fresh water juveniles prefer temperatures around 60° F. High levels of mortality occur during the low flows and high water temperatures present in the summer months.

Fall Chinook Salmon

Fall chinook, also known as king salmon for their large size is the first salmon to arrive in the Slate Creek drainage usually, in early November with the fall rains. Depending on the water flow, Slate Creek has exhibited two peaks of chinook; one in November and December, with December being the norm (Fustish personal. conv.). The Applegate River typically peaks the 3rd week October. With the release of water from Applegate Dam, the Applegate River flows increase ensuring sufficient water for spawning chinook. Fall chinook weigh between 15-30 pounds. Fall chinook will create redds in gravel sized marble to softball. After about month, fry will emerge from the gravel

Table 23. Chinook Life History Stages within the Applegate Basin (BLM/USFS 1995).

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Adult Migration	░	░	░	░								░
Adult Spawning	▓	▓	▓	▓								
Eggs/Fry Emerge					░	░	░					
Fingerlings Rearing	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓
Juvenile Migration	░	░	░	░	░	░	░	░	░	░	░	░
Smolt outmigration		▓	▓			▓	▓	▓	▓	▓		

Coho Salmon

Coho or silvers as they called by many fisherman, enter fresh water beginning in September and hold in the main rivers until rains allow them to move into tributaries to spawn in December and January. Having spent only two years in the ocean, coho are smaller than chinook. Adults average about seven pounds and produce approximately 2,500 eggs per female spawn in the low gradient riffle areas over small gravel.

Fry emerge during the month of April. Unlike chinook, coho juveniles will inhabit the fresh cold water for one year. During the summer low flows coho are the greatest risk, searching for suitable cold water, food, and cover. High water temperatures, water withdraws, pushup dams, culverts, and predators (especially the Great Blue Heron) often hinder the escapement success. Beaver ponds, large wooded debris jams, and side channels were historically sources of refuge for coho juveniles. Due to many human influences including mining, stream, channelization, beaver eradication, water withdraw, and removing large wood from the stream, coho rearing habitat has been greatly reduced.

Coho are present in the mainstem of Slate Creek, Round Prairie Creek, Elliot Creek, Salt Creek, Waters Creek, Bear Creek, Upper Slate Creek, Butcherknife Creek, and Knight Creek (ODFW 1996, 1999).

Table 24. Coho Life History Stages within the Applegate Basin (BLM/ USFS1995)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Adult Migration	░	░	░	░								░
Adult Spawning		▓	▓	▓								
Eggs/Fry Emerge						░	░	░				
Fingerlings Rearing	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓
Juvenile Migration	░	░	░	░	░	░	░	░	░	░	░	░
Smolt outmigration		▓	▓			▓	▓	▓	▓	▓		

Steelhead

The steelhead present in the Slate Creek Watershed are classified under the Klamath Mountains Providence ESU (Evolutionary Significant Unit). This ESU occupies basins from the Elk River in Oregon to the Klamath and Trinity Rivers in California (Busby et al 1996). The steelhead from this region are not only genetically distinct from other steelhead populations, but also obtain the unique life history component of "half-pounder" runs. After living in the ocean for 3-5 months, the halfpounders do not spawn and return to the ocean. About 30% of wild winter steelhead make a false spawning migration as half-pounders before returning as adults (Busby et al. 1996). Half-pounders, which are present in the Applegate River, are about 11-16 inches in length. They enter the river 2-4 months after migrating to the ocean, remain in freshwater over the winter, and return to the ocean the following spring (ODFW 1990).

Steelhead are the anadromous form of rainbow trout, genetically the same as resident rainbow trout, but ocean-going. Adults can spend up to 4 years in the ocean before returning to fresh water. The winter run of steelhead enters the Applegate River in late January, peaking in late February or March. These runs have been observed spawning as early as mid-December and as late as mid-June. Winter steelhead spawn primarily in tributary streams. They may use the mainstem when access to the tributary of their choice is limited by a barrier or when elevated winter flows do not occur. They spawn in low gradient riffles with small to medium size gravel and lay approximately 2,500 eggs per female. Unlike salmon, steelhead have the ability the spawn more than once (iteroparity).

Steelhead fry emerge from early April in the warmer sections of the basin to August in the cooler headwater streams. Because of reduced water flows during summer months, many steelhead fry emerge and barely have time to migrate to larger tributaries before natal streams dry up. Fingerlings in tributary streams move to pools almost exclusively as streamflow diminishes during the summer. Steelhead of all sizes most often choose territories over large rubble substrate and move from shallow, slow water at the stream margin to deeper, faster water as they mature.

Juvenile steelhead can spend up to 4 years in fresh water streams, indistinguishable from rainbow trout until they migrate to the ocean.

Table 25. Winter Steelhead Life History Stages within the Applegate Basin (Prevost et al.1997b).

	Oct	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
Adult Migration			▒	▒	▒	▒	▒					
Adult Spawning				■	■	■	■	■	■			
Eggs/Fry Emerge							▒	▒	▒			
Fingerlings Rearing	■	■	■	■	■	■	■	■	■	■	■	■
Juvenile Migration	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒		▒
Smolt outmigration						■	■	■	■			

<u>Cutthroat Trout</u>

There are three life history types for cutthroat trout: anadromous coastal cutthroat (sea-run), migratory resident cutthroat (fluvial), and non-migratory resident cutthroat. Anadromous cutthroat were found in the Applegate drainage through the late 1950s (Rivers in press). Since 1978, distribution of sea-run cutthroat is thought to be limited in the lower 30 miles of the Rogue River and its estuary (Tomasson 1978). Their presence in the Slate Creek drainage is unknown. The Applegate River has fluvial cutthroat which migrate between tributaries and the mainstem. Non-migratory cutthroat trout are present in the Slate Creek watershed (BLM 1995,1996). Found throughout the system, cutthroats are most abundant in the upper reaches of small tributaries above barriers to anadromous fish. Cutthroat trout inhabit colder water with pools created by large wooded debris jams, beaver dams, and pocket water.

Table 26. Rainbow and Cutthroat Trout Life History Stages within the Applegate Basin (BLM 1995)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Adult Migration	░	░	░	░	░	░	░	░	░	░	░	░
Adult Spawning					▓	▓	▓	▓	▓			
Eggs/Fry Emerge							░	░	░	░		
Fingerlings Rearing	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓
Juvenile Migration	░	░	░	░	░	░	░	░	░	░	░	░

Pacific Lamprey

Like the salmon of the Northwest, the Pacific lamprey migrates from the ocean to its natal stream in order to spawn. Common called eels; these fish are one of the oldest fish species. Surprisingly the distribution, population sizes and life history of the Pacific lamprey are not completely understood.

Adults enter the Rouge River in the fall after 1-3 years in the ocean (Lake 2001). In the ocean lamprey are parasitic, attaching themselves to salmon and marine mammals. During the fresh water migration lamprey do not eat. Typically adults spawn in sand and gravel substrates (Applegate 1950). Spawning lamprey move gravel with their suction-cup mouth to create redds. The adults die within 4 days of spawning, after laying approximately 10,000 to 100,000 eggs (www.psmfc.org). Young lamprey, known as ammocoetes hatch within 3 weeks and burrow themselves into the sand and silty backwaters. Filter feeding on microscopic plants and animals for 4-6 years they will emerge as adults averaging 4.5 inches long (www.psmfc.org). During the high flows adults will out-migrate to the ocean.

Because Pacific lamprey have similar habitat requirements as salmon, they are subjected to many of the same problems: impassable dams, low water, scoured out streams, low stream productivity and predation. Once a large source of food for coastal tribes of the Northwest, Klamath River Tribes such as the Yurok, Hupa, and Karuk, continue to harvest Pacific lamprey for their high caloric meat (Lake 2001).

