MIDDLE COW CREEK WATERSHED ASSESSMENT AND ACTION PLAN

Prepared by

Heidi Kincaid, Umpqua Basin Watershed Council

Contributors
Janet Levinson Barnes, Land and Water Environmental Services
Bureau of Land Management
Nancy Geyer, Umpqua Basin Watershed Council
Oregon Department of Forestry

Reviewers
Board of Directors, Umpqua Basin Watershed Council
Mark Kincaid, Lone Rock Timber Company
Middle Cow Creek Landowner Group
John Runyon, Watershed Professionals Network
Technical Advisory Committee, Umpqua Basin Watershed Council

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Umpqua Basin Watershed Council
1758 Northeast Airport Road
Roseburg, Oregon 97470
(541)673-5756
www.ubwc.org

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1. Introduction

1.1. Purpose of the Watershed Assessment and Action Plan

The Umpqua Basin Watershed Council

The Middle Cow Creek Watershed Assessment and Action Plan was prepared by the Umpqua Basin Watershed Council (UBWC). The UBWC is organized to address issues of water quality and fish habitat in accordance with the Oregon Plan for Salmon and Watersheds. The Umpqua Basin Watershed Council is a non-profit organization, which represents interest groups of agriculture, livestock, timber, aggregates, construction, mining, fishing, recreation, conservation, cities, special districts, public utilities, and the county. Council members are working toward effective, efficient, and doable management solutions for clean water and healthy, native fish populations. As a part of these efforts, the Watershed Council is conducting watershed assessments and defining action plans for the watersheds of the Umpqua Basin.

Watershed Assessment and Action Plan

The purpose of this Watershed Assessment is to:

1. Understand the current status of water quality and stream conditions for fish habitat
2. Understand the processes that affect these conditions
3. Discover restoration opportunities in regards to water quality and fish habitat

When the Watershed Assessment uncovered restoration opportunities that could be done voluntarily by landowners, an Action Plan was developed. This action plan lists both general areas of concern and specific restoration projects.

The purpose of an Action Plan is to:

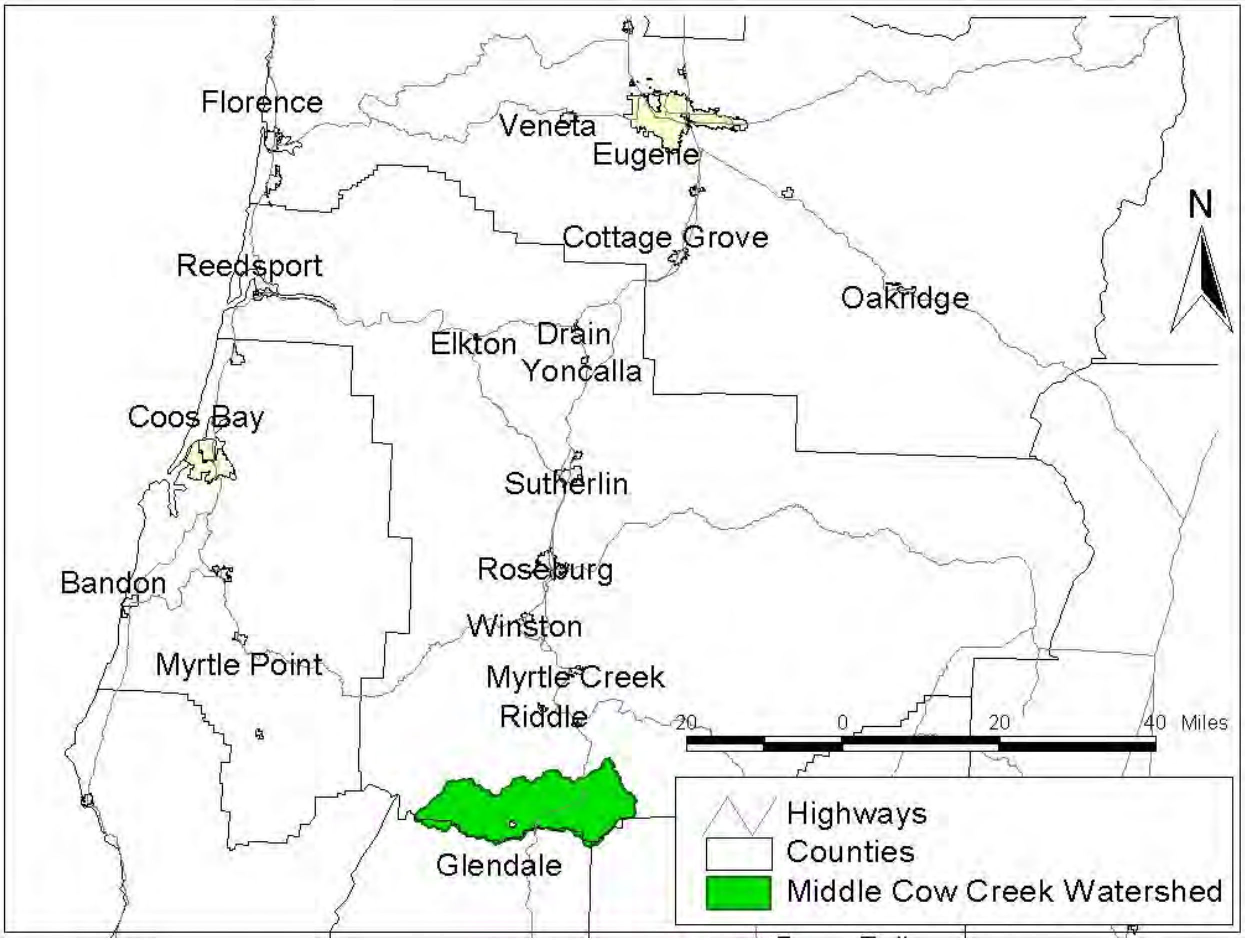
1. Provide a reference list of activities and locations thereof that improve the water quality and fish habitat in the watershed.
2. Recommend future data collection needs.
3. Determine opportunities for objective-based landowner training and education programs.
4. Identify resources to support voluntary or grant-funded actions.

1.2. Process of the Watershed Assessment and Action Plan

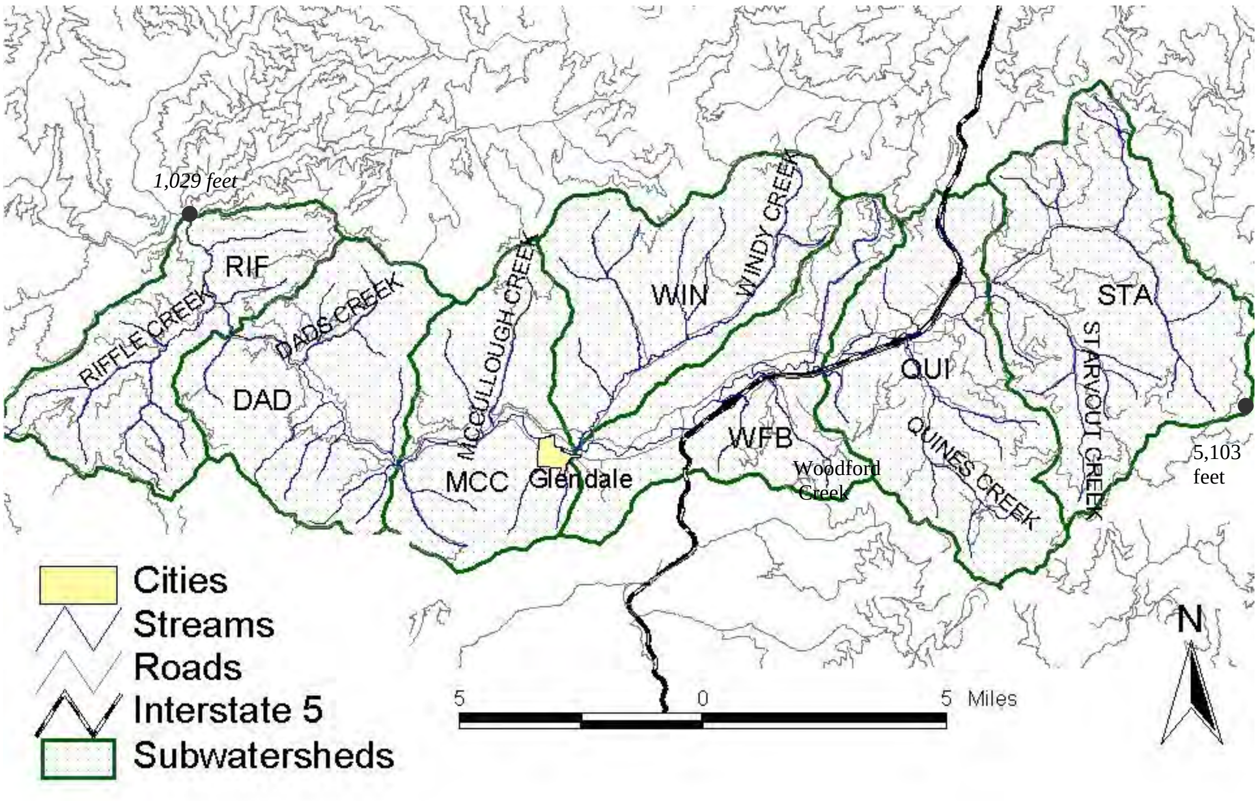
The Middle Cow Creek Watershed Assessment process has been contributed to by a group of local landowners. The group met fifteen times to review data about their watershed going into the document and portions of the watershed assessment. Members of the Middle Cow Creek landowner group represented private landowners, private industrial timber companies, rural residents, the City of Glendale, the Bureau of Land Management Medford District (BLM), the Oregon Department of Forestry, the UBWC, and the Oregon Department of Environmental Quality (DEQ).

1.3. Watershed Description

The Middle Cow Creek Watershed is 113,023 acres and is located in the southern part of Douglas County (Map 1:1). The watershed begins at the Galesville Dam and continues 34 miles downstream to the confluence of Cow Creek and Middle Creek (Map 1:2). The watershed contains the city of Glendale, which is 22 miles North of Grants Pass along Interstate 5. The highest point in the watershed is Cedar Springs Mountain at 5,103 feet elevation and the lowest point is at the confluence of Middle Creek to Cow Creek at 1,029 feet elevation.



Map 1:1 Vicinity Map



Map 1:2 Middle Cow Creek Watershed

Subwatershed Abbreviations

For the purpose of this watershed assessment, the Middle Cow Creek Watershed has been divided into seven subwatersheds by which much of the data will be summarized. These subwatersheds can be seen in Map 1:2. Table 1-1 describes which creeks are located in each subwatershed.

SUBWATERSHED	STREAMS	SUBWATERSHEDS	STREAMS
Riffle Creek Subwatershed (RIF): 13,637 Acres	Susan Creek	Woodford/Fortune Branch Subwatershed (WFB): 13,875 Acres	Swamp Creek
	Riffle Creek		Woodford Creek
	Bonnie Creek		Fortune Branch
	Sled Creek		
Dads Creek Subwatershed (DAD): 15,752 Acres	Skull Creek	Quines Creek Subwatershed (QUI): 18,334 Acres	McCollum Creek
	Dads Creek		Quines Creek
	Benson Gulch		Bull Run
	Cook Creek		Little Bull Run
	Tuller Creek		Tennessee Gulch
	Marion Creek		S Fork Quines Creek
	Battle Creek		Wildcat Creek
	Panther Creek		Blue Creek
	Perkins Creek		Clear Creek

McCullough Creek Subwatershed (MCC): 13,885 Acres	Rattlesnake Creek	Starvout Creek Subwatershed (STA): 21,956 Acres	Booth Gulch
	Stevens Creek		Starvout Creek
	Totten Creek		Hogum Creek
	McCullough Creek		Fizzleout Creek
	Lunsbury Creek		Boulder Creek
	Section Creek		Jones Creek
	Mill Creek		Russel Creek
Windy Creek Subwatershed (WIN): 15,710 Acres	Windy Creek		W Fork Russel Creek
	Deeds Creek		Whitehorse Creek
	Wood Creek		E Fk Whitehorse Ck
	Lawson Creek		Blackhorse Creek
	Bear Creek		Albro Creek

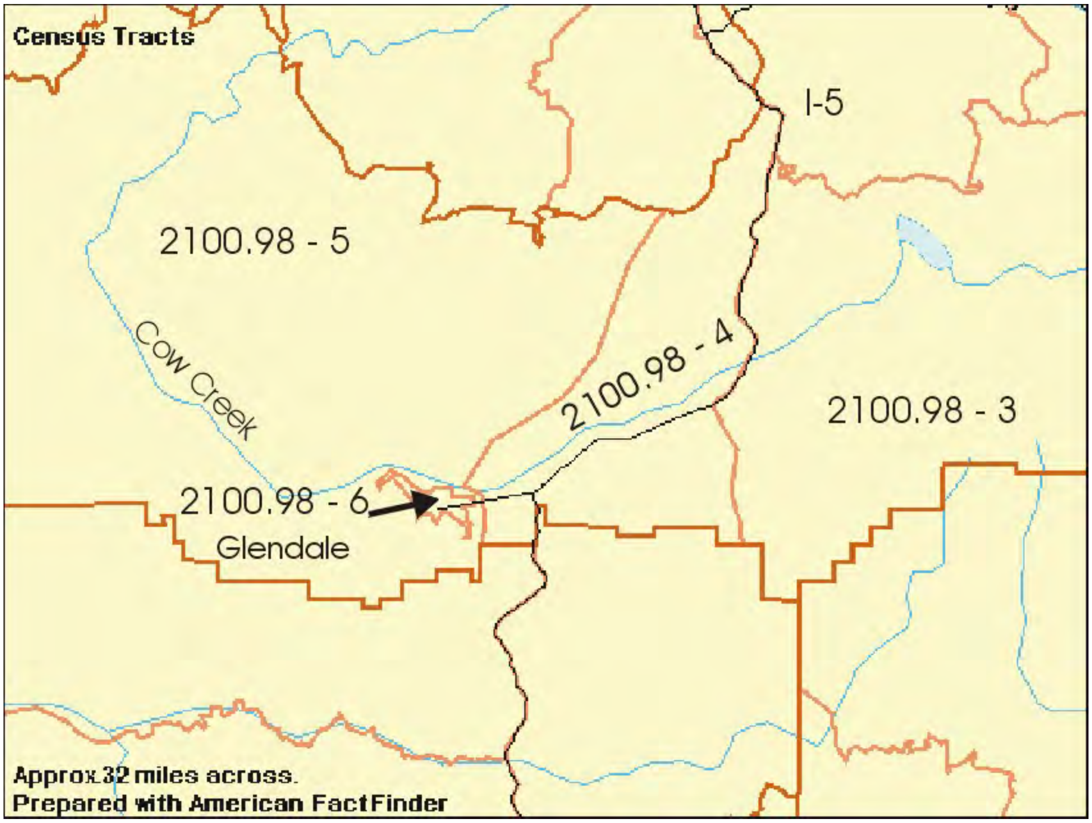
Table 1-1 Subwatersheds

1.3.1. Population

The population of the Middle Cow Creek Watershed was approximately 2,750 in 1990 (US Census data). There is one census tract that contains the entire Middle Cow Creek Watershed (Map 1:3). A census tract is a geographic unit defined by the U.S. Census Bureau. Census tracts are further subdivided into block groups. Table 1-2 shows the 1990 population count in each of the four block groups that cover the Middle Cow Creek Watershed. The city of Glendale (2100.98 – 6) contained 725 people in 1990, which is about 26% of the population of the Middle Cow Creek Watershed.

Name	Census Tract – Block Group	1990 Population
East Middle Cow Creek	2100.98 – 3	664
Woodford – Fortune Branch	2100.98 – 4	665
West Middle Cow Creek	2100.98 – 5	697
Glendale	2100.98 – 6	725
Total		**2,751**

Table 1-2 Middle Cow Creek 1990 Population



Map 1:3 Census Tracts in the Middle Cow Creek Watershed

1.3.2. Ecoregions

Ecoregions are a way to describe areas with similar climate, geology, and vegetation patterns. According to Omernik's Level IV ecoregion classification (1998), the entire Middle Cow Creek Watershed is located within the Inland Siskiyous ecoregion. The Roman numeral of the ecoregion classification denotes the scale and detail of the ecoregion description. For the Level I Ecoregion, the coarsest level, North America was divided into fifteen ecological regions. At the Level III Ecoregion, the continental United States was divided into 98 regions. The Level IV Ecoregions are a further division of the Level III Ecoregions (Omernik 1998).

The Inland Siskiyous ecoregion is considered mountainous. Granitic and sedimentary rocks underlie the ecoregion and distinguish it from the volcanic mountains of the Cascades. Greater fire frequencies, less annual precipitation, longer summer droughts, and less tanoak differentiate it from the neighboring Coastal Siskiyous ecoregion (Omernik 1998).

1.3.3. Geologic Overview

The Middle Cow Creek watershed lies in the northern Klamath Mountains physiographic province (Map 1:4). A physiographic province is a region in which all parts are similar in climate and geologic structure, and whose pattern of relief features or landforms differs significantly from that of adjacent regions. The following geologic information is from Blake et al. (1985), Pessagno and Blome (1990), Walker and MacLeod (1991) and Orr and Orr (1999).

More detailed geologic mapping and interpretation of the area is available from Wells et al. (2000).

Klamath Mountains Physiographic Province

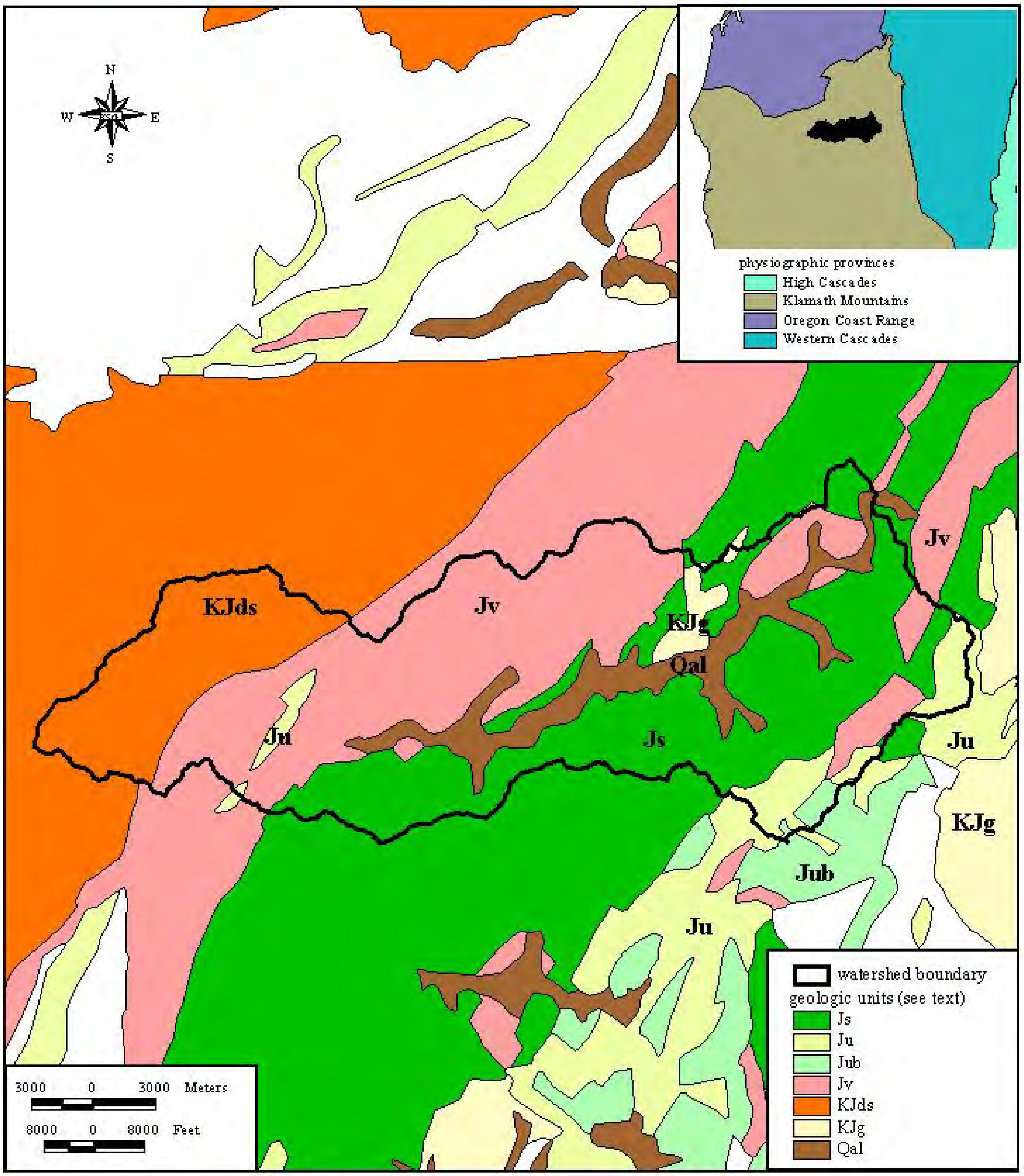
The geology of the Klamath Mountains is particularly complex, and the following overview is general. The Klamath Mountains are composed of slabs of oceanic rock with overlying sedimentary rock. The slabs collided with, and were fused to the North American continent. As the slabs were fused to the continent, the succeeding slabs were thrust beneath each other like shingles on a roof, with the first to the southeast and the last to the northwest (imagine the Hawaiian islands thrust onto the Pacific Coast, followed by another island chain, which was shoved underneath, etc). Hence, each slab is separated by a major thrust fault. In addition, the tremendous pressures involved caused much folding and many faults within the slabs. That is, the various rock units that comprise an individual slab generally do not lay one on top of another, i.e., “layer cake” stratigraphy.

The Middle Cow Creek watershed contains rocks mostly from the Rogue Valley subterrane, with rocks from the Yolla Bolly terrane in the northwest portion of the watershed, and rocks from the Rattlesnake subterrane in the southeast portion of the watershed (Map 1:5). All of the terranes are separated by fault zones, and have been intruded by molten masses of granitic rocks (KJg, Map 1:4). Map 1:4 shows the rock types present at the ground surface (bedrock) in the vicinity of the watershed. In general, only rock types present in the watershed are discussed in this report.

The oceanic rock is largely basalt and andesite (Jv) and ultramafic rocks (Ju). Basalt is a black, very fine-grained volcanic rock. Andesite is a salt and pepper-colored, very fine-grained volcanic rock. Ultramafic rocks are greenish black rocks from the Earth’s mantle that are extremely rich in iron and magnesium and low in silica. The overlying sedimentary rock (KJds) is mostly yellowish brown sandstone and brown shale (fissile mudstone) or black phyllite (shale partially converted to slate). In places, the overlying sedimentary rock unit is composed of numerous thin (6-16 cm/2-6 inches) chert beds. Chert is a hard, extremely dense rock, consisting dominantly of interlocking, microscopic quartz crystals.

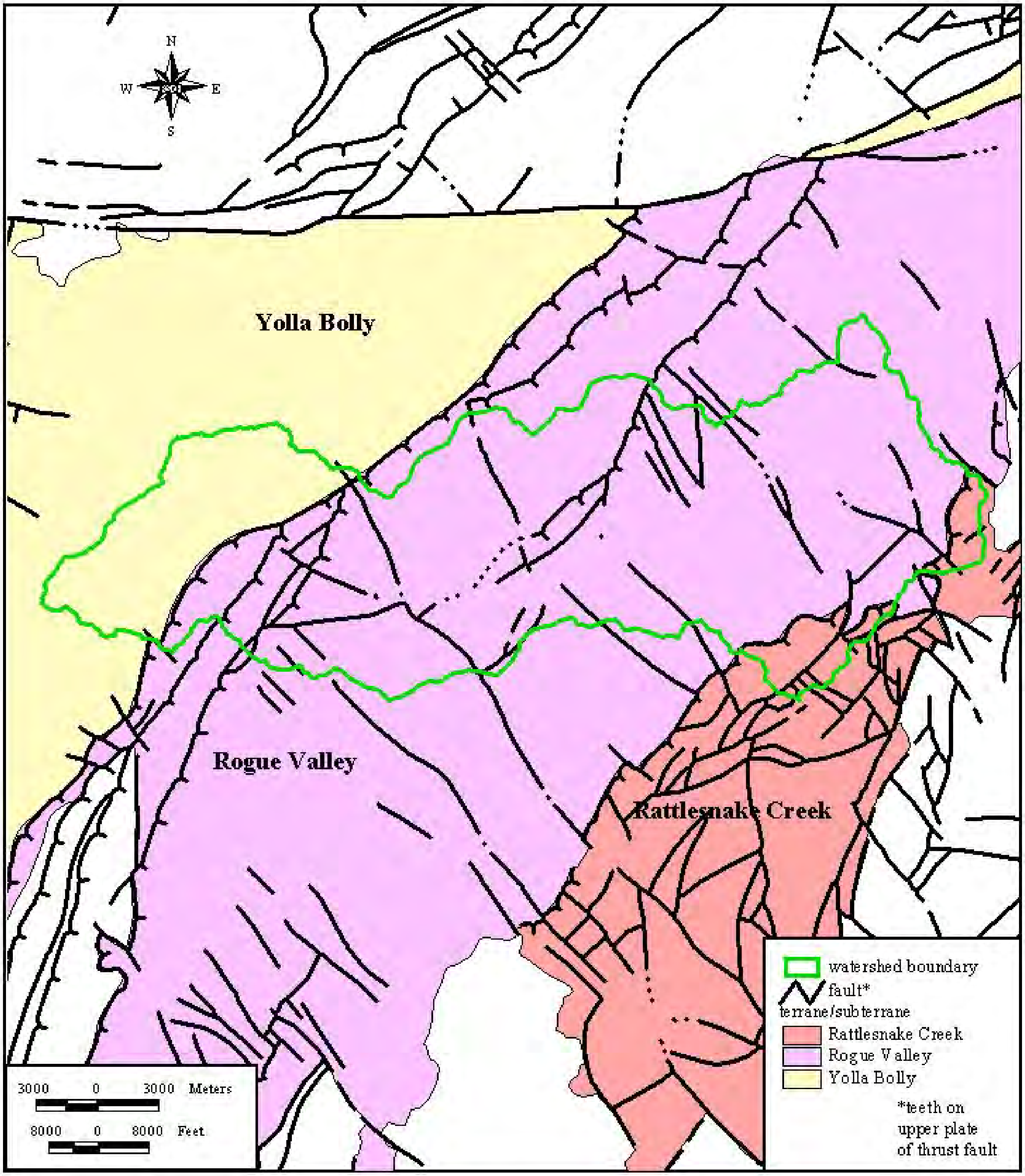
The unit Js is composed of mudstone, shale, and very fine-grained sandstone mixed with water-laid volcanic ash. The unit Jub is composed of basalt intermixed with shale, chert, siltstone and mudstone. Stream deposits of sand, gravel and silt (Qal) are mapped over the bedrock along portions of Cow Creek in the watershed.

The Klamath rocks are highly deformed (i.e., compacted, distinctly folded, sheared) to the point where new rock textures and minerals have formed. For example, many of the grains in the sandstone rocks are partially fused and these rocks are most properly termed “metasandstone.” Also, alteration of minerals in much of the basalt and ultramafic rock has left a yellowish green rock termed “serpentinite” or “greenstone.” All Klamath rocks near the ground surface display various degrees of yellow-brown-red iron stain, the result of weathering. In addition, abundant veins of quartz and calcite typically occur throughout the rocks.



Map 1:4 Aerial Geology (after Walker and MacLeod, 1991)

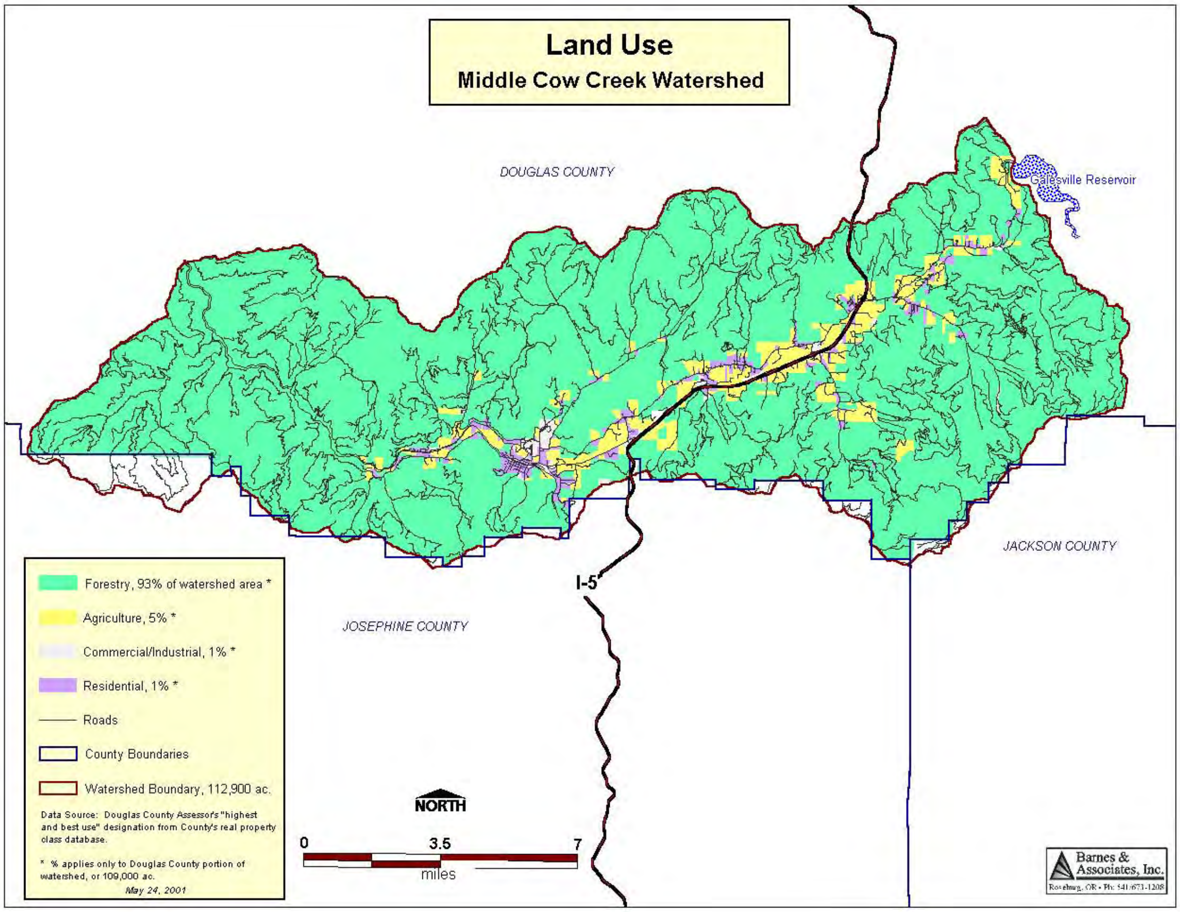
The orientation of rock units in the watershed is distinctly northeast-southwest, although the overall grain of the terranes curves northeast by southwest, with the convex side to the northwest. Two major faults sets occur in the watershed region. The first set trends northeast-southwest, whereas the second set is perpendicular and trends northwest-southeast (Map 1:5).



Map 1:5 Fault lines and terranes/subterranes (after Walker and MacLeod, 1991; Orr and Orr, 1999).

1.3.4. Land Ownership and Land Use

The Middle Cow Creek Watershed is entirely located within the Inland Siskiyous Ecoregion and consists of mountains with deep, v-shaped stream valleys. The land use and ownership reflects this rugged landscape. As shown in Map 1:6, the small amount of agricultural, residential, and industrial land is limited to the lower elevation valleys, mostly around Cow Creek and its major tributaries. The remaining 93% of the Middle Cow Creek Watershed is used for forestry.

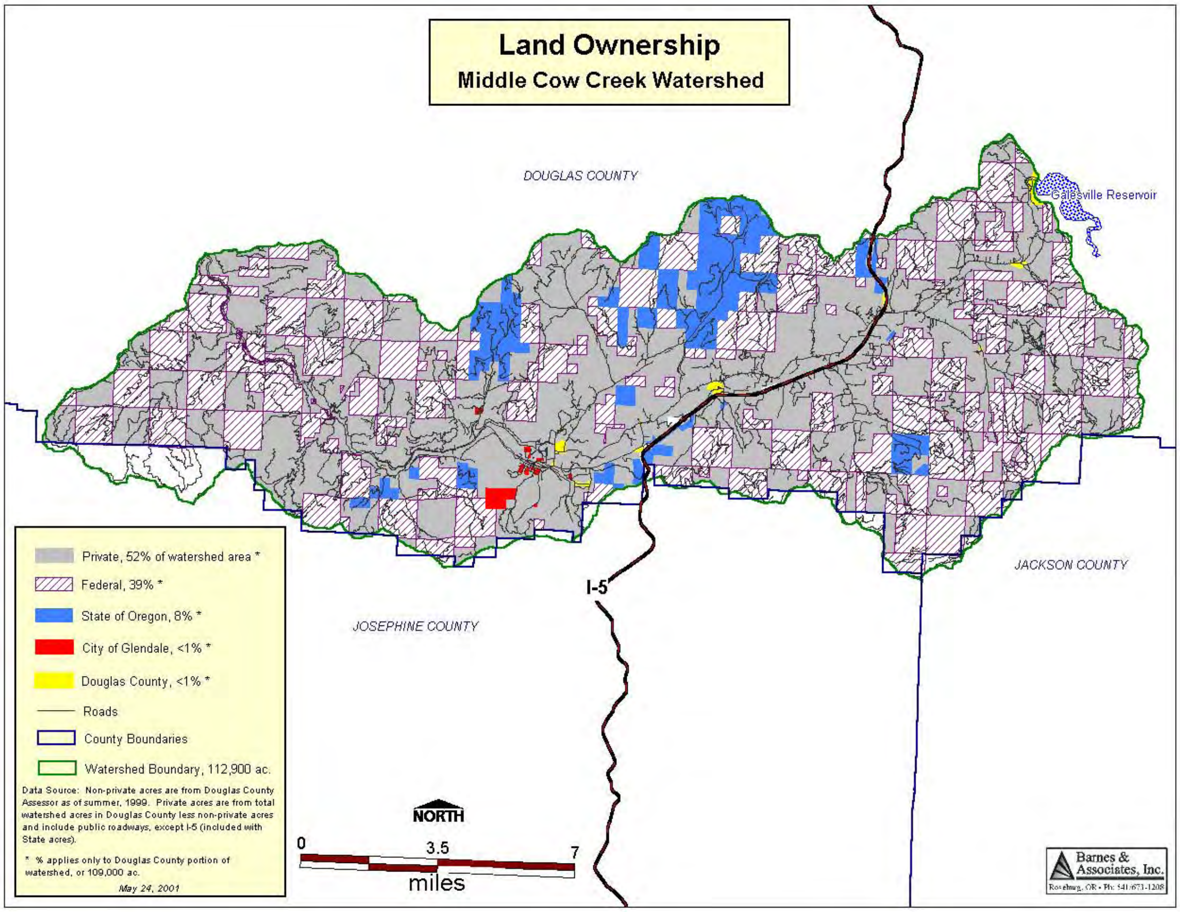


Map 1:6 Land Use

The land ownership within Middle Cow creek is evenly split between public and private ownership (Map 1:7). As expected, most of the land adjacent to Cow Creek and in the Glendale area is privately owned, with some small holdings by the City of Glendale, Douglas County, and the State of Oregon. Beyond the Cow Creek valley, the ownership is a checkerboard of private and public lands. The majority of public land is federally owned and managed by the BLM. The Oregon Department of Forestry also managed land in the Middle Cow Creek mountains. Industrial timber companies own most of the private land outside of the Cow Creek valley and the City of Glendale.

