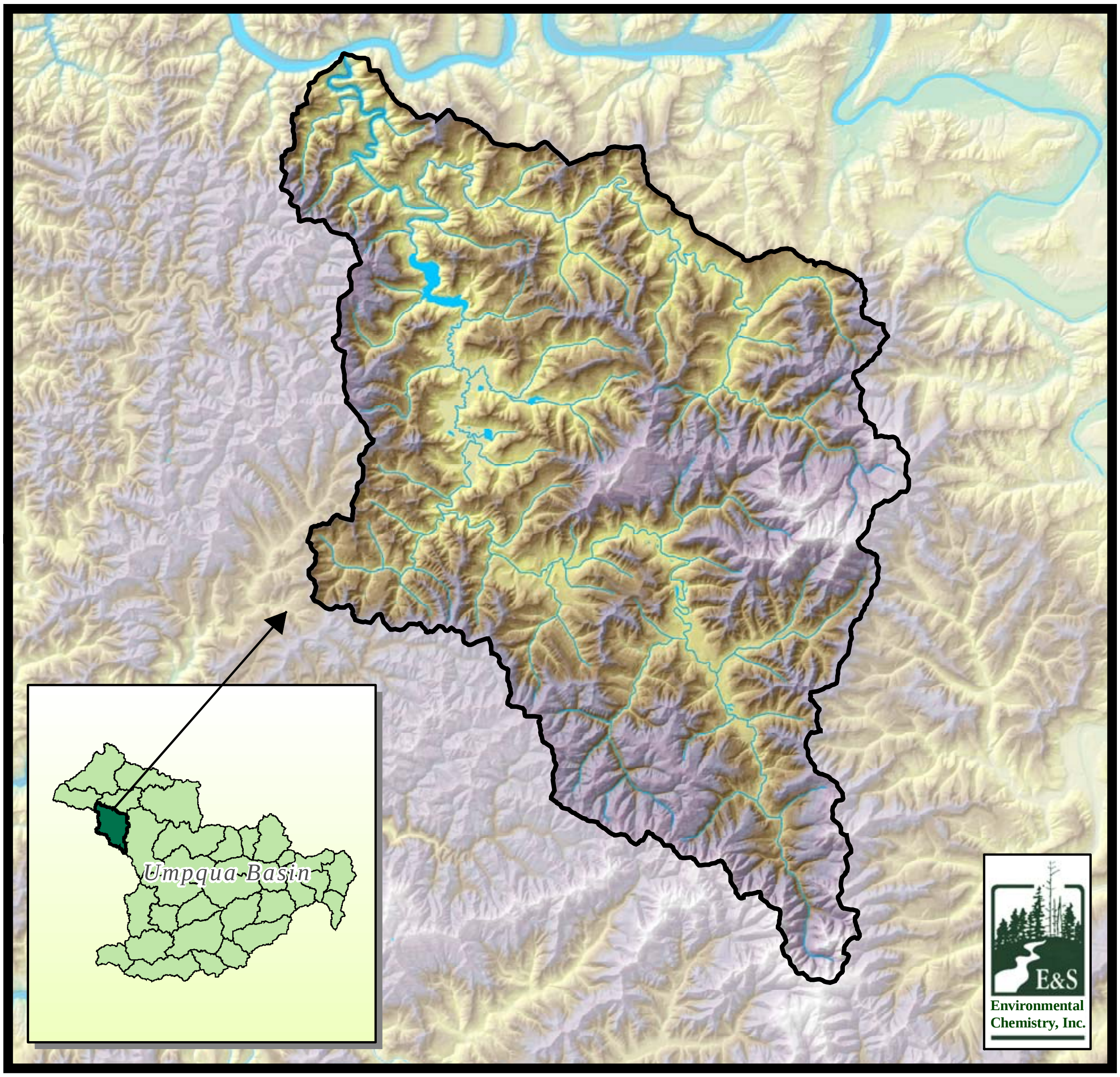
Mill Creek Watershed Assessment



Prepared by E&S Environmental Chemistry, Inc.
for the Umpqua Basin Watershed Council

May, 2006

UMPQUA BASIN WATERSHED COUNCIL

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Mill Creek Watershed Assessment

Final Report

May, 2006

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1. Introduction

The introduction provides a general description of the watershed in terms of its natural and human-made features, ownership and current land uses, and the communities within the watershed. Information in sections 1.2 and 1.3 was compiled from the *South Umpqua River Watershed Assessment and Action Plan* (Geyer 2003), *Mill Creek Watershed Analysis* (Bureau of Land Management 2005), *Elliott State Forest Watershed Analysis* (Biosystems 2003), and *Oregon Watershed Assessment Manual* (Watershed Professionals Network 1999). Additional information is from the following sources' databases: The Oregon Climate Service, the US Census Bureau, and the Douglas County Assessor.

<u>Key Questions</u>

- What is the Umpqua Basin Watershed Council?
- What is the purpose of the watershed assessment and action plan document?
- How was the watershed assessment developed?
- Where is the Mill Creek Watershed and what are its defining characteristics?
- What is land ownership and land use within the watershed?
- What are the demographic, educational, and economic characteristics of Mill Creek Watershed residents?

1.1. Purpose and Development of the Watershed Assessment

1.1.1. The Umpqua Basin Watershed Council

The Umpqua Basin Watershed Council (UBWC) is a non-profit, non-government, non-regulatory charitable organization that works with willing landowners on projects to enhance fish habitat and water quality in the Umpqua Basin. The council had its origins in 1992 as the Umpqua Basin Fisheries Restoration Initiative (UBFRI), and its name was changed to the UBWC in May of 1997. Three years later, the council was incorporated as a non-profit organization. The UBWC's 17-member Board of Directors represents resource stakeholders in the Umpqua Basin. The board develops localized and basin-wide fish habitat and water quality improvement strategies that are compatible with community goals and economic needs. Activities include enhancing salmon and trout spawning and rearing grounds, eliminating barriers to migratory fish, monitoring stream conditions and project impacts, and educating landowners and residents about fish habitat and water quality issues in their areas. Depending on the need, the UBWC will provide direct assistance to individuals and groups, or coordinate cooperative efforts between multiple partners over a large area.

1.1.2. The Watershed Assessment and Action Plan

The Mill Creek Watershed assessment has two goals:

1. To describe the past, present, and potential future conditions that affect water quality and fish habitat within the subject watershed; and
2. To provide a research-based action plan that suggests voluntary activities to landowners in order to improve fish habitat and water quality within the watershed.

The action plan developed from findings in Chapter 3 is a critical component of the assessment. The subchapters include a summary of each section's key findings and a list of action recommendations developed by UBWC staff, E&S Environmental Chemistry (E&S) scientists, landowners, and restoration specialists. Chapter 5 is a compilation of all key findings and action recommendations and includes a summary of potential UBWC watershed enhancement opportunities. Activities within the action plan are suggestions for the kinds of voluntary projects and programs that would be most likely to have positive impacts on water quality and fish habitat in the watershed. The action plan should not be interpreted as landowner requirements or as a comprehensive list of all possible restoration opportunities.

1.1.3. Assessment Development

This report was compiled by staff of E&S, working together with the UBWC. It is the product of a collaborative effort between the UBWC, E&S, and watershed residents, landowners, and stakeholders. Members of the E&S and UBWC staffs assembled information about each assessment topic and compiled the data into graphic and written form. Landowners and other interested parties met with E&S and UBWC staff to review information about the watershed and offer comments and suggestions for improvement of draft versions of this assessment.

The Mill Creek Watershed assessment meetings were held in conjunction with efforts to prepare this assessment. Landowners and residents met for three meetings and one field trip in 2005. A total of 37 people attended one or more meetings and the field trip, with an average of 14 participants per meeting. Meeting participants included ranchers, family forestland owners, industrial timber company employees, city officials, city residents, and land management agency personnel.

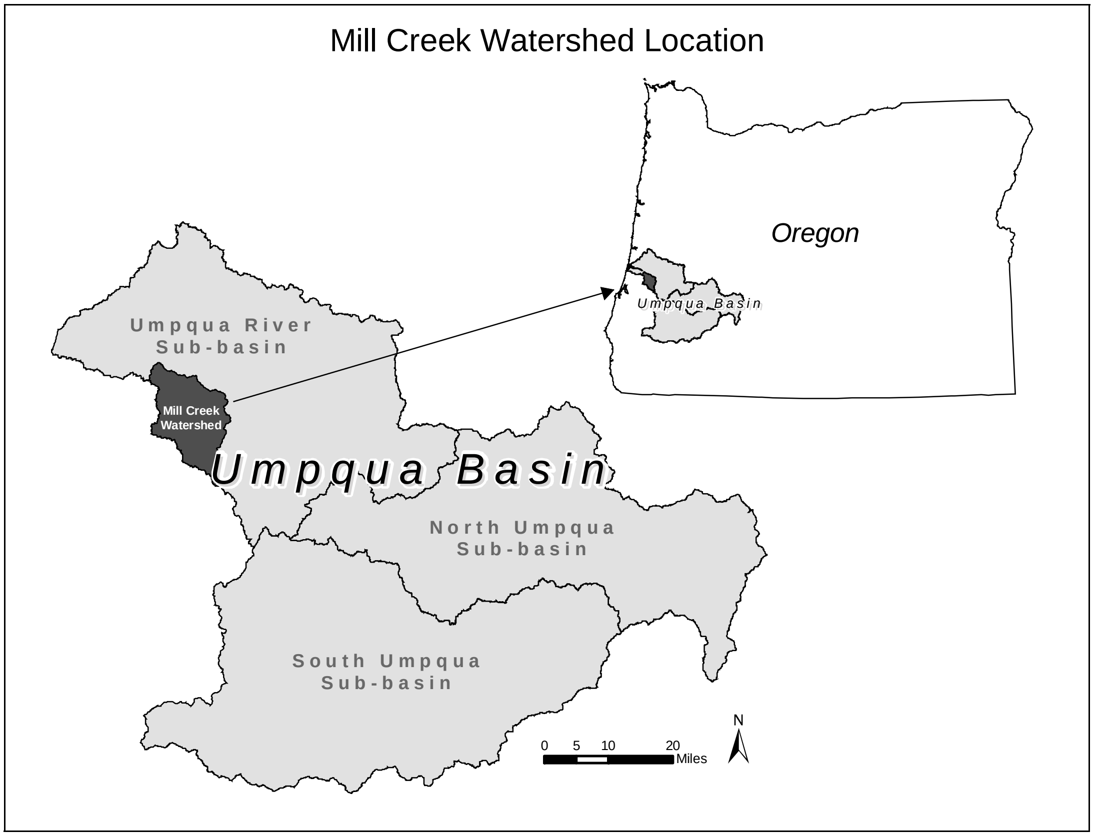
1.2. Watershed Description

1.2.1. Location, Size, and Major Features

For the purpose of this watershed assessment, the Umpqua Basin refers to the entire 2.7 million acre drainage area of the main Umpqua River, the North Umpqua River, the South Umpqua River, and all associated tributary streams. The Umpqua River sub-basin refers to the 387,000-acre area drained by the Umpqua River only. The North Umpqua sub-basin and the South Umpqua sub-basin are the drainage areas for the North Umpqua River and the South Umpqua River, respectively.

The area addressed in this assessment is the Mill Creek Watershed, a 86,039-acre area in the Umpqua River sub-basin that drains into the Umpqua River just below Scottsburg. The watershed stretches a maximum of 21 miles north to south and 10 miles east to west (Map 1.1). The watershed contains Loon Lake, Loon Lake Recreation Area, and Ash Valley. Ash Valley is the only population center within the watershed. Highway 38, which runs east-west paralleling the Umpqua River, crosses Mill Creek at the confluence with the Umpqua River. The only road of any size within the watershed is Loon Lake Road.

The Mill Creek Watershed is perhaps best known for Loon Lake, a popular summer recreation site. Loon Lake is about 280 acres in area, with a maximum depth of about 150 feet. It is about 0.5 miles wide and 2.5 miles long. The lake is believed to have been formed about 1,500 years



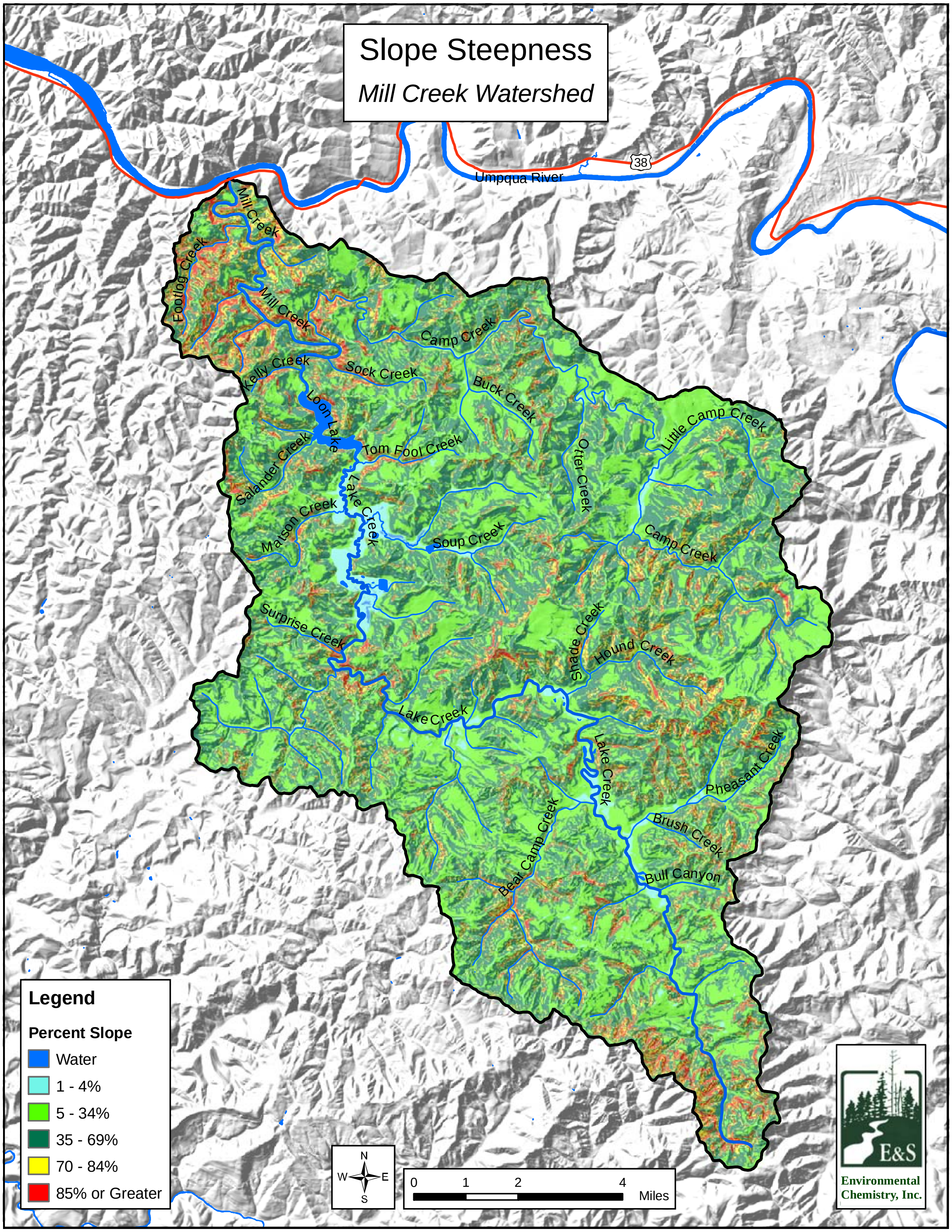
Map 1.1. Location of the Mill Creek Watershed.

ago in response to a large landslide triggered by an earthquake. Although Mill Creek flows out of Loon Lake, the stream flowing into Loon Lake is called Lake Creek. For the purpose of this assessment, we refer to the Mill Creek Watershed as the drainage basin that includes both Mill Creek and Lake Creek, plus associated tributary streams.

The watershed drains a varied landscape, from steep-sloped, highly-dissected headwaters to low-gradient floodplains along some portions of Mill Creek. Steep slopes and rock outcrops characterize some of the upland terrain. Many small, high-gradient streams with deeply incised channels originate from headwalls at higher elevations. The major tributary streams within the watershed flow into Lake Creek, which empties into Loon Lake, with the exception of Camp Creek, which joins Mill Creek below Loon Lake (Map 1.2).

1.2.2. Ecoregions

Ecoregions are land areas that are similar in climate, physiography, geology, natural vegetation, wildlife distribution, and land use that shape and form the function of watersheds. The hierarchical system of defining distinct ecoregions helps resource managers and scientists by identifying natural divisions and functional ecological units across the landscape. The entire Mill Creek Watershed lies within the Mid-Coastal Sedimentary Ecoregion. This ecoregion is characterized by moderately-sloping, dissected mountains with medium to high gradient streams. Its Douglas-fir forests are intensively managed for timber. The mountainous Mid-Coastal



Map 1.2. Percent slope for the Mill Creek Watershed.

Sedimentary Ecoregion lies outside of the coastal fog zone and is typically underlain by massive beds of sandstone and siltstone. Slopes are prone to failure when disturbed, particularly south of the Siuslaw River. Stream sedimentation is higher than in the Volcanics Ecoregion, located to the east.

1.2.3. Topography

The Mill Creek Watershed exhibits varied relief. Most of the watershed contains areas of steep ground with a high density of stream channels that dissect the landscape. The largest low-relief features in the watershed are Loon Lake and Ash Valley, which lie along Lake Creek between the confluence with Surprise Creek and Loon Lake.

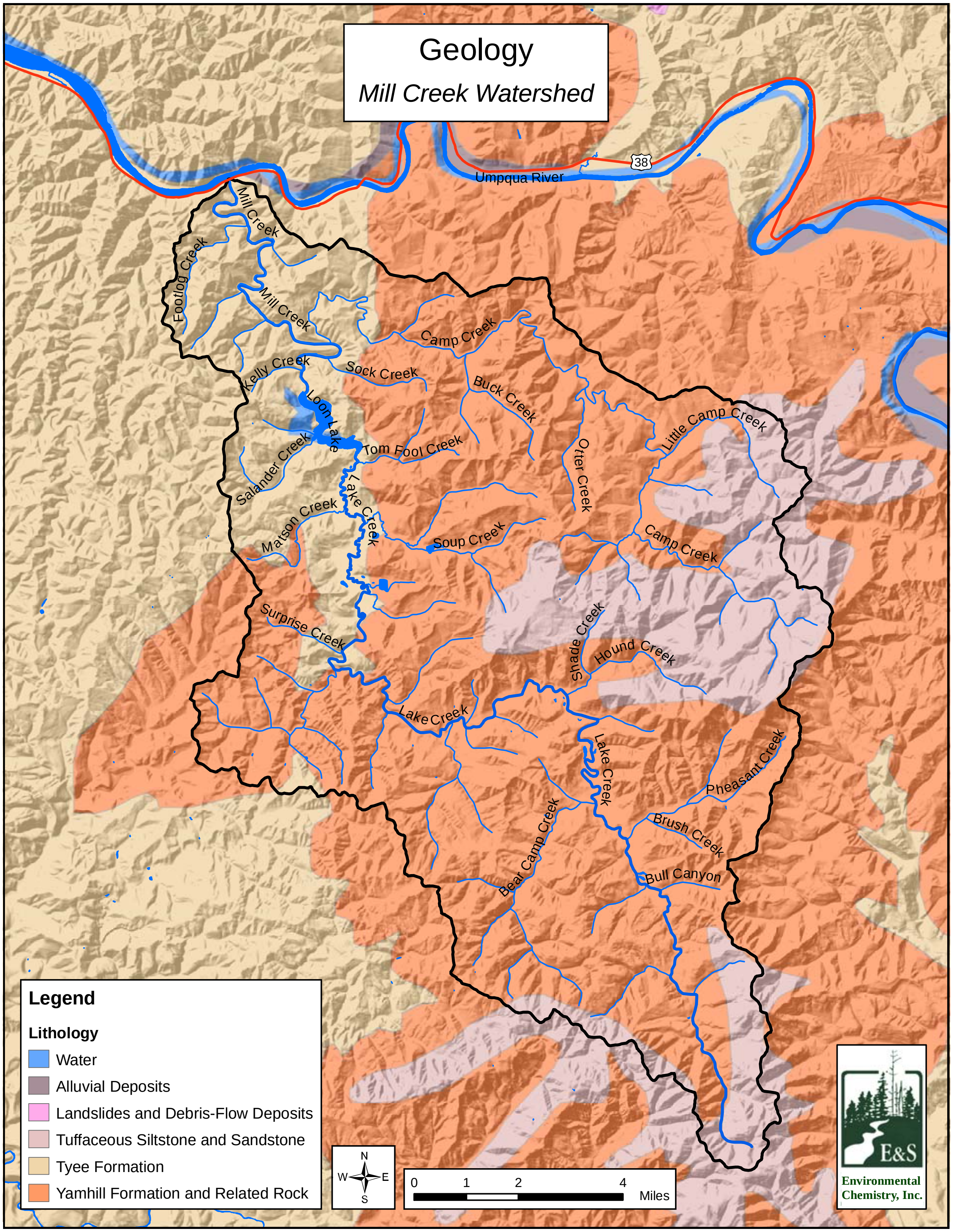
In the Mill Creek Watershed, slopes range from 0% to 4% in the floodplains along portions of Mill Creek. Topography is highly variable, with a mix of land slope classes (Map 1.2). The steepest lands (greater than 85% slope) are found mainly in the northern portions of the watershed and the upper reaches of Lake Creek. The lowest point in the watershed, at the base of Mill Creek, lies at nine feet above sea level. The highest point is 2,608 feet in the eastern portion of the watershed. In the Mill Creek Watershed, only 3.7% of the land base is above 2,000 feet. Areas between 2,000 and 5,000 feet in elevation are known as the transient snow zone. Rain-on-snow events, in which rain falls on accumulated snow causing it to melt, are more likely to occur in these moderately-higher areas.

1.2.4. Geology

The geologic history and current setting of the watershed is critical to understanding natural resource issues within it. In particular, geologic variation throughout the watershed can influence the delivery of sediment to the stream system. This sediment is critical to maintaining suitable fish spawning habitat. In Oregon, geologic processes have created a unique and varied landscape throughout the state. In southwestern Oregon, the history of the landscape is dominated by the collision of western North America with the floor of the Pacific Ocean and fragments of earth crust lying on it. This section summarizes the geology and geomorphology of the Mill Creek Watershed. Information in this section has been taken from the following documents: *Geology of Oregon* (Orr et al. 1992); *Northwest Exposures, A Geologic History of the Northwest* (Alt and Hyndman 1995); *Earth* (Press and Siever 1986); *Geologic Map of Oregon* (Walker and MacCleod 1991); and *Atlas of Oregon* (Loy et al. 2001).

Geologic processes have created many different physiographic provinces, or areas of similar geomorphology, within the state. The Umpqua Basin lies at the intersection of three physiographic provinces: the Coast Range, the Klamath Mountains, and the Western Cascades. All of the Mill Creek Watershed occurs in the Coast Range Province.

Uplifted geological strata in the watershed are largely marine sedimentary rocks, interspaced with some basalt formations (Map 1.3, Table 1.1). Marine sedimentary rocks in this region belong to the Yamhill and Tyee Formations and the Tuffaceous Siltstone and Sandstone geological unit. The Yamhill Formation is comprised of muds and silts formerly deposited in shallow seas. The Tyee Formation is composed of sandstone beds up to 30 feet thick, separated



Map 1.3. Geologic units within the Mill Creek Watershed.

Table 1.1. Geologic units in the Mill Creek Watershed.

Lithology	Area (acres)	Percent of Watershed
Water	287	0.3
Tuffaceous Siltstone and Sandstone	14,530	16.9
Tyee Formation	14,203	16.5
Yamhill Formation and Related Rock	57,019	66.3

by thin deposits of mudstone (Skaugset et al. 2002). These deposits are weak in shear and tensile strength (Ryu et al. 1996).

Geologic processes govern the topography of an area, which in turn greatly influences the morphology of streams. The hydraulic conductivity, or permeability, of rock units plays a significant role in determining the groundwater inputs to streams, and groundwater can contribute to stream water quality. Generally, groundwater has a more consistently high quality than surface water. However, many streams in mountainous areas, such as the Mill Creek Watershed, are naturally surface-water dominated, with groundwater playing a relatively minor role.

The topography that results from geologic processes helps to shape the steepness of slopes and their likelihood of failing. Topography also influences the local climate, causing, for instance, more rain on the western slopes of large hills than on the eastern slopes. This may influence runoff and sediment inputs locally. Geology largely governs the process of soil formation. Rocks provide the parent material for soil development. The minerals within rocks also influence the organisms that live within the soil. Relief and climate, both influenced by geology, also impact soil genesis. The characteristics of the resulting soil impact the contribution of sediment to streams.

There are two distinct zones of erosional processes in the watershed: the steep, forested uplands, and the floodplains along Lake Creek. On the steep slopes and shallow soils of the forested uplands, mass wasting is the dominant erosional system. Mass wasting includes a variety of erosional processes such as shallow landslides, rock slides, debris slides, and debris flows in steeper terrain, and earth slides and earth flows on gentler slopes. Under natural conditions, geology, topography, and climate interact to cause landslides. Slope steepness is shown in Map 1.2, giving an indication of the location of steep areas that are more prone to landslides.

Streambank erosion also naturally occurs in the uplands, most notably in the Camp Creek subwatershed. Roads in the uplands further increase the potential for erosion. Roads have been identified as the single greatest human-caused source of sediment in Oregon forest lands (Oregon Department of Forestry 1999)

Streambank cutting and sheet and rill erosion are the two primary erosional processes in the floodplain zone. Streambank erosion is the more prevalent of the two, and typically occurs in response to selective stratigraphic failure, soil saturation, or sloughing during high-flow events.

Land use practices have caused stream channelization and modification of the riparian zone in some areas, thereby altering the natural patterns and rates of streambank erosion.

1.2.5. The Mill Creek Watershed Stream Network

The Mill Creek Watershed includes about 9 stream miles of Mill Creek and 19 stream miles of Lake Creek.[1] Map 1.2 shows all of the tributaries that are visible on a US Geological Survey 1:100,000 resolution map, where one inch equals 8,333.3 feet. According to this map, there are 163.2 stream miles in the Mill Creek Watershed. The longest tributary to the lower section of Mill Creek is Camp Creek (over 10 stream miles).

Streams in the watershed are characteristically "flashy." They respond very quickly to rainfall by rapidly increasing discharge due to the steep topography in some portions of the watershed, high stream density, and intensity of precipitation. High flows typically occur between November and March and low flows from May through October. However, there are no gaging stations on Mill Creek and discharge data are not available for the watershed.

1.2.6. Climate

The watershed is exposed to a marine climate that is influenced by proximity to the Pacific Ocean and elevation. Westerly winds predominate and carry moisture and temperature-moderating effects from the ocean, resulting in winters that are moderate and wet, and summers that are cool and dry. Annual precipitation is high and occurs mostly during the winter months (Figure 1.1). Average annual precipitation is approximately 75 to 80 inches along Mill Creek. Slightly higher values occur at the higher elevations in Elliott State Forest. Average annual precipitation in this part of the Coast Range peaks at 100 inches per year just west of the western boundary of the Lake Creek subwatershed (Bureau of Land Management 2005). Rainfall averages 76 inches in Reedsport, but can vary widely depending upon the year. In Reedsport, rainfall averages over 9.5 inches for each of the months of November through March and less than 2 inches per month for June through August. Intense winter storms occur periodically, accompanied by high winds and heavy precipitation. Snow falls occasionally at the high elevations during the winter, but usually melts quickly with the warm rain that is typical of Pacific winter storms.

The nearest climate station to the Mill Creek Watershed is at Reedsport.[2] Figure 1.1 shows the average monthly minimum and maximum temperatures for Reedsport. Air temperatures in the watershed are mild throughout the year with cooler temperatures at higher elevations. Due to the moderating effect of the Pacific Ocean, summer air temperatures in the lower reaches of the watershed may increase significantly only a few miles inland, relative to areas near the ocean. Maximum temperatures in the summer are generally near 70°F. Maximum temperatures can exceed 90°F, but marine air generally keeps summer temperatures much cooler.

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[1] Stream miles and river miles measure distance from the mouth following the center of the stream channel to a given point. "Total stream miles" is the length of a stream in miles from the mouth to the headwaters. "Stream mile zero" always refers to the mouth.

[2] The National Oceanographic and Atmospheric Administration (NOAA) administers this station. Data are available from the Oregon Climate Station website http://ocs.oce.orst.edu/.

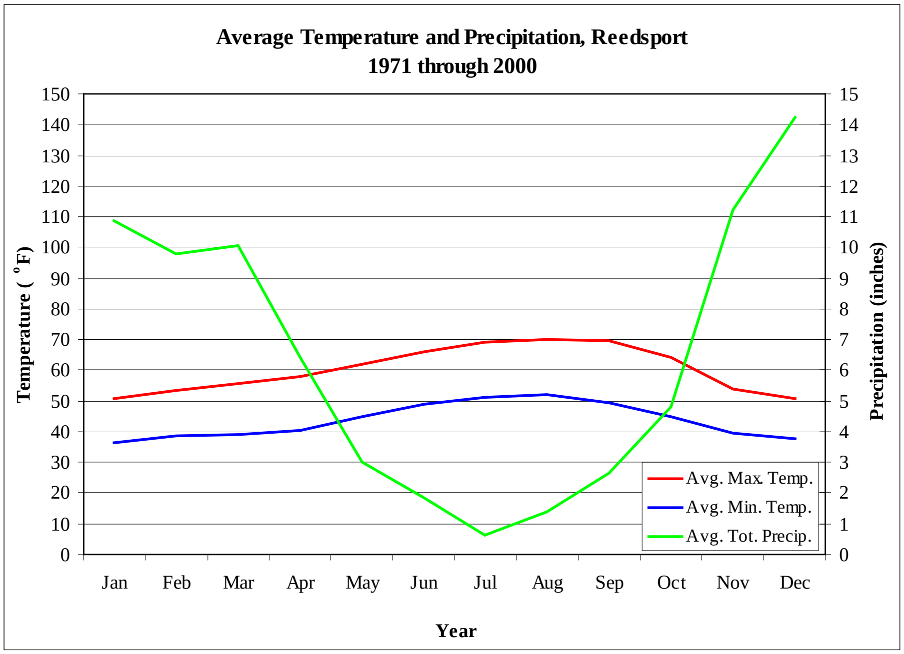


Figure 1.1. Thirty-year average monthly temperature (^oF) and precipitation (inches) at Reedsport (1971 through 2000).[3]

Minimum winter temperatures are usually above freezing, generally near 40^{o}F. Few days in winter have temperatures below freezing.

High-intensity rainfall is associated with the initiation of shallow landslides on steep slopes in the region. For example, intense rainstorms during the winters of 1981/1982 and 1996/1997 initiated many shallow landslides region-wide including many in the Camp Creek Watershed. Nearly seven inches of rain was recorded at North Bend within a 24-hour period in November, 1996, causing extensive landslide activity.

1.2.7. Vegetation

The upland portions of the watershed are mainly forested with coniferous forest stands, especially Douglas-fir. Coniferous forests cover 80% of the watershed, over half (57%) of which are less than 20 inches in diameter at breast height (DBH)[4] (Table 1.2). Approximately 12% of the coniferous forests within the watershed are comprised of trees larger than 30 inches DBH, and virtually all of those are found on federal and state lands.

Table 1.2. Landscape cover types in the Mill Creek Watershed.

Type	Percent	Acres
Barren	0.1	93
Conifer (<10" DBH)	20.8	17,880
Conifer (10-19" DBH)	36.2	31,102
Conifer (20-29" DBH)	11.1	9,590
Conifer (>30" DBH)	11.8	10,140
Hardwood (10-19" DBH)	1.3	1,086
Hardwood (20-29" DBH)	4.6	3,978
Non-Forest	11.9	10,114
Urban/Agriculture	2.2	1,790
Total	100.0	86,039

[3] Source: http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?orreed
[4] Diameter at breast height (DBH) indicates the measurement of the diameter of a tree trunk at approximately 4.5 feet above the ground.

Hardwood forests comprise 5.9% of the watershed, and are most common along stream corridors and in some of the lower-elevation areas. Alder-dominated hardwood stands grow next to streams and in headwall areas throughout the watershed. The streamside alder stands are generally wider on the north and east facing aspects next to the lower gradient streams. The highest concentrations of alder-dominated hardwood stands are in the western quarter of the watershed where the annual rainfall is higher. Chinquapins grow on the driest south-facing ridges. Myrtles are found on seasonally saturated soils and dry slopes. Bigleaf maples grow on moist well-drained soils, typically near streams (Map 1.4).

Based on aerial photo interpretation, field measurements of individual trees, and timber harvest records for young stands, trees currently growing in the portion of Elliott State Forest that drains to the Umpqua River Basin are an even mix of stands over 100 years old and younger plantations (Biosystems 2003). Within the subwatersheds of Elliott State Forest that drain directly to the Mill Creek Watershed, there are 104 acres (1%) of forest estimated to be over 200 years old, 4,068 acres (43%) estimated to be between 100 and 200 years old, and the balance (56%) less than 100 years old (mostly in the 13 to 24 and 25 to 49 year age classes).

1.3. Land Use, Ownership, and Population

1.3.1. Land Use and Ownership

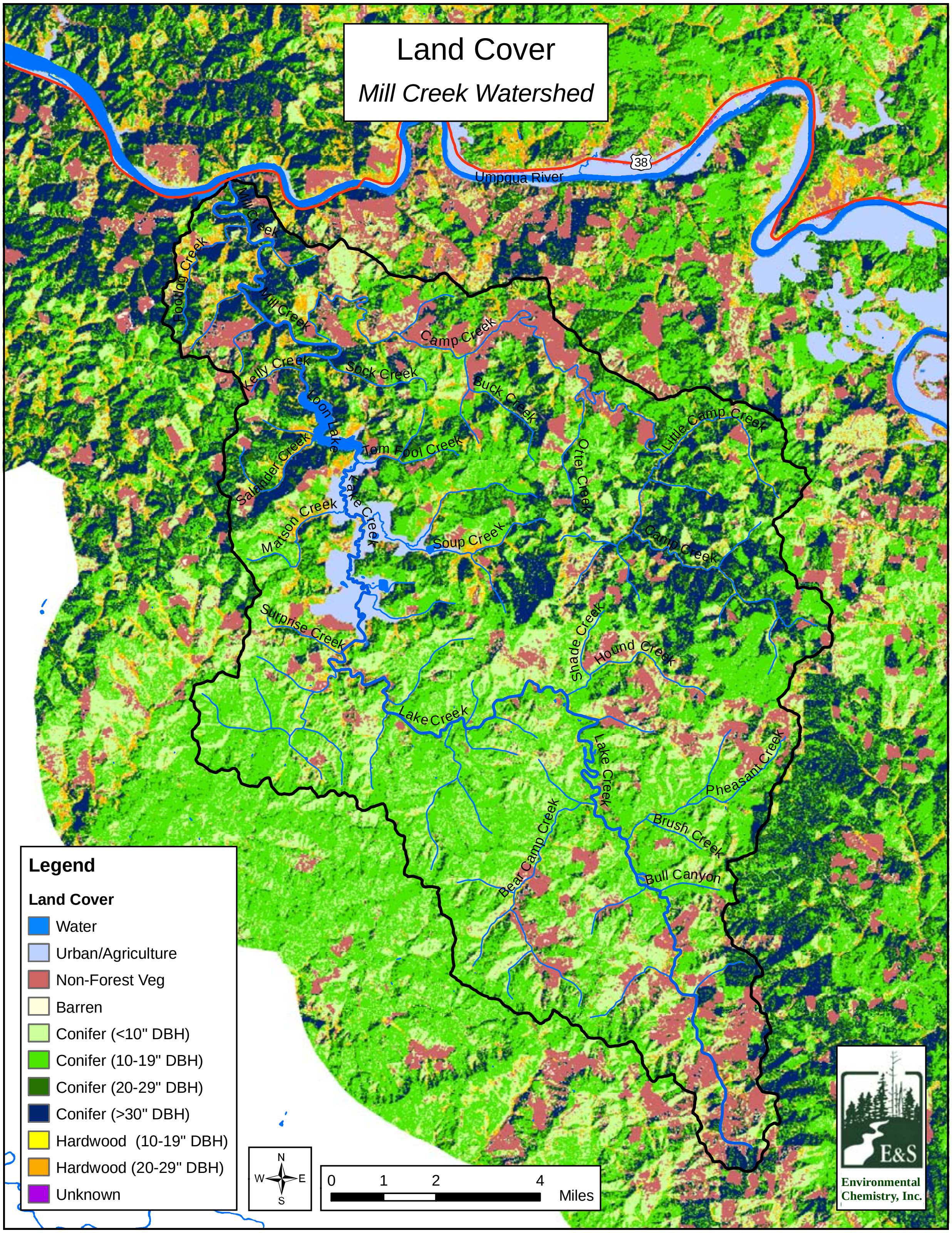
The most common land use in the Mill Creek Watershed is forestry, accounting for 85.8% of the watershed. Much of the forested land is used for public or private forestry. Agricultural and livestock use constitutes only about 2.2% of the land use, and mostly occurs in the floodplains of Lake Creek (Table 1.2, Map 1.4).

Table 1.3. Land ownership in the Mill Creek Watershed.

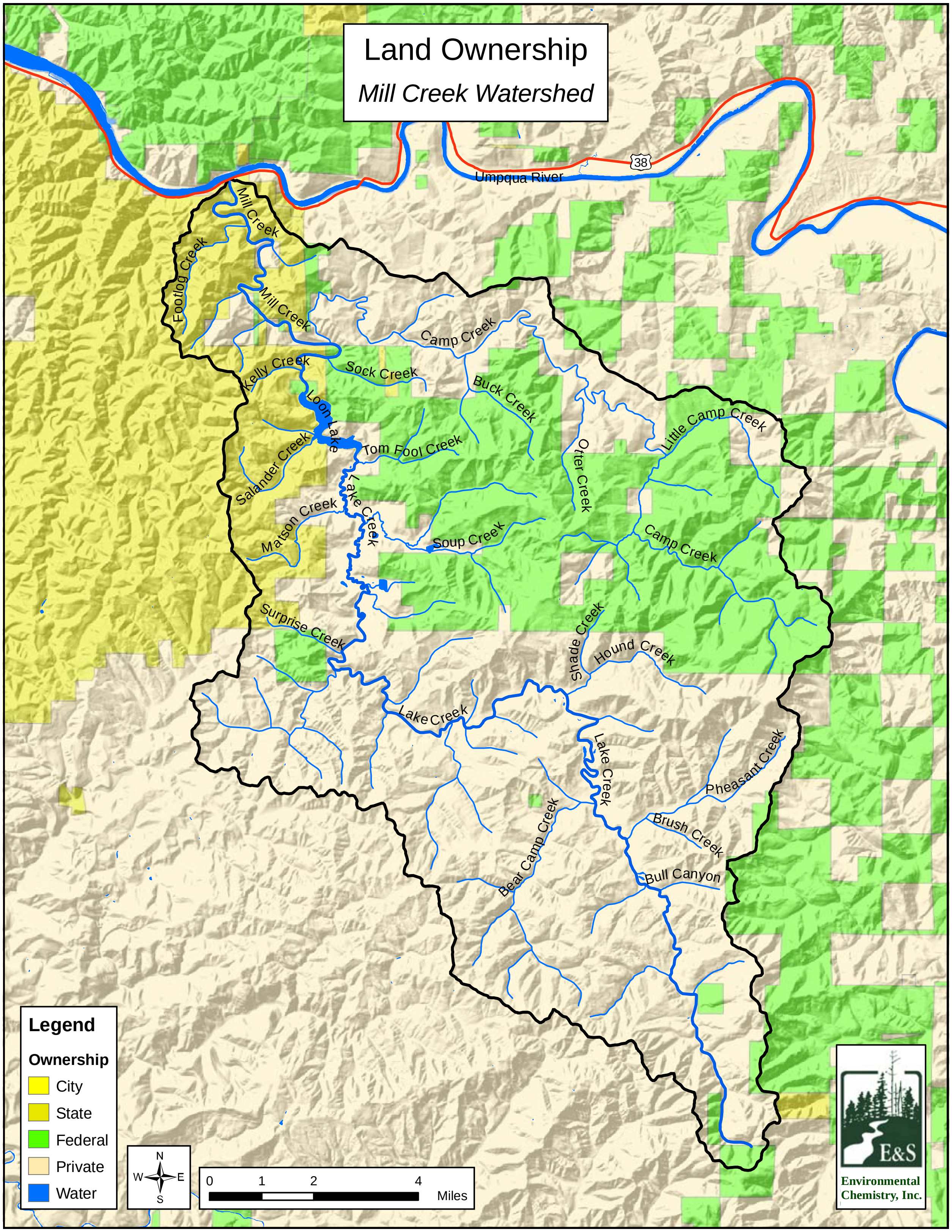
Ownership	Area (acres)	Percent of Watershed
Federal	24,634	28.6
Private	52,437	61.0
State	8,968	10.4

The major landholders in the watershed are Roseburg Resources Co., Silver Butte Timber Co., Weyerhaeuser, Bureau of Land Management (BLM), and the Oregon Department of Forestry (ODF). Other landowners include John Hancock Mutual Life and Plum Tree. As shown on Map 1.5, land ownership includes 61.0% private land, 28.6% federally-owned, and 10.4% state-owned land (Table 1.3). Public ownership is mostly administered by the BLM and ODF. Private lands are concentrated in the southern half of the watershed, along Camp Creek, and south of Loon Lake. State ownership (Elliott State Forest) is mostly confined to lands in the northwestern portion of the watershed, and federal lands lie to the east. ODF also manages scattered tracts of land at Ash Valley and Sock Creek. The Sock Creek tract includes a fish-bearing stream, but Ash Valley does not. ODF anticipates a near-term timber harvest on the Ash Valley tract (Biosystems 2003).

Land management by BLM is important to the overall environmental health of the Mill Creek Watershed because BLM manages about 29% of the land base within the watershed. The majority (82%) of the BLM land within the watershed is managed as Late Successional Reserve (LSR) to foster development of mature forests. Late-successional forest is characterized by old-growth trees and understory trees of varying heights, standing snags, decomposing logs, and a



Map 1.4. Landscape cover types in the Mill Creek Watershed.



Map 1.5. Land ownership in the Mill Creek Watershed.

diversity of shrub and wildflower species. Most of the remainder is managed as Matrix General Forest Management Areas (GFMA). About 12% of the Matrix lands (3,000 acres) are included within Riparian Reserves (RR), which are managed for watershed health and protection of streamside ecological integrity. BLM land includes Loon Lake Recreation Area, one of the most popular destination sites in the region. It averages about 75,000 visitors each year. Activities include campground interpretation programs, hiking, camping, picnicking, swimming, boating, and fishing.

