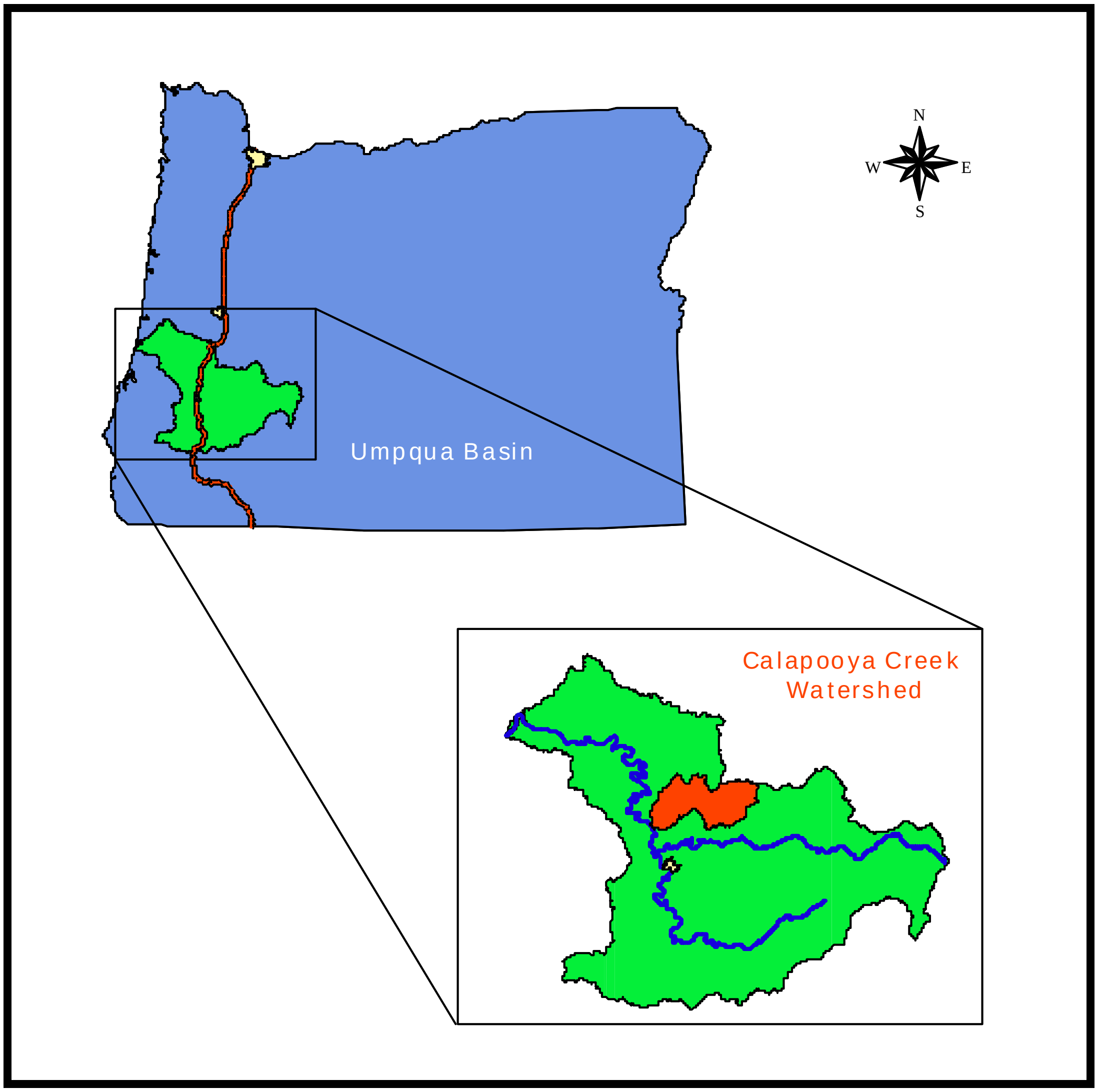
Calapooya Creek

Watershed Assessment and Action Plan



Prepared by Nancy A. Geyer for the

Umpqua Basin Watershed Council

July, 2003

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Prepared by

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Acronym List

BLM	Bureau of Land Management
Cfs	Cubic feet per second
DFPA	Douglas Forest Protective Association
GIS	Geographic information system
NTU	Nephelometric turbidity units
ODEQ	Oregon Department of Environmental Quality
ODF	Oregon Department of Forestry
ODFW	Oregon Department of Fish and Wildlife
OWEB	Oregon Watershed Enhancement Board
OWRD	Oregon Water Resources Department
TMDL	Total maximum daily load
TSZ	Transient snow zone
UBWC	Umpqua Basin Watershed Council
USDI	United States Department of the Interior
USGS	United States Geological Survey
WAB	Water availability basin

Forward

We often hear the term "watershed" these days. We all live within a watershed. Fish habitat and water quality can be affected by the watershed's condition and by the activities within it. All of us depend upon the water that flows from our watershed. But what exactly is a watershed?