4.6.2 Aquatic Productivity

Salmonids

In efforts to manage and monitor salmonid populations, state and federal agencies conduct surveys to estimate the health and success of fish runs. These surveys and monitoring efforts help better understand the distribution of anadromous fishes in the drainage. With the cooperation of landowners, habitat and spawning surveys are conducted. The information obtained from these surveys is used to assist agencies in changing fishing regulations, implementing environmental protection standards, and making population estimates.

Spawning Surveys

As part of the ODFW Coastal Salmonid Inventory Project, spawning surveys are conducted throughout the Coast Range, including Slate Creek and many tributaries. Information from these surveys is used to estimate the population size of Oregon Coastal natural coho and chinook spawning runs. Information regarding the methods, results, and contact personnel for the Coastal Salmonid Inventory Project can be obtained on the following website: http://osu.orst.edu/Dept/ODFW/spawn/index.htm.

During the 2000 fall season (Sept-Dec), Oregon Department of Fish Wildlife conducted chinook spawning surveys on one mile of mainstem Slate Creek. Ten visits were made, in which 23 adult and 3 jack salmon were recorded during the peak time of December 20th. Surveys conducted in the mainstem Applegate showed peaks on November 2nd, 3rd, and December 11th. Although Slate Creek is the first large tributary in the system, the mainstem peaks are earlier. Increase flows in the mainstem from the release of water from Applegate Dam may attribute to this timing.

During the 2000 fall/winter season (Nov-Jan); 2.0 miles of Slate Creek and 1.0 miles on Waters Creek were surveyed for spawning coho salmon. Three adults and two jacks were counted during the peak date of January 4, 2001on Upper Slate Creek from the mouth of Ramsey Creek upstream 0.84miles. Seven adults and seven jacks were reported for the upstream on USFS Road 020 upstream 1.24 miles with and the peak occurring on December 29, 2000.
Waters Creek from Salt Creek to Bear Creek was surveyed 11 times during the winter 2000-2001 season. Three adult and two jack salmon were reported during the peak. The peak date for the run was estimated to be December 27, 2000.

The 2001- 2002 spawning survey in Slate Creek reported 29 adults and 7 jacks during the peak of December 12th. Residents on both Upper Slate Creek and Waters Creek expressed that this run was the best they had seen in years.

Smolt Trapping
As part of multi agency effort between the ODFW Rouge District, BLM Butte Falls Resource Area, and the USFS Ashland Ranger Station, a five-foot rotary screw trap was installed at road mile 0.3 of Slate Creek in March 1999. The intent was to 1) obtain an estimate of the production of coho salmon and steelhead smolts; 2) determine the timing of outmigration of smolts; and 3) determine the sizes of smolts migrating from each of the stream systems (ODFW 1999). Other trap locations in Southwest Oregon include Big Butte, Little Butte, West Fork Evans Creeks, South Fork Big Butte Creek and the Little Applegate River.

The 1999 Slate Creek trap had poor capture efficiency for smolts, presumably from poor trap site rather than low fish numbers (ODFW 1999). Due to poor trapping efficiently no coho smolt production estimates were made. The Slate Creek steelhead out-migration peaked during the week of April 13th and declined until the week of May 18th, when no smolts were reported (ODFW 1999).

Of the sites in Southwest Oregon, the averaged Slate Creek coho smolt lengths were the largest (107mm). Compared to coho smolt lengths on Little Butte Creek (106mm), Big Butte Creek (103mm), and West Evans Creek (106mm).
Steelhead smolts lengths on average in Slate Creek (151mm) were larger the Little Applegate (149mm) and West Evans Creek (147 mm), and smaller then the Big Butte Creek smolts (156mm).

During the 2000 trapping season, the coho population estimate was estimated to be 2,827, with an out-migration peak in late April. The steelhead population was estimated to be 4,115, and peaking in early April. The 2000 steelhead out-migration peak was two weeks prior to the 1999 peak. Due to extreme low flows in 2001, the Slate Creek trap did not operate properly and therefore did not reflect true population numbers (ODFW 2001).

Table 23. Timing of Downstream Smolt Migration in Slate Creek.

Year	Coho	Steelhead
1999	------------	mid-April
2000	mid-April	early-April
2001	mid-April	early-April

Macroinvertebrates

Macroinvertebrates constitute the majority of food source for salmonids. Often used as an indicator for the health of aquatic systems, macroinvertebrates are not as freely mobile as fish (Ward and Kondratieff 1992). The tolerance of aquatic insects to water quality parameters such as temperature, dissolved oxygen, nitrogen, and primary productivity provide valuable information on the stream health.

Aquatic insects such as caddisflies (Order *Trichoptera*), stoneflies (Order *Plecoptera*), and mayflies (Order *Ephemeroptera*) are macroinvertebrates that are commonly found throughout the Slate Creek drainage. Caddisfly pupae feed by scraping rocks and the substrate. Easily identified by their cases made of silk wrapped wood, sand and rocks. Stonefly nymphs are predators often located in the faster riffles waiting prey to float by. Their hollow exoskeletons can be found on rocks and trees along the water edge. Mayflies with a two winged stage are often referred to as spinners or duns. With their translucent wings, mayflies often bounce up and down above the water surface looking for mates and laying eggs.

The BLM Grants Pass Resource Area conducted macroinvertebrate surveys in Slate Creek and Waters Creek in 1996. The Slate Creek survey site was located just upstream from the mouth of Butcherknife Creek. The Waters Creek survey site was at the Bear Creek mouth. Using a 3-Habitat Protocol of erosional, margin, and detritus, relative abundance and diversity were estimated. From the abundance and diversity findings, taxa richness, and number of positive and negative indicators were scored. Positive indicators require higher water quality standards than negative indicators. Tables 24-26 summarize the findings.

Table 24. 1996 BLM Slate Creek Macroinvertebrate Survey.

Habitat	Taxa Richness	Positive Indicator Taxa	Negative Indicator Taxa	Biotic Integrity
Erosional	Extremely Low	Very Scarce	High	**Low-Severe**
Margin	Extremely Low	Generally Scarce	High	**Severe**
Detritus	Extremely Low	Generally Scarce	Rare-Absent	**Low**

Table 25. 1996 Waters Creek BLM Macroinvertebrate Survey.

Habitat	Taxa Richness	Positive Indicator Taxa	Negative Indicator Taxa	Biotic Integrity
Erosional	Low	Generally Scarce	Rare-Absent	**Low**
Margin	Extremely Low	Generally Scarce	Rare-Absent	**Low**
Detritus	Extremely Low	Generally Scarce	Rare-Absent	**Low**

Table 26. 1996 BLM Elliot Creek and Round Prairie Creek Macroinvertebrate Survey.

Stream	Erosional Habitat	Margin Habitat	Detritus Habitat
Elliot Creek	Moderate	Low	Low
Round Prairie	Low	Low	Low

As evident macro invertebrate scores were low for all sample sites. High water temperatures, streambed scour and lack of complex habitats were identified as the causal factors.

4.6.3 Fish Passage Barriers

Fish barriers are any physical/chemical/biological factor that prohibits upstream or downstream migration of juvenile or adult fish. Examples are dams, culverts, low water flow, high water temperature, waterfalls, and log jams. Table 27 lists the attributes necessary for successful passage.

Table 27.. Minimum Depth, Maximum Velocity, Water Temperatures (ODFW 1999), and Maximum Jump Height (Bjornn 1991) for Anadromous Salmonids.