Loon Lake is the major recreational draw in the watershed. The lake offers visitors from the interior valleys an escape from the summer heat and visitors from the coast a reprieve from the summer winds. The BLM manages the Loon Lake Recreation Area, located at the north end of the lake. It has a 60-unit campground with a beach and a boat launch. East Shore is a six-unit campground a half mile to the south of the Loon Lake Recreation Area. Summer homes, accessible by boat only, dot the west shore. Loon Lake Lodge and Fish Haven are commercial recreation sites on the east shore of Loon Lake. Together they provide a store, gas station, restaurant, rental cabins, camping, public phone, and boat ramp. Elliot State Forest does not have any developed recreation sites but does allow dispersed recreation throughout the forest. People also use old landings, wide turnouts, and rock stockpile sites on BLM lands as dispersed camping sites.

Elliott State Forest comprises 10% of the watershed, and management of this land by ODF is very important to the watershed as a whole. Management priorities in Elliott State Forest have changed in recent years. The forest has adopted, on an interim basis, the stream protection criteria implemented by northwestern Oregon State Forest Districts. Stream protection measures are intended to match the conditions within individual timber harvest units, but are established within the general framework of the Forest Practices Act and the Elliott State Forest Management Plan. Based on conversations with ODF foresters, Biosystems (2003) judged that the following measures, among others, generally apply to the current management of Elliott State Forest:

- Surveys for marbled murrelets within proposed harvest units occur each of two years prior to finalizing timber sales.
- All streams within a harvest unit that could be fish-bearing (using criteria outlined in the Forest Practices Rules) are treated as fish-bearing, even if a field survey has not been conducted to confirm the presence of fish.
- All trees growing within 100 feet of a fish-bearing stream are retained. Buffers are expanded to include areas of slope instability, wetlands, and other special features. In-unit trees (green trees and a certain number of snags per acre of clearcut harvest) are often retained as extensions of streamside buffers.
- All trees growing within 50 feet of perennial streams (not considered fish bearing) are retained. These buffers also may be extended laterally to include areas of slope instability, wetlands, and other special features. These buffers are often expanded to satisfy in-unit tree requirements for clearcut harvest units.
- The southwest region geotechnical specialists review proposed harvest units to determine if unusual slope instability problems exist. If so, higher risk areas may be excluded from

the harvest unit, or trees may be retained on those portions of the harvest unit where slope instability is high.

- Opportunities to improve fish habitat and slope stability within nearby streams are often incorporated into timber sales. This can include adding large trees from the harvest unit to fish-bearing streams deficient in large wood, or decommissioning old roads.

The annual acreage of clearcut harvest in Elliott State Forest is now about 510 acres annually. Thinning of stands, mostly in the 30- to 70-year-old age class also occurs. An average of 535 acres per year was thinned from late 1997 to early 2001.

Under the 1995 Habitat Conservation Plan for northern spotted owls, the Forest is segregated into short (80 to 135 years) and long (160 to 240 years) rotation basins. Most of the Umpqua region (75%) of the forest is designated as long rotation. Past timber harvest now curtails additional harvest in the long rotation basins, putting more pressure for near-term future harvest in the adjacent Coos Region.

1.3.2. Population and Demographics

1.3.2.1. Population

Areas for which the US Census Bureau has population and demographic information do not correspond with the Mill Creek Watershed boundary. There are no population centers within the Mill Creek Watershed having census data. The major community within the watershed is Ash Valley, which has about 37 households.

Part of the Reedsport Census County Division (CCD) is within the watershed (Map 1.6).[5] Data from this area and from the county are included in this section to provide a general overview of the populations that live within the Mill Creek Watershed.

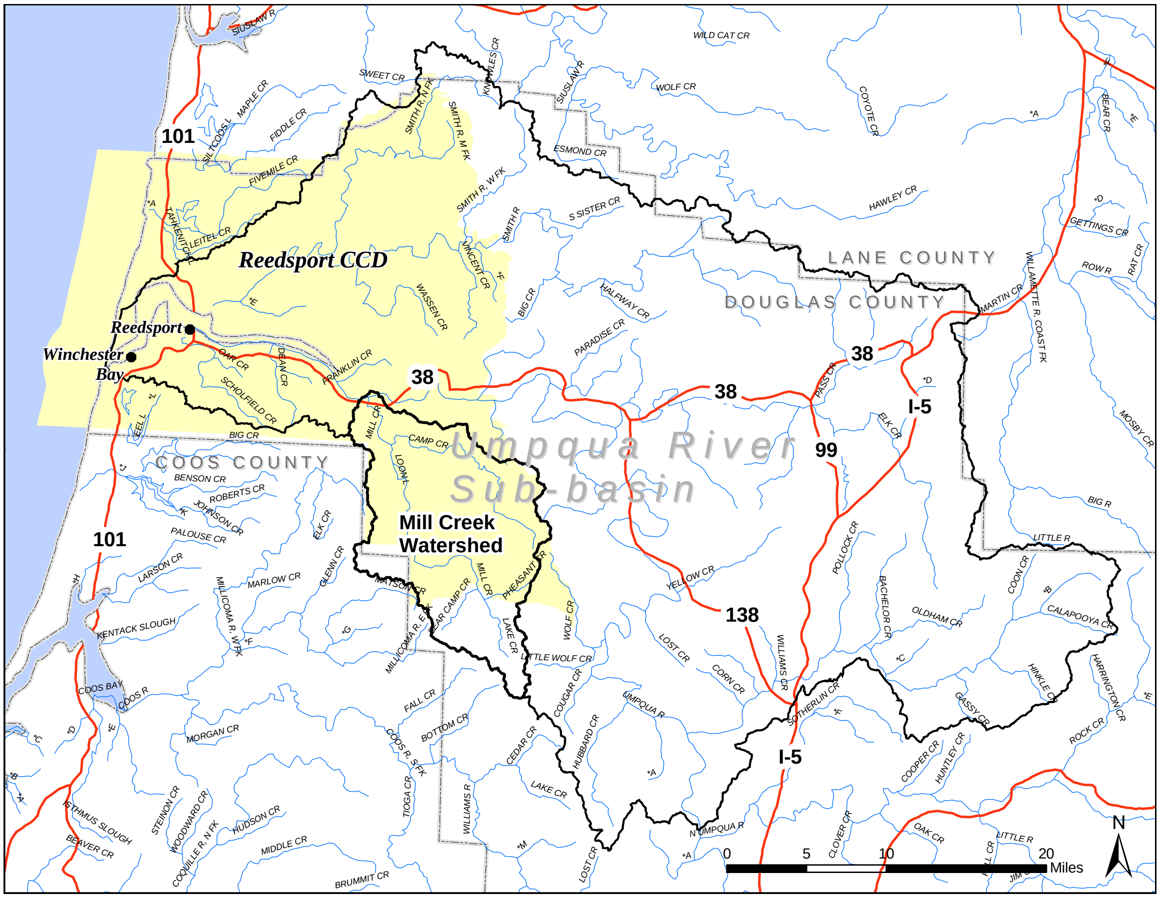
1.3.2.2. General Demographic Characteristics and Housing

Table 1.4 provides Census 2000 information about general demographic characteristics and housing for the Reedsport CCD; Douglas County data are provided for comparison. The Reedsport CCD is higher than the county's median age by almost six years. The largest racial group for both areas is white, with the next largest group being Hispanic or Latino. Average household size and family size are smaller in the Reedsport CCD than in the county. The Reedsport CCD has a lower percentage of owner-occupied housing than the county, as well as a higher housing vacancy rate.

1.3.2.3. Social Characteristics

Table 1.5 provides information from the 2000 Census for education, employment, and income for the Reedsport CCD and Douglas County. In both areas, slightly more than 80% of the adult population over age 25 has at least a high school graduate level of education, and about 13% have a bachelor's degree or higher. The percent of unemployed persons in the labor force is

[5] According to the US Census Bureau (http://factfinder.census.gov/servlet/BasicFactsServlet), a census county division (CCD) is "a subdivision of a county that is a relatively permanent statistical area established cooperatively by the Census Bureau and state and local government authorities. Used for presenting decennial census statistics in those states that do not have well-defined and stable minor civil divisions that serve as local governments."



Map 1.6. Location of the Reedsport CCD.[6]

Table 1.4. 2000 Census general demographic characteristics and housing information for the Reedsport CCD and Douglas County.		
Parameter	**Reedsport CCD**	**Douglas County***
Median age (years)	47.1	41.2
Race		
White	94.1%	93.9%
Hispanic or Latino	3.9%	3.3%
Asian	0.4%	0.6%
American Indian or Alaskan Native	1.3%	1.5%
African American	0%	0.2%
Native Hawaiian or Pacific Islander	0%	0.1%
Households		
Avg. household size (#)	2.21	2.48
Avg. family size (#)	2.69	2.90
Owner-occupied housing	68.3%	71.7%
Vacant housing units	14.9%	8.0%

* In 2000, the population of Douglas County was 100,399 people.

[6] Source: US Census Bureau's American FactFinder website: http://factfinder.census.gov

Table 1.5. 2000 Census information for education, employment, and income for the Reedsport CCD and Douglas County.

Parameter	Reedsport CCD	Douglas County
Education – age 25+		
High school graduate or higher	80.8%	81.0%
Bachelor's degree or higher	13.5%	13.3%
Employment- age 16+		
In labor force	46.9%	56.9%
Unemployed in labor force	5.6%	4.3%
Top three occupations	Management, professional, and related occupations; Sales and office occupations; Service occupations	Management, professional and related occupations; Sales and office; Production, transportation, and material moving.
Top three industries	Educational, health, and social services; Arts, entertainment, recreation, accommodation and food services; Retail trade	Educational, health, and social services; Manufacturing; Retail trade
Income		
Per capita income	$16,178	$16,581
Median family income	$33,056	$39,364
Families below poverty	11.8%	9.6%

slightly higher in the Reedsport CCD than in the county. The top three occupations in Table 1.5 account for around 70% of the labor force, and the top three industries employ about half of the workers. Median family income ranges from about $33,000 to $39,000 in both areas considered There are more families below the poverty level in the Reedsport CCD than in Douglas County as a whole.

2. Past Conditions[7]

The past conditions section provides an overview of events since the early 1800s that have impacted land use, land management, population growth, and fish habitat in Douglas County and in the Mill Creek Watershed. Sections 2.1 through 2.5 describe the history of Douglas County. Section 2.6 provides information specific to the study watershed. Most of sections 2.1 through 2.5 is based on S.D. Beckham's 1986 book *Land of the Umpqua: A History of Douglas County, Oregon*, the *South Umpqua Watershed Assessment and Action Plan* (Geyer 2003), the *Elliott State Forest Watershed Analysis* (Biosystems 2003), and *Loon Lake and Ash Valley Revisited* (Sims 1998). A complete list of citations can be found in the References section.

Key Questions

- What were the conditions of the Umpqua Basin watersheds before the arrival of the settlers?
- What events brought settlers to Douglas County?
- How did land management change over time and how did these changes impact fish habitat and water quality?
- What were the major socioeconomic changes in each period?
- When were laws and regulations implemented that impacted natural resource management?

2.1. Pre-Settlement: Early 1800s

The pre-settlement period was a time of exploration and inspiration. In 1804, President Thomas Jefferson directed William Clark and Meriwether Lewis to "secure data on geology, botany, zoology, ethnology, cartography, and the economic potentials of the region from the Mississippi Valley to the Pacific" (Beckham 1986, p. 49). The two men successfully completed their journey in 1806 and returned with field collections, notes and diaries. The information they collected soon became an inspiration for others to follow their path. Fur trappers came first, reaching Douglas County in the 1820s.

2.1.1. Native Americans

The Native Americans of Douglas County used fire to manipulate the local vegetation to improve hunting success and facilitate travel. Accounts of the native Douglas County vegetation reveal extensive prairies and large trees. The Pacific Railroad Surveys passed through the Umpqua Valley in 1855. The oak groves

> Origin of the Name "Umpqua"
>
> Many ideas exist about the origin of "Umpqua." A Native American chief searching for hunting grounds came to the area and said "umpqua" or "this is the place." Other natives refer to "unca" meaning "this stream." One full-blooded Umpqua tribe member interviewed in 1960 believed the term originated when white settlers arrived across the river from their village and began shouting and gesturing their desire to cross. "Umpqua," might mean "yelling," "calling," or a "loud noise" (Minter 1967, p. 16). Another Native American when asked the meaning of "Umpqua" rubbed his stomach, smiled, and said, "Uuuuuump-kwa – full tummy!" (Bakken 1970, p. 2)

[7] Robin Biesecker and Jeanine Lum of Barnes and Associates, Inc., contributed to this section.

found in the valleys were reported to grow both in groups and as single trees in the open. The oaks were described as reaching two to three foot diameters and to have a low and spreading form. Many early visitors described the fields of camas. Hall Kelley traveled the Umpqua River in 1832. "The Umpqua raced in almost constant whitewater through prairies covered with blue camas flowers and then into dense forest" (Cantwell 1972, p. 72).

The diet of the native people included fish and wildlife. Venison was their main game meat that, prior to the use of guns, was taken with snares and bows and arrows (Chandler 1981). Salmon was the fundamental food of the native people along the main Umpqua River. The Lower Umpqua natives fished with spears and by constructing barriers along the narrow channels. The large number of fish amazed a trapper working for the Hudson's Bay Company: "The immense quantities of these great fish caught might furnish all London with a breakfast" (Schlesser 1973, p. 8). Wildlife was prevalent throughout Douglas County and included elk, deer, cougar, grizzly bear, beaver, muskrat, and coyote.

2.1.2. European Visitors

The Lewis and Clark Expedition provided glowing reports of the natural riches of the region and proved travel to Oregon was difficult but possible. Fur seekers, missionaries, and surveyors of the native geology, flora, and fauna were among the first European visitors to Douglas County.

Pre-settlement Timeline

1804 - 1806	Lewis & Clark Expedition
1810	John Jacob Astor establishes Pacific Fur Company in Astoria

Fur trading in Douglas County began in 1791 in the estuary of the Umpqua River. Captain James Baker traded with the local native people for about 10 days and obtained a few otter skins. The first land contact by fur traders in the Umpqua Valley was in 1818 by the Northwest Company of Canada. Trapping did not expand until Alexander Roderick McLeod, working for Hudson's Bay Company, explored the Umpqua Valley in 1826. The number of trappers steadily increased along the Umpqua River from 1828 to 1836. Hudson's Bay Company established Fort Umpqua first near the confluence of Calapooya Creek and the Umpqua River in the 1820s and then, in 1836, near the present-day city of Elkton. Fort Umpqua was reduced in size in 1846 and finally destroyed in a fire in 1851. By 1855, the beaver were largely trapped out and fur trading had ended along the Umpqua River (Schlesser 1973).

The travel routes of the trappers and early explorers closely paralleled many of Douglas County's current roads. The Native American trails followed the major rivers and streams of the county, including the main Umpqua and the North and South Umpqua rivers (Bakken 1970).

The population of the Umpqua Valley is estimated to have been between 3,000 and 4,000 before the arrival of Euro-American settlers (Schlesser 1973). The Europeans brought diseases that reduced the population of native people. Disease occurrences in Douglas County probably started between 1775 and the 1780s with the first smallpox outbreak. A smallpox or measles outbreak may have affected the far western part of the county in 1824 and 1825. The possibility of malaria in the central portion of the county occurred in 1830 through 1837. Smallpox was documented in the coastal portions of Douglas County in 1837 and 1838. Measles occurred in the western portions of the county in 1847 and 1848 (Loy et al. 2001).

2.2. Settlement Period: Late 1840s to the 1890s

California's Gold Rush was one factor in the early settlement of the county. The new miners demanded goods and services. "The California Gold Rush of 1849 suddenly created a market for Oregon crops and employment for Oregonians" (Loy et al. 2001). In addition, travelers on their way to the gold fields passed through Douglas County. Many of these visitors observed the great potential for farming and raising stock and later returned to Douglas County to take up permanent residence.

The Donation Land Act of 1850 was a further impetus for the settlement of Douglas County. This act specified married couples arriving in Oregon prior to December 1850 could claim 640 acres; a single man could obtain 320 acres. Men arriving after December 1850 were allowed to claim 320 acres if married and 160 acres if single. The patent to the land was secured with a four-year residency. The Donation Land Act was scheduled to end in December of 1853 but an extension increased this deadline to 1855. After 1855, settlers in Oregon were allowed to buy their land claims for $1.25 per acre following a one-year residency (Loy et al. 2001, Patton 1976).

Settlement Period Timeline

1849	California Gold Rush
1850	Donation Land Act
1850s	Indian Wars; Douglas County native people relocated to Grand Ronde Reservation
1860	Daily stages through Douglas County
1861	Flood
1870	*Swan* travels Umpqua River (Gardiner to Roseburg)
1872	Railroad to Roseburg
1873	Coos Bay Wagon Road completed
1887	Railroad connection to California
1893	Flood

In 1840, Reverend Jason Lee inspected the lower Umpqua River and recorded in his journal:

> There is a bar at the mouth of the river, which I judge no ship can pass. The immense hills or mountains, which close in so closely upon the river as to leave it but just room to pass, are covered with dense forests to the water's edge – whole region gloomy and lonesome. (Markers 2000)

Early settlers began arriving in 1847 to make their homes in the valleys of the Umpqua. Settlement increased substantially in the 1850s. In August of 1850, a group of explorers from the Winchester Paine Company first crossed the Umpqua River bar. Nathan Scholfield, a surveyor and cartographer, described in his diary how the schooner was taken to the head of tidewater and of navigation about 30 miles from the ocean. A townsite was named Scottsburg, in honor of Captain Levi Scott who had done much early exploring of the Umpqua Valley. The next day they proceeded on foot to Fort Umpqua on the south bank of the Umpqua River 16 miles above Scottsburg. At this place, they surveyed for a town site on both sides of the Elk River (creek) at its junction, which they called Elkton. Scholfield states, "At and above this place the country is more open, with fine prairies along the rivers extending over to the swelling hills, some of which are sparsely covered with oak" (Winterbotham 1994). Land claims were established by William Slone, Eugene Fiske, and Levi Scott along the north side of the Umpqua River, and these provided the location of the first Scottsburg settlements. Fiske did not return to California on the ship, but rather remained and constructed the first cabin in Scottsburg.

Upon return to San Francisco, members of the Winchester Paine Company advertised lots for sale in Umpqua City, Scottsburg, Elkton, and Winchester, even though the company did not yet have title to the land. Three weeks later, they chartered a vessel, the *Kate Heath*, and returned with about 100 passengers who wanted to settle along the Umpqua River. Word of the fertile Umpqua region spread quickly, attracting people from far away. Even before the large influx of settlers arrived from California, many of the choice claims along the river had been taken.

The *Ortolan* was the second vessel to cross the Umpqua bar in 1850. It included the Rackliff (Rackleff) family from Maine, who selected a claim at Mary's Creek (now Mill Creek) where they built a house and a mill.

The *Bostonian*, captained by George Snelling, foundered while attempting to cross the Umpqua River bar on October 1, 1850. The crew salvaged much of the cargo, which they stored on a beach upstream that they named Gardiner, after the Boston merchant who owned most of the cargo. The Winchester Paine Company immediately set up a logging operation to obtain pilings for the San Francisco waterfront. They used the Gardiner site as their headquarters.

Development of the port of Scottsburg resulted in considerable trade with the mines of northern California and southern Oregon. The freighting business provided most of the revenue for the new ferry business, largely controlled by E.P. Drew.

Large numbers of settlers entered Douglas County between 1849 and 1855. The rich bottomland of the Umpqua Valley was attractive to the immigrants looking for farmland. As the number of settlers increased, the native population of the county decreased. Diseases continued to take a toll, as did the Indian Wars of the 1850s. Douglas County Native Americans were relocated to the Grand Ronde Reservation in the 1850s.

2.2.1. Gold Mining

Gold mining affected the fish habitat of the streams and rivers. The drainage patterns were changed when miners diverted and redirected water flow. The removal of vegetation along the stream banks increased erosion and added sediment to the waterways. Salmon spawning grounds were damaged when the gravels were washed away and the stream bottom was coated with mud.

Mining Techniques

Placer mining was commonly used to recover gold. Gravel deposits were washed away using water from ditches (often hand-dug) and side draws. The runoff was directed through flumes with riffles on the bottom. The gold settled out of the gravel and was collected by the riffles.

Hydraulic mining was essentially placer mining on a large scale. A nozzle or "giant" was used to direct huge amounts of water under pressure at a stream bank. The soil, gravel, and, gold were washed away and captured downstream.

2.2.2. Agriculture

The early settlers brought livestock and plant seeds to use for food and for trade. Settler livestock included cattle, sheep, hogs, and horses. The early farmers sowed cereal crops of oats, wheat, corn, rye, and barley. Gristmills, used to grind the cereal crops into flour or feed, were first established in Douglas County in the 1850s, and within 20 years almost every community in the county had one. Water was diverted from nearby streams and rivers to create power for the gristmills.

The early farmers reduced the indigenous food sources and changed the natural appearance of Douglas County. Hogs ate the acorns in the oak groves. The camas lilies were grazed by livestock and diminished in number when the bottomlands were plowed to plant cereal crops. Deer and elk herds were decreased as the settler population increased. Native people were no longer allowed to burn the fields and hillsides in the fall because the settlers were concerned about their newly constructed log cabins and split rail fences.

2.2.3. Commercial Fishing

In 1877 the *Hera*, a boat with 100 Chinese workers and canning machinery, visited the lower Umpqua River. Local fishermen used gill nets stretched from the shore into the river to capture large numbers of fish as quickly as possible. Six-foot-long sturgeon were unwelcome captives. They were clubbed and thrown back in the river to rot on the shore. Yearly visits by the *Hera* and other cannery boats continued for three decades. The fishermen constructed small dams and breakwaters. These obstructions created eddies and slow-moving water, which were ideal for capturing fish with gill nets.

The canning industry began on the Umpqua in 1875. William Dewar built the first cannery on Winchester Bay. It was later sold to Al Reed and moved to Cannery Island, across from Gardiner. A cannery was also built on the Umpqua River at Reedsport. The best fishing grounds were around Scottsburg. In 1876, the wagon road opened from Elkton over Hancock Mountain on the south side of Elk Creek. People in Elkton now had a closer market route to the railroad in Drain, and this provided an opportunity for fisherman on the Umpqua to get their fish to market (Markers 2000).

2.2.4. Logging

The first wood product export was shipped from the Umpqua estuary in 1850. Trees were felled into the estuary, limbed, and loaded out for piling and spars on sailing ships. The earliest sawmills in Douglas County appeared in the 1850s. The sawmills were water powered, often connected with a gristmill, and scattered throughout the county. An early sawmill was built on the main Umpqua River at Kellogg.

Gartam Rackliff built the first sawmill on the Umpqua River at the mouth of Mill Creek in 1851. It operated until floodwaters washed it away 10 years later. Lumber production by the Gardiner Lumber Company increased to 12 million board feet per year by 1881. Most of that lumber was derived from Smith River, Camp Creek, and Mill Creek. Oxen skidded the logs to both Camp Creek and Mill Creek. Water released from splash dams carried the logs to the Umpqua River, and they were then floated downriver to Gardiner. Loggers built half moon splash dams 30 feet high, which backed up water for three miles (Sims 1998). Obstacles in the channel such as boulders and leaning trees were removed by early loggers to minimize formation of logjams.

Log drives were used on many of the streams and rivers of Douglas County to deliver logs to the mill. The most common form of log drive involved loading the stream channels with logs in the drier part of the year and then waiting for a winter freshet. When the rains came and the logs began to float, the "drive" would begin. Loggers would be positioned along the banks and at times would jump on and ride the logs. They used long poles to push and prod the logs downstream. Stubborn log jams would be blasted apart with dynamite. Log drives were often aided by the use of splash dams (see box). During these log drives, the stream channels were gouged, spawning gravels were removed or muddied, and fish passage may have been affected (Markers 2000).

> Splash Dams
>
> Loggers created splash dams to transport logs to the mills. A dam was built across the stream, creating a reservoir. Logs were placed in the reservoir. The dam timbers were knocked out and the surge of water started the logs on their journey downstream.

2.2.5. Transportation

Improvements in transportation were key to the economic development and population growth within the watershed during the early development period. Initially, there were limited transportation options into and through Douglas County. Ships came into the Umpqua River estuary and delivered goods destined for the gold miners and settlers of southern Oregon and northern California. Goods moved from the estuary inland along the Scottsburg-Camp Stuart Wagon Road. The Coos Bay Wagon Road opened in 1873 allowing stage travel from Roseburg to Coos Bay.

Another form of transportation was attempted in 1870. A group of hopeful investors, Merchants and Farmers Navigation Company, financed a small sternwheel steamer, *Swan*, to navigate the Umpqua and South Umpqua Rivers from Gardiner to Roseburg. The voyage began February 10, 1870, and became a great social event as whole communities lined the riverbanks to watch the *Swan's* progress. Witness accounts recall the slowness of the trip upriver and the swiftness of the downriver journey. The *Swan* safely arrived in Roseburg with the captain, Nicholas Haun, very optimistic about vessel travel on the Umpqua. Captain Haun thought a minor clearing of the channel would allow a ship the size of the *Swan* to pass the rapids except in periods of very low water (Minter 1967).

The US Army Corps of Engineers surveyed the river and reported that it could be made navigable seven months of the year. Congress appropriated money for the removal of obstructions, and W.B. Clarke was awarded the job. Reports are sketchy about how much channel modification was actually carried out. One witness remembered some blasting in the Umpqua River channel near Tyee. In February, 1871, the *Enterprise* began a maiden voyage upriver but because of low water, only reached Sawyers Rapids, downstream of Elkton. The cargo was subsequently dumped at the rapids, and no further attempt was made to navigate the upper Umpqua River (Minter 1967).

River travel on the Umpqua was soon forgotten when the Oregon California Railroad reached Roseburg in 1872. Financial problems stalled the southerly extension of the railroad for 10 years. Those 10 years proved to be an economic boon for Roseburg. Travelers heading south took the train to Roseburg and then rode the stage into California. Travelers poured in and out of Roseburg creating a need for new hotels and warehouses and leading to rapid population growth. Finally, in 1887, the tracks were completed, extending the railroad into California.

The shipping business to and from Gardiner increased in the late 1890s. By 1902 the number of vessels in and out of Gardiner increased to 169 per year, of which 120 were steam-powered. In the mid-1800s, travel from Scottsburg to Ash Valley involved crossing the river by ferry, followed by a full day on horseback, largely over a faint trail made by elk, over a distance of more than 20 miles. The first wagon road to Loon Lake was built about 1878. Initially passable only in summer, the route was improved as a stage line about 1910. The county built a road up Mill Creek from the Umpqua River around 1920. Work on the road was done by a crew of 30 convicts from the Roseburg jail, under the supervision of Jacob Lucksinger, after whom Lucksinger Creek was named. His name was frequently misspelled and the creek is commonly called "Lutsinger" Creek.

<u>1890s to the 1960s Timeline</u>

1900	Fish hatchery established near Glide
1903	Prunes major agricultural crop
1909	Flood
1923	Pacific Highway (Highway 99) completed
1927	Flood
1929	Northwest Turkey Show in Oakland (Douglas County ranked 6th in U.S. turkey production)
1936	Kenneth Ford establishes Roseburg Lumber Company
1945	Returning soldiers (WW II) create a housing and timber boom
1947 - 1956	Eight dams are built in the headwaters of the North Umpqua River as part of the North Umpqua Hydroelectric Project
1950	Flood
1953	Hanna Nickel production
1955	Flood
1962	Columbus Day Storm
1964	Flood
1966	Interstate 5 completed

2.3. Onset of the Modern Era: Early 1900s to the 1960s

2.3.1. Transportation

The first automobiles arrived in Oregon in 1899 and in Douglas County in the early 1900s. After 1910, automobile travel in western Oregon became a key motivation for road construction and improvements in Douglas County. One of the first major road construction projects in the state was the Pacific Highway (Highway 99) running from Portland to Sacramento and Los Angeles. Construction began in 1915 and by 1923 Oregon had a paved highway running the entire length of the state. In Douglas County, the Pacific Highway passed through Drain, Yoncalla, Oakland, Sutherlin, Roseburg, Myrtle Creek, Canyonville, and Galesville for a total length of 97.7 miles.

Other major road construction projects completed before 1925 included routes between Roseburg and Coos Bay, Dixonville to Glide, Drain to Elkton, and Elkton to Reedsport. These roads were built to meet the expanding numbers of vehicles in the state. Registered vehicles in Oregon rose from 48,632 in 1917 to 193,000 in 1924. World War II slowed the road construction projects in the early 1940s, but when the soldiers returned in 1945 road construction accelerated.

The railroad planned to come to the Umpqua River region in 1912. Warren Reed owned about 4,000 acres along the south bank of the river. He began diking and filling the lowlands with river dredgings in order to develop the townsite in preparation for the railroad. With the railroad station and potential power sites and a gravity water supply, the new town of Reedsport developed as a manufacturing seaport town (Markers 2000).

Prior to World War I, roads in the Elliott State Forest were built by the Civilian Conservation Corp, primarily to access fire towers. These access roads included one built between 1933 and 1935 from the vicinity of Lake Creek in Ash Valley to Scholfield Creek. Small amounts of road building occurred near Ash Valley and Mill Creek in 1945. The first large increase in road building began in 1955, in conjunction with timber sales (Biosystems 2003). Roads constructed after the Columbus Day storm of 1962 were generally below prior standards, with little engineering. Construction involved extensive side-cast, no surfacing or ditching, and a minimal 14-foot width. After 1966, some of the existing roads in the state forest were upgraded, including some road surfacing, ditching, and upgrading of bridges from log to concrete.

2.3.2. Logging

Logging expanded in Douglas County in the early 1900s for two main reasons: the invention of the steam donkey engine and the use of logging railroads. The steam donkey engine was a power-driven spool with a rope or cable attached for yarding logs. It could be mounted on a log sled and yard itself, as well as logs, up and down extremely steep slopes. The logs were yarded with the steam donkey engine and then hauled to the sawmill on logging railroads. In Douglas County, more than 150 miles of logging railroads were used between 1905 and 1947.

Splash dams and log drives were used in Douglas County into the 1940s (Markers 2000). Log drives were phased out as more roads were built into the woods. In 1957, log drives in Oregon were made illegal; sport fishermen led the campaign against this form of log transport (Beckham 1990). Waterways used to transport logs had been scoured to bedrock, widened, and channelized in many areas. The large woody debris had been removed and fish holding pools lost. As more logging roads were built in the 1950s, fish habitat was further affected. Landslides associated with logging roads added fine sediment to the waterways. Logging next to streams removed riparian vegetation, and the possibilities for elevated summer water temperatures and stream bank erosion were increased. Fewer old-growth conifers were available as a source of large woody debris in many Douglas County streams (Oregon Department of Fish and Wildlife 1995).

Following World War II, larger sawmills with increased capacity began to operate just in time to take advantage of the housing boom. Kenneth Ford established Roseburg Lumber Company in 1936 by taking over the operation of an existing sawmill in Roseburg. He built his own mill at Dillard in 1944.

Because of the common occurrence of very extensive log jams along some coastal waterways, the Oregon Game Commission[8] required loggers to prevent woody debris from entering streams, beginning in the 1930s. The practice of removing logs from stream channels gained emphasis when caterpillar tractors became available for logging. Stream cleaning activities were documented within the boundaries of Elliott State Forest beginning in 1956. This practice continued into the mid-1980s.

Woody debris removal was mainly conducted two ways. First, the Oregon Game Commission employed a "stream improvement" crew that drove throughout the region, identifying "obstructions" to fish passage. These were generally log jams. The crew then contacted landowners about debris removal. This program was active from about 1956 to 1976. The second tactic was the inclusion of logging debris removal in timber sale contracts on the state forest. This practice began as early as 1962, and continued until at least the mid-1980s (Biosystems 2003). Both kinds of stream cleaning often involved driving bulldozers up and down the stream channel.

2.3.3. Fisheries

Douglas County's first fish hatchery was located northeast of Glide on the North Umpqua River near the mouth of Hatchery Creek. Built in 1900, the hatchery had an initial capacity for one million eggs. In its first year of operations, 200,000 salmon eggs were harvested. Another 600,000 chinook salmon eggs were brought in from a federal hatchery on the Little White Salmon River. These eggs produced approximately 700,000 fry that were released in the Umpqua River system. In 1901, a hatchery was constructed at the mouth of Steamboat Creek. A hatchery on Little Mill Creek at Scottsburg began operation in 1927 and operated for eight years (Bakken 1970, Markers 2000). The single remaining hatchery in Douglas County was established in 1937 northeast of Glide on Rock Creek.

During the first decades of the 20th Century, large numbers of fish eggs were taken from the Umpqua River system. "In 1910 the State took four million chinook eggs from the Umpqua; the harvest increased to seven million eggs in 1914. Over the next five years, the State collected and shipped an estimated 24 million more eggs to hatcheries on other river systems" (Beckham 1986, p. 208). The early hatcheries were focused on increasing salmon production for harvest.

2.3.4. Agriculture

Crop irrigation was introduced to Douglas County farmers in 1928. J.C. Leady, who was the Douglas County Agent (predecessor of County Extension Agent), gave a demonstration of ditch blasting in 1928. The dimensions of the resulting ditch were four feet deep by six feet wide. The County Agent's report recommended this method of ditch creation in the lowlands adjoining the Umpqua and Smith Rivers (Leedy 1929).

In 1935, Douglas County Agent J. Roland Parker applied gas and electric pumps to crop irrigation. He stated that, "the lift necessary to place irrigation water upon most land, laying

[8] The Oregon Game Commission and the Oregon Fish Commission merged in 1975 to become the Oregon Department of Fish and Wildlife.

along the numerous streams throughout the county, ranges from 15 to 30 feet. Only in exceptional cases will a higher lift be necessary" (Parker 1936, p.15). Parker predicted that applications for water rights and installation of irrigation systems would double in 1936.

The appropriation of water rights for agriculture left less water in the streams for fish, especially during the critical months of late summer and early fall. Oregon water law follows the "prior appropriation" doctrine that is often described as "first come, first served." The first person to obtain a water right on a stream will be the last user shut off when the streamflows are low.[9]

2.4. Modern Era: 1970s to the Present

2.4.1. Logging

The Oregon Forest Practices Act became effective in 1972. Standards were set for road construction and maintenance, reforestation, and maintenance of streamside buffer strips during logging operations. New rules were added in 1974 to prevent soil, silt, and petroleum products from entering streams. Starting in 1978, forest operators were required to give a 15-day notification prior to a forest operation. New rules were also added to control stream channel changes. In 1987, riparian protection was increased by specifying the numbers and sizes of trees to be left in riparian areas. New rules were added in 1994 to help to create the desired future condition of mature streamside stands. Landowner incentives were provided for stream enhancement and for hardwood conversion to conifer along certain streams (Oregon Department of Forestry 2005).

1970 to the Present Timeline	
1971	Flood
1972	Clean Water Act
1972	Oregon Forest Practices Act
1973	Endangered Species Act
1974 1981 1983	Floods
1994	Northwest Forest Plan results in reduced federal log supplies
1996	Flood
1999	International Paper Mill in Gardiner closed

In the 1970s, Roseburg Lumber's plant in Dillard became the world's largest wood products manufacturing facility. Key to the development of this facility was the availability of federal timber from both the US Forest Service and the Bureau of Land Management. A housing slump in the early 1980s and a decline in federal timber in the 1990s resulted in the closure or reduction in size of many other manufacturing companies (Oregon Labor Market Information System 2002). In 2002 and 2003, increased wood product imports from foreign producers such as Canada and New Zealand resulted in a surplus of timber-based products in the US. This caused a depression in the local forest products manufacturing industry. In April, 2003, Roseburg Forest Products, the largest private employer in Douglas County, laid off approximately 400 workers.[10]

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[9] Contact the Douglas County Watermaster's office for more information on water rights.
[10] This information is based on conversations between Nancy Geyer, Society of American Foresters president and president-elect Jake Gibbs and Eric Geyer, and Dick Beeby of Roseburg Forest Products.

Because Elliott State Forest comprises a sizeable component of the watershed, its management history is important. Past management of the forest can be described in four phases, as outlined by Biosystems (2003). The forest was established in 1929 and its management was mainly custodial until the 1940s. During that custodial period, initial timber inventories were conducted and fire towers and some roads were built. Forest management procedures developed during the second phase, from World War II to the Columbus Day Storm of 1962. The timber sale program was developed and road construction accelerated. The Columbus Day storm triggered the third phase of Elliott State Forest management. The timber sale program was accelerated to salvage blowdown from the storm, and the road building program was completed. The fourth, and current, phase began with the listing in 1990 of the northern spotted owl as threatened under the federal Endangered Species Act and the development of the 1995 Habitat Conservation Plan.

2.4.2. Dam Construction

During the late 1960s through 1980s several dams were constructed in Douglas County. Information on the largest ones is presented in Table 2.1.

Table 2.1. Name, location, and storage capacity of Umpqua Basin dams built since 1960.

Year Completed	Dam Name	Creek	Storage Capacity (acre feet)
1967	Plat I Dam	Sutherlin	870
1971	Cooper Creek Dam	Cooper	3,900
1980	Berry Creek Dam	Berry	11,250
1985	Galesville Dam	Cow	42,225

2.4.3. Tourism

A rapid expansion of tourism in Douglas County followed World War II. The improving economy increased the standard of living and mobility of many Americans. The Umpqua Valley offered scenic attractions and good access roads. Interstate 5 and the connecting State Highways 38, 42, and 138 provided access to Umpqua Valley's excellent tourist areas. Tourist destination points included Crater Lake National Park, Wildlife Safari, Salmon Harbor, and the Oregon Dunes National Recreation Area. Tourism has been a growing industry in Douglas County in recent years.

2.5. Douglas County Population Growth

Figure 2.1 shows population growth data for Douglas County during the settlement period (1840s through 1890s), the onset of the modern era (1900 through 1960s), and the modern era (1970s to the present). Population growth has occurred in two phases. Slow growth occurred during the period 1860 to 1940. Subsequently, growth accelerated, slowing in the 1980s to a pace equivalent to that of pre-war years.

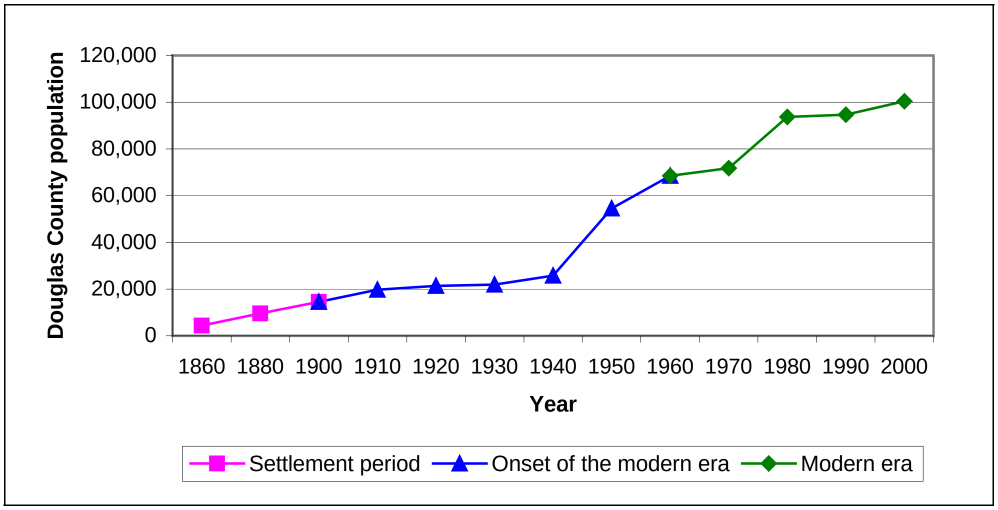


Figure 2.1 Population growth in Douglas County from 1860 through 2000.

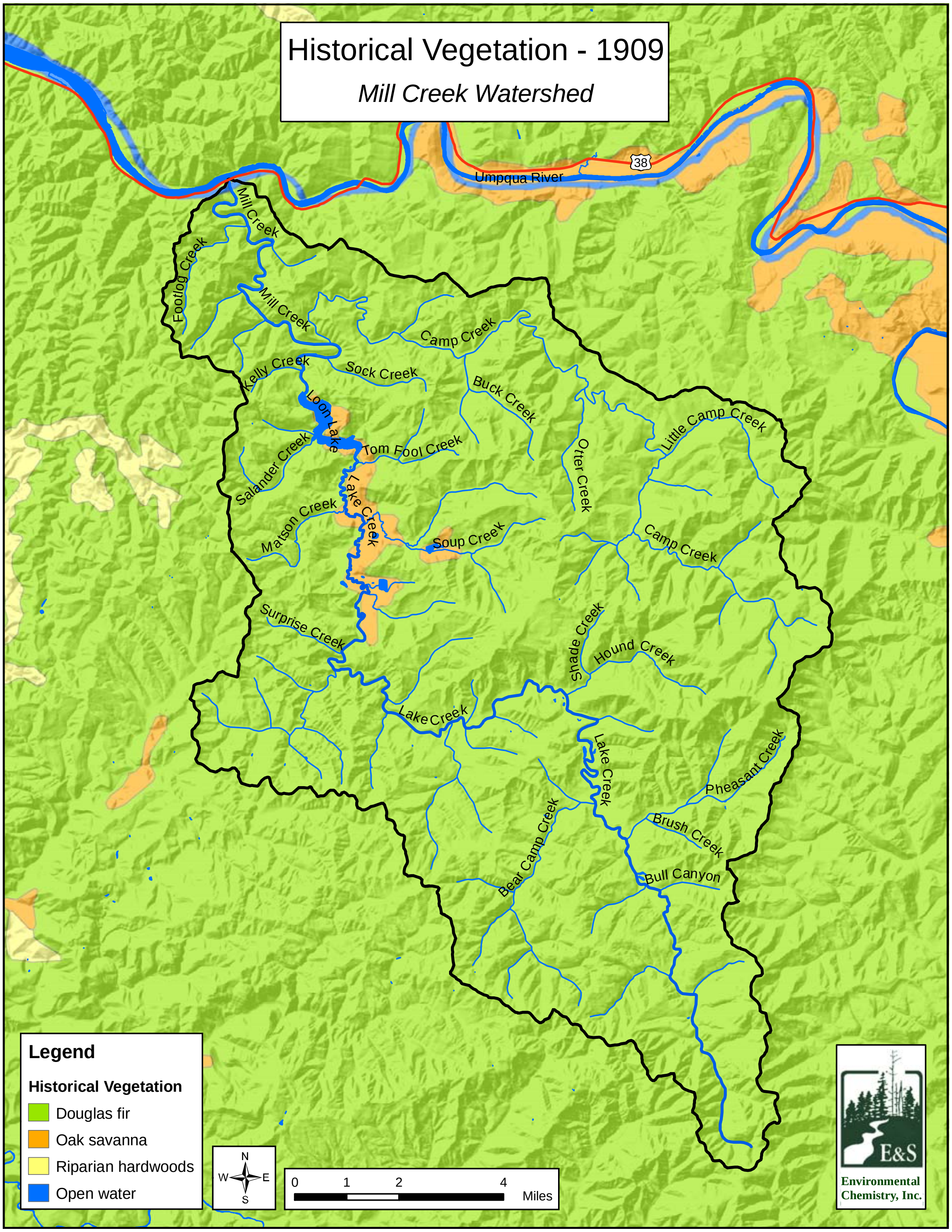
2.6. Historical Changes in Vegetation

Forest vegetation was somewhat different in pre-settlement times than it is today. Much of the forest vegetation in Elliott State Forest was initiated following a large fire in 1868 (Morris 1934). Historically, fire has played an important role in the watershed. Large stand-replacement fires caused by lightning and humans created a mosaic of age classes, even before any extensive logging began. However, historically old-growth forest was much more prevalent than it is today. Based on the current observed relationship between age class and tree diameter and forest measurements made in the 1878 to 1893 land surveys, Biosystems (2003) concluded that the trees consumed in the 1868 fire were mostly about 185 years old. Although the cause of the fire is not known, it has been established that Native Americans in the Umpqua Basin commonly used fire to improve browse.