Land ownership and land use were determined for the portion of the watershed that lies in Douglas County (109,000 of 112,900 acres [96.5%]). About half of the watershed (52%) is in private ownership, including most of the property along Cow Creek, and intermixed throughout the uplands among government lands. The federal ownership is 39%, mainly belonging to the BLM. The state of Oregon owns 8% of the watershed, with the major holdings located in the headwaters of McCullough and Windy Creeks. Douglas County ownership is less than 1%. The City of Glendale also owns less than 1% of the watershed, with the properties being mainly in Glendale and in the upper part of Section Creek.

Most of the landuse of the Middle Cow Creek Watershed is forestry (93%). Excluding the Riffle Creek and Dads Creek subwatersheds, most of the agricultural lands are along Cow Creek and compose 5% of the watershed. Less than 1% of the watershed is zoned as residential, with the concentration of this occurring in and around Glendale. There is less than 1% of the watershed in industrial use, mainly in Glendale near the confluence of Windy Creek.



Map 1:7 Land Ownership

1.3.5. Fish of the Middle Cow Creek Watershed

Both anadromous (spawn in fresh water and spend a portion of their life in the ocean) and resident fish are present in the Middle Cow Creek Watershed. The anadromous fish which are found in this watershed are winter steelhead (*Oncorhynchus mykiss*), coho (*O. kisutch*), fall chinook salmon (*O. tshawytscha*), and sea-run cutthroat trout (*O. clarkii*). Resident cutthroat and rainbow trout (*Salmo gairdneri*) inhabit the watershed, as well as non-game species such as Umpqua dace (*Rhinicthys cataractae*), Pacific lamprey (*Lampetra tridentata*), sculpin (*Cottus sp.*), and redside shiner (*Richardsonius balteatus*). According to the BLM, bluegill (*Lepomis macrochirus*), largemouth bass (*Micropterus salmoides*), and smallmouth bass (*M. dolomieui*) have also been reported (BLM, 1999).

The National Marine Fisheries Services, charged by the Endangered Species Act to review the status of anadromous fish species, has determined the Oregon Coast coho salmon to be threatened, although this designation was challenged and has not yet been resolved as of December 16, 2001. On federal lands, Cow Creek and its tributaries below natural waterfall barriers, along with a 300-foot riparian buffer on each side of the creek, has been designated as critical habitat for the coho salmon.

2. Past Conditions

The landscape of the Middle Cow Creek watershed has changed dramatically since the time of European exploration and settlement in the 1800's. Native American use emphasized hunting and gathering, with the rivers and streams providing abundant food resources such as salmon, Pacific lamprey, and mussels. These people managed the land primarily by setting fires to create open areas for game and to maintain prairies for camas and other food plants (Robbins, 1997).

From the beginning of settlement in the 1840's, the population of Douglas County has steadily increased (Table 2-1). This population growth, with its associated land use activities of farming, industry, housing, and logging, along with the corresponding change in the fire regimes, has had a dramatic impact on the watershed's present vegetation patterns and stream channels. These changes in the watershed's character have affected fish and wildlife habitat and populations. The suppression of wildfire, for example, has resulted in the conversion of areas that were once grass lands and open oak woodlands to conifer forests and agricultural pastures (Robbins, 1997). The largest population increase occurred between 1940 and 1950, when the Douglas County population more than doubled.

Year	Douglas County Population
1900	14,565
1910	19,674
1920	21,332
1930	21,965
1940	25,728
1950	54,549
1960	68,458
1970	71,743
1980	93,748
1990	94,649
2000	100,339

Table 2-1 Douglas County population trends (US Census Bureau)

2.1. Timeline of selected events and vegetation observations

1818 First recorded encounters between Umpqua Indians and white settlers (Bakken, 1970).

1840's Landscape is composed of prairies and woodlands, prairies occupy greater portion of the countryside, timber being principally along watercourses and on the bordering mountains (Robbins, 1997).

1841 "*Air is thick and smoky – the sun only seen occasionally. Principally oak trees with grass beneath*" (Robbins, 1997).

South Umpqua – "*camped on narrow prairie ground with very little vegetation or grass and that very dry and burnt, affording exceedingly scant allowance for animals"* (Robbins, 1997).
"*Hills surrounding valley 12 – 1500' in height with grass exceeding to summits, tops scattered with pines and oaks"* (Robbins, 1997).

1850 A dramatically altered landscape and ecology – within a decade the scattered oak openings and prairie grasslands turned into farms and fenced pasture (Robbins, 1997).

1850-1930 Agriculture development, scrub and forested riparian areas cleared, prairies plowed to the streams, lowland converted to fields.

1861 A flood that destroyed Scottsburg on the lower river washed away mills and bridges and halted mail and express shipments for a time (Bakken).

1901 City of Glendale incorporated.

1950-1980 Large wood and log jams removed from streams as an effort to improve fish passage.

1964 Flood.

1966 Interstate 5 constructed.

1974 Flood.

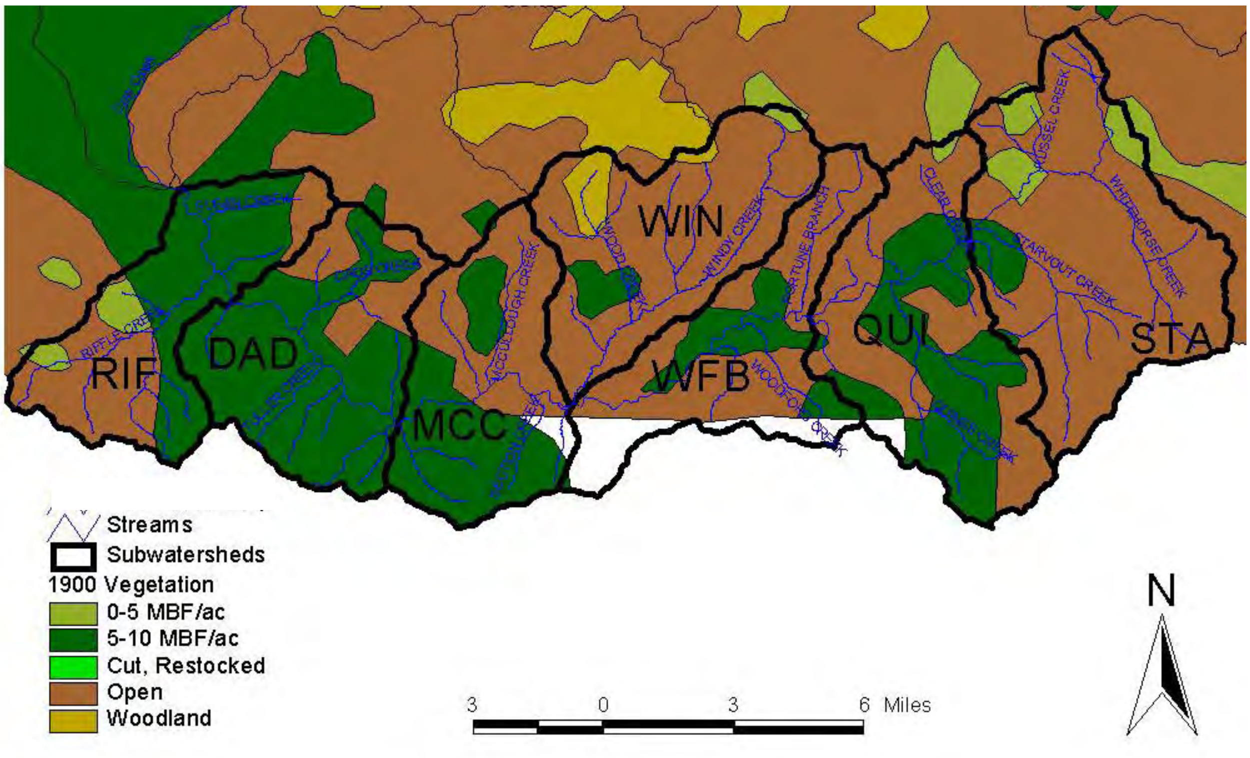
1986 Construction of Galesville Dam.

1990 Douglas County population was 94,649; Middle Cow Creek Watershed population was approximately 2,750.

2000 Douglas County's population is over 100,000.

2.2. Historical Vegetation

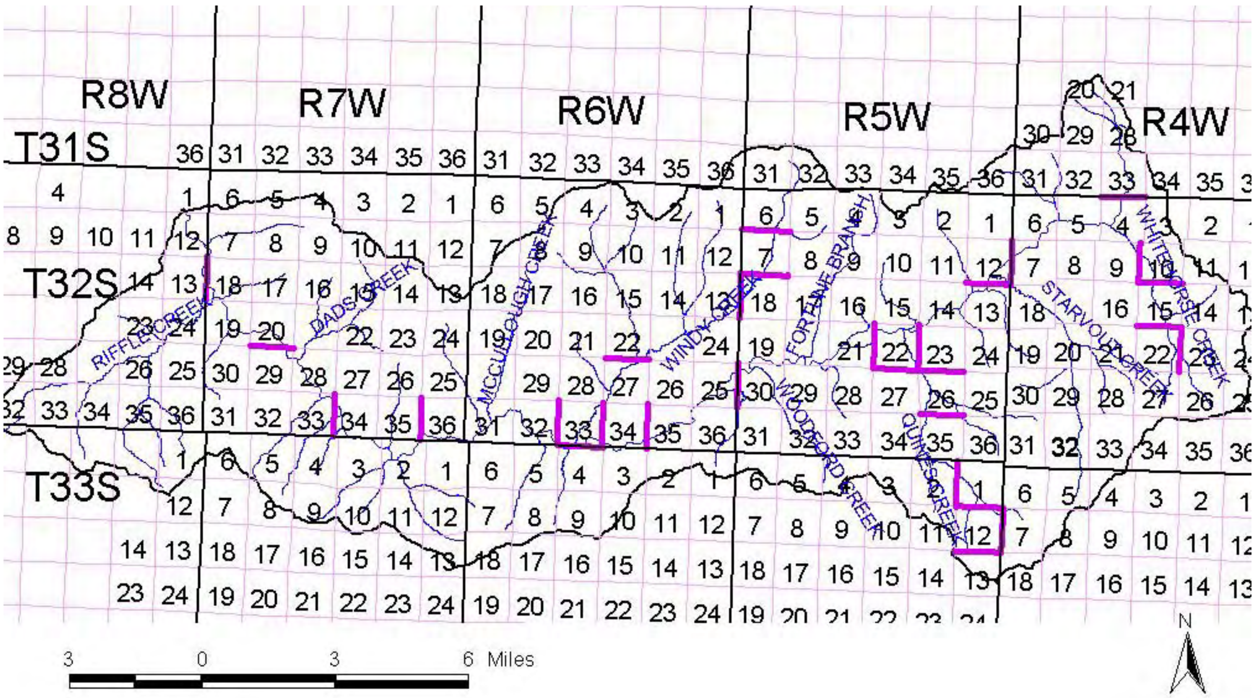
A vegetation map (Map 2:1) (Gannett, 1902) illustrates vegetation patterns of 1900. This historical vegetation pattern depicts management regimes of the 1800's, with fires happening frequently. In 1900 most of the landscape of the Middle Cow Creek Watershed was either open or forested with five to ten thousand board feet per acre (young forest or low stocking). The more forested subwatersheds included RIF, DAD, and the southern part of MCC. STA and WIN were mostly open. The most southern part of the watershed in WFB had been cut and restocked, possibly in connection with the railroad up Woodford Creek.



Map 2:1 1900 Vegetation in Middle Cow Creek

Government Land Office Public Land Surveys

The Government Land Office (GLO, now the Bureau of Land Management) conducted Public Land Surveys between 1854 and 1901 in order to delineate Townships, Ranges, and Sections. As the surveyors walked and marked the lines, they took notes on geologic and vegetation observations. Twenty-nine section lines that cross Cow Creek and some of its tributaries were reviewed to learn about the vegetation in the area during this time period (purple lines on Map 2:2). The hills were principally covered with dense timber or undergrowth. The bottomlands contained many prairies, and there was much brush and trees along the creeks. The dense brush mentioned around Whitehorse Creek corresponds with the open area described in the 1900 vegetation map. A summary of the vegetation recorded for the twenty-nine surveys is given in Table 2-2, and the details are presented in their entirety in Appendix A.



Map 2:2 Public Land Survey Section Lines

Location	Year	Vegetation Observations
Windy Creek:		
T32S R5W 7N	1900	Covered heavily with fir, cedar, and sugar pine. Mountainous or heavily timbered land.
T32S R5W 18N	1901	Mountainous land covered heavily with timber of fir, cedar, sugar pine, chinkapin, and laurel.
T32S R6W 13E	1855	Vine maple along creeks, fir timber on hills.
T32S R6W 22S	1855	Partially fir timber and partially open oaklands. Vine maple and prairies on bottoms.
T32S R6W 33E	1855	Timber along creek of balm, madrone, ash, and alder. Pine and oak along ridges. Some pine diameters ranging from 24 to 32 inches.
T32S R6W 33S	1855	Cow Creek bottom with ash, alder, vine maple, and some fir timber, dense undergrowth.
Quines Creek		
T33S R5W 13N	1893	Land mountainous with rocky spurs, bluffs and boulders; Heavy timber of fir, pine, cedar, and yew, with dense undergrowth.
T33S R5W 12E	1893	Land mountainous with rocky spurs, bluffs and boulders; Heavy timber of fir, cedar, pine, and madrone, with dense undergrowth.
T33S R5W 2E	1893	Rough ground, mining, with pine and fir on slopes.
T33S R5W 12N	1893	Heavy timber of fir, cedar, pine, and madrone, with dense undergrowth.
T32S R5W 35N	1871	Rolling hills with timber of fir, pine, cedar, madrone, ash, laurel, and oak.
T32S R5W 26N	1871	Oak woodlands.

T32S R5W 22E	1855	Half prairies and openings, half heavily fir timbered with dense undergrowth.
Whitehorse Creek		
T32S R4W 22E	1897	Mountainous land with timber of fir, pine, cedar, yew, and madrone, with dense undergrowth.
T32S R4W 22N	1897	Heavily timbered or covered with dense undergrowth.
T32S R4W 15N	1897	Heavily timbered or covered with dense undergrowth.
T32S R4W 9E	1871	Land mountainous covered with dense undergrowth and scattered timber of fir, cedar, madrone, alder, and myrtle.
Cow Creek		
T31S R4W 33S	1871	Fir timber.
T32S R4W 7W	1854	Openings and fir timber. Ash, fir, and vine maple near creek.
T32S R5W 13N	1855	Marshy prairies.
T32S R5W 21E	1855	Brush and willows along creek. Prairie on bottom, fir, chinkapin and hazel undergrowth on mountain.
T32S R5W 27N	1855	Dense undergrowth and brush, some timber.
T32S R6W 25E	1855	Prairie and fir, balm, ash, and oak timber.
T32S R6W 34E	1855	Brush along Cow Creek, prairies, and balm, vine maple, and alder on bottom, pine and oak on mountainsides.
T32S R6W 32E	1855	Prairies and alder on bottom, thick timber and brush of fir, pine, oak, laurel, and balm on upper slopes.
T32S R7W 35E	1881	Timber fir, pine, cedar, and laurel.
T32S R7W 33E	1881	Timber pine, fir, cedar, and laurel.
T32S R7W 20S	1881	Cow Creek in rocky canyon.
T32S R8W 13E	1881	Timber fir, cedar, pine, yew, live oak, and laurel, with dense undergrowth.

Table 2-2 Vegetation Observations of 1854 – 1901 Public Land Surveys

2.3. Resident Interviews: Historical Information

Interviews were conducted with people who have lived in the Middle Cow Creek Watershed for up to sixty-nine years. The following comments describe landowner perspectives of changes and events of the Middle Cow Creek Watershed.

Wetlands: *Wetlands were not common in the Middle Cow Creek Watershed, but occurred more near the mouth of Cow Creek in areas with lower gradients. Two ponds on one landowner's property have not changed much in the last 40 years.*

Change in Water Flows: *Landowners on Woodford Creek described that the rate and intensity of the fluctuation between high and low flows have increased in Woodford Creek after intensive logging. This same section of the creek has been significantly reforested since the 1940s. As the* 2^{nd} *growth has become predominant, the water levels in the creeks have increased. A similar increase in flow after logging was also reported in Woods Creek. Other residents mentioned little change to their property.*

Vegetation on stream banks: *Before the construction of Galesville Dam, floods changed the course of the creek, clearing channels, removing streambank vegetation, and creating new spawning beds. A lack of streamside vegetation was evidenced by the ease with which one could walk up to the stream bank to fish. Today, it is much harder to get to the edge of the creek because of the dense vegetation along the streambanks. The landowners described that this vegetation also slows the creek along the banks and gravel beds are accumulating at confluences.*

Floods: *The 1964 flood was the largest flood observed by a resident who has lived in the watershed for 69 years. Both floods in 1964 and in 1974 reduced the number of meanders in the creeks.*

Logging: *One landowner was a part of a logging crew and remembers that in the 1950s and 1960s much of Cow Creek was logged with ground-based equipment regardless of the slope. Most of Dads Creek, Panther Creek, and Whitehorse Creek were cat logged, often in deep mud, resulting in creeks with high turbidity. Hillsides were often logged down to the stream, and in some cases logs were skidded down the creeks.*

Splash dams were sometimes used in the past to get logs to the mill. Evidence of these dams are noticeable in some areas were remnant logs are still buried in the creek.

In the 1950s there was a small mill at nearly every tributary. Logs were mostly bucked to 14 to 16 feet and brought with trucks to the mills.

In 1962 the first protective regulations for streams were implemented, which prohibited skidding down creeks and mandated the removal of temporary bridges before the fall rains.

Cow Creek was dammed at two locations: Snow Creek and near Whitehorse Creek. The mill-workers near Whitehorse Creek would extend a boom past the end of the dam and use Cow Creek as a log pond. If there was a large storm coming, the boom would be brought in and the logs held to the side of the creek. The salmon were able to jump over these dams. Often fifteen salmon could be seen in the air at a time, jumping over the dam.

In the 1970s and 1980s a logger was involved in removing wood from the creeks, even going as far as raking tree needles.

Agriculture: *Agriculture is much less common now than historically, with only a few of the large farms still intact.*

Irrigation Ditches: *In the past there were many irrigation ditches in the Middle Cow Creek Watershed. The Johns Ditch left Cow Creek at Whitehorse Creek and went all the way to Azalea. It was built around the time of World War II, and contained a big flume at the entrance to Cow Creek where the bank had slid away. There is currently still one large ditch in operation; many landowners are now using pumps.*

Mining: *Mining was done prevalent, but mostly just at a small scale. On Whitehorse Creek there were hard rock tunnels and ditches, and on Blackhorse Creek there was a placer mine. A sluice mine was located in the headwaters of Quines Creek, but it has stopped operating. The effects of the mines were evidenced to landowners who at one time saw a creek turned to mud for three months due to sediment coming from the mines.*

Railroads: *There were several railroad tracks that went up the valleys for hauling logs. The railroad in Windy Creek was still running in the 1940s.*

Results of construction of Galesville Dam: *The construction of Galesville Dam has affected flows and water quality. The intense floods of the winters have been reduced and the flows in the summers have been increased greatly. In the 1940s there were many deep holes warm enough for swimming, but today the water is much cooler. The release of water from the bottom of the reservoir and the increased amounts of water in the summer has not only decreased the water temperatures, but increased water quality, as pollutants are diluted.*

The changes in flow have also affected gravel movement and streambank vegetation. The reduced flows down Cow Creek have allowed the accumulation of large gravel beds at the confluences of tributaries such as Whitehorse Creek and Quines Creek, as high flows coming down the tributaries carry gravel to their confluence with Cow Creek and create large gravel bars at these sites. The high flows of the tributaries are also redirecting Cow Creek at these confluences. Streambank vegetation along Cow Creek is also increasing, as high floods that would cause meanders and the removal of streamside vegetation have been reduced.

Galesville Dam has provided benefits in the form of recreation on the reservoir, but has had a negative impact in the removal of access to habitat for salmonids above the reservoir. One landowner indicated that the planting of fish from the Rock Creek Hatchery is currently mitigating this effect.

Results of construction of Interstate-5: *In the 1960s there were many salmon in Woodford Creek, but the numbers were reduced almost to zero after the construction of Interstate 5. In 1995, the creek eroded 15 to 20 feet of one landowner's property, after new installation of riprap along Interstate 5.*

Wildlife observations: *In the past landowners remember large populations of coyotes, bobcats, and cougars in the Middle Cow Creek Watershed. Two wolves were even seen at the lookout at Diamond Rock. In the 1940s there were no elk in the Middle Cow Creek Watershed, however, they were introduced to Windy Creek and other areas in the 1960s, and have flourished.*

The abundance of wildlife is still great, but not as visible due to increased brush. The populations of bear, elk, cougar, and deer seem to be increasing. There are also still some mink and eagles. Ospreys have returned to their nests at one landowner's property for the past fifteen years. There are also still many beaver, which are usually found in the flat headwater areas.

Fish Presence: *Coho, chinook, cutthroat, and steelhead have been seen in Cow Creek and its tributaries. Many salmon have been in Windy Creek, and they were also seen historically in Woods Creek. The cutthroat trout seem larger now than they were in the 1960s and the 1970s.*

Causes for change in fish abundance: *A landowner described that fish abundance has increased since the 1960s. Recently, there have been a tremendous amount of coho and a good amount of chinook. In 2000, the steelhead run was also very productive.*

Landowners also commented that the increased streambank vegetation and decreased water temperatures have helped to provide better fish habitat. However, the change in gravel movement has been harmful to fish, as access to tributaries, such as Whitehorse Creek, is more difficult.

2.4. Historical Fish and Fish Habitat Observations

There is very little documented information on fish use or habitat before the 1970's. In 1970 and in 1976, during the months of July and August, the Oregon Department of Fish and Wildlife (ODFW) conducted a total of 176.8 miles of stream surveys on Cow Creek and many of its tributaries. The fish that were recorded in the watershed during the 1970's were coho salmon, winter steelhead salmon, cutthroat trout (sea-run), resident trout, rough fish[1], and warm-water game fish. During the time of the surveys, the watershed was closed to salmon and steelhead angling. Information from the 1970 surveys also helps to describe conditions of the creeks (Table 2-3, this table also lists miles surveyed per creek).

CREEK	MILES SURV-EYED	OBSERVATIONS
Cow	81	Up to river mile 70: high water temperatures. From river mile 40 to mile 54: irrigation diversions near Azalea take all the surface flows in the summer.
RIF SUBWATERSHED		
Riffle	6	River mile 0 to mile 30: Logging has exposed streambed to sunlight, very poor reproduction of vegetation.
Bonnie	4	No observations recorded.
DAD SUBWATERSHED		
Skull	2	River mile 0 to mile 1: culvert under BLM road blocks access.
Dads	4	No observations recorded.
Tuller	1.6	No observations recorded.
Marion	2.4	River mile 0 – mile 2.4: excessive gradient for fish.
MCC SUBWATERSHED		
Rattlesnake	4	No observations recorded.
Totten	3.6	Logjam at river mile 0.25.
McCullough	5	River mile 0.25 to mile 1.5: unscreened diversion.

[1] Rough fish are non-game fish such as dace, shiners, and suckers.

WIN SUBWATERSHED		
Windy	9	At river mile 1.5: unscreened diversion; River mile 0 – mile 4: low summer flows and high temperatures; River mile 0 – mile 4: streambanks destroyed and littered with domestic junk.
Wood	4	No observations recorded.
Bear	4	No observations recorded.
Lawson	2.5	No observations recorded.
WFB SUBWATERSHED		
Woodford	3	No observations recorded.
Fortune Branch	4.5	River mile 0 – mile 0.4: Passage problems from ill-defined channel at mouth.
QUI SUBWATERSHED		
Quines	6	River mile 0 – mile 0.5: Diversion unscreened and cuts off summer flow, domestic development and water uses.
Bull Run	4	No observations recorded.
Little Bull Run	2.3	No observations recorded.
Tennessee Gulch	2	No observations recorded.
Blue	2	No observations recorded.
STA SUBWATERSHED		
Starvout	6	River mile 0 – mile 2.5: domestic development. Irrigation, gravel removal, and septic wastes. Domestic water use and low summer flows.
Hogum	1.5	No observations recorded.
Boulder	1	No observations recorded.
Fizzleout	2	No observations recorded.
Russel	3	No observations recorded.
Whitehorse	6.4	No observations recorded.

Table 2-3 1970 Creek Observations

The surveys from 1976 included the annual population of adult spawners (escapement) for each species of salmon and steelhead present[2]. Figure 2-1 shows the coho salmon spawning (escapement) population in 1976. The largest population was found in Cow Creek, followed by Windy Creek, Quines Creek, Starvout Creek, Riffle Creek, and Whitehorse Creek. The largest population per stream mile was found in Windy Creek, followed by Quines Creek, Hogum Creek, Riffle Creek, Starvout Creek, and Tennessee Gulch.

[2] The biologists were instructed to use their best estimates in the cases in which they did not have data, but did not keep records showing in which cases they made these estimates.

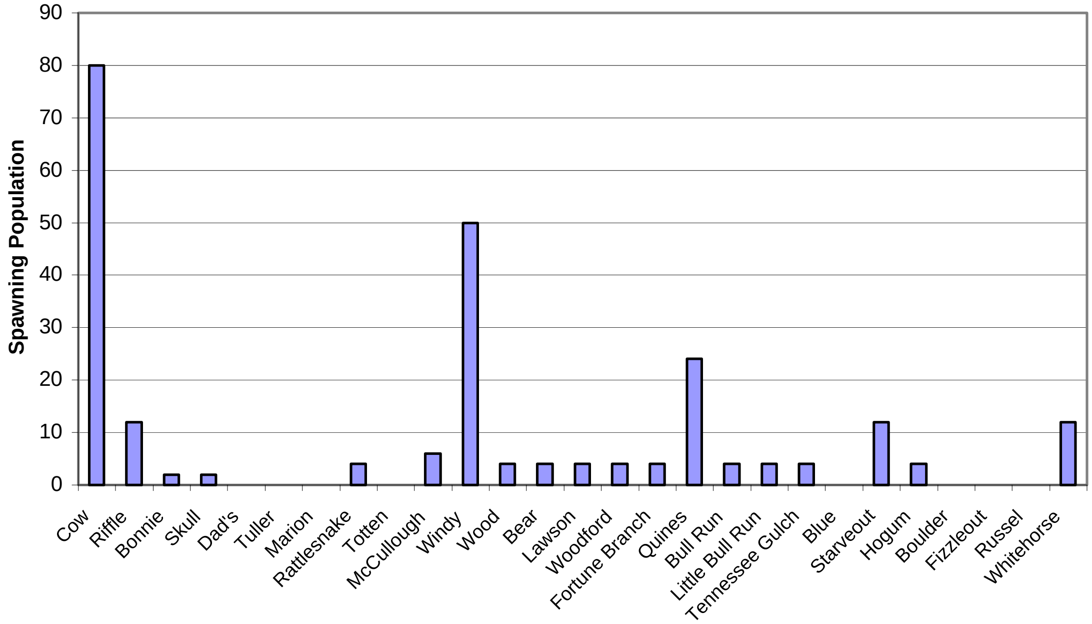


Figure 2-1 Coho Spawning Population, 1976

Figure 2-2 shows the winter steelhead salmon spawning (escapement) population in 1976. The largest population was found in Cow Creek, followed by Windy Creek, Quines Creek, Riffle Creek, and Starvout Creek. The largest population per stream mile was found in Quines Creek, followed by Windy Creek, Riffle Creek, and Starvout Creek.

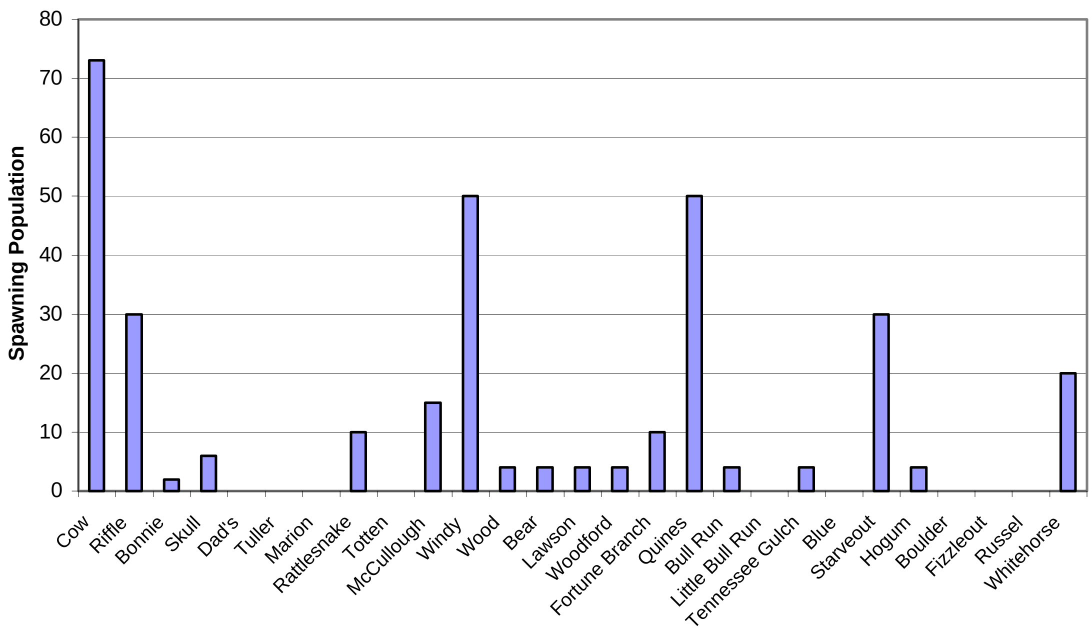


Figure 2-2 Winter Steelhead Spawning Population, 1976

High water temperatures were found throughout the watershed in 1976. The summer water temperatures reached 75°F in Cow Creek, Riffle Creek, and Windy Creek, and 70°F in Fortune Branch, Tennessee Gulch, Starvout Creek, and Fizzleout Creek. A low summer water temperature of 55°F was recorded for Skull Creek.

Although chemical contaminants from water from a log pond were observed in Fortune Branch in 1976, current contaminants have been reduced such that the current general discharge permits for log ponds are considering dropping the requirement of testing Biological Oxygen Demand, Total Suspended Solids, and oil/grease because reports in the recent past have shown that these are not a problem in the run-off from log ponds. Additionally, this permit allows water from log ponds to be discharged only for six months of the year in high flows, where the discharge is diluted 50:1.

The 1976 surveys included measures of stream habitat and flows (Table 2-4). In 1976 there were 2.75 recorded miles of channel modification, 62.1 miles of streambank habitat modified (mostly along Cow Creek), and 29 miles of creek that were heavily silted. Heavy siltation can smother redds, killing the fertilized eggs. All but two of the high fish producing streams (Cow Creek and Starvout Creek) did not have any miles of silted streambed. In 1976 there were also a total 17.75 miles of dry channel, 6.5 miles of which were thought to be caused by water withdrawals.

Creek	Man-Caused Channel Change	Streambank Habitat Modified	Streambed Silted	Natural Dry Channels in Summer	Man-Caused Dry Channels in Summer
Cow		50	20		
Bonnie	0.5	1.6	0.5		0.5
Dads			2		
Tuller			1		
Totten				1	
McCullough			0.5		
Windy		2			3
Woodford				1	
Fortune Branch	0.5	2			
Quines		1			1
Bull Run				2	
Little Bull Run				2	
Tennessee G.	1	2		2	
Blue	0.5	0.5		1.25	0.75
Starvout		1	2		1
Boulder	0.25	1	1		0.25
Fizzleout		1	2		
Russel				2	
Total	2.75	62.1	29	11.25	6.5

Table 2-4 Stream Morphology Changes, 1976 (miles)

The following table (Table 2-5) gives observations from the 1976 habitat surveys that clarify some of the numbers in Table 2-4 and discusses problems with fish passage, water levels, and other information.

CREEK	OBSERVATIONS
Cow	Miles of man-caused channel change along 35 miles of the creek was a result of being bounded by BLM road and railroad. Along this section regeneration has occurred but not up to the previous quality. Other change along Cow Creek was due to farmland that has been cleared from Glendale upstream. Pollution thought to be insignificant enters occasionally at Glendale from the municipal sewage plant and a sawmill. There are two earth fill dams that wash out during high water in the fall.
Riffle	A logjam at RM 3.5 blocks fish passage.
Bonnie	Massive logjam at RM 0.25 forces summer water subterranean through gravel backed up behind jam. 35’ waterfall blocks fish access.
Skull	A culvert under BLM road stops fish passage.
Dads	Gradient is steep at the mouth. Four logjams within the first 500 yards.
Tuller	A 12’ falls near mouth blocks fish passage.
Marion	Excessive gradients for anadromous fish, cutthroat only species present.
Rattlesnake	Series of impassable log jams within the first quarter mile.
Totten	Impassable logjam at RM 0.25
McCullough	Unscreened diversion takes downstream smolts and spent adults at RM 0.25.
Windy	Water is diverted in several places. Only a trickle remains through the summer. Autobodies have been used to form riprap. Watershed is recovering from extensive logging on upper watershed.
Wood, Bear	Not surveyed.
Quines	A dam, which is in place only in the summer, is an unscreened diversion for irrigation.
Little Bull Run	May rear some coho near the mouth.
Blue	Insignificant tributary but raises a few cutthroat. Most water is drawn off to fill an irrigation pond.
Hogum	Resident cutthroat only, not useable by anadromous fish.
Boulder	Diversion dam for hydraulic mining. Falls at mouth prevents anadromous fish access. Only resident cutthroat involved. Some flow has been diverted for mining operation.
Fizzleout	Resident cutthroat only species involved. Potential anadromous use.
Russel	Might have some spawning coho near mouth.
Whitehorse	There is a logjam at the top of a waterfall. The logjam if removed should provide access by steelhead upstream.