Species	**Min. Depth** (inches)	**Max. Velocity** (feet per second)	*Temperature* (Fahrenheit)	**Max. Jump** (feet)
Fall Chinook	10	8	51 – 67	7.9
Coho	7	8	45 – 60	7.2
Steelhead	7	8	-----	-----

The Rogue Basin Fish Access Team (RBFAT), an advisory committee to the Rogue Basin Coordinating Council (RBCC), has identified and ranked all barriers within the Rogue Basin. During the 1996 ODFW Habitat Inventory Survey of Slate Creek, many temporary push-up dams were also noted. In high flows most push-up dams are wiped out, therefore not posing a problem for adult migration. Many push-up dams do, however, create passage barriers to fish at low summer flows. The impact of these structures on juvenile salmonids searching for colder water upstream is unclear. Appendix D lists the fish passage barriers in the Slate Creek Watershed evaluated by RBFAT and identified during ODFW habitat surveys. Figure 17 displays the location in-stream barriers located within the watershed.

Residents on Waters Creek have reported that the culvert at the mouth of Bear Creek is a migration barrier to salmon and steelhead. In previous years many residents would hike up Bear Creek to watch spawning fish, the last few years they only see them below the culvert. Gravel and sediment are depositing above the culvert causing Bear Creek to flow over the culvert onto the road.

5.0 Action Plan

The action plan identifies restoration, conservation, outreach, and monitoring opportunities intended to improve watershed condition, coordination, and education.

To date, several restoration projects have been completed. Projects include riparian planting, blackberry removal, fuels reduction, and instream habitat enhancement. In addition, federal lands have established conservation areas in riparian zones, late successional habitats, and botanical areas as directed through agency management plans and the Northwest Forest Plan (1995). These plans will continue to direct federal land management into the near future. Therefore, this action plan focuses on working with private landowners in Slate Creek.

The identified opportunities and recommendations are split into the terrestrial, riparian, and aquatic environments. Although the recommendations are divided, they are intended to be implemented simultaneously for a cumulative benefit.

5.1 Terrestrial Ecosystem

The terrestrial ecosystem recommendations are intended to:

1. Reduce loss of residential homes and key habitats due to catastrophic fire
2. Accelerate the growth and development of early and/or mid-seral stands
3. Increase block size and connectivity of late seral habitat

Site assessments are required prior to identification of specific opportunities for thinning and other forest management. Therefore, this section outlines resources available to interested landowners and general guidelines for fuel treatments and forest thinning.

Technical Assistance

In 2002, the Applegate Fire Plan was completed. The plan identified high fire risk areas based on vegetation types and fuel loading. The plan also identified local resources for technical and financial assistance. Local contacts in the Slate Creek area for information regarding forest thinning and fuel reduction treatments include:

- Oregon Department of Forestry: Chuck Miller 541-664-3328
- Josephine County Department of Forestry: Virgel 541-474-5291
- Natural Resource Conservation District, Josephine County 541-476-5856
- Oregon State University Extension Service: Max Bennett 541-476-6613
- Rural/Metro Fire Department: 541-474-1218

Forest thinning/Fuels Reduction Guidelines

Dense understory vegetation, an increase in the amount of vegetation classified as mid seral, an increase in tanoak, and a decrease in ponderosa pine and mature conifer stands represent a shift away from reference conditions in the Slate Creek Watershed. In addition, structural and compositional changes have resulted in an increase in fuel buildup and fire hazard. These changes will be the primary focus of recommended treatments. Recommendations will also focus on improving conditions for conifers due to the increase in hardwoods at the expense of conifers over time.

Moving towards reference conditions will require the restoration and maintenance of uneven-aged stands and thinned stands across a portion of the landscape. Prior to fire suppression, fire maintained understory vegetation density and composition, and provided for the development of uneven-aged stands. Therefore, of critical importance in uneven-aged stand management is the management of understory species, precommercial thinning and release treatments (Main and Amaranthus 1996).

Sufficient data are available from the O & C revestment notes to sketch the species composition, fire regime and to a lesser extent the forest structure for vegetation in the watershed. Restoration planning should occur at the watershed scale; however a single treatment for all stands across the watershed is not appropriate. Prescriptions and treatments should be developed for "zones" based on the reference conditions and indexes for species (indexes may be obtained for tree species based on soil types from USDA Soil Surveys).

Mid/Earl and Early Seral Stands – Conifers

To cultivate a greater percentage of large-diameter conifers in immature stands precommercial thinning and multiple entry thinning is recommended. Precommercial thinning should reduce stand densities, while emphasizing reference species composition. The objective of the first entry is to begin stabilizing overstocked and stagnating stands, with the long-term goal of producing a stand dominated by mature Douglas-fir, ponderosa pine or Jeffrey pine (depending on reference conditions). At least two thinnings are necessary to fully release conifers. Where hardwoods dominate stands that were historically (as indicated by revestment notes) conifer-dominated, the density and basal area should be gradually shifted (through multiple entries) to conifers (Main and Amaranthus 1996).

Based on reference conditions and stand indexes, treatments should be implemented with a specific number of trees per acre and basal area per acre. The goal is to decrease the overall percent of standing volume in the stand while preferentially maintaining the volume in larger diameter classes.

Mid-Seral and Mature Stands – Conifers

To maintain large-diameter conifers in existing mid-seral and mature stands commercial and precommercial thinning of understory vegetation is recommended. The objectives include improving the overall vigor of large-diameter trees and maintaining larger diameter classes unless they are rapidly declining, insect or disease infested, or otherwise unlikely to survive (Main and Amaranthus 1996). Thinning from below assumes a role similar to that of fire by reducing the trees per acre and basal area in smaller diameter classes, while leaving an intact overstory. Moisture is the limiting factor to growth and development in much of the watershed. Thinning from below decreases root competition and encroachment.

As is the case with immature stands, treatments should be implemented with the objective of reducing stand volume to a specific number of trees per acre and basal area per acre. Treatments in the Douglas-fir series should seek to maintain a greater basal area than those applied in the ponderosa pine and Jeffery pine series respectively.

Hardwood Stands
Some species of hardwoods (tanoak) in the watershed have increased from reference conditions. When necessary, the reduction of hardwoods back to reference condition levels may be achieved largely through the management practices described above for conifer stands. Many hardwood species will rapidly recolonize. Thus, extra effort may be needed to keep unwanted hardwood sprouts in check until desired canopy structure and composition is established. In areas where hardwoods were the dominant cover type, stands may be thinned from below to basal area levels consistent with stand indexes. Thinning hardwood stands will also reduce fuel levels and the fire potential.

Connectivity
When possible, patches of mature forest should be maintained and expanded to connect with other existing mature patches. Retention of large patches is crucial. Connectivity between mature forest patches via mature corridors will provide essential species dispersal routes.

Patches of existing mature forest range in size from approximately 202 acres to less than one acre on BLM-managed land, and approximately 60 acres to approximately five acres on Forest Service-managed land. There is no recorded mature forest on private land. The greatest potential for mature forest connectivity exists on BLM land where some large patches are adjacent to each other. However, potential for mature forest connectivity planning exists on both BLM and Forest Service-managed lands due to the substantial portion of the landscape that supports mid-seral forest. Management of mid-seral stands between mature patches should center on promoting mature forest corridors and new mature forest patches.

Other Considerations
When implementing treatments, slope steepness, soil type and proximity to streams should be given special attention. It is important that instream sediment inputs be minimized through careful road layout, etc. Slope in a given treatment area may not be conducive to mechanical thinning. Stands near streams should be considered for their potential as instream wood sources, and should be treated appropriately. Removal of trees adjacent to ephemeral streams should also be minimized to prevent seasonal accelerated erosion. Wind firmness should be considered when removing trees adjacent to leave trees. Gradual thinning and group retention may be appropriate to mitigate windthrow. Treatments will produce slash material that must be burned in situ (piled and burned) or removed from the site in order to minimize fire potential. However, care are must be taken to leave the appropriate number of snags and downed logs for wildlife habitat.

5.2 Riparian Ecosystem

The biggest concern within the riparian area is the lack of large tree structure. The riparian zones are not functioning to provide large wood recruitment into the channel environment. High water temperatures, due to a lack of stream canopy, were also identified as a limiting factor to salmonid rearing and development. Lack of large tree structure has also reduced habitat connectivity and migration corridors.