Data are available with which to evaluate vegetation patterns in 1909 within the watershed (Map 2.1). Most upland areas were covered with coniferous forests dominated by Douglas-fir. Oak savanna vegetation occurred in some areas along Lake Creek and the lower section of Soup Creek (Map 2.1).

2.7. Major Natural Disturbances

The flood of 1961 was the largest flood on record in western Oregon, and may have exceeded a 100-year event (Taylor and Hatton 1999). Other known floods of great magnitude occurred in 1890, 1955/1956, and 1964 (Weyerhaeuser 1998, Taylor and Hatten 1999). The flood of 1964 yielded the highest recorded river levels on the Umpqua River.



Map 2.1. Distribution of major vegetation types within the Mill Creek Watershed in 1909.

Extreme windstorms occurred in the Coast Range in 1880, 1951, and 1962 (Ruth and Yoder 1953, Biosystems 2003). These storms toppled trees throughout extensive areas, created canopy openings, and altered vegetation succession. During the Columbus Day storm of 1962, about 100 million board feet of timber blew down within Elliott State Forest (ODF 1993), mostly in the western half of the forest. This storm was followed by extensive road building to access downed timber for salvage harvest. Other windstorms severe enough to uproot trees along clearcut edges and uncut riparian buffer areas occurred in 1971, 1973, 1981, 1983, and 2002 (Oregon Climate Service 2003).

3. Current Conditions

This chapter explores the current conditions of the Mill Creek Watershed in terms of in-stream, riparian, and wetland habitats, water quality, water quantity, and fish populations. Background information for this chapter was compiled from the following sources: the *Oregon Watershed Assessment Manual* (Watershed Professionals Network 1999), the *Watershed Stewardship Handbook* (Oregon State University Extension Service 2002), and the *Fish Passage Short Course Handbook* (Oregon State University Extension Service 2000). Additional information and data are from the following groups' documents, websites, and specialists: the Bureau of Land Management (BLM), the Oregon Department of Environmental Quality (ODEQ), the Oregon Department of Fish and Wildlife (ODFW), the Douglas Soil and Water Conservation District, the US Geological Survey (USGS), and the Oregon Water Resources Department (OWRD).

Key Questions

- In general, how are the streams, riparian areas, and wetlands within the Mill Creek Watershed functioning?
- How is water quality in terms of temperature, surface water pH, dissolved oxygen, and other parameters?
- What are the consumptive uses and in-stream water rights in the watershed, and what are their impacts on water availability?
- What are the flood trends within the watershed?
- What are the distribution and abundance of various fish species, what are the fish habitat conditions, and where are fish passage barriers?

3.1. Stream Function

3.1.1. Pre-Settlement Stream Channel Conditions

Stream channel conditions in the watershed prior to Euro-American settlement were notably different than they are today. Throughout the Oregon Coast Range, including the Mill Creek Watershed, stream channel morphology has been greatly simplified, especially in lowland areas. Over the past 150 years, the availability of gravel, wood, riparian forest, floodplains, backwater areas, and pool habitat has declined in response to a reduction in channel complexity.

Stream channels in the lowlands have likely experienced the greatest change. Prior to Euro-American settlement, the main channel was likely more sinuous, with many braided channels, secondary channels, oxbows, and backwaters. Riparian zones in many areas were heavily wooded with a diversity of species, and many large trees were present. Loss of late-successional[11] riparian vegetation throughout the watershed has resulted in a reduction in woody debris and loss of in-stream channel complexity in the lowlands and the estuary.

Channel structure was also more complex in the uplands prior to Euro-American settlement. There were more pools, pools were deeper, and large logs and woody debris jams were common

[11] Late-successional forest is generally characterized by the presence of old-growth trees and understory trees of varying heights, standing snags, decomposing logs, and a diversity of shrub and wildflower species.

in the stream channel. Streamside vegetation included a greater diversity of species and age classes, including large conifers which provided large woody debris to the stream channel.

3.1.2. Stream Morphology

3.1.2.1. Stream Morphology and Sediment Transport Processes

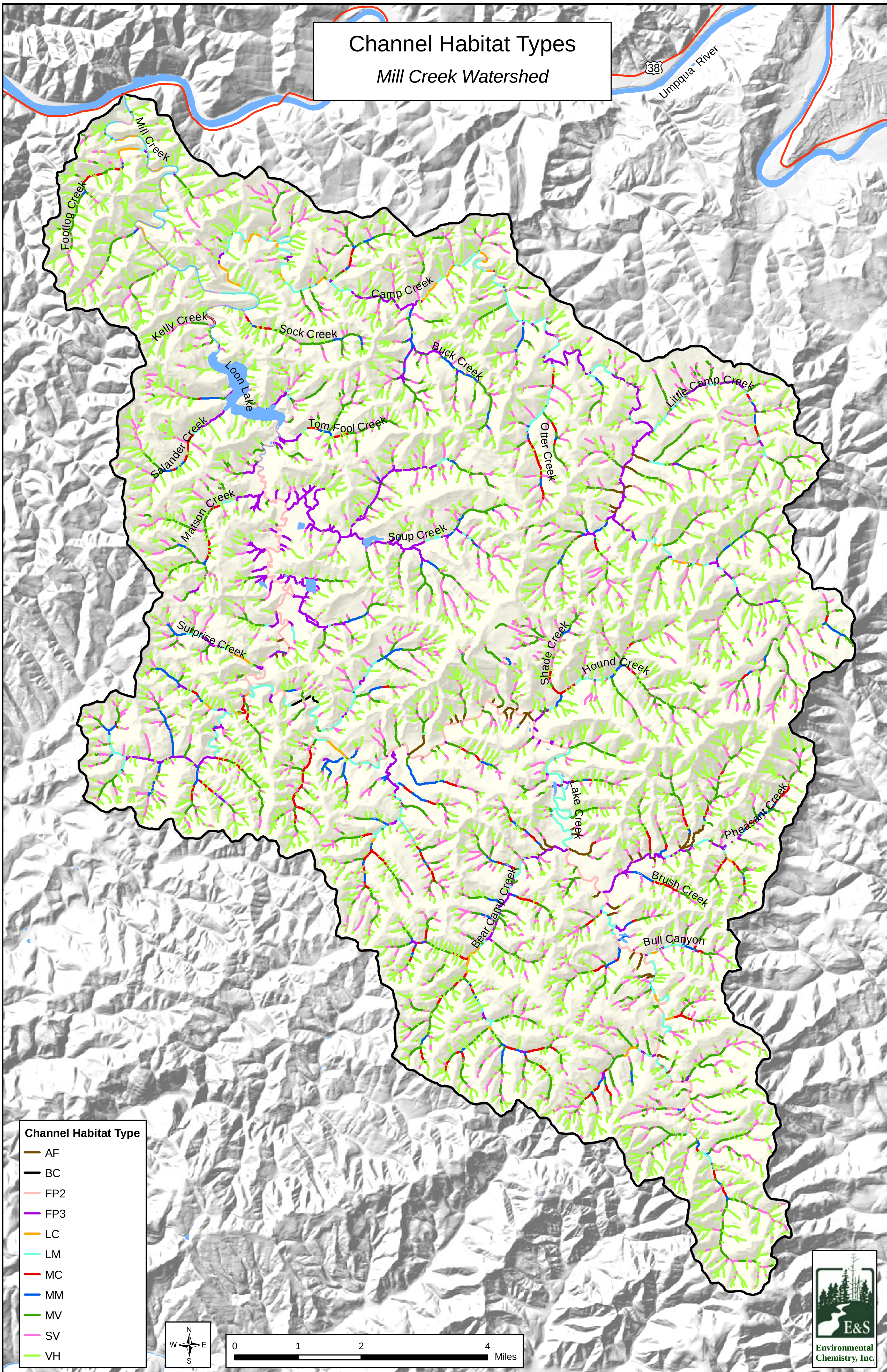
This section discusses the channel morphology of the Mill Creek Watershed. Information in this section has been summarized from the following documents: *Going with the Flow: Understanding Effects of Land Management on Rivers, Floods, and Floodplains* (Ellis-Sugai and Godwin 2002), *South Umpqua River Watershed Assessment and Action Plan* (Geyer 2003), *Elliott State Forest Watershed Analysis* (Biosystems 2003), and *Upper Umpqua River Watershed Analysis* (BLM 2002).

The Oregon Watershed Enhancement Board (OWEB) developed a system for classifying streams based on physical attributes that are important to the ecology of streams. This system, called the channel habitat type system, is based on features of stream gradient, valley shape, channel pattern, channel confinement, stream size, position in drainage, and substrate. Segregating stream segments into channel habitat types (e.g., low-gradient confined, very steep headwater, alluvial fan) based on stream morphology provides an overall indication of the distribution of various stream and associated riparian habitat characteristics throughout the watershed. Table 3.1 lists the channel habitat types that are found in the Mill Creek Watershed, specific stream examples, and possible restoration opportunities as described by OWEB. Locations are shown on Map 3.1.

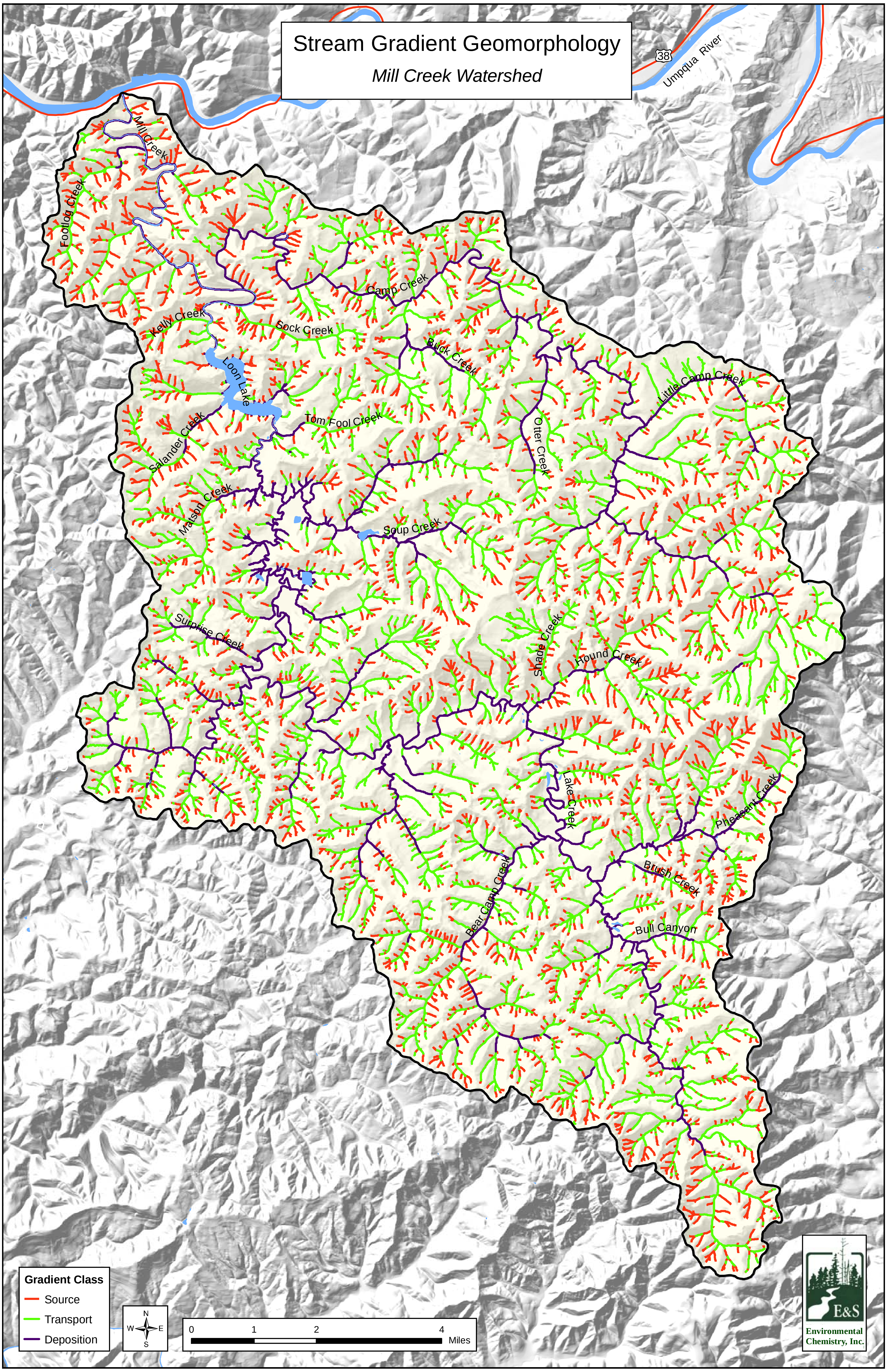
Streams in steep headwaters (often 20% slope or greater) are “source” streams, adding sediment and wood to the stream system. They have high-energy flows and no floodplain, and are prone to landslides. “Transport” streams have medium gradients, often between 3% and 20% slopes. They have small meanders and little or no floodplain. They carry sediment and wood during times of high flows and store them during low flows. “Depositional” streams lie in the downstream reaches of watersheds. The low gradients, large floodplains, and meanders of these streams dissipate the energy of the water current. As a result, sediment and wood settles out and is stored in these reaches of the streams for long periods. Depositional streams are often the most sensitive to changes in the watershed. Map 3.2 and Table 3.2 show the distribution and percent of streams within each gradient class.

Many of the tributary streams of Mill Creek and Lake Creek within the watershed are mature streams that have incised the landscape and now have a moderate to low stream gradient. There are also many headwater reaches that have steep gradients. The steeper gradient segments are sediment and wood source streams and are above the anadromous fish zone. Projects to improve future shade conditions and the development of large conifers in the riparian zone may help improve those stream reaches.

Streams in the middle elevations of the watershed are often moderate in gradient and confinement. These reaches function as transport streams, both storing and delivering sediment and wood downstream. These streams also are located in areas where the overall landscape is



Map 3.1. Channel habitat type (CHT) distributions within the Mill Creek Watershed. See Table 3.1 for CHT code descriptions.



Map 3.2. Stream gradient classes in the Mill Creek Watershed.

Table 3.1. Channel habitat types and examples within the Mill Creek Watershed.

Channel Habitat Type	Stream Miles (Percent)	Example within Watershed	Restoration Opportunities[1]
Alluvial fan (AF)	8.2 (0.9%)	Middle reaches of tributaries to Little Camp Creek	Alluvial fans are generally not well suited to restoration because they are highly active channels, and high sediment loads limit efforts to increase channel complexity.
Bedrock canyon (BC)	0.5 (0.1%)	Lake Creek upstream of confluence of Surprise Creek	These channels are unresponsive, and usually poor sites for restoration or enhancement projects.
Low gradient medium floodplain (FP2)	21.6 (2.3%)	Lake Creek upstream of Loon Lake	Because of the migrating nature of these channels, restoration opportunities such as shade and bank stability projects on small side channels may be the best option for improvement.
Low gradient small floodplain (FP3)	54.1 (5.7%)	Camp Creek at confluence of Little Camp Creek	Because of the migrating nature of these channels, restoration efforts may be challenging. However, because of their small size, projects at some locations would be successful.
Low gradient confined (LC)	9.6 (1.0%)	Camp Creek at confluence of Mill Creek	Though these channels are not often responsive, riparian planting projects may improve water temperature and erosion issues.
Low gradient moderately confined (LM)	36.1 (3.8%)	Mill Creek downstream of confluence of Sock Creek	These channels can be very responsive to restoration efforts. Adding large wood to channels in forested areas may improve fish habitat, while stabilizing stream banks in non-forested areas may decrease erosion.
Moderate gradient confined (MC)	21.1 (2.2%)	Shade Creek middle reaches	Though these channels are not often responsive, riparian planting projects may improve water temperature and erosion issues.
Moderate gradient moderately confined (MM)	25.1 (2.6%)	Buck Creek middle reaches	These channels are among the most responsive to restoration projects. Adding large wood to channels in forested areas may improve fish habitat, while stabilizing stream banks in non-forested areas may decrease erosion.
Moderately steep narrow valley (MV)	120.0 (12.6%)	Matson Creek middle reaches	Though these channels are not often responsive, riparian planting projects may improve water temperature and erosion issues.
Steep narrow valley (SV)	188.8 (19.9%)	Little Camp Creek upper reaches	Though these channels are not often highly responsive, the establishment of riparian vegetation along stable banks may address water temperature problems.
Very steep headwater (VH)	463.9 (48.9%)	Soup Creek headwater reaches	Though these channels are not often highly responsive, the establishment of riparian vegetation along stable banks may address water temperature problems.
TOTAL	949.0 (100.0%)		

[1] From WPN 1999

Table 3.2. Mill Creek Watershed stream miles within each gradient class.		
Gradient Class	**Stream Miles in the Watershed**	**Percent of Total**
Source	417.2	43.9
Transport	391.6	41.2
Deposition	141.9	14.9
Total	950.7	100.0

fairly steep, increasing debris flow hazards.[12] Adding large wood, stabilizing banks by planting trees, and improving shade in these reaches may be helpful for the stream system.

The lower section of Lake Creek has an extensive floodplain which is most developed within about five miles of Loon Lake. These broad, low-gradient reaches lend themselves to complex aquatic habitat with large wood, coarse sediment, pools, bars, and side channels. However, these reaches are difficult to enhance, as the meandering nature of the streams makes bank stabilization projects likely to fail. Therefore, special care should be given to project selection and planning.

Large wood such as logs, large branches, and root wads are the primary determinant of channel form in small streams (Bilby and Bisson 1998), and play an important role in the formation of side-channel areas along larger streams. Wood in the stream channel largely determines gravel capture and retention, pool size and frequency, and the occurrence of cold water refuges. The riparian forest is the most important source of large wood. Large trees in headwall[13] areas may also play an important role in large wood transport to the stream through natural landslides (Biosystems 2003).

3.1.2.2. Stream Habitat Surveys

Since 1992, ODFW has conducted stream habitat surveys throughout the Umpqua Basin. The purpose of these surveys has been to gather basic data about Umpqua Basin streams, and to compare current stream conditions to the habitat needs of salmonids and other fish. In recent years, 39.3 stream miles were surveyed in the Mill Creek Watershed. Each stream was divided into reaches based on channel and riparian habitat characteristics for a total of 23 reaches averaging 1.7 miles in length. Stream habitat survey data are only available for the Mill Creek and Camp Creek drainage systems. There are no data available for Lake Creek or any of its tributaries.

For each stream, surveyors measured a variety of pre-determined habitat variables. Since a primary purpose of the stream habitat surveys was to evaluate the stream's current condition with regard to fish habitat needs, ODFW developed habitat benchmarks to interpret stream measurements that pertain to fish habitat. This assessment includes nine measurements that have been grouped into four categories: pools, riffles, riparian areas, and large in-stream woody material. Table 3.3 provides the habitat measurements included in each category.

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[12] Debris flows are rapidly-moving landslides that enter a stream channel transporting a large volume of water, sediment, rocks, boulders, and logs. Debris flows generally scour the streambed to bedrock, depositing the transported material at the end of their pathways.

[13] A headwall is a very steep concave slope at the top of a stream channel, generally near the ridgeline.

Table 3.3. Stream habitat survey benchmarks.

Habitat Characteristic	Measurements Used for Rating Habitat Quality	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 < 12m (39 ft) b) For a stream with width > 12m	1. large diameter conifers 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 wood pieces**[1] per 100m (328 ft) 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

[1] Minimum size is 6-inch diameter by 10-foot length or a root wad that has a diameter of 6 inches or more.

Stream habitat benchmarks rate the values of the components of the survey in four categories: excellent, good, fair, and poor. For this watershed assessment, “excellent” and “good” have been combined into one “good” category. Table 3.3 indicates the parameters used to develop the benchmark values.

For this assessment, we simplified the stream data by rating the habitat categories by their most limiting factors. For example, there are two components that determine the “pool” rating: percent area in pools and residual pool depth. If a reach of a small stream had 50% of its area in pools, then according to Table 3.3, it would be classified as “good” for “percent area in pools.” If average pool depth on the same reach was 0.4 meters in depth, this reach would rate “fair” in “residual pool depth.” This reach’s classification for the “pool” habitat category would therefore be “fair.” Most habitat categories need a combination of components to be effective, and therefore are rated by the most limiting factor, which is “pool depth” in this example.

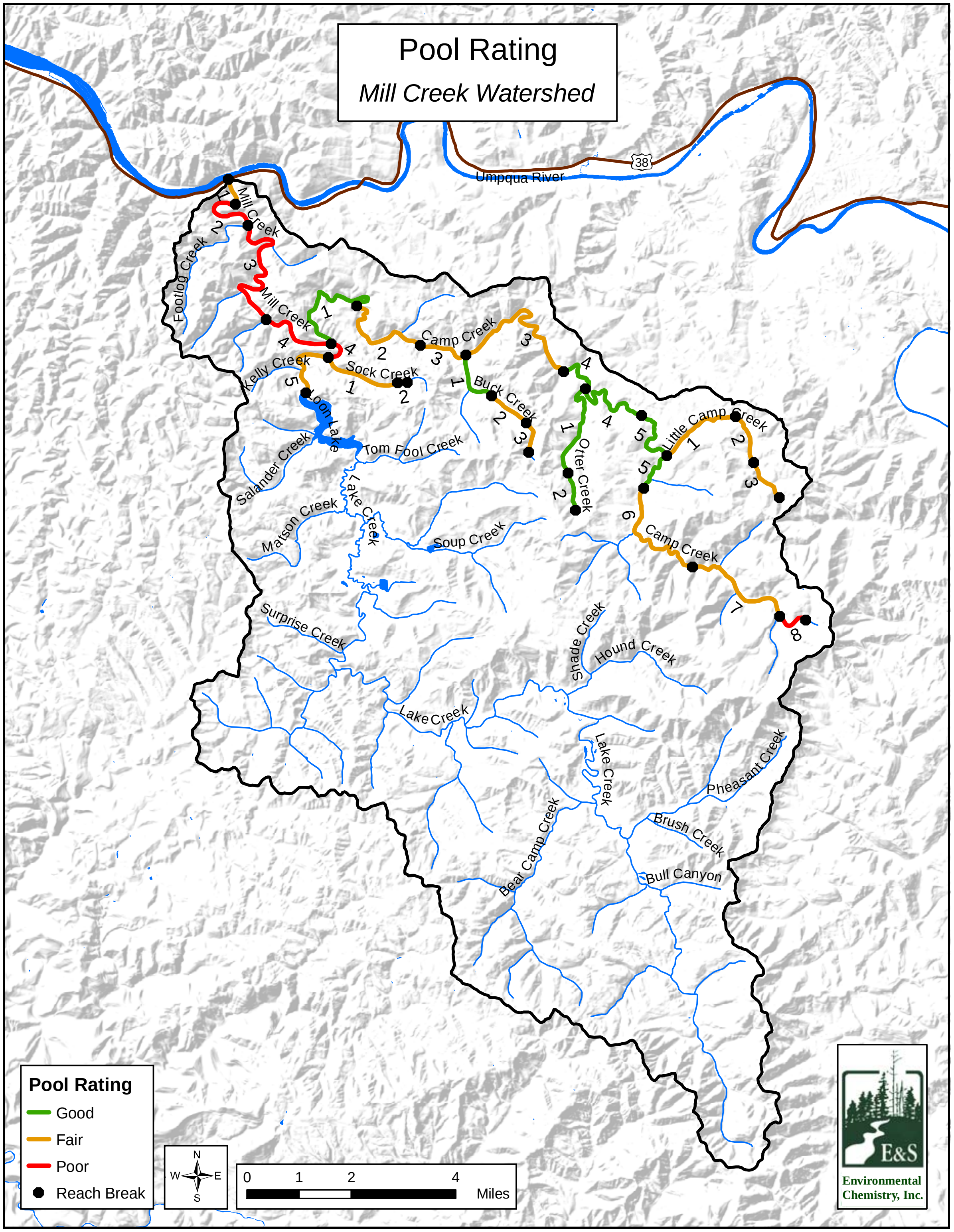
The benchmark ratings should not be viewed as performance values, but as guides for interpretation and further investigation. Streams are dynamic systems that change over time, and the stream habitat surveys provide only a single picture of the stream at one particular point in time. For each habitat variable, historical and current events must be considered to understand the significance of the benchmark rating. Take, for example, a stream reach with a poor rating for in-stream large wood. Closer investigation could determine that this stream is located in an area that historically never had any large riparian trees. Failing to meet the benchmark for in-stream large wood might not be a concern because low in-stream wood levels might be the stream’s normal condition.

3.1.2.3. Overview of Conditions

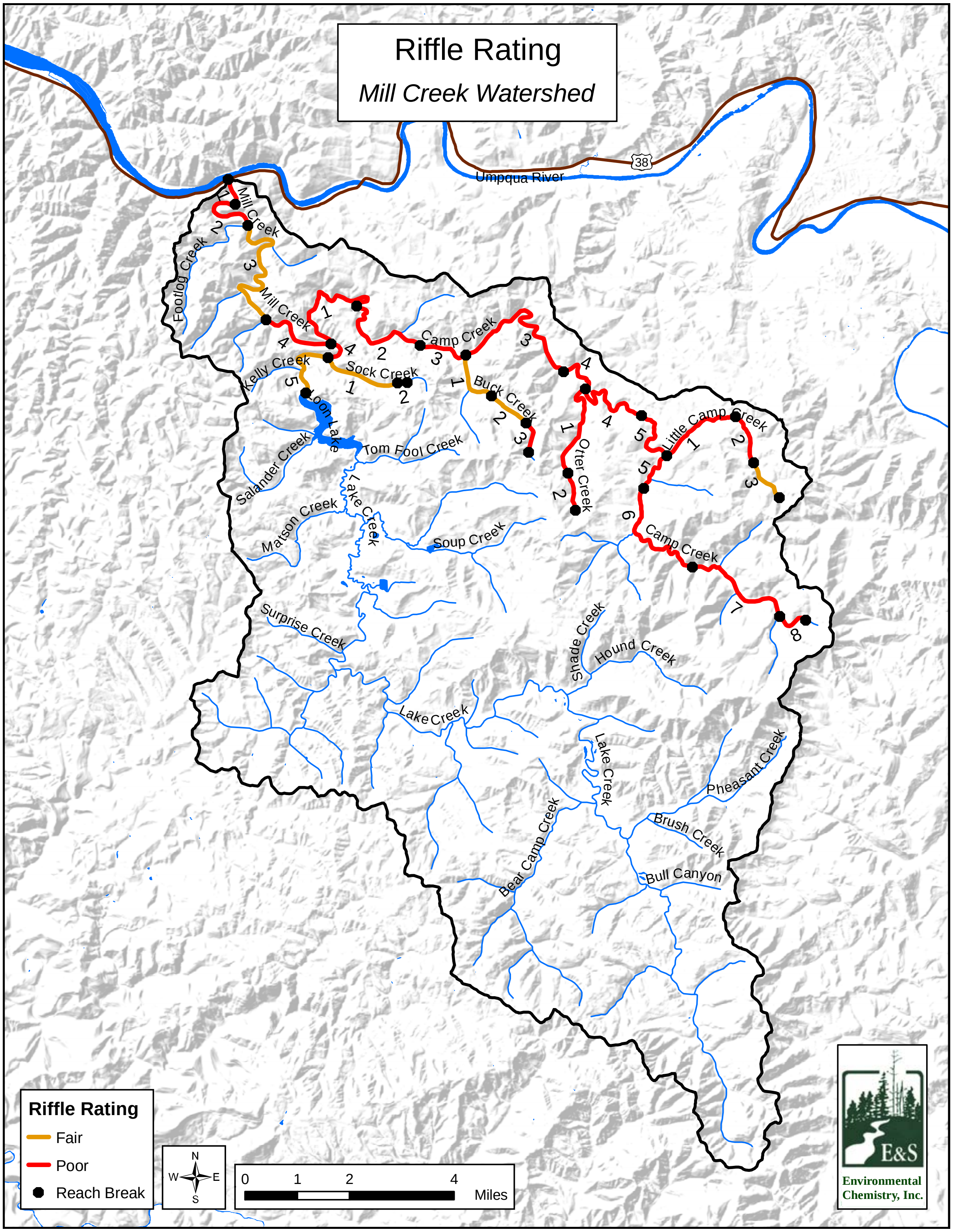
Summary results of ODFW stream habitat surveys are presented in Maps 3.3 through 3.6 and Table 3.4. Based on OWEB methods, we look for patterns in habitat conditions relative to benchmark values both within the whole watershed and along the stream length. The objective is to provide a broad view of the stream system and help determine issues that might be of greatest concern.

Of the 23 surveyed stream reaches, only three rate as fair or good in all four categories (13.0%). More than two-thirds (69.6%) of all surveyed streams were rated as poor for riffle conditions and 47.8% as poor for large woody debris conditions. There were no reaches rated as good for riffle conditions, and only 4.3% as good for riparian conditions (Table 3.4).

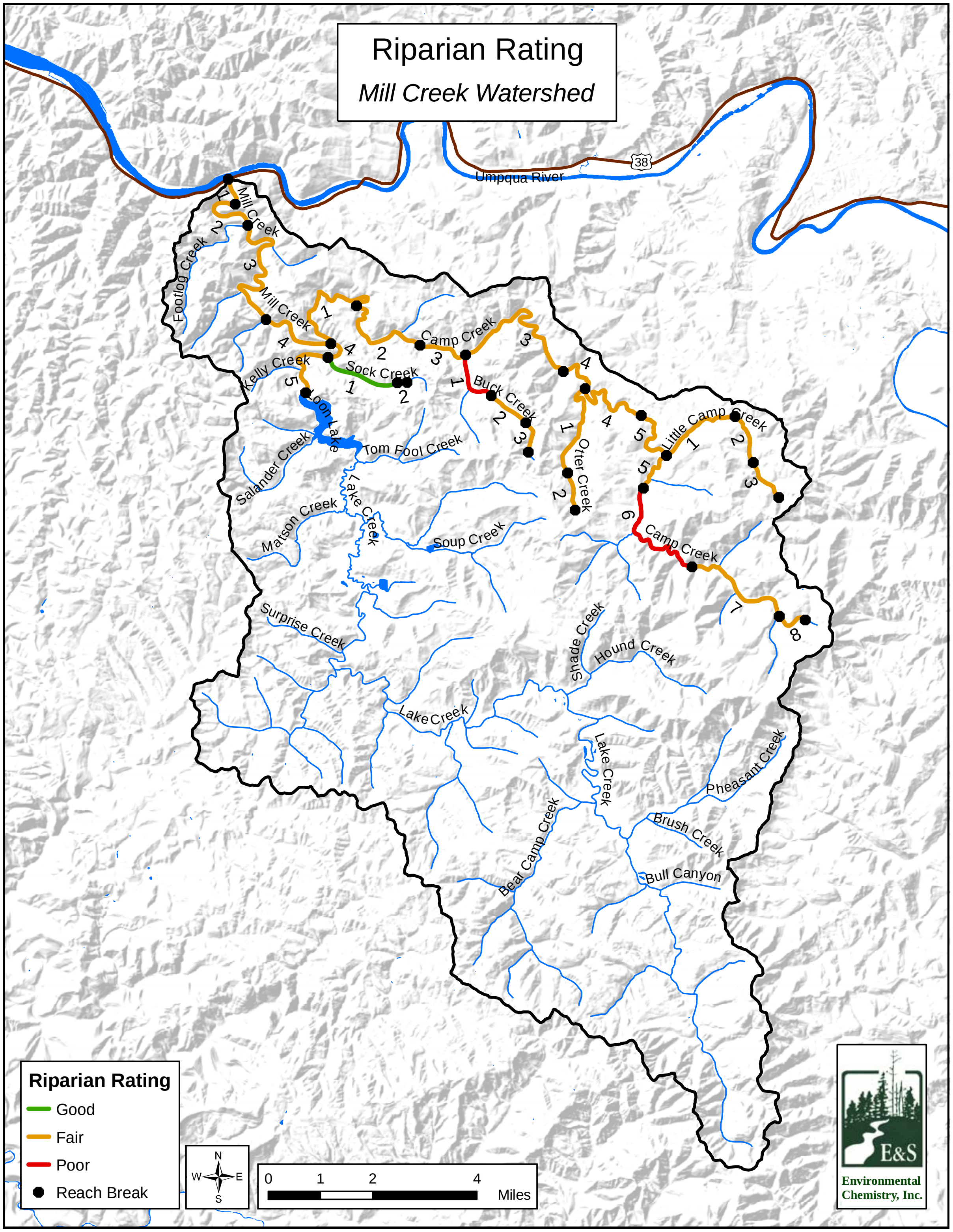
The pool rating was generally poor in the lower reaches of Mill Creek, but somewhat better further upstream on Camp Creek and its tributaries (Map 3.3). Riffle ratings were primarily poor throughout the surveyed reaches, but they were slightly better in Mill Creek than they were in the Camp Creek drainage (Map 3.4). Riparian conditions were rated as fair in 83% of the surveyed reaches. The only reach that exhibited good riparian conditions was Sock Creek, reach 1 (Map 3.5). Large woody debris conditions were primarily poor, including all of the Mill Creek sites and most of the Camp Creek sites. Good large woody debris conditions were found in the uppermost reaches of several tributary systems (Map 3.6).



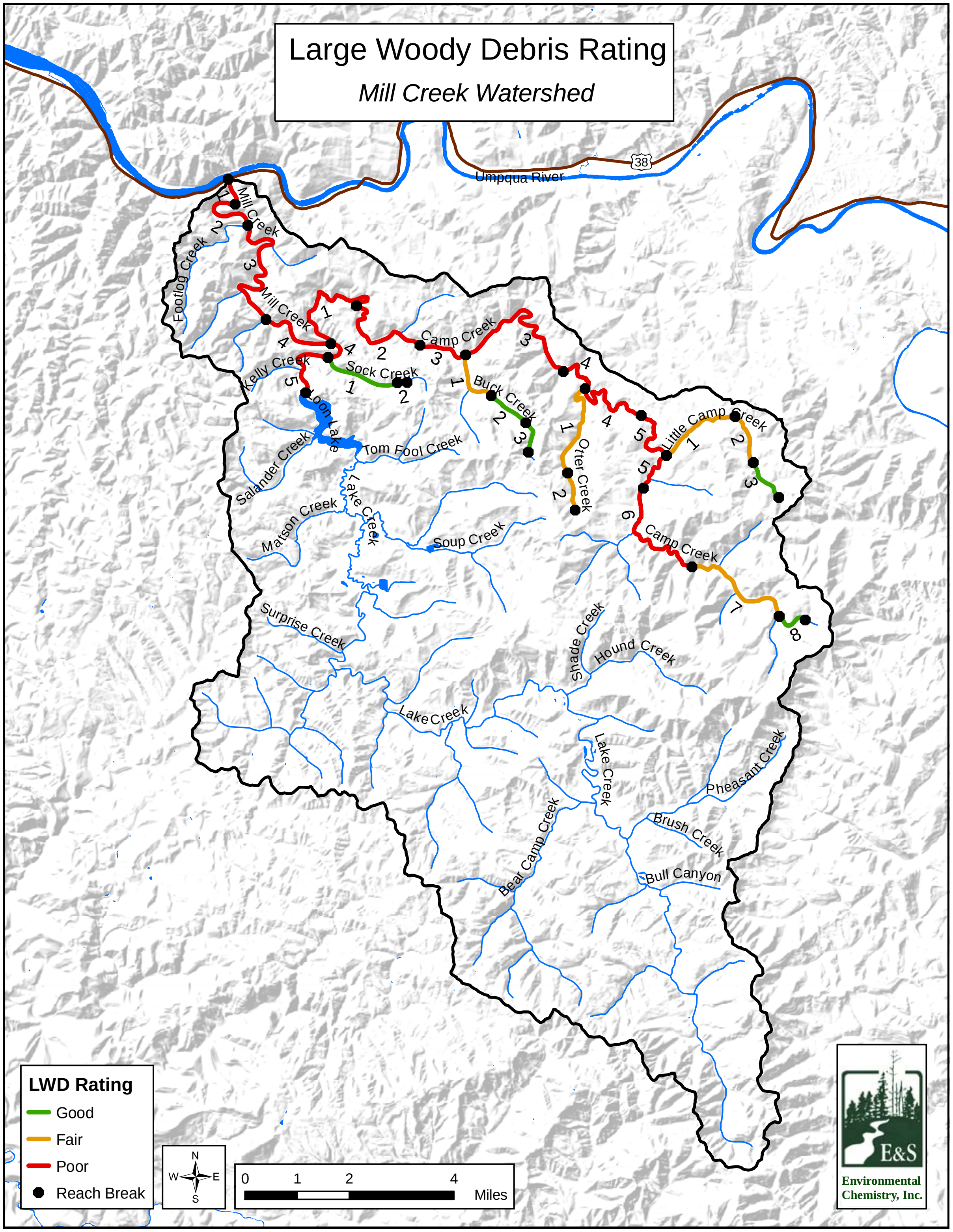
Map 3.3. Overall pool rating of Mill Creek Watershed stream reaches surveyed by ODFW, based on results for percent area in pools and residual pool depth. Numbers correspond to the reach numbers in Table 3.4. Some reaches are intersected by tributary junctions. In such cases, the reach number is shown both upstream and downstream of the tributary junction.



Map 3.4. Overall riffle rating of Mill Creek Watershed stream reaches surveyed by ODFW, based on results for percent gravel and percent fine sediments in riffles and also on riffle width to depth ratio. Numbers correspond to the reach numbers in Table 3.4.



Map 3.5. Overall riparian rating of Mill Creek Watershed stream reaches surveyed by ODFW, based on dominant riparian species (hardwood or conifer) and percent of the creek that is shaded by riparian vegetation. Numbers correspond to the reach numbers in Table 3.4.



Map 3.6. Overall in-stream large wood condition rating of Mill Creek Watershed streams surveyed by ODFW, based on number of wood pieces and volume of wood per unit stream length. Numbers correspond to the reach numbers in Table 3.4.

Table 3.4. Mill Creek Watershed stream habitat conditions (see Map 3.3 for stream locations).

Stream	Reach	Pools	Riffles	Riparian Rating	Large Wood
Buck Creek (Camp)	1	●●●	●●	●	●●
Buck Creek (Camp)	2	●●	●●	●●	●●●
Buck Creek (Camp)	3	●●	●	●●	●●●
Camp Creek	1	●●●	●	●●	●
Camp Creek	2	●●	●	●●	●
Camp Creek	3	●●	●	●●	●
Camp Creek	4	●●●	●	●●	●
Camp Creek	5	●●●	●	●●	●
Camp Creek	6	●●	●	●	●
Camp Creek	7	●●	●	●●	●●
Camp Creek	8	●	●	●●	●●●
Little Camp Creek	1	●●	●	●●	●●
Little Camp Creek	2	●●	●	●●	●●
Little Camp Creek	3	●●	●●	●●	●●●
Mill Creek	1	●●	●	●●	●
Mill Creek	2	●	●	●●	●
Mill Creek	3	●	●●	●●	●
Mill Creek	4	●	●	●●	●
Mill Creek	5	●●	●●	●●	●
Otter Creek	1	●●●	●	●●	●●
Otter Creek	2	●●●	●	●●	●●
Sock Creek	1	●●	●●	●●●	●●●
Sock Creek	2	●●	●●	●	●●

● Poor ●● Fair ●●● Good

3.1.3. Stream Connectivity

Stream connectivity reflects the ability of resident and anadromous fish, as well as other aquatic organisms, to navigate the stream network and access areas that contain suitable habitat. The stream system becomes disconnected when natural and human-made structures such as waterfalls, log jams, and dams inhibit fish passage. Although some stream disconnection is normal, a high degree of disconnection can reduce the amount of suitable spawning habitat available to salmonids. This, in turn, reduces the stream system's salmonid productivity potential. Poor stream connectivity can increase juvenile and resident fish mortality by blocking access to critical habitat, such as rearing grounds and cool tributaries which can provide refuges during the summer months.

For this assessment, fish passage barriers are structures that are believed to completely block all fish passage. A juvenile fish passage barrier permits adult passage but blocks all young fish.

Structures that allow some adults or some juvenile fish to pass are referred to as obstacles. Although a single obstacle does not prevent passage of all fish, when there are multiple obstacles, fish can expend so much energy in their passage efforts that they may die or be unable to spawn or feed. This assessment reviews the known distribution and abundance of three common human-made fish passage barriers and obstacles: irrigation ditches, dams, and culverts.

3.1.3.1. Irrigation Ditches

Irrigation ditches without fish wheel screens are primarily a problem for juvenile fish.[14] When the water diversion is in place, young fish swim into the ditches in search of food. When the diversion to the ditch is removed, the young fish left in the ditch cannot return to the stream network and will eventually die. At the writing of this assessment, no unscreened irrigation ditches in the Mill Creek Watershed had been identified as significant juvenile fish obstacles.