A watershed is the area of land where all surface and groundwater drains into the same body of water, such as a river, wetland, or the ocean. Watersheds can be many millions of acres like the Colombia River Basin, or less than a dozen acres for a single small stream. Since the term "watershed" can be used for drainage areas of any size, the US Geological Survey (USGS) has divided watersheds into distinct units, or "fields," based on size. Sizes range from multi-million acre first-field watersheds to seventh-fields that can be less than 3,000 acres.

For this assessment, the most important fields are third-field and fifth-field watersheds.[1] Third-field watersheds are large river basins. The Umpqua River Basin includes the South, North, and main Umpqua Rivers, as well as Smith River, and has roughly the same boundary as Douglas County. Third-field watersheds are usually referred to as "basins," and in this document "basin" will be used to refer to the Umpqua Basin third-field watershed. Fifth-field watersheds have become the standard size used for research and projects by a variety of agencies and organizations. Therefore, it is convenient for fifth-field watershed to be the unit usually referred to herein by the term "watershed." Watersheds are around 40,000 to 120,000 acres, and there are 33 fifth-fields in the Umpqua Basin.

Although the borders of the watersheds are standardized, the names are not. Different organizations and agencies may call the watersheds by different names, but, in general, all watersheds are named for the creek or the section of stream into which all tributaries drain.[2] For example, the Calapooya Creek Watershed includes all land that drains into Calapooya Creek or its tributaries. A very large stream, such as the South Umpqua River, is usually separated into multiple fifth-field watersheds.

All watersheds have their own features, challenges, and potential. The conditions in one watershed may not reflect the conditions in a neighboring watershed. This assessment evaluates the unique past, present, and potential future conditions of the Calapooya Creek Watershed in terms of fish habitat and water quality.

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[1] Fourth-field watersheds refer to sub-basins. Just as there are three main rivers in the Umpqua Basin, there are also three fourth-field watersheds, or sub-basins: the Umpqua River fourth-field watershed, the North Umpqua River fourth-field watershed, and the South Umpqua River fourth-field watershed.

[2] When one watershed does not encompass the entire drainage area, such as with a river or large creek, names reflect the relative location of the watershed along the main stem. Upper South Umpqua would be near the headwaters of the South Umpqua River, while Middle Cow Creek is somewhere in the middle of Cow Creek.

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 *Oregon Watershed Assessment Manual* (Watershed Professionals Network, 1999), the *Calapooya Creek Watershed Analysis* (USDI Bureau of Land Management, 1999), and the *Lower South Umpqua Watershed Analysis* (USDI Bureau of Land Management, 2000). Additional information is from the following sources' databases: The Oregon Climate Service, the US Census Bureau, and the Douglas County Assessor.

Key Questions

- 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 Calapooya Creek Watershed and what are its defining characteristics?
- What are the demographic, educational, and economic characteristics of Calapooya Creek Watershed residents?
- What is land ownership, use, and parcel size within the watershed?

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 corporation that works with willing landowners on projects to enhance fish habitat and water quality in the Umpqua Basin. The council has its origins in 1992 as the Umpqua Basin Fisheries Restoration Initiative (UBFRI) and was changed to the UBWC in May of 1997. Three years later, the council was incorporated as a non-profit organization. The UBWC's 16-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, and conducting workshops with 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 Calapooya 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 Calapooya Creek Watershed; and
2) To provide a research-based action plan that suggests voluntary activities to improve fish habitat and water quality within the watershed.

The action plan developed from findings in Chapter Three 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, landowners, and restoration specialists. Chapter Six is a compilation of all key findings and action recommendations and includes a summary of potential UBWC Calapooya Creek Watershed enhancement opportunities. Activities within the action plan *are suggestions for voluntary projects and programs*. 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 document is the product of a collaborative effort between the UBWC and Calapooya Creek Watershed residents, landowners, and stakeholders. Members of the UBWC staff assembled information about each assessment topic and compiled the data into graphic and written form.[3] Landowners and other interested parties met with Nancy Geyer of the UBWC staff to review information about the Calapooya Creek Watershed and offer comments and suggestions for improvement.