Invasion of blackberries is greatly hindering, and in many cases, preventing the growth and development of hardwood and conifer species. The continued dominance of blackberries could increase the time to develop mature riparian species by several decades.

Increased riparian complexity and species diversity would also benefit amphibian and wildlife species. Therefore, riparian planting and buffer expansion is a high priority activity in Slate Creek.

Riparian Restoration Opportunities

On federally managed lands, continued implementation of the riparian reserves and Aquatic Conservation Strategy will protect riparian areas. On private lands, outreach, blackberry removal, and riparian planting of native species is necessary to improve riparian integrity. The ARWC has been actively involved in outreach and riparian planting. In the lower reach (RM 0-2), several landowners participated in riparian restoration resulting in nearly two miles of planting. In the upper watershed, ARWC's outreach resulted in numerous landowners interested in riparian and aquatic habitat restoration. Considering all low gradient, high value habitat lies within private ownership continued outreach and project development is imperative to restore function and condition on private land.

Three priority areas have been identified to target outreach and restoration and include:

1. Slate Creek mainstem from the confluence of Round Prairie to the mouth
2. Slate Creek mainstem from the FS boundary to Hwy 199 bridge
3. Waters Creek from the BLM boundary to the mouth

Riparian function on federal land can be improved via thinning in early seral structural stands. The intent is to expedite the development of large tree structure. Because alder is desirable for invertebrates, silvicultural treatments within 50 feet of the channel should maintain a mixture of hardwoods and conifers.

Commercial thinning in riparian reserves in conjunction with thinning opportunities discussed in the terrestrial section, will expedite mature vegetation development. Mature vegetation along stream corridors will improve habitat connectivity and migration corridors.

In developing management guidelines within riparian reserves, the following site characteristics should be considered during project planning:

- Sensitivity of hillslope erosion and mass wasting. Identify hillslope angle of repose and soil erodibility.
- Potential fluvial erosion. Identify the location of management activity relative to high flow stages (2, 5, 25 flood return interval)
- Instream beneficial uses and their sensitivity to disturbances
- Streamside canopy and large wood recruitment potential

Riparian areas identified as needing thinning to release conifer species include upper Slate Creek, Elliott Creek, and Round Prairie.

5.3 Aquatic Ecosystem

This section describes management actions intended to improve aquatic conditions through improvements to surface runoff, channel processes, instream flows and fish passage.

Nearly all stream reaches lack channel complexity to provide quality habitat. Loss of sinuosity in low gradient reaches, and removal of large wood in low and moderate gradient reaches has simplified instream habitat. Namely, pool habitat for holding adult fish and rearing juvenile fish, backwater areas for rearing and velocity refugia, and structure to sort sediment and retain gravel. Additionally, large wood recruitment from the riparian zone is rated low for the next several decades.

Instream summer flows are very low throughout Slate Creek significantly reducing habitat conditions. Additionally, water temperatures in the mainstem from Waters Creek down to the mouth reach lethal levels. Summer streamflow enhancement will not only increase habitat availability but also reduce water temperature. Due to low flow conditions and high use by anadromous species, Slate Creek at mouth, Waters Creek, and Slate Creek above Butcherknife was identified by ODFW and ODWR as high priority areas to improve summer low flow conditions.

The Rogue Basin Fish Access Team (RBFAT) and ODFW identified 40 fish passage barriers in Slate Creek. Of the 40, ten were identified as either a passage barrier at most flows or a passage barrier at all flows. Because of the poor water quality in the Lower Slate Watershed, it is critical that juveniles have access to the healthier upstream portions of the watershed.

Aquatic Habitat Opportunities

Surface runoff: To improve hydrologic function, focus road decommissioning in hydrologically sensitive areas. Identified hydrologically sensitive areas are the Middle Slate and Elliot subbasins where road densities are 7 and 6 miles of road per square mile of drainage, respectively. Target road densities to the range of 2-3 miles per square mile based on NMFS guidelines is recommended. High priority locations are roads or sections of roads that increase the drainage network. Such roads are typically long sections of road without a culvert relief that drain into streams, or areas where a series of roads cross the drainage. To reduce upslope erosion potential and to reduce risk of future road failures target road decommissioning on high erosion potential roads indicated on Figure 8. These roads are located on step slopes in unstable terrain.

Instream habitat improvement: To improve aquatic habitat, in-channel placement of large native material is recommended. Placement of large wood debris is critical to increase channel integrity and channel complexity. Large wood debris provides essential habitat including holding pools for adult migrating fish, pools and cover for juveniles and stores and sorts river sediments. Large substrate, (36 inches or larger) will converge flows necessary to scour the channel bottom, creating pool habitat and complexity.

Placement of large wood is preferable in stream sections reestablishing floodplain interaction. These reaches are reestablishing equilibrium; placement of large wood will assist in the process. In these areas, stream energy dissipation is greater due to floodplain interaction, reducing scouring forces on the large wood. Additionally, bank erosion as a result of wood placement is less likely in reaches with an establishing floodplain. Boulder placement is preferred in reaches that maintain no floodplain connectivity. Boulders in these reaches will create a “step” in the longitudinal profile, creating backwater and scour pool habitat.

ARWC has been actively planning with residents in Waters Creek and Upper Slate Creek to identify locations and design instream projects. Namely, in Upper Slate from the forest service boundary to Highway 199 bridge and in Waters Creek from the BLM boundary to the mouth, residents have expressed interest in instream habitat improvement. These reaches are key tributaries to core coho habitat designated in the mainstem as they support coho and steelhead through the summer months.

In conjunction with instream habitat improvement residents expressed an interest in increasing summer low flows. Improving irrigation efficiency and leasing water rights to instream flows are excellent opportunities to improve low flow conditions.

Continued outreach efforts and cooperation is essential to continue community involvement and to improve aquatic habitat. ARWC will continue to work with residents to identify appropriate location for large wood and boulder placement.

Fish Passage: The Lovelace (RM 3), Harlbolt (RM 7), and Fenner Dams (RM 8) were identified by the Rogue Basin Fish Access Team as passage barriers under most flow conditions (See Appendix D.1). Located in the mainstem of Slate Creek, these permanent structures may inhibit the upstream migration of anadromous adult fishes and most notable juvenile upstream migration during low water conditions. Little is known as to the present use of these structures and the landowners associated with their usage.

More information needs to be obtained on these structures. Outreach efforts by the ARWC may assist the dam owners in alternatives and/or upgrades to the structures. Recommendations are to investigate these structures at various levels of flows and outreach to landowners.

Push-up Dams
Due to the variability of these structures year to year, it is difficult to assess their impact on the migration of juvenile salmonids. Construction of side channels and permitting continuous flow under the dam may aid juvenile salmonids in accessing suitable habitat upstream.

Culverts
Bear Creek culvert (at mouth) is a high priority, due to the information presented by residents (See Section 4.6.3). Collaborating with Josephine County Public Works to replace the culvert is recommended.

Salt Creek culvert on Waters Creek Road has been identified by residents a major problem. This culvert does not function properly. Residents report that during rain events, water continuously flows over the two culverts onto the road. At low water, the stream flows under the culverts. Replacement of these culverts is recommended.

Grantham Gulch (RBFAT Rank 3) culvert on was the only structure identified as a passage barrier under all flow conditions (See Appendix D.1). This culvert is a low priority due to it obtains only 0.04 miles of fish bearing water.

Groundwater: Due to high levels of heavy metals found in stream sediments and in the geology surrounding Slate Creek, well water quality testing is advised.

When assessing well placement, slope breaks are indicative of changes in lithology where water is trapped. Water quantity in groundwater wells can be increased in fractured aquifer systems by drilling a well perpendicular to fracture patterns. Drilling wells at an angle to the fractures in the bedrock increases the surface area to the available water. Local well drillers look for high fracture frequency and abundance of quartz in the slate to indicate good groundwater.