3.1.3.2. Dams

In the Umpqua Basin, many dams on larger streams are push-up dams used to create pools to pump irrigation water.[15] These dams are typically only used during the summer months, and therefore pose no passage barrier to fish during the winter. Dams can be barriers or obstacles to fish passage if the distance from the downstream water surface to the top of the dam (the "drop") is too far for fish to jump. Whether or not a fish can overcome this distance depends on three factors: the size and species of the fish, the height of the drop, and the size of the pool at the base of the dam, which is where fish gain momentum to jump. As pool depth decreases or height increases, fish have difficulty jumping high enough to pass over. There are no dams identified in the ODFW Fish Passage Barrier database in the Mill Creek Watershed that are barriers or obstacles to adult or juvenile fish passage.

3.1.3.3. Culverts

Culverts can be either barriers or obstacles to fish passage, especially if the distance from the downstream water surface to the culvert outfall is too far for fish to jump. Culverts can also block fish access by creating high velocity in the pipe. A drop of two feet can cause problems for adult cutthroat trout, whereas adult steelhead can jump five feet or more. Even a drop of one foot or less can impede passage of juvenile fish. Oregon Forest Practices rules require that new culverts generally have no more than a 0.5% gradient and no more than a six inch drop at the outlet. Higher gradients are allowed for culverts having baffles installed in the culvert bottom.

In natural stream systems, fish are able to navigate high velocity waters by periodically resting behind rocks and logs or in pools. Smooth-bottomed culverts offer no such protection, and water velocities can prevent some or all fish from passing through the pipe. Fish may face an additional velocity barrier at the upstream end of a culvert if it has been placed so that the stream flows sharply downward into the culvert entrance. In general, smooth-bottomed culverts at a 1% gradient or more are obstacles to fish passage. Culverts that are partially buried underground or built to mimic a natural streambed provide greater protection and allow fish passage at steeper gradients and higher water velocities.

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[14] Fish wheel screens are self-cleaning screens that prevent fish from entering an irrigation ditch while passing floating debris that may prevent water flow.
[15] Some landowners may have dams on small tributaries to provide water for wildfire control, livestock, or landscape aesthetics.

It is important to note that it is possible for culverts to be fish passage obstacles or barriers for only part of the year. As water levels change, so do pool depth, drop distance, and water velocity. A culvert with a five-foot drop in the summer may, in some cases, be easily navigated in the winter. High winter water flows can increase pool size and reduce jumping distance. However, high flows can also increase water velocities, making culverts impassable.

Map 3.7 shows road/stream crossings within the Mill Creek Watershed. Most of these crossings contain culverts. A culvert is the most common method of passing a road over a stream; however, bridges and hardened crossings are used as well. The ODFW Fish Passage Barrier database identifies one culvert that is a known barriers to salmonids.

Currently, the Umpqua Basin Fish Access Team (UBFAT) is working on identifying and prioritizing fish passage-limiting culverts, as well as other fish passage barriers and obstacles, on public and private land throughout the Umpqua Basin. Future prioritization will focus on identifying the fish passage barriers that will give the highest cost-to-benefit ratio, such as culverts blocking fish access near the mouths of streams that are within the distribution of salmonids. More information will be available later this year.

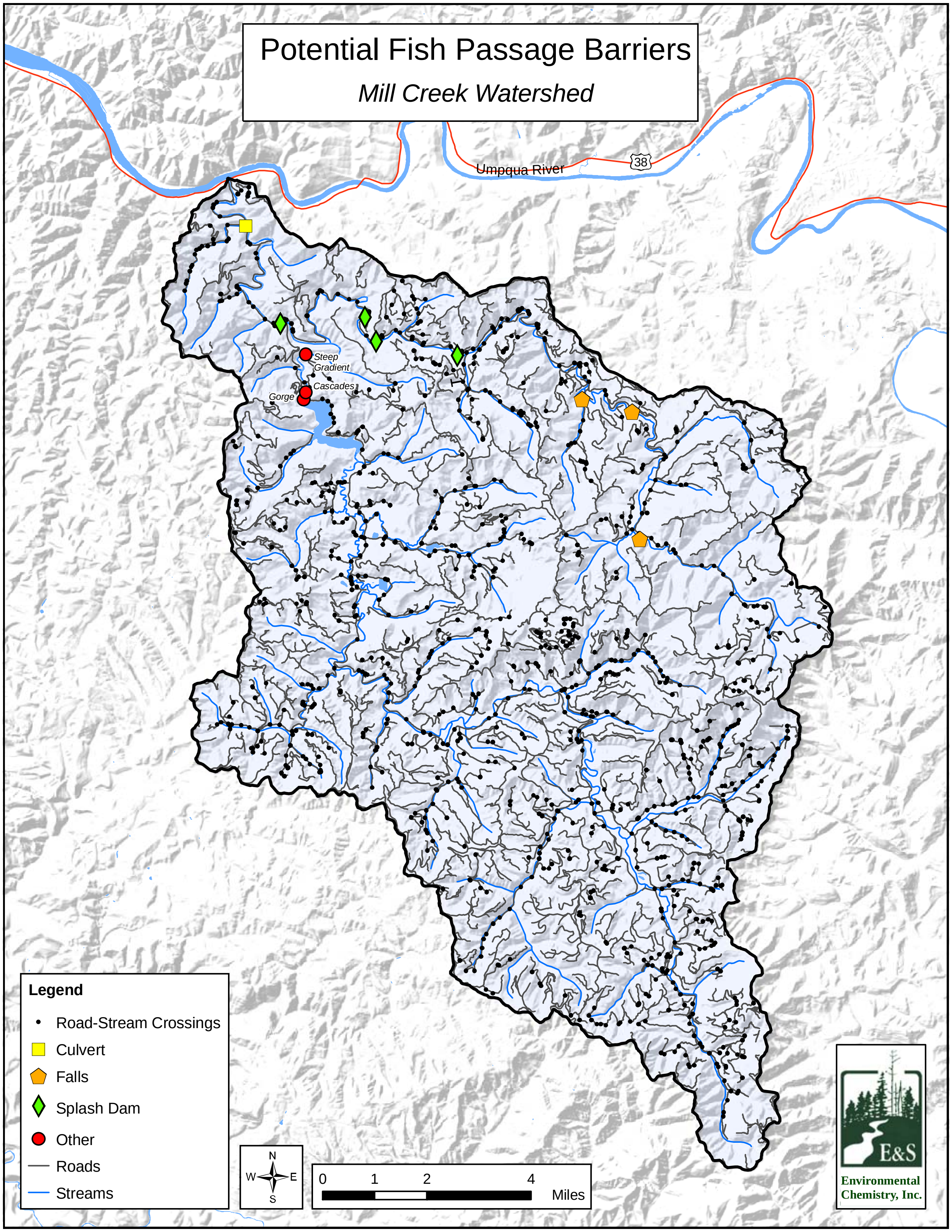
3.1.4. Channel Modification

For the purpose of this assessment, “channel modification” is defined as any human activity designed to alter a stream’s flow or its movement within the floodplain, such as installation of riprap along the bank, dredging, or other “non-restorative” activities. Although placing structures like boulders or logs in a stream alters the channel, this type of work is done to improve aquatic habitat conditions and is not intended to necessarily alter the stream’s path. As such, in-stream structure placement projects are not considered channel modification activities for this assessment.

In Oregon, the state has the authority to regulate all activities that modify a stream’s active channel. The active channel is all the area along a stream that is submerged during normal high waters. Even if the entire stream is within a landowner’s property, the active channel, like the water within it, is regulated by public agencies, and channel modification projects can only be done with a permit.[16] History has shown that channel modification activities are often detrimental to nearby aquatic ecosystems and to other reaches of the same stream. Streams naturally meander; attempts to halt meandering can alter aquatic habitats in localized areas and cause serious erosion or sedimentation problems further downstream. Although channel modification projects can often be done with a permit, obtaining a permit can be a lengthy process.

Removal of wood from streams in the past has seriously altered stream. Large logs, stumps and root wads affect stream morphology by creating debris dams and pools, trapping sediment, and

[16] Under the Oregon Removal/Fill Law (ORS 196.800-196.990), removing, filling, or altering 50 cubic yards or more of material within the bed or banks of the waters of the state or any amount of material within Essential Habitat streams or State Scenic Waterways requires a permit from the Division of State Lands. Waters of the state include the Pacific Ocean, rivers, lakes, most ponds and wetlands, and other natural bodies of water. Tree planting in the active stream channel, and timber harvesting in some circumstances, can be done without a permit.



Map 3.7. Potential fish passage barriers, including road-stream crossings, in the Mill Creek Watershed.

providing physical complexity. These functions create critical habitat for aquatic organisms (Reeves et al. 2002). We did not find specific information regarding such stream "cleaning" activities that occurred historically in the Mill Creek Watershed. Nevertheless, recent surveys of the stream system by ODFW indicate a lack of large woody debris and related physical complexity throughout most of the watershed.

3.1.4.1. Historical Channel Modification Projects

Quantifying historical channel modification activities is difficult because in many cases no permits were issued, and the evidence is often hidden. Many involved removing gravel bars from the stream or bank stabilization. Property owners removed gravel bars to sell the gravel as aggregate, to reduce water velocities, and "to put the creek where it belongs." Gravel bars are not stationary. In general, a gravel bar that has no grass or other vegetation is very unstable, and during every flood event gravel is washed away and replaced by upstream materials. Consequently, a gravel bar in the same location was often removed every year.

Human activities that have influenced stream morphology in the past include log drives, yarding in channels during timber harvest, road construction, beaver eradication,[17] reservoir construction, and stream cleaning. Log drives historically occurred most frequently along the mainstem river. It is unknown exactly how far upstream log drives were conducted. Logs were stored on the banks until high flows, and then pushed into the rivers and transported downstream to be milled. Impacts associated with log drives included bank erosion, damage to riparian vegetation, mechanical erosion of channel substrate, and sediment removal (USFS 1985).

Information on the history of splash damming and logging in this region is provided by Beckham (1990) and Farnell (1979, 1981). Documented cases of splash damming in the region are rare. It is known, however, that intensive splash damming occurred on Mill Creek, near the confluence with Camp Creek, and at three locations on Camp Creek (Map 3.7; P. Olmstread, BLM, pers. comm., April 2005; Saltzman 1959).

During the salvage logging following the Columbus Day storm in 1962, road construction likely impacted stream channels, although specific locations in the watershed were not determined. Many roads were constructed near streams at that time, resulting in sedimentation of the streams by sidecast material (Levesque 1985). Sedimentation conditions associated with old roads have improved, and active management of roads to reduce erosion is ongoing.

Bank stabilization involves adding material to the stream bank to prevent or minimize erosion and stream meandering. The term "riprap" refers to large rock material used for bank stabilization. Frequently, riprap becomes buried by sediment only to be exposed years later when a stream alters its path. During the 1996 floods, riprap and debris from many past bank stabilization projects were exposed along the Umpqua River as sediment was washed away.

3.1.4.2. Recent Channel Modification Projects

We are not aware of any recent channel modification projects in the Mill Creek Watershed. However, landowners and stream restoration professionals report that non-permitted channel

[17] According to ODFW, beavers were nearly eliminated throughout much of North America by the mid-1800s. Extensive transplanting efforts in Oregon have assisted in the recovery of beaver populations in many streams.

modification activities still occur throughout the Umpqua Basin. In many cases, the people involved are unaware of the regulations and fines associated with non-permitted channel modification projects and the effects on aquatic systems.

3.1.5. Stream Function Key Findings and Action Recommendations

3.1.5.1. Stream Morphology Key Findings

- A wide variety of stream channel habitat types are found in the watershed, and several enhancement opportunities exist.
- Stream habitat surveys suggest that poor riffles, poor to fair large wood conditions, and generally fair riparian conditions limit fish habitat in surveyed streams. Pool conditions also limit fish habitat in some surveyed reaches but are generally better than conditions for the other stream habitat variables.

3.1.5.2. Stream Connectivity Key Findings

- Dams and culverts that are barriers and/or obstacles to fish reduce stream connectivity, affecting anadromous and resident fish productivity in the Mill Creek Watershed.

3.1.5.3. Channel Modification Key Findings

- There are few examples of permitted channel modification projects in the Mill Creek Watershed.
- Many landowners may not understand the detrimental impacts of channel modification activities or may be unaware of active stream channel regulations.

3.1.5.4. Stream Function Action Recommendations

- Where appropriate, improve pools and riffles while increasing in-stream large woody material by placing large wood and/or boulders in streams with channel types that are responsive to restoration activities and have an active channel less than 30 feet wide.[18]
- Encourage land use practices that enhance or protect riparian areas:
    - Protect riparian areas from livestock browsing and bank erosion by providing stock water systems and shade trees outside of the stream channel and riparian zones. Fence riparian areas as appropriate.
    - Plant native riparian trees, shrubs, and understory vegetation in areas with poor or fair riparian area conditions.
    - Manage riparian zones for uneven-aged stands with large diameter trees and younger understory trees.
- Maintain areas with good native riparian vegetation.
- Encourage landowner participation in restoring stream connectivity by eliminating barriers and obstacles to fish passage. Restoration projects should focus on barriers that,

[18] Thirty feet is the maximum stream width for which in-stream log and boulder placement projects are permitted.

when removed or repaired, create access to the greatest amount of high quality fish habitat.

- Increase landowner awareness and understanding of the effects and implications of channel modification activities through public outreach and education.

3.2. Riparian Zones and Wetlands

3.2.1. Riparian Zones

For the purpose of this assessment, the riparian zone is the vegetation immediately adjacent to a stream. Riparian zones influence stream conditions in many ways. Above-ground vegetation can provide shade, reduce flood velocities, and add nutrients to the stream. Roots help prevent bank erosion and limit stream meandering. Trees and limbs that fall into streams can increase fish habitat complexity and create pools. Insects that thrive in streamside vegetation are an important food source for fish.

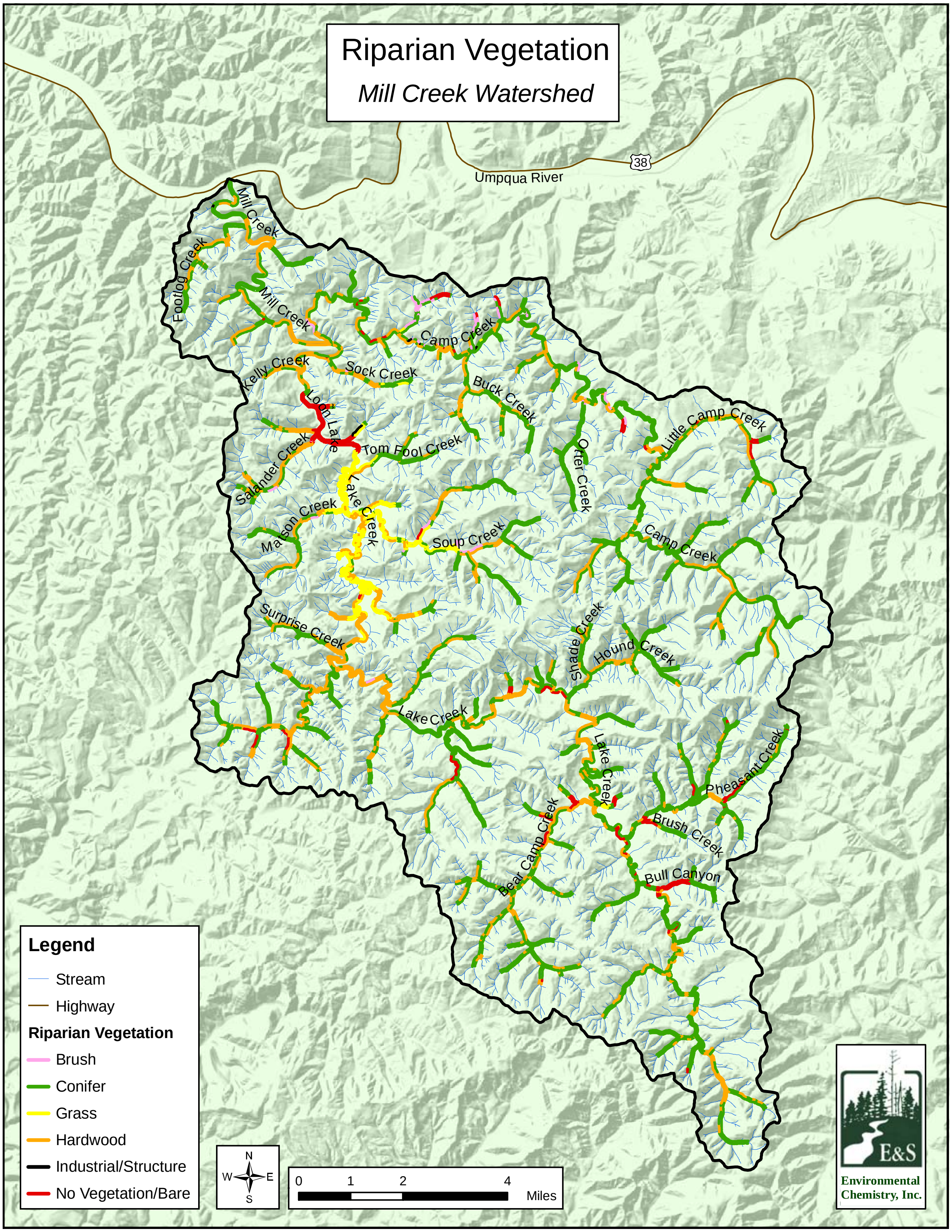
The "health" of the riparian area is dependent on many factors. Although large-diameter conifers are especially important in providing shade and woody debris, many streams flow through areas that do not normally support large conifers. In some areas, current land uses may not permit the growth of "ideal" vegetation types. Conclusions about stream riparian zone conditions should take into consideration location, known historical conditions, and current land uses. Therefore, this assessment's riparian zone findings should be viewed primarily as a guide for interpretation and further investigation.

Riparian vegetation in the watershed was primarily (62%) conifer, followed by hardwood forest (26%; Table 3.5). This suggests good potential to develop future large wood sources to the stream system. Riparian conifers were found interspersed throughout the watershed along the mainstems of Mill and Lake creeks, and also along the tributary stream systems (Map 3.8). Also apparent in the conifer-dominated riparian areas were limited stretches devoid of vegetation, possibly associated with recent logging activities, steep terrain, or both. Grasses occupy the riparian zone along much of lower Lake Creek.

Riparian vegetation along significant portions of the mainstems of Mill and Lake creeks was mostly hardwood forest (Map 3.8). Overall, riparian vegetation in the watershed provides a reasonably good degree of shade-producing cover. Nearly 78% of the riparian areas were classified as having high cover (Figure 3.1). Areas lacking cover included mainly the areas adjacent to Loon Lake and lower Lake Creek, and also the lower section of Soup Creek.

Table 3.5. Mill Creek Watershed aerial photo interpretation of riparian vegetation.

Vegetation Type	Left Bank (Miles)	Right Bank (Miles)	Left Bank (Acres)	Right Bank (Acres)	Total (Acres)	Total (Percent)
Brush	0.8	4.3	14.7	77.3	92.0	1.3
Conifer	115.6	124.6	2,100.6	2,267.3	4,367.9	62.0
Grass	11.8	11.4	214.6	207.8	422.4	6.0
Hardwood	55.9	44.0	1,016.9	799.3	1,816.2	25.8
Industrial	0.1	0.6	1.6	10.6	12.2	0.2
No Vegetation/Bare	9.4	8.7	171.6	157.7	329.3	4.7
Total	193.6	193.6	3,520.0	3,520.0	7,040.0	100.0



Map 3.8. Distribution of riparian vegetation classes throughout the Mill Creek Watershed.

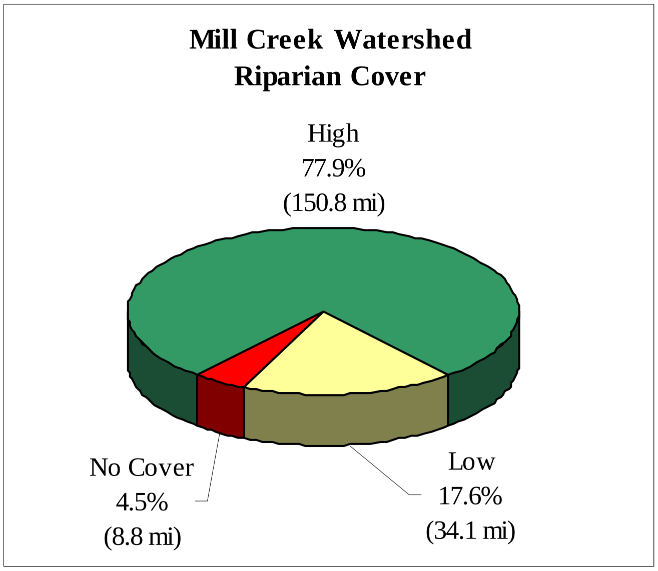


Figure 3.1. Results of aerial photo interpretation of riparian cover in the Mill Creek Watershed.

3.2.2. Wetlands[19]

The hydrology of wetlands is often complex and interconnected with the stream system. The purpose of this section is to review current wetland locations and attributes, and to discuss opportunities for wetland restoration. Background information for this section was compiled from the recent tidal wetland restoration assessment by Brophy and So (2004), the *South Umpqua River Watershed Assessment and Action Plan* (Geyer 2003), and the following groups' documents, websites, and specialists: Oregon Division of State Lands (DSL), US Environmental Protection Agency (EPA), US Fish and Wildlife Service (USFWS), and Wetlands Conservancy. Additional information was compiled from *Wetland Plants of Oregon and Washington* (Guard 1995).

3.2.2.1. Overview of Wetland Ecology

<u>What is a wetland?</u>

Wetlands are transitional areas between terrestrial and aquatic ecosystems, where the water table is usually at or near the surface of the land or the land is covered by shallow water. The following three attributes must be found together to establish the existence of a regulated wetland.

1. Under normal circumstances there is inundation or saturation with water for two weeks or more during the growing season.[20]
2. The substrate is predominantly undrained hydric soil as indicated by the presence of such features as dull colored or gleyed (gray colors) soils, soft iron masses, oxidized root channels, or manganese dioxide nodules.

[19] Jeanine Lum of Barnes and Associates, Inc., contributed material for section 3.2.2.
[20] The growing season in Douglas County is approximately from March 1 through October 31.

3. At least periodically, the land supports predominantly hydrophytic (water-loving) vegetation.

<u>Function and values</u>

In the past, wetlands were regarded as wastelands. As early as 1849 with the enactment of the Swamp Act, wetlands removal was encouraged by the US government. Wetlands were feared as the cause of malaria and other waterborne diseases. However, research over the years has led to a greater appreciation of the many important ecological functions that wetlands perform. These include:

- Flood prevention and water retention - wetlands are able to absorb water from runoff during storms and gradually release the water that would otherwise flow quickly downstream.
- Water filtration - wetlands improve water quality by trapping sediment and removing excess nutrients such as phosphorous and nitrogen.
- Groundwater recharge - water that is held in wetlands can move into the subsurface soil, thus recharging the groundwater.
- Stream bank stabilization - wetlands and associated vegetation slow the movement of water and help reduce erosion of stream banks.
- Fish and wildlife habitat - many species of fish and other aquatic organisms depend on wetlands for food, spawning, and rearing habitat.

<u>Background on the Clean Water Act and National Wetlands Inventory</u>

Section 404 of the federal Clean Water Act of 1972 requires that anyone planning to place dredged or fill material into waters of the United States, including wetlands, must first obtain a permit from the US Army Corps of Engineers. Established (on-going) and normal farming, ranching, and forestry activities are exempt. The Emergency Wetlands Resources Act of 1986 requires the USFWS to inventory and map wetlands in the United States. This mapped inventory is called the National Wetlands Inventory (NWI).

Nationally, an estimated 46 million acres, or 50%, of the original wetlands areas have been lost to clearing, filling, draining and flood control since the 1600s. In 1997, the USFWS reported an 80% reduction in wetlands loss during the period 1986 to 1996, as compared to the decade prior. Although the nation has not met the goal of no net loss of wetlands, it has slowed the rate of wetlands loss.

<u>Types of wetlands</u>

A wetland that holds water all year round is the easiest wetland to recognize and the one most people understand as a wetland. Another type of wetland is the ephemeral wetland, or a wetland that holds water for only a few weeks or months during the year. The timing and duration of water holding are important factors that dictate which plants and wildlife will inhabit a particular wetland.

The NWI classifies wetlands based on guidelines established by Cowardin et al. (1979). The "palustrine" classification includes all nontidal wetlands dominated by trees, shrubs, emergents (erect, rooted, non-woody plants), mosses, or lichens. It groups the vegetated wetlands traditionally called by such names as marsh, swamp, bog, fen, and prairie pothole. The palustrine wetland type also includes the small, shallow, permanent or intermittent water bodies often called ponds. Bodies of water that are lacking such vegetation and are less than 20 acres in size are included in this category. The "lacustrine" classification refers to wetlands associated with lakes that are dominated by trees, shrubs, persistent emergents[21], emergent mosses, or lichens. It may include freshwater marshes and aquatic beds. The "littoral" habitats of the lacustrine category extend to a depth of 6.6 feet below low water or to the maximum extent of nonpersistent emergents. The "limnetic" subsystem of the lacustrine category refers to wetlands that are in water more than 6.6 feet in depth. Upper perennial refers to riverine wetlands along perennial streams in the upper portion of the drainage basin. The "riverine" classification includes wetlands within a stream channel, except those dominated by trees, shrubs, and persistent emergents. Two subsystems of riverine wetlands occur in this watershed. "Tidal" riverine wetlands are found on rivers or streams that have tidal influence. "Upper perennial" riverine wetlands occur on high gradient streams that typically have a gravel, rock or cobble bottom, with occasional sandy patches. NWI data are displayed in Map 3.9 and Table 3.6.

3.2.2.2. Description of Current Wetlands in the Mill Creek Watershed

Based on the current NWI wetlands data, palustrine systems encompass 73.9% of the wetlands present in the Mill Creek Watershed. These wetland types are found mostly along Lake Creek, above Loon Lake, and in associated tributaries such as Soup Creek and Pheasant Creek (Map 3.9). Palustrine wetlands are also thinly spread along Camp Creek. Lacustrine systems, which include limnetic and littoral wetlands, are isolated in and around Loon Lake. These wetland types constitute 24.9% of the wetlands in the watershed (Figure 3.2, Table 3.6). Nine acres (1.2% of total wetlands) of riverine systems occur near the lower portion of Mill Creek, below Loon Lake.

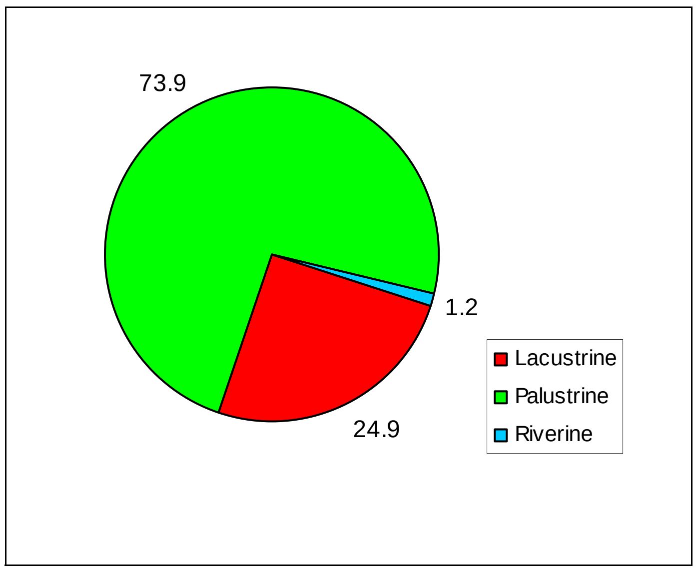


Figure 3.2. Percent of wetland types in the Mill Creek Watershed.

3.2.2.3. Restoration Opportunities in the Mill Creek Watershed

There is little specific reference in historical records to wetlands in the Mill Creek Watershed. However, it is believed that about 53% of the original wetlands acreage in western Oregon has been lost to development or converted to other uses (Wetlands Conservancy 2003). We expect that wetland loss within the Mill Creek Watershed has also been substantial.

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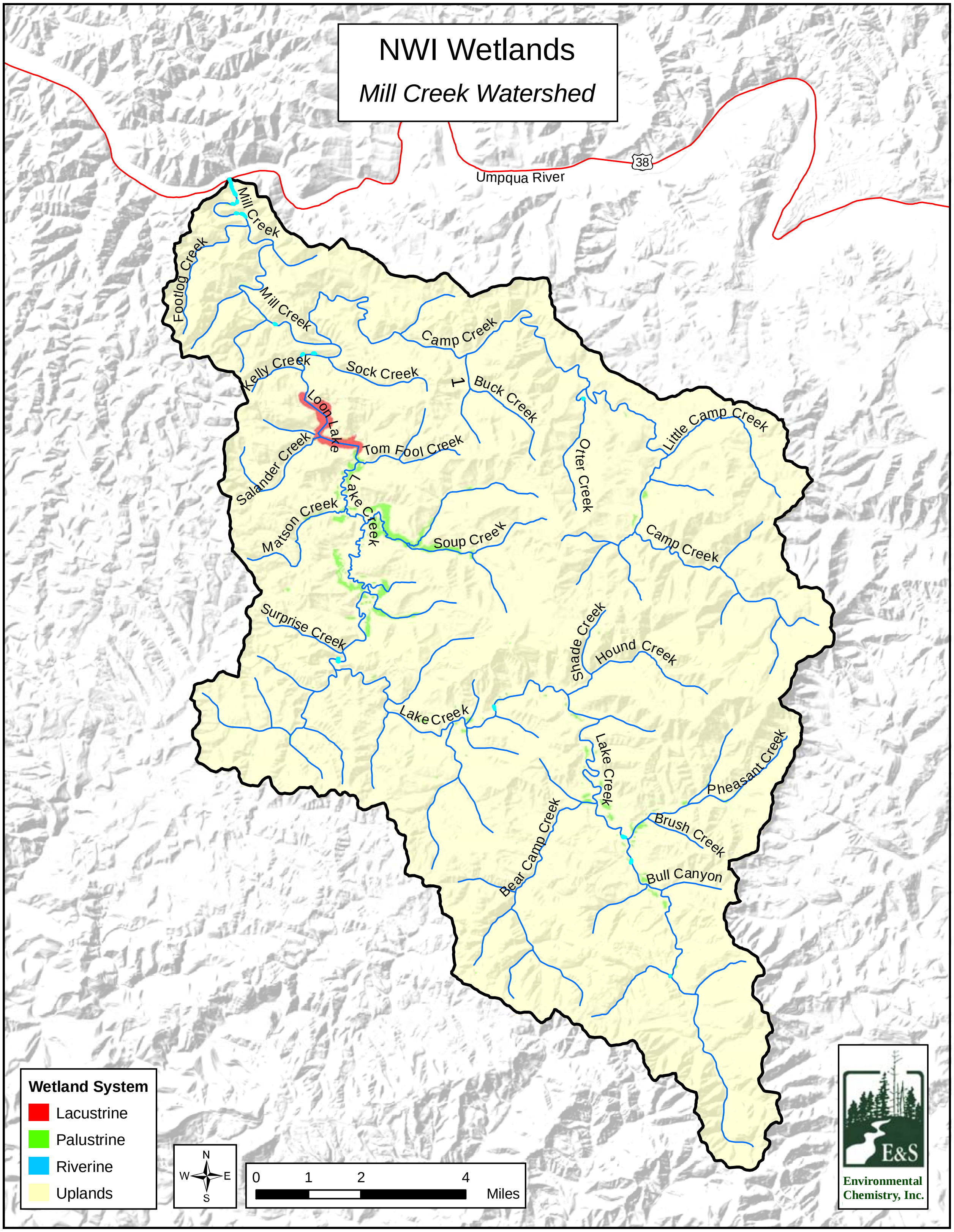
[21] Persistent emergents are present for more than one growing season. Nonpersistent emergents are annuals, or perennials that disappear above ground each season.



Map 3.9. Mill Creek Watershed wetlands.

Table 3.6. Mill Creek Watershed wetlands and deepwater habitat classification.

Wetland Type	Wetland Area	
	Acres	**Percent**
Lacustrine		
Limnetic - Unconsolidated Bottom	245.9	24.6
Littoral - Unconsolidated Shore	2.4	0.2
Total[1]	**248.2**	**24.9**
Palustrine		
Aquatic Bed - Semipermanently Flooded	7.4	0.7
Emergent	65.7	6.6
Emergent - Temporarily Flooded	0.6	0.1
Emergent - Saturated	180.4	18.1
Emergent - Seasonally Flooded	160.8	16.1
Emergent - Semipermanently Flooded	6.7	0.7
Emergent - Permanently Flooded	0.8	0.1
Forested - Temporarily Flooded	64.5	6.5
Forested - Saturated	1.3	0.1
Forested - Seasonally Flooded	153.7	15.4
Forested - Temporary Tidal	1.1	0.1
Scrub/Shrub - Temporarily Flooded	6.5	0.6
Scrub/Shrub - Saturated	3.4	0.3
Scrub/Shrub - Seasonally Flooded	68.6	6.9
Unconsolidated Bottom - Semipermanently Flooded	2.8	0.3
Unconsolidated Bottom - Permanently Flooded	14.1	1.4
Unconsolidated Bottom	0.2	0.0
Total[1]	**738.4**	**73.9**
Riverine		
Tidal - Unconsolidated Bottom - Seasonally Flooded	2.7	0.3
Upper Perennial - Rock Bottom	0.4	0.0
Upper Perennial - Rocky Shore	5.2	0.5
Upper Perennial - Unconsolidated Shore	3.6	0.4
Total[1]	**12.0**	**1.2**
Grand Total	**998.6**	**100.0**

[1] Numbers may not sum due to rounding

Wetland loss and degradation is caused by human activities that change wetland water quality, quantity, and flow rates; increase pollutant inputs; and change species composition as a result of disturbance and introduction of non-native species. Although one of the functions of wetlands is to absorb pollutants and sediments from runoff water, there is a limit to their capacity to do so.

The primary agricultural use of wetlands in the watershed is grazing of domestic animals that often congregate in riparian zones and wetlands during dry and hot periods. Best management practices can reduce the impact of livestock in the wetlands and riparian areas. Off-channel watering, hardened crossings, irrigation, livestock exclusion (part or all of the year), and providing shade away from these areas are examples of improvements that can be implemented to minimize damage to wetlands.

There are many opportunities for landowners to participate in incentive, cost-share, and/or grant awarding programs that encourage good land stewardship and benefit wetlands. Although programs vary in terms of incentives and eligibility, landowners share these common concerns:

- Lack of awareness of available programs
- Overwhelming program choice
- Concern about hidden agendas and "fine print"
- Anxiety over bureaucracy and contracts
- Fear of the loss of privacy, increased regulation, or the discovery of threatened or endangered species on the property.

3.2.3. Riparian Zones and Wetlands Key Findings and Action Recommendations

3.2.3.1. Riparian Zones Key Findings

- Approximately 62% of streamside riparian areas are dominated by coniferous vegetation. These streamside conifers will provide important woody debris to the stream in the future.
- Hardwood forests in the riparian zone are scattered throughout the watershed.
- Riparian areas dominated by grasses are found mainly near Loon Lake, lower Lake Creek, and lower Soup Creek. The scarcity of trees in streamside riparian areas along lower Lake and Soup creeks limits stream shading and contributes to relatively high stream temperatures.
- Stream shading was classified as high along 78% of the stream reaches within the watershed.

3.2.3.2. Wetlands Key Findings

- Historical settlement, development, and long-term agricultural use of the Mill Creek Watershed have probably affected the original wetland hydrology and resulted in loss of wetland areas.
- Most of the remaining wetlands in the Mill Creek Watershed are found on private land near Loon Lake, Lake Creek, and Soup Creek.
- Landowner "buy-in" and voluntary participation must be fostered if wetland conservation is to be successful in the watershed.
- There are opportunities for enhancement and protection of wetlands, including palustrine wetlands near Soup Creek and Lake Creek and lacustrine wetlands near Loon Lake.

3.2.3.3. Riparian Zones and Wetlands Action Recommendations

- Where canopy cover is less than 50%, establish buffers of native trees (preferably conifers) and/or shrubs, depending upon local conditions. Priority areas are fish-bearing streams for which more than 50% canopy cover is possible.
- Identify riparian zones dominated by grass and blackberry and convert these areas to native trees (preferably conifers) and/or shrubs, depending on local conditions.
- Where possible, maintain riparian zones that are two or more trees wide and provide more than 50% cover.
- Encourage best management practices that limit wetland damage, such as off-channel watering, hardened crossings, livestock exclusion (part or all of the year), and provide stream shade.
- Develop opportunities to increase awareness of what defines a wetland and its functions and benefits. This is a fundamental step in creating landowner interest and developing landowner appreciation for wetland conservation.
- Identify or establish various peer-related demonstration projects as opportunities to educate stakeholders.
- Establish an approachable clearinghouse to assist landowners in enrolling in programs that can benefit wetlands and meet landowner goals. A friendly and “non-governmental” atmosphere can reduce some of the previously identified landowner concerns. A central site can identify and coordinate partners, streamline landowner paperwork, and facilitate securing funding and in-kind services often needed for a successful project. Combining local programs with national programs maximizes flexibility and funding. For example, a landowner could receive a tax exemption under the local Wildlife Habitat Conservation and Management Program, receive technical assistance in planning and cost share from the Natural Resources Conservation Service, and receive grant money from Partners for Wildlife and Ducks Unlimited.

3.3. Water Quality

This section discusses the condition of water quality in the Mill Creek Watershed, with a focus on six important water quality parameters. Background information for this chapter was compiled from the following sources: the *Oregon Watershed Assessment Manual* (Watershed Professionals Network 1999), *Elliott State Forest Watershed Analysis* (Biosystems 2003), *Upper Umpqua River Watershed Analysis* (BLM 2002), and the *South Umpqua River Watershed Assessment and Action Plan* (Geyer 2003). Additional information and data are from the following groups' documents, websites, and specialists: the Oregon Water Resources Department (OWRD), Oregon Department of Environmental Quality (ODEQ), the Umpqua Soil and Water Conservation District (SWCD), the Bureau of Land Management (BLM), and the Natural Resource Conservation Service (NRCS).

3.3.1. Pre-Settlement Water Quality

Water quality conditions in the watershed at the time of Euro-American settlement are undocumented. However, based on descriptions of the landscape at the time, it is possible that water temperatures in Mill Creek, Lake Creek and some of the tributary streams were lower than they are today. Early records suggest that the streambanks and some of the lowland floodplains were mostly wooded, with many large trees present to provide adequate shade to moderate streamwater temperature. Bacterial conditions are less certain. Beaver ponds have been associated with high levels of fecal coliform bacteria in small tributary streams. Beaver ponds probably occurred throughout the watershed in pre-settlement times.

Chronic turbidity and suspended sediment concentrations were probably somewhat lower in pre-settlement times than they are today. This was largely because of the absence of roads and, to a lesser extent, the absence of other anthropogenic watershed disturbances. However, large episodic disturbance events, such as fires and floods, would have resulted in periodic spikes in turbidity and suspended sediment levels.

Primary sources of nutrient loading in the streams below Loon Lake prior to Euro-American settlement included decaying salmon carcasses subsequent to spawning, and nitrogen fixation associated with plants such as red alder in the riparian zone. The timing of nutrient input has been altered, and the pulse of nutrients subsequent to spawning has been reduced. Nitrogen and phosphorus loading due to salmon mortality were higher historically and have been replaced by other sources of nutrient loading.

3.3.2. Stream Beneficial Uses and Water Quality Impairments

The OWRD has established a list of designated beneficial uses for surface waters, including streams, rivers, ponds, and lakes. Beneficial uses are based on human, fish, and wildlife activities associated with water. This assessment focuses on the designated beneficial uses for flowing water, i.e. streams and rivers. Table 3.7 lists the beneficial uses for streams and rivers within the Umpqua Basin.

In order to protect the beneficial water uses, ODEQ established water quality standards. These standards determine the acceptable levels or ranges for water quality parameters. ODEQ monitors streams and stream reaches throughout Oregon, and streams or reaches that are not within the standards are identified as "water quality limited" or "impaired."[22] Section 303(d) of the Clean Water Act of 1972 requires each state to submit this list of impaired streams to the US Environmental Protection Agency (EPA). This is commonly referred to as the "303(d) list." ODEQ is then required to determine the maximum amount of pollution, or "load," that each impaired steam can receive without violating water quality standards. This is referred to as the "total maximum daily load," or "TMDL."[23] A TMDL document is currently being completed for streams in the Umpqua Basin, and will be available later this year. Streams can be de-listed once TMDL plans are complete, when monitoring shows that the stream is meeting water quality standards, or if evidence suggests that a 303(d) listing was in error.

Table 3.7. Stream beneficial uses in the Umpqua Basin, including the Mill Creek Watershed.
Public Domestic Water Supply[1]
Private Domestic Water Supply[1]
Industrial Water Supply
Irrigation
Livestock Watering
Anadromous Fish Passage
Salmonid Fish Rearing
Salmonid Fish Spawning
Resident Fish and Aquatic Life
Wildlife and Hunting
Fishing
Boating
Water Contact Recreation
Hydropower
Aesthetic Quality
[1] With adequate pretreatment (filtration and disinfection) and natural quality to meet drinking water standards

3.3.3. 303(d) Listed Parameters

To evaluate water quality in the Mill Creek Watershed, six water quality parameters are reviewed in this section. These parameters are temperature, pH, DO, nutrients, bacteria, and sedimentation/turbidity. Most of the emphasis in this section is placed on temperature and bacteria, the water quality parameters that have been identified as being impaired in this watershed. Water quality criteria are provided in Table 3.8, based on Oregon Watershed Enhancement Board (OWEB) and EPA guidelines. In this assessment, we evaluate available data in the Mill Creek Watershed relative to these indicator values. OWEB recommends evaluating water quality impairment on the basis of the percent of samples that exceeded the various criteria values (Table 3.9).

Table 3.10 summarizes the water quality data from the ODEQ database for streams in the Mill Creek Watershed. The "Listing Status" column in Table 3.10 includes several categories of water quality impairment. "303(d) List" identifies streams required for listing under the Clean Water Act, and for which a TMDL must be conducted. "Water Quality Limited Not Needing a TMDL" indicates that a TMDL is not required because a pollutant does not cause the impairment. "Attaining Criteria/Uses" indicates that the water quality standards were not achieved during a

[22] ODEQ can also use data collected by other agencies and organizations to evaluate water quality.
[23] TMDL plans are limits on pollution developed when streams and other waterbodies do not meet water quality standards. TMDL plans consider both human-related and natural pollution sources.