Table 2-5 Stream Habitat Observations, 1976

Resident Interviews

In the 1930’s, salmon were observed in all the main tributaries to Cow Creek, with the exceptions of West Fork Cow Creek, Panther Creek, and Bear Creek. Records of letters from 1900 were found where a request was made that West Fork Cow Creek be stocked with salmon, *because it contained none. Loggers also observed the lack of salmon in Panther Creek and Bear Creek in the 1950s.*

In the past, Coho salmon have spawned in large numbers in the mainstem, as well as the tributaries of Cow Creek. In Whitehorse Creek salmon abundance reached 5 to 10 in each pool. Almost all of the salmon in the Cow Creek Watershed were coho.

Shiners, suckers, and chub were caught in Cow Creek before the construction of Galesville Dam. These fish now seem to be much less abundant. Cold-water temperatures from the dam release of water may be responsible in the decline in the other fish species.

In 2001, one long-term resident has observed as many salmon spawning as were historically present. There were 65 to 100 in a row stacked up below Galesville Dam in Cow Creek. This number of fish has not been observed since the 1960s. A resident has also observed that the cutthroat are larger than they were in the past forty years. It is a general consensus that fish abundance has increased in the last few years in the Middle Cow Creek Watershed. There have been a tremendous amount of coho, a good number of Chinook, and last year the steelhead run was very strong.

2.5. Past Enhancement Activities

The Oregon Watershed Enhancement Board (OWEB) maintains a database of enhancement activities performed in Oregon, with the following information recorded for the Middle Cow Creek Watershed.

- There have been several activities in and along Woodford Creek. In 1994, the Indian Hill Limited Partnership conducted legacy road improvements, surface drainage improvements, installed a culvert, improved another culvert for fish passage by upgrading the culvert and installing an outlet weir. In 1998 the Oregon Department of Transportation retrofitted a culvert to improve fish passage. In 1999, the Mountain Grove Center installed large wood in the stream, anchored structures and “V” structures, donated an instream water right lease, applied erosion control through grass seeding, native grass seed production, and established a conservation buffer. They also improved fish passage of two culverts.
- In 1997, the Glendale High School placed deflectors and large wood in Windy Creek.
- Superior Lumber conducted road surveys and performed legacy road improvements in 1997 along Susan Creek and Swamp Creek. They also used lower impact logging and ODF riparian forestry measures in 1999 along Cow Creek.
- In 1997, the Indian Hill Limited Partnership performed a hardwood conversion with ODF riparian forestry measures along Spring Creek, and also conducted a road closure.
- The Silver Butte Timber Company performed instream large wood placement in Whitehorse Creek in 1998.
- In 2001, the UBWC replaced two culverts on two tributaries to Wood Creek and one culvert on Hittle Creek (tributary to Cow Creek), which together provided access to an additional 2.7 miles of fish habitat.
- In 2001, the UBWC placed 57 large logs at 15 sites along 2/3-mile section of Starvout Creek, in order to increase complexity in the stream, increase in-stream cover for fish, slow water velocity, and accumulate additional spawning gravel for coho salmon, winter steelhead, and cutthroat trout.

3. Current Conditions

3.1. Stream Function

3.1.1. Stream Morphology – Fish Habitat

Stream Gradients

The average gradient of Cow Creek within the watershed is 0.5%. The average gradient of the tributaries in the individual subwatersheds is as follows:

- 8.5% in the Starvout Subwatershed;
- 5.9% in the Quines Subwatershed;
- 4.5% in the Woodford – Fortune Branch Subwatershed;
- 4.8% in the Windy Subwatershed;
- 5.8% in the McCullough Subwatershed;
- 10.4% in the Dads Subwatershed; and
- 9.2% in the Riffle Subwatershed.

Cow Creek and its tributaries located in the Middle Cow Creek Watershed have been divided into three categories based on gradient[3]. These categories fulfill different functions in the woody debris flow system and gravel movement. The steepest category (Category III) contains all streams with a gradient greater than 30%, and is called the source area (where most of the wood and gravel enters the stream system), and is rated as poor in fish productivity. Category II, the transport zone, has slopes from 3% to 30%, is moderately productive for fish and is a transitional area for large wood and gravel. Category I, the deposition zone (where the wood and gravels become lodged for longer periods), has gradients less than 3%. The deposition zone is the most productive area for fish, containing primary spawning and rearing habitat, with deeper pools and complex habitat for fish to hide and feed in. (Montgomery and Buffington, 1993)

The miles of creek by gradient class are listed in Table 3-1. Most of Cow Creek and Windy Creek have a gradient in the deposition zone category. Most of the tributaries in RIF and DAD Subwatersheds have a gradient in the transport zone category. The lower part of the tributaries in the eastern part of the watershed are in the deposition zone category, while their upper parts are transport zones. The source zones are located at the upper reaches of Riffle, Bonnie, Tuller, Panther, Bear, Quines, Starvout, Whitehorse, and Dark creeks.

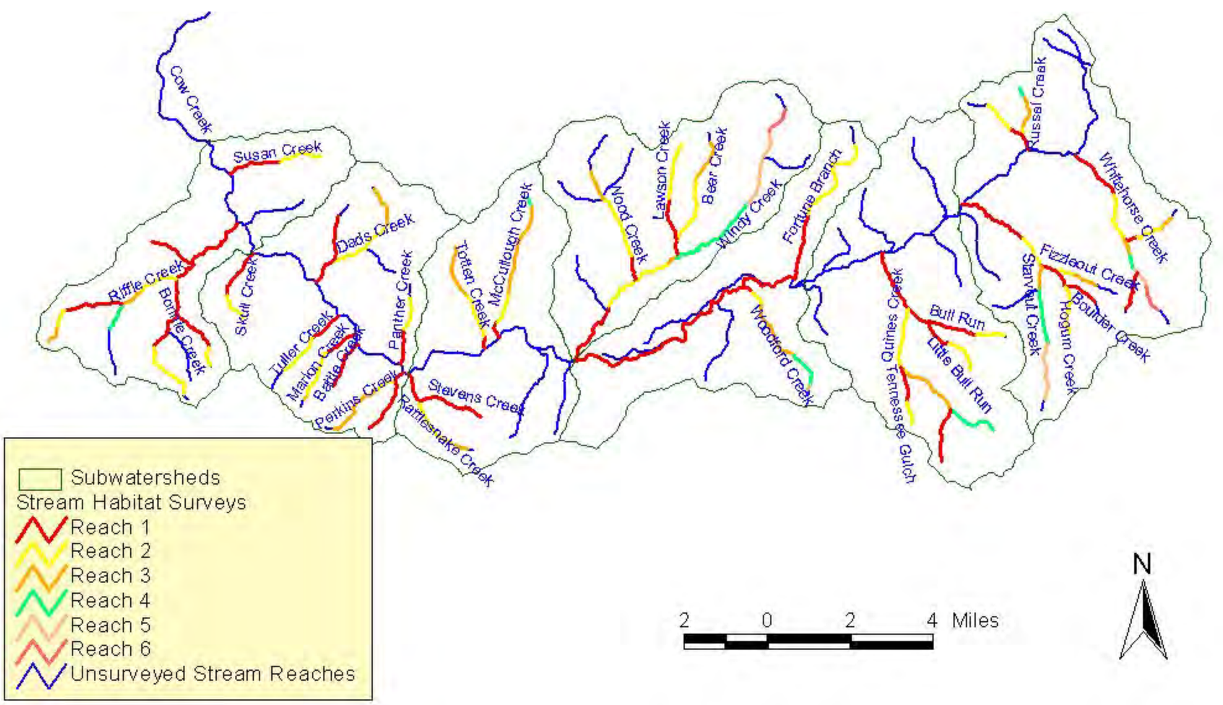
Gradient Class	Length (miles)
<=3%	73.87
>3%, <=30%	105.09
>30%	2.52

Table 3-1 Miles of Cow Creek and tributaries by Gradient Class

[3] Gradients were determined through GIS techniques using 10 M DEMs for 1000 foot stream segments.

The miles of creek can also be divided based on gradient to describe the lengths of stream potentially open to different species of fish. Typically coho salmon inhabit streams with a gradient less than 4% which covers 89 miles of the watershed, and cutthroat trout, which often inhabit waters up to a gradient of 15%, have potential habitat in an additional 79 miles of the watershed.

Stream Habitat Surveys
In 1993 through 1997, Oregon Department of Fish and Wildlife (ODFW) staff conducted stream habitat surveys along 109 miles of streams in the Middle Cow Creek Watershed, which included Cow Creek and most of its tributaries. The surveyed stream locations are provided in Map 3:1. The stream system was divided into 104 reaches, with each reach having similar channel and riparian habitat characteristics. The average reach length in the Middle Cow Creek Watershed is 1 mile. For each stream reach, surveyors measured a variety of pre-determined habitat variables.



Map 3:1 Stream Habitat Surveys

The ODFW developed habitat benchmarks to interpret the results of the stream habitat measurements. This assessment includes nine measurements that were selected because they are important for fish habitat. These measurements have been grouped into four categories: Pools, riffles, riparian areas and large instream woody material. Table 3-2 provides the habitat measurements and parameters included in each category. The stream habitat benchmarks rate the values of the components of the survey in four categories: excellent, good, fair, and poor. For the purpose of this watershed assessment, “excellent” and “good” have been combined into one “good” category.

Habitat characteristic	Habitat measurements used to create the rating	Benchmark values		
		Good	**Fair**	**Poor**
Pools	1. **Percent area in pools:** percentage of the creek area that has pools 2. **Residual pool depth:** depth of the pool (m), from the bottom of the pool to the bottom of the streambed below the pool a) small streams b) large streams	1. > 30 2a. > 0.5 2b. > 0.8	1. 16-30 2a. 0.5 - 0.3 2b. 0.8 - 0.5	1. <16 2a. < 0.3 2b. < 0.5
Riffles	1. **Width to depth ratio:** width of the active stream channel divided by the depth at that width 2. **Percent gravel in the riffles:** percentage of creek substrate in the riffle sections of the stream that are gravel 3. **Percent sediments** (silt, sand, and organics) **in the riffles:** percentage of creek substrate in the riffle sections of the stream that are sediments	1. ≤ 20.4 2. ≥ 30 3. ≤ 7	1. 20.5-29.4 2. 16-29 3. 8-14	1. ≥ 29.5 2. ≤ 15 3. ≥ 15
Riparian	1. **Dominant riparian species:** hardwoods or conifers 2. **Percent of the creek that is shaded** a) for a stream with width < 12 m (39 feet) b) for a stream with width > 12m	1. large diameter conifers[4] 2a. > 70 2b. > 60	1. medium diameter conifers & hardwoods 2a. 60 – 70 2b. 50 – 60	1. small diameter hardwoods 2a. < 60 2b. < 50
Large Woody Material in the Creek	1. **Number of pieces of wood**[5] per 100m (328 feet) of stream length 2. **Volume of wood** (cubic meters) per 100m of stream length	1. > 19.5 2. > 29.5	1. 10.5-19.5 2. 20.5-29.5	1. < 10.5 2. < 20.5

Table 3-2 Stream Habitat Survey Benchmarks

[4] [4] See Appendix C for a complete description.

[5] Minimum size is 6 inch diameter by 10 ft length or a root wad with at least a 6 inch diameter bole.

Pools are important because they provide resting places for fish and deep pools can be protective pockets of cool water during the hot season. Riffles provide salmonid spawning ground, and gravel is the preferred substrate for redds. High levels of sediment can bury eggs and suffocate the developing fry. The riparian habitat is important for large wood recruitment, which provides stream complexity and shade. Large conifers and hardwoods are more valuable than small ones because they decompose more slowly and are less likely to be washed away. Shade can limit stream warming from solar radiation. Finally, in-stream wood increases stream complexity that provides food and cover. Instream wood can interact with the stream channel to form pools and add cover to pools, which protects the fish.

For this assessment, the UBWC developed a method to simplify the stream data by rating the habitat category by its most limiting factor. For example, there are two components that determine the "pools" rating: percent area in pools and residual pool depth. In the case of Windy Creek Reach 1, 62% of the length of this reach is in pools, which according to Table 3-2 is rated as "good". The residual pool depth in Windy Creek Reach 1 is 0.6 meters, which receives a "fair" rating. Based on the most limiting factor, the pool rating for Windy Creek Reach 1 is "fair." Most habitat categories need a combination of components to be effective, and therefore are rated by the most limiting factor, in this case pool depth.
`

The benchmark ratings should not be viewed as performance values, but as guides for interpretation and further investigation. Streams are dynamic systems that change over time, and the stream habitat surveys provide only a single picture of the stream. The benchmarks used to rate each parameter are based on "ideal" fish habitat conditions, and may not reflect what an individual stream reach can achieve. For each habitat variable, the historic and current events must be considered in order to understand the significance of the benchmark rating. Take, for example, a stream reach that is rated as "poor" for instream large wood. Closer investigation could uncover that this stream is located in an area that historically never had any large riparian trees. Failing to meet the benchmark for instream large wood may not be of concern if this is the stream's normal condition.

On the other hand, meeting a benchmark does not necessarily mean all is well. A stream reach with no riparian trees could meet its benchmark for large instream wood because of instream wood placement, which addresses the short-term problem, but no the long-term one if that stream reach has no natural sources of woody material.

It is also useful to consider the combinations and interactions of stream habitat features. It is generally considered that large wood within a stream will often interact with the channel to form pools. If a stream has poor large woody debris and poor pools, efforts to improve large woody debris may also improve pools.

Overview of Conditions

Looking at the historic and the proximate conditions is necessary to fully understand the value of each reach's benchmark rating. However, conducting this type of study for every reach within the Middle Cow Creek Watershed is beyond the scope of this assessment. Therefore, this assessment looks for patterns within the whole watershed and along the stream length to provide a broad view and help determine trends.

The ratings for all reaches surveyed are displayed in Table 3-3. The highest rated reach is Woodford Creek, Reach 3, where pools, riffles, and the riparian area are all rated as good. The large woody material in the creek was rated as poor, however, since these surveys were completed in 1997, many wood structures have been placed in Woodford Creek, increasing the rating. Other sections of creeks that showed positive characteristics included Riffle Creek, Tuller Creek, Rattlesnake Creek, McCullough Creek, Windy Creek, Quines Creek, Starvout Creek, and Russel Creek.

Stream – Reach	**Pools**[6]	**Riffles**	**Riparian Area**	**LWM**
RIF Subwatershed				
Susan Creek – 1	●	●●	●●●	●
Susan Creek – 2	●	●	●●	●
Riffle Creek – 1	●●	●	●●●	●
Riffle Creek – 2	●●	●●●	●	●●
Riffle Creek – 3	●●	●●	●●●	●●●
Riffle Creek – 4	●	●●	●	●
Riffle Creek Trib B – 1	●	●●●	●●●	●●
Riffle Creek Trib C – 1	●	●	●●●	●
Riffle Creek Trib C – 2	●	●●	●	●●
Riffle Creek Trib C – 3	●	●●●	●●	●
Bonnie Creek – 1	●●	●●	●	●
Bonnie Creek – 2	●	●	●●●	●●
Bonnie Creek Trib A – 1	●	●●	●●●	●●
Bonnie Creek Trib A – 2	●	●●	●●●	●
DAD Subwatershed				
Skull Creek – 1	●●	●●	●●●	●
Skull Creek – 2	●	●●	●●●	●●
Dads Creek – 1	●●	●●	●●	●
Dads Creek – 2	●	●	●●	●
Dads Creek Trib A – 1	●	●	●●	●
Dads Creek Trib B – 3	●	●	●●	●
Tuller Creek – 1	●	●	●●●	●●
Tuller Creek – 2	●	●	●●●	●●●
Marion Creek – 1	●	●	●●	●●
Marion Creek – 2	●	●●	●●	●●
Marion Creek – 3	●	●	●●	●●●
Panther Creek – 1	●	●●	●●	●
Panther Creek – 2	●	●	●●	●
Battle Creek – 1	●	●●	●●	●
Perkins Creek – 1	●	●	●	●
Perkins Creek – 2	●	●	●	●

[6] ●●●=Good, ●●=Fair, ●=Poor

Stream – Reach	Pools[6]	Riffles	Riparian Area	LWM
Perkins Creek – 3	●	●	●●●	●●
Perkins Creek Trib A – 1	●	●	●●	●
MCC Subwatershed				
Rattlesnake Creek – 1	●	●	●●	●
Rattlesnake Creek – 2	●	●●	●●●	●
Rattlesnake Creek – 3	●	●●●	●●●	●
Stevens Creek – 1	●	●	●●	●
Totten Creek – 1	●●	●●●	●●	●
Totten Creek – 2	●	●●●	●●	●
Totten Creek – 3	●	●●●	●●	●
McCullough Creek – 1	●●	●●	●	●
McCullough Creek – 2	●●	●●●	●●●	●
McCullough Creek – 3	●●	●●●	●●●	●
McCullough Creek – 4	●	●●	●●●	●●●
WIN Subwatershed				
Windy Creek – 1	●●	●●	●	●
Windy Creek – 2	●●●	●●●	●	●
Windy Creek – 3	●	●	●	●
Windy Creek – 4	●●	●●●	●	●
Windy Creek – 5	●●	●●●	●	●
Windy Creek – 6	●	●	●	●
Wood Creek – 1	●●●	●	●	●
Wood Creek – 2	●●	●	●●	●
Wood Creek – 3	●	●	●●	●
Lawson Creek – 1	●●●	●	●●	●
Lawson Creek – 2	●	●	●●	●●
Bear Creek – 1	●●●	●	●●	●
Bear Creek – 2	●	●	●●●	●
Bear Creek – 3	●	●	●●●	●●
WFB Subwatershed				
Woodford Creek – 1	●	●	●	●
Woodford Creek – 2	●●●	●●	●●●	●
Woodford Creek – 3	●●●	●●●	●●●	●
Woodford Creek – 4	●	●	●	●
Woodford Creek – 5	●	●	●●●	●●
Fortune Branch – 1	●●●	●	●●	●
Fortune Branch – 2	●●	●	●●●	●
QUI Subwatershed				
Cow Creek – 1	●●	●	●	●
Quines Creek – 1	●●	●	●	●
Quines Creek – 2	●●●	●	●●●	●

Stream – Reach	**Pools**[6]	**Riffles**	**Riparian Area**	**LWM**
Quines Creek – 3	●●	●	●●●	●
Quines Creek – 4	●	●	●●●	●
Quines Creek Trib 1 – 1	●	●	●●●	●
Bull Run Creek – 1	●●	●	●●●	●
Bull Run Creek – 2	●	●	●●●	●●
Little Bull Run Creek – 1	●●	●	●●●	●
Little Bull Run Creek – 2	●	●	●●●	●●
Tennessee Gulch – 1	●●	●	●●●	●
Tennessee Gulch – 2	●	●	●●●	●
STA Subwatershed				
Starvout Creek – 1	●●	●	●●	●
Starvout Creek – 2	●●	●	●●●	●
Starvout Creek – 3	●●	●	●●●	●
Starvout Creek – 4	●	●	●●●	●●●
Starvout Creek – 5	●	●	●●●	●●
Hogum Creek – 1	●	●	●●●	●
Hogum Creek – 2	●	●	●●●	●
Fizzleout Creek – 1	●	●	●●●	●
Fizzleout Creek – 2	●●	●	●●●	●
Fizzleout Creek – 3	●	●	●●●	●
Boulder Creek – 1	●	●	●●●	●
Russel Creek – 1	●●	●●●	●●●	●
Russel Creek – 2	●●	●●	●●●	●
Russel Creek – 3	●	●	●●●	●●
Russel Creek – 4	●	●	●●●	●●●
West Fork Russel Creek – 1	●●	●●	●	●●
West Fork Russel Creek – 2	●●	●	●●●	●●
Whitehorse Creek – 1	●●	●●	●●	●
Whitehorse Creek – 2	●●	●●	●●	●
Whitehorse Creek – 3	●	●	●	●
Whitehorse Creek – 4	●	●●	●	●
Whitehorse Creek – 5	●	●	●	●●
Whitehorse Creek – 6	●	●●	●	●
Whitehorse Creek Trib B – 1	●	●	●●●	●
Blackhorse Creek – 1	●●	●●	●	●
Blackhorse Creek – 2	●	●	●●●	●
Blackhorse Creek – 3	●	●	●●	●●●

Table 3-3 Rating of pools, riffles, riparian area, and LWM ●●●=Good, ●●=Fair, ●=Poor

3.1.2. Connectivity – Passage barriers

Fish passage barriers can affect fish populations by "disconnecting" the stream network. Passage barriers can affect both anadromous and resident fish. Anadromous fish, such as salmon, cannot access spawning habitat upstream of a passage barrier. Resident fish, such as trout, are prevented from moving through the stream system, which can limit access to needed habitat, for example, tributaries with cool water during the summer.

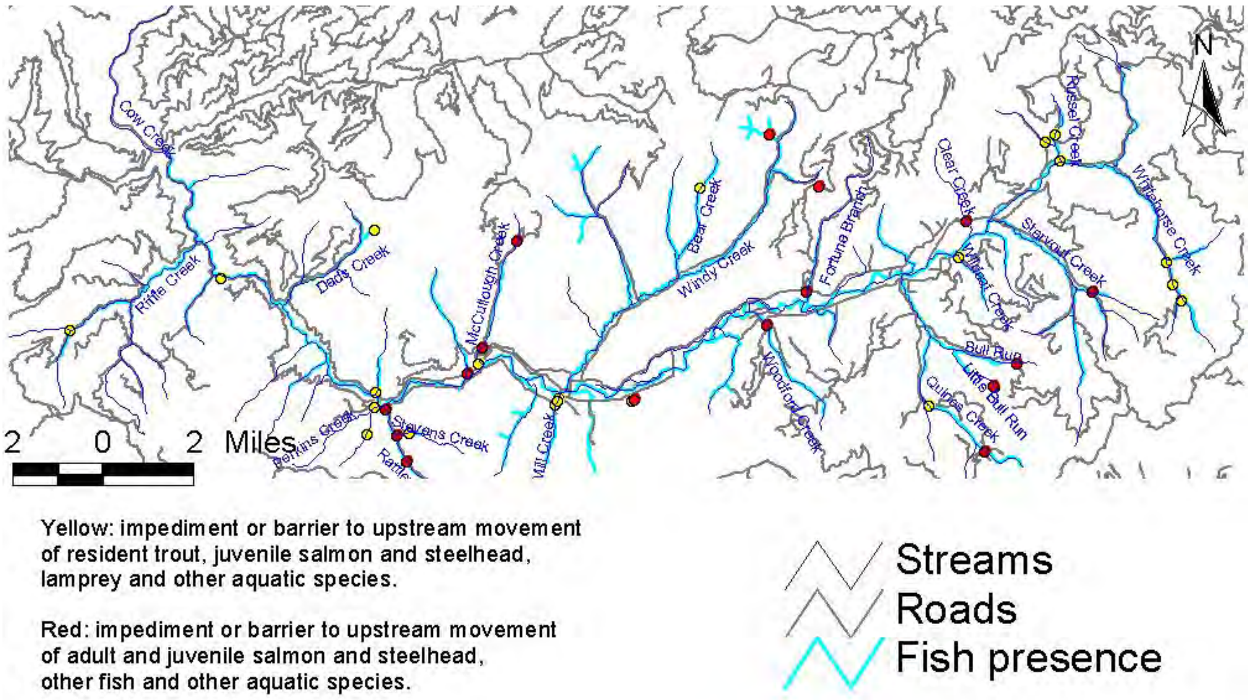
Fish passage barriers cause significant reduction in useable stream habitat and associated fish production (John Runyon, Fish Passage Short Course 2000). Irrigation ditches lacking fish wheels can be a fish passage problem. Fish enter the ditches in the summer, and when the diversion to the ditch is removed, the fish are stranded and die.

Culverts can be barriers to fish passage if fish cannot enter culverts or fish cannot pass through culverts. Fish entering into culverts can be hindered if the jump from the water level to the culvert is too high, and/or if the pool preceding the culvert is not deep enough for the fish to gain sufficient momentum to jump. Generally a culvert drop of 2 feet is considered passable for adult salmon, and 0.5 feet for juvenile salmon, both with a pool depth of at least 2 feet. A culvert with a drop greater than 2 feet for adult salmon or 0.5 feet for juveniles, and with a pool depth of less than 2 feet does not necessarily constitute a barrier, but instead may be an obstacle for impediment. The presence of an obstacle means that some fish will still be able to pass, while others will expend so much energy entering or attempting to enter the culvert that they cannot reach their spawning grounds and die or are unable to spawn. Consequently, spawning success declines due to an obstacle.

Passage through the culvert can be too difficult for fish if water velocity is too high. Generally 1% is considered too steep if the bottom of the culvert is bare. Fish are able to pass through streams at higher velocities, but that is because water velocities decline near rocks and other structures where fish can rest. If the culvert is countersunk, a steeper gradient is acceptable, as the bottom of the culvert simulates a natural stream bottom and provides resting areas for fish. Finally, a drop in the water level into the culvert can also produce a velocity barrier to the fish exiting the culvert.

The BLM and ODF have inventoried culverts on their lands. According to BLM and ODF data[7], the culverts pictured in Map 3:2 are impediments or barriers to fish movement[8]. Some creeks, such as Totten Creek and McCullough Creek are blocked at the mouths and restrict fish use of the entire stream system. Culverts on other streams like Fizzleout Creek may limit passage into critical spawning habitat. Whitehorse Creek has multiple culverts that are passable to adults only. Besides hindering resident species, these multiple impediments and barriers can be a problem if they cause fish to expend too much energy and reduce spawning success. Only a portion of culverts on private lands has been inventoried.

[7] BLM culverts were already categorized. ODF culverts were labeled as impassable to adults and juveniles if the outlet drop was ≥ 1.5 feet and as impassable to juveniles if the outlet drop was ≥ 0.5 feet.
[8] Map 3:2 does not include unscreened ditches.



Map 3:2 Culverts Impediments

Action Recommendations

- *Obtain permission from landowners to conduct culvert surveys on un-surveyed tributaries.*
- *Improve fish passage in culverts that have been found to have problems.*
- *Evaluate other barriers.*
- *Screen diversions.*

3.1.3. Stream Meandering – Channel Confinement

There is little written history on channel modification projects for the Middle Cow Creek Watershed. The history presented here should not be viewed as a comprehensive list of channel modification projects in the Middle Cow Creek Watershed. Instead, it should be seen as an overview of the types of project that have been attempted by organizations, agencies, and landowners in the area. This overview is based on interviews with Walter Barton from the Douglas Soil and Water Conservation District (DSWCD). A lifetime Douglas County Resident, Walter began working on Douglas County-based stream restoration projects in the 1980's with DSWCD. Walter is currently employed as the DSWCD's field engineer, and is considered an expert on Douglas County stream restoration projects. The Middle Cow Creek Landowner Group confirmed Walter's summary and provided additional information.

The earliest known project occurred in the 1930's. Cow Creek above Quines Creek was diked prior to the construction of I-5. There is a large information gap until 1974, when a portion of the Azalea-Glen Road west of Barton Road was washed away. To repair the damage, 750 feet of the stream bank was filled with riprap on top of which the road was re-built. In the early 1980's a landowner lined about 550 feet of Cow Creek below what is now the Galesville Dam with riprap.

Landowners mentioned the big flood in 1974, that took out part of the Azalea-Glen Road and damaged much of the riparian area, causing trees to fall, and Cow Creek to change its channel. The effects of this flood and other events are still evident today as more trees from the riparian area are falling into the creek, and the creek is meandering and eroding people's property.

In 1997, David Liscia with the Oregon Department of Fish and Wildlife (ODFW) coordinated the installation of instream log deflectors along Windy Creek on Glendale High School property to collect spawning gravel, slow water velocities, and prevent streambank erosion. Whitehorse Creek had an instream wood placement project in 1998 on BLM lands.

Much work was done on Woodford Creek in 1999. Instream improvement projects included large wood placement, anchoring structures into the stream, "V" structure placement, and building palisades. Bank erosion control efforts included seeding with grass, creating a conservation buffer, and encouraging native grass seed production.

A Starvout Creek landowner historically had a permit to annually remove a gravel bar on their property at the confluence with Cow Creek. When the bar is in place, the Starvout Creek channel is very narrow and the water flows swiftly into Cow Creek. The flow from Starvout Creek hits a Cow Creek landowner's property at a 90° angle, causing streambank erosion that is severe enough that it will eventually destroy the landowner's home. When the gravel bar is removed, Starvout's channel is wider and flow is slower, significantly reducing the damage to the Cow Creek landowner's property.

The gravel bar at the confluence of Starvout and Cow Creek was removed several times from the mid to late 1980's, although not every year. Between 1997 and 1998, the gravel bar was once again removed. No work has been done again since then. Three or four times the material from the gravel bar was removed entirely, otherwise it was pushed into a dike on the Starvout Creek landowner's property, or scattered on both sides on the stream.

In 2000, a Christmas tree revetment with one log barb[9] was installed on Starvout Creek at river mile 1.2. In this section, the creek was rapidly moving into a pasture. Christmas trees were linked to a wire along the bank of the stream to trap sediment. Once sufficient sediment has settled among the Christmas trees, seedlings will be planted to stabilize the new bank. In 2001 two more Christmas tree revetments were installed, one on Starvout Creek at river mile 1.5 and one on Quines Creek at river mile 0.4. The DSWCD hopes to put in more of such revetments at the confluence of Cow and Starvout creeks.

Finally in 2001, the UBWC managed a project to place 62 logs along a 2/3-mile Starvout Creek reach to collect spawning gravel, slow water velocities, and to prevent streambank erosion.

Action Recommendations

- *Provide education about stream meandering for landowners and entities involved with the sale or purchase of creek-front property.*

[9] A log barb is a tree placed in the stream in order to prevent streambank erosion.

3.2. Riparian Zone Function

The riparian area is the zone adjacent to the stream where the soil is wet and affected by the stream, for example, around springs, ponds, and streams. Trees along a stream shade the water, provide leaves that add nutrients to the system, and supply bank stability. When trees fall into the stream they provide structure that creates pools and cover for fish to hide. Conifers, oak, ash, maple, and cottonwood are species that take longer to decompose than other riparian tree species, providing a benefit to fish habitat for a longer time.

3.2.1. Riparian Zone Composition and Function

Using aerial photos, the condition of the riparian areas along Cow Creek and 59 tributaries was assessed. This included identifying various aspects of the riparian area, such as vegetation type. Each streambank was classified separately, since the vegetation on opposite stream banks is often different. In the rest of this assessment, the separate stream banks are labeled as "left" and "right," as they would be if one were standing in the creek looking downstream. The categories by which the riparian areas were categorized are listed in Table 3-4.[10]

CATEGORY	ATTRIBUTES	AFFECTED RIPARIAN ZONE FUNCTIONS
Vegetation Type	• Conifers[11] • Hardwoods • Shrub/brush • Blackberries • Range/grass • Lawn • Pond • No vegetation (e.g., roads) • Infrastructure (e.g., in culvert, under bridge)	Different types of vegetation create diverse microclimates and provide various types of habitat, food, and canopy cover. Also, tree type is one of the determinations of the quality of large woody material (LWM).
Streamside Tree Status	• Majority non-tree species • 1 tree width[12] • 2 or more tree widths	Wider buffers have an increased microclimate cooling effect.
Tree Size Class	• Majority non-tree species • <20" diameter • >20" diameter	Tree size influences the longevity of LWM.
Canopy Cover over Stream	• No cover • <50% stream surface covered • >50% stream surface covered	Canopy cover provides shade to the stream, cooling the water.

Table 3-4 Riparian Area Classification

[10] Due to time and financial constraints, no field verification of aerial photo data was performed in the Middle Cow Creek Watershed. Field verification was performed for the Deer Creek Watershed Assessment.
[11] If trees cover over 50% of the riparian zone canopy, then vegetation is classified as either conifers or hardwoods based on the dominant tree type.
[12] One tree width is equal to the width of the canopy of one tree. Two or more tree widths describes a riparian area that is deeper than the canopy of one tree.

Classification Results

This analysis does not include a comparison to desired conditions. However, it does give a picture of the current state of the riparian areas and possible areas to enhance in order to meet goals of improved fish habitat and water quality.

In general, trees dominate almost 90% of the riparian areas of the Middle Cow Creek Watershed (Figure 3-1). Over 50% of the riparian areas are predominantly hardwood trees, while another 31% are primarily conifers. The 7.5% of the riparian areas that are shrubs or bushes could also include small trees, as these two vegetation types are indistinguishable from each other when using aerial photos. Approximately 2% of the riparian areas contain blackberries or grass vegetation. The lawn vegetation category contained only 0.01 miles in the Middle Cow Creek Watershed, which is 0.003% of the total and is not visible on the pie chart. The remaining 0.58% of the riparian areas has no vegetation directly next to the stream and includes areas such as large gravel bars, bridges, culverts, and ponds.