Due to the high shrink-swell potential of serpentinite, it is not advised to drill wells in serpentine (Quinn's Well Drilling Inc). In addition serpentine contains minerals, primarily iron that can precipitate in fractures and clog wells.

In the Slate Creek area mineralization of wells is common and cause well yield to decline overtime. Recirculation of chlorine or vacuuming has proven to be an effective method of decreasing mineralization.

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Figure 13. Chinook Distribution in the Slate Creek Watershed.

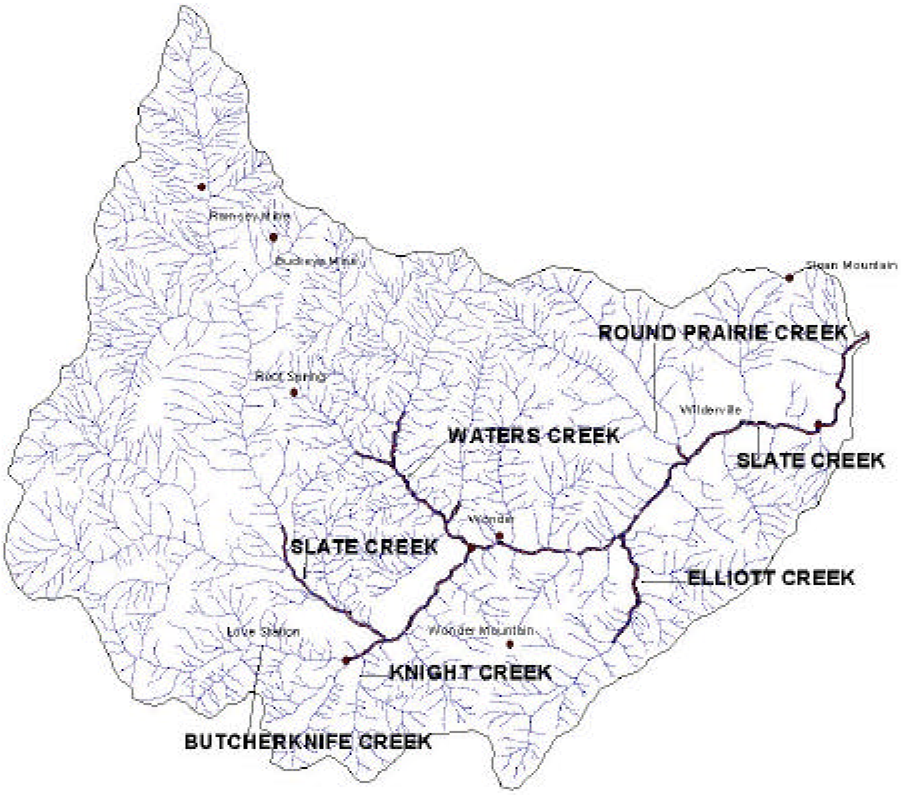


Figure 14. Coho Distribution in the Slate Creek Watershed.

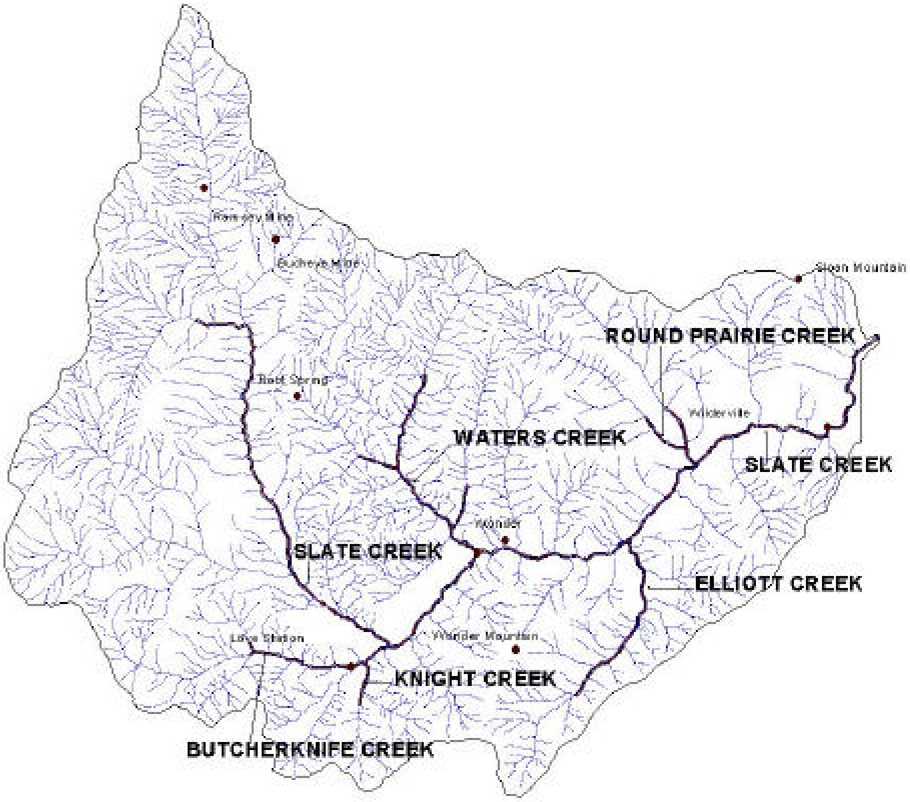


Figure 15. Steelhead/Rainbow Trout Distribution in the Slate Creek Watershed.

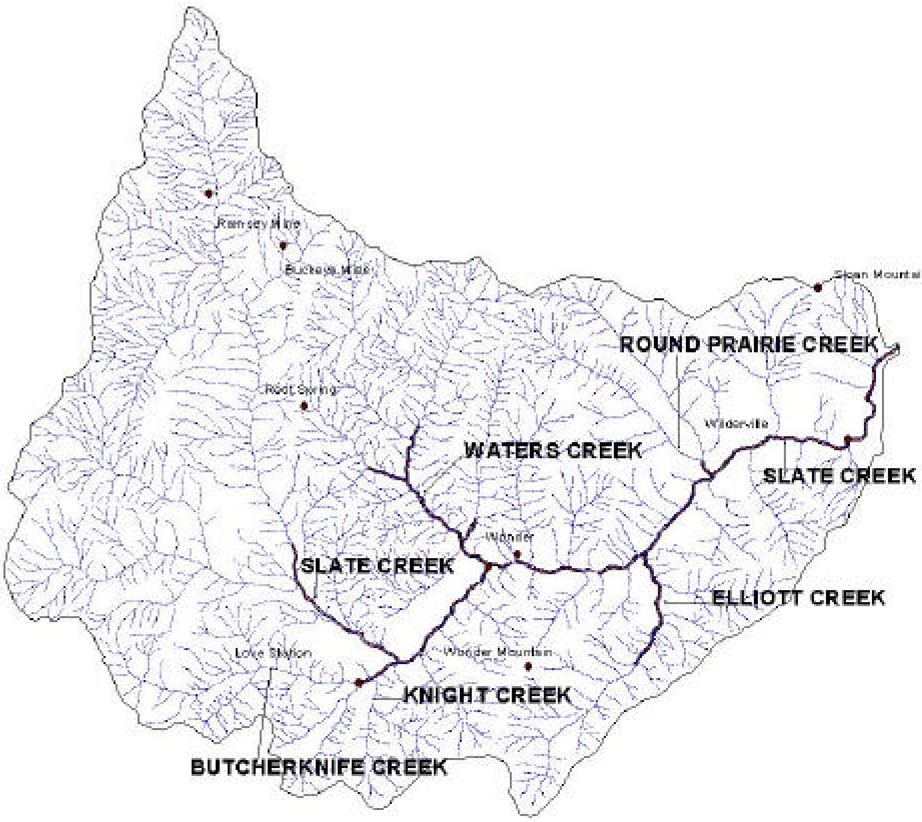


Figure 16. Cutthroat Trout Distribution in the Slate Creek Watershed.