Table 3.8. Water quality criteria and evaluation indicators. (Source: WPN 1999)

Water Quality Attribute	Evaluation Criteria
Temperature	Daily maximum of 64EF (17.8EC) during summer months (7-day moving average)
Dissolved Oxygen	8.0 mg/L salmonid rearing, 6.5 mg/L estuarine
pH	Between 6.5 and 8.5
Nutrients Total Phosphorus Total Nitrogen	 8.75 :g/L 0.10 mg/L
Bacteria	Water-contact recreation 126 *E. coli*/100 ml (30-day log mean, 5 sample minimum) 406 *E. coli*/100 ml (single sample maximum)
	Marine water and shellfish areas 14 cfu/100 ml (median) 43 cfu/100 ml (not more than 10% of samples)
Turbidity	50 NTU maximum (fish feeding impaired) 10 NTU adverse aesthetic effect

Table 3.9 Criteria for evaluating water quality impairment. (Source: WPN 1999)

Percent of Data Exceeding the Criterion	Impairment Category
Less than 15%	No impairment
15 to 50%	Moderately impaired
More than 50%	Impaired
Insufficient data	Unknown

drought year, but were achieved during other years. Streams in this category are monitored for declining trends in water quality. Camp, Lake, Mill, and Otter creeks are listed as water quality limited due to habitat modification, and Otter Creek is also listed for flow modification. The ODEQ is no longer placing streams on the 303(d) list due to habitat or flow modification. All streams that were on previous 303(d) lists under these categories are now in the “Water Quality Limited Not Needing a TMDL” category.

Table 3.11 and Map 3.10 show the streams identified in Table 3.10 for inclusion on the 303(d) list with supporting information regarding the listing. The primary water quality concern in the watershed is water temperature, with Soup Creek and the lower 0.7 miles of Buck Creek having been listed for temperature exceedence. However, residents of the watershed are aware that Soup Creek dries up in the summer during some years, and are discussing this listing with ODEQ.

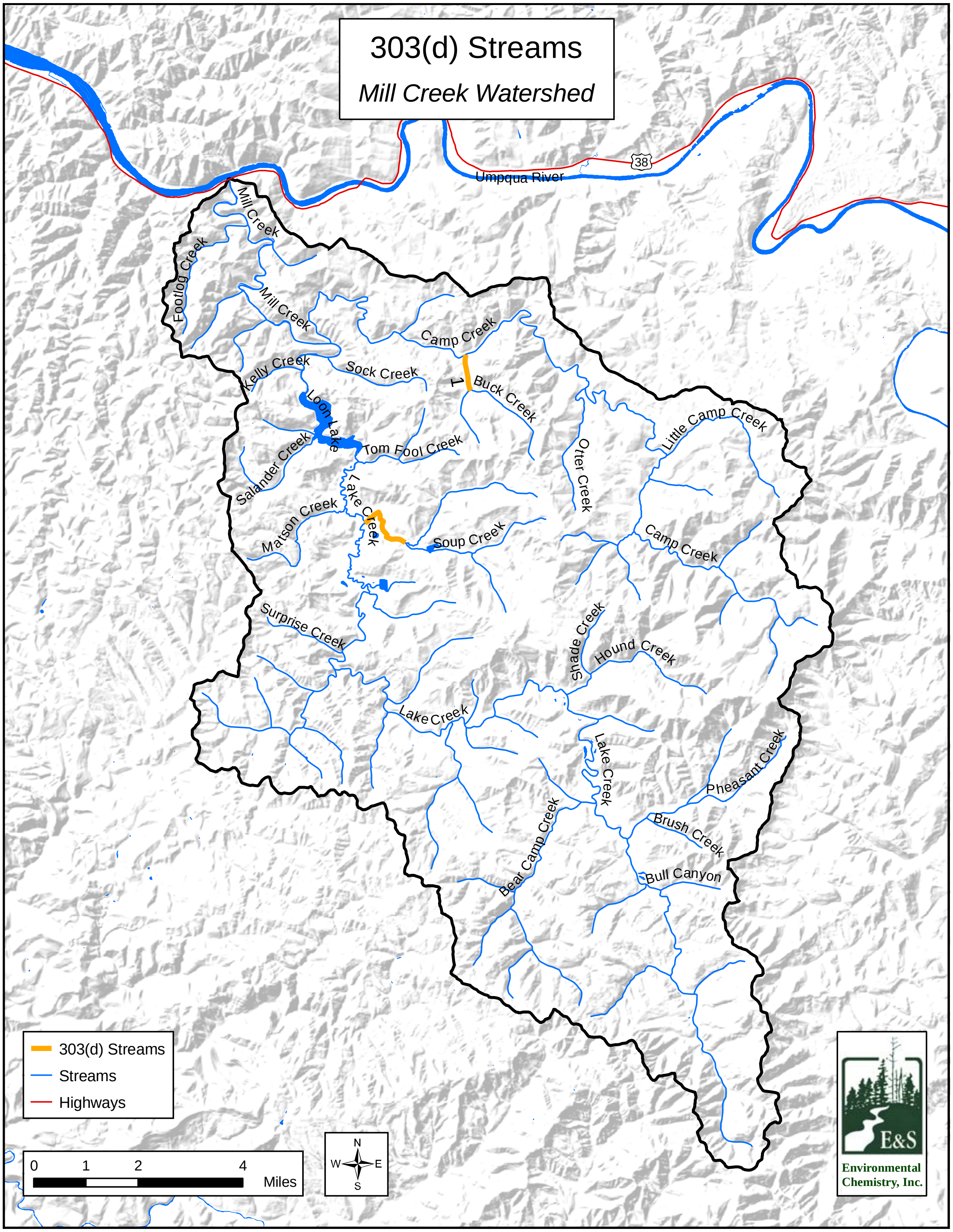
Table 3.10. Mill Creek Watershed stream reaches in ODEQ's water quality limited streams database. (Source: http://www.deq.state.or.us/wq/WQLData/SubBasinList02.asp)

Record ID	Waterbody Name	River Mile	Parameter	Season	List Date	Listing Status
5785	Buck Creek	0 to 0.7	Temperature	Summer	1998	303(d) List
5790	Buck Creek	0 to 0.7	Temperature	Summer	1998	Attaining Criteria/Uses
5791	WF Buck Creek	mouth	Temperature	Summer	1998	Attaining Criteria/Uses
5520	Camp Creek	0 to 20.4	Habitat Modification	N/A	2002	Water Quality Limited Not Needing a TMDL
5403	Lake Creek	0 to 27.3	Temperature	Summer	1998	Insufficient/No Data
5621	Lake Creek	0 to 27.3	Sedimentation	N/A	1998	Insufficient/No Data
5527	Lake Creek	0 to 27.3	Habitat Modification	N/A	2002	Water Quality Limited Not Needing a TMDL
5719	Mill Creek	0 to 8.8	Temperature	Summer	1998	Insufficient/No Data
5720	Mill Creek	0 to 8.8	Habitat Modification	N/A	2002	Water Quality Limited Not Needing a TMDL
5786	NF Soup Creek	0 to 3.3	Temperature	Summer	1998	Attaining Criteria/Uses
5623	Otter Creek	0 to 4.2	Sedimentation	N/A	1998	Insufficient/No Data
5532	Otter Creek	0 to 4.2	Flow Modification	N/A	2002	Water Quality Limited Not Needing a TMDL
5641	Otter Creek	0 to 4.2	Habitat Modification	N/A	2002	Water Quality Limited Not Needing a TMDL
5788	Soup Creek	0 to 1.3	Temperature	Summer	1998	303(d) List
5789	Soup Creek	0 to 1.4	Temperature	Summer	1998	Attaining Criteria/Uses

Table 3.11. The 303(d) listed stream reaches in the Mill Creek Watershed. (Source: http://www.deq.state.or.us/wq/WQLData/SubBasinList02.asp)

Record ID	Waterbody Name and River Mile	Parameter, Criteria, and Season	Supporting Data	Sample Matrix	List Date	Beneficial Uses	303(d) Stream Miles	Percent of Streams in Watershed
5785	Buck Creek 0 to 0.7	Temperature Rearing: 17.8ºC (64.0ºF) Summer	BLM (2 sites in 1997: 66.0ºF at the mouth and 62.7ºF in the headwaters).	Water Column	1998	Salmonid fish rearing Anadromous fish passage	0.7	1.8
5788	Soup Creek 0 to 1.31	Temperature Rearing: 17.8ºC (64.0ºF) Summer	66.1ºF in 1997.	Water Column	1998	Salmonid fish rearing Anadromous fish passage	1.3	3.3
Total							2.0	5.1

Since these two stream reaches were listed, the ODEQ has made a slight upward adjustment (+0.4ºF) in the stream temperature standard for salmonid rearing. Currently, the seven-day-average maximum temperature of a stream identified as having salmon and trout rearing and migration use may not exceed 17.8ºC (64.4ºF). Salmonid rearing occurs during the summer months. This temperature standard applies to all streams within the Mill Creek Watershed. The seven-day-average maximum is the average of the daily maximum stream temperatures for the seven warmest consecutive days during the summer.



Map 3.10. 303(d) listed streams within the Mill Creek Watershed.

3.3.4. Temperature

3.3.4.1. Importance of Stream Temperature

Aquatic life is temperature-sensitive and requires water that is within certain temperature ranges. The Umpqua Basin provides important habitat for many cold-water species, including salmonid fish. When temperature exceeds tolerance levels, cold-water organisms become physically stressed and have difficulty obtaining enough oxygen.[24] Stressed fish are more susceptible to predation, disease, and competition from temperature-tolerant species. For all aquatic life, prolonged exposure to temperatures outside tolerance ranges will cause death. Therefore, the beneficial uses affected by temperature are resident fish and aquatic life, and salmonid spawning and rearing.

Temperature limits vary depending upon species and life cycle stage. Salmonids are among the most sensitive fish, and consequently ODEQ standards have been set based on salmonid temperature tolerance levels. From the time of spawning until fry emerge, 55°F (12.8°C) is the maximum temperature criterion. For all other life stages, the criterion is set at 64°F (17.8°C) during summer months. Salmonids commonly live in streams that are warmer than 64^{o}F, although physiological stress and behavioral changes occur when temperatures approach 70°F. Temperatures 77°F (25°C) or higher are considered lethal.

3.3.4.2. Available Stream Temperature Data

Stream temperature fluctuates by time of year and time of day. In general, water temperature during the winter and most of spring (between November and May) is well below both the 55°F and 64°F standards, and is not an issue. In the summer and fall months, water temperature can exceed the 64°F standard and cause streams to be water quality limited. In the Mill Creek Watershed, the main Lake Creek and Mill Creek systems, as well as the lower reaches of several tributary streams, were 303(d) listed for temperature (Table 3.10).

In 1999, the Umpqua Basin Watershed Council (UBWC) undertook a study of stream temperature for the entire Lower Umpqua River sub-basin to determine temperature trends for the Lower Umpqua River and its tributaries, including streams in the Mill Creek Watershed (the Smith report).[25] Continuously sampling sensors were placed at 119 locations within the sub-basin. During 2000, 48 temperature loggers were deployed. On average, the daily fluctuation in temperature at a given site was 8.3^{o}F. Tributary streams tended to be about 10^{o}F cooler than the Umpqua River, with smaller streams generally cooler than larger streams. Maximum temperature of the coldest streams suggested that stream temperature increased about 10^{o}F every 10 miles, but some streams were warmer than would be suggested by this relationship.

Measured temperature during 2000 is illustrated in Figure 3.3 for Camp Creek at its mouth. Also shown are seven-day average maximum and mean temperature values during the monitoring period. Available stream temperature data are summarized in Table 3.12 and Map 3.11 for 21 monitoring sites within the watershed. Results are highly variable depending on location. The

[24] Cold water holds more oxygen than warm water; as water becomes warmer, the concentration of oxygen decreases.

[25] Copies of this study, "Lower Umpqua Watershed Temperature Study, 1999" by Kent Smith, are available at the UBWC office.

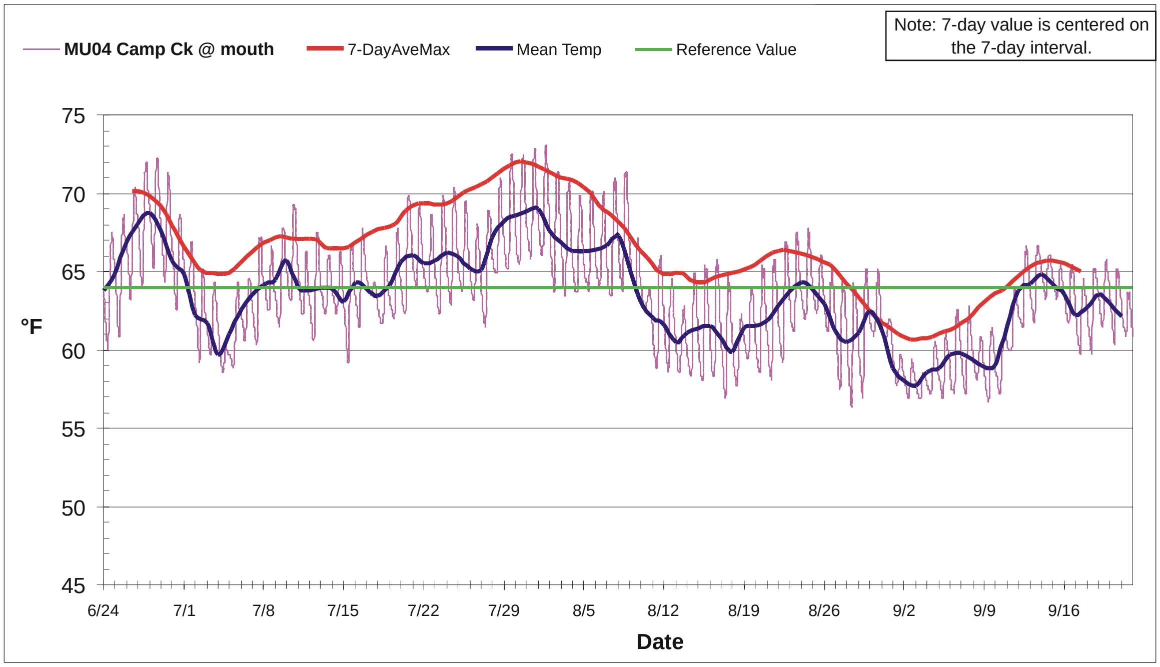
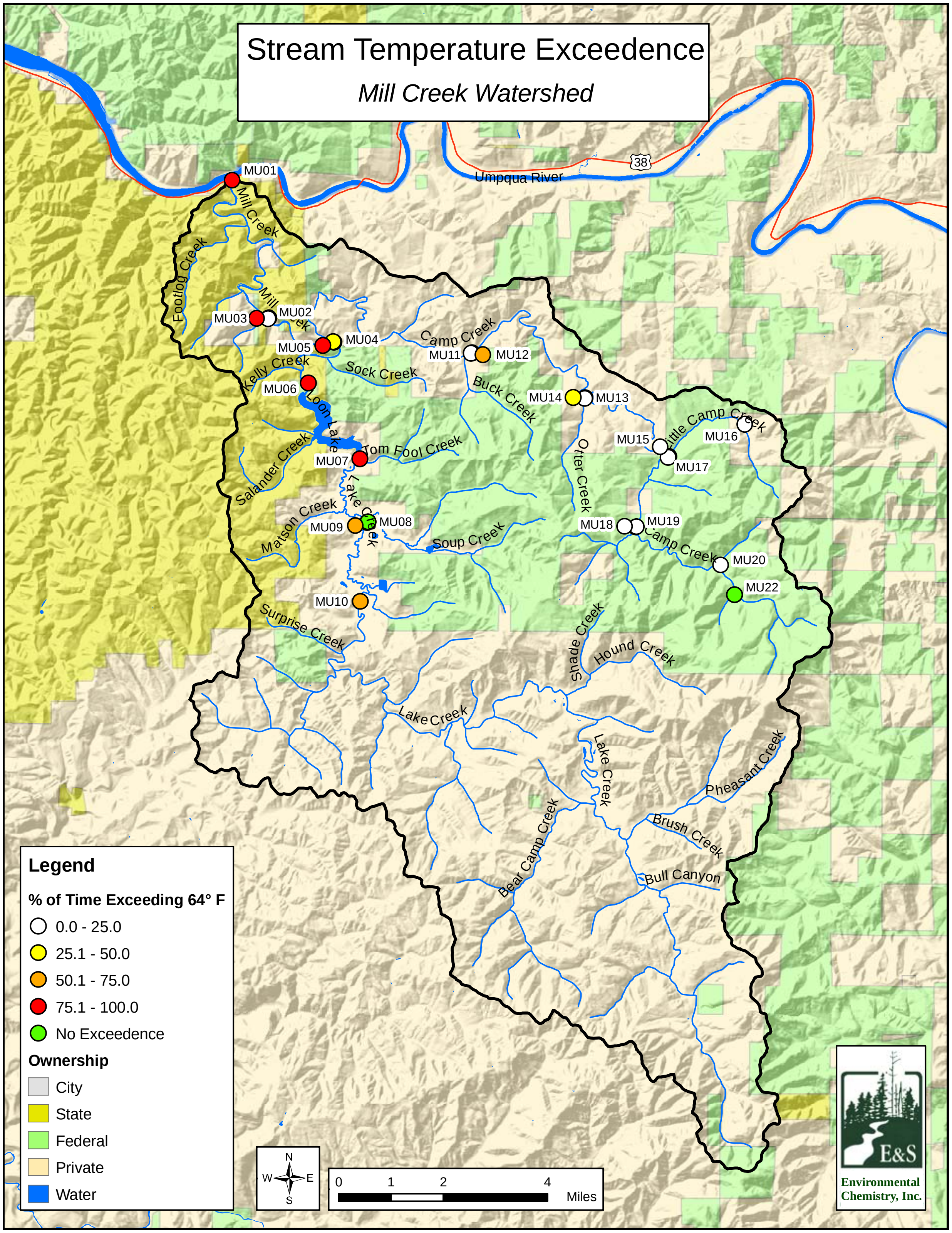


Figure 3.3. Measured stream temperature during the summer to early fall period for Camp Creek at its mouth.

Table 3.12. Percent of time during the summer to early fall monitoring period that streamwater temperature exceeded the 64°F standard, based on UBWC monitoring data.

Site Name	Site No.	Percent Exceeded		Site No.	Percent Exceeded
Mill Creek at mouth	MU01	100.0	Camp Creek above Buck Creek	MU12	53.5
Double Barrel Creek at mouth[1]	MU02	0.3	Otter Creek at mouth	MU13	7.2
Mill Creek above Double Barrel	MU03	91.2	Camp Creek above Otter Creek	MU14	43.7
Camp Creek at mouth	MU04	44.1	Little Camp Creek at mouth	MU15	4.1
Mill Creek above Camp Creek	MU05	99.4	Upper Little Camp Creek	MU16	3.0
Mill Creek below Loon Lake[1]	MU06	99.9	Camp Creek above Little Camp Creek	MU17	19.2
Lake Creek above lake	MU07	100.0	Small tributary at mouth	MU18	13.9
Soup Creek at mouth	MU08	0.0	Camp Creek above tributary	MU19	1.2
Lake Creek above Soup Creek	MU09	56.0	Tributary at mouth	MU20	0.5
Lake Creek at 13818	MU10	74.0	Belshazzar Creek near mouth	MU22	0.0
Buck Creek at mouth	MU11	18.6			

[1] Stream temperature monitoring did not begin until 7/16/00 for these two sites.



Map 3.11. Water temperature exceedences at UBWC monitoring site locations in the Mill Creek Watershed.

upper reaches of the Camp Creek tributary system exhibited little temperature exceedence. Temperature exceedences above the 64°F standard were much more common along the mainstem of Lake Creek and especially Mill Creek.

3.3.4.3. Influences on Stream Temperature

The ultimate source of stream heat is the sun, either by direct solar radiation or by ambient air and ground temperatures around the stream, which are also a result of solar energy.[26] Groundwater is not exposed to solar energy, and therefore is at the coolest temperature (near 52°F in the Umpqua Basin). Since groundwater accounts for a large proportion of a stream's flow at the headwaters, streamflow is generally coolest at the headwaters. When groundwater enters a stream and become surface water, it is exposed to solar energy and will become warmer as it flows downstream until it reaches equilibrium with ambient temperatures and direct solar radiation levels. As solar energy inputs change, such as at night, so do the ambient and stream temperatures.

Stream temperature at a given location is influenced mainly by two factors: the temperature of the upstream flow and local conditions. As upstream flow reaches a given stream location, factors such as stream morphology and riparian buffer conditions can affect warming rates. For example, the Smith (1999) report indicates that when upstream flow enters a reach that is highly exposed to direct solar radiation, the flow in that reach is usually warmer than would be expected from the upstream flow's temperature.

Data reported by Biosystems (2003) indicate that streams in Elliot State Forest within the Mill Creek and nearby Lower Umpqua River watersheds generally maintain-stream temperatures below 70°F, even at distances of 20 miles from the drainage divide (Biosystems 2003), where riparian shade is greater than 80%. Even with full shading, however, it is highly likely that stream temperatures will warm to above the 64°F temperature standard during the summer months within a certain distance from the drainage divide. For example, Biosystems (2003) presented stream temperature data for 13 sites along the West Fork Millcoma River in the Coos Bay River Basin. They found that stream temperature increased, on average, to above 64°F about 3.4 miles below the drainage divide under existing shade conditions. When they added a variable to reflect stream shading (average percent shade within two miles upstream from the site), the stream temperature would be predicted to exceed 64°F at a distance of 10 miles below the drainage divide even under 100% shade conditions. If average shade was only 80%, then stream temperature was predicted to exceed 64°F at distances greater than 2.2 miles below the drainage divide. Thus, the amount of stream shading can have a large impact on temperature standard exceedences, but temperatures can exceed the standard even with the full shading. This relationship also suggests that for streams with 70% shade that are within 20 miles of the drainage divide, a 10% loss of shade would result in an increase in stream temperature of about 2.4°F.

Although shade and distance from the drainage divide are clearly important in regulating stream temperature, other factors can also be important. Localized groundwater influx and tributary flow can reduce stream temperature. When groundwater enters a stream, it mixes with the

[26] Friction adds a very small amount of heat to streams. Geothermal heat is a minor factor in the Umpqua Basin.

warmer surface flow until temperature equilibrium is reached. As the proportion of groundwater increases, so will the cooling effect. Groundwater has the greatest influence on small and medium-sized streams. This is partially because groundwater constitutes a greater proportion of the flow in a small stream. Cooler flow from small tributaries entering larger streams can, like groundwater influx, reduce stream temperature. In some cases, this may also occur when a tributary is practically dry. Evidence from the Smith (1999) report suggests that in some cases tributaries with gravel-dominated streambeds permit cooler subsurface water to pass into the mainstem, even when the stream has no surface flow. Smith (1999) suggests that the lower reaches and mouths of small and medium-sized tributaries, and reaches within warm streams that have high groundwater influx and shade, may provide important shelter for fish during the summer months. This suggests that re-introduction of large boulders and large woody debris, which will increase the amount of gravel retained in the stream channel, may help to cool streamwater. Local restoration projects that improve shade and gravel conditions may be effective in improving stream temperature conditions in many small streams in the Umpqua Basin.

3.3.5. Surface Water pH

The hydrogen ion concentration of a liquid, which determines acidity or alkalinity, is expressed using pH. A logarithmic scale that ranges from 1.0 to 14.0 measures pH. On this scale, a pH of 7.0 is neutral, more than 7.0 is alkaline, and less than 7.0 is acidic. Unpolluted rainwater is normally slightly acidic due to the presence of carbonic acid, which is derived from carbon dioxide present in the atmosphere.

The beneficial uses affected by high or low pH levels are resident fish and aquatic life, and water contact recreation. When pH levels are outside of the stream’s normal range, fish and other animals become more susceptible to diseases. Also, pH affects nutrients, toxics, and metals within the stream. Changes in pH can alter the chemical form and affect availability of nutrients and toxic chemicals, which can harm resident aquatic life and be a human health risk. In mining areas, there is the potential for both low pH levels and the presence of heavy metals.

In an attempt to differentiate between the natural variability of surface water pH and the changes caused by other factors, ODEQ established a range of acceptable pH levels for river basins or for specific bodies of water. In the Umpqua Basin, the acceptable pH range is 6.5 to 8.5. When 10% or more of pH measurements from the same stream are outside of the 6.5 to 8.5 range, the stream is designated water quality limited.

Available data from the Umpqua Soil and Water Conservation District (SWCD) suggest that Lake Creek has pH that ranges between about 6.6 and 6.7 (Table 3.12). Data were not available for other streams within the watershed. There is no reason to believe that these pH values are impacted by human activities.

3.3.6. Dissolved Oxygen

In the Umpqua Basin, cold-water aquatic organisms are adapted to waters with high amounts of dissolved oxygen (DO). Salmonid eggs and smolts are especially sensitive to DO levels. If levels drop too low for even a short period of time, eggs, smolts, and other aquatic organisms can die. Therefore, the beneficial uses most affected by DO are resident fish and aquatic life, salmonid fish spawning, and salmonid fish rearing.

The amount of oxygen that is dissolved in water will vary depending upon temperature, barometric pressure, flow, and time of day. Cold water dissolves more oxygen than warm water. As barometric pressure increases, so does the amount of oxygen that can dissolve in water. Flowing water has more DO than still water. Aquatic organisms produce oxygen through photosynthesis and use oxygen during respiration. As a result, DO levels tend to be highest in the afternoon when algal photosynthesis is at a peak, and lowest before dawn after organisms have used oxygen for respiration during the night.

Since oxygen content varies depending on many factors, ODEQ has many DO criteria. ODEQ's standards specify oxygen content of streamwaters during different stages of salmonid life cycles and for gravel beds. Standards change based on differences in elevation and stream temperature. During months when salmon are spawning, ODEQ uses 11.0 mg/L as the DO standard for freshwaters in the Mill Creek Watershed. For the rest of the year, the standard is 8.0 mg/L. For estuarine waters, which include the lower reaches of Mill Creek within the watershed, the standard is 6.5 mg/L.

Information regarding DO in the Mill Creek Watershed is inconclusive. Data available from the EPA include two water samples that were collected between 1994 and 1996, neither of which indicated low DO values (Table 3.13). The Umpqua SWCD collected samples on two occasions in the summer of 2002 at sites approximately 200 feet apart. DO levels were below water quality standards for these samples; however the number of locations and samples is insufficient to draw conclusions about DO conditions based on these data. Further investigation of DO conditions in the watershed may be advisable. No streams are 303(d) listed for DO in the watershed.

3.3.7. Nutrients

The beneficial uses affected by nutrients are aesthetics or "uses identified under related parameters."[27] This means that a stream may be considered water quality limited for nutrients if nutrient levels adversely affect related parameters, such as DO, that negatively impact one or more beneficial uses, such as resident fish and aquatic life. Possible nutrient sources include feces and urine from domestic and wild animals, wastewater treatment plant effluent, failing septic system waste, fertilizers, and nitrogen fixation associated with certain plant species, especially red alder. High nutrient levels during the summer encourage the growth of algae and aquatic plants. Excessive algal and vegetative growth can result in reduced DO, and interfere with aesthetics and water contact recreation. Also, some species of algae produce by-products that are toxic to humans, wildlife, and livestock, as occurred in Diamond Lake in the summer of 2002.[28]

Currently, there are no Umpqua Basin-based ODEQ values for acceptable stream nutrient levels and no streams that are 303(d) listed for nutrients in the Mill Creek Watershed. Therefore, this assessment used the OWEB recommended standards for evaluating nutrient levels in the

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[27] From ODEQ's *Oregon's Approved 1998 303(d) Decision Matrix* (1998).
[28] Diamond Lake is within the Umpqua National Forest in the extreme eastern portion of the Umpqua Basin.

Table 3.13. Mill Creek water quality data available from EPA. Also provided is the percent of samples below the dissolved oxygen criterion of 6.5 mg/L and above the turbidity criterion of 50 NTU.

Parameter Name	Station Description	Year	Number of Samples	Median[1]
Dissolved Oxygen (mg/L)	Unnamed tributary of Lake Creek at River Mile 1.0	1994-1996	2	9.90
Nitrate as N (mg/L)	Unnamed tributary of Lake Creek at River Mile 1.0	1994-1996	2	0.04
Phosphorus (: g/L)	Unnamed tributary of Lake Creek at River Mile 1.0	1994-1996	2	25.00
Turbidity (NTU)	Unnamed tributary of Lake Creek at River Mile 1.0	1994-1996	2	2.50
	Lake Creek downstream of Craig Creek	2001	3	6.00
	Lake Creek at mouth of unnamed tributary, upstream of Loon Lake	2001	3	7.00

[1] Not enough samples were gathered to accurately determine whether water quality conformed to the criterion.

watershed. OWEB recommends using 0.05 mg/L for total phosphorus, and 0.3 mg/L for total nitrate (including nitrites and nitrates).

Table 3.13 shows total nitrate and phosphorus sampling locations and results available from EPA for monitoring sites within the Mill Creek Watershed since 1979. There are not sufficient data available with which to make a determination regarding the nutrient status of streams within the watershed. At the present time, there is no reason to suspect that nutrients limit water quality in the Mill Creek Watershed.

3.3.8. Bacteria

Mill Creek is not 303(d) listed for fecal coliform bacteria, and water quality monitoring efforts in the watershed to date have not studied bacteria. Consequently, the quality of water with regard to fecal coliform bacteria is unknown in the Mill Creek Watershed.

However, there are many streams and rivers throughout the Umpqua Basin that are water quality limited due to fecal coliform bacteria affecting water contact recreation and shellfish harvest. The Umpqua River (including the estuary), South Umpqua River, Scholfield Creek, Deer Creek, North Fork Deer Creek, Elk Creek, and Calapooya Creek have violated water quality standards for fecal coliform bacteria. In response to 303(d) listings for bacteria, ODEQ prepared a draft TMDL analysis for the entire Umpqua Basin in April, 2004. Fecal coliform bacteria sources may include wildlife and livestock waste, failing residential septic systems, wastewater treatment plant malfunctions, rural residential runoff, and urban runoff. The TMDL analysis includes descriptions of individual watersheds, the pollutants responsible for impairment, standards being applied, sources of the pollutants, a description of data collected, loading capacity, and determined allocations of fecal coliform bacteria loads on a watershed scale, incorporating a margin of safety.

In general, fecal coliform bacteria loading in the Umpqua Basin appears to be dominated by nonpoint sources, although point sources also impact the estuary on occasion. Nonpoint source pollution comes from diffuse sources such as livestock and agricultural runoff, as opposed to point source pollution, which is discharged by individual facilities through a pipe into a waterbody.

3.3.9. Sedimentation and Turbidity

3.3.9.1. Overview of Sedimentation and Turbidity

Natural resource scientists refer to sediment as any organic or inorganic material that enters a stream and settles to the bottom. In addition to small particles of clay or silt, sediment also includes larger particles such as sand, gravel, and boulders, as well as branches and logs. When considering water quality and aquatic habitat, this assessment specifically refers to two different aspects of sediment delivery to the stream and transport within the stream channel. Very fine particles of organic or inorganic material have the potential to form streambed "sludge." This excessive accumulation of fine sediment within the stream channel causes deterioration of aquatic habitat quality. The other important aspect of sediment delivery and transport is the delivery of gravel to the stream (generally from landslides) and subsequent movement of that gravel within the stream channel. Availability of gravel in the streambed is important for salmonid spawning. Thus, sediment contribution to the stream channel can have both negative (fine sediment) and positive (coarse sediment) effects on in-stream habitat quality. Both issues are addressed in this section, but the emphasis is on the role of fine sediments in the streamwater.

The beneficial uses affected by sediment delivery and transport are resident fish and aquatic life, and salmonid fish spawning and rearing. Salmonids need gravel beds for spawning. Eggs are laid in a gravel-covered nest called a "redd." Water is able to circulate through the gravel, bringing oxygen to the eggs. The sludge layer resulting from excess fine sediment accumulation restricts water circulation through the redd and can suffocate salmonid eggs. Although there are many aquatic organisms that require gravel beds, others, such as the larvae of the Pacific lamprey (*Lampetra tridentata*), thrive in streams having large amounts of fine sediment.

Turbidity is a measurement of water clarity, which provides an indication of the amount of fine sediment suspended in the water. In many cases, high turbidity indicates a large amount of suspended fine sediment in a stream. Small particles of silt and clay will stay suspended in solution for the longest amount of time. Therefore, streams flowing through areas with soils comprised of silt and clay are more likely to be turbid than streams in areas with coarser soil types. Also, turbidity levels rise during storm events. This is because rapidly moving water has greater erosional energy than slower water. During storms, streambanks erode and some upland material can be washed into the stream from surface flow, which adds additional fine sediment to the stream system.

The beneficial uses affected by turbidity are resident fish and aquatic life, public and private domestic water supply, and aesthetic quality. As turbidity increases, it becomes more difficult for sight-feeding aquatic organisms to see, impacting their ability to search for food. High levels of suspended sediment can clog water filters and the respiratory structures in fish and other aquatic life. Suspended sediment is a carrier of other pollutants, such as bacteria and toxins, which is a concern for water quality in general. Finally, clear water is simply more pleasant than cloudy water for outdoor recreation and enjoyment.

Suspended sediment is considered to be water quality limiting if beneficial uses are impaired. ODEQ determines impairment by monitoring changes in aquatic communities (especially macroinvertebrates, such as aquatic insects), and fish populations, or by using standardized protocols for evaluating aquatic habitat and fish population data. Currently, ODEQ monitors streams for total suspended solids. However, neither ODEQ nor OWEB has established criteria for this parameter. There are currently no streams in the Mill Creek Watershed that are 303(d) listed for sedimentation. Available data are limited, but generally do not suggest that sedimentation is a problem in the watershed**.**

Turbidity is measured by passing a light beam through a water sample. As suspended sediment increases, less light penetrates the water. Turbidity is recorded in NTUs (nephelometric turbidity units), and high NTU values reflect high turbidity. According to ODEQ, turbidity is water quality limiting when NTU levels have increased by more than 10% due to an on-going operation or activity, such as dam release or irrigation. There are no streams in the Mill Creek Watershed that are 303(d) listed for turbidity.

The Oregon water quality standard for turbidity does not specify a numerical value. OWEB recommends using 50 NTU as the turbidity evaluation criteria for watershed assessments. At this level, turbidity may interfere with sight-feeding aquatic organisms. None of 24 Mill Creek Watershed turbidity samples exceeded 50 NTU (Table 3.12). Measured values at all sampling sites were less than about 25% of the evaluation criterion value. There is no reason to suspect that turbidity is an important water quality concern in the mainstem river. Additional monitoring is necessary to determine if turbidity levels are of concern in tributaries.

3.3.9.2. *Erosion and Sediment Delivery Processes*[29]

Erosion is a naturally-occurring process, which is primarily determined by climate, geology, soils and topography. In the Mill Creek Watershed, there are two distinct zones of erosional activity: the steep, forested upland, and the broad, lowland floodplain of Lake Creek before it enters Loon Lake. On the steep slopes and shallow soils of the forested uplands, landslides, including debris slides and debris flows, account for the majority of erosion. In lowland areas, the dominant erosional processes include streambank erosion and erosion associated with livestock and agricultural practices.

Table 3.14 displays the geological formations within the Mill Creek Watershed. These features have erosional hazards associated with them based on properties such as texture, permeability, and mineral content. The content of this table is based primarily on Beaulieu and Hughes’s 1975 work on environmental geology, updated by BLM to reflect more recent work on the geologic stratigraphy as shown in geology maps prepared by Niem and Niem (1990).

The majority of erosion and sediment movement occurs during infrequent, large flood events, which often result from an intense rainstorm that melts an existing snowpack, causing extremely high flows in the streams and rivers. Over the past half-century there have been two unusually

[29] Kristin Anderson, Tim Grubert, and John Runyon of BioSystems, Inc., contributed portions of the introductory text for this section.

large flood events in western Oregon (December, 1964 and February, 1996). Exceptionally high rates of erosion occur when a severe wildfire is followed by a large flood in the subsequent winter, triggering numerous landslides.

Table 3.14. Descriptions of primary geologic formations in and near the Mill Creek Watershed. (Source: BLM 2005)

Formation (Symbol)	Rock Type, Structure and Bedding	Soils	Associated Hazards	Activity Most Affected
Bateman (Teb)	Thick-bedded to cross-bedded, medium-grained micaceous arkosic sandstone and minor siltstone. Locally bearing subbituminous coal and carbonaceous siltstone	Loamy sand and sandy loam; very thin soils on steeper slopes with abrupt transition to bedrock. The typical soils are: Preacher, Bohannon, Milbury, Umpcoos, and rock outcropping.	Rapid erosion, flash flooding, rapid mass movement, debris flows, stream bank erosion.	Roads and clearcut timber harvest Side cast road construction on very steep and extremely steep slopes risks overloading marginally stable slopes.
Tyee, undifferentiated, fan and slope facies (Tet_b)	Thick to very thick-bedded cliff-forming, micaceous arkosic sandstone and thin-bedded siltstone.			
Flournoy Siuslaw Member (Tef_3)	Very thick-bedded, massive to graded fine-grained micaceous amalgamated lithic-feldspathic sandstone with minor sequence of thin-bedded siltstone and fine- to very fine-grained sandstone beds and some very thick-bedded channalized sandstone.			
Elkton (Tee)	Micaceous siltstone with thin to thick sandstone lenses and rhythmically interbedded thin graded micaceous sandstone and siltstone.	Silty loam and silty clay loam; locally very thin. Typical soils are: Preacher, Blachley, and Bohannon, Jason, and Digger.	Rapid erosion, mass movement, slumps, stream bank erosion.	Roads Road failures frequently involve poorly consolidated or poorly drained road fills. Failures are also associated with embankments greater than 12 to 15 feet on any red clayey soil (for example: Honeygrove, Blachley, or Jory)

Landslides are the primary erosional process, and are responsible for depositing sediment and woody debris into streams. A landslide from a forested hillside will generally contain soil, gravel, organic material, and a substantial amount of woody debris. This mixture causes significant changes in the affected stream reach. In the short term, a landslide or debris flow can scour a channel and remove beneficial prey (i.e. stream insects) and channel structures, depositing large amounts of silt, gravel, boulders, and wood downstream. Over the long term, these events maintain the balance of woody debris, organic matter, and gravel that are requirements of productive aquatic habitat.

Native fish and aquatic organisms are adapted to natural levels of erosion and sediment deposition. However, the additional erosion attributed to human activities can result in an excess of fine sediment (small particles, such as clay and silt) in the stream system. Increased erosion can be harmful to many aquatic organisms, including threatened salmon species, because excessive amounts of fine sediment can decrease sunlight penetration, leading to reduced photosynthesis, decreased DO levels, and increased siltation of spawning gravels.

3.3.9.3. Impacts on Erosional Processes and Sediment Production

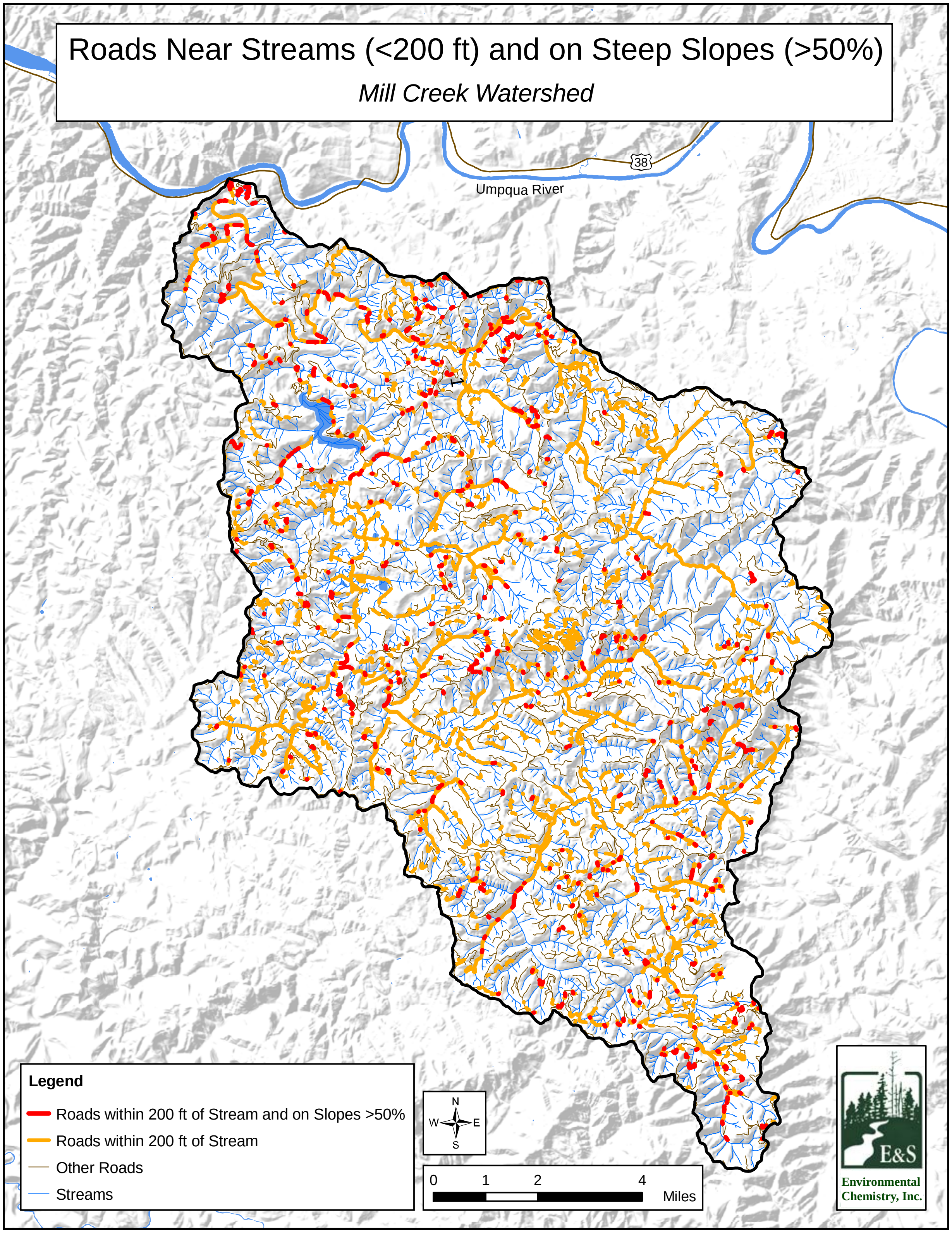
Although landslides occur under natural conditions, human activities have been shown to influence the timing or rate of erosion throughout western Oregon. Poor road construction and inadequate road maintenance can result in increased erosion and sedimentation, adversely impacting the stream system. Vegetation removal, such as by logging or wildfire, may also increase the likelihood of landslide occurrence. Sedimentation can also be associated with urban development. However, with proper management, impacts associated with land use activities can be minimized.