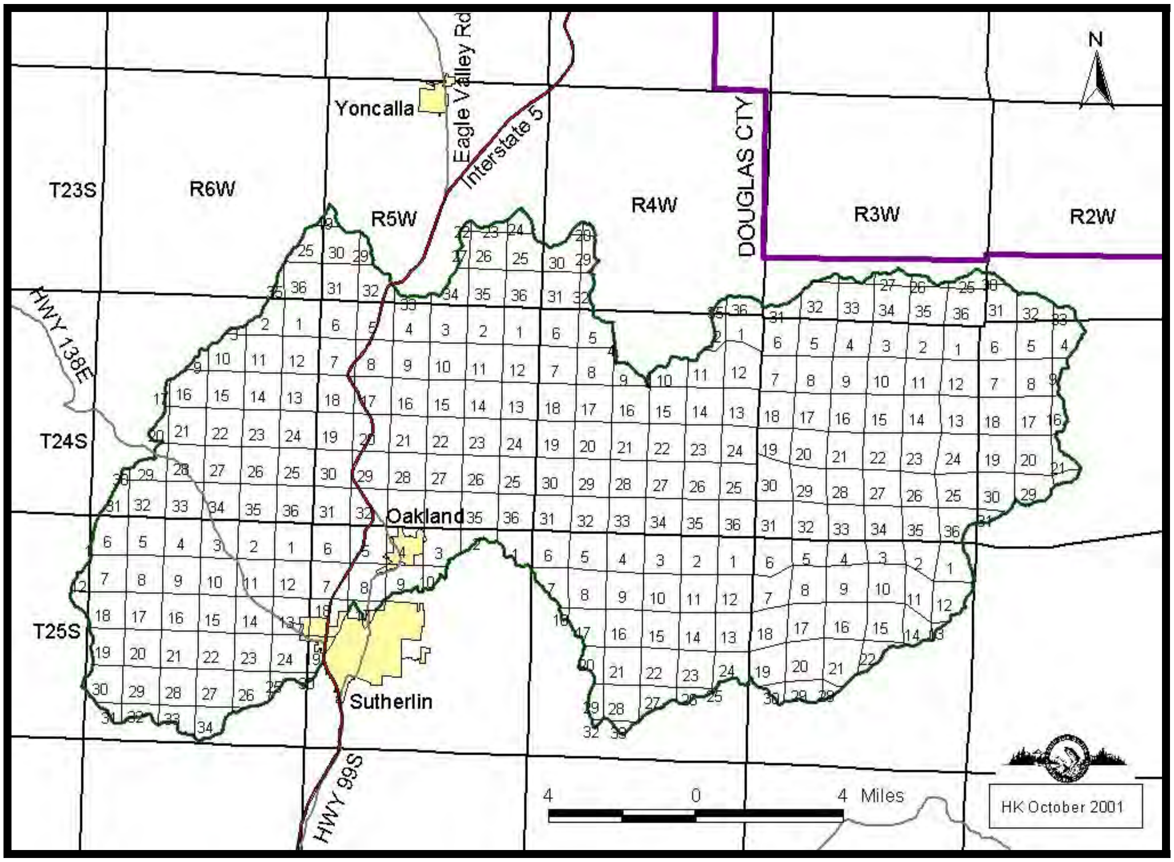
The Calapooya Creek Watershed assessment meetings were held in conjunction with Lower North Umpqua Watershed meetings.[4] Landowners and residents met 12 times from September, 2001, until January, 2003. A total of 51 people attended one or more meetings, with an average of 8.2 participants per meeting. Meeting participants included farmers and ranchers, family forestland owners, industrial timber company employees, city officials, city residents, and Bureau of Land Management personnel.

1.2. Watershed description

1.2.1. Location, size, and major features

The Calapooya Creek fifth-field watershed is located in Douglas County, Oregon, and is 157,281.8 acres (see Map 1-1). The watershed stretches a maximum of 13 miles north to south and 27 miles east to west. There are three highways within the western portion of the watershed: Interstate Five (I-5), Highway 99, and Highway 138. The City of Oakland is entirely within the watershed boundary. The northwestern section of Sutherlin is also within the Calapooya Creek Watershed.

[3] Unless otherwise indicated, Nancy Geyer and Heidi Kincaid of the Umpqua Basin Watershed Council developed all text, tables, maps, and figures.
[4] The Lower North Umpqua Watershed Assessment and Action Plan (Geyer, 2003) is available from the UBWC office.



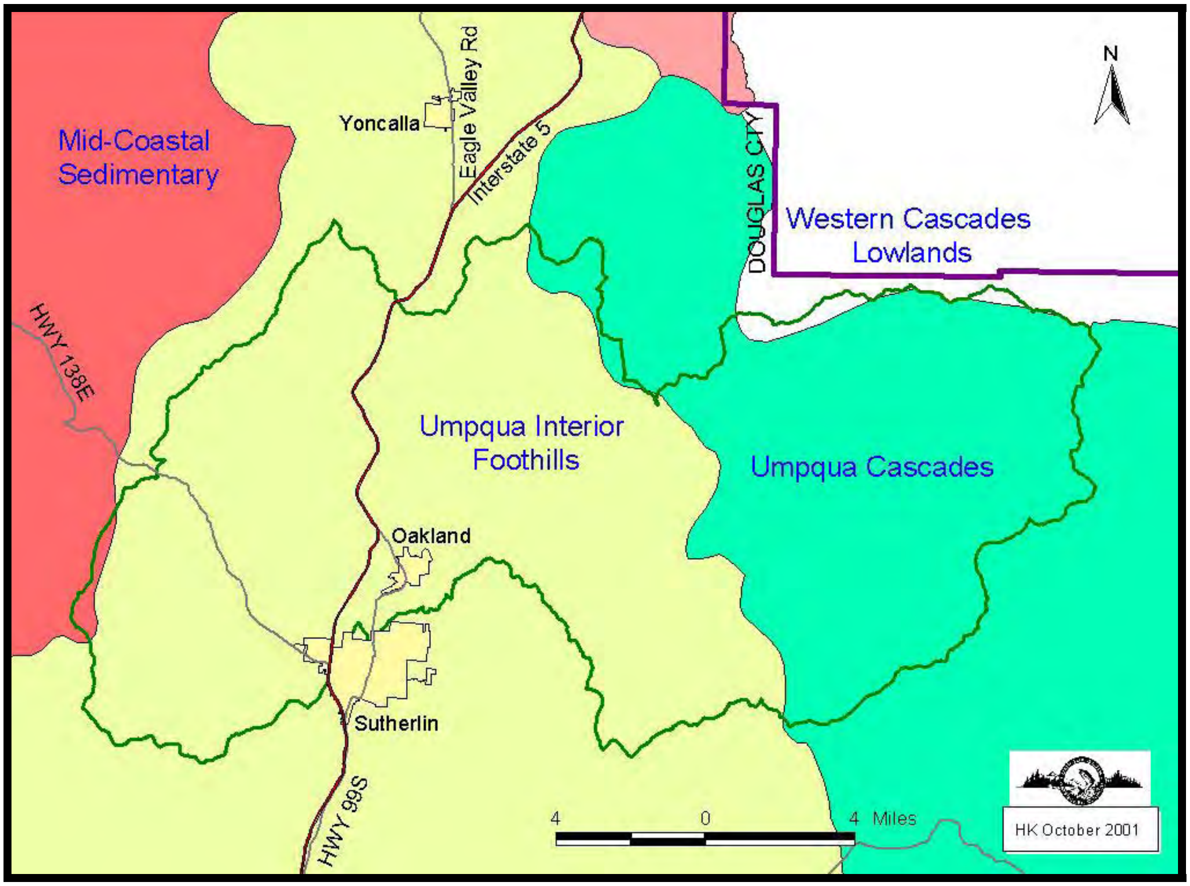
Map 1-1: Location of the Calapooya Creek Watershed.