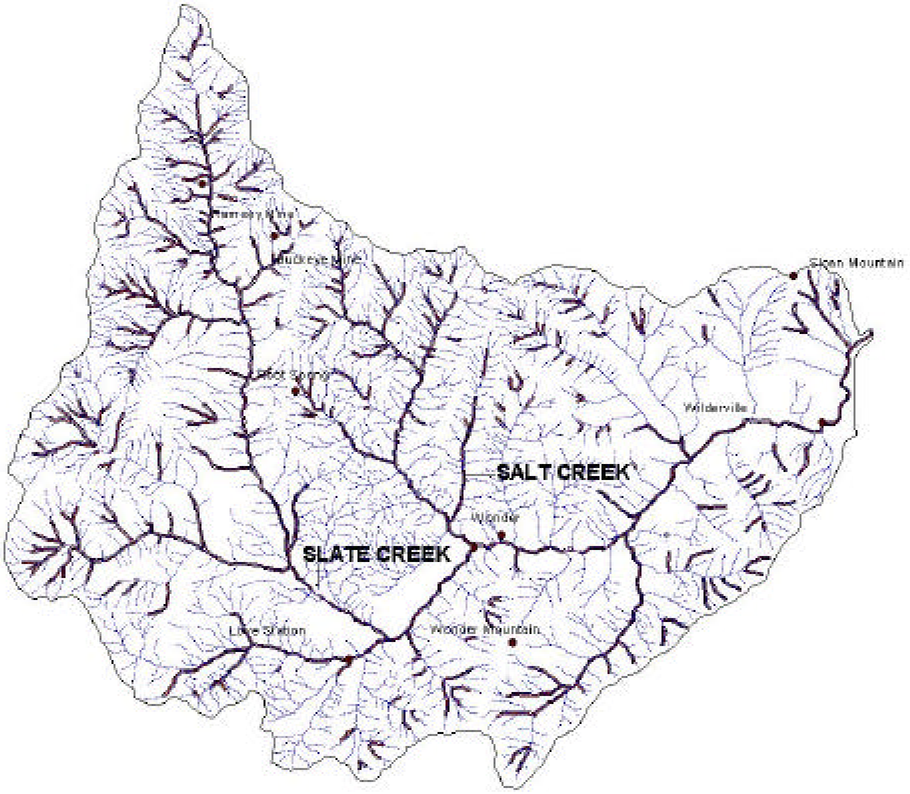
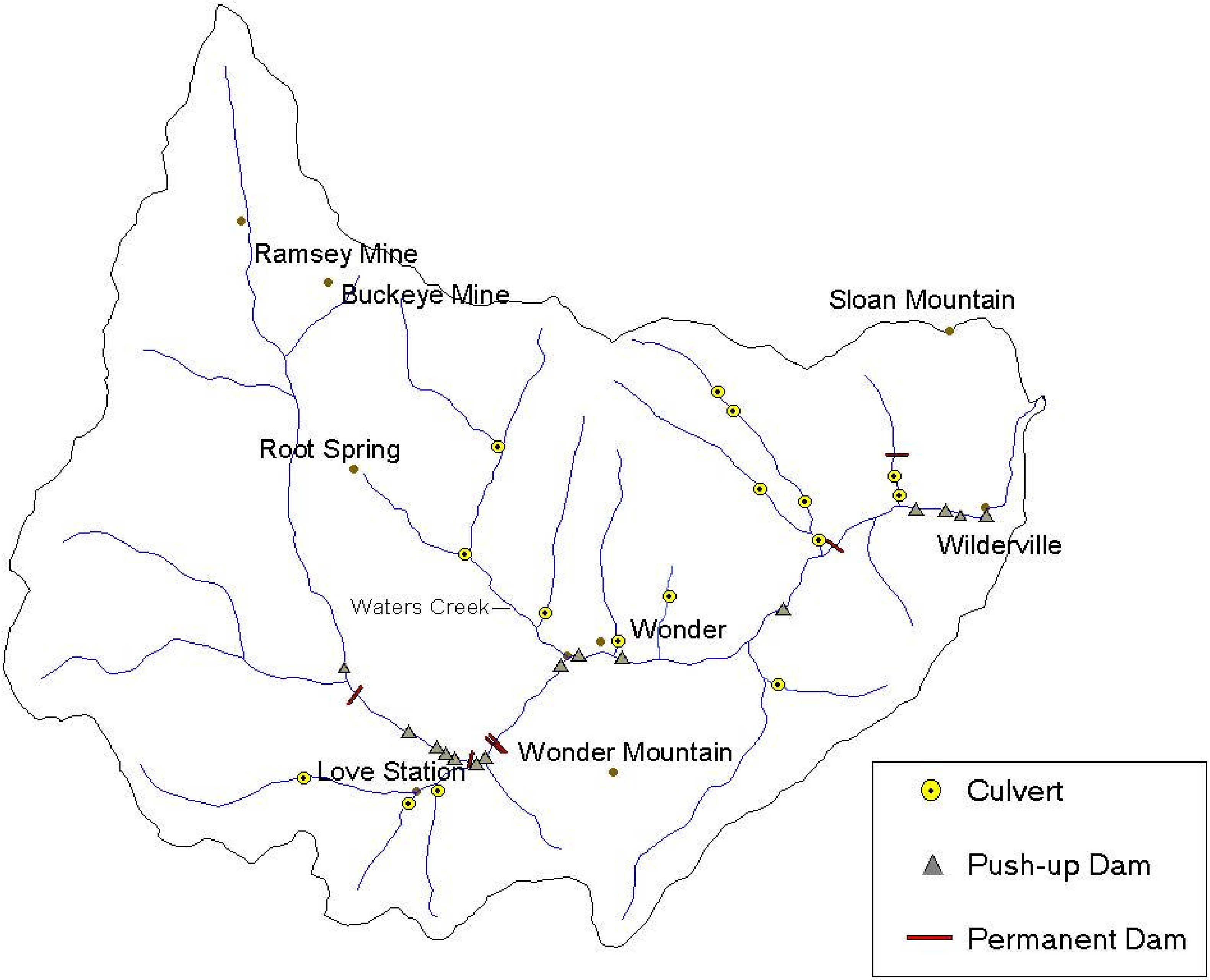


Figure 17. In-stream Barriers in the Slate Creek Watershed.



Appendix A

Participants

List of participants:

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Appendix B

Special Status Species and Habitat Associations

U.S. Forest Service Regional Forester's Sensitive Animal List, Siskiyou National Forest (USFS 1994, USDA 2000).