Changes in road construction methods over the past several decades have improved road conditions. If roads are well constructed and maintained, erosion and sedimentation can be minimal. The extent of the impact of a road on the stream system is dependent on many factors, including road location, proximity to stream, slope, and construction techniques. Ridge top roads on slopes less than 50% generally have little impact on streams. Valley bottom and mid-slope roads, especially those on steep slopes or near streams, can affect sediment delivery to streams. Road design issues include the road surface type, ditch infeed lengths, proximity to nearest stream channel, road condition, and level and type of use the road system receives. Since complete road data for the watershed are not available, specific values for sediment delivery from the road system are not included in this assessment. Rather, this assessment looks at the road-to-stream proximity and slope of roaded areas to determine the likely relative impacts of roads on sediment delivery to streams.

The closer a road is to a stream, the greater the likelihood that road-related runoff contributes to sedimentation. In the Mill Creek Watershed, there are 220 miles of roads (31% of 707 total miles) within 200 feet of streams (see Map 3.12). No impending landslide sites were identified during the Elliott State Forest Assessment.

Roads on steep slopes have a greater potential for erosion and/or failure than roads on level ground. There are only approximately 18.7 miles of roads (2.6% of 707 total miles) located on a 50% or greater slope and within 200 feet of a stream within the Mill Creek Watershed (see Map 3.12). An analysis of road conditions near streams is necessary to determine how much stream sedimentation is potentially attributable to road conditions. Information on road surface types and conditions is lacking from most areas of the Mill Creek Watershed.

Like roads, culverts can contribute to stream sedimentation when they are failing. Culverts often fail when the pipe is too narrow to accommodate high streamflows, or when the pipe is placed too high or too low in relation to the stream surface. In the latter cases, the amount of flow overwhelms the culvert's drainage capacity, and water floods around and over the culvert, eroding the culvert fill, road, and streambank. The Umpqua Basin Fish Access Team (UBFAT)



Map 3.12. Mill Creek Watershed roads within 200 feet of a stream and on slopes greater than 50%.

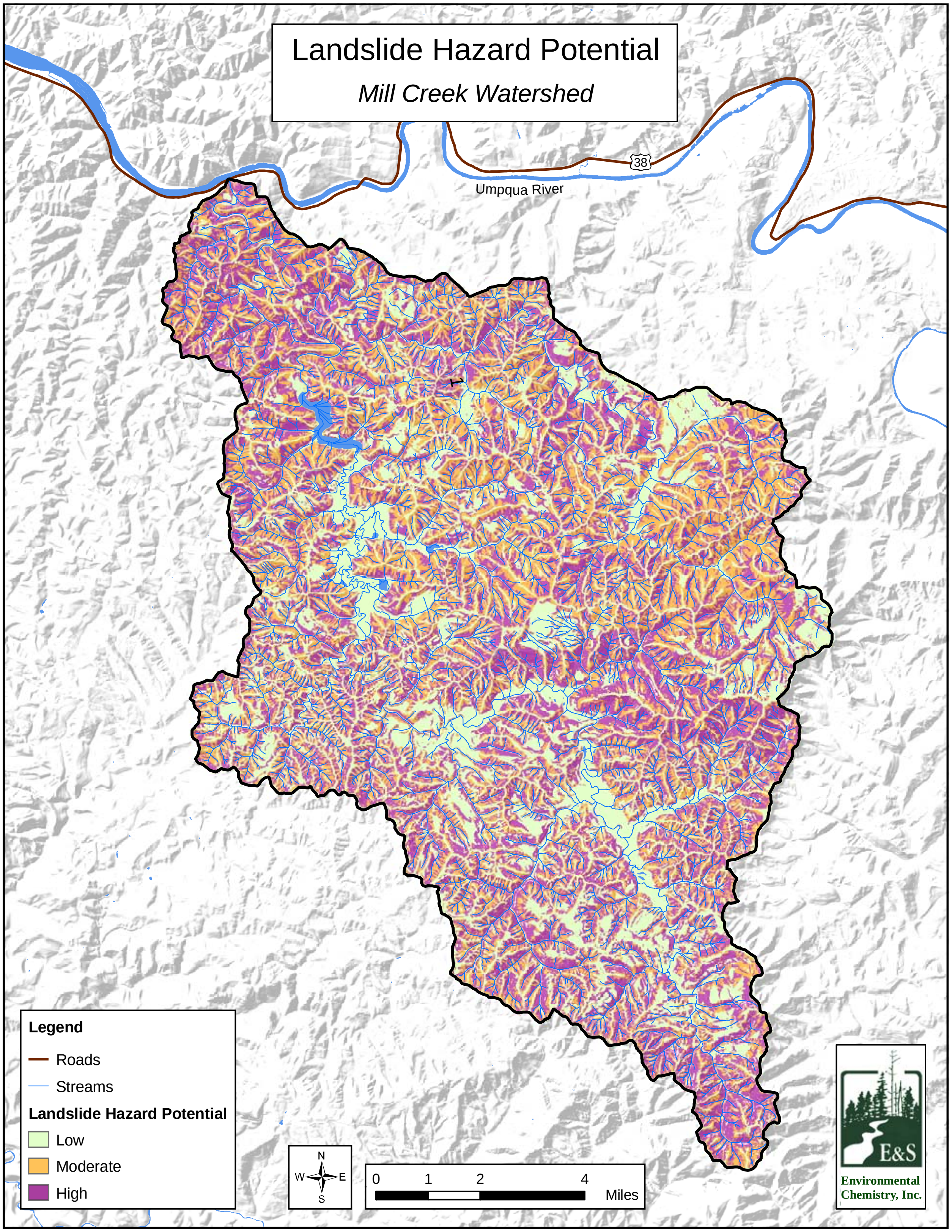
is currently evaluating culverts throughout the Umpqua Basin, but results were unavailable at the time of writing. See Section 3.1.3 for a discussion of the effects of culverts on fish populations.

Steep slopes provide greater energy to runoff and therefore have more power to deliver sediment to streams. Slope is an important factor in determining sediment delivery to streams, both in long-term erosion processes and in catastrophic events. Map 1.2 on page 1-4 shows the slope throughout the watershed. The northwestern portion of the watershed and some of the uppermost tributary systems generally have steeper slopes.

The slope will clearly influence the hazards for landslide and mass sediment delivery downslope. Physical characteristics of geologic units have also been shown to influence the occurrence of debris flows. The Oregon Department of Forestry (ODF 2000) identified areas that may be naturally prone to debris flows. Using slope steepness, geologic units, stream channel confinement, geomorphology, and historical information on debris flows, they created coarse-scale maps of moderate, high, and extreme natural debris flow hazards. While this information is not intended for localized management decisions, it is a tool to locate areas where further field investigations may be pertinent when determining management plans.

Natural debris flow hazards in the Mill Creek Watershed are shown in Map 3.13. Hazard potential was derived from an empirically-based landslide initiation model developed by the Coastal Landscape Analysis and Modeling Study (CLAMS), a collaborative project of the USDA Forest Service, ODF, and Oregon State University. Landslide density was modeled from a 10-meter Digital Elevation Model and ranges from 0 to 25 landslides per square kilometer (0 to 64.7 landslides per square mile). High landslide potential was defined for this assessment as greater than 1.5 landslides per square kilometer (3.9 landslides per square mile). Moderate landslide potential was defined as 0.1 to 1.5 landslides per square kilometer (0.26 to 3.9 landslides per square mile), and low landslide potential less than 0.1 landslides per square kilometer (0.26 landslides per square mile). Thirty percent of the land area within the Mill Creek Watershed was classified as having high debris flow hazard.

Mass movement following a fire can transport tremendous amounts of sediment and wood debris to stream channels. Burned areas erode more easily than unburned areas because of the temporary lack of vegetative cover, loss of soil cohesion provided by roots, and abundance of fine material, such as ash. Reeves (1996) concluded that mass movement following fire can deposit so much material that 6 to 12 feet of sediment and coarse debris can still remain in the channel 100 years after the event. Many terrace-like features next to mountain streams are deposits of debris avalanche transported material that the stream subsequently cut through. The accelerated erosion associated with intense fire, compared with normal background levels, may cause a five-fold increase in sediment yield. The recovery to pre-fire sediment yields may take 20 to 30 years (Swanson 1981). In the Coast Range, very large stand-replacement fires have a return rate of about 240 years (Ripple 1994). Based on that return rate, elevated sediment levels are observed 8% to 12% of the time when periods long enough to include stand replacement fires are considered. Smaller fires and less severe fires caused additional smaller spikes of fire-associated sediment. However, there are no data suggesting that fires have contributed excessive amounts of sediment to streams in the watershed in recent years.



Map 3.13. Natural debris flow hazard areas in the Mill Creek Watershed.

3.3.9.4. Role of Soils in Sedimentation Processes[30]

Certain characteristics of soils within the watershed play important roles in erosion and storm runoff, both of which impact streams. Rapid runoff from rain events can cause pulses of sediment throughout stream systems. Both erosion potential and hydrologic soils grouping reflect qualities of soils that can indicate areas prone to erosion that may negatively impact stream characteristics.

The K-factor, or soil erodibility, is a measure of detachability of the soil, infiltration, runoff, and the transportability of sediment that has been eroded from the soil. Texture (the relative percentage of different grain sizes within the soil), organic matter, structure, and permeability of the soil determine the K-factor value assigned to a soil. In general, soils with high infiltration rates (and thus low runoff rates), low detachability, and low transportability are least likely to erode, and are given low K-factor values (USDA Agriculture Research Service National Sedimentation Laboratory 2003). K-factor values typically range from 0.0 to 0.6. K-factor values for soils are determined in the Natural Resources Conservation Service's (NRCS) soil survey process.

Map 3.14 depicts the K-factor within the Mill Creek Watershed. Most of the watershed has low erosion potential. The most erosive areas are located in the eastern portion of the watershed (Map 3.14). Nearly half of the watershed has been assigned a K-factor of zero, whereas only about 5% of the watershed has been assigned a K-factor greater than 0.3 (Table 3.15).

Table 3.15. Soil erodibility in the Mill Creek Watershed.

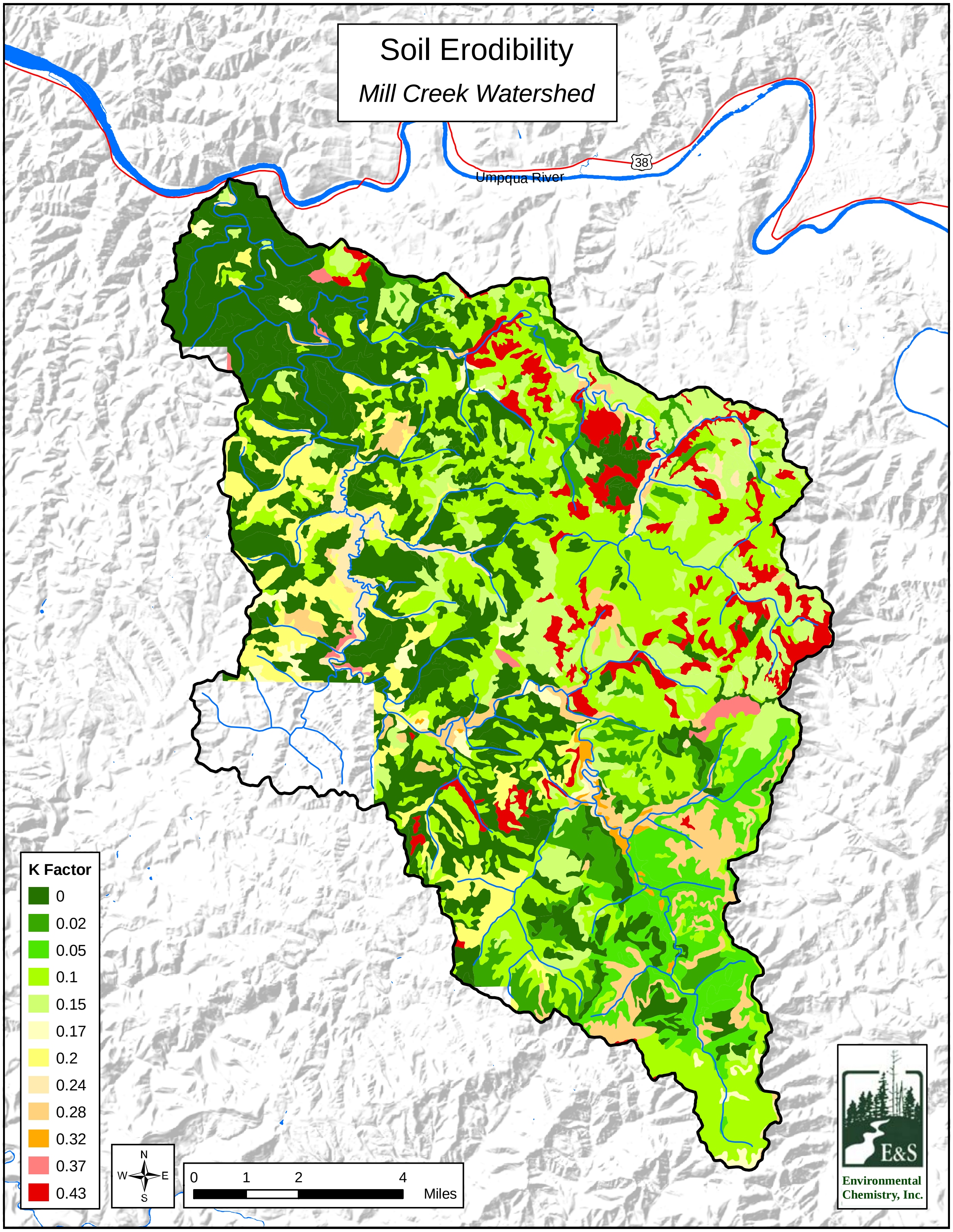
K-Factor	Area (acres)	Percent[1]
0.00	54,057	44.7
0.02	4,838	4.0
0.05	5,283	4.4
0.10	26,184	21.7
0.15	11,294	9.3
0.17	1,512	1.3
0.20	5,223	4.3
0.24	2,160	1.8
0.28	4,191	3.5
0.32	448	0.4
0.37	496	0.4
0.43	5,232	4.3

[1] Percents may not equal 100 due to rounding.

Hydrologic soil groups (HSG) provide a categorization of soils by their runoff potential and infiltration capacity. In these groupings, group A represents soils with the lowest runoff potential and the highest infiltration rate, while group D is on the opposite end of the spectrum, having high runoff potential and a low infiltration rate. The runoff potential and infiltration rate of soils influence the likelihood of erosion. With greater amounts of runoff, more erosion and higher peak flows are likely to occur, with the possibility of large pulses of sediment to streams.

Table 3.16 provides descriptions of the hydrologic soil groups. Map 3.15 and Table 3.17 show the distribution of hydrologic soils in the Mill Creek Watershed. The majority of the Mill Creek Watershed has soils in the B and C hydrologic soils groups (see Map 3.15), which have low to moderate infiltration rates. Soils with lowest infiltration rates and highest runoff potential are found in the northern portions of the watershed. These areas may be more prone to delivering sediment and faster runoff than other areas.

[30] Kristin Anderson and John Runyon of BioSystems, Inc., contributed some of the material for this section.



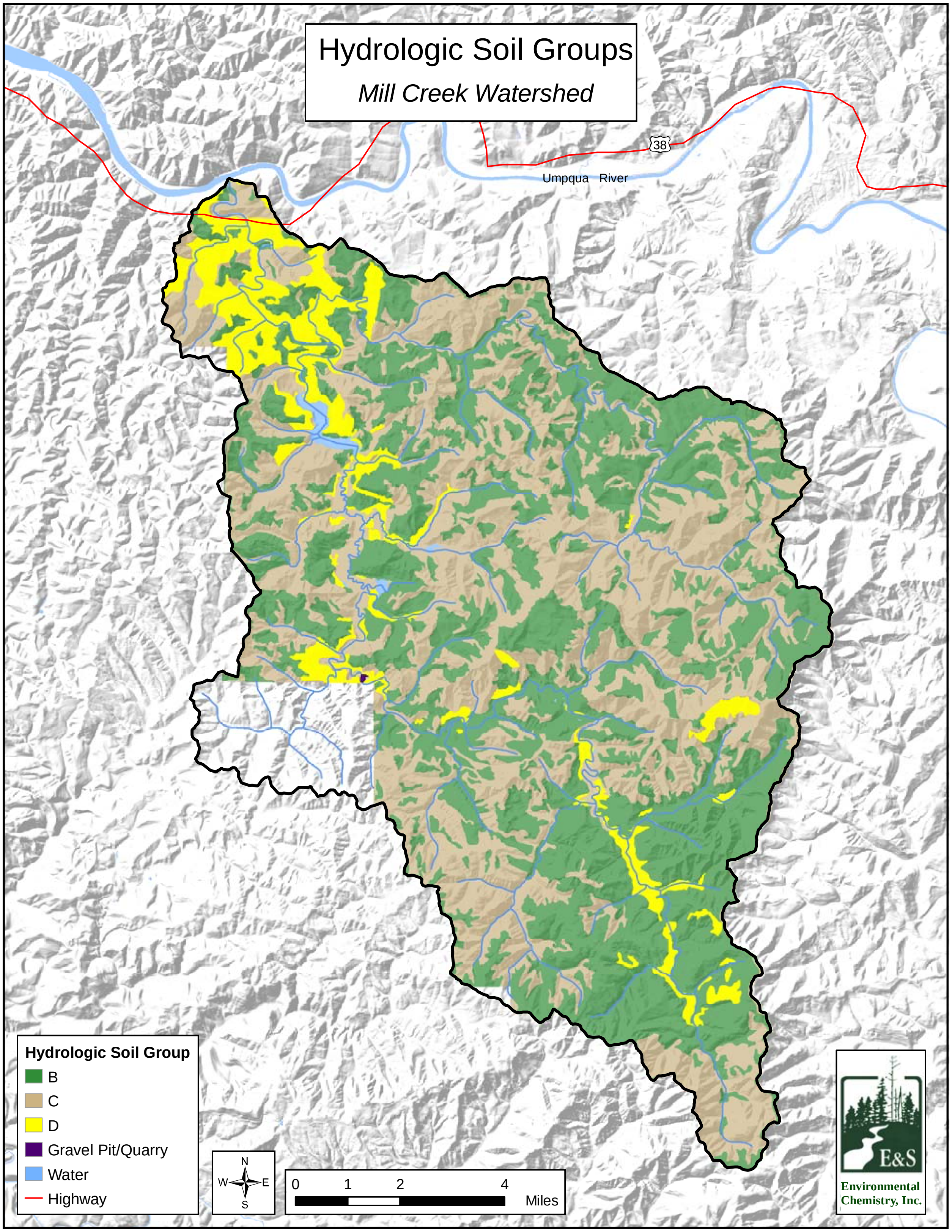
Map 3.14. Soil erosion potential and K-factor for the Mill Creek Watershed. Data are not available for the portion of the watershed that is uncolored.

Table 3.16. Hydrologic soil group descriptions.

HSG	Soil Description
B	Have moderate infiltration rates when thoroughly wetted and consist chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures; have a moderate rate of water transmission (0.15-0.30 in/hr).
C	Have low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine texture; have a low rate of water transmission (0.05-0.15 in/hr).
D	Have high runoff potential; have very low infiltration rates when thoroughly wetted and consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material; have a very low rate of water transmission (0-0.05 in/hr).

Table 3.17. Summary of hydrologic soil group statistics for the Mill Creek Watershed.

Hydrologic Soil Group (HSG)	Amount in Watershed	
	Square Miles	Percent
B	58.6	46.2
C	57.6	45.4
D	10.6	8.4
Gravel Pit/Quarry	< 0.1	< 0.1
Grand Total	126.8	100.0



Map 3.15. Hydrologic soils map of the Mill Creek Watershed. Data are not available for the portion of the watershed that is uncolored.

3.3.10. Water Quality Key Findings and Action Recommendations

3.3.10.1. Temperature Key Findings

- Portions of Mill, Camp, Little Camp, Buck, and Soup creeks have stream temperatures that periodically exceed the state standard for salmonids rearing and migration.
- Establishment of more riparian tree cover, to provide additional stream shading, would help to lower stream temperatures.

3.3.10.2. Surface Water pH, Dissolved Oxygen, Nutrients, Bacteria, and Toxics Key Findings

- Data are limited, but in general do not suggest that there are water quality concerns for pH or nutrients. Information regarding bacteria is lacking.
- Few data have been collected for DO. Results from the limited available data are inconclusive, but indicate the possibility that DO may be an issue of concern. Additional study is warranted.
- We found no data regarding toxics in this watershed. However, activities associated with the use of toxics are uncommon in the watershed, so it is unlikely that toxics are an issue in this watershed.

3.3.10.3. Sedimentation and Turbidity Key Findings

- Turbidity data indicate that usual turbidity levels in the Mill Creek Watershed should not affect sight-feeding fish like salmonids.
- Areas of moderate soil erodibility and runoff potential occur along several tributary streams in the eastern portions of the Mill Creek Watershed.
- Steep to moderately steep slopes are found through much of the watershed. Particularly steep slopes exist in the eastern portions of the watershed, especially in the upper Camp Creek subwatershed.
- The combination of steep slope and erosion-inducing human modifications such as roads, timber harvesting, agriculture, and residential development can make some areas prone to increased erosion.
- Runoff from impervious surfaces, such as roads, can increase sediment loads to streams.

3.3.10.4. Water Quality Action Recommendations

- Continue monitoring the Mill Creek Watershed for water quality conditions. Expand monitoring efforts to include more monitoring of tributaries.
- Identify stream reaches that may serve as “oases” for fish during the summer months, such as at the mouth of small or medium-sized tributaries. Protect or enhance these streams’ riparian buffers and, when appropriate, improve in-stream conditions by placing logs and boulders within the active stream channel to create pools and collect gravel.
- In very warm streams, increase shade by encouraging development of riparian buffers and managing for full stream canopy coverage.

- Encourage landowner practices that will minimize Lake Creek bacteria and sediment levels:
  - Limit livestock stream access by providing stock water systems and shade trees outside of the stream channel and riparian zones. Fence riparian areas as appropriate.
  - Relocate structures and situations that concentrate domestic animals near streams, such as barns, feedlots, and kennels. Where these structures cannot be relocated, establish dense riparian vegetation zones to filter fecal material.
  - Repair failing septic tanks and drain fields.
- In areas with high debris flow hazards and/or with soils that have high K-factor values and are in the C or D hydrologic group, encourage landowners to identify the specific soil types on their properties and include soils information in their land management plans.

3.4. Water Quantity

This chapter analyzes hydrology and water use and availability in the Mill Creek Watershed. Background information for this chapter was compiled from the *Oregon Watershed Assessment Manual* (Watershed Professionals Network 1999) and the *South Umpqua River Watershed Assessment and Action Plan* (Geyer 2003). Additional information and data are from the following groups' documents, websites, and specialists: the Oregon Water Resources Department (OWRD), and the Bureau of Land Management (BLM).

3.4.1. Human Impacts on Hydrology

Human activities in a watershed can alter the natural hydrologic cycle, potentially causing changes in water quantity and availability. Water is withdrawn from the stream system for municipal and industrial use, agriculture, and other purposes. In addition, changes in the landscape can increase or decrease the volume, size, and timing of runoff events and affect low flows by changing groundwater recharge. Important examples of human activities that have affected hydrology in the Mill Creek Watershed are water withdrawal for domestic, industrial, and agricultural use, timber harvesting, conversion of forested land to agriculture, and construction of road networks. The focus of the hydrologic analysis component of this assessment is to evaluate the potential impacts from land and water use on the hydrology of the watershed. It is important to note, however, that this assessment only provides a screening for potential hydrologic impacts based on current water and land use activities in the watershed. Quantifying those impacts would require a more in-depth analysis and is beyond the scope of this assessment.

The two principal land use activities that can affect the hydrology of upland portions of this watershed are forestry and forest roads. In lowland areas, livestock/agriculture and residential uses can also be important. Increased peak flows in response to management are a concern because they can have deleterious effects on aquatic habitats by increasing streambank erosion and scouring. High peak flows can cause downcutting of channels, resulting in channelization and a disconnection of the stream from the floodplain.

The Mill Creek Watershed has limited areas of livestock/agricultural land use. Land cover in Ash Valley and other tributary lowland areas changed significantly following Euro-American settlement. It is possible that livestock/agricultural practices changed the infiltration rates of the soils in higher, well-drained areas. Historical efforts to protect floodplain land uses may have simplified natural streamflow processes in some places and reduced the complexity of in-stream habitats that support fish and aquatic organisms. Loss of historical floodplain acreage and land cover (such as wetlands and forested valley bottoms) have likely had impacts on hydrologic conditions. Disconnecting the floodplain from the river may have contributed to a reduction in flood attenuation[31] capacity, increased peak flows, downcutting of channels, and increased flow velocities in Lake Creek.

Forestry practices have the potential to influence the magnitude of flooding, but it is difficult to quantify such effects because of the large natural variability in discharge. However, elevated

[31] Flood attenuation refers to the provision of temporary water storage during flood events, either naturally or through human intervention, for the purpose of reducing the impact of the peak flow.

peak flows and "flashiness" for small to moderate storm events might result from timber harvesting and road building activities. Potential effects include reduced evapotranspiration, decreased infiltration and subsurface flow, and increased runoff. Such changes may result in modified peak- and low-flow regimes and subsequent effects on in-stream aquatic habitat quality. However, quantitative information is not available regarding the magnitude of the changes in hydrology of the Mill Creek Watershed that might be attributable to forestry or any other land use. In addition, it is likely the land use changes would have to be made on a very large scale in order to have an appreciable effect on stream flows.

Past fires were associated with changes in the hydrologic regime. In general, a large proportion of the trees must be removed from a watershed before significant increases in peak flows are observed. The effects of fire on peak flows generally persist until trees are re-established, which is usually within a decade following the fire. Fires in the past several decades have not burned large areas of the Mill Creek Watershed, so we do not expect that there are significant effects of fire on hydrology in the watershed today.

3.4.2. Water Availability

In the book *Loon Lake and Ash Valley Revisited*, Sims (1998) provides a chronology of floods and snowstorms as dated by residents and visitors to the watershed. Although not comprehensive, some of the accounts do parallel local and regional weather events summarized in other publications and captured by nearby monitoring stations. Five notable snow events are mentioned in Sims' book. Valley snow depths of 37, 24, 19, 48, and 16 inches were reported in 1937, 1940, 1945, 1969, and 1988/1989, respectively. The 1937 event also produced heavy snowfalls on the west slopes of the Cascades and the Willamette Valley. In 1940, a resident reported that the snow caved in most barn roofs, froze and covered Loon Lake after Groundhog Day (February 2nd), and stayed for three weeks. In 1969, snow persisted for 19 days at the Elkton 3 SW weather station located 110 feet above sea level. The maximum snow depth recorded between January 25th and February 12th was 33 inches.

Data from OWRD have been used to determine water availability in the Mill Creek Watershed. Availability is based on streamflow, consumptive use, and in-stream water rights. The amount of water available for issuance of new water rights is determined by subtracting consumptive use and the in-stream water rights from streamflow. In most of the Umpqua Basin, there is little or no water available for new water rights from "natural" streamflow during the summer.[32]

To analyze water availability, OWRD has divided the Umpqua Basin into water availability basins, or WABs. The Mill Creek Watershed consists of two WABs, Camp Creek (#292) and Mill Creek (#327). Figure 3.4 shows the surface water availability for these two WABs.

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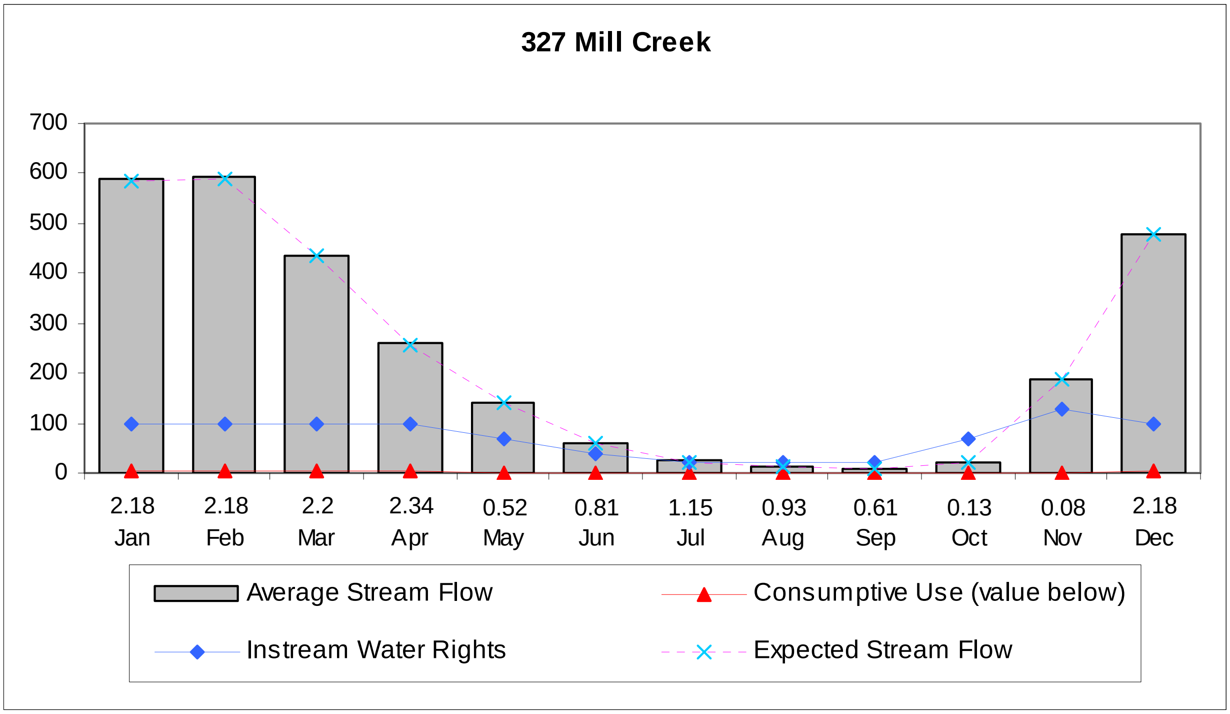
[32] In some circumstances, domestic water rights can be obtained if there is no other source of water on a property. Contact the Oregon Water Resources Department for more information.



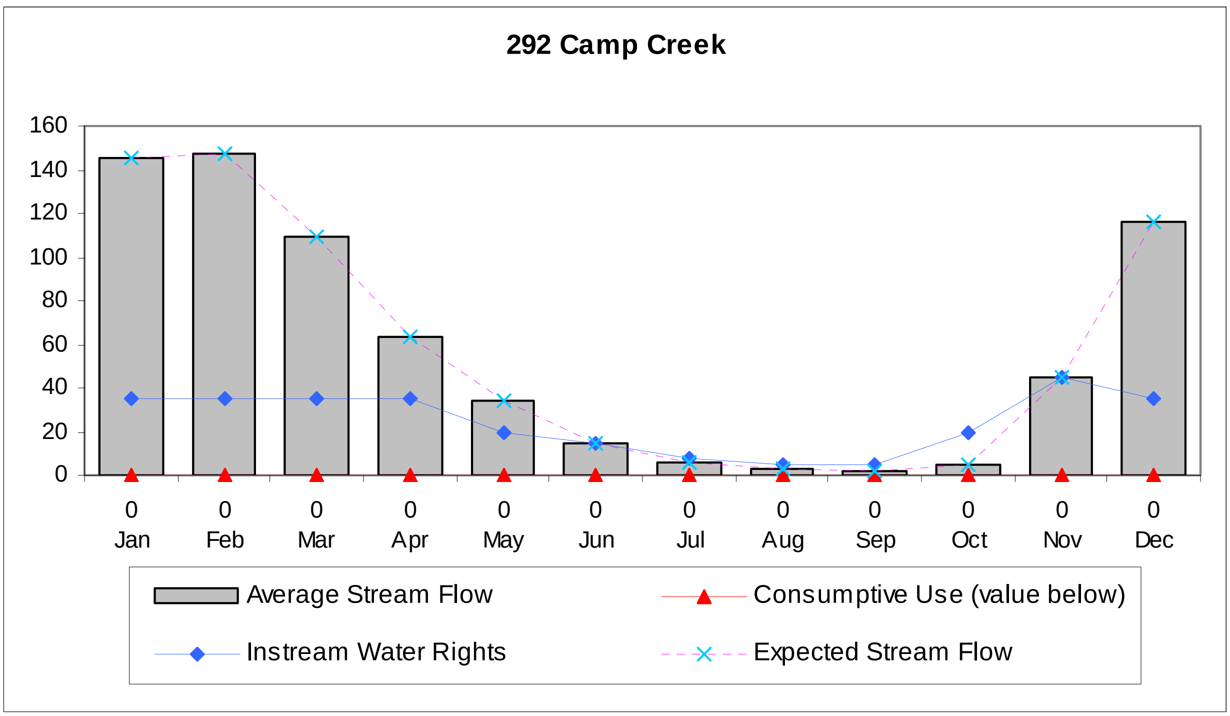


Figure 3.4. Water availability in the Mill Creek (327) and Camp Creek (292) WABs.

The shaded bars on Figure 3.4 represent the 50% exceedence, or average, streamflow in cubic feet per second (cfs). The dark blue diamonds represent the cfs for in-stream water rights, and the red triangles and corresponding numbers are the estimated consumptive use values. The red x's represent the expected streamflow, which is calculated by subtracting consumptive use from the average streamflow. In this WAB, in-stream water rights are consistently below average streamflow during the period November through June. During July and August, in-stream water rights approximately equal average streamflow, indicating that the available water is fully allocated, based on average flow conditions. During September and October, water is over-allocated. There is not enough streamflow during a typical year to satisfy the existing water rights. Expected streamflow is close to average streamflow all year.

Oregon law provides a mechanism for temporarily changing the type and place of use for a certified water right by leasing the right to an in-stream use. Leased water remains in-channel and benefits streamflows and aquatic species. The water right holder does not have to pay pumping costs, and, while leased, the in-stream use counts as use under the right for purposes of precluding forfeiture. The Oregon forfeiture statute states that if an owner of a water right "ceases or fails to use all or part of the water appropriated for a period of five successive years, the failure to use shall establish a rebuttable presumption of forfeiture of all or part of the water right."

3.4.3. Water Rights by Use

According to the OWRD there are 38 registered water rights in the Mill Creek Watershed. Approximately 15.2 acre-feet[33] of water is stored in 21 relatively small reservoirs, primarily for forest management and fire protection. In addition, up to 5.8 cfs of stream flow may be diverted by water users for irrigation, forest management, livestock, wildlife, fire protection, domestic use, and human consumption. Figure 3.5 shows consumptive use by category for the Mill Creek Watershed. Included in the figure are all uncancelled water rights. Therefore these data do not indicate exact water consumption.[34]

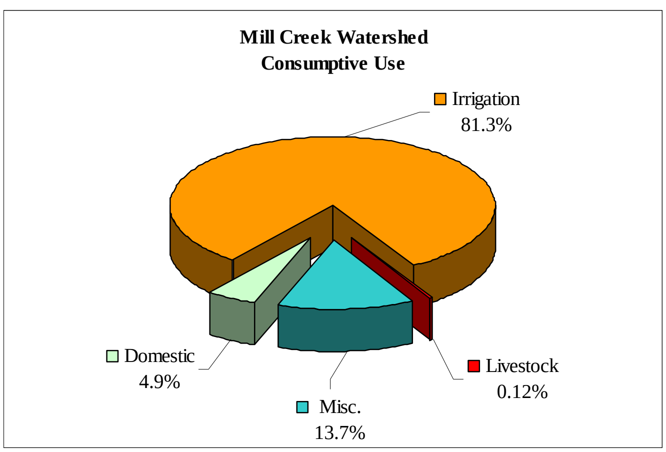


Figure 3.5. Mill Creek Watershed consumptive use.

The state holds one in-stream water right in the watershed for the purpose of supporting aquatic life. The right is for flows to be maintained in Camp Creek at or near its confluence with Mill Creek (SW$^1/_4$, Sec. 36, T.22S., R.10W.), and it is limited to not more than the amounts during the time periods listed in Table 3.18. Despite a priority date of March 26, 1974, this in-stream water right does

[33] One acre-foot is the volume of water which will cover one acre (43,560 square feet) to a depth of one foot.
[34] Uncanceled water rights include: 1) valid rights, which are ones that have not been intentionally canceled and the beneficial use of the water has been continued without a lapse of five or more consecutive years in the past 15 years; and 2) rights that are subject to cancellation due to non-use. For more information about water rights, contact the Oregon Water Resources Department.

not have priority over appropriations of water for human consumption, livestock, irrigation of non-commercial gardens exceeding one-half acre in area, and waters legally released from storage.

Table 3.18. Camp Creek in-stream water right. (Source: BLM 2005)

Period	Flows (cfs)	Period	Flows (cfs)
Oct 1 – Oct 15	10	May 1 – May 31	20
Oct 16 – Oct 31	20	Jun 1 – Jun 30	15
Nov 1 – Nov 30	45	Jul 1 – Jul 31	8
Dec 1 – Apr 30	35	Aug 1 – Sep 30	5

3.4.4. Streamflow and Flood Potential

There are no continuous records of streamflow within the watershed, so we were unable to conduct an analysis of minimum flows and peak flows in the Mill Creek Watershed. The only data that we were able to find was a limited amount of historical peak flow information available for drainages within the watershed. For water years[35] 1908 through 1912 and 1916 through 1917, the US Geological Survey (USGS) recorded annual peak streamflows on Mill Creek below Loon Lake. Peak flows from the 90 square mile drainage ranged from 2,920 cfs to 10,000 cfs. The USGS also recorded peak flows on Buck Creek, a tributary to Camp Creek, during water years 1971 through 1974 and 1976 through 1981. Peak flows from a drainage area of 0.05 square mile ranged between 1.0 cfs and 47.0 cfs. Annual peak streamflows occurred most often during January at both stations.

Additional gaging information from discontinued stations in the vicinity of the watershed is suitable for further characterizing peak flows from relatively small drainages. Between water years 1971 and 1977, the USGS operated a station on Sawyer Creek, a direct tributary to the Umpqua River within 3 miles of the northeastern boundary of the watershed. Peak flows from a drainage area of 0.30 square mile ranged from 9.2 cfs to 39.0 cfs. Another stream monitoring station near Drain measured peak discharge from Elk Creek from water year 1956 to water year 1977. The station was located approximately 18 miles east of the watershed boundary in an area that receives an average of 45 inches of precipitation per year. Peak flows ranged from 715 cfs to 19,000 cfs.

Peak flow is highly variable from year to year, as evidenced by seven years of data for Mill Creek in the early 1900s (Figure 3.6). Steep slopes and stream gradients, a high drainage density, and low groundwater storage capacity throughout much of the Mill Creek Watershed cause quick hydrographic response and flashy flow after the onset of rain. Figure 3.7 shows the characteristically steep rising and falling limbs of a coastal Oregon stream hydrograph following rainfall events.

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[35] In hydrological studies it is preferable to compute annual statistics based on the water year. The water year, October 1st to September 30th, is defined such that the flood season is not split between consecutive years. Water year 1908, for example, would end on September 30, 1908.

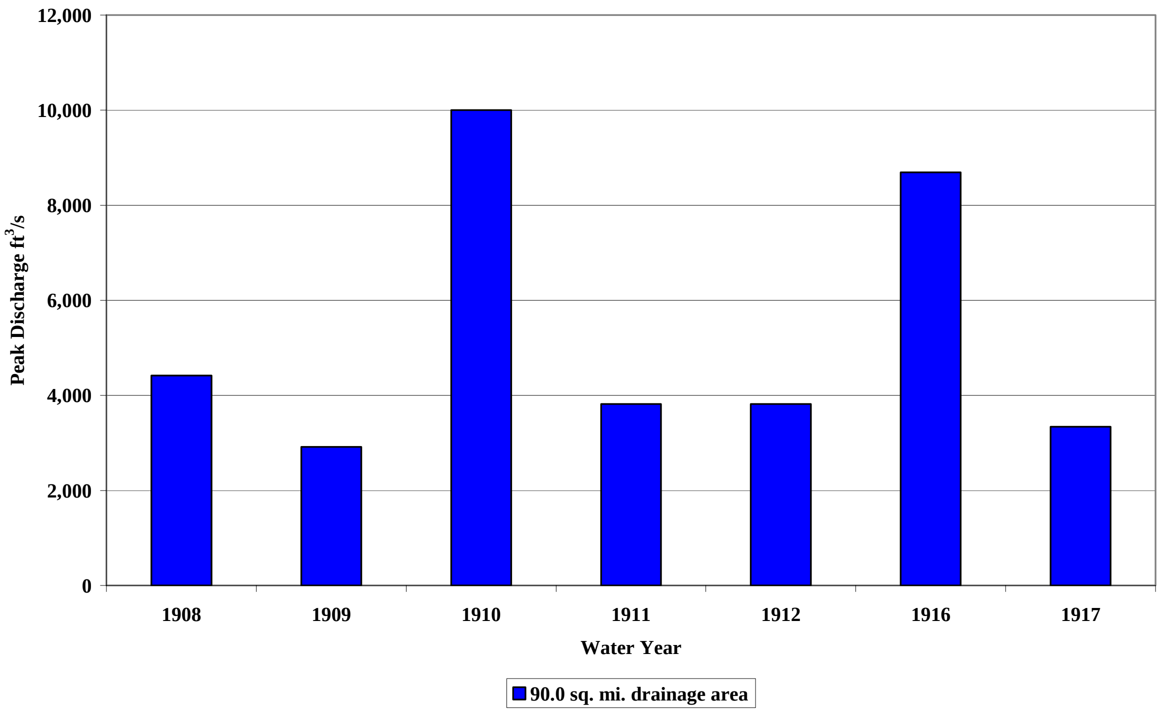


Figure 3.6. Peak discharge for Mill Creek. (Source: BLM 2005)

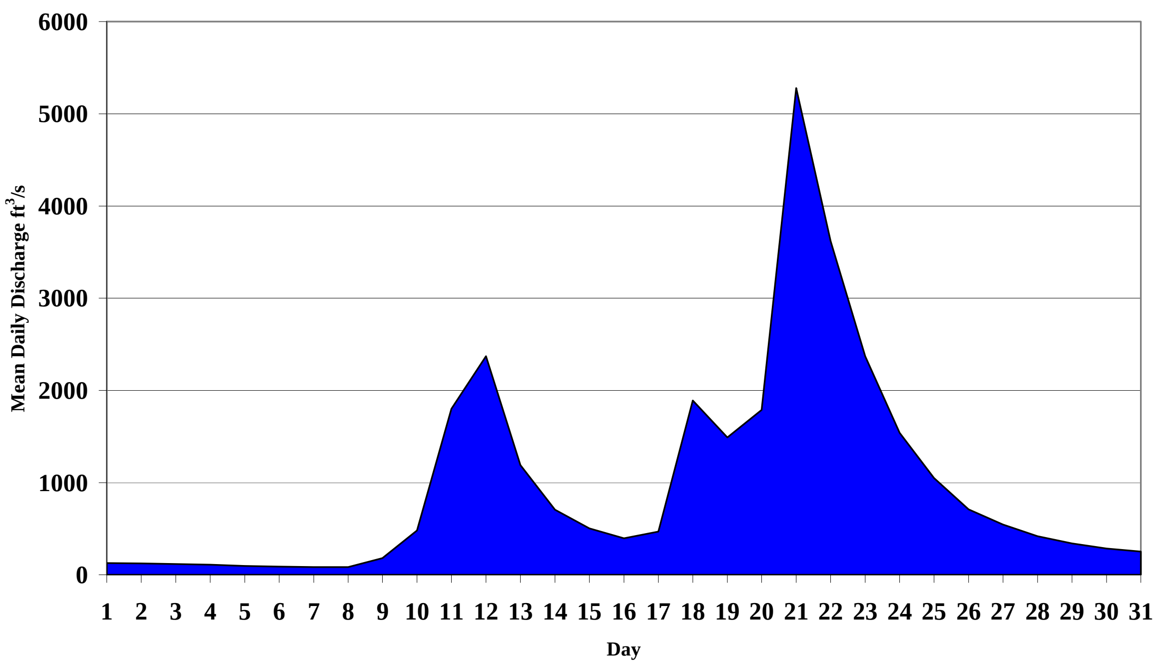


Figure 3.7. Typical storm event hydrograph (Elk Creek near Drain, Oregon (USGS 14322000), January 1-31, 1972). (Source: BLM 2005)

Because a watershed with a well-developed drainage system will have a shorter lag time between a rainfall event and the corresponding runoff peak compared to a watershed with many marshy areas, lakes, reservoirs, and other surface depressions, Figure 3.7 is most representative of the steeper portions of the watershed. Water courses with a more gentle longitudinal profile such as lower Lake Creek and Loon Lake likely have a slower, more prolonged discharge response than depicted in Figure 3.7. In addition to longitudinal profile, the condition and shape of the channels in the watershed, the presence of vegetation in and along the channels, and basin shape will also have an effect on hydrograph shape.