1.2.2. Ecoregions

Ecoregions are areas with similar type, quality, and quantity of environmental resources, including landscape, climate, vegetation, and human use.[5] Ecoregion information is not specific to an individual watershed and is too general for the purposes of this assessment. However, ecoregions are useful because they divide the watershed into areas based on natural characteristics rather than on political boundaries or township, ranges, and sections. In this section, ecoregions are used to distinguish three unique areas in the Calapooya Creek Watershed. In some cases, ecoregion information is used to supplement other data.

Map 1-2 and Table 1-1 show the Calapooya Creek Watershed's location, acres, and percent within each ecoregion. Over 98% of the watershed is within the Umpqua Interior Foothills (part of the Klamath Mountains) and the Umpqua Cascades Ecoregions. A small area along the northeastern-most boundary is within the Western Cascades Lowlands and Valleys Ecoregion. The western-most point of the watershed is part of the Mid-Coastal Sedimentary Ecoregion, which is part of the Coast Range.

[5] The Environmental Protection Agency (EPA) and the Oregon Natural Heritage Program (ONHP) developed ecoregion boundaries for the State of Oregon.



Map 1-2: Ecoregions of the Calapooya Creek Watershed.

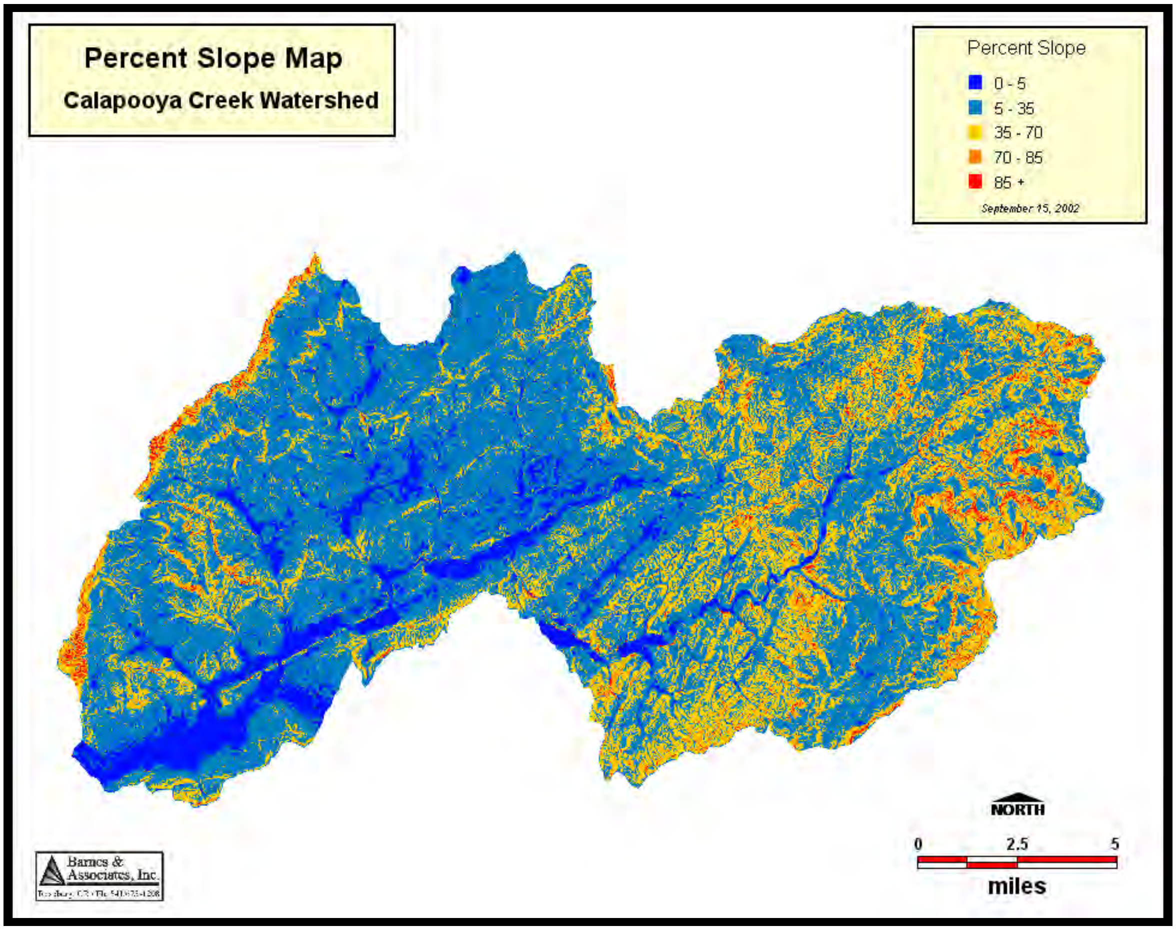
Ecoregion	Acres	Percent of total
Umpqua Interior Foothills	98,899.0	62.9%
Umpqua Cascades	56,209.9	35.7%
Western Cascades Lowlands and Valleys	1,405.6	0.9%
Mid-Coastal Sedimentary	767.3	0.5%
Total	157,281.8	100.0%