Common Name	**Scientific Name**	**Seral Stages Present In**	**Habitat Types** **Primary/*Secondary***	**Natural Heritage Rank**	**Oregon List**	**Federal List**	**Year Listed**	**Occurrence**
AMPHIBIANS								
Black Salamander	Aneides flavipunctatus			S2	SP		00	S
California Slender Salamander	*Batrachoseps attenuatus*	S,P,Y,M,O,G	D/*T,R,*	S2	SP		00	D
Del Norte Salamander	*Plethodon elongatus*	Y,M,O	T/*D*	G3	SV		89	D
Siskiyou Mtn. Salamander	*Plethodon stormi*	Y,M,O,P	T/*D,R*	G2	SV		89	S
S. Torrent Salamander	*Rhyacotriton variegatus*			G3	SV		00	D
Foothill Yellow-legged Frog	*Rana boylii*	G,S,P	R	G3	SV		00	D
Oregon Spotted Frog	*Rana pretiosa*		R	G2G3	SC	C	97	
REPTILES								
Northwestern Pond Turtle	*Clemmys marmorata marmorata*	G,S,	D,R	G3T3	SC		86	D
Common Kingsnake	*Lampropeltis getula*	G,S,P,Y	*D,T*	S2	SV		89	D

Common Name	**Scientific Name**	**Seral Stages**	**Habitat Types** **Primary/*Secondary***	**Natural Heritage Rank**	**Oregon Status**	**Federal List**	**Year Listed**	**Occurance**
BIRDS								
American Peregrine Falcon	Falco peregrinus anatum	G,S,M,O	C,R/*T*	T3	E		99	D
MAMMALS								
Pacific Shrew	*Sorex pacificus pacificus*	P,Y,M,O	D,R	T3			00	D
Pacific Pallid Bat	*Antrozous pallidus pacificus*	Y,M,O,P,G	CB,C,R	T3T4	SV		00	S
Pacific Fringe-tailed Bat	*Myotis thysanodes vespertinus*	M,O,S,G	CB,C,	T2			00	D
California Wolverine	*Gulo gulo*		CB,D,T,R	S2			86	D
Pacific Fisher	*Martes pennanti*	Y,M,O,	D,T,R/*C*	S2	SC		00	D

Key to acronyms and abbreviations

Seral Stages: G= Grass/forbs; S= Shrub dominated; P= Pole/sapling; Y= Young forest; M= Mature forest; O= Old growth
Habitat Types: CB= Caves/Burrows; C= Caves D= Downed Large Material; T=Talus; R= Riparian
Natural Heritage Rank: G1= Critically imperiled globally (5 or fewer occurrences); G2= Imperiled globally (6-20 occurrences); G3= Vulnerable:either very rare throughout range or locally restricted (20-100 occurrences)
T1= Subspecific taxon is critically imperiled (5 or fewer occurrences); T2= Subspecific taxon is imperiled globally (6-20 occurrences)
T3= Subspecific taxon is either very rare throughout range or locally restricted (20-100 occurrences
S1= Critically imperiled in respective state; S2= Imperiled in respective state
Oregon Status: SC= Sensitive species, critical category ; SV= Sensitive species, vulnerable category; SP= Sensitive species, peripheral or naturally rare category
SU= Sensitive species, undetermined status
Federal Status: C= Candidate for Federal listing under Endangered Species Act (ESA)

Special status mammals that potentially inhabit the Slate Creek Watershed (BLM 1996).

Common Name	Scientific Name	Presence	Status	Surveyed
Gray Wolf	Canis lupus	Absent	FE, SE	None
White-footed vole	*Aborimus albipes*	Unknown	BS, SP	None
Red tree vole	*Aborimus longicaudus*	Present	SM	Limited
California red tree vole	*Aborimus pomo*	Unknown	BS	None
Fisher	*Martes pennanti*	Unknown	SC, AS, SC	None
American marten	*Martes americana*	unknown	SC, AS	None
Ringtail	*Bassacriscus astutus*	Present	SU	Limited
California wolverine	*Gulo gulo luteus*	Unknown	BS, ST	None
Townsand's big-eared bat	*Plecotous townsendii*	Present	BS, SC	Limited
Fringed myotis	*Myotis thysanodes*	Suspected	BS, SV, SM	None
Silver-haired bat	*Lasionycteris noctivagans*	Present	SM	None
Yuma myotis	*Myotis yumanensis*	Present	BS	None
Long-eared-myotis	*Myotis evotis*	Suspected	BS	None
Hairy-winged myotis	*Myotis volans*	Suspected	BS	None
Pacific pallid bat	*Antrozous pallidus*	Present	SC, AS, SM	Limited

Status Abbreviations

FE--Federal Endangered
FT--Federal Threatened
FP--Federal Proposed
FC--Federal Candidate
SE--State Endangered
ST--State Threatened
SM—Survey and Manage

SC-- ODFW Critical
SV--ODFW Vulnerable
SP--ODFW Peripheral or Naturally Rare
SU--ODFW Undetermined
BS--Bureau Sensitive
AS--Assessment Species

Special status reptiles and amphibian species that potentially inhabit the Slate Creek Watershed (BLM 1996).

Common Name	Scientific Name	Presence	Satus	Surveys
Western pond turtle	Clemmys marmorata	Present	BS, BC	Incidental Sightings
Del Norte salamander	Plethodon elongatus	Present	BS, SV, SM	Limited
Red-legged frog	Rana aurora	Unknown	BS,SU	None
Foothills yellow-legged frog	Rana boylii	Present	BS, SU	Limited
Tailed frog	Ascaphus truei	Present	SV, AS	Incidental sightings
Clouded salamander	Aneides ferreus	Suspected	SP, AS	Incidental sightings
Southern torrent salamander	Rhyacotriton variegatus	Present	BS, SV	Limited
Black salamander	Aneides flavipunctatus	Suspected	SP, AS	Limited
Sharptail snake	Contia tenuis	Suspected	SC	None
California mtn. kingsnake	Lampropeltis zonata	Present	SP, AS	Incidental sightings
Common kingsnake	Lampropeltis getulus	Present	SP, AS	Incidental sightings
Northern sagebrush lizard	Sceloporus graciousus	Present	BS	Incidental sightings

Status Abbreviations

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SE--State Endangered
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SP--ODFW Peripheral or Naturally Rare
SU--ODFW Undetermined
BS--Bureau Sensitive
AS--Assessment Species

Special status avian species that potentially inhabit the Slate Creek Watershed (BLM 1996).

Common Name	Scientific Name	Presence	Satus	Surveys
Northern spotted owl	Strix occidentalis	Present	FT, ST	Limited
Peregrine falcon	*Falco peregrinus*	Unknown	Delisted (2000)	None
Bald Eagle	*Haliaeetus leucocephalus*	Present	FT, ST	Limited
Marbled murrelet	*Brachyramphus marmoratus*	Unknown	FE, SC	Limited
Northern goshawk	*Accipitergentilis*	Unknown	BS, SC, AS	Some
Mountain quail	*Oreotyx pictus*	Present	BS	None
Pileated woodpecker	*Dryocopus pileatus*	Present	SC, AS	None
Lewis woodpecker	*Melanerpes lewis*	Suspected	SC, AS	None
White-headed woodpecker	*Picoides albolarvatus*	Unknown	SC, AS	None
Flammulated owl	*Otus flammeolus*	Unknown	SC, AS	None
Purple martin	*Progne subis*	Unknown	SC, AS	None
Great gray owl	*Strix nebulosa*	Unknown	SV, AS, SM	Limited
Western bluebird	*Sialia mexicana*	Suspected	SV, AS	None
Acorn woodpecker	*Melanerpes formicivorus*	Present	SU	None
Tricolored blackbird	*Agelaius tricolor*	Unknown	BS, SP	None
Black-backed woodpecker	*Picoides arcticus*	Suspected	SC	None
Northern pygmy owl	*Glaucidium gnoma*	Present	SU	Limited
Grasshopper sparrow	*Ammodramus savannarum*	Unknown	SP	None
Bank swallow	*Riparia riparia*	Migratory	SU	None

Status Abbreviations

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ST--State Threatened
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SC-- ODFW Critical
SV--ODFW Vulnerable
SP--ODFW Peripheral or Naturally Rare
SU--ODFW Undetermined
BS--Bureau Sensitive
AS--Assessment Species

Appendix C
Hydrology Method

In developing a conceptual model and forming assumptions for factors leading to peak flow alteration, research conducted in Western Oregon and Northern California (e.g., Harr et al. 1979; Harr 1975; Harr et al. 1975; Keppeler et al. 1990; Jones et al. 1996; Wemple et al. 1996) was used. A summary of Key findings is described below:

Storms produced higher peak discharges and volume when 25-30 percent of the watershed is in clear cut condition. Mean daily flows increased and number of low flow days decreased. The greatest peakflows are generated within the transient snow zone (elevation 3500 – 5000 feet). Loss of plant transpiration accounted for 2/3 of the change in flow and 1/3 from loss of transpiration. Road network increased drainage density and flow routing efficiency. Elevated peak flows from clear cuts decreased rapidly after year five, but remained altered for 20-30 years. Peakflows in lower magnitude floods (0.4-2 year floods) have a greater percentage of increased flows. A greater percent of flow augmentation occurs early in the wet season due to higher pre-existing levels of soil moisture in harvested units.