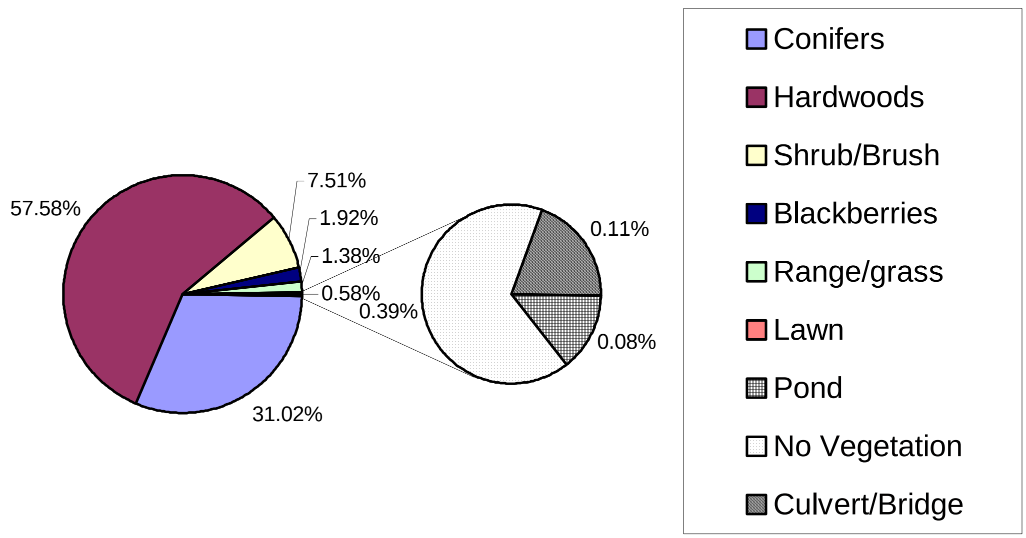


Figure 3-1. Riparian Vegetation of the Watershed

As seen in Figure 3-2, Cow Creek is dominated by hardwoods and has only a few areas dominated by coniferous trees (7.5%). Conifers dominate between 24% and 60% of the tributaries' riparian areas, most of which are found in the Riffle, Quines, and Starvout Subwatersheds. The Windy Subwatershed has over 2 miles of riparian areas dominated by blackberries, which is the most significant amount in the Middle Cow Creek Watershed. The greatest percentages of grass riparian areas are in the Quines Subwatershed (1.5 miles) and the Windy Subwatershed (1.4 miles). Along Cow Creek there are 0.7 miles of stream edge without vegetation, where there are large gravel bars and few streamside trees.

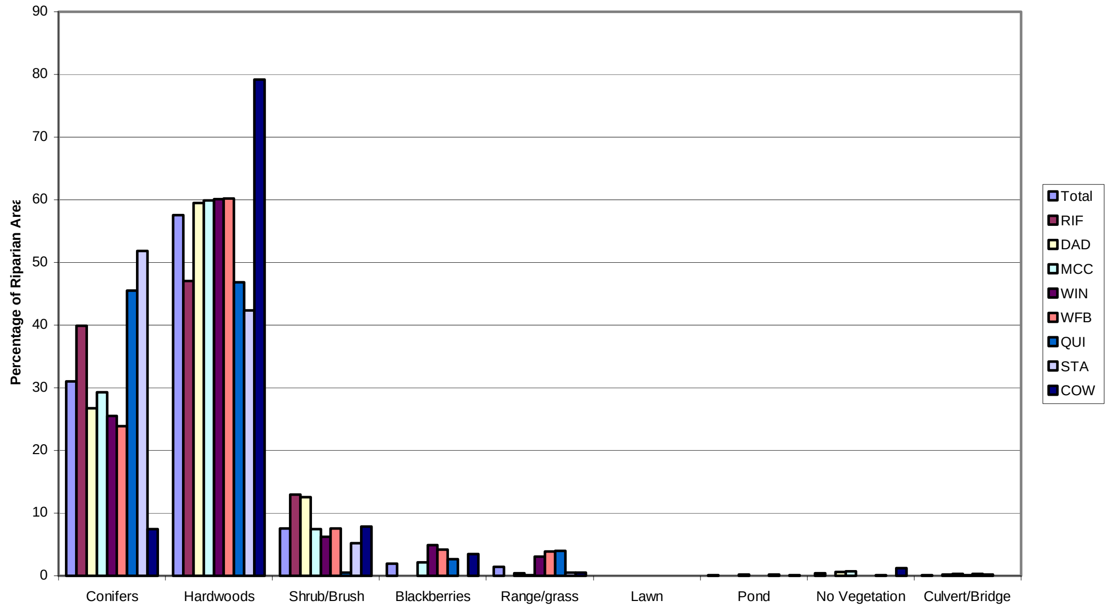


Figure 3-2 Riparian Vegetation by Subwatershed

Almost three-quarters of the riparian areas in the Middle Cow Creek Watershed have a width that is at least two tree crowns wide (Figure 3-3). Sixteen percent of the riparian areas have a width of one tree crown. Eleven percent of the riparian areas are classified as having less than 50% tree cover. Along these reaches, trees occupy less than half of the riparian area and are interspersed with other vegetation types and with areas classified as having no vegetation. Where trees are less than 50% of the vegetation type, tree width was not measured because there are not enough continuous sections of trees along the stream to determine overall width. Figure 3-4 shows that with the exception of Cow Creek, the individual subwatersheds follow the same overall trend as the watershed as a whole. Cow Creek has more reaches with one-tree width riparian areas.

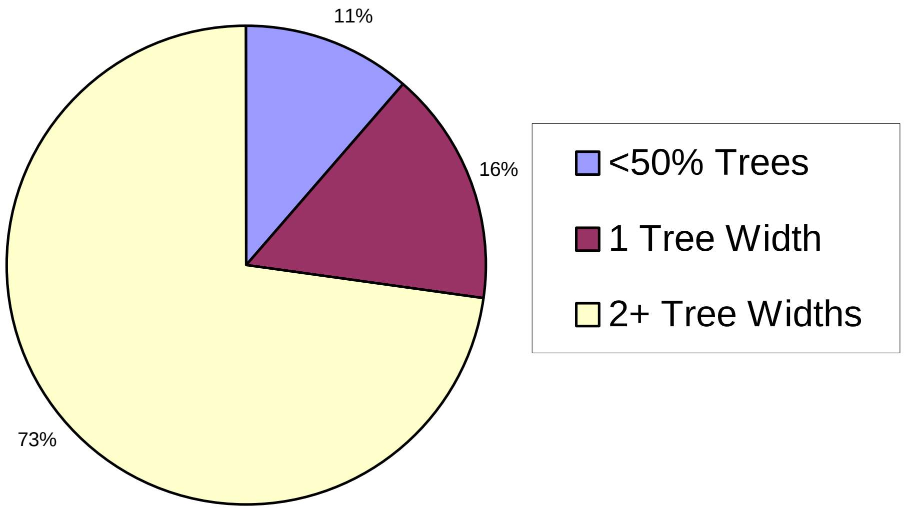


Figure 3-3 Streamside Tree Status

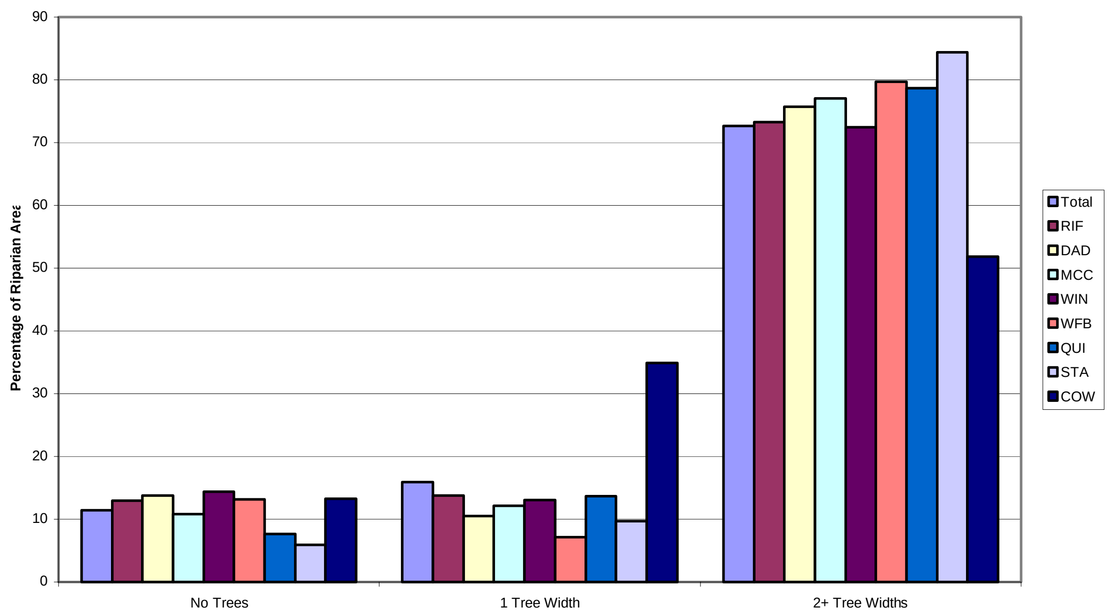


Figure 3-4 Streamside Tree Status by Subwatershed

Most of the trees in all the subwatersheds are less than 20 inches in diameter (Figure 3-5). There are three subwatersheds with approximately two miles of riparian areas with larger sized trees, estimated at greater than 20 inches in diameter; these are Riffle, Dads, and Starvout.

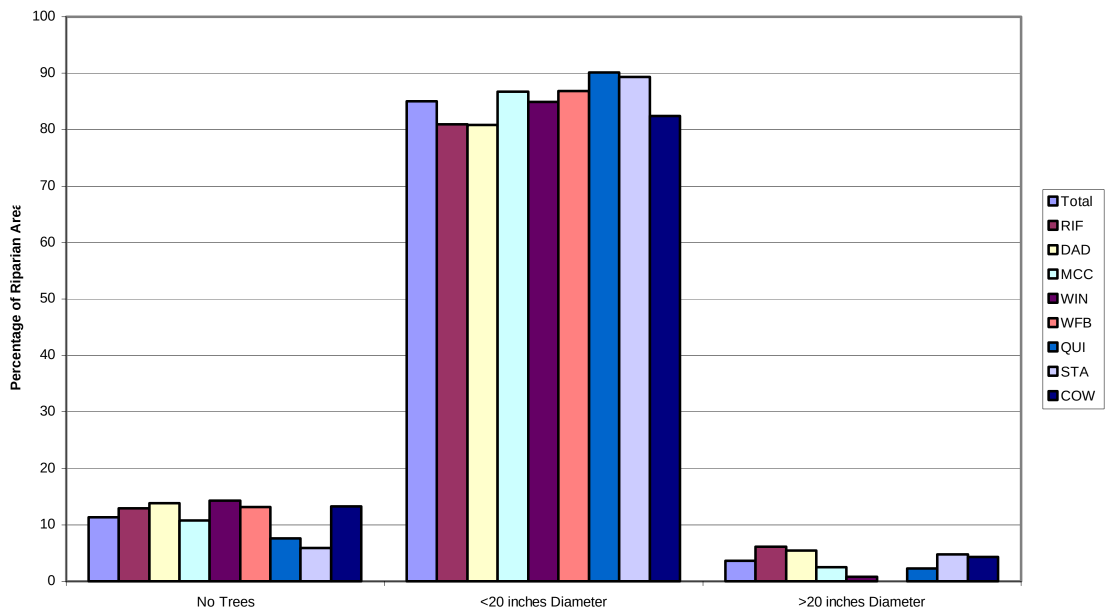


Figure 3-5 Tree Size by Subwatershed

The overall watershed status of canopy cover is that 73% of the riparian areas provide more than 50% canopy cover over the stream (Figure 3-6). Twenty-six percent has less than 50% stream cover. Over half of the riparian areas with less than 50% canopy cover are along Cow Creek. This is because over 90% of Cow Creek has less than 50% canopy cover (Figure 3-7). However, it would be impossible to achieve over 50% canopy cover everywhere on Cow Creek, as many reaches are too wide to allow higher canopy coverage. Other reasons for less than 50% canopy cover in the entire watershed are reaches dominated by short vegetation and areas with tall vegetation on only one side of the stream. One percent of reaches are classified as having no shade because there is no detectable vegetative cover.

Riparian Protection in Forests

On federal lands, the riparian areas are protected based on the Northwest Forest Plan, which requires large riparian buffers. The riparian areas on private forest ground are protected by the Forest Practices Act, based on their size and use (fish or domestic).

Action Recommendations

- *Protect riparian areas that have a width of two or more trees.*
- *Increase canopy cover by planting trees in predominately brush riparian areas.*
- *Where feasible, establish conifers and other native vegetation in areas now dominated by blackberries and other invasive plant species, or which lack any tall vegetation.*
- *Manage the riparian areas for tree crown growth.*
- *Manage livestock so that they do not intrude on the riparian area.*
- *Plant native vegetation.*

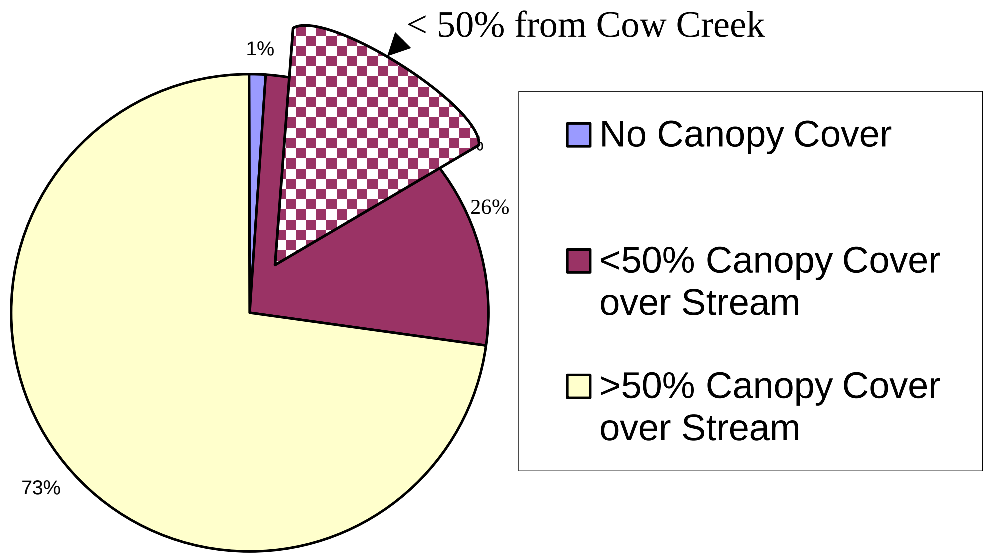


Figure 3-6 Canopy Cover over Stream

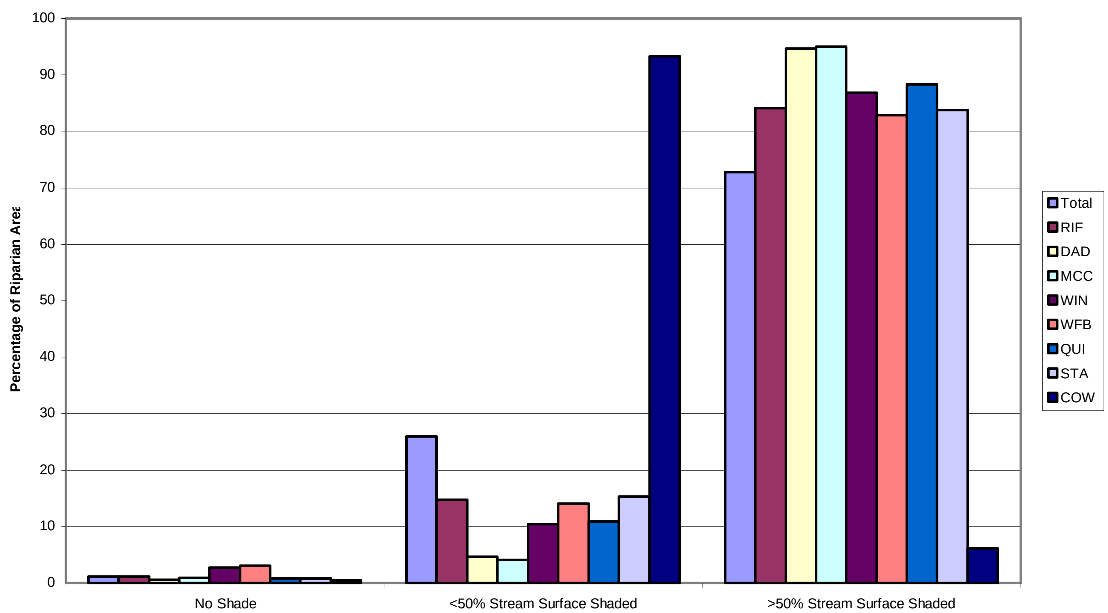


Figure 3-7 Canopy Cover over Stream by Subwatershed

3.2.2. Wetland Attributes[13]

Purpose
The purpose of this section is the identification and evaluation of wetlands in the Middle Cow Creek Watershed, from Galesville Dam to the confluence of Cow Creek and Middle Creek. These wetlands are stream-associated or located in the flood plain of Cow Creek. This section also will examine present and potential negative impacts on wetlands and identify key potential restoration areas.

The historical and current stream-associated wetlands and wetlands in uplands include:

- Riparian forest communities,
- Wet prairie/vernal pool communities,
- Ash groves, and
- Side slope seeps.[14]

Evaluation of these wetlands includes:

- Wildlife habitat,
- Riparian forest strata for songbirds,
- Riparian forest for travel ways (corridors),
- Wet prairie grasses for food and cover,
- Vernal pool depressions, habitat for amphibians, western pond turtles, and threatened and endangered species of vernal pool plants,
- Water quality,
- Sediment trapping (stabilizing erosive banks),
- Water temperature, and
- Hydrologic control.

Review of the U.S. Fish and Wildlife National Wetland Inventory (NWI) maps for the watershed indicates that the main channel and tributaries of Middle Cow Creek are classified as riverine (rivers) or palustrine systems (marshes), permanently or seasonally flooded. Most of the palustrine wetlands are small groves of wet forest. There are ponds (farm ponds) but not much emergent wetland.

Historical Wetlands
The Cow Creek Valley was settled in the late 1800's and wetlands were ditched, drained, and/or filled by agricultural use. Logging impacted the slopes adjacent to Cow Creek and the flood plain. Bar run rock was mined from Cow Creek in quite a few areas, impacting the channel and banks.

After the 1940's, seral ecosystems that had been maintained by fire were invaded by woody vegetation. Himalayan blackberry, a very aggressive invasive species, invaded disturbed areas of the riparian corridor and suppressed ash, oak, and cottonwood regeneration.

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[13] This section was contributed by Janet Levinson Barnes, Land and Water Environmental Services. Wetlands are areas that contain wetland vegetation, which is able to live in saturated conditions for at least part of its growing season.
[14] A side slope seep is an area on a hillside where ground water comes to the surface and leaves a small wetland.

Cow Creek is typical of the Umpqua valleys, which were prairie when first settled. The prairie was composed of wetland and upland grasslands that were maintained by frequent fires caused by lightning or set by Native Americans. Stands of tall prairie grasses provided food and cover for wildlife. Swales and depressions contained vernal pools that were inundated during the growing season and dried out in summer. Amphibians, reptiles, and vernal pool plants adapted to ponds that had water in the spring and no water at all in the summer. In depressions too wet for fire, plant succession would become the climax seral stage: groves of Oregon ash.

It is evident that the riparian forest along Cow Creek was a diverse community of Oregon ash, bigleaf maple, black cottonwood, red alder and Oregon white oak overstory with occasional Ponderosa pine and Douglas-fir over a shrub understory of red stem dogwood, vine maple, and snowberry. Ground cover was sword fern, forbs and grasses in well-drained areas and rushes and sedges in depressions. From the Galesville Dam to the town of Glendale, the Cow Creek Valley is wide. Stands of willow covered the gravel bars in the channel of Cow Creek. From Glendale to the confluence of Middle Creek, Cow Creek leaves the Interior Valley and enters the Coast Range and the Cow Creek Valley becomes a narrow deep canyon. As the gradient increased and the floodplain narrowed, significantly less wetland existed away from the immediate channel. Instead of stands of willow in a wide channel, red alder and vine maple grew in a narrow channel and bigleaf maple, Douglas-fir and vine maple grew just above the water on rocky banks.

Current Wetland Status

The majority of the wetlands that existed historically along Cow Creek and its tributaries between the dam and the town of Glendale have been filled or significantly altered by agricultural and residential development. Most of the remaining wetlands within the valley floor have been converted to farmed wet pasture and are currently being used for grazing and hay production. Mowed or grazed grasslands do not provide cover or food for prairie wildlife, which is one of the ecosystem functions of wetlands. Remnants of vernal pools can still be observed in pastures, however, now they are plowed depressions colonized by invasive species. Deep ponds for livestock and log ponds have been constructed and retain water all year. Deep ponds provide habitat for non-native species such as the bullfrog, and if present, the bullfrog is a predator of young pond turtles and other native species. Invasive plants, such as Himalayan blackberry, have invaded riparian stands and prevented the regeneration of willow and other wet forest species.

Additional impacts are caused by dirt roads that converge at the creek, channeling sediment into the water. Fire suppression has also had a profound effect on the ecosystem as woody plants have replaced prairie plants such as tufted hairgrass and red fescue.

The Cow Creek within the Middle Cow Creek Watershed has a fairly contiguous riparian area. However, there are gaps in this riparian cover, some caused by the meandering of the creek and wildlife, others by management activities.

The result of these impacts is a general degradation of the riparian and wet forest areas and a significant reduction, if not a complete elimination of wetland function in the wet prairie/vernal pool areas. Few, if any, unaltered wetlands remain in this portion of the watershed.

Factors and Activities That May Continue to Impact Wetlands

Loss of connectivity between Cow Creek and adjacent wetlands due to grading and filling activities has resulted in a reduction in the hydrologic control functions of the floodplain. This reduction in hydrologic control function will continue to magnify the effects of storm events and erosion within the channel and riparian area.

Although Douglas County enforces planning and development guidelines (such as a 50 foot setback along Cow Creek) and the state regulates wetland fills under the Removal-Fill Law, the wetlands currently impacted by agricultural activities will continue to be impacted or may be filled as residential and rural development spreads to include these areas.[15]

There have been few opportunities in the past for private landowners to partner with agencies to mitigate impacts on wetlands. The UBWC is one arena that helps landowners with grant-funded projects. One example involves providing fencing materials to landowners who want to fence their riparian areas.

Restoration Opportunities

The best restoration of a wet prairie ecosystem occurs when a large contiguous area is restored within the floodplain. This could be accomplished by identifying and restoring the wettest, lowest value agricultural lands, which are often high clay and are difficult to manage with machinery. Any of the large areas of farmed wet pasture along Cow Creek and its tributaries that are currently being used for grazing and hay production could be restored to wet prairie and vernal pools by grading to wetland enhancing microtopography. Restoration would include filling and blocking ditches, removing or blocking drains, and removing fill to restore the microtopography.

Several kinds of habitat could be enhanced. Wet prairie/vernal pools interfacing with small areas of upland prairie could be restored. Deeper depressions could be constructed to create marshy areas. Ash groves could be restored as part of riparian area plantings.

In the wet prairie complex, tall grasses would provide food and cover for western meadowlarks and orb weaver spiders. Raptor perches could be placed for red-tailed hawks. Nest boxes could be placed for sparrow hawks and other cavity dwellers. Shallow vernal pool depressions could be constructed for wading birds, amphibians, reptiles, and vernal pool plants. Threatened and endangered species could be planted in the vernal pools and monitored. Basking logs could be placed in the pools for western pond turtles. Bat houses could be placed on poles. Stands of willows would provide habitat for the Lorquin's Admiral butterfly, the yellow warbler and many other species. The ecosystem would be maintained by burning during the field-burning season once every two or three years. In the marshy areas, cattails would provide habitat for red-winged blackbirds. Small-fruited bulrushes would provide food and cover for small mammals and songbirds. Restored ash groves would provide thermal cover for deer in summer and strata of habitat for warblers and vireos. Hiding cover could be planted around side slope seeps to benefit a great variety of wildlife.

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[15] This expansion is not projected at the current date.

Approximately half of the land in the Middle Cow Creek Watershed is in private ownership. Partnerships among private landowners could also accomplish large-scale restoration, albeit it in a more fragmented fashion. Additional restoration opportunities exist, such as stabilizing the erosion source that causes an unnamed tributary just below Galesville Dam to become very turbid in the winter. Skid roads on logged areas adjacent to the Cow Creek floodplain could be inspected for erosion and water-barred. In the area just north of the confluence with Susan Creek, a one-acre slide that removed part of the riparian area could be stabilized with fiber matting and planted.

Deeply incised portions of Cow Creek can be reshaped to reestablish the hydrologic connection to the floodplain. Additional possibilities for enhancement or restoration immediately adjacent to the creek or elsewhere within the floodplain are likely to exist in locations yet to be identified. Restoration of forested wetland could take place in conjunction with riparian enhancement by recontouring the channel and riparian area. Instream structures and large woody debris could be placed in the channel to create pools, and riparian species could be planted in the riparian area to eventually stabilize the banks and shade the water.

The middle portion of Cow Creek meanders and has a fairly continuous riparian corridor. However there are many gaps in the riparian canopy that could be reforested with Oregon ash, black cottonwood, and Oregon white oak seedlings, after the Himalayan blackberry thickets are removed. Reforestation of the gaps in the riparian corridor will create more shade for cooler water temperatures and a continuous travel way for wildlife.

3.3. Water Quality

Streams are often the center of human populations and are used for various purposes, such as irrigation and swimming. The Oregon Department of Environmental Quality (DEQ) has classified these different uses (known as “designated beneficial uses”) and has summarized them by basin. It is important to understand the designated beneficial uses for Middle Cow Creek, because different water quality standards are applied based on the most sensitive beneficial uses for the creek. The designated beneficial uses for the Umpqua Basin waters are shown in Table 3-5. Those practiced in Cow Creek and its tributaries are checked.

Beneficial Use	Cow Creek	Beneficial Use	Cow Creek
Public Domestic Water Supply	✔	Private Domestic Water Supply	✔
Industrial Water Supply	✔	Irrigation	✔
Livestock Watering	✔	Boating	
Aesthetic Quality	✔	Anadromous Fish Passage	✔
Commercial Navigation and Transportation		Resident Fish and Aquatic Life	✔
Salmonid Fish Spawning	✔	Salmonid Fish Rearing	✔
Wildlife and Hunting	✔	Fishing	✔
Water Contact Recreation	✔	Hydro Power	✔

Table 3-5 Beneficial Uses in the Umpqua and Cow Creek as defined by DEQ in OAR-340-41-322 Table 3

The DEQ has collected data from Middle Cow Creek indicating that the water in some streams is not meeting the most limiting standard. The standards are not met because water temperatures are too high for salmonid fish rearing and there are indications of reduced quality of fish habitat in terms of large woody material, pool frequency, channel width to depth ratio for resident fish and aquatic life, and salmonid fish spawning and rearing (the combination of these factors are referred to as “habitat modification”). This caused Cow Creek and some of its tributaries to be listed in a 303(d) report, which is a report of all water quality limited streams in Oregon (DEQ 1998). The specific stream reaches that are listed are shown in Table 3-6.

Stream Reach	Summer Temperature	Habitat Modification
Cow Creek, West Fork to Quines Creek	✔	
Dads Creek, mouth to headwaters	✔	Need data
Fortune Branch, mouth to headwaters	✔	
Quines Creek, mouth to headwaters	✔	Need data
Riffle Creek, mouth to headwaters	✔	
Skull Creek, mouth to headwaters	✔	
Whitehorse Creek, mouth to headwaters		✔
Windy Creek, mouth to headwaters	✔	✔
Woodford Creek, mouth to headwaters	✔	

Table 3-6 303(d) Listed Streams

Additionally, concern is shown for some stream reaches, where there is no data, but only general observations that may indicate poor water quality. Sediment problems have been recorded as moderate in Dads Creek (based on observation), and as severe in Quines Creek (based on observation) and Starvout Creek (based on data collected prior to 1988[16]). Flow modification usually refers to reduced flows that negatively impact resident fish and aquatic life, and salmonid fish spawning and rearing. Severe flow modification observations have been recorded for Quines Creek (based on data collected prior to 1988) and Windy Creek (based on data collected prior to 1988).

3.3.1. Sediment

Sediment is a natural part of every stream system. In water quality terms, sediment is a particulate matter of any size, from a microscopic piece of clay to a large boulder. There is not a most beneficial use designated for sediment. Because sediment is so variable, it is difficult to assign a numerical standard. Some water quality measures related to sediment are turbidity and total suspended solids. DEQ bases sediment listing on the following narrative criteria:

“The formation of appreciable bottom or sludge deposits or the formation of any organic or inorganic deposits deleterious to fish or other aquatic life or injurious to public health, recreation, or industry shall not be allowed.” (OAR 340-041-0285(2)(J))

Some of the impacts of an imbalance in a stream’s sediment regime include

- the smothering of salmonid eggs and fry by excess fine sediments,

[16] The data collected prior to 1988 is currently not available.

- eroding streambanks and widening of streams caused by larger sediment scouring the stream channel,
- filling of holes used by fish,
- clogging of water intakes, and
- increasing nutrient levels from phosphorus attached to soil particles.

Sediment is difficult to measure; therefore, this assessment presents several themes that are linked to sediment, including turbidity of the water, and effects of burns, roads, and soils.

Turbidity
Turbidity is an inverse measure of water clarity determined by light penetration through water. It is an optical measurement and is expressed in terms of Nephelometric Turbidity Units (NTUs), where the greater the NTUs, the more turbid the water.

The water quality standard for turbidity is based on resident fish and aquatic life, water supply, and aesthetics. Salmonids are sight-feeders; if the water is too cloudy, they cannot obtain their food supply. Suspended sediment can also damage gill tissue. Drinking water systems need water with low suspended sediment to avoid clogging up the filtration system.

The DEQ standard requires that no more than a 10% cumulative increase in natural stream turbidities shall be allowed, as measured relative to a control point immediately upstream of the turbidity causing activity, unless a permit is obtained for emergency activities, dredging, construction, or other legitimate activities. In order to be listed as water-quality impaired for sediment, there must be a systematic or persistent increase (of greater than 10%) in turbidity due to an operational activity that occurs on a persistent basis (e.g. dam release or irrigation return, etc.).

This standard is mostly useful for point sources of sediment (clearly defined contributions, such as the end of a pipe). The Oregon Watershed Assessment Manual recommends a measure of 50 NTUs as the level at which sight feeding of salmonids is adversely affected (Watershed Professionals Network, 1999).

The United States Geological Survey (USGS) sampled the turbidity of Cow Creek at their gage station near Azalea. Of the 75 samples from December 1980 to May 1981, only one of the samples (at 110 NTU) was above the 50 NTU benchmark. Ninety-three percent of the samples were below 15 NTU.

Burns
Little field burning occurs in the Middle Cow Creek Watershed. Table 3-7 displays a summation of the permits given for field burning and the burning of debris piles by the Douglas Forest Protective Association. It is unlikely that much sediment is delivered to the streams as a result of the burning, since so little occurs.

Subwatershed	Year	Field Burning: Acres	Burning: Debris Piles
Dads	1999	2	0
Woodford/Fortune Branch	1998	0	2
	1999	0	6
	2000	0	2
Quines	1998	10	0
	1999	0	4
	2000	0	3
Starvout	1999	0	6
	2000	0	4

Table 3-7 Field Burning and Debris Pile Burning

Roads

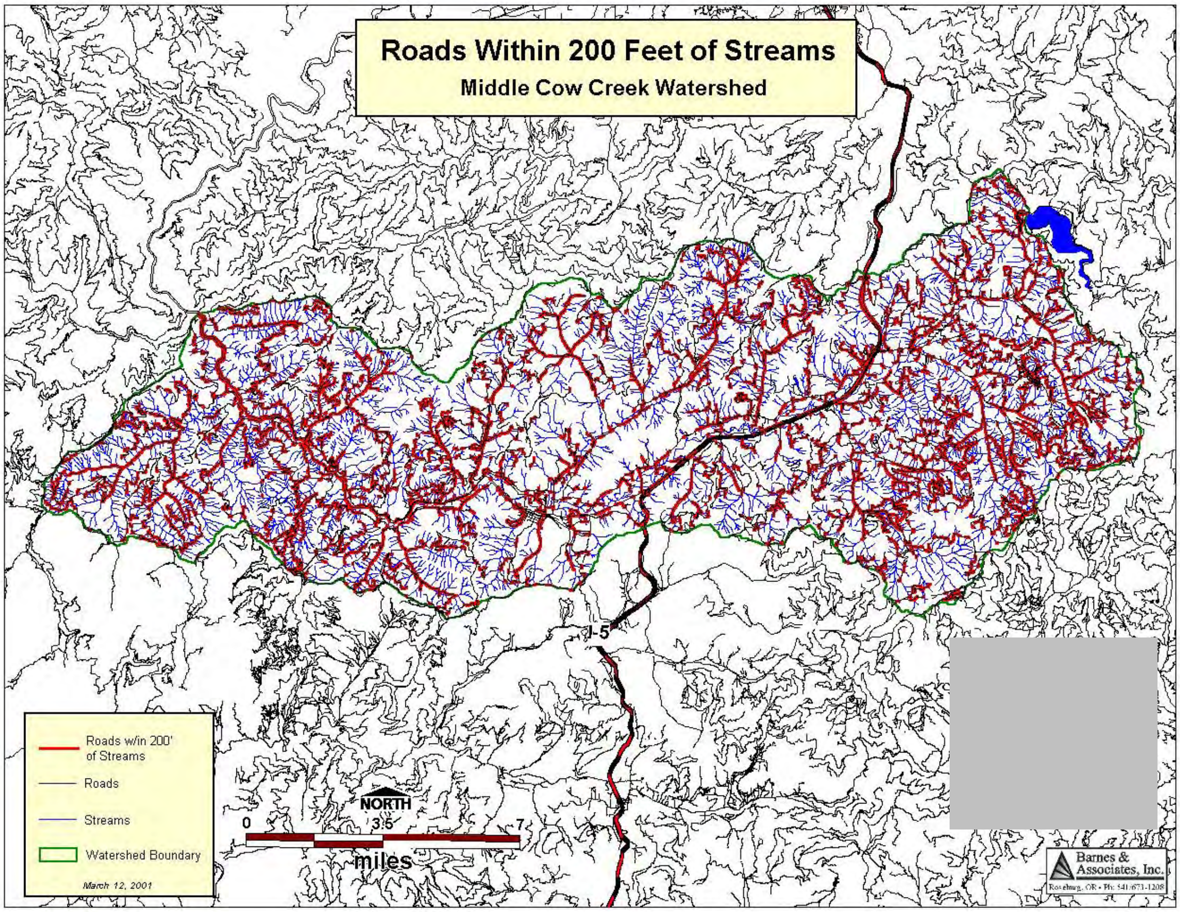
In Douglas County there are 1,100 miles of roads controlled by the county, 800 of which are open ditched roads. In an interview with Jim Alberding of Douglas County Public Works on August 14, 2000, he indicated that the county generally does not have problems with roads in the Middle Cow Creek Watershed.