Table 1-1: Acres and percent of the Calapooya Creek Watershed within each ecoregion.

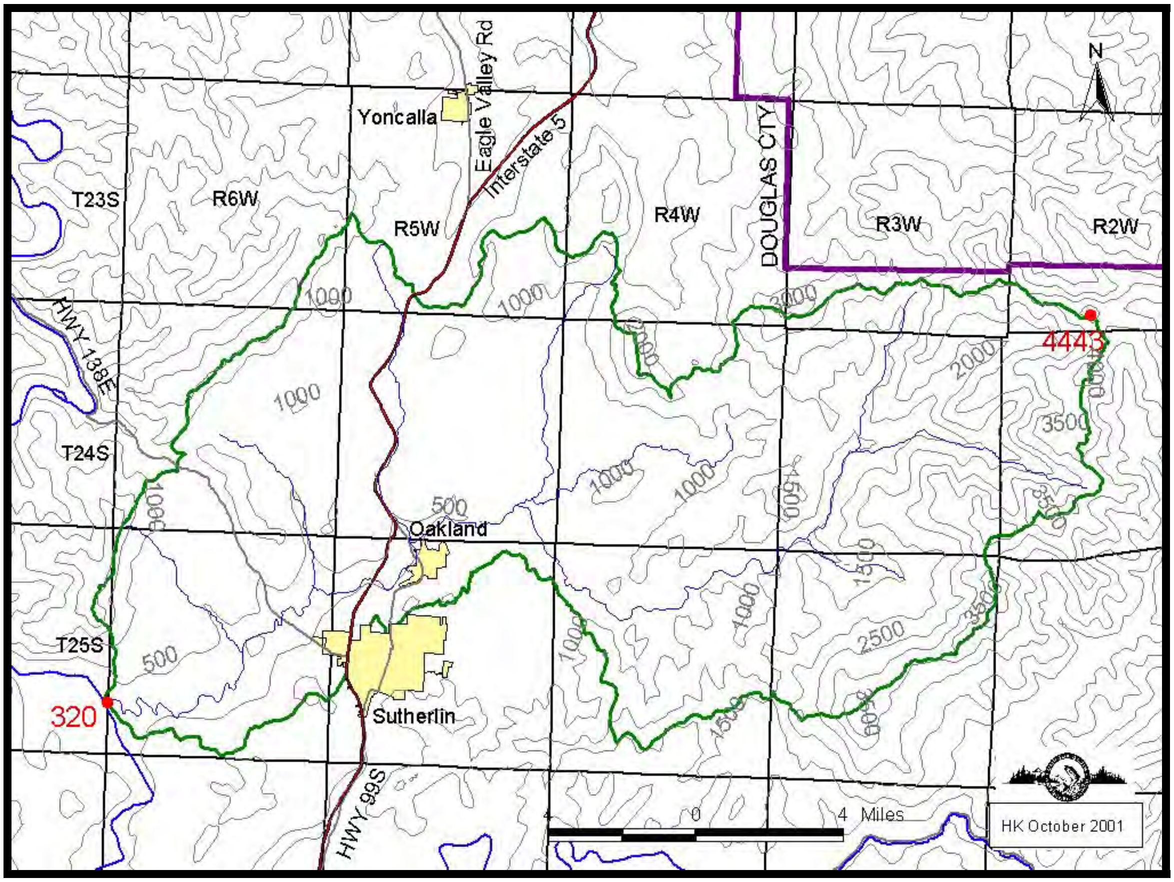
1.2.3. Topography

As shown in Map 1-3 and Map 1-4, narrow interior valleys, broad floodplains, and terraces, with gentle to moderate slopes characterize the Umpqua Interior Foothills Ecoregion. Elevation for most of the area ranges from 500 to 1,000 feet. The lowest point in the watershed is 320 feet where Calapooya Creek meets the Umpqua River in the southwest.