The net effect of decreased evapotranspiration and canopy interception, and road development was assumed to be the most influential in altering peak flow timing and discharge. “Net effect” was chosen because all three factors are simultaneously involved. Consequently, determining the relative contribution of any one variable is not significant.

Harvest units were considered hydrologically recovered when re-establishment of leaf area is sufficient to return plant transpiration and canopy interception rates to pre-harvest levels. Leaf area index is an ideal variable to express recovery; however, considering mixed ownership and availability of data area in a non-forest or early seral condition was used as a surrogate. For this model non-forest was considered unrecovered and early seral stands were considered 80 percent recovered; early seral stands were assumed to be 15-20 years old. For example, 10 acres in early seral condition translates to 2 acres unrecovered.

Appendix D

Identified Fish Barriers in Slate Creek
Miles of Fish Bearing Streams

Barriers identified by the Rogue Basin Fish Access Team

Stream	Structure Type	Location Road Mile/TRS	Species[1]	Passage Rank[2]
Bear Creek	5' round metal culvert	Near mouth 37S-7W-5	CT, ST	2
Butcherknife Creek	CMP*	RM 0.5 37S-7W-19	Co, ChF. ST	2
Round Praire Creek	RCBC**	RM 0.1 37S-7W-2	Co, ChF. ST	2
Round Praire Creek	CMP	RM 0.5 37S-7W-2	Co, ChF. ST	2
Round Praire Creek	2 round metal culverts	RM 1.6 36S-7W-34	CT	1
Round Praire Creek	3' metal culvert	RM 1.8 36S-7W-34	CT	1
S.Fk. Round Praire	3' metal culvert	RM 0.7 37S-7W-3	ST, CT	1
Grantham Gultch	40" round metal culvert	Near Mouth 37S-7W-10	ST, CT	3
Slate Creek	4' concrete dam (Lovelace)	RM 3 37S-7W-2	Co, ST, ChF	2
Slate Creek	concrete dam (Harbolt)	RM 7.0 37S-7W-17	Co, ChF. ST	2
Slate Creek	Stop logs (Fenner)	RM 8.0 37S-7W-18	Co, ChF. ST	2
Trib A (Waters Cr.)	2 round culverts 28" & 34" dia.	Near mouth 37S-7W-5	CT	1
Newt Gultch	Culvert	RM 0.1 37S-7W-9	CT, ST	1
Knight Creek	RCBC	RM 0.04 37S-7W-18	Co, ST	1
Love Creek	CMP	RM 0.1 37S-7W-19	CT	1
Salt Creek	CMP	RM 0.1 37S-7W-8	Co, ChF. ST	2
Squaw Gultch	2'x3' metal culvert	RM 0.6 37S-7W-4	CT	1
Minnie Creek	6'x3' metal culvert	RM 0.1 37S-7W-1	CT	1
Minnie Creek	5' metal culvert	RM 0.4 37S-7W-1	CT	1
Minnie Creek	6' concrete dam	RM 0.5 37S-7W-1	CT	3

*CMP: Corrugated Metal Pipe

**RCBC: Reinforced Concrete Box Culvert

[1] Species: CT-Cuthroat trout; ST-Steehead; ChF.-Fall Chinook; Co-Coho.

[2] Passage Rank Scale: 1-Passage limited under certain flows; 2-Passage limited under most flow conditions; and 3- Passage limited under all flow conditions.

Barriers Identified during the 1996 ODFW habitat survey

Barrier Name	**Structure Type**	Location rivermile	Height Meters
	Boulder/Cobble Dam	1.2	0.7
	Boulder/Cobble Dam	1.5	0.4
	Boulder/Cobble Dam	1.6	0.3
	Boulder/Cobble Dam	1.9	0.4
Lovelace	Concrete Check Dam	2.7	1.5
	Boulder/Cobble Dam	3.6	0.4
	Boulder/Cobble Dam	5.3	0.4
	Boulder/Cobble Dam	5.7	0.4
	Boulder/Cobble Dam	5.8	0.4
Harbolt #1	Concrete Check Dam	6.7	2.0
Harbolt #2	Concrete Check Dam	6.7	1.3
	Boulder/Cobble Dam	6.9	0.4
	Boulder/Cobble Dam	7.0	0.7
	Concrete/Wood	7.0	0.7
	Boulder/Tin Sheet	7.2	0.7
	Boulder/Cobble Dam	7.3	0.4
	Boulder/Cobble Dam	7.4	0.3
	Boulder/Cobble Dam	7.7	0.8
Fenner	Boulder/Tin/Log Dam	8.3	0.7
	Boulder/Cobble Dam	8.6	0.4

Stream	**Chinook**	**Coho**	**Steelhead (S)**	**Steelhead (W)**	**Resident Trout**
Slate Creek	8.1	11.0	15.25	15.25	15.4
Butcher Knife Creek	1.0	1.5	2.6		2.9
Buckeye Creek					1.0
Bear Creek	0.3	0.3	0.8		1.0
Cedar Log Creek		0.5	0.95	0.95	1.25
Knight Creek		0.5	0.3		
Love Creek					0.06
Round Prairie Creek	0.5	0.3	1.3		2.0
South Fork Round Prairie Creek	0.5	0.2	1.0		2.0
Salt Creek	0.3	0.5	0.5		1.7
Ramsey Creek		1.1	2.1		2.1
Waters Creek	2.0	2.5	3.0		4.3
Elliot Creek	1.5	2.2	2.4		2.9
Welter Creek					0.25
Little Cedar Creek					0.7
Haven Creek			1.2		1.5
Newt Creek			1.0		1.0
Minnie Creek					0.5
Squaw Gulch					1.0
Sulpher Gulch					0.3
Right Fork Waters Creek		1.0			
Grantham Gulch					0.04
Mine Cabin Creek					0.1
Dutch Creek					2.0

Stream	Chinook	Coho	Steelhead (S)	Steelhead (W)	Resident Trout
Buckeye Creek					1.0
Silver Fork					1.75
Trib B(37S-8W-10) trib to Ramsey Cr					2.0
Trib B1(37S-8W-11) trib to Trib B of Ramsey Cr					0.3
Trib A(37S-8W-24) trib to Butcher Knife Cr			0.3		0.7
Trib B(37S-8W-24) trib to Butcher Knife Cr		0.2			0.5
Trib B1(37S-8W-13) trib to Trib B of Butcher Knife Cr					0.1
Trib B(36S-8W-24) trib to Slate Cr					0.1
Trib D(37S-8W-2) trib to Ramsey Cr					0.3
Trib H(37S-7W-5) trib to Waters Cr					0.05
Trib A(37S-7W-21) trib to Elliot Cr					0.2
Trib A1(37S-7W-21) trib to Trib A of Elliot Cr					0.07
Trib G(36S-7W-33) trib to Right Fork Waters Cr					0.3
Trib A(37S-7W-5) trib to Waters Cr					0.02
Trib B(36S-7W-31) trib to Waters Cr					0.2
Trib B1(36S-7W-31) trib to Trib B of Waters Cr					0.2
Trib C(36S-7W-32) trib					0.5

Stream	Chinook	Coho	Steelhead (S)	Steelhead (W)	Resident Trout
to Waters Cr					
Trib F(37S-7W-7) trib to Slate Cr		0.2			0.9
Trib G(37S-7W-17) trib to Slate Cr					0.1
Trib C(36S-8W-35) trib to Cedar Log Cr					0.4