Sedimentation from drainage ditches does not appear to be a problem. Often driveway culverts will trap the sediment from the ditch water. On steep roads the county uses 6-inch rock and places water bars in the ditch about every 20 feet.

There are 813 miles of roads in the Middle Cow Creek Watershed, 80 of which have paved surfaces, 368 have gravel surfaces, and 365 have unpaved or unknown surfaces.

Roads near streams pose significant management challenges, as they can impact water quality by delivering sediment to the streams. Cross-drains that release the ditch water onto a hillside, rather than directly into the stream, help filter sediment out of the ditch water. This practice may cause problems when done incorrectly, as the ditch water can erode the soil, therefore this practice needs to be designed by an engineer. The following map displays the roads near streams (Map 3:3). Landowners who manage these roads need to be aware of their management practices and adjust accordingly. The second map displays roads near streams on slopes over 50% (Map 3:4). These roads have even greater potential to impact water quality.

Roads within 200 feet of the stream are more likely to have ditches that divert directly into the creek. These pose the greatest challenge in keeping road related sediment from entering the creek. Roads across steep slopes have more soil accumulating in the road ditches. The more soil in the ditch, the greater chance of the ditch blocking, causing standing water and undermining the road surface integrity. In a worst-case scenario, this could cause the road to collapse.

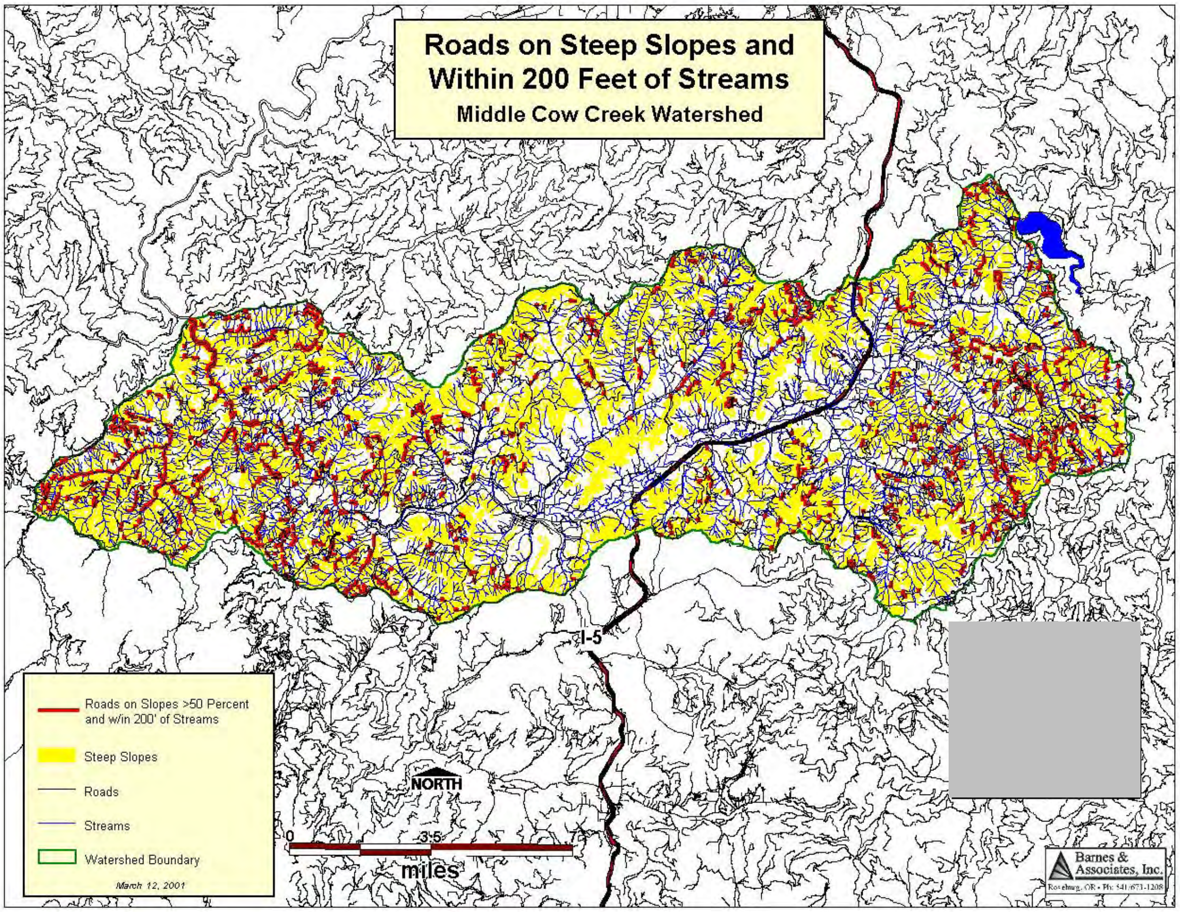


Map 3:3 Roads within 200 Feet of Streams

The information displayed in Map 3:3 and Map 3:4 is summarized in Table 3-8. Almost 400 miles of road in the Middle Cow Creek Watershed lie within 200 feet of Cow Creek and its tributaries, and could provide a source of sediment, heavy metals, and petroleum hydrocarbons into the stream (EWEB 2001). Close to 70 miles of roads were constructed across steep slopes and have a greater chance of failing and delivering material into the creek. While roads have the potential to add sediment to the stream, they also provide fire protection access, which could help prevent larger sediment sources from large-scale fires.

Road Surface Material	Miles of Road within 200 feet of a creek	Miles of Road within 200 feet of a creek and on a slope greater than 50%
Paved	37 (46%)	2 (2%)
Gravel	188 (51%)	32 (9%)
Non-surfaced or Unknown	173 (47%)	34 (9%)
Total	398 (49%)	67 (8%)

Table 3-8 Miles of Sensitive Roads



Map 3:4 Roads on Steep Slopes within 200 Feet of Streams

Properly maintained roads with cross drains have little danger of contributing sediment to creeks. However, many of the roads constructed in the past deliver ditch water directly into the creek, without filtering it across a hillside, and also contain undersized culverts, which have the potential of failing. These factors can pose a sediment hazard to adjacent creeks.

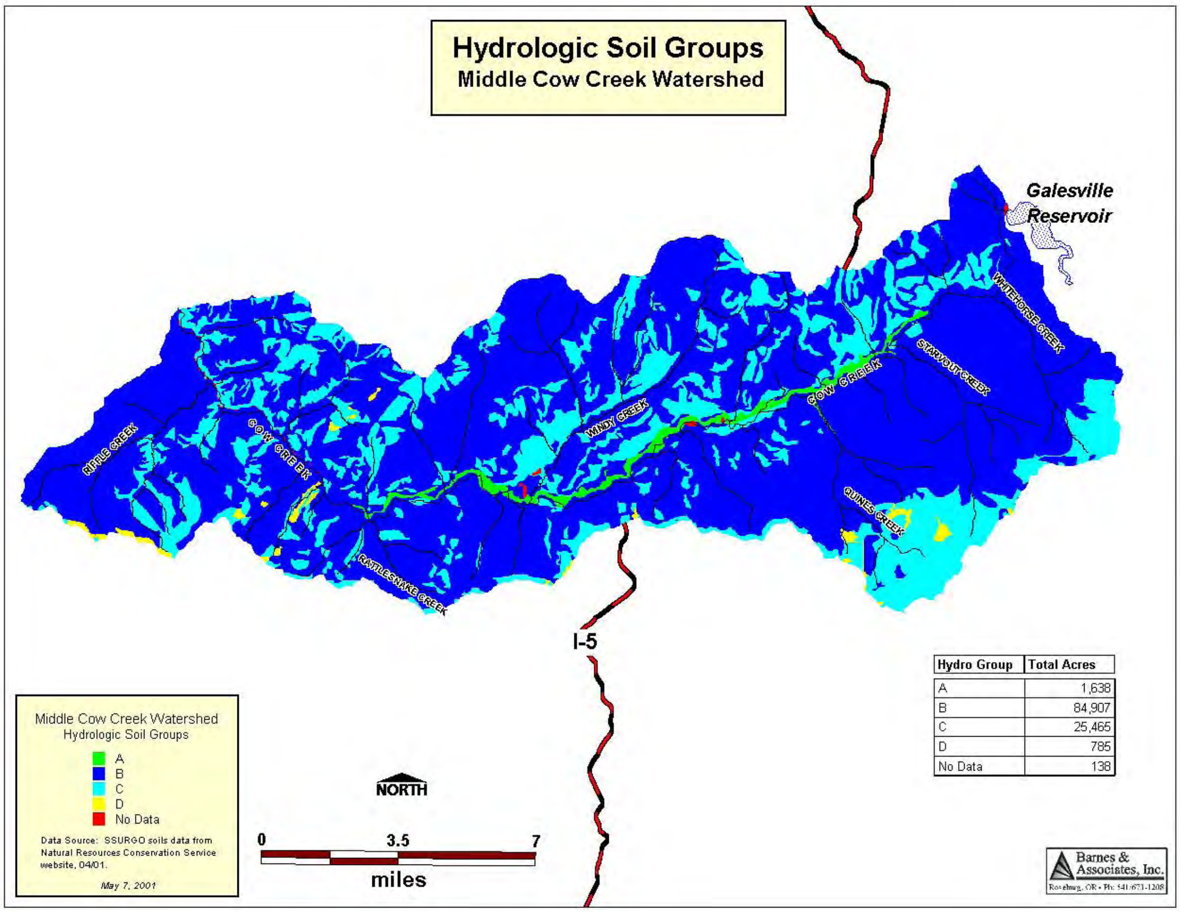
Infiltration and water run-off

When rain falls, soil types absorb rainwater at different rates. Using the Natural Resources Conservation Service's classification of soils in the Middle Cow Creek Watershed, it is possible to divide the soils into four hydrologic soil groups by similar infiltration rates. The soils are assigned an A, B, C, or D, where "A" represents soils that have the highest infiltration rates and "D" those with the lowest infiltration rates.

The predominant soil group in the Middle Cow Creek Watershed is "B" comprising 75% of the watershed. "B" soils have a fairly high infiltration rate, producing less overland run-off. Very little of the watershed is found in the low infiltration rate class of soils. Twenty-three percent of the watershed has soils with low infiltration rates. These are located primarily in the headwaters of Quines Creek and Whitehorse Creek, and are also found along Bonnie Creek and Windy Creek, and North of Cow Creek upstream of Glendale. See Table 3-9 and Map 3:5 for a display and summary of the hydrologic soil group by area.

Hydrologic Soil Group	Acres
A	1,638 (1%)
B	84,907 (75%)
C	25,465 (23%)
D	785 (1%)

Table 3-9 Hydrologic Soil Groups



Map 3:5 Hydrologic Soil Groups

Key Findings

- During 1981 and 1982 there was no problem with high turbidities that interfered with salmon feeding. The current situation is unknown, although with the increased water from the Galesville Dam, turbidity levels are likely to be lower.
- Almost 400 miles of road in the Middle Cow Creek Watershed are within 200 feet of Cow Creek and its tributaries, and could be a large source of sediment, heavy metals, and petroleum hydrocarbons into the stream. Close to 70 miles of roads were constructed across steep slopes and have a higher chance of failing and delivering material into the creek.

- 75% of the soils have a good infiltration rate and therefore it is likely that there is little sediment input from overland flow.

Action Recommendations

- *Encourage seeding and water-barring of new or temporary roads.*
- *Perform turbidity measurements (none have been done for 20 years), especially in Dads Creek, Quines Creek, and Starvout Creek, as there is concern of high sediment levels in these creeks.*

3.3.2. Temperature

Aquatic life is sensitive to water temperature, and cold-water salmonid fish and some amphibians are highly sensitive to temperature. In particular, coho salmon are among the most temperature sensitive of the cold-water fish species.

Stresses induced by high temperatures result in fish injury or mortality. This can be attributed to a combination of factors which result from high temperatures:

- decreased energy for feeding,
- negative changes in growth and/or reproductive behavior,
- increased exposure to pathogens (viruses, bacteria and fungus),
- decreased food supply (impaired macroinvertebrate [aquatic insect] populations),
- and increased competition from warm water-tolerant species.

This mode of thermally induced stress and/or mortality, termed indirect or sublethal, is delayed, and occurs weeks to months after the onset of elevated temperatures.

The most sensitive beneficial use to temperature in Cow Creek is salmonid fish rearing during summer months. The DEQ water quality criterion for temperature states that the seven-day moving average of the maximum daily water temperature should be below 64°F. In the winter the temperatures are low and are not harmful to the most sensitive beneficial use, salmonid spawning and incubation.

The pattern of the temperature during a season can be very complicated and difficult to describe, therefore there are several different ways to summarize water temperature. One is the seasonal maximum, which is the highest stream temperature reached during a season. Another is the seven-day moving average of the maximum daily temperatures. For this measure, the average is computed of the maximum temperatures reached during an interval of seven days. Commonly, the seven-day moving average is 2°F less than the seasonal maximum (Smith, personal communication).

A wealth of water temperature information has been collected in the Middle Cow Creek Watershed. Most of the data have been collected since 1994, and therefore this report will focus on these data.

STA Subwatershed

Galesville Dam has a significant impact on water temperatures of Cow Creek. Water released from the reservoir maintains Cow Creek at relatively cool temperatures. At a site above Whitehorse Creek the water temperature of **Cow Creek** was above 64°F for 5 days in 1994 and for 6 days in 2000, but not once during the years 1995 through 1999. The temperature of **Whitehorse Creek** was measured about 0.75 miles from the mouth in 1994 and 1997. There the water temperatures were above 64°F for 25 days in 1994, and for 4 days in 1997. Although the water temperature was high for many days in 1994, the maximum temperature reached was only 65.3°F.

In 1994 the water temperatures above the mouth of **Fizzleout Creek** did not surpass 64°F. Water temperatures were also measured in **Hogum Creek** at the confluence of Boulder Creek in 1995, 1996, and 1997. The numbers of days with water temperatures above 64°F were respectively 0, 28, and 0. The temperatures of the water in **Starvout Creek** have not been measured, as the lower end often goes dry in the summer. However, such streams often contribute cooler water to Cow Creek, as water is flowing subsurface through the gravels and is cooled.

QUI Subwatershed

Tennessee Gulch was monitored extensively in 1999. There were no observations of high water temperatures in the upper part of Tennessee Gulch. The lower portions of **Tennessee Gulch** warmed up at a beaver pond bordered by a meadow, with 40 days above 64°F and a high temperature of 67.5°F. Near the confluence with Quines Creek, Tennessee Gulch was cooler with 9 days above 64°F.

The maximum water temperature of **South Fork Quines Creek** at the confluence with Quines Creek was 61.8°F in 1998. At this same confluence, the water temperatures of **Quines Creek** were above 64°F for 7 days in 1998 and not at all in 1999. The water temperatures above the confluence of Tennessee Gulch had increased to 25 days above 64°F in 1998, and 3 days above 64°F in 1999. At a site 1 mile above the confluence with Bull Run, the number of days above 64°F in 1998 had decreased to 13. Finally, the mouth of **Quines Creek** was sampled in 2000, when the maximum water temperatures were above 64°F for 34 days and the maximum water temperature was 76.5°F. **Cow Creek**, at a site above the confluence with Quines Creek had a maximum water temperature of 62.5°F.

At a site on **Cow Creek** below Quines Creek the water temperatures have been measured continuously since 1988. In 1994 the water temperatures were above 64°F for 33 days, with a maximum of 66.7°F. In 1995, 1996, 1998, and 1999 the water temperatures never went above 64°F, and in 1997 they did so for only one day.

WFB Subwatershed

The temperature of **Fortune Branch** has been measured extensively at a site 1 mile from the mouth at the lower BLM Boundary. The number of days at which the maximum water temperatures were above 64°F were as follows: 1994 – 1 day, 1995 – 60 days, 1996 – 1 day, 1997 – 44 days, 1998 – 33 days, and 1999 – 24 days. In 1998, at a site 0.7 upstream from this site the number of days above 64°F were 3 and the maximum water temperature had decreased from 68°F to 64.4°F. Another mile upstream the maximum water temperature was 63.6°F.

In 1995, the water temperatures reached above 64°F for 18 days in **Woodford Creek** at a measuring station about 1 mile upstream from the mouth.

The water temperatures of **Cow Creek** were measured above the confluence with Windy Creek in 2000. The maximum temperatures were above 64°F for 67 days, with a maximum of 73.4°F.

WIN Subwatershed

The upper reaches of **Windy Creek** were sampled at four sites in 1997 and 1998. Of these 4 sites, the highest water temperature was recorded at the most downstream site, 1.5 miles above the confluence of Lawson Creek. At this site the high temperature was 63.9°F in 1997 and 65.6°F in 1998, where the temperature reached above 64°F for 9 days. The temperatures at the North and West Forks of Windy Creek were also sampled in 2000, where the highest temperatures reached 61.8°F.

The maximum water temperature in 2000 for **Windy Creek** above the confluence of Lawson Creek was 68.4°F, with 36 days of temperatures above 64°F. At the mouth of **Lawson Creek**, the maximum temperature was 68.4°F, with 31 days of temperatures above 64°F.

The water at the mouth of **Wood Creek** was sampled in 2000, with temperatures reaching above 64°F for 7 days.

The water in **Windy Creek** was sampled above the high school in 2000, where water temperatures reached above 64°F for 60 days; the water sampled further downstream at the high school exceeded 64°F for 54 days. The water at the high school was also sampled in 1995, 1997, and 1998; the number of days above 64°F was respectively 31, 50, and 30.

Finally, the water was sampled at the mouth of **Windy Creek** in 2000, showing temperatures reaching above 64°F for 51 days.

MCC Subwatershed

Cow Creek was sampled in Glendale in 1995 and 1996 where water temperatures reached above 64°F for 53 days and 63 days respectively.

The upper reach of **McCullough Creek** has been sampled many times during the period of 1994 through 2000, and the temperature was always below 64°F. The mouth of **McCullough Creek** was sampled in 1997, 1998, and 2000, where the temperatures reached above 64°F for 1 day in 1997, for 0 days in 1988, and for 8 days in 2000.

DAD Subwatershed

The upper portion of **Dads Creek** was sampled in 1998 and 1999, and no water temperatures reached above 64°F. The first major tributary to Dads Creek was also sampled in 1998 and 1999, with water temperatures above 64°F for 69 and 62 days respectively and maximum water temperatures of 72.5°F and 66.1°F. The creek also went dry for a few days each year. At a site below the confluence of this tributary the maximum water temperature exceeded 64°F for 15 days in 1998, and even further downstream the water temperature was below 64°F the entire summer. Near the mouth of **Dads Creek** the water temperature has been sampled with the number of days above 64°F as follows: 1994 – 7, 1995 – 11, 1996 – 13, 1997 – 1, 1998 – 17, 1999 – 9, and 2000 – 0.

The mouth of **Skull Creek** has been sampled in 1994, 1995, 1996, 1998, and 1999. The number of days with water temperatures reaching above 64°F was respectively 15, 28, 24, 25, and 2.

RIF Subwatershed
The **East and West Forks of Bonnie Creek** were sampled in 1994, 1995, and 1996. There were two days during which 64°F was exceeded. These two days occurred in West Fork in 1996. The mouth of **Riffle Creek** was sampled during these same years. The number of days with water temperatures reaching above 64°F was 47, 43, and 12 respectively.

Cow Creek was sampled at Susan Creek during the same years as Riffle Creek. The water temperatures reached above 64°F 100, 79, and 73 days respectively.

The final measurement of water within the watershed was **Cow Creek** above the confluence with Middle Creek in 2000. The number of days with water temperatures reaching above 64°F at this site was 76.

Effect of Galesville Dam
At one site on Cow Creek above Whitehorse Creek water temperature has been collected since 1980. The cooling effect of the dam can be seen in the difference of the average of the yearly maximum temperatures before and after the construction of the dam. For the years 1980 – 1985 the average summer maximum temperature was 77.5°F, while that of the years 1986 – 2000 was 62.3°F.

Studies in the year 2000
InSight Consultants performed a detailed temperature study of the Cow Creek basin in the year 2000. Some information from this study was given above, however, a detailed summary of the results of this study is contained in Appendix C.

A Forward-Looking Infra-Red survey of Cow Creek was conducted on July 25, 2000 from the confluence with the South Fork Umpqua River to the Galesville Reservoir, a distance of 60 miles and was able to measure surface water temperatures. The survey was conducted in mid-afternoon about 1 hour prior to the maximum stream temperatures.

The median temperature for each sample frame from the confluence with the South Umpqua River upstream to the Galesville Reservoir was plotted versus river mile (Figure 3-8). The figure shows how temperature varied longitudinally along this reach and identifies the location and temperature of tributary inflows. In general, stream temperatures increased in the downstream direction for the survey section but temperatures did cycle up and down irregularly over the course of the study reach.

At the outlet of Galesville Reservoir (river mile 59.6), Cow Creek was 62.8°F with the surface temperature of the reservoir immediately upstream of the outlet measured at 72.7°F. From the outlet downstream to river mile 55 stream temperatures increase rapidly to 68.5°F. Over the next 3.5 miles, stream temperatures decreased to 65.1°F (river mile 51.5). At river mile 51.5 stream temperatures increase steadily over the next 8.5 miles to a maximum of 72.3°F. From river mile 43 to 33, stream temperatures again decreased in the downstream direction to a minimum of

68.9°F. Over the next 30 miles stream temperatures increased steadily to a maximum for the survey of 75.2°F at river mile 3.3. From river mile 3.3 to the mouth stream temperatures decrease to 73.2°F at the confluence with the South Umpqua River. The South Umpqua River was 75.0°F at the confluence with Cow Creek. For the survey reach, the temperatures of 14 tributaries were detected contributing flow to Cow Creek. Of the 14 tributaries we detected, 13 were contributing cooler flows to Cow Creek. Downstream of Whitehorse Creek, the surface temperature of Cow Creek did not go below 64°F again.

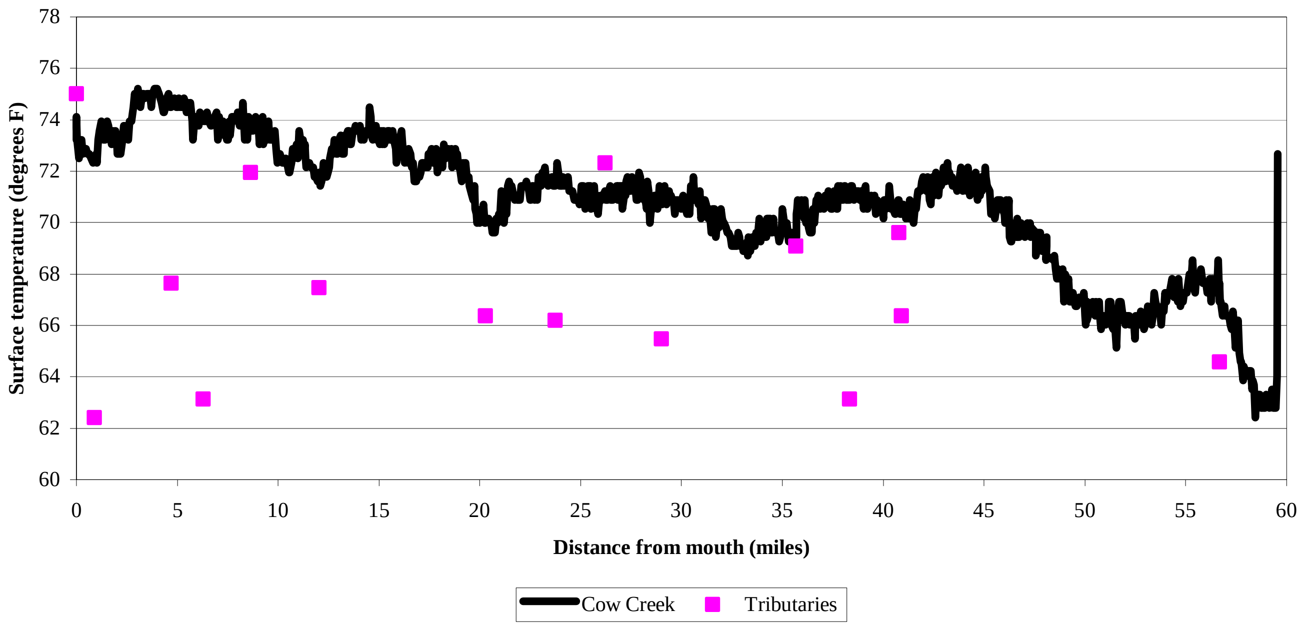


Figure 3-8 Water Surface Temperature of Cow Creek

Possible Causes of High Stream Temperatures

Many factors affect stream temperatures. Some of them (latitude, aspect, climate, daily temperatures, and precipitation) are beyond human control. Floods can wash out riparian areas and change the width and depth of a channel. Human influences include heated discharges, removal or planting of vegetation that intercepts solar radiation, the level of flow (withdrawals), and channel complexity (removal or addition of wood to streams).

Key Findings

- The temperature of Cow Creek above Quines Creek is adequate to provide fish rearing in the summer.
- Temperatures vary over different years, therefore, if stream temperatures are found to be low/high one year that does not mean they will be so every year.
- McCullough Creek, Bonnie Creek, and many upper portions of other creeks seem to provide water sufficiently cool for fish rearing.
- At the mouths of Dads, Skull, Quines, Windy, and Fortune Branch the water temperature levels appear high enough to limit fish rearing in the summer.

Action Recommendations
- *Plant native vegetation to establish a tall and dense shade wall along and over streams.*
- *Establish trees in brushy and open areas along the stream.*
- *Place large wood structures in the streams that accumulate gravels and create subsurface flows that can cool the water.*

3.3.3. Nutrients

Nutrients can have an impact on water quality. High levels of nitrogen and phosphorus can over-stimulate algae and plant growth, raising pH levels and lowering dissolved oxygen levels.

There are no specific state numerical standards for the amounts of nutrients in the waters of the Umpqua tributaries. There is a narrative (non-quantitative) standard for aquatic weeds and algae that states that levels of aquatic weeds and algae are not allowed such that they have a deleterious effect on stream bottoms, fish, or other aquatic life, or that they cause injury to health, recreation, or industry (DEQ, 1999).

The Oregon Watershed Assessment Manual recommends using a benchmark of 0.30 mg/L for total nitrates as an indicator of water quality (Watershed Professionals Network, 1999). For total phosphorus, a benchmark of 0.05 mg/L is recommended by the Oregon Watershed Assessment Manual (Watershed Professionals Network, 1999).

There are no known samples for nutrients of the waters within the Middle Cow Creek Watershed. The nearest samples were obtained by the DEQ at the mouth of Cow Creek near Riddle. Of 183 Phosphorus samples from 1977 to 2000, 24 (13%) were above the 0.5 mg/L benchmark. The sample values ranged from 0.007 mg/L to 2.8 mg/L. Of 313 Nitrate/Nitrite samples, 3 (1%) were above the 0.3 mg/L benchmark. The sample values ranged from 0.005 mg/L to 2.8 mg/L.

Often nutrients in the water column will stimulate algal growth that incorporates the nutrients, removing them from the water column. Thus, nutrients can be a problem even when levels of nutrients in the water column are low. Excessive growth of algae or aquatic weeds is a strong indication of excess nutrients evens if the water column levels are low.

Possible Sources of Nutrients
Possible sources of nutrients include animal manure, commercial and home-use fertilizers, decaying organic matter, and inadequate and failing septic systems. Erosion and run-off from construction sites, recent burns, stream banks and other slopes can also be a source of phosphorus, because it is an element that clings strongly to soil particles. Traces of phosphorus can also come from the weathering of rocks.

Key Findings
- The presence of nutrients in waters within the Middle Cow Creek Watershed is unknown;
- At the mouth of Cow Creek elevated levels of phosphorus were found 13% of the time;
- The levels of nitrogen at the mouth of Cow Creek do not indicate a problem.

Action Recommendations

- *Develop a targeted monitoring program to sample for nutrients if algae indicate a problem;*
- *Provide education regarding the concern with excess nutrients;*
- *Encourage construction site erosion control to limit the transfer of sediment (a likely source of nutrients) from the site into storm drains and creeks;*
- *Test/inspect septic systems to identify those needing repair or replacement;*
- *Fix failing septic tanks that contribute nutrients to the creeks; and*
- *Manage livestock so animal wastes do not contaminate the riparian area.*

3.3.4. Dissolved Oxygen

Dissolved oxygen is essential for all aquatic life, but can have an especially significant effect at the early life stages of salmonids. The redds containing the salmonid eggs are in the gravels and the survival of these eggs is affected by the level of dissolved oxygen within the gravels. The most sensitive time for dissolved oxygen is during the salmonid spawning season, which in Cow Creek occurs during the fall, winter, and spring.

According to the DEQ, during this time the minimum level of dissolved oxygen (DO) needed for survival of the eggs is 11.0 mg/L. Where conditions of barometric pressure, altitude, and temperature preclude the attainment of 11.0 mg/L, the criterion is 95% of saturation at the ambient conditions during which the water sample was taken (barometric pressure, altitude, and temperature at the time and place of the sampling). Samples of dissolved oxygen have been recorded at the gage station above Whitehorse Creek since 1986. The seasonal minimum dissolved oxygen levels ranged from 1.7 to 9.5 over the years sampled (Figure 3-9), consistently below the standard for salmonid egg survival. This site is located about two miles downstream of the Galesville Dam, and the amount of dissolved oxygen in the water is significantly affected by the activities of the dam; for instance, the level of 15.1 mg/L of dissolved oxygen was likely caused by the operation of the bypass valve of the dam. There are no other samples of dissolved oxygen in the watershed.

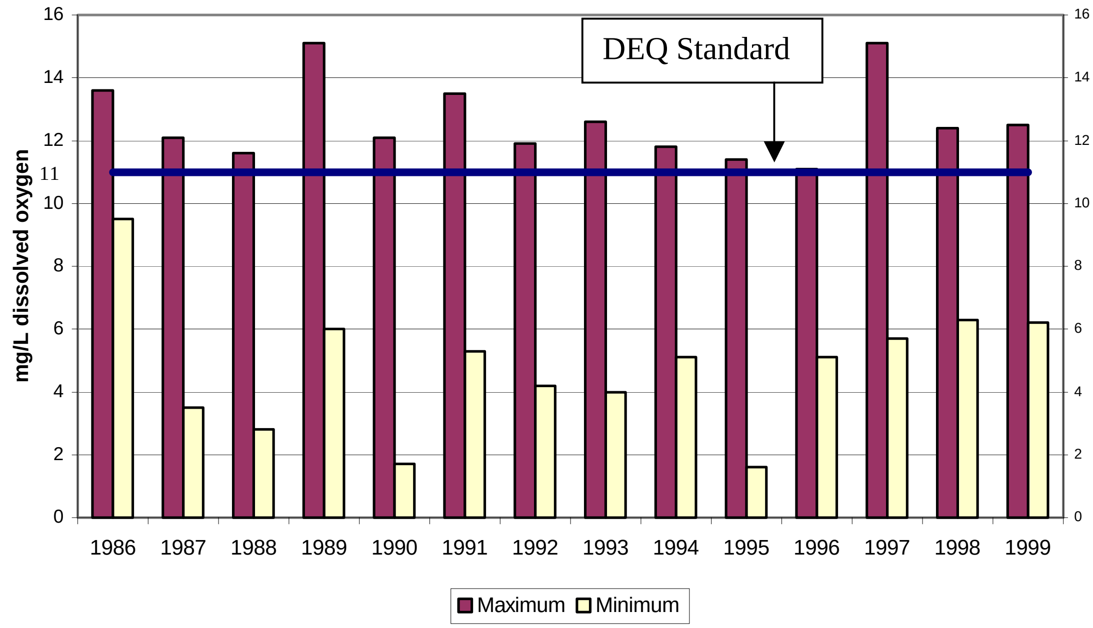


Figure 3-9 Maximum and Minimum Dissolved Oxygen Levels of the Fall, Winter, and Spring in Cow Creek above Whitehorse Creek

During the summer, the most sensitive user of dissolved oxygen is cold-water aquatic life, with the criterion being a minimum of 8.0 mg/L dissolved oxygen. Where conditions of barometric pressure, altitude, and temperature preclude the attainment of 8.0 mg/L, the criterion is 95% of saturation at the ambient conditions. The seasonal minimum has been below the benchmark values in Cow Creek above Whitehorse Creek for the last 15 years (Figure 3-10).

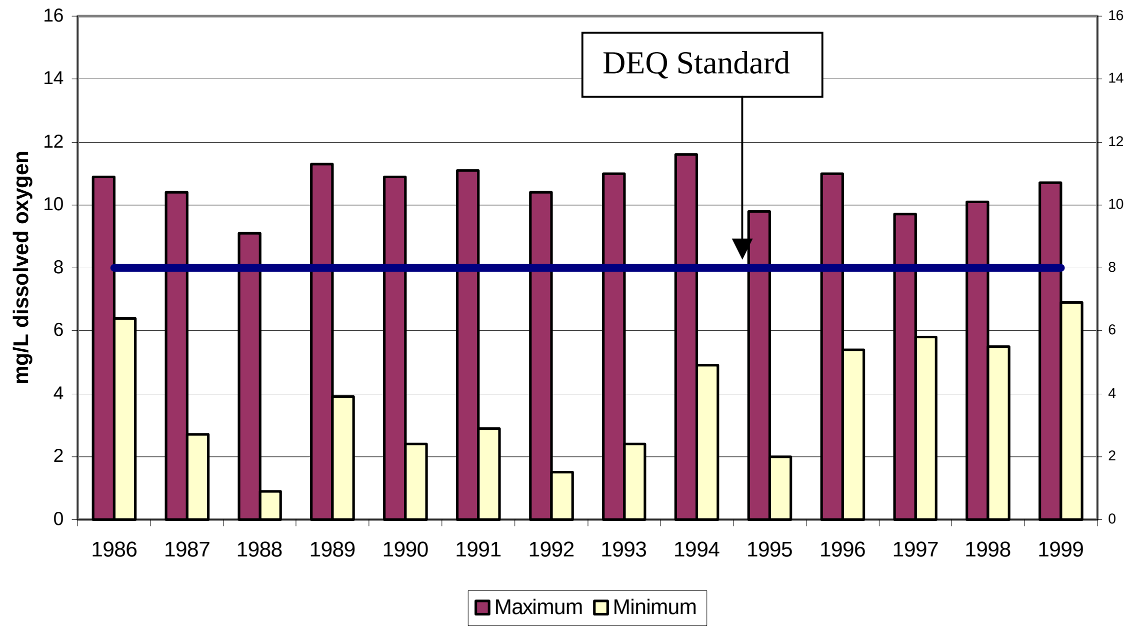


Figure 3-10 Maximum and Minimum Dissolved Oxygen Levels of the Summer in Cow Creek above Whitehorse Creek

Key Findings

- The dissolved oxygen levels in the summer, as well as during the rest of the year, limit salmonid egg survival, as well as cold-water aquatic life in Cow Creek near the dam.
- There is little information concerning dissolved oxygen, especially for the tributaries.