The Umpqua Cascades Ecoregion and the western border of the watershed are generally mountainous. Elevations range from 1,500 to 4,000 feet, and some slopes are steeper than 70%. The maximum height is 4,443 feet at Middle Mountain on the eastern border of the Cascades.



Map 1-3: Percent slope for the Calapooya Creek Watershed.



Map 1-4: Elevation of the Calapooya Creek Watershed with highest and lowest points.

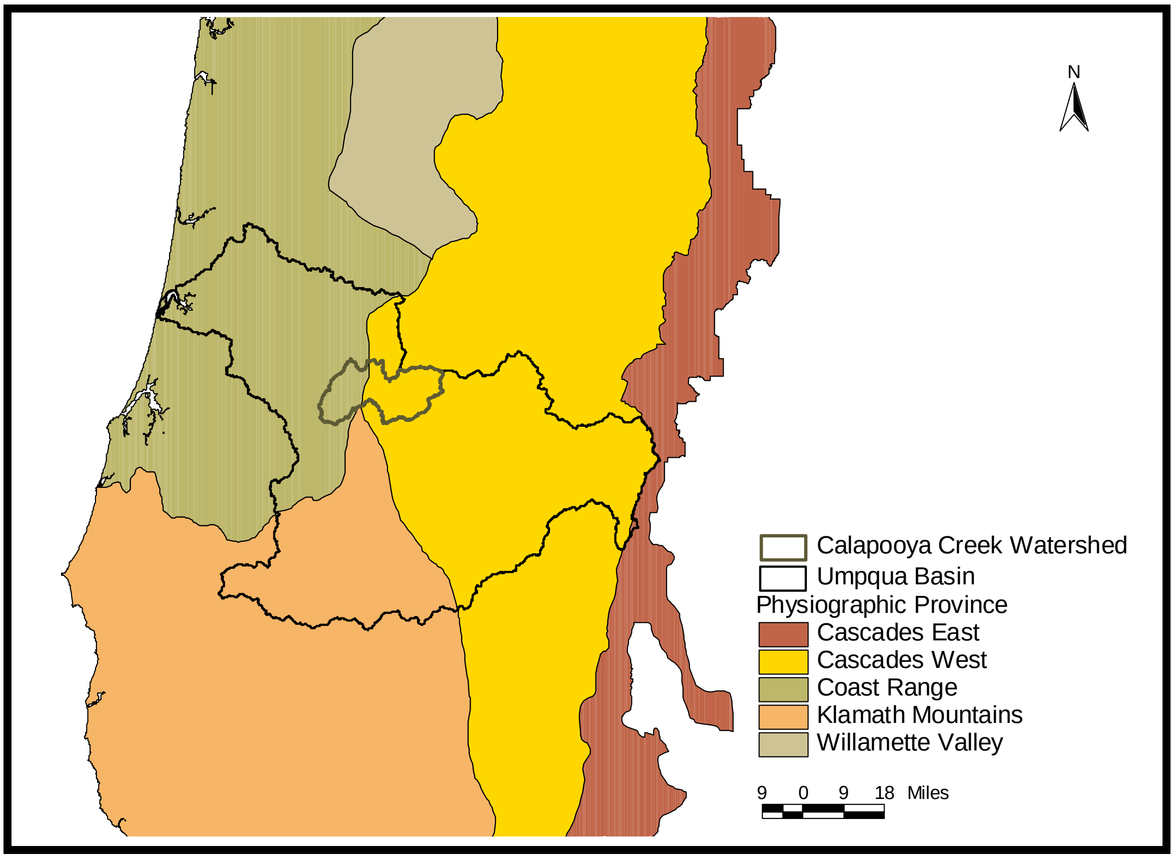
1.2.4. Geology[6]

Oregon has a complex geological history resulting in a variety of landscape types throughout the state. In southwestern Oregon, the most significant event in the history of the formation of the present day landscape is the collision of the western North America continental plate with the Pacific oceanic plate. This report summarizes the geology and geomorphology of this watershed. Appendix 1 provides more information about the geologic history of western Oregon and a glossary of terms. Information in this section and in Appendix 1 has been summarized from the following documents: *Northwest Exposures, A Geologic History of the Northwest* (Alt and Hyndman, 1995); *Atlas of Oregon* (Allan et al., 2001); *Geology of Oregon* (Orr et al., 1992); *Earth* (Press and Siever, 1986); and *Geologic Map of Oregon* (Walker and MacCleod, 1991).

[6] Jenny Allen, Tim Grubert, and John Runyon of BioSystems, Inc., contributed the text and table for section 1.2.4. Terms such as "Jurassic" and "Cretaceous" refer to periods in the geologic/evolutionary timetable. However, the UBWC takes no position regarding the time periods with which these terms are associated and is using the terms to refer to natural processes and the relative order in which they occurred.

Physiography

The Umpqua River Basin is located within three physiographic provinces: the Klamath Mountains, the Western Cascades, and the Coast Range. A physiographic province is defined as a geographic area that demonstrates similar climate and geologic structure but differs topographically from its surrounding areas. The three provinces of the Umpqua River Basin developed under varying geologic processes, resulting in the geologically complex features. The Calapooya Creek Watershed lies within two of these physiographic provinces, the Western Cascades and Coast Range. The westernmost portion of the Calapooya is situated within the Coast Range Province with the remaining two-thirds located in the adjacent Western Cascades Province. Map 1-5 illustrates the physiographic province distribution within the watershed.