The earliest documented major flood in the Umpqua River Basin was in 1861. Information provided by local residents indicated that the 1861 flood peaked at about 45.5 feet gage height at Elkton. The Umpqua River did not reach that height again until December 22, 1955, when the river peaked at 45.6 feet gage height. The 1861 flood was a regional event, which among other things, produced the largest flood event recorded for the Willamette River. Summarized accounts in newspapers and letters of the time show that this was part of a series of regional-scale events that began with heavy snowfall in early November, 1861. In western Oregon, this was followed by very heavy rainfall throughout December. Heavy precipitation continued until March 1, 1862. Between 75% and 80% of all livestock in the Northwest either froze to death, starved, or were lost in the December floods. Many farm houses, most bridges, and some whole communities were washed away. Other large storms are listed in Table 3.19.

Table 3.19. Major historical (through 1964) rainstorms affecting the Oregon Coast that resulted in high rainfall and possible flooding in the Mill Creek Watershed. (Source: Meteorology Committee, Pacific Northwest River Basins Commission 1969)

January 28 to February 3, 1890	Very heavy rainfall affected all of western Oregon. The 7-day totals for the Oregon Coast ranged from 15 to 20 inches of rainfall.
November 12 to 17, 1896	Heavy precipitation along the entire Oregon Coast dropped 15 to 20 inches on the coast and 5 to 10 inches inland. Maximum 24-hour totals of 5 to 7 inches observed at a number of coastal sites.
November 18 to 24, 1909	Two storms in rapid succession dropped 10 to 20 inches of rain on the coast and 4 to 6 inches on the inland valleys. On the coast and in the upper Cascades, 24-hour totals of 4.50 to 5.50 inches were common.
December 26 to 29, 1945	During the peak of the storm, 24-hour totals of 3 to 5 inches were common.
October 26 to 29, 1950	Storm totals ranged from 10 to 12 inches on the extreme south of the state and decreased to 4 to 5 inches on the state's north border.
January 16 to 19, 1953	Precipitation was heaviest on the south coast with storm totals of 15 to 20 inches, and 1-day totals of 4 to 8 inches. Reedsport had a 1-day total of 4.11 inches.
November 22 to 24, 1953	The most intense part of the storm centered on the south coast. South coast observing stations reported 1-day totals of 4 to 7 inches and 72-hour totals of 6 to 10 inches. Reedsport reported a 4.45 inch 1-day total and a 7.34 inch total.
December 20 to 24, 1964	This is the most severe rainstorm on the Oregon coast since the start of regular weather data collection. The rainfall total in Reedsport for the month of December 1964 was 22.01 inches. The average rainfall for December in Reedsport is 11.94 inches.

The peak discharge for the period of record at the Elkton stream gage was 265,000 cfs on December 23, 1964. The Umpqua River reached 51.9 feet gage height based on flood marks. Large storms that produce peak flows like these do exhibit variation across the affected area. For example, the 1964 storm caused a 50- to 100-year flood event in many watersheds, including the South Fork Coquille where it is the flood of record. However, the 1964 flood was not a high magnitude event at the Millicoma gage station in the Coos River Basin.

The most recent major storms hit in mid-December, 1995, February 6 through 9, 1996, November 18 through 20, 1996, December 10 through 12, 1996, and November 24 through 26, 1999. The *Register Guard* Newspaper (March 1, 1996) reported the December, 1995 storm as a 1 in 5-year windstorm, a 1 in 10-year precipitation event and a 1 in 25-year flood event. The 24-hour rainfall on November 18, 1996, was 6.67 inches at the North Bend Airport.

3.4.5. Water Quantity Key Findings and Action Recommendations

3.4.5.1. Water Availability and Water Rights by Use Key Findings

- In both Mill Creek Watershed WABs, in-stream water rights are equal to or greater than average streamflow during the summer and fall seasons.
- During the summer and fall, there is little or no “natural” streamflow available for new water rights.
- Irrigation is the largest use of water in the watershed. Domestic water use is the second largest use, but accounts for less than five percent of the total water rights in the watershed.

3.4.5.2. Streamflow and Flood Potential Key Findings

- Major floods during the last century occurred in 1909, 1945, 1950, 1953, 1964, and 1996.
- The degree to which land use influences flood potential in the Mill Creek Watershed is unknown at this time, but is not expected to be substantial.

3.4.5.3. Water Quantity Action Recommendations

- In general, water use is not a significant issue of concern in this watershed.

3.5. Fish

This chapter examines the presence, distribution, and abundance of fish species in the Mill Creek Watershed. Background information for this chapter was compiled from the *Oregon Watershed Assessment Manual* (Watershed Professionals Network 1999), and the *South Umpqua River Watershed Assessment and Action Plan* (Geyer 2003). Additional information and data are from the following groups' documents, websites, and specialists: the Oregon Department of Fish and Wildlife (ODFW), the National Oceanic and Atmospheric Administration Fisheries Service (NOAA Fisheries), the US Fish and Wildlife Service (USFWS), and the Bureau of Land Management (BLM).

3.5.1. Fish Presence

The Mill Creek Watershed is home to many fish species. Table 3.20 lists many common fish species in the watershed that have viable, reproducing populations. In addition to salmon and trout, many warm water fish, including largemouth bass (*Micropterus salmoides),* white crappie (*Pomoxis Annularis*), and bluegill (*Lepomis macrochirus*) reside in the watershed. These fish were introduced to portions of the Mill Creek system, including Loon Lake. The lake provides an important recreational fishery that includes native cutthroat trout (*Oncorhynchus clarkii clarkii*) plus hatchery rainbow trout (*Oncorhynchus mykiss*). ODFW has conducted an extensive rainbow trout stocking program in the lake for decades. Other species were also stocked prior to about 1970.

The landslide that created Loon Lake provides an effective barrier to anadromous salmonids in the Mill Creek Watershed. Therefore, these species are generally limited to Mill Creek, the Camp Creek system, and a few smaller tributaries. There is a waterfall on Camp Creek that is approximately 12 feet high, located about 8.0 miles upstream of the confluence of Camp Creek and Mill Creek. The mainstem of Camp Creek extends 4.3 miles above the waterfall barrier, and there are four fish-bearing (cutthroat trout) perennial tributaries in the upper reaches with a cumulative length of about 1.9 miles.

3.5.2. Listed Fish Species

Population levels have been so depressed that all salmonid species on the Oregon Coast have been considered for listing under the federal Endangered Species Act (Reeves et al. 2002). In 1998, the Oregon Coast coho salmon (*Oncorhynchus kisutch*) was listed as a threatened species under the Endangered Species Act (ESA) by NOAA Fisheries Service, formerly the National Marine Fisheries Service. However, in recent years the population has increased substantially, probably because of improvement in ocean conditions, habitat restoration efforts, and reduced fishing pressure. In January, 2006, a status review conducted by NOAA Fisheries concluded that listing was no longer warranted, and the Oregon coastal coho salmon was delisted.

The Umpqua River population of the coastal cutthroat trout was listed as endangered in 1996. NOAA Fisheries delisted the species on April 19, 2000, with concurrence from the USFWS. The delisting was based on the determination that the population was not a distinct

Table 3.20. Fish with established populations or runs within Mill Creek Watershed. (Source: ODFW 2004)

Category	Common Name	Scientific Name
Native Salmonid Species	Coho salmon	*Oncorhynchus kisutch*
	Chinook salmon (spring and fall)	*Oncorhynchus tshawytscha*
	Steelhead (winter and summer)/ Rainbow trout	*Oncorhynchus mykiss*
	Coastal cutthroat trout	*Oncorhynchus clarkii clarkii*
Other Native Fish Species	Pacific lamprey	*Lampetra tridentata*
	Western brook lamprey	*Lampetra richardsoni*
	River lamprey	*Lampetra ayresi*
	Umpqua chub	*Oregonichthuys kalawatseti*
	Three-spined stickleback	*Gasterosteus aculeatus*
	Sculpin (various sp.)	*Cottus species*
	Redside shiner	*Richardsonius balteatus*
	Umpqua dace	*Rhinicthys cataractae*
	Speckled dace	*Rhinicthys osculus*
	Long nose dace	*Rhinicthys cataracatae*
	Umpqua pikeminnow	*Ptychocheilus umpquae*
	Largescale sucker	*Catostomus macrocheilus*
	Green sturgeon	*Acipenser medirostris*
	White sturgeon	*Acipenser transmontanus*
Non-Native Fish Species	Smallmouth bass	*Micropterus dolomieu*
	Largemouth bass	*Micropterus salmoides*
	Striped bass	*Morone saxatilis*
	Crappie	*Pomoxis* spp.
	Yellow perch	*Perca flavescens*
	Mosquito fish	*Gambusia affinis*
	Fathead minnow	*Pimephales promelas*
	Bluegill	*Lepomis macrochirus*
	American shad	*Alusa sapidissima*
	Brown bullhead	*Ameiurus nebulosus*

"evolutionarily significant unit" (ESU), but a part of the larger Oregon Coast ESU.[36] The USFWS and NOAA Fisheries have listed Oregon's coastal cutthroat trout as a candidate species under the ESA, and transferred jurisdiction on any final listing and responsibilities for consultation to the USFWS.

NOAA Fisheries reviewed the status of the Oregon Coast steelhead trout (*Oncorhynchus mykiss*) population to determine whether listing as a threatened species under the ESA was warranted. As of preparation of this report, NOAA has not found that ESA listing of Oregon Coast steelhead trout is warranted. In January, 2003, various groups petitioned to protect the Pacific lamprey

[36] An ESU is defined as a population that 1) is substantially reproductively isolated from conspecific populations and 2) represents an important component in the evolutionary legacy of the species. Consequently, an ESU is an evolutionarily distinct population that is irreplaceable.

(*Lampetra tridentata*) and western brook lamprey (*L. richardsoni*), as well as two other lamprey species, under the ESA. The green sturgeon (*Acipenser medirostris*) was also petitioned for listing under the ESA, but listing was determined to be unwarranted in 1993. Currently, there are no other ESA-listed threatened or endangered aquatic species in the Mill Creek Watershed. A number of amphibians are listed by the State of Oregon as species of special concern due to declines in abundance, including the northern red-legged frog (*Rana aurora aurora*), tailed frog (*Ascaphus truei*), and Columbia torrent salamander (*Rhyacotriton kezeri*). Like fish, these species depend on healthy aquatic ecosystems.

3.5.3. Fish Distribution and Abundance

Information on fish distribution and abundance within the Mill Creek Watershed is mainly limited to salmonids. Although non-salmonid fish species are important as well, there is little information available on these types of fish.

A typical life cycle of an anadromous salmonid consists of several stages, each with different habitat requirements. Habitat features that affect migrating salmonids are water depth and velocities, water quality, cover from predators, and the presence of full or partial migration barriers. Substrate composition, cover, water quality, and water quantity are important habitat elements for salmonids before and during spawning. Important elements for rearing habitat for newly emerged fry and juvenile salmonids are quantity and quality of suitable habitat (overhanging vegetation, undercut banks, submerged boulders and vegetation, etc.), abundance and composition of food (primarily macroinvertebrates, such as aquatic insects), and water temperature.

Salmon population abundance has declined significantly over the past 150 years along the Oregon Coast. Many factors are associated with this decline, including degradation of habitat quality and availability, ocean conditions, impacts of non-native fish, fishing pressure, and predation. The effect of predation has been an issue of concern for many local residents. Increases in the seal and sea lion populations over the past several decades has led to rising predation pressure near the river mouth. Several studies have investigated the effect of seal and sea lion predation on the Oregon Coast, and have concluded that the impact to the salmon population is relatively minor, although it may be significant to local threatened populations. ODFW data indicate that seal and sea lion populations have stabilized over the past decade, but the agency is in favor of specific changes to the Marine Mammal Protection Act that would allow it to deal more efficiently with acute local problems or rogue animals.[37]

The ODFW has developed anadromous salmonid distribution maps based on fish observations, assumed fish presence, and habitat conditions. Fish observations are the most accurate because agency biologists have recorded fish presence in the stream. With assumed fish presence, stream reaches are included in the distribution map because of their proximity to known fish-bearing stream reaches or the observed presence of adequate habitat. As of January, 2003, ODFW has been revising the salmonid distribution maps to distinguish observed fish-bearing streams from the others. The maps presented in this section include those changes.

[37] For more information, see http://resourcescommittee.house.gov/108cong/fish/2003aug19/brown.htm.

Stream gradient is a useful indicator of potential fish habitat. In order to get a general sense of the amount of potentially suitable fish habitat in the watershed, we have mapped streams in three gradient classes: 0% to 4%, 4% to 15%, and greater than 15%. Anadromous salmonids generally use streams having a gradient of less than 4%, whereas resident cutthroat inhabit streams in the 4% to 15% gradient class.

Table 3.21. Miles of stream potentially supporting anadromous salmonids in the Mill Creek Watershed, based on mapping at a scale of 1:100,000 by ODFW.

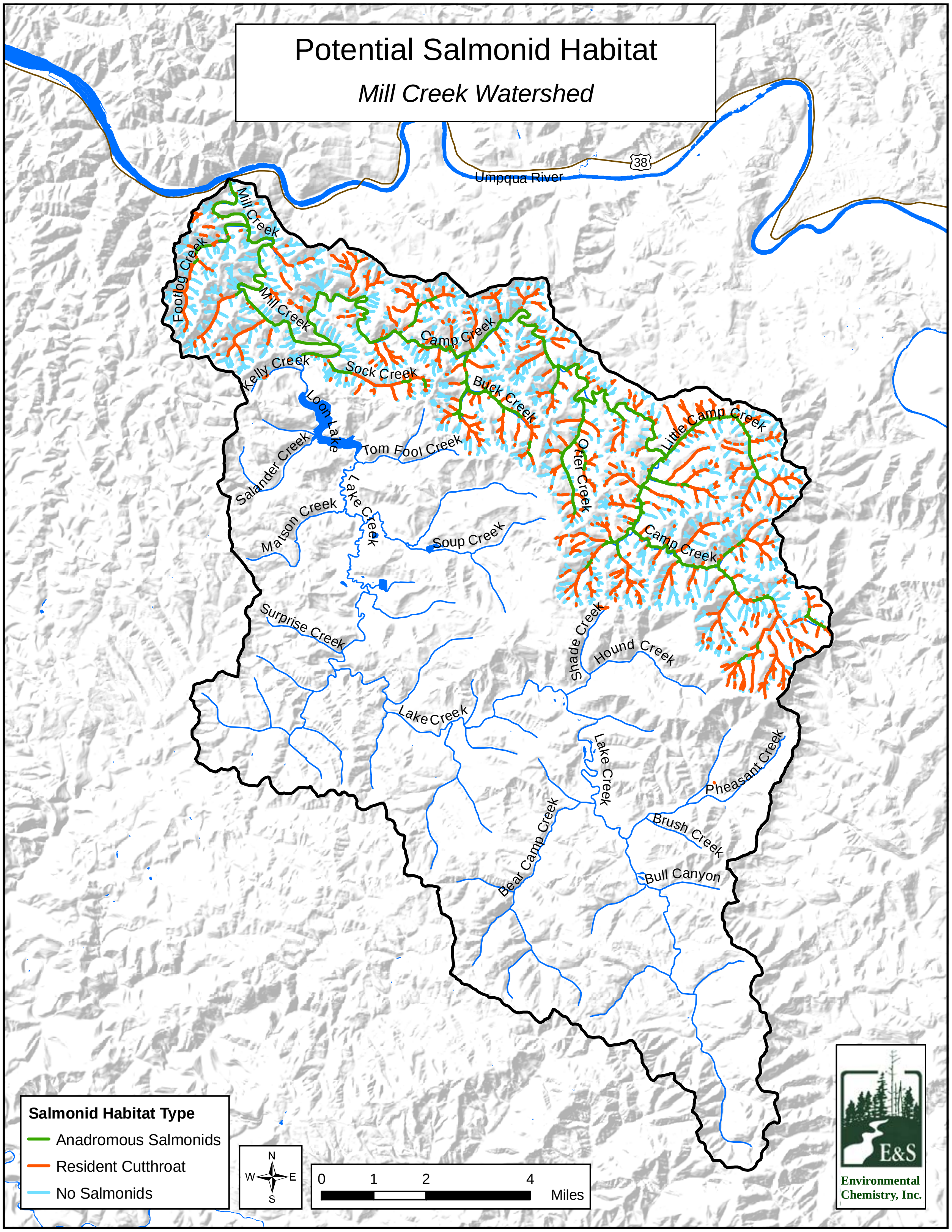
Species	Fish Utilization (miles)	Percent of Potential Habitat Utilized
Coho	26	53
Fall Chinook	10	20
Winter Steelhead	28	57

A comparison of the length of streams identified by ODFW as salmonid habitat with the number of streams that are less than 4% gradient provides a rough estimate of the percentage of potential anadromous salmonid habitat that is currently being utilized. Map 3.16 shows the distribution of anadromous salmonids and resident cutthroat trout within the watershed. There are about 48 stream miles of potential anadromous salmonid habitat (below Loon Lake) within the Mill Creek Watershed. Winter steelhead and coho each use about half of the potential available habitat.[38] Fall chinook use only 20% (Table 3.21). The total of all stream miles with anadromous salmonids given in Table 3.21 does not equal the sum of miles used by all species collectively because the distributions of many species overlap. Coho and steelhead use many of the same stream reaches but at different times of the year. Potential habitat may not be utilized because of a passage barrier, or because other habitat conditions are unsuitable, such as insufficient spawning substrate, low flows, or unfavorable water temperature conditions.

3.5.3.1. Cutthroat Trout

Coastal cutthroat trout exhibit diverse patterns in life history and migration behavior. Populations of coastal cutthroat trout show marked differences in their preferred rearing environment (river, lake, estuary, or ocean), size and age at migration, timing of migrations, age at maturity, and frequency of repeat spawning. Both sea-run and resident cutthroat trout utilize smaller streams for spawning and rearing than do salmon and steelhead (ODFW 1993). Anadromous populations migrate to the ocean (or estuary) for usually less than a year before returning to fresh water. Anadromous cutthroat trout either spawn during the first winter or spring after their return and may migrate between the ocean and fresh water many times for spawning. Anadromous cutthroat are present in most coastal rivers, and may be present in the Camp Creek system. The steep outflow from Loon Lake blocks upstream passage, so sea-run cutthroat are absent from the Lake Creek system. The non-anadromous or resident cutthroat are generally smaller, become sexually mature at a younger age, and may have a shorter life span than many anadromous cutthroat trout populations. There are no comprehensive data about resident cutthroat distribution in the watershed.

[38] Maps are available from the ODFW website http://www.streamnet.org/online-data/GISData.html.



Map 3.16. Potential anadromous and resident salmonid distribution within the Mill Creek Watershed.

Biologists at Oregon State University's Cooperative Forest Ecosystem Research program (CFER) conducted a study of the effects of landscape patterns on the distribution of resident cutthroat trout in Oregon streams. Four third-order stream watersheds were selected for study (1998 through 2001), including Camp Creek. Over 5,000 cutthroat were captured and fin-clipped in the mainstem of Camp Creek (8.0 miles of stream above the waterfall located at about stream mile eight) and associated tributaries (an additional 1.9 miles of fish-bearing stream) between June 1999 and August 2000. Fish distribution was found to vary seasonally. Spatial patterns in fish distribution appeared to correspond with the large-scale distribution of historic debris flows, intermediate-scale spacing of tributary junctions, and fine-scale changes in channel gradient.

Resident populations of coastal cutthroat trout occur in small headwater streams and may migrate within the freshwater of the stream network (i.e. potadromous migration). Anecdotal evidence suggests that potadromous migration may occur between Loon Lake and Tom Fool Creek, Soup Creek, and other tributary streams. They reside for one to two years in the streams and then spend several months to years feeding in the lake, before migrating back into the tributaries upstream to spawn. The lake-dwelling fish receive angling pressure and also compete with the introduced rainbow trout in the lake.

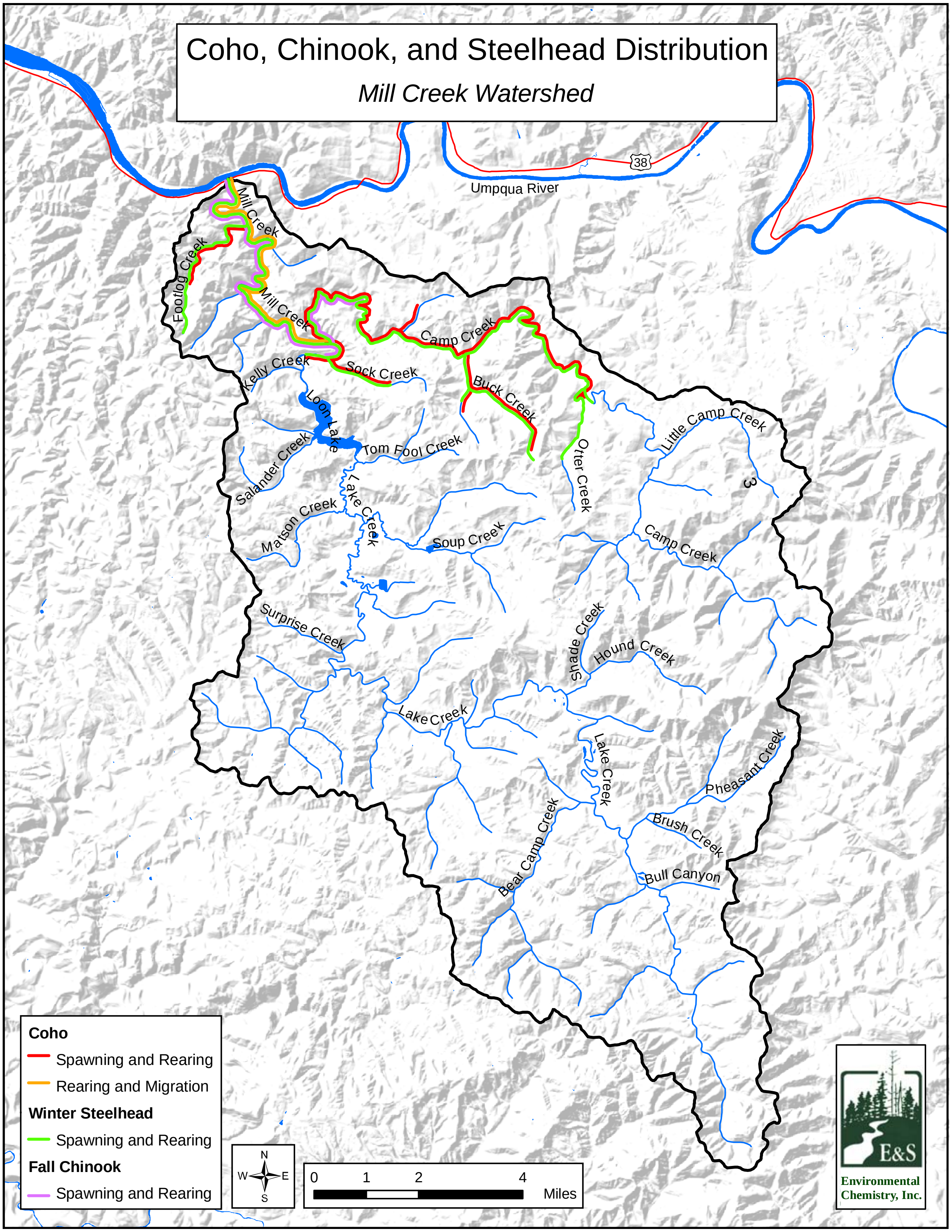
3.5.3.2. Coho Salmon

Coho distribution within the watershed is shown in Map 3.17. Some of the tributary streams, especially Camp Creek, provide spawning habitat for coho. Mill Creek provides important coho rearing and migration habitat. ODFW conducts coho spawning surveys throughout the Umpqua Basin.[39] Volunteers and ODFW personnel survey pre-determined stream reaches and count the number of live and dead coho. The same person or team usually does surveys every 10 days for two or three months.

Annual estimates of wild coho spawner abundance have been made by ODFW in coastal basins throughout the Oregon Coastal ESU. Data are available for the period from 1990 through 2004 for the mainstem Umpqua River during the spawning season (Figure 3.8). The numbers of adult wild coho in the mainstem Umpqua River during the spawning season (called "spawners") increased 10-fold starting in 2001, as compared with the average number of spawners in the 1990s. Spawner population estimates over the past four years have ranged from 5,309 in 2004 to 9,188 in 2002. Similar patterns were observed throughout the Oregon Coastal ESU for coho.

Coho population estimates for the Mill Creek Watershed are less complete than the Umpqua River sub-basin data depicted in Figure 3.8. During counts from 1998 through 2000 on Camp Creek, no fish were found in 1998 or 2000, and only four fish were counted in 1999. Coho spawner abundance was estimated coast-wide in 2004 using statistically-based protocols of EPA's Environmental Monitoring and Assessment Program (EMAP). Results are shown in Table 3.22, including estimates of total and wild coho as well as 95% confidence intervals associated with those estimates.[40] It is important to note that the Umpqua River system accounted for more total and wild coho spawners than any other river in Oregon, and the

[39] Coho spawning survey data can be requested from the ODFW Corvallis Research Laboratory.
[40] A 95% confidence interval is the range of values within which there is 95% certainty that the exact population value lies. The "estimate" represents the most likely correct population value, based on the data (see Table 3.22).



Map 3.17. Coho, chinook, and steelhead distribution within the Mill Creek Watershed.

Table 3.22. Estimated coho spawner abundance during the 2004 spawning season, based on statistical protocols of EPA's Environmental Monitoring and Assessment Program (EMAP).[41]

Monitoring Area, Basin	Spawning Miles	Survey Effort		Adult Coho Spawner Abundance			
				Total		Wild	
		Number of Surveys	Miles	Estimate	95% Confidence Interval	Estimate	95% Confidence Interval
Coast Wide	4,124	482	449.0	181,376	18,245	176,576	17,969
North Coast	920	113	109.5	34,167	5,959	33,063	5,819
Necanicum R., Ecola Cr., and Midsize Ocean Tributaries	65	8	7.7	3,301	1,238	3,142	1,178
Nehalem R.	505	62	63.1	21,579	4,807	21,479	4,785
Tillamook Bay	187	23	20.9	3,039	1,707	2,290	1,286
Nestucca R.	155	19	17.5	6,248	1,879	6,152	1,850
Sand Lake and Neskowin Cr.	8	1	0.3	0		0	
Mid Coast	1,164	108	102.3	43,214	9,601	40,393	9,246
Salmon R.	75	7	7.7	5,094	3,141	2,374	1,464
Siletz R.	194	18	14.9	6,399	3,041	6,399	3,041
Yaquina R.	108	10	9.3	5,091	3,964	4,989	3,885
Devils Lake, Beaver Cr., and Midsize Ocean Tributaries	54	5	5.4	7,179	4,262	7,179	4,262
Alsea R.	259	24	22.4	6,005	2,291	6,005	2,291
Small Ocean Tributaries	11	1	0.6	49		49	
Yachats R.	22	2	1.1	641	488	641	488
Siuslaw R.	399	37	35.8	8,443	2,658	8,443	2,658
Mid-Small Ocean Tributaries	43	4	5.2	4,315	8,457	4,315	8,457
Mid-South Coast	583	93	83.2	66,704	12,670	66,545	12,652
Siltcoos and Tahkenitch Lakes	50	8	5.2	14,655	10,871	14,655	10,871
Coos R.	213	34	31.8	24,232	7,482	24,116	7,446
Coquille R.	288	46	42.8	22,318	8,077	22,276	8,062
Tenmile Lakes	6	1	0.6	0		0	
Floras Cr., New R., and Sixes R.	25	4	2.8	5,498	5,627	5,498	5,627
Umpqua	1,031	115	104.0	28,139	6,112	27,639	6,028
Lower Umpqua and Smith R.	229	43	39.6	8,046	2,796	8,046	2,796
Mainstem Umpqua R.	223	20	18.9	5,432	2,967	5,309	2,899
Elk Cr. and Calapooya Cr.	134	12	11.8	2,667	856	2,602	836
Cow Cr.	201	18	13.7	2,555	1,208	2,351	1,111
South Umpqua R.	245	22	19.9	9,440	6,281	9,333	6,209
South Coast	426	53	50.0	9,152	2,703	8,936	2,670
Elk R.	8	1	0.5	0		0	
Lower Rogue R.	8	1	0.7	0		0	
Applegate R.	96	12	10.7	2,511	1,279	2,374	1,209
Illinois R.	72	9	7.2	3,181	2,362	3,162	2,348
Mainstream Tributaries	129	16	17.1	844	552	783	513
Little Butte Cr.	48	6	5.7	547	504	547	504
Evans Cr.	64	8	8.2	2,069	1,515	2,069	1,515

[41] Source: http://oregonstate.edu/Dept/ODFW/ spawn/pdf%20files/coho/2004PopEstCoastwide.pdf

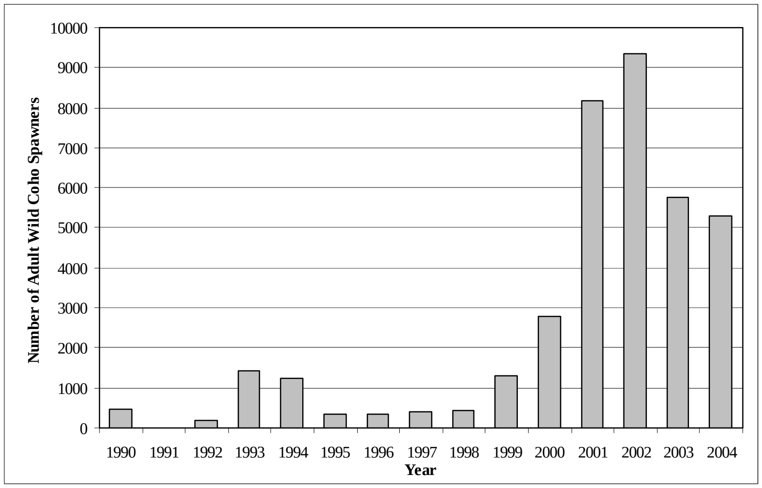


Figure 3.8. Estimates of annual adult wild coho spawner abundance in the mainstem Umpqua River for the period 1990 through 2004. No coho were observed in 1991. Estimates were prepared by ODFW, based on results from randomly-selected spawning surveys.

Umpqua River system represented about 15% of the estimated coho spawners coast-wide. Only the Coos, Coquille, and Nehalem rivers were close to the number of spawning coho estimated for the Umpqua system.

Recently, the Oregon Watershed Enhancement Board (OWEB) and ODFW synthesized available information on the status of coho relative to viability criteria and conservation efforts to address factors responsible for decline in Oregon coho populations. Nicholas et al. (2005) concluded that the most important limiting factors affecting coho populations in the Umpqua River sub-basin are stream complexity, water quantity, and water quality. It appears that during the winter months stream complexity and associated off-channel habitat availability are more important limiting factors than water quality throughout the ESU. However, during periods of good ocean conditions, it appears that Umpqua River coho populations are also limited by summer rearing capacity, which is associated with water quantity and water quality.

3.5.3.3. Chinook Salmon

Within the Mill Creek Watershed, the only known spawning and rearing habitat for chinook salmon is found along Mill Creek from the confluence with Sock Creek to the mouth, and in Camp Creek (Map 3.17). Most of the fall chinook salmon (perhaps 85 to 90%) in the Umpqua Basin spawn in the South Umpqua/Cow Creek portion of the Umpqua system. However, recent data collected using radio telemetry suggest that there may also be substantial numbers of fall chinook spawning in portions of the Umpqua River sub-basin (Moyers et al. 2003). Data compiled on chinook spawning in Mill and Camp Creeks are summarized in Table 3.23.

Table 3.23. Spawning survey data for Mill and Camp creeks for chinook salmon.

Year	Live Adults	Dead Males	Dead Females	Redds
2001	43	-	-	19
2002	37	17	20	71
2003	8	39	32	20

Fall chinook spawner escapement estimates for the entire Umpqua Basin are available for 2001 and 2002. A total of 116 adults and 53 jack chinook were captured and tagged in the Umpqua River sub-basin between July 31 and October 2, 2001. Spawning surveys were conducted from catarafts from October 14 through November 24, 2001. The estimated spawner abundance in 2001 was 6,612 fish. Data collected in 2002 suggested a total spawner abundance of 13,064 fish (Moyers et al. 2003). The increase in estimated spawner abundance observed in 2002 agreed with data from other basins studied by ODFW. There are also data available on recreational harvest of fall chinook in the Umpqua River and Winchester Bay, based on angler catch cards and limited creel surveys. The annual catch has been relatively stable since 1991, about 1,000 to 3,000 fish per year (Figure 3.9).

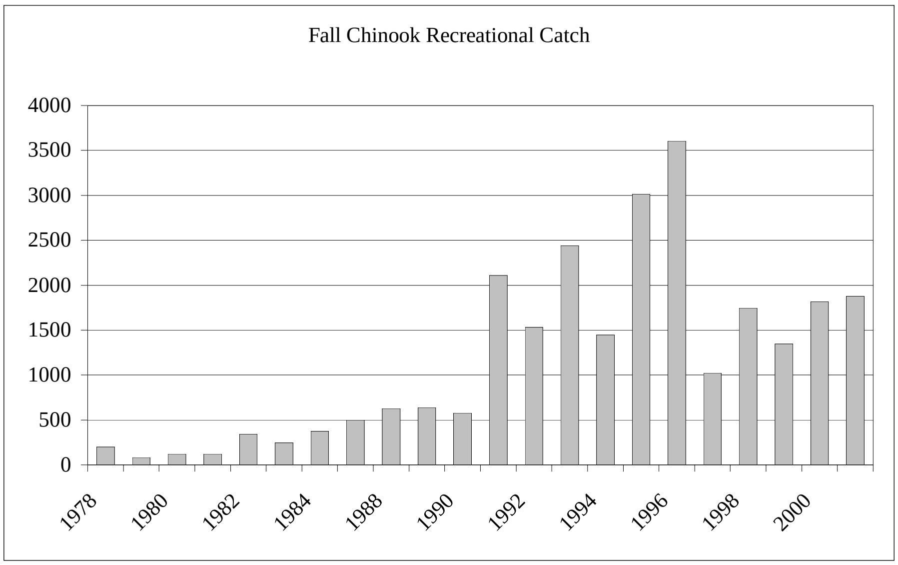


Figure 3.9. Estimated recreational catch of fall chinook salmon in the Umpqua River and Winchester Bay. Data were not collected in 1985 and 1986. (Source: Moyers et al. 2003)

3.5.3.4. Steelhead Trout

Steelhead trout include a resident phenotype (rainbow trout) and an anadromous phenotype (steelhead). Steelhead express a further array of life histories, including various freshwater and saltwater rearing strategies and various adult spawning and migration strategies. Juvenile steelhead may rear one to four years in fresh water prior to their first migration to saltwater. Saltwater residency may last one to three years. Adult steelhead may enter freshwater on spawning migrations year round if habitat is available for them, but generally spawn in the winter and spring. Both rainbow and steelhead may spawn more than once. Steelhead return to saltwater between spawning runs. Summer steelhead are not known to spawn in the Mill Creek Watershed, but migrate along the length of the mainstem Umpqua River to spawning areas further upstream. Spawning and rearing habitat for winter steelhead is found in the lower portion of Mill Creek, and associated tributaries including Camp Creek, Sock Creek, and Footlog Creek (Map 3.17). Winter steelhead generally enter streams from November through March and spawn soon after entering freshwater. Age at the time of spawning ranges from two to seven years, with the majority returning at ages four and five (Emmett et al. 1991).

Population and trend data are not available for the Mill Creek Watershed. However, several studies have been conducted to determine an Umpqua Basin-wide population estimate for winter steelhead. These studies consisted of 1) using radio telemetry and Winchester Dam counts as a basis for the basin-wide estimate, 2) a Peterson mark/recapture estimate, and 3) population estimates utilizing Area Under the Curve (AUC) methodology.[42]

ODFW has maintained a long-term fish counting station at Winchester Dam since 1946 (Figure 3.10). Winchester Dam is located on the North Umpqua River at river mile seven. The wild winter steelhead counts for each return year have ranged from a low of 3,928 in 1990/1991 to a high of 12,888 in 2003/2004. The average wild winter steelhead count from 1946 through 2004 was 6,948. Over the last 10 years the average steelhead return passing over Winchester Dam was 6,945 fish.

The distribution of radio-tagged fish per year was fairly consistent over the ODFW study period. The three-year average indicated that 54% of the winter steelhead spawned in the mainstem Umpqua River and its tributaries, 24% of the fish entered the North Umpqua River, and 22% of the fish migrated up the South Umpqua River. Winchester Dam counts were then utilized as an index, based on a 24% return rate, to estimate the Umpqua Basin population (Figure 3.11). The population estimate for the Umpqua Basin in 2002/2003 was 35,313 (pre-harvest).

Table 3.24 compares the population estimates for the various study designs conducted on the Umpqua Basin. The estimates for the population in run year 2002/2003 are statistically similar, all within the 95% confidence interval. The sample sizes for the telemetry and Peterson mark/recapture studies were limited due to budget constraints. These studies should be conducted over several years and with larger samples. ODFW has the most confidence in the AUC spawning survey methodology. Whatever the study method, the counts at Winchester Dam are real time and accurate. The telemetry and Peterson mark/recapture are reflective of Winchester Dam counts and therefore add further validity to these population estimates.

Table 3.24. Comparison of the various winter steelhead population estimates for run year 2002/2003. (Source: ODFW 2005)

Study Method	Population Estimate for the Umpqua Basin	95 % Confidence Interval
Telemetry	35,313 (pre-harvest)	30,268 to 47,083
Peterson Mark/Recapture	36,931 (pre-harvest)	18,244 to 55,618
AUC Spawning Surveys	(24,739 post harvest) + (3,198 average harvest) = 27,812 (pre-harvest)	22,155 to 33,469

[42] For more information, see Hart. and Reynolds (2002).

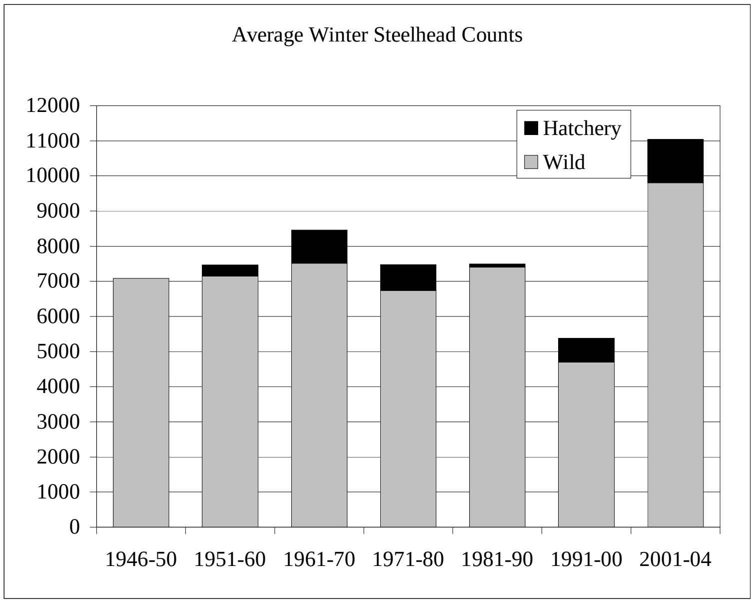


Figure 3.10. Average winter steelhead counts at Winchester Dam Fishway on the North Umpqua River. (Source: ODFW 2005)

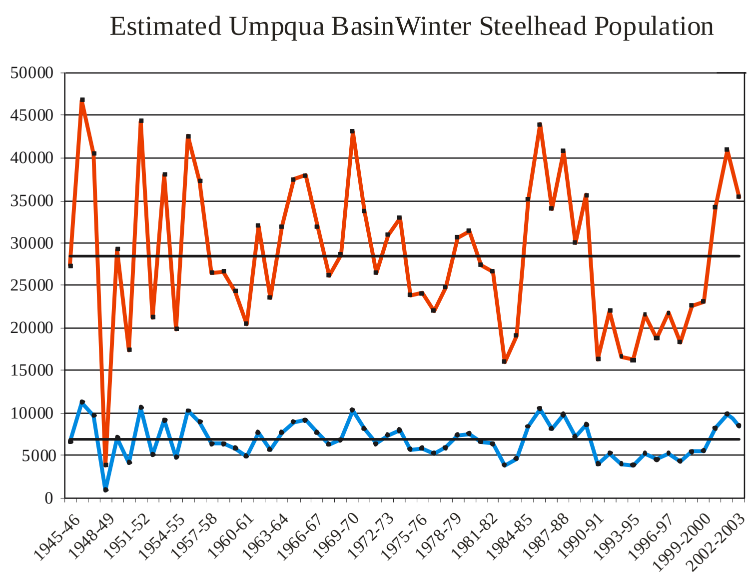


Figure 3.11. Umpqua Basin (red) and North Umpqua River sub-basin (blue) winter steelhead population estimates (excluding Smith River). (Source: ODFW 2005)

The Umpqua River was surveyed for winter steelhead spawning from 2002 through 2005. Counts ranged from 345 spawners in 2005 to 962 spawners in 2004 (Figure 3.12). However, the elusive behavior of adult steelhead pose difficulties in conducting spawning surveys for this species. Therefore, these numbers should be considered to be only rough estimates.