Possible Causes of Dissolved Oxygen Impairment

Factors that could contribute to low dissolved oxygen levels in the tributaries are high stream temperatures and high nutrients levels. In the case of water temperature, the warmer the water, the less amount of dissolved oxygen it can hold. At high levels of nutrients in a stream, algae blooms deplete the dissolved oxygen through respiration.

Action Recommendations

- *Sample for dissolved oxygen throughout the watershed.*

3.3.5. pH

pH is a measure of the number of hydrogen ions in a substance, and is measured in Standard Units (SU) from 1 to 14, with 7 being neutral. Values below 7 are considered acidic, while values above 7 are considered basic.

Many chemical and biological processes in a stream are affected by pH. The standard for pH values indicate the lower and upper limits that protect most aquatic species in western Oregon. Values outside of this range may result in toxic effects to resident fish and aquatic life (USEPA 1986).

For purposes of protecting aquatic species, the pH needs to be between 6.5 and 8.5. During the years 1998 through 2000 the Douglas County Health and Social Services made 16 pH measurements in Cow Creek near Glendale. These measurements were collected once a month in May through October. All sample values fell within the desired pH range, thus Cow Creek near Glendale does not seem to have a pH problem.

Possible Causes of pH Values beyond the Desired Range

Elevated nutrient inputs from fertilizers, poorly sited or faulty septic systems, and sewage treatment system discharges affect algae growth which elevates pH levels. Chemical fertilizers applied to residential yards, agricultural areas, and forestlands may be non-point sources of nutrients impacting pH levels.

Key Findings

- The data collected indicate that pH levels are sufficient to protect fish and aquatic life at one site on Cow Creek.
- The pH levels of other locations in the watershed is unknown.

Action Recommendations

- *Periodically measure pH levels in Cow Creek and its tributaries.*

3.3.6. Toxics

This component refers to materials that may cause toxicity in aquatic organisms, and include chemicals and heavy metals. Chemicals are man-made and serve a variety of purposes in industry, such as pesticides and herbicides, and for non-industrial uses, such as washing cars. Metals come from a variety of sources. The Oregon Watershed Assessment Manuals provides benchmarks for Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, and Zinc, that if exceeded are toxic to freshwater aquatic life.

The Umpqua Basin Watershed Council is unaware of any sampling for chemicals or metals in the streams of the Middle Cow Creek Watershed.

Possible Sources of Toxics
Possible sources of toxics in the streams include pesticides, herbicides, fertilizers, abandoned mines, and natural weathering of rocks with elevated levels of heavy metals.

Action Recommendations

- *Sample for toxics throughout the watershed.*

3.3.7. Bacteria

The water quality standard for bacteria is designed to protect human health during water contact recreation. The standard is based on the number of fecal coliform in a 100 ml sample. Fecal coliform bacteria are used as an indicator of bacteria and pathogens from warm-blooded animals that are harmful to humans.

The Douglas County Health and Social Services sampled a site near Glendale for bacteria monthly during May through October in the years 1998-2000. Only 2 of 18 samples (11%) exceeded the acute standard of 400 fecal coliform per sample[17] (648 in October, 1999, and 707 in July, 2000). Bacteria are considered a problem when over 15% of the samples exceed the standard.

Potential Sources of Bacteria
There are a variety of activities in the watershed which have the potential for delivering bacteria to streams, including livestock manure, inadequate or failing septic systems, pet feces in runoff, wild animal feces, and animal carcasses in the streams.

Key Findings
Samples taken near Glendale in Cow Creek do not indicate a persistent bacteria problem, although occasional samples have shown contamination. This is limited data and the condition of other parts of Cow Creek and the tributaries is unknown.

Action Recommendations

- *Periodically sample for bacteria throughout the watershed.*

[17] It is not known if the samples were taken during/after a rain event.

3.4. Water Quantity

3.4.1. Water Availability

Data from the Oregon Water Resources Department (OWRD) has been used to determine water availability in the Middle Cow Creek Watershed. Availability is based on streamflow, consumptive use, and instream water rights. The OWRD has divided the Middle Cow Creek Watershed into seven sub-basins (Water Availability Basins – WABs) for the purpose of analyzing water availability. These WABs are not the same as the subwatersheds of this assessment. The amount of water available for any new water rights is determined by subtracting consumptive use and instream rights from streamflow.

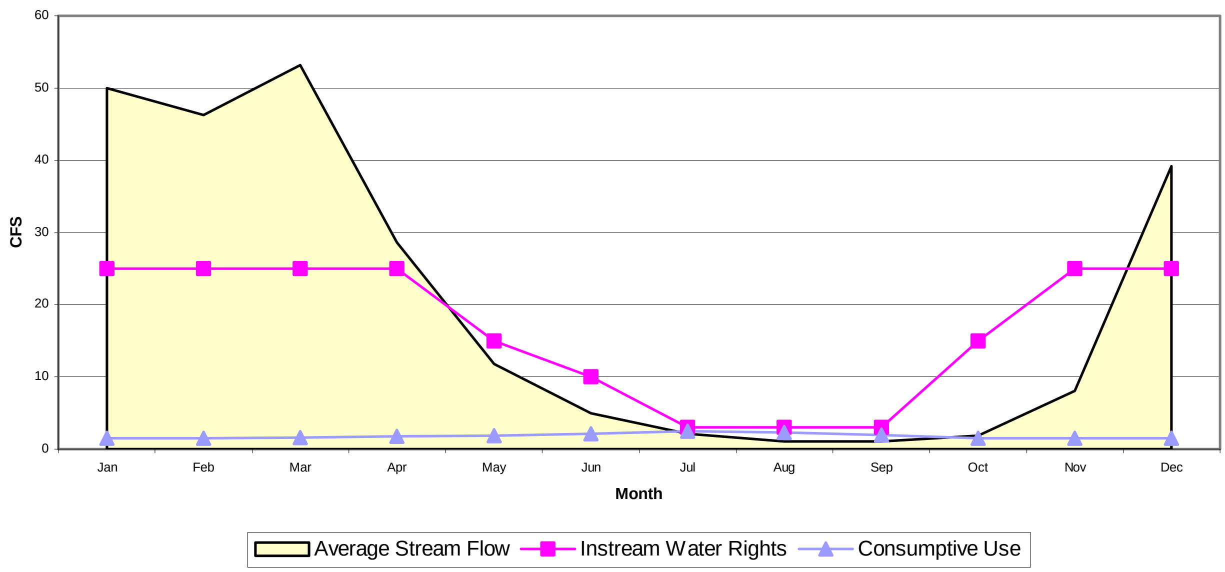


Figure 3-11 Water Availability in the Windy Creek Water Availability Basin

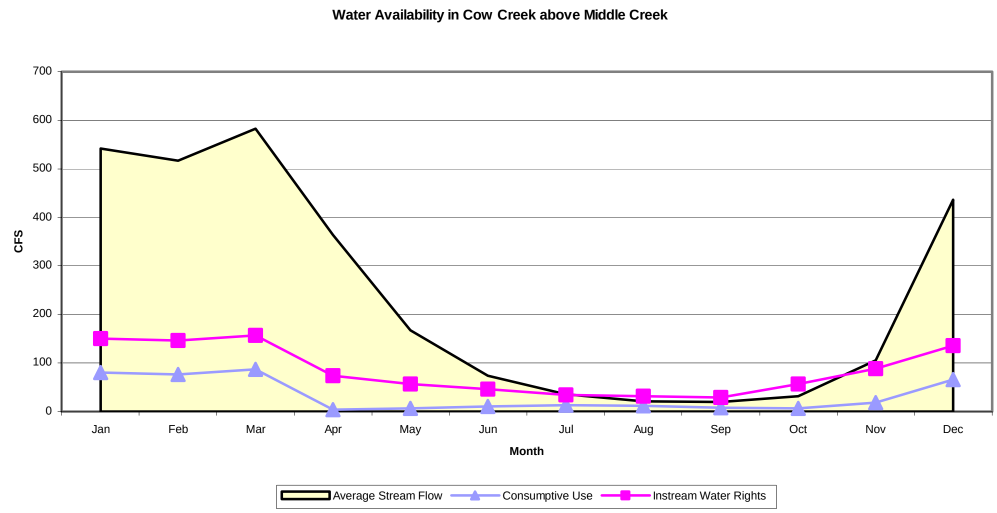
Oregon law provides a mechanism for temporarily changing the type and place of use for a certificated water right by leasing the right to an instream use. The stream benefits by leaving the leased water instream while the water right holder benefits by not having to pay pumping costs. Because the lease is a beneficial use of the water right, the right is protected from the five-year nonuse forfeiture statue. Another benefit to the water right holder is that upon expiration of the water lease, the five-year forfeiture period starts from zero. Instream leasing and purchases of rights are both useful ways of enhancing aquatic habitat during critical low flow periods. Increased flow provides fish habitat, dilutes the concentration of bacteria, and dissipates heat energy.

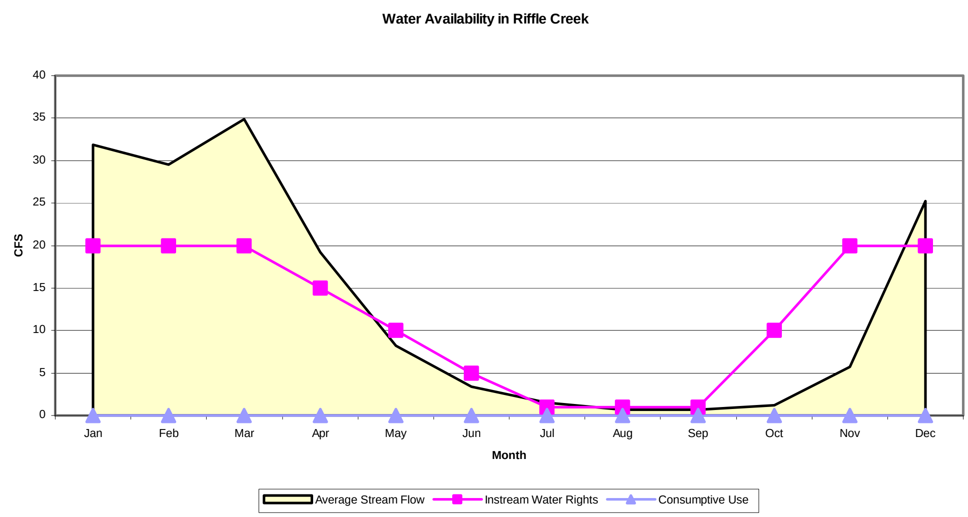
As demonstrated in Figure 3-11, Figure 3-12, and Table 3-10, water availability is a concern in each WAB at some time during the summer and fall. In the Whitehorse and Riffle WABs there is no consumptive use, and in Starvout and Quines it is minimal. However, in the Windy Creek WAB, consumptive use is greater than the natural stream flow (Figure 3-11).

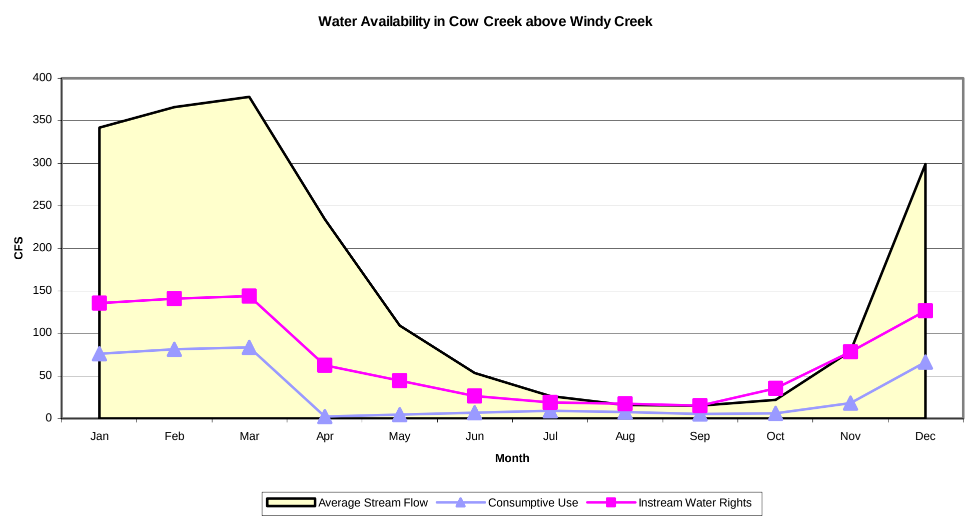
Month	Flow	Consumptive Use						
		White-horse	Starvout	Quines	Cow abv Windy	Windy	Riffle	Cow abv Middle
Jan	Average[18]	21.3	28.4	32.9	342	50	31.9	542
	Net[19]	1.3	13.3	7.87	206	23.5	11.9	391
Feb	Average	19.8	26.3	30.6	366	46.3	29.5	517
	Net	-0.2	11.2	5.57	225	19.8	9.5	370
Mar	Average	24.7	32.2	37.4	378	53.2	34.9	583
	Net	4.7	17.1	12.4	234	26.6	14.9	427
Apr	Average	15.3	19	22.5	234	28.6	19.2	364
	Net	0.3	8.84	2.4	172	1.85	4.2	290
May	Average	7.76	8.99	10.9	109	11.8	8.23	168
	Net	-2.24	0.78	-4.31	64.6	-5.1	-1.77	111
Jun	Average	3.65	3.8	4.95	53.3	4.95	3.4	74
	Net	-1.35	-1.46	-0.37	26.7	-7.21	-1.6	28.5
Jul	Average	1.7	1.59	2.28	26.2	2.16	1.47	35.6
	Net	0.7	0.26	-1.18	7.07	-3.31	0.47	1.8
Aug	Average	0.86	0.74	1.15	16	1.03	0.69	20.8
	Net	-0.14	-0.54	-2.22	-1.48	-4.24	-0.31	-10.9
Sep	Average	0.89	0.76	1.19	14.7	1.04	0.7	20.4
	Net	-0.11	-0.47	-2.06	-0.39	-3.95	-0.3	-8.16
Oct	Average	1.58	1.48	2.04	21.6	1.84	1.24	31.3
	Net	-3.42	-3.65	-13	-14.2	-14.7	-8.76	-25.8
Nov	Average	4.97	6.01	6.84	79.3	8.05	5.69	106
	Net	-10	-9.12	-18.2	0.94	-18.4	-14.3	18.2
Dec	Average	16.9	22.6	25.9	299	39.2	25.2	437
	Net	-3.1	7.47	0.87	173	12.7	5.2	302

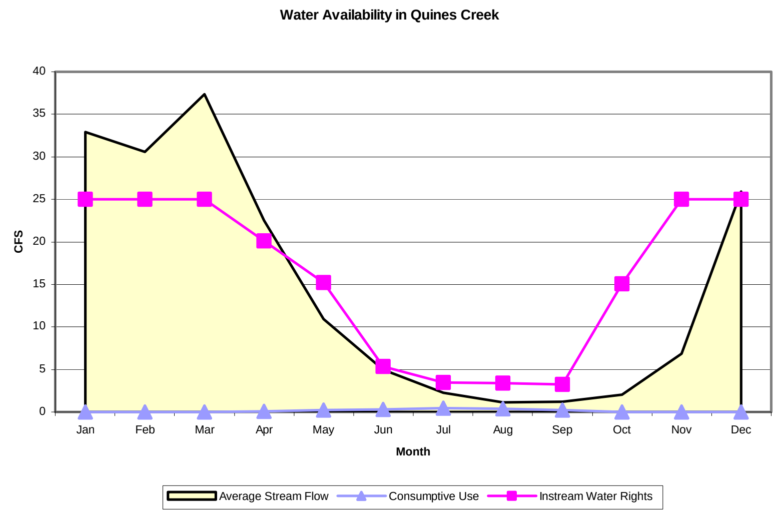
Table 3-10 Average and Net Available Water Flow (cubic feet per second [cfs])

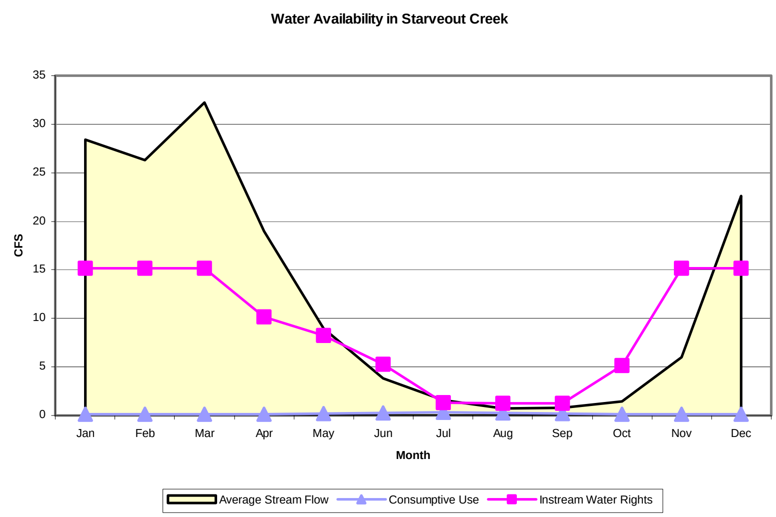
[18] Average flow.
[19] Average flow minus consumptive use.


Water Availability in Cow Creek above Middle Creek
CFS
0
100
200
300
400
500
600
700
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month
Average Stream Flow
Consumptive Use
Instream Water Rights


Water Availability in Riffle Creek
CFS
0
5
10
15
20
25
30
35
40
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month
Average Stream Flow
Instream Water Rights
Consumptive Use


Water Availability in Cow Creek above Windy Creek
CFS
0
50
100
150
200
250
300
350
400
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month
Average Stream Flow
Consumptive Use
Instream Water Rights





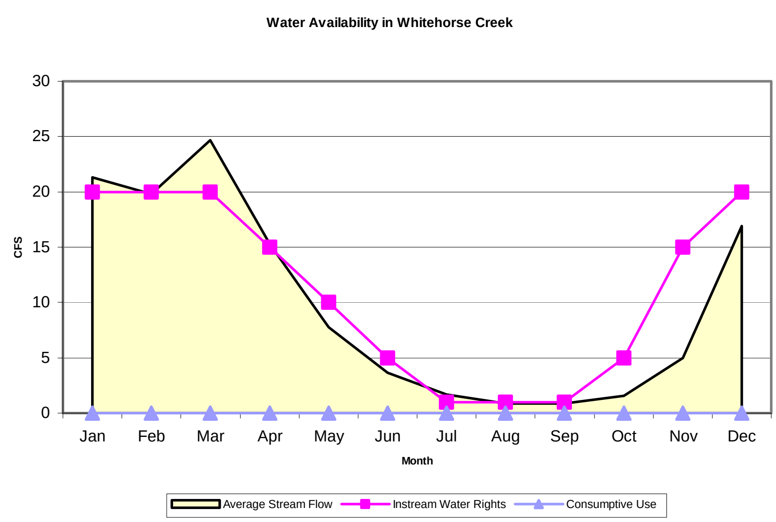


Figure 3-12. Water Availability by month for Whitehorse, Starvout, Quines, Cow Creek above Windy, Riffle and Cow Creek above Middle WABs

Water Rights by Use
Table 3-11 shows consumptive uses by category based on water rights of record in the Middle Cow Creek Watershed. The largest use of water is for industry (74% of all water rights), followed by fish and wildlife (15%) and irrigation (10%).

Subwatershed	Total	Irrigation	Fish/ Wildlife	Agriculture	Industry	Municipal	Domestic	Recreation	Miscellaneous
Riffle	1	0	0	0	1	0	0	0	0
Dads	75.36	0.51	0	0	74.85	0	0	0	0
McCullough	6.90	3.22	0	0.03	0.57	2.82	0.24	0	0.02
Windy	12.53	3.91	0	0.01	8.56	0	0.06	0	0
Woodford/ Fortune Branch	6.88	4.80	0	0	2	0	0.08	0	0
Quines	90.99	10.22	0	0.01	80.5	0	0.25	0.01	0
Starvout	149.88	12.23	50	0	87.16	0	0.33	0	0.16
Total	342.54	34.89	50	0.05	254.64	2.82	0.96	0.01	0.18

Table 3-11 Water Rights by Category and Subwatershed (cfs)

Action Recommendations
- *Secure water right leases or purchase water rights for conversion to instream use in Quines, Windy, and the two Cow Creek Water Availability Basins.*
- *Improve irrigation efficiency.*

3.4.2. Hydrology
There are two gaging stations on Cow Creek in the Middle Cow Creek Watershed: one near Azalea and one below McCullough Creek. The one near Azalea has been operating since 1926 and the one below McCullough Creek since 1986. Galesville Dam was constructed in 1986 and the gaging station near Azalea documents the changes in flow as a result of releases from the dam.

The peak flows by year are displayed in Figure 3-13. Also displayed are the yearly total flows of Cow Creek. These are depicted on different scales, but they demonstrate the correspondence of high yearly and high peak flows before 1986, and the continuation of high yearly flows, but low peak flow after 1986. The years with the highest instantaneous peak flow were in 1964, 1974, 1982 and 1983. The years with the highest annual flow were in 1938, 1956, 1974, and 1983.

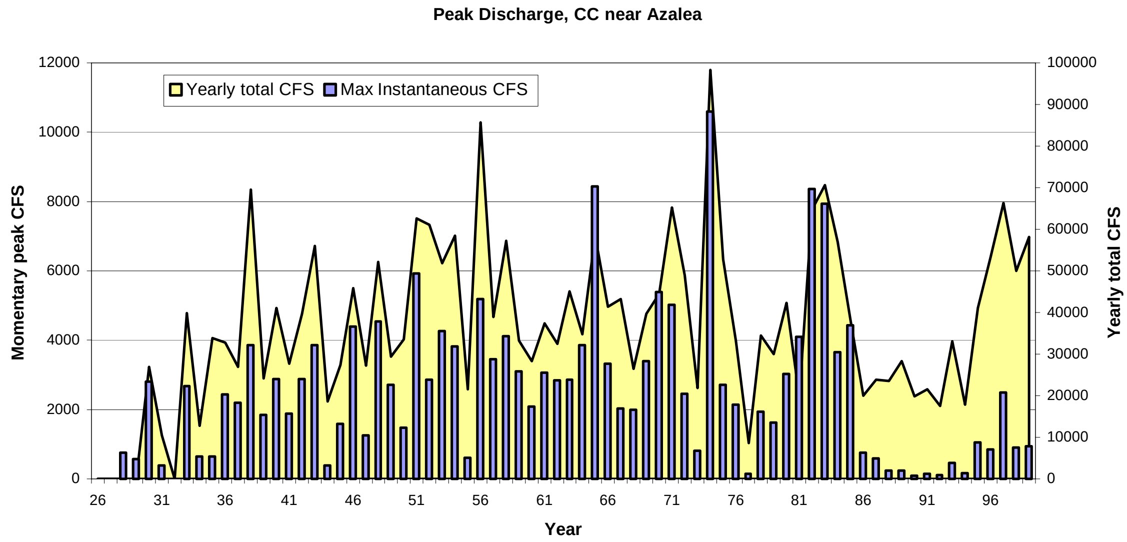


Figure 3-13 Total and maximum instantaneous discharge of Cow Creek near Azalea

The low flows by year are displayed in Figure 3-14. The low flow level has increased significantly since 1992, once the reservoir contained enough water to release flows up to 40 CFS during the summer. The lowest flows occurred in the summers of 1971 and 1982.

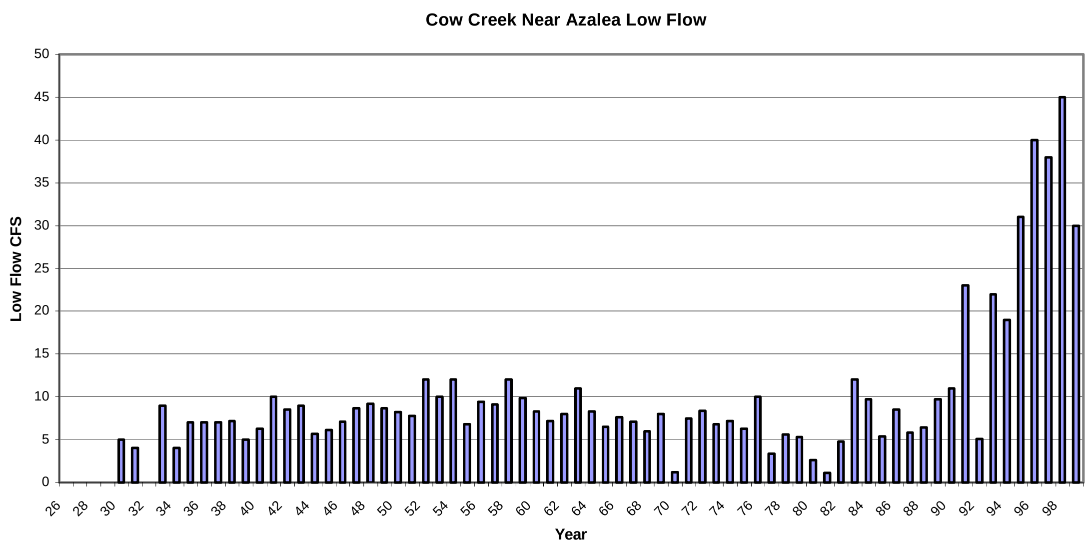


Figure 3-14 Low flow discharge of Cow Creek near Azalea

3.5. Fish

Anadromous salmonids present in the Middle Cow Creek Watershed include winter steelhead, coho salmon, fall chinook salmon, and cutthroat trout. A list of fish which inhabit the waters of the Middle Cow Creek Watershed is displayed in Table 3-12.

Native Species		**Non-native Species**	
Common Name	*Scientific Name*	*Common Name*	*Scientific Name*
Winter steelhead	*Oncorhynchus mykiss*	Brown bullhead	*Ameiurus nebulosus*
Coho salmon	*O. kisutch*	Smallmouth bass	*Micropterus dolomieui*
Fall chinook salmon	*O. tshawytscha*		
Cutthroat trout	*O. clarkii*		
Rainbow trout	*Salmo gairdneri*		
Brook lamprey	*Lampetra spp.*		
Pacific lamprey	*Lampetra tridentata*		
Umpqua dace	*Rhinicthys cataractae*		
Sculpin	*Cottus sp.*		
Redside shiner	*Richardsonius balteatus*		
Speckled dace	*Rhinicthys osculus*		
Umpqua Pikeminnow	*Ptychocheilus umpquae*		
Largescale sucker	*Catostomus macrocheilus*		

Table 3-12 Fish in the Middle Cow Creek Watershed

Other warmwater species such as largemouth bass, bluegill, and green sunfish are released voluntarily and accidentally from basin farm ponds. These species may be present for a short time and then disappear.

3.5.1. Middle Cow Creek Fish Presence

It is difficult to access precise data about fish species location within Umpqua Basin streams and rivers. The Oregon Department of Fish and Wildlife (ODFW) is compiling regional data and will develop maps indicating fish presence by stream. However, this project will not be completed until December 2002. Therefore, fish presence surveys and known habitat preferences have been used to determine the streams and reaches that support salmonid and non-salmonid game fish species within the Middle Cow Creek watershed. Although non-salmonid, non-game fish species are important as well, there is insufficient accessible data on the location of these types of fish and they could not be included in the assessment.

The Oregon Department of Forestry (ODF) and the ODFW conduct fish presence surveys on private lands throughout the Umpqua Basin. At this time, fish presence surveys on private lands are done in response to a landowner permit application for certain management practices, such as timber harvests. Therefore, not all streams have been surveyed.

A stream that has "fish use" means that a stream is "inhabited at any time of the year by anadromous or game fish species or fish that are listed as threatened or endangered species under the federal or state Endangered Species Act[20]." Streams that have fish use are classifieds as

[20] From Oregon Department of Forestry, 2000.

"Type F" streams. When conducting fish presence surveys, the surveyors only indicate fish presence when an anadromous salmonid, game fish, or threatened or endangered fish species is present. A stream with fish that do not fall into one of these categories, such as largescale suckers, would not be classified as having "fish presence".

There are no threatened or endangered non-salmonid fish in the Umpqua Basin, although the Pacific lamprey is a federally listed species of concern. The only non-salmonid game species are the smallmouth and largemouth bass, which are warmwater species. In general, streams become warmer as they flow from their headwaters to the mouth[21]. Water that is close to its source, such as found in short tributaries, is usually too cold to support bass, and fish presence in these streams can be assumed to be evidence of salmonids.

Steelhead, coho, and chinook prefer reaches with a gradient of approximately 0-4%. Cutthroat trout can be found in reaches with a 4-15% gradient. Gradients greater than 15% are generally too steep for salmonid fish.

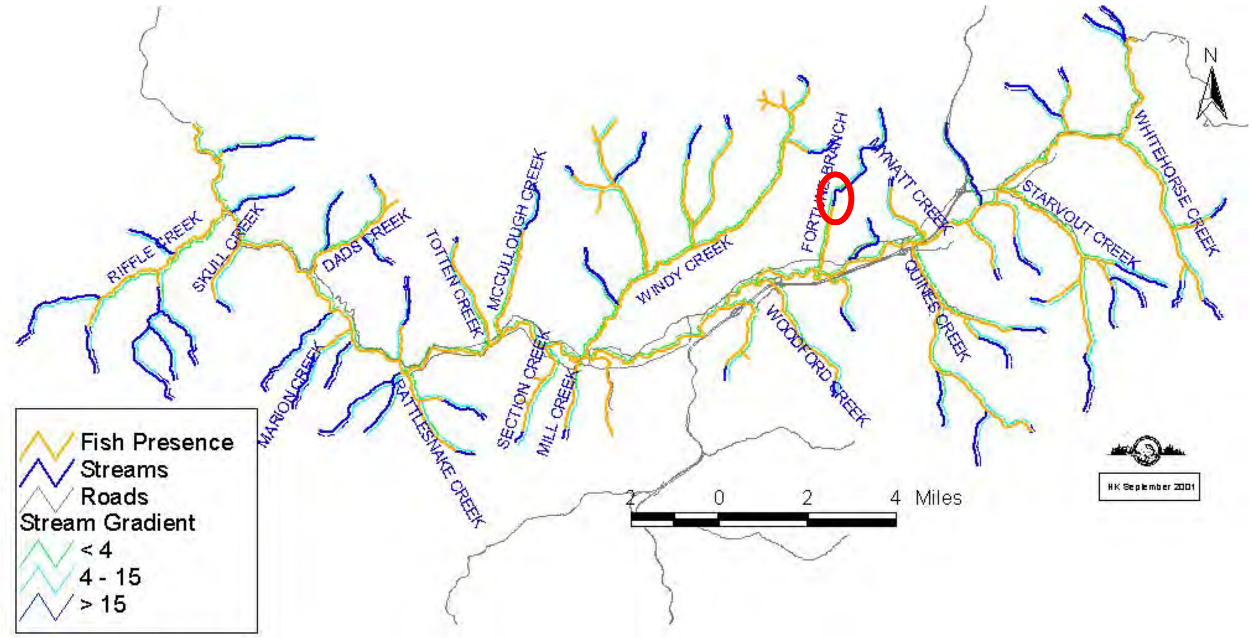
In the Middle Cow Creek Watershed, surveys have been completed on all of Cow Creek within the watershed, and on all or part of 27 tributaries. Map 3:6 shows fish presence in the surveyed streams and the gradient for each reach. The dark blue line indicates areas that have been surveyed. The line next to the dark blue line indicates the gradient. Light green is a 0-4% gradient, light blue is 4-15% gradient, and the medium blue is a 15-60% gradient.

In the Middle Cow Creek watershed, stream temperature would limit bass to Cow Creek and lower reaches of major tributaries. Smallmouth bass may be year-round residents of some Cow Creek reaches and seasonal residents of other reaches and tributaries. Largemouth bass are released voluntarily and accidentally from basin farm ponds, and may be present in the same areas as smallmouth bass for a short time and then disappear. Coho, chinook, and steelhead anadromous salmonid species are found in both the mainstem of Cow Creek and in the tributaries with a 0-4% gradient. Fish presence in short, low gradient streams such as Skull Creek indicates anadromous salmonids. Cutthroat trout are found in higher gradients reaches with fish presence, such as Section Creek and Marion Creek.

There are limitations to the fish presence map. Map 3:6 shows a red circle on Fortune Branch Creek. The gradient level of the headwaters of this stream is low and it would seem that fish could be found there, but there is no fish presence indicated. There are three potential reasons for this. First, as stated earlier, fish presence surveys have not been conducted in all of the Umpqua Basin. It is possible that this length of stream has not been surveyed, therefore it is unknown if fish are found there. Secondly, there could be a fish passage barrier, such as a culvert, dam, or waterfall, that prevents fish from accessing this habitat, and so there are no fish in that reach. Thirdly, the fish might have access to the stream reach but for unknown reasons do not inhabit that reach.

[21] Current research by Kent Smith of InSight consultants has suggested that groundwater infiltration may alter or even reverse this trend during drought years. It is unknown at this time if this trend has been found within the Middle Cow Creek watershed.

Action Recommendations
- *Complete presence/absence electro-shocking surveys in areas where fish presence/absence is unknown.*



Map 3:6 Fish Presence in the Middle Cow Creek Watershed

3.5.2. Coho Spawning Surveys
Coho spawning surveys are conducted yearly by the ODFW. During the months of October to January a section of a creek is sampled, and the number of coho and redds are recorded. One section of Quines Creek is sampled yearly, while other survey sections are determined on a random basis by the ODFW department in Corvallis. Until 1996 volunteers in the basin also conducted these coho spawning surveys. The highest peak counts of coho per mile have been found in Wildcat Creek, Whitehorse Creek, Starvout Creek, Clear Creek, and Windy Creek. It is likely that coho have not been found at some sites because there are barriers downstream of the survey site. Graphs showing the results of each survey are located in Appendix B.