Map 1-5: Physiographic provinces of the Calapooya Creek Watershed.

<u>Western Cascades Province</u>

The Western Cascades Province are a north-south trending mountain chain that stretches from Snoqualmie Pass, Washington, south to California. This province has a high rate of precipitation, averaging 80 to 100 inches per year, most of it in the form of snow. The high annual precipitation has contributed to the physical weathering processes that have reduced the once high peaks to round, rolling hills.

Coast Range Province

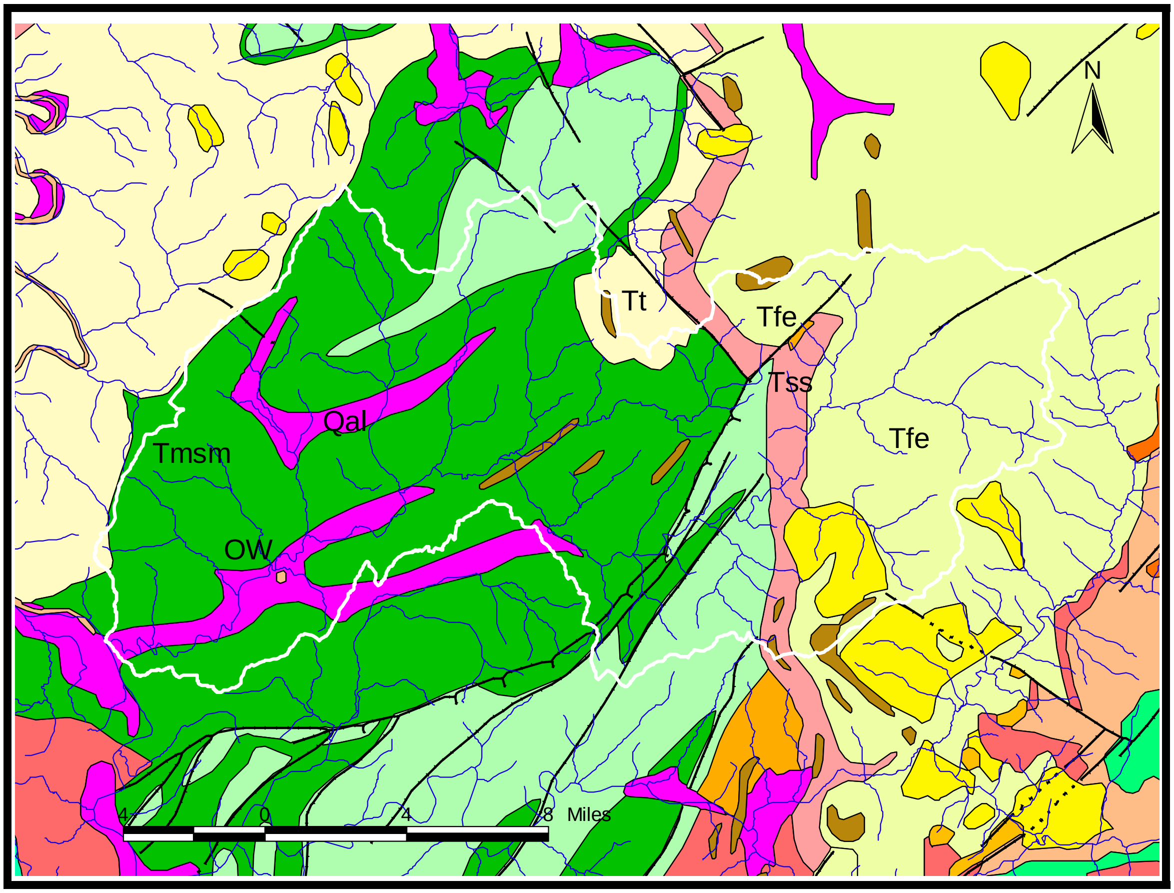
The Coast Range Province is just over 200 miles long, extending south from Washington State to the Middle Fork of the Coquille River. The terrain consists of mountains and coastal headlands, which create the rolling hills characteristic of this province. The Coast Range Province is also influenced by a maritime climate of moderate temperatures and high annual rainfall exceeding 100 inches in some parts of the province. Due to this maritime climate, the Coast Range has developed lush, temperate forests and mature soils. However, due to its high average rainfall and steep gradients, erosion can be more problematic within this province.

Geologic units of the Calapooya Creek Watershed

Rocks of the Calapooya Creek Watershed date to the Tertiary and Quaternary periods with sedimentary deposits dominating the area (see Table 1-2 for the geological time sequence). Included among these are marine deposits of tuffaceous siltstone and sandstone (Tss), marine sandstone, siltstone, and mudstone (Tmsm), the Eugene Formation (Tfe), and the Tyee Formation (Tt). Landslide and debris deposits (Qls) and alluvial deposits (Qal) are also represented within the watershed. These latter deposits are made up of sand, gravel, and silt and commonly form floodplains and fill of current streams (MacCleod, 1991). Marine sandstone, siltstone, and mudstone (Tmsm) cover approximately three-quarters of the western portion of the area. Within the watershed, there are geologic units of igneous origin such as the Siletz River Volcanics and related rocks (Tsr) and basalt and andesite intrusions (Tib and Tu). Map 1-6 shows the geologic units within the watershed. Appendix 1 provides a glossary of terms and more information about the geologic units in the Calapooya Creek Watershed.