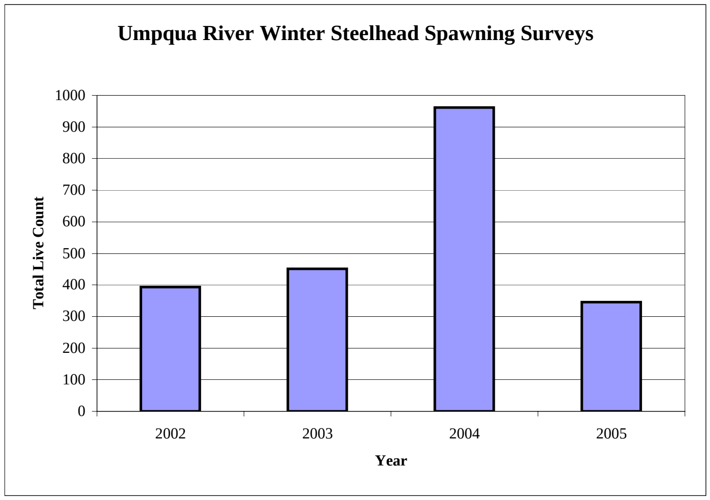


Figure 3.12. Winter steelhead spawning surveys for the Umpqua River.

3.5.3.5. Other Selected Native Fish Species

Both green sturgeon and white sturgeon (*Acipenser transmontanus*) reside in the Umpqua River. They are primitive, bottom-dwelling fish. White sturgeon can live to over 100 years old, can grow to over 20 feet in length, and may weigh up to 1,500 pounds. Green sturgeon are smaller, reaching up to seven feet in length and 350 pounds in weight. They are anadromous, and prefer to spawn in the lower reaches of swift-flowing rivers with cobble-lined streambeds. The juveniles live in freshwater, feeding on algae and invertebrates, before migrating downstream to the estuary and entering the ocean. They can spawn multiple times during their life, entering the streams every 4 to 11 years. Sturgeon are fished recreationally, although not as intensively as salmon. Very little is known about their population sizes or distributions in the Umpqua River.

Lamprey are among the oldest vertebrates in the world. Four species are recognized in Oregon, three of which are believed to occur in the Umpqua River, although presence of the river lamprey (*Lampetra ayresi*) is uncertain. The Pacific lamprey and river lamprey are anadromous, and may be parasitic during their adult phase, attaching themselves to larger fish, including salmon. The western brook lamprey is not anadromous, living exclusively in freshwater. Juvenile lamprey are referred to as ammocetes or larva. They look similar to worms, are eyeless, and burrow in silt and mud.

After spawning, lamprey bury their eggs beneath sand and gravel. Incubation lasts from 10 to 20 days. A week to a month after hatching, the larva move downstream and construct U-shaped burrows in areas of fine silt, where they remain for three to seven years. As ammocetes, they are filter feeders, gathering their food by straining organic material from the water.

Very little is known about lamprey in the watershed. An estimate of the population size in the Mill Creek Watershed has not been calculated due to insufficient data. ODFW surveyed the locations of eggs (i.e., “redds”) in 2004, finding an average of 4.8 redds in the lower 1.2 miles of Camp Creek. There is also an on-going study of lamprey at Smith River Falls, but findings are not yet available. The only long-term records of lamprey abundance in the Umpqua Basin are from counts of Pacific lamprey at Winchester Dam in the North Umpqua sub-basin (Figure 3.13). Pacific lamprey is listed as vulnerable on Oregon’s sensitive species list (Kostow 2002).

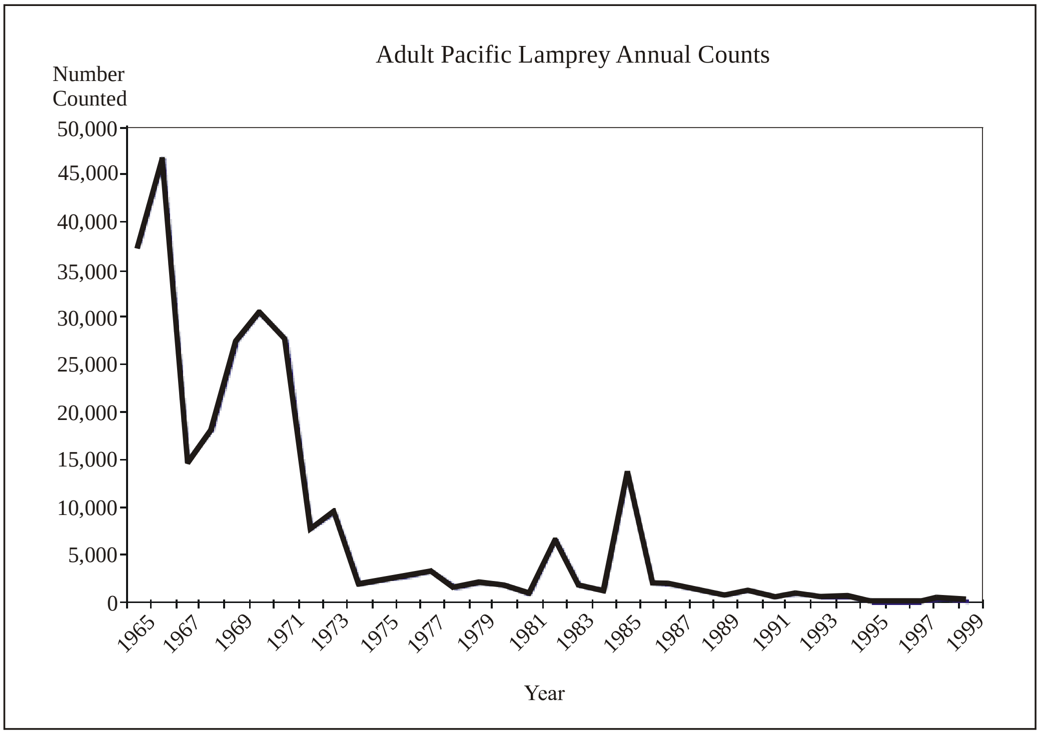


Figure 3.13. Annual counts of Pacific lamprey at Winchester Dam on the North Umpqua River, 1965 through 1999.

Lamprey redd counts are now being conducted throughout the Umpqua Basin, but results are not yet available.

3.5.4. Population Trends

The decline in suitable aquatic habitat is frequently cited as an important reason (along with ocean conditions and over-harvest) for the general decline in fish populations over a period of many decades. High-quality aquatic habitat was abundant in the Umpqua Basin prior to Euro-American settlement, both in the stream channel and in backwater and wetland areas. The diversity of habitat conditions for fish and other aquatic species was provided by the widespread presence of beavers and the historical array of physical elements in the stream channel, including logs, woody debris, boulders, and gravel.

Adult salmonid returns throughout the Umpqua Basin generally increased over the past five to seven years. Based on spawning survey results, fall chinook populations in the region have generally increased in recent years (Jacobs et al. 2002). This trend may be due, at least in part, to greater numbers of wild and hatchery fish surviving to adulthood because of normal winter storm events (i.e. no major floods or landslides) and ocean conditions that favored survival and growth. When both of these limiting factors are favorable over several years or fish generations, the result is an increase in adult run sizes. This trend is expected to continue until there is a change in ocean conditions or winter storm events. Activities that improve freshwater conditions for salmonids will also help increase fish runs. These activities include removing barriers to fish passage, increasing in-stream flows, and improving critical habitat in streams and estuaries.

Angler harvest-reporting data suggested that most coastal steelhead runs were below long-term average levels during the 1970s and 1980s (Nickelson et al. 1992). However, newer restrictions on the harvest of wild steelhead have made it difficult to continue monitoring abundance levels using data from angler harvest reporting. In 2003, ODFW began implementing a coast-wide survey method for estimating winter steelhead spawning by counting redds.

Coastal populations of coho salmon historically have been variable. Recent spawner abundance was lowest in 1997 and highest in 2001 and 2002 (Jacobs et al. 2002). Between 1990 and 2002, coho spawner abundance in Oregon was highest in the mid-south coast monitoring area, which extends from the Umpqua Basin south to Sixes River. The return of coho adults is heavily influenced by conditions in the ocean (productivity and fish harvest). Since about 1998, ocean conditions for coho have generally been good.

Relatively little is known about population trends of Pacific lamprey (anadromous) or brook lamprey (resident), although available evidence suggests that lamprey numbers have declined significantly (Figure 3.13). Fish biologists believe that more lamprey are passing over Winchester Dam than are counted, however. More research is needed to better understand the status of the Pacific lamprey population. A lack of historical population information makes it difficult to assess the relative abundance of current populations. However, anecdotal evidence indicates that lamprey were very abundant, and were a significant food source for native Americans. The Winchester Dam counts indicate a precipitous decline in the population of Pacific lamprey in the Umpqua Basin since 1965 (Kostow 2002).

3.5.5. Fish Populations Key Findings And Action Recommendations

3.5.5.1. Fish Populations Key Findings

- The anadromous salmonid species in the Mill Creek Watershed with annual runs are coho, winter steelhead, and fall chinook. Cutthroat trout is the only resident salmonid species.
- More quantitative data are needed to evaluate salmonid abundance and the distribution and abundance of non-salmonid fish in the watershed.
- Although watershed-specific data show tremendous fluctuation in annual salmonid abundance, Umpqua Basin-wide data indicate that salmonid returns have recently improved. Ocean conditions are a strong determinant of salmonid run size; however, improving freshwater conditions will also help increase salmonid fish populations.
- A coast-wide EPA study in 2004 found that the Umpqua Basin accounted for more total and wild coho salmon spawners than any other river in Oregon. Some of the coho that comprise the Umpqua Basin population use the Mill Creek Watershed for rearing and spawning.
- In-stream complexity and water quality are the most important limiting factors for coho in the Mill Creek Watershed.
- Very little information exists regarding lamprey and sturgeon, but limited data suggest that population levels are low.

3.5.5.2. Fish Populations Action Recommendations

- Work with local specialists and landowners to verify the current and historical distribution of salmonids in tributaries within the watershed.
- Encourage landowner and resident participation in fish monitoring activities.
- Conduct landowner education programs about the potential problems associated with introducing non-native fish species into Umpqua Basin rivers and streams.
- Encourage landowner participation in activities that improve freshwater salmonid habitat conditions.

4. Current Trends and Potential Future Conditions

This chapter evaluates the current trends and the potential future conditions that could affect important stakeholder groups in the watershed.

Key Questions

What are the important issues currently facing the various stakeholder groups?

How can these issues affect the future of each group?

4.1. Overview

There are many commonalities among the identified stakeholder groups. All landowners are concerned that increasing regulations will affect profits, and all have to invest more time and energy in the battle against noxious weeds. Smaller timber and agricultural interests are concerned about the global market's effect on the sale of local commodities. These groups also struggle with issues surrounding property inheritance. Some groups are changing strategies in similar ways; community outreach is becoming increasingly important for both the Oregon Department of Environmental Quality (ODEQ) and industrial timber companies. Overall, the future of fish habitat and water quality conditions in the Umpqua Basin is bright. According to ODEQ, basin-wide conditions are improving and have the potential to get better.

4.2. Stakeholder Perspectives[43]

4.2.1. Population and Economy

There are no incorporated towns or cities in the Mill Creek Watershed. Approximately 37 families live in the watershed full-time. Many of the residents work in Reedsport, or elsewhere outside of the watershed, and manage their land for beef cattle and timber production, as well. In the summer months, the population increases due to tourism at Loon Lake, and part-time residents who spend the summer in the watershed.

4.2.2. Agricultural Landowners[44]

Beef cattle is the primary agricultural product provided by the Mill Creek Watershed.[45] Almost all agricultural lands are privately held and are located in Ash Valley.[46] Throughout the Umpqua Basin, the agricultural community could potentially have the greatest influence on fish habitat and water quality restoration. Obstacles to farmer and rancher participation in fish habitat and

[43] It was not possible to develop a comprehensive viewpoint of the current trends and potential future conditions for the conservationist and environmentalist community in the Umpqua Basin. Therefore, this perspective is not included in section 4.2.
[44] The following information is primarily from interviews with Tom Hatfield, the former Douglas County Farm Bureau representative for the Umpqua Basin Watershed Council, and Kathy Panner, a member of the Douglas County Livestock Association. Shelby Filley from the Douglas County Extension Service and Stan Thomas from the USDA Wildlife Services provided additional information.
[45] There are people who raise pigs, dairy cows, horses, llamas, and other animals, but few are commercial operators.
[46] Many farmers and ranchers are also forestland owners (see section 4.2.3).

water quality activities are limited time, limited money, and in many cases limited awareness or understanding of restoration project requirements, benefits, and funding opportunities.
Local observation suggests that there are four types of agricultural producers in the Umpqua Basin/Douglas County area. The first group is people who have been very successful in purchasing or leasing large parcels of lands, sometimes thousands of acres, to run their operations. This group generates all their income from agricultural commodities by selling very large quantities of goods on the open market. The second group is medium- to large-sized operators who are able to support themselves by selling their products on the direct market (or "niche" market). This group is able to make a profit on a smaller quantity of goods by "cutting out the middlemen." The third group is smaller operators who generate some income from their agricultural products, but are unable to support themselves and so must have another income as well. The last group is "hobby" farmers and ranchers who produce agricultural goods primarily for their own enjoyment and have no plans in place to make agricultural production their primary income source. Agricultural hobbyists often produce their goods to sell or share with family and friends. In many cases, members of this group do not identify themselves as part of the agricultural community. Observation suggests that in Douglas County the few very large producers are continuing to expand their operations. At the same time, smaller operators who hold outside jobs and agricultural hobbyists are becoming more common.

4.2.2.1. Weeds

One concern for farmers and ranchers is weeds. There are a greater variety and distribution of weeds now than there were 20 years ago, including gorse, Himalayan blackberry, a variety of thistles, and Scotch broom.[47] Many of these species will never be eradicated; some, like Himalayan blackberries, are too widespread, and others, like Scotch broom, have seeds that can remain viable for at least 30 years.

Weeds are a constant battle for farmers and ranchers. These plants often favor disturbed areas and will compete with crops and pastures for water and nutrients. Many weeds grow faster and taller than crops and compete for sunlight. On pasturelands, weeds are a problem because they compete with grass and reduce the number of livestock that the land can support. Some species are poisonous; tansy ragwort is toxic to cattle, horses, and most other livestock except sheep. Whereas foresters must battle weeds only until the trees are "free to grow," farmers and ranchers must battle weeds every year. As a result, an enormous amount of time, effort, and money are invested for weed management, reducing profits and possibly driving smaller operators out of business.

4.2.2.2. Predators

Predators have always been a problem for ranchers. Cougar, coyote, and bear cause the most damage, but fox, bobcat, domestic dogs, and wolf/dog hybrids have also been documented killing and maiming livestock.[48] Prior to the 1960s, the US Department of Agriculture (USDA) handled all predator management in Douglas County. The county took over predator control programs in the 1960s through 1999. Now, the USDA once again handles predator management.

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[47] Tansy ragwort is less common today than10 years ago due to the introduction of successful biological control methods.
[48] The last confirmed wild wolf sighting in Douglas County occurred in the late 1940s. Wolf/dog hybrids are brought to the Douglas County/Umpqua Basin area as pets or for breeding, and escape or are intentionally released.

The populations of cougar and bear appear to be on the rise because of changes in predator control regulations.[49] These species are territorial animals. As populations increase, animals that are unable to establish territories in preferred habitat will establish themselves in less suitable areas, often around agricultural lands and rural residential developments. Some wildlife professionals believe that cougars are less shy than they have been in the past, and are becoming increasingly active in rural and residential areas. As cougar and bear populations continue to rise, so will predation by these species on livestock. It is also possible that incidents involving humans and predators will increase as well.

4.2.2.3. Regulations

Another concern for ranchers and farmers is the threat of increasing regulations. Since the 1970s, farmers and ranchers have had to change their land management practices to comply with stricter regulations and policies such as the Endangered Species Act, the Clean Water Act, and the Clean Air Act. The costs associated with farming and animal husbandry have increased substantially, partially attributable to increased standards and restricted use of pesticides, fertilizers, and other products. More regulations could further increase production costs and reduce profits.

4.2.2.4. Market Trends

Perhaps the most important influence on agricultural industries is market trends. In the United States, there are around 10 food-marketing conglomerates that control most of the agricultural market through their immense influence on commodity prices. These conglomerates include the "mega" food chains like Wal-Mart and Costco. Also, trade has become globalized, and US farmers and ranchers are competing with farmers in countries that have lower production costs, because they pay lower wages, have fewer environmental regulations, and/or have more subsidies. The conglomerates are in fierce competition with one another and rely on being able to sell food at the lowest possible price. These food giants have limited allegiance to US agriculture, and the strength of the dollar makes purchasing overseas products very economical. On the open market, US farmers and ranchers must sell their goods at the same price as their foreign competitors or risk being unable to sell their products at all. In many cases, this means US producers must sell their goods at prices barely above production costs. As a result, it is very difficult for small producers to compete with large producers and importers of foreign agricultural goods, unless they are able to circumvent the open market by selling their goods directly to local or regional buyers ("niche" marketing).

4.2.2.5. The Future of Local Agriculture

The future of farmers and ranchers depends a lot on the different facets of these groups' ability to work together. The agricultural community tends to be very independent, and farmers and ranchers have historically had limited success in combining forces to work towards a common goal. By working together, Oregon's agricultural community may be able to overcome the issues described above. If not, it is likely that in the Umpqua Basin hobby farms and residential developments will become increasingly common and profitable family farms and ranches will continue to decline in number.

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[49] Cougar populations have been increasing since protection laws were passed beginning in the 1960s. A law was passed in 1994 banning the use of dogs when hunting cougar. Coyote, fox, bobcat, and other predator populations appear to be stable.

4.2.3. Family Forestland Owners[50]

The term "family forestland" is used to define forested properties owned by private individuals and/or families. Unlike the term "non-industrial private forestland," the definition of "family forestlands" excludes non-family corporations, clubs, and other associations. Of the 86,039 acres in the Mill Creek Watershed, approximately 61% , most of which are private forestlands. Family forestlands most likely constitute a slightly smaller percent of the private non-industrial forests.

Family forestlands differ from private industrial forests. Industrial timber companies favor expansive stands of even-aged Douglas-fir. Family forestlands are more often located in lower elevations, and collectively provide a mixture of young and medium-aged conifers, hardwood stands, and non-forested areas such as rangeland. Family forestland owners are more likely to manage their properties for both commercial and non-commercial interests such as merchantable timber, special forest products, biological diversity, and aesthetics.

Family forestland owners play a significant role in fish habitat and water quality restoration. Whereas most public and industrial timber forests are in upper elevations, family forestlands are concentrated in the lowlands and near cities and towns. Streams in these areas generally have low gradients, providing critical spawning habitat for salmonids. As such, issues affecting family forestland property management may impact fish habitat and water quality restoration efforts.

Who are Douglas County's family forestland owners? In Oregon, most family forestland owners are older; nearly one in three is retired and another 25% will reach retirement age during this decade. Douglas County woodland owners seem to follow this general trend. Local observation suggests that many family forestland owners in Douglas County are either connected to the timber industry through their jobs or are recent arrivals to the area. The impression is that many of the latter group left higher-paying jobs in urban areas in favor of Douglas County's rural lifestyle. In general, few family forestland owners are under the age of 35. It is believed that most young forestland owners inherit their properties or have unusually large incomes, since the cost of forestland and its maintenance is beyond the means of people just beginning their careers.

4.2.3.1. Changing Markets

There are very few small private mills still operating in Douglas County, so timber from family forests is sold to industrial timber mills. Timber companies are driven by the global market, which influences product demand, competition, and production locations. As markets change, so do the size and species of logs that mills will purchase. Family forestland owners must continually re-evaluate their timber management plans to meet the mills' requirements if they want to sell their timber. For example, mills are now favoring smaller diameter logs; hence family forestland owners have little financial incentive to grow large diameter trees.

Another aspect of globalization is a growing interest in wood products certified as derived from sustainably managed forests. Many family forestland owners follow the Oregon Forest Practices

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[50] The following information is from an interview with Bill Arsenault, President of the Douglas Small Woodland Owners Association and member of the Family Forestlands Advisory Committee, and from "Sustaining Oregon's Family Forestlands" (Committee for Family Forestlands, 2002).

Act and consider their management systems sustainable. The Committee for Family Forestlands is concerned that wood certification parameters do not take into account small forest circumstances and management techniques. They fear that wood certification could exclude family forest-grown timber from the expanding certified wood products market. However, the long-term effect of wood certification is still unclear.

Ultimately, the key to continued family forestland productivity is a healthy timber market. Although globalization and certification may change the way family forestland owners manage their timber, foreign log imports have kept local mills in operation, providing a place for family forestland owners to sell their timber. The long-term impact of globalization on forestland will depend on how it affects local markets.

Indirectly, changes in the livestock industry also influence family forestland owners. The livestock market is down, and many landowners are converting their ranchlands to forests. Douglas County supports these efforts through programs that offer landowners low-interest loans for afforestation projects.[51] Should the market for livestock remain low, it is likely that more pastureland will be converted to timber.

4.2.3.2. Land Management Issues

Exotic weeds are a problem for family forestland owners. Species like Scotch broom, gorse, and blackberries can out-compete seedlings and must be controlled. Unlike grass and most native hardwoods, these exotic species require multiple herbicide applications before seedlings are free to grow, which raises the cost of site maintenance by about $200 per acre. The cost is not enough to “break the bank” but can narrow family forestland owners’ profit margins. The cost of weed control may increase if these exotic species and others such as Portuguese broom become more established in the Umpqua Basin.

4.2.3.3. Regulations

Many family forestland owners fear that increasing regulations will diminish forest management profitability. For example, some Douglas County forestland owners are unable to profitably manage their properties due to riparian buffer protection laws. Although most family forestland owners support sound management practices, laws that take more land out of timber production would further reduce the landowners’ profits. This would likely discourage continued family forestland management.

4.2.3.4. Succession/Inheritance

Succession is a concern of many family forestland owners. It appears that most forestland owners would prefer to keep the property in the family; however, an Oregon-wide survey indicates that only 12% of private forestland owners have owned their properties since the 1970s. Part of this failure to retain family forestlands within the family unit may result from complex inheritance laws. Inheritors may find themselves overwhelmed by confusing laws and burdensome taxes and choose to sell the property. Statewide, over 20,000 acres of timberland leave family forestland ownership every year. Private industrial timber companies are the

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[51] Afforestation is planting trees in areas that have few or no trees. Reforestation is planting trees in areas that recently had trees, such as timber harvest sites or burned forests. Contact the Douglas County Extension Forester for more information on this program.

primary buyers. Although the land remains forested, private industrial timber companies use different management prescriptions than do most family forestland owners. Other family forestlands have been converted to urban and residential development to accommodate population growth.

4.2.4. Industrial Timber Companies[52]

In the Mill Creek Watershed, 61% of the land base is privately owned, the majority of which belongs to industrial timber companies. Most industrial timberlands are located in areas that favor Douglas-fir, tending to be hillsides and higher elevations.[53] These lands are intensively managed for timber production. For all holdings, timber companies develop general 10-year harvest and thinning schedules based on 45 to 60 year timber rotations, depending upon site indices.[54] The purpose of these tentative harvest plans is to look into the future to develop sustained yield harvest schedules. These harvest and thinning plans are very general, modified over time depending on market conditions, fires, regulatory changes, and other factors, but are always developed to maintain sustained timber yield within the parameters outlined by the Oregon Forest Practices Act.

4.2.4.1. Land Acquisition

Most industrial timber companies in the Umpqua Basin have an active land acquisition program. When assessing land for purchase, industrial timber companies consider site index along with the land's proximity to a manufacturing plant, accessibility, and other factors. The sale of large private forestlands is not predictable, and it would be difficult for timber companies to try to consolidate their holdings to a specific geographic area. However, most land holdings and acquisitions by timber companies tend to be where conditions favor Douglas-fir production. While purchasing and selling land is commonplace, land exchanges are rare.

4.2.4.2. Weeds

Noxious weeds are a concern for industrial timber managers. As with family forestlands, species such as Scotch broom, hawthorn, and gorse increase site maintenance costs. Weeds can block roads, adding additional costs to road maintenance. Some weeds are fire hazards; dense growth creates dangerous flash and ladder fuels capable of spreading fire quickly. To help combat noxious weeds, some industrial timber companies are working with research cooperatives to find ways of controlling these species.

4.2.4.3. Fire Management

Fires are always a concern for industrial timber companies. The areas at greatest risk are recently harvested and thinned units, because of the flammable undecayed slash (debris) left behind. Timber companies believe that the fire risk is minimized once slash begins to decay.

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[52] The following information is primarily from an interview with Dick Beeby, Chief Forester for Roseburg Forest Product's Umpqua District, and Jake Gibbs, Forester for Lone Rock Timber.
[53] Hillsides and higher elevations are often a checkerboard ownership of Bureau of Land Management administered lands (see section 4.2.5) and industrial timberlands.
[54] Site index is a term used to describe a specific location's productivity for growing trees. Specifically, it relates a tree's height relative to its age, which indicates the potential productivity for that site.

Although many timber companies still use prescribed burning as a site management technique, it is becoming less common due to regulations and the associated cost versus risk factors.

4.2.4.4. Road Maintenance

Although a good road system is critical to forest management, poorly maintained roads can be a source of stream sediment, and undersized or damaged culverts can be fish passage barriers. Roads on industrial timberlands are inventoried and monitored routinely. Problems are prioritized and improvements scheduled, either in conjunction with planned management activities or independently based on priority. Currently, most industrial timber companies repair roads so they do not negatively affect fish habitat and water quality, and failing culverts are replaced with ones that are fish-passage friendly. Road decommissioning is not common, but is occasionally done on old roads. When a road is decommissioned, it is first stabilized to prevent erosion problems, and then nature is allowed to take its course. Although these roads are not tilled or plowed to blend in with the surrounding landscape, over time vegetation is re-established. New roads are built utilizing the latest technology and science to meet forest management objectives while protecting streams and other resources.

4.2.4.5. Community Outreach

The population of Douglas County is growing. Local observation suggests that many new residents are retirees or incomes transferred into the watershed from other areas. Many of these new residents moved to the area for its “livability” and are not familiar with the land management methods employed by industrial timber companies. As a result, establishing and maintaining neighbor relations is becoming increasingly important. Many timber companies will go door-to-door to discuss upcoming land management operations with neighboring owners and address any questions or concerns that the owners may have. These efforts will continue as the rural population within the Umpqua Basin grows.

4.2.4.6. Regulations

Increased regulations will probably have the greatest impact on the future of industrial timber companies. Like family forestland owners, most industrial timber companies believe in following sound forest management principles and consider their current management systems sustainable. There is concern that the efforts and litigation that changed forest management methods on public lands will now be focused on private lands. Should forestry become unprofitable due to stricter regulations, industrial timber companies would be forced to move their businesses elsewhere, potentially converting their forestlands to other uses.

4.2.5. The Bureau of Land Management

The Coos Bay District Office of the Bureau of Land Management (BLM) administers approximately 24,600 acres of land in the Mill Creek Watershed. The BLM and US Forest Service activities within the range of the northern spotted owl follow the guidelines of the 1994 Northwest Forest Plan. In compliance with this policy, the Coos Bay BLM’s District Office developed a Record of Decision and Resource Management Plan in 1995. The plan outlines the on-going resource management goals and objectives for lands administered by the BLM. However, shortly after the completion of the Northwest Forest Plan, the American Forest Resource Council filed a lawsuit against the BLM. The major issues concerned the alleged inappropriate application of reserves and wildlife viability standards to Oregon and California Railroad lands (O&C lands). In part because of this lawsuit, the BLM is currently revising its land use plans in western Oregon. During this process, the BLM will develop alternatives that address a variety of issues, including at least one that will propose eliminating reserves on O&C lands, except where threatened or endangered species would be put at risk. The public will have opportunities to review and comment on the revision of the plan at multiple points throughout the process. [55]

4.2.6. Oregon Department of Environmental Quality[56]

ODEQ plays an important and unique role in fish habitat and water quality restoration. ODEQ's primary responsibility is to support stream beneficial uses identified by the Oregon Water Resources Department by:

Establishing research-based water quality standards;

Monitoring to determine if beneficial uses are being impaired within a specific stream or stream segment; and

Identifying factors that may be contributing to conditions that have led to water quality impairment.

Approximately every three years, ODEQ reassesses its water quality standards and streams that are 303(d) listed as impaired. Throughout the development and reassessment of water quality standards, ODEQ attempts to keep the public involved and informed about water quality standards and listings. All sectors of the public, including land managers, academics, and citizens-at-large, are encouraged to offer input into the process. Water quality standards and 303(d) listings may be revised if comments and research support the change.

4.2.6.1. Current and Future Efforts

To fulfill its responsibilities into the future, ODEQ will continue to prioritize areas that are important for the various beneficial uses as determined by their own research and the research of other groups. When these areas have been identified and prioritized, ODEQ will examine current land use practices to determine what changes, if any, will result in preserving and/or restoring resources. Also, ODEQ will continue its efforts to work with individuals, agencies, citizen groups, and businesses to encourage them to voluntarily improve fish habitat and water quality conditions.

ODEQ hopes that education and outreach will help residents understand that improving conditions for fish and wildlife also improves conditions for people. For example, well-established riparian buffers increase stream complexity by adding more wood to the stream channel. Increased stream complexity provides better habitat for fish. Buffers also help

[55] For more information, contact the Bureau of Land Management Coos Bay District Office at 1300 Airport Lane North Bend, OR 97459.
[56] The following information is primarily from an interview with Paul Heberling, a water quality specialist for the Oregon Department of Environmental Quality in Roseburg.

downstream water quality by trapping nutrients and preventing stream warming, which can lead to excessive algae growth and interfere with water contact recreation.

4.2.6.2. Potential Hindrances to Water Quality Restoration

One hindrance to ODEQ's work is the financial reality of many water quality improvement activities. In some cases, the costs associated with meeting current standards are more than communities, businesses, or individuals can easily absorb. For example, excessive nutrients from wastewater treatment plants can increase nitrate and phosphate levels and result in water quality impairments. The cost for upgrading a wastewater treatment plant can run into tens of millions of dollars, and costs are usually passed on to the community through city taxes and higher utility rates. Upgrading septic systems to meet current standards can cost a single family in excess of $10,000, more than many low and middle-income rural residents can afford. People's interest in improving water quality often depends on the degree of financial hardship involved.

Other potential hindrances to ODEQ's work are budget cuts and staff reductions. There are only two Healthy Stream Partnership positions assigned to the Umpqua Basin, which is approximately 2.7 million acres. Without sufficient funding or personnel, it is difficult for ODEQ to conduct its basin-wide monitoring activities and reassess current water quality standards and impaired streams.

4.2.6.3. Current and Potential Future Water Quality Trends

In order to identify trends in water quality, water samples must be gathered at the same location for a sufficient length of time. Additionally, the sampling sites should be distributed throughout the watershed at strategic locations in order to make generalizations about the entire stream network. The distribution and sampling frequency of water quality data in the Mill Creek watershed is insufficient to detect trends in water quality. However, changes in water quality at the watershed scale are frequently associated with changes in land use. We are unaware of significant changes in land use in the Mill Creek Watershed that would suggest an alteration in the trend in water quality.

5. Action Plan

5.1. Property Ownership and Restoration Potential

For some projects, such as eliminating fish passage barriers, the actual length of stream involved in implementing the project is very small. If only one culvert needs to be replaced, it doesn't make any difference if the participating landowner has 50 feet or a half mile of stream on the property. The benefits of other activities, such as riparian fencing and tree planting, increase with the length of the stream included in the project. Experience has shown that for the Umpqua Bay Watershed Council, conducting projects with one landowner, or a very small group of landowners, is the most efficient approach to watershed restoration and enhancement. Although working with a large group is sometimes feasible, as the number of landowners cooperating on a single project increases, so do the complexities and difficulties associated with coordinating among all the participants and facets of the project. For large-scale enhancement activities, working with one or a few landowners on a very long length of stream is generally preferred to working with many landowners who each own only a short segment of streambank.

5.2. Mill Creek Watershed Key Findings and Action Recommendations

5.2.1. Stream Function

5.2.1.1. Stream Morphology Key Findings

- A wide variety of stream channel habitat types are found in the watershed, and several enhancement opportunities exist.
- Stream habitat surveys suggest that poor riffles, poor to fair large wood conditions, and generally fair riparian conditions limit fish habitat in surveyed streams. Pool conditions also limit fish habitat in some surveyed reaches but are generally better than conditions for the other stream habitat variables.

5.2.1.2. Stream Connectivity Key Findings

- Dams and culverts that are barriers and/or obstacles to fish reduce stream connectivity, affecting anadromous and resident fish productivity in the Mill Creek Watershed.

5.2.1.3. Channel Modification Key Findings

- There are few examples of permitted channel modification projects in the Mill Creek Watershed.
- Many landowners may not understand the detrimental impacts of channel modification activities or may be unaware of active stream channel regulations.

5.2.1.4. Action Recommendations

- Where appropriate, improve pools and riffles while increasing in-stream large woody material by placing large wood and/or boulders in streams with channel types that are responsive to restoration activities and have an active channel less than 30 feet wide.
- Encourage land use practices that enhance or protect riparian areas:

- Protect riparian areas from livestock-caused browsing and bank erosion by providing stock water systems and shade trees outside of the stream channel and riparian zones. Fence riparian areas as appropriate.
- Plant native riparian trees, shrubs, and understory vegetation in areas with poor or fair riparian area conditions.
- Manage riparian zones for uneven-aged stands with large diameter trees and younger understory trees.
- Maintain areas with good native riparian vegetation.
- Encourage landowner participation in restoring stream connectivity by eliminating barriers and obstacles to fish passage. Restoration projects should focus on barriers that, when removed or repaired, create access to the greatest amount of high quality fish habitat.
- Increase landowner awareness and understanding of the effects and implications of channel modification activities through public outreach and education.

5.2.2. Riparian Zones and Wetlands

5.2.2.1. Riparian Zones Key Findings

- Approximately 62% of streamside riparian areas are dominated by coniferous vegetation. These streamside conifers will provide important woody debris to the stream in the future.
- Hardwood forests in the riparian zone are scattered throughout the watershed.
- Riparian areas dominated by grasses are found mainly near Loon Lake, lower Lake Creek, and lower Soup Creek. The scarcity of trees in streamside riparian areas along lower Lake and Soup creeks limits stream shading and contributes to relatively high stream temperatures.
- Stream shading was classified as high along 78% of the stream reaches within the watershed.

5.2.2.2. Wetlands Key Findings

- Historical settlement, development, and long-term agricultural use of the Mill Creek Watershed have probably affected the original wetland hydrology and resulted in loss of wetland areas.
- Most of the remaining wetlands in the Mill Creek Watershed are found on private land near Loon Lake, Lake Creek, and Soup Creek.
- Landowner “buy-in” and voluntary participation must be fostered if wetland conservation is to be successful in the watershed.
- There are opportunities for enhancement and protection of wetlands, including palustrine wetlands near Soup Creek and Lake Creek and lacustrine wetlands near Loon Lake.

5.2.2.3. Riparian Zones and Wetlands Action Recommendations

- Where canopy cover is less than 50%, establish buffers of native trees (preferably conifers) and/or shrubs, depending upon local conditions. Priority areas are fish-bearing streams for which more than 50% canopy cover is possible.
- Identify riparian zones dominated by grass and blackberry and convert these areas to native trees (preferably conifers) and/or shrubs, depending on local conditions.
- Where possible, maintain riparian zones that are two or more trees wide and provide more than 50% cover.
- Encourage best management practices that limit wetland damage, such as off-channel watering, hardened crossings, livestock exclusion (part or all of the year), and providing stream shade.
- Develop opportunities to increase awareness of what defines a wetland and its functions and benefits. This is a fundamental step in creating landowner interest and developing landowner appreciation for wetland conservation.
- Identify or establish various peer-related demonstration projects as opportunities to educate stakeholders.
- Establish an approachable clearinghouse to assist landowners in enrolling in programs that can benefit wetlands and meet landowner goals. A friendly and "non-governmental" atmosphere can reduce some of the previously identified landowner concerns. A central site can identify and coordinate partners, streamline landowner paperwork, and facilitate securing funding and in-kind services often needed for a successful project. Combining local programs with national programs maximizes flexibility and funding. For example, a landowner could receive a tax exemption under the local Wildlife Habitat Conservation and Management Program, receive technical assistance in planning and cost share from the Natural Resources Conservation Service, and receive grant money from Partners for Wildlife and Ducks Unlimited.

5.2.3. Water Quality

5.2.3.1. Temperature Key Findings

- Portions of Mill, Camp, Little Camp, Buck, and Soup creeks have stream temperatures that periodically exceed the state standard for salmonids rearing and migration.
- Establishment of more riparian tree cover, to provide additional stream shading, would help to lower stream temperatures.

5.2.3.2. Surface Water pH, Dissolved Oxygen, Nutrients, Bacteria, and Toxics Key Findings

- Data are limited, but in general do not suggest that there are water quality concerns for pH or nutrients. Information regarding bacteria is lacking.
- Few data have been collected for DO. Results from the limited available data are inconclusive, but indicate the possibility that DO may be an issue of concern. Additional study is warranted.

- We found no data regarding toxics in this watershed. However, activities associated with the use of toxics are uncommon in the watershed, so it is unlikely that toxics are an issue in this watershed.

5.2.3.3. Sedimentation and Turbidity Key Findings

- Turbidity data indicate that usual turbidity levels in the Mill Creek Watershed should not affect sight-feeding fish like salmonids.
- Areas of moderate soil erodibility and runoff potential occur along several tributary streams in the eastern portions of the Mill Creek Watershed.
- Steep to moderately steep slopes are found through much of the watershed. Particularly steep slopes exist in the eastern portions of the watershed, especially in the upper Camp Creek subwatershed.
- The combination of steep slope and erosion-inducing human modifications such as roads, timber harvesting, agriculture, and residential development can make some areas prone to increased erosion.
- Runoff from impervious surfaces, such as roads, can increase sediment loads to streams.

5.2.3.4. Water Quality Action Recommendations

- Continue monitoring the Mill Creek Watershed for water quality conditions. Expand monitoring efforts to include more monitoring of tributaries.
- Identify stream reaches that may serve as “oases” for fish during the summer months, such as at the mouth of small or medium-sized tributaries. Protect or enhance these streams’ riparian buffers and, when appropriate, improve in-stream conditions by placing logs and boulders within the active stream channel to create pools and collect gravel.
- In very warm streams, increase shade by encouraging development of riparian buffers and managing for full stream canopy coverage.
- Encourage landowner practices that will minimize Lake Creek bacteria and sediment levels:
    - Limit livestock stream access by providing stock water systems and shade trees outside of the stream channel and riparian zones. Fence riparian areas as appropriate.
    - Relocate structures and situations that concentrate domestic animals near streams, such as barns, feedlots, and kennels. Where these structures cannot be relocated, establish dense riparian vegetation zones to filter fecal material.
    - Repair failing septic tanks and drain fields.
- In areas with high debris flow hazards and/or with soils that have high K-factor values and are in the C or D hydrologic group, encourage landowners to identify the specific soil types on their properties and include soils information in their land management plans.

5.2.4. Water Quantity

5.2.4.1. Water Availability and Water Rights by Use Key Findings

- In both Mill Creek Watershed WABs, in-stream water rights are equal to or greater than average streamflow during the summer and fall seasons.
- During the summer and fall, there is little or no “natural” streamflow available for new water rights.
- Irrigation is the largest use of water in the watershed. Domestic water use is the second largest use, but accounts for less than five percent of the total water rights in the watershed.

5.2.4.2. Streamflow and Flood Potential Key Findings

- Major floods during the last century occurred in 1909, 1945, 1950, 1953, 1964, and 1996.
- The degree to which land use influences flood potential in the Mill Creek Watershed is unknown at this time, but is not expected to be substantial.

5.2.4.3. Water Quantity Action Recommendations

- In general, water use is not a significant issue of concern in this watershed.

5.2.5. Fish

5.2.5.1. Fish Populations Key Findings

- The anadromous salmonid species in the Mill Creek Watershed with annual runs are coho, winter steelhead, and fall chinook. Cutthroat trout is the only resident salmonid species.
- More quantitative data are needed to evaluate salmonid abundance and the distribution and abundance of non-salmonid fish in the watershed.
- Although watershed-specific data show tremendous fluctuation in annual salmonid abundance, Umpqua Basin-wide data indicate that salmonid returns have recently improved. Ocean conditions are a strong determinant of salmonid run size; however, improving freshwater conditions will also help increase salmonid fish populations.
- A coast-wide EPA study in 2004 found that the Umpqua Basin accounted for more total and wild coho salmon spawners than any other river in Oregon. Some of the coho that comprise the Umpqua Basin population use the Mill Creek Watershed for rearing and spawning.
- In-stream complexity and water quality are the most important limiting factors for coho in the Mill Creek Watershed.
- Very little information exist regarding lamprey and sturgeon, but limited data suggest that population levels are low.

5.2.5.2. Fish Populations Action Recommendations

- Work with local specialists and landowners to verify the current and historical distribution of salmonids in tributaries within the watershed.
- Encourage landowner and resident participation in fish monitoring activities.
- Conduct landowner education programs about the potential problems associated with introducing non-native fish species into Umpqua Basin rivers and streams.
- Encourage landowner participation in activities that improve freshwater salmonid habitat conditions.

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