RIF Subwatershed
Five sets of coho spawning surveys were performed for Riffle Creek from 1989 to 1999. The highest peak count per mile was seven in 1999. No coho were seen during the survey in 1989.

DAD Subwatershed
Six sets of coho spawning surveys were performed for Skull Creek and one for Panther Creek from 1994 to 1996. The highest peak count per mile was four in 1993. No coho were seen during most of the other surveys.

MCC Subwatershed
Five sets of coho spawning surveys were performed for Stevens Creek, three for McCullough Creek, three for Lunsbury Creek, one for Totten Creek, and one for Rattlesnake Creek from 1994

to 1999. The highest peak count per miles was 2.5 in Rattlesnake Creek in 1993. There were no coho seen in any of the surveys on Lunsbury and Stevens Creeks.

WIN Subwatershed
There have been three sets of coho spawning surveys performed for Bear Creek, one for Lawson Creek, twenty for Windy Creek, and five for Wood Creek between 1989 and 1999. The highest peak count per mile occurred in Windy Creek, where 26.7 coho were seen during one survey in 1989. Some years the surveys showed no coho.

WFB Subwatershed
A survey on Fortune Branch revealed a peak coho count of 2.7 in 1999. A survey on Woodford Creek did not find any coho in 1997.

A landowner on Woodford Creek reported that three skeletons were found in 1997. Additionally, in 2001 another landowner saw trout for the first time and nineteen coho in Woodford Creek.

QUI Subwatershed
There have been twenty-four sets of coho spawning surveys performed on Quines Creek, one on Mynatt Creek, two on Wildcat Creek, five on Bull Run Creek, and two on Clear Creek. One of the sites on Quines Creek is a yearly survey, while the others are determined randomly. The highest peak coho count was found in Wildcat Creek at 53.6 coho per mile in 1996. The other surveys fairly consistently showed between three and seven coho per mile as peak counts. The one survey in Mynatt Creek did not find any coho.

STA Subwatershed
There have been sixteen sets of coho spawning surveys performed on Whitehorse Creek, five on Starvout Creek, and one on Booth Gulch. The highest peak count of 47.1 coho per mile was found in Whitehorse Creek in 1996. No coho were found in Booth Gulch when it was surveyed in 1997.

Action Recommendations
- Continue spawning surveys.

4. Future Conditions

4.1. Summary

The Middle Cow Creek watershed is primarily composed of publicly owned forests, private industrial timber property, and agricultural lands. The only incorporated city is Glendale, and the largest employers in the area are Superior Lumber Company and A&M Transport. The Middle Cow Creek Watershed has a stable population and there are no immediate plans to attract industry, although new residents are still moving to the area. The Middle Cow Creek watershed is dependent upon the natural resources industry. Changes in natural resource laws will have a great impact on the Middle Cow Creek area, although the types of changes are very difficult to predict.

4.2. Population Centers

4.2.1. The City of Glendale

The only incorporated city in the Middle Cow Creek Watershed is Glendale. During the 2000 census, the population of Glendale was 855 people. According to Larry Andrew, the City of Glendale's interim city manager and head of the Glendale Water Improvement Project, city officials predict that Glendale's population will remain stable. The city is estimating three water connections per year between 2000 and 2020. One connection is sufficient for an average of 2.5 people. Therefore, the population growth of Glendale is not expected to exceed seven or eight people per year, or 140 to 160 people over twenty years.

To comply with Oregon Department of Environmental Quality (ODEQ) water quality standards, Glendale is currently improving its water system and sewer facilities. The water improvement facility construction was started in August of 2001, and is expected to be complete by March 2002. The city's sewer improvement system will begin construction in 2002 with the project completion date set for 2005. The city is limited in its ability to connect additional users until the sewer and water system upgrades are complete.

4.2.2. Azalea

Azalea is the second largest population center in the Middle Cow Creek Watershed. Azalea is not an incorporated city, and there is no census data on the Azalea area. Unlike Glendale, there is no single large employer in Azalea. Most residents are farmers, ranchers, own/manage local private businesses, work in Glendale and other cities along the I-5 corridor, or are retired. Residents say that although many people move to Azalea, it appears that most newcomers purchase existing homes since only a few new houses have been built or are under construction.

4.3. Industry

There are many timber management companies with landholdings in Middle Cow Creek. The two private industrial timber companies that own the largest amount of land in the watershed are Superior Lumber Company and Roseburg Forest Products.

4.3.1. Superior Lumber Company

Superior Lumber Company, at 325 employees, is the largest employer in the Glendale area. Superior owns three plants in Glendale that produce lumber, plywood, and veneer. Around 60% of Superior's workers commute to Glendale from other areas, such as Grants Pass and Roseburg. At the completion of this document, Superior Lumber had no plans to expand or reduce the size or production of the mills, and mill operations are not expected to change in the next 20 years, except for equipment upgrades and general improvements.

Superior also owns about 23,000 acres of land within the watershed and is the largest private landowner in the area. All of Superior's land is managed for timber production. According to Ken Mauer, Superior's Chief Forester, units are managed on a 40-year rotation, and harvested units are replanted with similar tree stock. The future of Superior's timber management practices is dependent on federal laws. As long as public lands are closed to timber harvesting, Superior will continue its short-rotation management to supply its mills. Should federal laws change so timber on public lands is accessible, Superior would most likely lengthen its rotation age. Although Superior is not currently planning any major purchases, they are always looking for opportunities to buy land in the Middle Cow Creek watershed.

Superior has no plans to decommission roads on its property, but may build more roads as necessary with fish-passage friendly culverts. As Superior re-enters older sections of its property, it is this company's policy to replace damaged culverts or ones that are barriers to fish passage. Additionally, Superior Lumber Company will continue to support instream work on its lands as long as the economy is strong and this type of work is economically feasible.

4.3.2. Roseburg Forest Products

Roseburg Forest Products, based out of Dillard, Oregon, owns approximately 7,600 acres of land within the watershed, all of which is managed for timber production. According to Dick Beeby, Roseburg's Chief Forester for the Umpqua area, units are managed on a 50-60 year rotation. With its current intensive management practices, the productivity of Roseburg's lands in Middle Cow Creek will increase over their present condition. This is due, in large part, to the fact Roseburg purchased most of these lands in a cut over condition from a landowner who followed different management practices. Roseburg Forest Products has an active land acquisition program and would consider land exchanges with other organizations.

Roseburg Forest Products policy includes decommissioning roads that are no longer useful, as well as building new roads as necessary that adequately address fish passage at stream crossings. In 1998, Roseburg inventoried its roads in Middle Cow Creek to identify problem culverts. At that time, there were no culverts identified that were causing fish passage or sediment problems. However, Roseburg Forest Products re-evaluates culverts as the company returns to older sections of its property, and will replace damaged culverts or ones that are a barrier to fish passage as they are identified. In the past, Roseburg implemented instream fish habitat-improvement projects on their property. At this time, no instream projects are in process or have been planned for the immediate future.

4.3.3. A & M Transport

A&M Transport, which is owned by the Owens family, is the second largest employer in the Glendale area with 140 employees. The Owens family trucking began in 1972 and was established as a company in 1989. It is a terminal based long line trucking business focused on the west coast, with all units based in Glendale. With its unique slip seat system of placing drivers in charge of either the north or the south coast and switching drivers in Glendale, drivers are able to be home every weekend. All maintenance and bodywork is performed in Glendale and the company employs eight mechanics. A& M Transport is steadily expanding. Last year six units were added to the fleet and this year there will be eight more.

Good stewardship is important to this company and is evidenced by their special automatic drive through truck wash. One of the few that exist on the west coast, the discharge water is cycled through a sand and charcoal filter system. Microbes are injected into the water, which remove all harmful chemicals such as metals, greases, and hydrocarbons. This water, which is clean enough to drink, is then discharged into a drainfield before is seeps back to the creek.

The family company is closely linked to the Owens ranch of 700 acres. It is a cow/calf operation with 60 cows. The ranch lies along both sides of 1.25 miles of Cow Creek. The Owens family is working with consultants to deal with flooding problems and enhancing Cow Creek.

4.3.4. Small Business

Small business is a major source of income for many people in the Middle Cow Creek. The types of businesses include trucking, plastic manufacturing, quarter horse breeding, wreath production, satellite TV service, tree service, portable x-ray service, general contracting, shoe cleaning, and stock exchange. Many people operate the businesses out of their homes.

4.4. Public Lands

Although all levels of government have land within the Middle Cow Creek watershed, the two largest public land managers in the Middle Cow Creek Area are the Bureau of Land Management and the Oregon Department of Forestry. These groups have significantly reduced their timber harvesting and are focusing management on other goals.

4.4.1. Bureau of Land Management[22]

The Bureau of Land Management (BLM) Medford Office is responsible for 45,817 acres within the Middle Cow Creek watershed, which is approximately 40% of the watershed land base within Douglas County.

In addition to providing commercial products, the Northwest Forest Plan (NFP) focuses public land agencies on restoration activities within each watershed. Restoration includes the use of timber harvesting, as well as treatments that do not produce a product, in the regeneration of forestlands. The Resource Management Plans (RMP) for each BLM District prescribes the methods to be used to harvest timber and to restore watersheds. These two documents are used in tandem to provide overall direction for land management. The Medford District RMP Record of Decision, Appendix E, for example, provides descriptions of practices that can occur. This

[22] The Bureau of Land Management office in Medford contributed this section.

appendix gives basic treatment guidelines and goals but leaves discretion to the manager to determine which treatment(s) is (are) appropriate for a particular forest stand considering conditions and the objectives of the land use allocation.

As a result of the Northwest Forest Plan, timber harvest on the Medford District has changed. The number of board feet that the Medford District BLM is expected to harvest has been reduced from 213 million board feet per year in the 1980s and early 1990s to the present 57 million board feet per year. Harvest prescriptions also have changed. "Regeneration cuts" that leave a minimum of 6-8 large conifers per acre have replaced traditional clear cuts which removed almost all the merchantable trees. There is now a greater emphasis on commercial thinnings and density management that remove only portion of the stand, generally the smaller and less vigorous trees. Commercial thinnings would apply only on lands within the watershed that are available for timber harvest activities, those lands designated in the NFP and RMP as General Forest Management Areas (GFMA), and that are not Riparian Reserves or do not contain species that require protection buffers. On the Medford District, lands available for planned timber harvest comprise approximately 20% of the total land base of public lands. Density management has other objectives that supercede timber production, such as habitat development, creation or retention of desired stand characteristics, and reduction of fuels. Volume produced from density management treatments is considered a by-product of the treatment.

Much of the land managed by the BLM within the Middle Cow Creek Watershed has been classified as Late Successional Reserve (LSR). These lands along with Riparian Reserves are not managed in the same manner as GFMA lands. Rather, these lands are managed as habitat for old growth associated species. Where there is currently older forest, the objective is to maintain it. Where there are younger stands emphasis is placed on accelerating stand development and the development of stand characteristics common to old growth stands. LSR assessments have been prepared for the LSRs by interdisciplinary teams. These assessments provide information on the current condition of the area and potential treatment for management.

Within the Middle Cow Creek drainage, the Glendale Resource Area of the Medford District plans to accomplish restoration activities and provide commercial products over the next two to three years, with the following treatments:

Commercial Thinning/Density Management	400-500 acres
Pre-commercial Thinning/Release	600-800 acres
Manual Release/Manual Maintenance (Brushing forested units)	600-800 acres
Planting	200-300 acres
Pruning	300-400 acres
Commercial Timber sales	Approximately 13 MMBF over approx. 1,200 acres

Restoration activities are identified through the development of Watershed Analyses and monitoring of current forest stand conditions. Several Watershed Analyses have been written for the drainages within the Cow Creek watershed. These documents outline conditions at the time of writing the analysis, and potential activities to enhance and restore the watershed.

The BLM also continues efforts to decommission roads it deems as unneeded. Other roads are maintained by the installation of water dips and outsloping to manage water run-off. Several culverts are planned for installation and/or replacement for fish passage.

BLM continues to survey and monitor wildlife populations. Along with surveys for all ground disturbing activities, broad surveys for populations are also taking place. This information adds to the body of knowledge of these species.

Recreation is another focus of the Glendale Resource Area. Within the Middle Cow Creek drainage, the BLM manages the Back Country Byway between Riddle and Glendale. BLM also manages the Glendale to Powers bicycle route on which the Tour De Fronds runs annually. Skull Creek Campground, along Riffle Creek on the Back Country Byway, is also managed by BLM.

The Glendale Resource Area in currently in the process of expanding the Fuels Management Program. As part of this process, combined with an increase in funding through the National Fire Plan, and the wildland-rural interface problems associated with the Glendale and Azalea communities, it is anticipated that sometime in the near future, BLM will be identifying fuel treatments within the Middle Cow Creek watershed. Though no specific fuels treatments are currently planned, it is anticipated that some fuels management activities will occur throughout the watershed in conjunction with other management activities. Fuels treatments will occur to treat slash associated with timber sales. Additional fuels treatments may be applied to reduce the risk of a wildfire throughout the watershed where management activities have created slash. Such treatments will include, but not be limited to, hand piling and pile burning of pre-commercial thin units and roadside brushing activities.

The creation of partnerships with industry, landowners, and other agencies is a major focus for the Glendale Resource Area. Through partnerships we are able to reduce erosion and provide fish passage by pooling resources. Partnerships have also allowed the BLM to monitor populations of migratory birds and bats.

The BLM plans to continue land management activities within the Middle Cow Creek drainage now and into the future. Management will continue to include the public process as well as creating and maintaining partnerships to accomplish common goals.

4.4.2. Oregon Department of Forestry[23]

The Oregon Department of Forestry (ODF, Southwest Oregon District) manages approximately 18,000 acres of which approximately 7,500 acres are located within the Middle Cow Creek Watershed. Between 1997-2001, ODF developed a long-range management plan for their lands in Southwest Oregon. As part of the long-range plan, ODF developed specific management strategies for Type F streams and additional management constraints for operations near Type N streams of all size classes. This district's initial 10-year implementation plan allows for clearcutting up to 30 total acres of coniferous forest and 30 total acres of hardwood forest across the district each year provided the agency acquires a Habitat Conservation Plan for ODF

[23] The Oregon Department of Forestry office in Grants Pass contributed this section.

managed lands in Western Oregon. An additional 300 to 600 acres of the district will be partial cut annually to increase tree growth, maintain forest health, and reduce the likelihood of a catastrophic wildfire.

In the year 2001, ODF had five active timber sale contracts for both conifers and hardwoods, and an additional 2 to 3 are planned each year over the next 10 years across the district. ODF's long-term goal is to consider consolidation of the majority of their holdings to the Windy Creek/McCullough Creek areas. This will potentially be done by trading outlying parcels for ones within the desired area or possibly through land purchases. Through consolidation, the Southwest Oregon District believes they will be able to make additional positive and comprehensive contributions to the riparian ecosystem in that area when compared to the current ownership configuration.

ODF currently has no formal, approved plans for stream enhancement projects in the Middle Cow Creek area. A 1988-1989 road survey indicated some problem roads and culverts on their lands. ODF has already repaired most of these problem culverts and roads, and the remaining fish passage barriers will be repaired as part of upcoming timber sales. ODF supports fish habitat and water quality improvement projects and will continue to pursue these opportunities as they arise.

4.4.3. Galesville Dam

Galesville Dam management is governed by the county’s contractual agreements with the Bureau of Reclamation, legal requirements under the dam's license with the Federal Energy Regulatory Commission (FERC), and by state and federal laws. The Army Corps of Engineers has jurisdiction of the flood control functions as a result of those agreements and license. From November to February, the Army Corps of Engineers controls a large portion of the reservoirs capacity for flood control. Army Corps of Engineers regulations governs water releases and storage. From February through May, the Corps' regulations allow filling of the reservoir at a prescribed rate. The summer releases are predicated on State water laws and contractual obligations of the Douglas County Natural Resources Division. The Galesville Dam license with FERC outlines other legal responsibilities, such as flow limitation, environmental conditions, and safety standards, and dam management is required by law to comply with the license agreement. The dam's management is also highly influenced by state and federal laws. As these laws and policies change, so does the dam's management. Consequently, Galesville Dam management has limited flexibility.

5. Action Plan

Activities within the action plan *are suggestions for voluntary projects and programs.* The action plan should neither be interpreted as landowner requirements nor as a comprehensive list of all possible restoration opportunities.

5.1. Summary of Action Recommendations

Stream Morphology/Fish Habitat Action Recommendations

- Obtain permission from landowners to conduct culvert surveys on un-surveyed tributaries.
- Improve fish passage in culverts that have been found to have problems.
- Evaluate other barriers.
- Screen diversions.

Stream Meandering/Channel Confinement Action Recommendations

- Provide education about stream meandering for landowners and entities involved with the sale or purchase of creek-front property.

Riparian Zone Composition and Function Action Recommendations

- Protect riparian areas that have a width of two or more trees.
- Increase canopy cover by planting trees in predominately brush riparian areas.
- Where feasible, establish conifers and other native vegetation in areas now dominated by blackberries and other invasive plant species, or which lack any tall vegetation.
- Manage the riparian areas for tree crown growth.
- Manage livestock so that they do not intrude on the riparian area.
- Plant native vegetation.

Sediment Action Recommendations

- Encourage seeding and water-barring of new or temporary roads.
- Perform turbidity measurements (none have been done for 20 years), especially in Dads Creek, Quines Creek, and Starvout Creek, as there is concern of high sediment levels in these creeks.

Temperature Action Recommendations

- Plant native vegetation to establish a tall and dense shade wall along and over streams.
- Establish trees in brushy and open areas along the stream.
- Place large wood structures in the streams that accumulate gravels and create subsurface flows that can cool the water.

Nutrients Action Recommendations

- Develop a targeted monitoring program to sample for nutrients if algae indicate a problem;
- Provide education regarding the concern with excess nutrients;
- Encourage construction site erosion control to limit the transfer of sediment (a likely source of nutrients) from the site into storm drains and creeks;
- Test/inspect septic systems to identify those needing repair or replacement;
- Fix failing septic tanks that contribute nutrients to the creeks; and
- Manage livestock so animal wastes do not contaminate the riparian area.

Dissolved Oxygen Action Recommendations

- Sample for dissolved oxygen throughout the watershed.

pH Action Recommendations

- Periodically measure pH levels in Cow Creek and its tributaries.

Toxics Action Recommendations

- Sample for toxics throughout the watershed.

Bacteria Action Recommendations

- Periodically sample for bacteria throughout the watershed.

Water Availability Action Recommendations

- Secure water right leases or purchase water rights for conversion to instream use in Quines, Windy, and the two Cow Creek Water Availability Basins.
- Improve irrigation efficiency.

Fish Presence Action Recommendations

- Complete presence/absence electro-shocking surveys in areas where fish presence/absence is unknown.

5.2. Enhancement Activities

For reference to subwatersheds, see Map 1:2.

Entire Middle Cow Creek Watershed

- Plant trees and shrubs in riparian areas. High priorities are those with less than 50% canopy cover and have a channel width for which 50% or greater cover is feasible (82 miles of riparian areas).
- Screen all unscreened diversions to protect fish.
- Perform streambank erosion control emphasizing bioengineering techniques.
- Encourage other native understory and tree species in monoculture riparian areas, especially those dominated by alder.
- Conduct blackberry removal in a way that minimizes sedimentation and interplant with trees. Establish conifers and other native vegetation in areas now dominated by blackberries (low priority, 6 miles of riparian areas).
- Place large woody material in streams less than 30 feet wide on a site-by-site basis.
- Protect and enhance existing wetlands.
- Consult soil/geology specialist before conducting soil-disturbing practices, as these soils are highly erodible (especially in the Riffle and Dads Creek Subwatersheds).

Cow Creek from Starvout Creek to Woodford Creek

- Develop stream restoration project with Azalea Landowner Group.

Quines Subwatershed

- Replace or retrofit culvert near mouth of Wildcat Creek that blocks access to an additional mile of resident and anadromous fish habitat[24].
- Replace or retrofit culvert on Quines Creek near South Fork Quines Creek and check weirs by the pump chance for fish passage. This will provide access to an additional mile of fish habitat.

Woodford/ Fortune Branch Subwatershed

- Replace or retrofit culvert near mouth of Fortune Branch. This will provide access to an additional 1.25 miles of anadromous and resident fish habitat.
- Replace or retrofit culvert near mouth of Woodford Creek. This will provide access to an additional 2.5 miles of fish habitat.
- Limit livestock access to riparian habitat and streams through riparian fencing (some areas are already fenced), cattle crossings, off-channel watering, off-channel provision of shade, and cross fencing. Continue to use designated stream crossings and minimize number of crossings.
- Modify placement of power lines along Fortune Branch. Current maintenance requires pruning streamside trees and limits riparian habitat development.

Windy Subwatershed

- Replace or retrofit two culverts on West Fork Windy Creek. This will provide access to an additional 0.75 miles of anadromous and resident fish habitat.
- Replace or retrofit culvert on Bear Creek. This will provide access to an additional mile of fish habitat.
- Limit livestock access to riparian habitat and streams through riparian fencing, cattle crossings, off-channel watering, off-channel provision of shade, and cross fencing. Continue to use designated stream crossings and minimize number of crossings.

McCullough Subwatershed

- Seek alternative to runoff from industrial sites.
- Replace or retrofit two culverts near mouth of McCullough Creek. This will provide access to an additional 2.25 miles of anadromous and resident fish habitat.
- Add fish ladder to man-made dam on Totten Creek. This will provide access to an additional 2.5 miles of fish habitat.
- Replace or retrofit three culverts on Rattlesnake Creek. This will provide access to an additional 2.25 miles of fish habitat.
- Assess culverts on Mill Creek.
- Limit livestock access to riparian habitat and streams through riparian fencing, cattle crossings, off-channel watering, off-channel provision of shade, and cross fencing. Continue to use designated stream crossings and minimize number of crossings.

[24] Estimates for additional fish habitat are based upon stream gradients and known problem culvert locations. It is possible that there are other fish passage barriers upstream from the ones identified that would reduce the estimated additional habitat availability.

Dads Subwatershed

- Replace or retrofit culvert near mouth of Rattail Creek. This will potentially provide access to one mile of habitat for fish (a survey of fish use on this creek has not yet been completed).
- Replace or retrofit culvert near mouth of Perkins Creek. This will provide access to an additional three miles of anadromous and resident fish habitat. Assess culvert on tributary to Perkins Creek.
- Replace or retrofit culvert near mouth of Panther Creek. This will provide access to an additional 0.75 miles of fish habitat.

Riffle Subwatershed

- Replace or retrofit culvert on Riffle Creek. This will provide access to an additional 0.75 miles of fish habitat.

5.3. Outreach Programs

- Collaborate with local citizens and groups to develop volunteer-based fish habitat and water quality monitoring teams that would evaluate current local conditions and post-project success, identify critical salmonid spawning and rearing habitat, and work with private landowners to determine restoration opportunities.
- Implement public information and educational programs about the problems associated with culverts and other fish passage barriers, ways of identifying barriers, and opportunities to replace or retrofit problem culverts and other barriers.
- Cooperate with local citizen's groups and agencies to conduct public information and education programs about the importance and benefits of a healthy riparian habitat. Emphasize the potential funding sources for stock water management, riparian fencing, and riparian planting and conversions to encourage landowner participation.

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Glossary

BLM	Bureau of Land Management
CFS	Cubic Feet per Second
DEQ	Oregon Department of Environmental Quality
LWM	Large Woody Material
ODFW	Oregon Department of Fish and Wildlife
OWEB	Oregon Watershed Enhancement Board
OWRD	Oregon Water Resources Department
RM	River Mile
UBWC	Umpqua Basin Watershed Council
USGS	United States Geological Survey
WAB	Water Availability Basin

Appendices

Appendix A.
Middle Cow Creek: Government Land Office Public Land Survey

Oregon Cadastral Field Notes collected between 1854 and 1901.
Length of the survey is 1 mile. Length measurements were made in chains, a surveying measurement unit. The left column displays the length in chains from the starting point of the survey. The right column describes what occurs at that point. Following each table is a general description of the mile surveyed.
1 mile = 80 chains = 5280 feet
1 chain = 100 links = 66 feet
1 link = 0.66 feet

Windy Creek
1. T32S R5W 7 N going E. 1900. Descend E slope of mountain. Covered heavily with fir, cedar, and sugar pine.

42.60	A stream 2 links wide 600 ft below section corner, continue descent.
44.26	Set a fir post from which a sugar pine 72 inches in diameter is 102 links away, and a fir tree 14 inches in diameter is 56 links away.
49.10	A stream 2 links wide 80 ft below quarter section post, continue descent.
54.75	A stream 10 links wide, begin gradual ascent.
60.75	A stream 8 links wide, along timber bench.
77.76	Same stream 8 links wide, continue ascent.
79.20	A mountain trail.
84.26	Corner of sections 5,6,7, and 8 125 feet above stream 10 links width.

Land mountainous. Soil gravelly 3rd rate. Timber fir, sugar pine, cedar. Undergrowth hazel, vine maple, and small firs. Mountainous or heavily timbered land.

2. T32S R5W 18 N July 24, 1901. Going E. Begin steep ascent of slope of mountain spur – covered heavily with timber.

8.20	Top of spur, bears N and S, 100 ft above corner. Begin descent of E and SE slope, covered with a dense undergrowth of young fir and hazel.
28.00	A spring branch 1 link wide, course SE, descent becomes more gradual.
35.00	Foot of descent, into bottom, heavily timbered, 250 ft below top of spur.
37.00	A trail.
37.75	A creek 15 links wide.
44.00	Begin ascent of W mountain slope.
44.45	Set yew post from which a fir 40 inches in diameter is 55 links away, and a fir 10 inches in diameter is 30 links away, continue ascent of a steep and rocky western mountainside, covered heavily with large firs and cedars.
84.45	The corner.

Land mountainous. Soil loam gravelly or rocky 3rd and 4th rate. Timber fir, cedar, sugar pine, chinkapin, laurel. Undergrowth hazel and small firs.

3. T32S R6W 13 E 1855. Going N.

2.31	A fir, 30 inches in diameter.
15.35	A branch a link wide.

20.00	Summit of line on spur.
29.00	Branch 12 links wide, vine maple bottom.
40.00	Set quarter section post from which a cedar 8 inches in diameter is 22 links away, and a fir 6 inches in diameter is 42 links away.
44.50	Branch 1 link wide.
48.45	A cedar 24 inches in diameter.
71.00	A branch 3 links wide.
80.00	Set post from which a fir 10 inches in diameter is 48 links away, and a cedar 12 inches in diameter is 34 links away, and a laurel 9 inches in diameter is 47 links away.

Surface broken. N ½ slopes south and S ½ slopes N. Good 2nd rate soil gravelly loam soil timber principally fir. Undergrowth arrowwood, hazel, fir, and vine maple.

4. T32S R6W 22 S 1855. Going E.

11.00	A branch 16 links wide, enter creek bottom.
23.75	A branch 10 links wide.
24.00	Enter prairie.
32.00	Leave prairie, enter openings, begin SE slope ascent.
39.90	Set quarter section post from which a white oak 16 inches in diameter is 188 links away, and a white oak 15 inches in diameter is 168 links away.
52.25	Springs branch 3 links wide.
79.80	To section corner.

Surface rolling. E ½ fir timber, W ½ open oak and fir timber. Vine maple undergrowth on bottom. Good 2nd rate soil.

5. T32S R6W 33 E going N, 1855.

10.40	Left bank of Cow Creek 98 links wide.
11.38	Right bank of Cow Creek .
13.86	A yellow pine 24 inches in diameter.
17.00	Enter prairie cultivated fields.
28.75	Leave fields in prairie.
37.50	A spring, good water.
40.00	Set quarter section post from which a black oak 18 inches in diameter is 250 links away, and a black oak 14 inches in diameter is 235 links away.
42.50	Enter first oak openings.
52.00	Summit of line on SW slope, enter thick timber and brush.
71.00	Enter creek bottom.
76.60	A branch 20 links wide.
80.00	Set post from which a yellow pine 30 inches in diameter is 90 links away, a yellow pine 24 inches in diameter is 43 links away, a yellow pine 32 inches in diameter is 35 links away, and a yellow pine 24 inches in diameter is 62 links away.

Surface somewhat broken. Soil a good quality of clay and gravel land. Timber along creek balm, madrone, ash, and alder. Pine and oak along ridges with undergrowth of hazel and lilac.

6. T32S R6W 33 S Boundary going W, 1855.

10.75	Creek 16 links wide.

30.50	Red fir 36 inches in diameter.
33.00	Intersect S bend of Cow Creek from N45°E. Offset 50 links.
35.50	Offset 50 links N to line on left bank.
37.00	To standard corner section corner.
39.00	A creek at North.
40.00	Set quarter section post from which a madrone 9 inches in diameter is 25 links away, and a ash 10 inches in diameter is 13 links away.
40.29	A white fir 28 inches in diameter.
41.50	Intersect S bend of Cow Creek 10 links wide.
48.00	Enter Sam Creek 15 links wide.
49.00	Leave Sam Creek.
50.00	Branch 5 links wide @ N.
50.50	1 chain N to Cow Creek.
52.00	Intersect left bank of Cow Creek.
59.00	Along left bank and leave same.
64.84	Left bank of Cow Creek.
67.50	Offset 150 links S.
73.70	Return to line.
77.00	To standard section corner.
80.00	Set post from which a fir 18 inches in diameter is 28 links away, and a fir 7 inches in diameter is 28 links away.

Line runs along Cow Creek bottom. South of line touching it at several points. Soil 1st rate loam, some gravel and clay. Ash, alder, vine maple, some fir timber. Dense undergrowth vine maple, and fir.

Quines Creek

7. T33S R5W 13 N going W, 1893, Descend on N slope.

0.50	Spring branch 3 links wide.
6.90	Foot of descent. Spring branch 3 links wide. Ascending gradually.
14.55	Top of line. Descending over steep rocky NW slope over continuous pile of boulders.
34.22	A fir 16 inches in diameter.
38.74	Branch 3 links wide.
39.80	Foot of descent, creek 5 links wide.
40.22	Set basaltic stone from which a fir 10 inches in diameter is 10 links away, and a fir 8 inches in diameter is 31 links away.
41.40	Spur 5 ft high.
42.75	Ravine 20 ft deep and spring branch 2 links wide.
47.70	Begin to descend.
55.00	Top of bluff 40 ft high and a fir 20 inches in diameter. Descend rapidly into canyon.
57.22	Foot of descent. Creek 10 links wide.
57.32	Foot of sloping bluff.
61.75	Foot of rocky bluff 60 ft high. A fir 24 inches in diameter.
62.55	Top of mountain spur, descend rocky slope.
68.20	Foot of descent and canyon. Spring branch 1 link wide. Ascend rapidly on N slope.

69.45	Ascend more gradually on N slope.
78.45	Ravine.
80.44	Corner.

Land mountainous, broken and very rough and all sloping to N. Heavy timber fir, pine, cedar, yew. Dense undergrowth small fir, live oak, chinkapin, yew, hazel and vine maple. Soil 4th rate gravely and rocks.

8. T33S R5W 12 E going N. 1893. Descend mountain on NW slope

17.00	Ravine.
20.00	Fir 3 inches in diameter on line.
24.00	Mountain spur.
32.50	Mountain spur.
40.00	Set quarter section post from which a cedar 10 inches in diameter is 19 links away, and a cedar 24 inches in diameter is 30 links away. Continue descent.
52.50	Mountain spur.
57.90	Alder 3 inches in diameter.
58.90	Ravine.
63.00	Top of spur.
68.00	Foot of descent, 1500 below section corner.
70.50	Creek 20 links wide. Ascend 100 ft.
80.00	Set a basaltic stone from which a fir 18 inches in diameter is 52 links away, a yellow pine 30 inches in diameter is 67 links away, a madrone 6 inches in diameter is 59 links away, and a madrone 5 inches in diameter is 3 links away.

Land mountainous broken rough high, sloping NW and West. Soil gravely, 3rd and 4th rate. Heavy timber fir, cedar, pine, and madrone. Dense undergrowth vine maple, hazel, yew, small fir, chinkapin, and madrone.

9. T33S R5W 2 E going N. 1893. Ascend 50ft.

5.00	Top of divide.
7.00	Top of divide? (va) here 18°E.
9.00	Top of divide? (va) here 24°E.
12.00	Top of divide? (va) here 27°E.
17.20	A cedar 36 inches in diameter.
31.00	Descend abruptly on N slope.
40.00	Set basaltic stone from which a sugar pine 30 inches in diameter is 39 links away, and a fir 10 inches in diameter is 91 links away.
53.00	A trail.
53.60	Miner's ditch 3 ft wide.
58.00	F 24 inches in diameter tree marked in the bark "MSS" and "BT" by some local survey of mining claims.
61.00	Foot of descent. (Quick) Creek 40 links wide along creek bottom.
65.00	A trail.
66.60	Cut bus West?.
67.20	Branch 3 links wide.
80.00	Intersect N boundary from which a yellow pine 30 inches in diameter is 36 links away, a

	yellow pine 20 inches in diameter is 162 links away, a yellow pine 24 inches in diameter is 105 links away, and a yellow pine 20 inches in diameter is 25 links away.

10. T33S R5W 12 N going W. 1893. Descend on W slope.

20.40	Quines Creek 20 links wide. Ascend 30ft N slope.
31.75	Top of ascent, a fir 3 inches in diameter, descend.
38.86	Spring branch 2 links wide.
40.38	Set quarter section post from which a fir 16 inches in diameter is 23 links away, and a fir 12 inches in diameter is 14 links away.
54.00	Foot of descent, creek 12 links wide. Ascend on E slope.
73.00	A fir 48 inches in diameter.
80.76	Set corner of sections 1,2,11,12.

Land mountainous broken and rough. Heavy timber fir, cedar, pine, madrone. Dense undergrowth small fir, vine maple, hazel, madrone. Soil 3rd rate.

11. T32S R5W 35 N going E, 1871.

9.50	A creek 25 links wide.
35.50	Top of spur.
40.00	Set quarter section post from which a laurel 24 inches in diameter is 22 links away, and a pine 36 inches in diameter is 52 links away.
72.00	A dry bed of creek 10 links wide.
74.00	Begin ascent.
80.00	Set post from which a live oak 8 inches in diameter is 33 links away, a live oak 6 inches in diameter is 10 links away, a live oak 6 inches in diameter is 22 links away, and a live oak 6 inches in diameter is 23 links away.

Soil good 2nd rate, rolling timber 1st rate fir, pine, cedar, madrone, ash, laurel, oak. But little undergrowth same and vine maple.

12. T32S R5W 26 N going W. 1871.

40.00	Set quarter section post from which an oak 6 inches in diameter is 25 links away, and an oak 8 inches in diameter is 24 links away.
83.00	A creek 25 links wide.
85.50	The corner of section 22, 23, 26, and 27.

Soil sand west part good, 2nd rate. East part 2nd and 3rd rate.

13. T32S R5W 22 E going S. 1855.

00.79	A balm 30 inches in diameter.
4.40	Cow Creek 60 links wide.
6.50	Enter small prairie.
11.00	Leave same.
18.10	A branch 3 links wide and begin steep ascent.
18.60	Leave creek bottom. Enter table lands and prairie.
37.00	Leave prairie. Enter dense firs and brush.
40.00	Set quarter section post from which a fir 10 inches in diameter is 56 links away and a fir 12 inches in diameter is 14 links away. Foot of mountain about 2 chains SE thence

	extending NE, leaving about 100 acres of land for settlement in the NW ¼ of section 23.
43.00	Begin ascent of W slope of mountain.
51.00	Summit of line on W slope.
76.50	A creek 20 links wide (rocky rapid bed).
80.00	Set pot from which a cedar 14 inches in diameter is 42 links away, a cedar 11 inches in diameter is 55 links away, a cedar 15 inches in diameter is 42 links away, and a fir 8 inches in diameter is 28 links away.

Surface descends to the NW. North ½ in prairie and openings. S ½ is heavily timbered fir and runs along the foot of a mountain lying east of it. Dense undergrowth of hazel, willow, ninobark, and arrowwood. Soil 2nd rate.

Whitehorse Creek

14. T32S R4W 22 E going N. 1897.

15.25	Top of spur.
15.73	A fir 30 inches in diameter.
30.2	A creek 10 links wide.
40.00	Set quarter section post from which a madrone 6 inches in diameter is 10 links away and a fir 48 inches in diameter is 23 links away.
45.75	Top of spur.
51.10	A creek 15 links wide. Ascend.
53.78	A creek 1 link wide.
80.00	Set fir post from which a fir 20 inches in diameter is 27 links away, a fir 24 inches in diameter is 57 links away, a fir 24 inches in diameter is 17 links away, and a fir 24 inches in diameter is 69 links away.

Land mountainous. Soil 3rd rate. Timber fir, pine, cedar, yew, madrone. Dense undergrowth of rhododendron, madrone, and chinkapin. Heavily timbered.

15. T32S R4W 22 N going W. 1897.

2.50	Begin steep ascent. Enter green timber.
25.65	Foot of descent, Whitehorse Creek 15 links wide. Ascend spur.
39.84	Set madrone post from which a pine 10 inches in diameter is 108 links away, and a pine 36 inches in diameter is 92 links away.
43.30	Top of spur.
45.50	Ravine, ascend.
47.50	Top of spur.
69.50	Top of ridge, descend.
79.68	Set corner of sections 15,16, 21, and 22 100 ft below top of ridge.

Land mountainous, soil 3rd and 4th rate. Timber fir, cedar, madrone, yew, hemlock, and pine. Dense undergrowth rhododendron, chinkapin, madrone, mountain balm, and salalberry. Land mountainous, heavily timbered or covered with dense undergrowth.

16. T32S R4W 15 N going W. 1897.

7.00	Rock 20ft high.
27.25	Bottom of canyon, 700 ft below section corner. Ascend spur.
30.00	Top of spur, descend.

32.80	Ravine, ascend spur.
36.50	Top of spur, descend.
39.88	Set fir post, from which a dead fir 12 inches in diameter is 73 links away, and a dead fir 48 inches in diameter is 60 links away.
46.75	Water ditch course N constructed by miners.
54.97	Whitehorse Creek 50 links wide, ascend.
56.00	Abandoned placer mine, excavation bears N and S.
70.50	Top of spur, descend. Enter green timber.
73.25	Ravine, ascend spur.
74.25	Top of spur, descend.
76.25	Ravine, ascend spur.
77.75	Top of spur, descend.
79.76	Set corner of section 9, 10, 15, and 16.

Land mountainous. Soil 3rd and 4th rate. Timber fir, hemlock, madrone, live oak, and chinkapin. Dense undergrowth rhododendron, mountain balm, salal-berry, oceanspray, and vine maple. Mountainous land, heavily timbered or covered with dense undergrowth.

17. T32S R4W 9 E going N. 1897.

7.00	Top of spur, descend.
14.53	Creek 1 link wide, ascend spur.
16.00	Top of spur, descend.
17.25	Creek 2 links wide, ascend spur.
26.50	Top of spur, descend.
40.00	Set fir post from which a fir 16 inches in diameter is 67 links away, and a fir 36 inches in diameter is 102 links away.
52.20	Whitehorse Creek 20 links wide, ascend spur gradually.
53.50	Wagon road.
55.50	Water ditch to abandoned mine.
55.96	A trail.
57.00	Top of spur, descend.
58.95	A creek 2 links wide, ascend spur.
65.00	Top of spur, descend.
67.75	A creek 1 link wide, ascend.
71.25	Intersect E and W line away from corner 3,4,9, and 10. Set fir post, from which a fir 30 inches in diameter is 45 links away, and a madrone 5 inches in diameter is 112 links away.

Land mountainous. Soil 3rd and 4th rate. Timber scattering of fir, cedar, madrone, alder, and myrtle. Dense undergrowth of mountain balm, rhododendron, vine maple, huckleberry, salal-berry, and thimbleberry. Land mountainous, covered with dense undergrowth.

Cow Creek

18. T31S R4W 33 S going E. 1871.

27.50	Foot of mountain.
31.00	Trail up Cow Creek.
40.00	Set quarter section post from which a fir 14 inches in diameter is 29 links away, and a fir

	40 inches in diameter is 23 links away.
40.50	Cow Creek 50 links wide.
50.00	Leave creek bottom and begin ascent.
80.00	Set post for section 3,4,33, and 34 from which a fir 24 inches in diameter is 32 links away, a fir 5 inches in diameter is 7 links away, a fir 4 inches in diameter is 22 links away, and a fir 4 inches in diameter is 40 links away.

Land level. 1st rate soil in creek bottom, 2nd rate soil on hills. Timber good, principally for good mill power on creek.

19. T32S R4W 7 W going S between section 12 and 7. 1854.

18.25	Foot of Umpqua Mountains and Eritia Bow Creek Valley. This valley extends down its creek about 14 miles… and is about 1 mile mostly settled. Leave openings and enter fir timber.
26.00	A fir 30 inches in diameter.
30.00	An Indian trail.
30.73	Intersect Cow Creek 70 links wide, current ok, the rapids gravelly bottom and shale. A fir 4 inches in diameter is 66 links away and an ash 14 inches in diameter is 24 links away.
37.18	Over creek and set post from which an ash 12 inches in diameter is 45 links away, and a vine maple 3 inches in diameter is 25 links away.
40.00	Set quarter section post from which a fir 13 inches in diameter is 21 links away and a fir 12 inches in diameter is 12 links away.
48.67	A fir 18 inches in diameter.
54.00	Commence ascent of hill.
64.50	Summit of west point of a ridge spur.
75.40	Stream 30 links wide, flat rock bed.
80.00	Set post from which a fir 18 inches in diameter is 12 links away, a fir 18 inches in diameter is 94 inches in diameter is, a fir 16 inches in diameter is 7 links away, a fir 14 inches in diameter is 17 links away, and a hemlock 14 inches in diameter is 34 links away.

Land N 20 chains SE slope of hill. Residue mostly level. Soil good 2nd rate clay loam. Timber fir, oak, and laurel. Undergrowth vine maple.

20. T32S R5W 13 going E between section 12 and 13. 1855.

3.00	A trail to Starvout Creek Mines.
14.50	A trail to Starvout Creek Mines.
15.50	Leave marshy prairies.
25.50	A branch 7 links wide.
30.50	A branch 7 links wide.
32.50	Leave round prairie.
40.00	Set quarter section post from which a black cherry 7 inches in diameter is 12 links away, and a black cherry 6 inches in diameter is 4 links away.
40.50	Left bank of Cow Creek.
41.30	Right bank of Cow Creek 60 links wide.
50.30	A branch 3 links wide.

58.00	Leave creek bottom.
70.20	A branch 8 links wide.
72.00	Enter prairie, leave timber.
80.00	Section corner.

21. T32S R5W 21 E going S. 1855.

7.50	Foot of hill. Enter prairie.
20.00	Road.
22.00	Right bank of Cow Creek 1 chain wide. Enter brush and timber.
37.50	A slough 20 links wide. Enter prairie.
40.00	Set quarter section post from which a white oak 30 inches in diameter is 39 links away, and a madrone 15 inches in diameter is 184 links away.
77.50	Head of ravine.
81.00	Set post from which a madrone 7 inches in diameter is 41 links away, a fir 10 inches in diameter is 32 links away, a chinkapin 6 inches in diameter is 25 links away, and a laurel 12 inches in diameter is 56 links away.

This mile crosses Cow Creek bottom and runs onto high timber mountain unfit for settlement. Creek bottom 1st rate loam and gravel soil. Timber fir, pine, oak, madrone, alder, and vine maple. Willow on bottom and fir, chinkapin, and hazel undergrowth on mountain.

22. T32S R5W W on line between 22 and 27. 1855.

19.50	A branch 3 links wide.
32.00	Begin steep brushy ascent of SE slope of mountain.
40.20	Set quarter section post from which a white oak 2 inches in diameter is 85 links away, and a white oak 8 inches in diameter is 135 links away.
53.00	Summit of line on ridge.
60.00	A ravine at N.
65.00	Summit on spur.
76.50	Peak of ravine.
79.00	Summit on spur.
80.00	To section corner.

Surface broken and mountainous. W ½ on steep descent to N crowing many ravines. E ½ slopes eastward. Dense undergrowth of fir and vine maple. Timber fir, some pine, oak, and laurel. Soil 2nd rate and stony on mountain.

23. T32S R6W 25 E going N. 1855.

6.05	A fir 36 inches in diameter, leave bottom slope.
17.00	Begin descent of N point of ridge.
28.00	Enter Cow Creek bottom.
32.00	Leave same.
34.00	Enter prairie near W end.
39.50	Leave same.
40.00	Set quarter section post from which a thorn 9 inches in diameter is 20 links away, and an ash 20 inches in diameter is 36 links away.
42.00	NW point of prairie.

42.25	Bank of slough.
44.00	Leave same 20 links wide, 50 ft deep.
44.60	Enter ploughed ground and prairie.
48.00	Leave ploughed ground, extends 2 chains SW 10 chains NE.
61.00	Leave prairie near west side.
67.75	Left bank of Cow creek.
68.75	Right bank, banks 10 ft high, water 3 ft.
70.75	Leave bottom, ascent mountain.
74.00	E.G. Mays house 30 links east.
74.40	Fence and road.
80.00	Set post from which a black oak 12 inches in diameter is 67 links away, a pine 36 inches in diameter is 28 links away, a white oak 9 inches in diameter is 57 links away, and a black oak 9 inches in diameter is 82 links away.

Surface nearly level. Timber fir, balm, ash, and oak. Undergrowth vine maple, and willow. Soil 1st rate.

24. T32S R6W 34 E going N. 1855.

10.00	Enter Cow Creek bottom.
15.50	A slough 25 links wide.
16.82	Left bank of Cow creek.
18.06	Right bank of Cow Creek.
29.00	Leave brush and enter prairie.
37.50	A trail, begin ascending.
40.00	Set quarter section post from which a white oak 12 inches in diameter is 112 links away, and a pine 10 inches in diameter is 46 links away.
46.00	Leave prairie, enter fir and oak openings.
54.00	Begin ascent on SE slope.
80.00	Set post from which a black oak 13 inches in diameter is 93 links away, a black oak 12 inches in diameter is 115 links away, a black oak 16 inches in diameter is 125 links away, and a black oak 14 inches in diameter is 96 links away.

Fine crops Cow Creek bottom extending onto mountain in the South. Timber on bottom balm. Balm, vine maple, alder on bottom. Pine and oak on mountain side. 1st rate black loan on bottom. 2nd rate and gravelly on mountain.

25. T32S R6W 32 E going N. 1855.

00.48	A fir 10 inches in diameter.
3.75	Left bank of Cow creek.
5.00	Enter small prairie.
12.00	Leave small prairie.
20.00	East bank of Cow creek and offset 45 links.
23.40	Leave bend of creek and offset to line.
30.00	Leave creek bottom and enter prairie. Commence ascending.
40.00	Set quarter section post from which a white oak 20 inches in diameter is 353 links away and a white oak 18 inches in diameter is 170 links away.
42.00	Enter prairie and oak openings.

61.00	Summit on ridge. Enter thick timber and brush. Begin descent on NE slope.
80.00	Set post from which a laurel 10 inches in diameter is 22 links away, a black oak 10 inches in diameter is 47 links away, a laurel 10 inches in diameter is 63 links away, and a fir 5 inches in diameter is 43 links away.

S ½ nearly level with 1st rate soil. N ½ with 2nd rate soil. Fir, pine, oak, laurel with balm. Madrone and alder on bottom.

26. T32S R7W 35 E going N. 1881.

5.00	Cow Creek 140 links wide.
12.18	Wagon road.
30.00	Spring branch 1 link wide.
40.00	Set quarter section post from which a pine 36 inches in diameter is 24 links away, and a pine 40 inches in diameter is 20 links away.
61.00	Lot of spurs.
71.50	A spring.
80.00	Set a cedar post from which a pine 15 inches in diameter is 50 links away, a fir 18 inches in diameter is 57 links away, a fir 15 inches in diameter is 55 links away, and a fir 20 inches in diameter is 17 links away.

Land level in valley, otherwise mountainous. Soil sandy loam 2nd rate in valley, otherwise clay and gravelly 3rd rate. Timber fir, pine, cedar, and laurel. Undergrowth same with vine maple in valley.

27. T32S R7W 33 E going N. 1881.

0.75	A creek 5 links wide.
6.00	Lots of spur at NE.
24.00	Lots of spur.
29.75	A creek 8 links wide.
40.00	Set a fir post from which a sugar pine 24 inches in diameter is 8 links away and a sugar pine 20 inches in diameter is 30 links away.
49.00	Enter mine. Merrimans' house west ~5 chains.
58.00	Leave mine – steep ascent.
62.50	Cow Creek 150 links wide.
65.00	Trail E and W begin ascent.
80.00	Set fir post from which a pine 16 inches in diameter is 30 links away, a fir 24 inches in diameter is 20 links away, a fir 18 inches in diameter is 15 links away, and a fir 8 inches in diameter is 50 links away.

Land hilly. Soil clay and loam 3rd rate. Timber chiefly pine, fir, cedar, and laurel. Undergrowth same.

28. T32S R7W 20 S going E along Ck on random line. 1881.

40.00	Set quarter section post.
55.00	Steep rocky canyon.
63.00	Cow Creek 200 links wide.
70.00	E side of rocky canyon.
78.00	Trail NW.

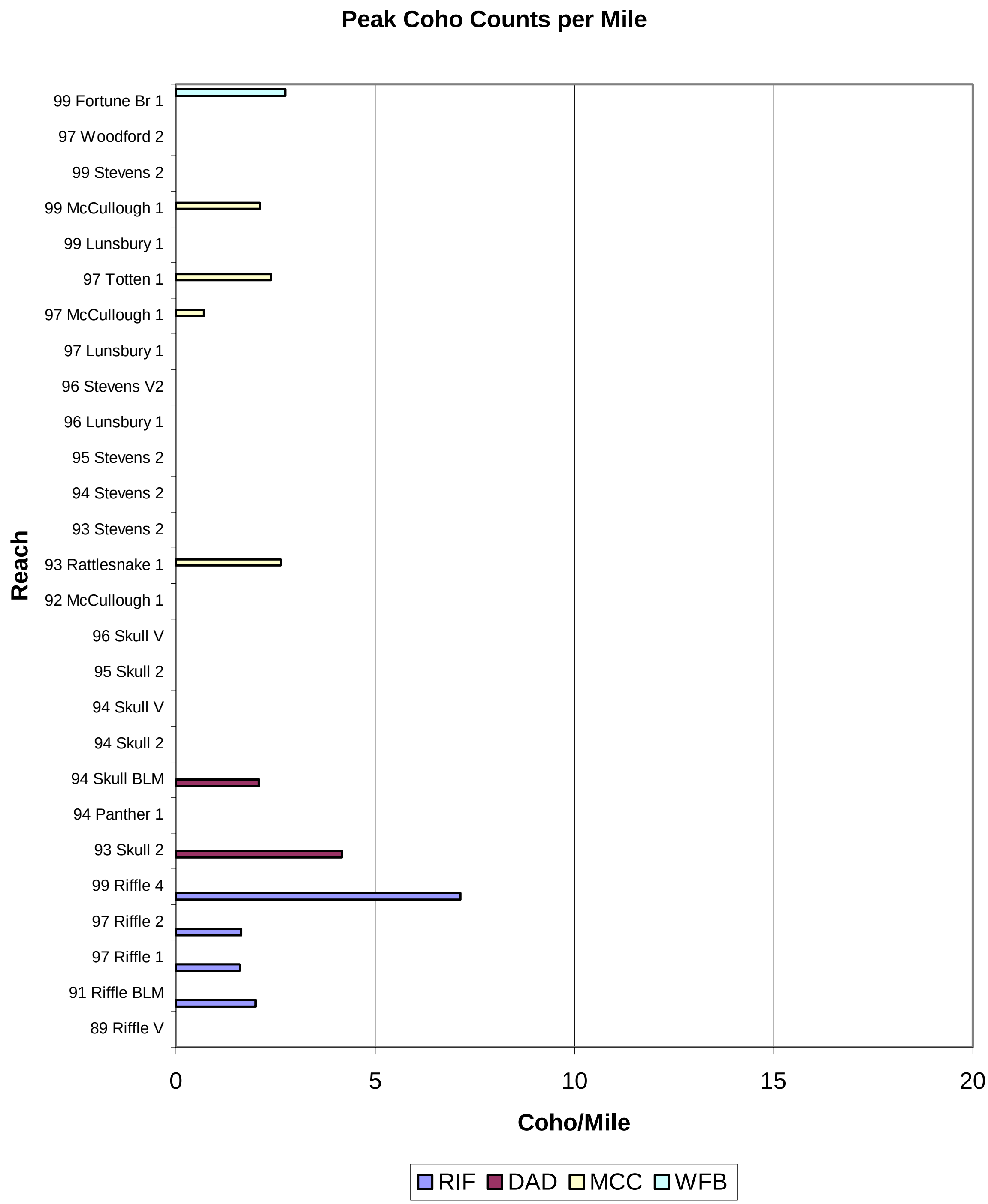
80.00	Intersect line 14 links S of certified section corner.

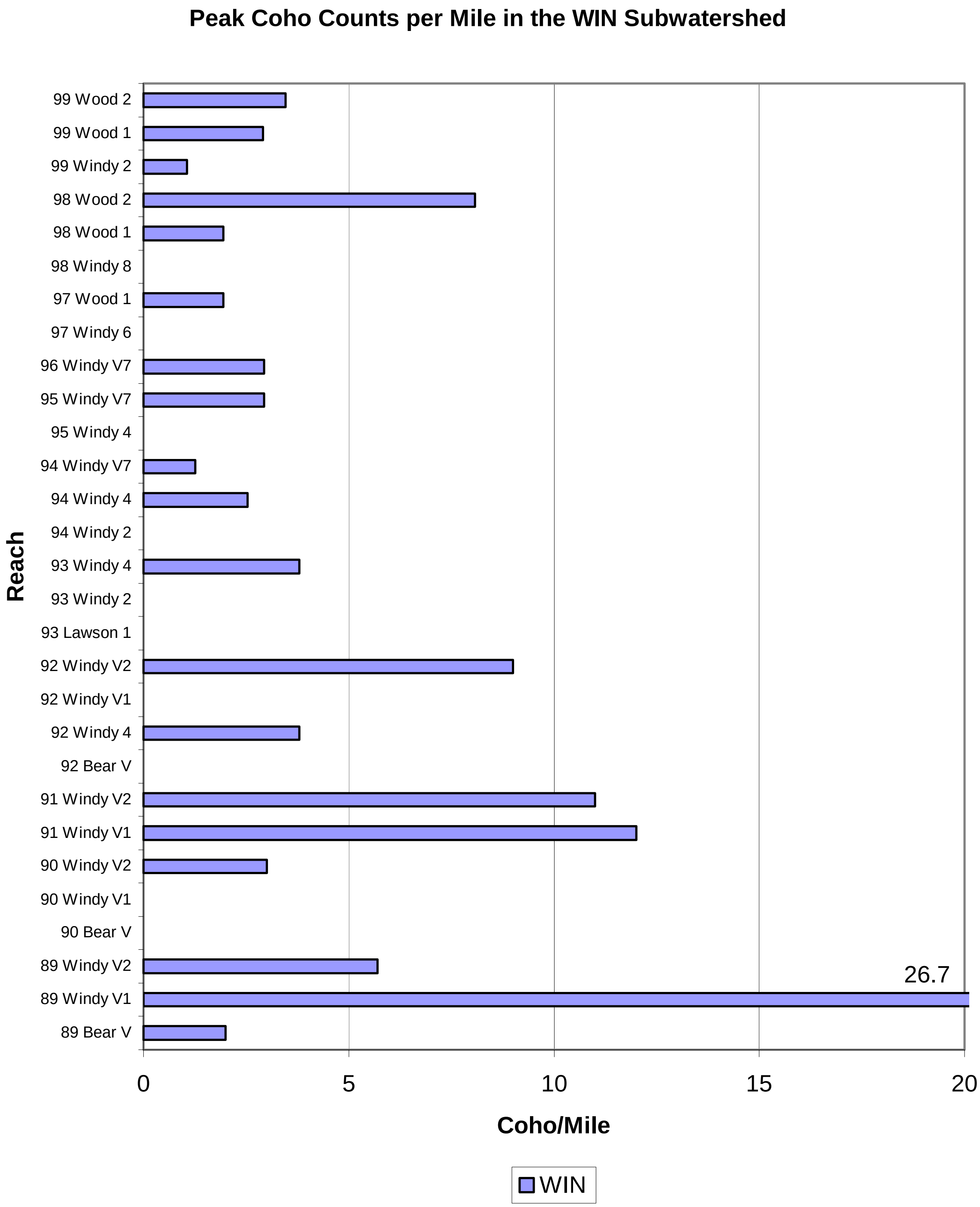
29. T32S R8W 13 E going N. 1881.

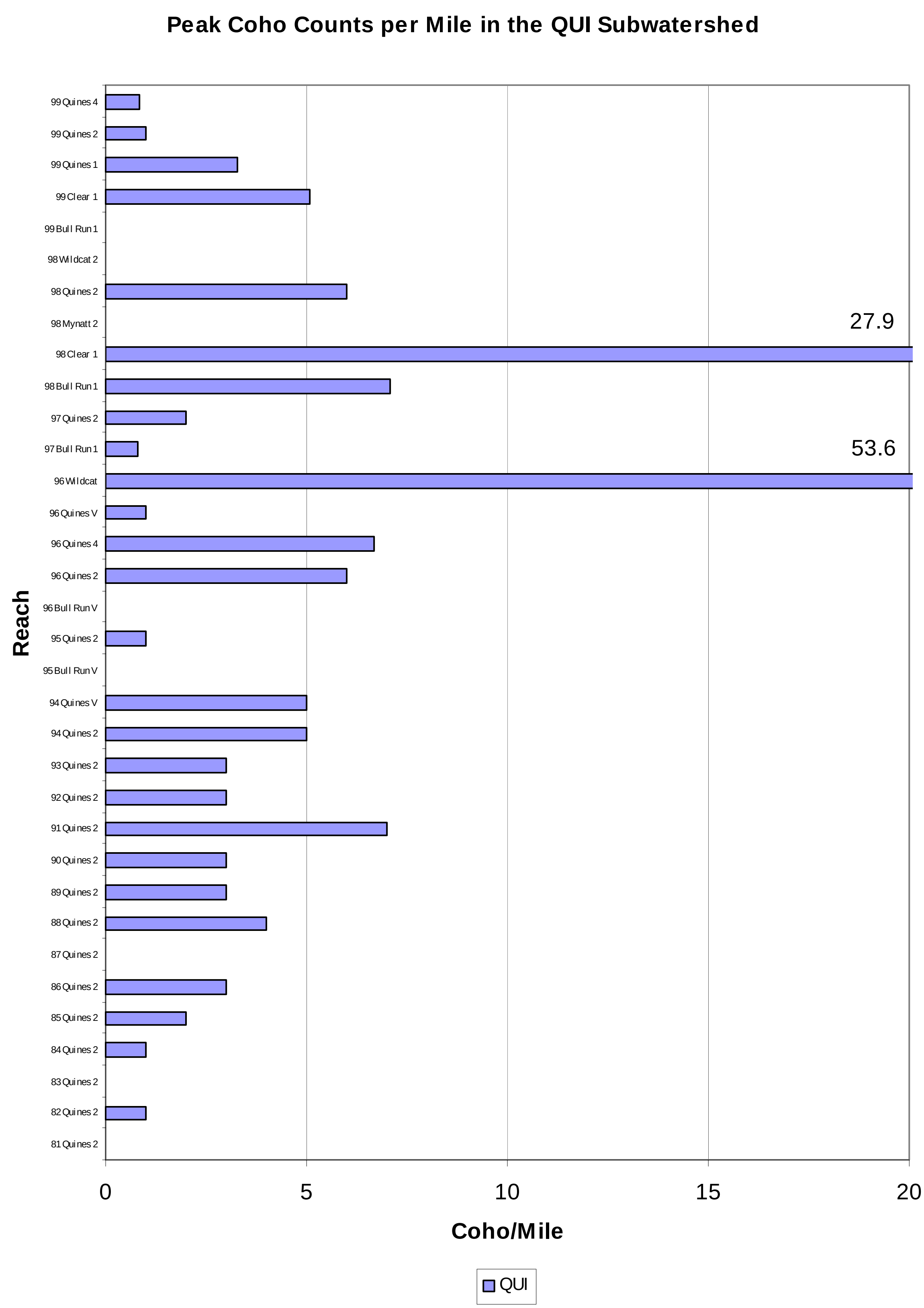
6.50	Along steep E slope of mountain.
15.00	Begin steep ascent.
28.00	Cow reek 100 links wide at NW steep rocky ascent.
40.00	Set quarter section post from which a live oak 6 inches in diameter is 10 links away, and a fir 12 inches in diameter is 8 links away.
55.00	Begin steep ascent.
58.00	Descend bluff.
65.20	Cow creek 160 links wide.
80.00	Set laurel post from which a fir 36 inches in diameter is 15 links away, a pine 15 inches in diameter is 53 links away, a fir 20 inches in diameter is 64 links away, and a laurel 10 inches in diameter is 40 links away.

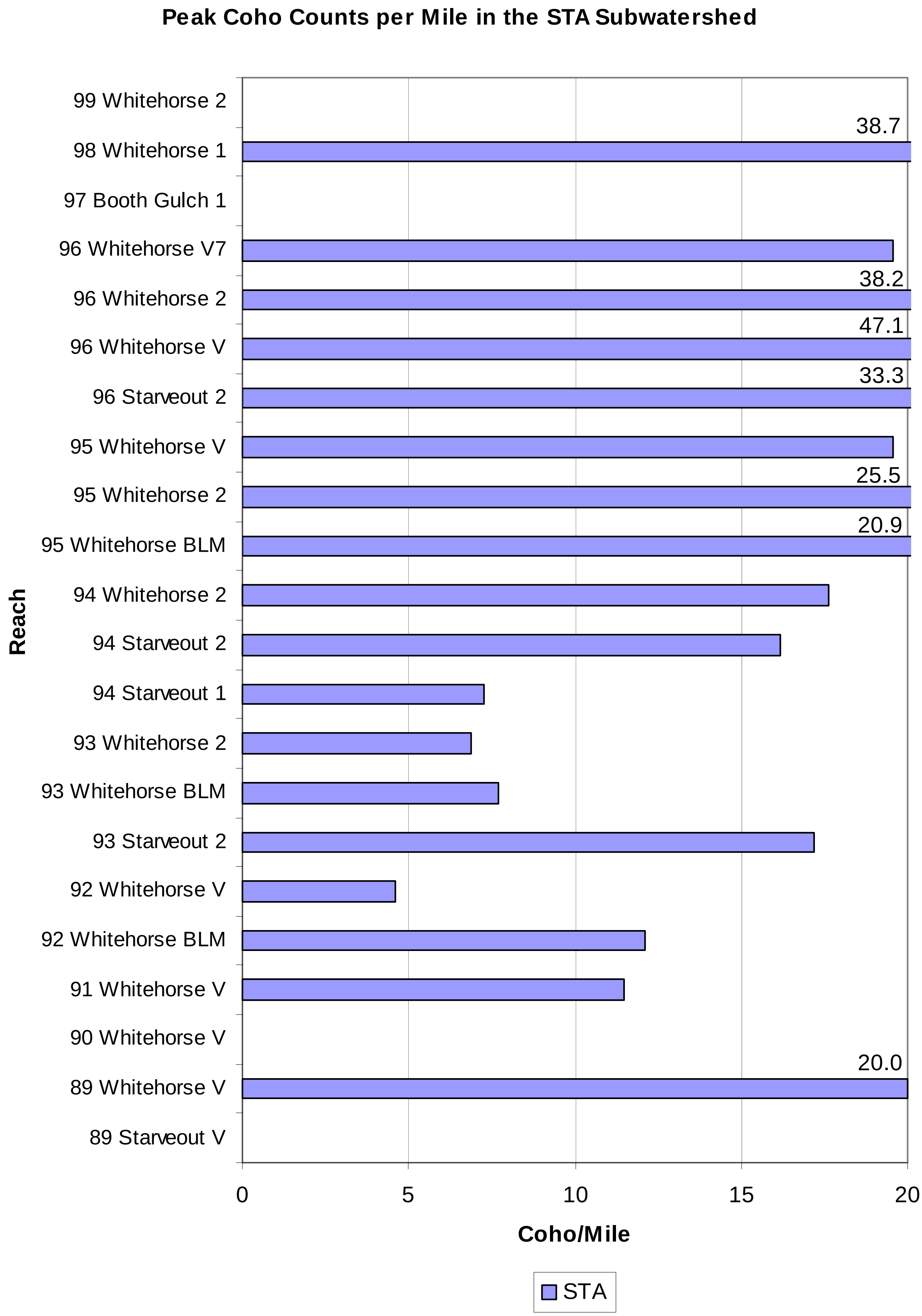
Land broken and rocky. Soil clay and gravel 4th rate. Timber chiefly fir, cedar, pine, yew, live oak, and laurel. Undergrowth same, very dense.

Appendix B.


Peak Coho Counts per Mile
Reach
99 Fortune Br 1
97 Woodford 2
99 Stevens 2
99 McCullough 1
99 Lunsbury 1
97 Totten 1
97 McCullough 1
97 Lunsbury 1
96 Stevens V2
96 Lunsbury 1
95 Stevens 2
94 Stevens 2
93 Stevens 2
93 Rattlesnake 1
92 McCullough 1
96 Skull V
95 Skull 2
94 Skull V
94 Skull 2
94 Skull BLM
94 Panther 1
93 Skull 2
99 Riffle 4
97 Riffle 2
97 Riffle 1
91 Riffle BLM
89 Riffle V
0
5
10
15
20
Coho/Mile
RIF
DAD
MCC
WFB


Peak Coho Counts per Mile in the WIN Subwatershed
Reach
99 Wood 2
99 Wood 1
99 Windy 2
98 Wood 2
98 Wood 1
98 Windy 8
97 Wood 1
97 Windy 6
96 Windy V7
95 Windy V7
95 Windy 4
94 Windy V7
94 Windy 4
94 Windy 2
93 Windy 4
93 Windy 2
93 Lawson 1
92 Windy V2
92 Windy V1
92 Windy 4
92 Bear V
91 Windy V2
91 Windy V1
90 Windy V2
90 Windy V1
90 Bear V
89 Windy V2
89 Windy V1
89 Bear V
26.7
0
5
10
15
20
Coho/Mile
WIN


Peak Coho Counts per Mile in the QUI Subwatershed
Reach
99 Quines 4
99 Quines 2
99 Quines 1
99 Clear 1
99 Bull Run 1
98 Wildcat 2
98 Quines 2
98 Mynatt 2
98 Clear 1
98 Bull Run 1
97 Quines 2
97 Bull Run 1
96 Wildcat
96 Quines V
96 Quines 4
96 Quines 2
96 Bull Run V
95 Quines 2
95 Bull Run V
94 Quines V
94 Quines 2
93 Quines 2
92 Quines 2
91 Quines 2
90 Quines 2
89 Quines 2
88 Quines 2
87 Quines 2
86 Quines 2
85 Quines 2
84 Quines 2
83 Quines 2
82 Quines 2
81 Quines 2
27.9
53.6
0
5
10
15
20
Coho/Mile
QUI


Peak Coho Counts per Mile in the STA Subwatershed
99 Whitehorse 2
98 Whitehorse 1
97 Booth Gulch 1
96 Whitehorse V7
96 Whitehorse 2
96 Whitehorse V
96 Starveout 2
95 Whitehorse V
95 Whitehorse 2
95 Whitehorse BLM
94 Whitehorse 2
94 Starveout 2
94 Starveout 1
93 Whitehorse 2
93 Whitehorse BLM
93 Starveout 2
92 Whitehorse V
92 Whitehorse BLM
91 Whitehorse V
90 Whitehorse V
89 Whitehorse V
89 Starveout V
38.7
38.2
47.1
33.3
25.5
20.9
20.0
Reach
0
5
10
15
20
Coho/Mile
STA

Appendix C

Dominant Riparian Species

The following table shows the rating of the riparian area by species composition and average diameter.

Species Composition	**Average Diameter (inches)**				
	1.2	**6**	**12**	**20**	**35**
Deciduous	Poor	Poor	Fair	Fair	
Mixed	Poor	Fair	Good	Good	Good
Coniferous	Poor	Good	Good	Good	Good

EPA 319 nonpoint source project funds were used as match for the Middle Cow Creek Watershed Assessment and Action Plan. Partnership was described in section 1.2.