Era	**Period**	**Epoch**
Cenozoic	Quaternary	Holocene
		Pleistocene
	Tertiary	Pliocene
		Miocene
		Oligocene
		Eocene
		Paleocene
Mesozoic	Cretaceous	
	Jurassic	
	Triassic	
Paleozoic	Permian	
	Pennsylvanian	
	Mississippian	
	Devonian	
	Silurian	
	Ordovician	
	Cambrian	
Precambrian	Proterozoic	
	Archean	

Table 1-2: Relative geologic time scale (most recent to oldest – top to bottom).



Map 1-6: Geologic units and faults within the Calapooya Creek Watershed.

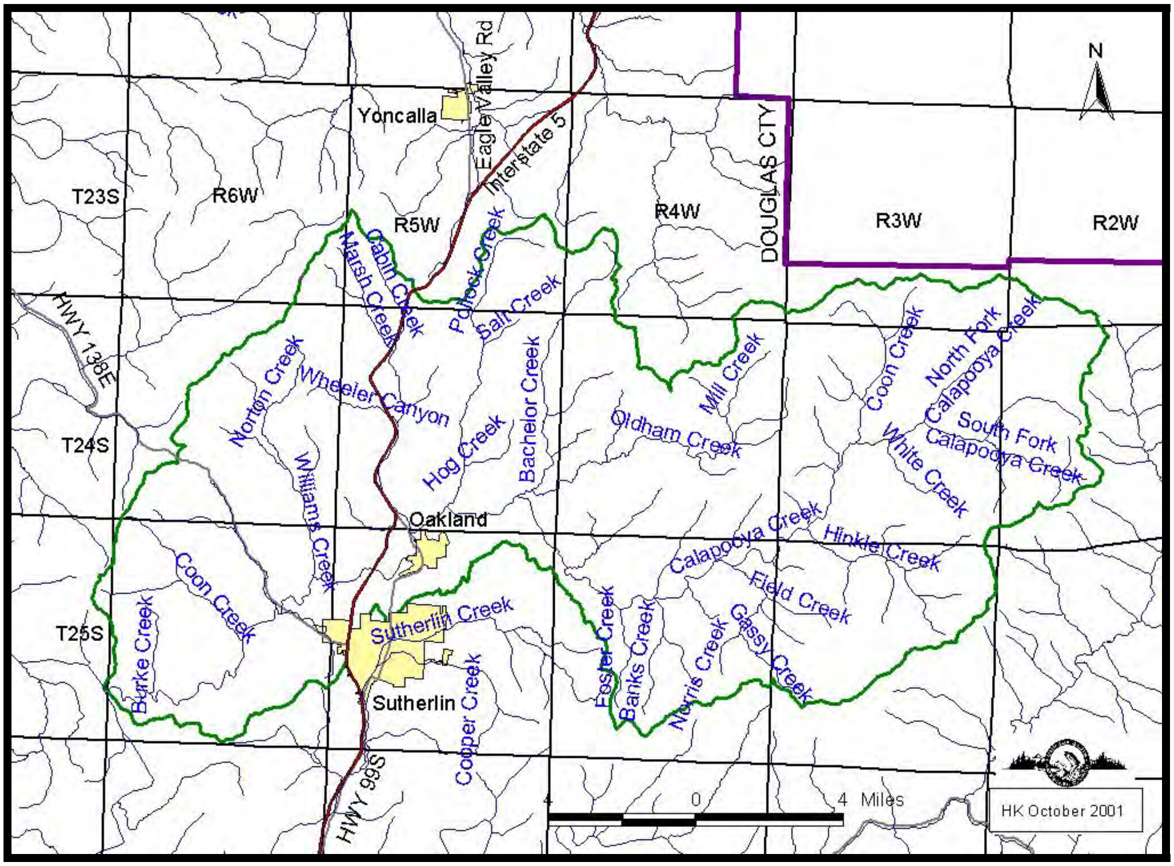
Structural Geology
Within the Calapooya Creek Watershed, the general orientation of the geologic units is in a northeast-southwest pattern. The eastern portion of the Calapooya appears to be influenced by thrust faults that are also situated in a northeast-southwest trend. A thrust fault is a tensional fault with the plane of slippage dipping toward the down-thrown block. The streams within the Calapooya Creek Watershed do not appear to be strongly influenced by the fault system in terms of location, gradient, or direction of flow. The black lines in Map 1-6 represent the faults located within the Calapooya Creek Watershed.

1.2.5. The Calapooya Creek stream network

Map 1-7 shows all of Calapooya Creek's tributaries that are visible on a US Geological Survey 100,000 resolution map (224.2 total stream miles).[7,8] Calapooya Creek is a tributary of the Umpqua River, running 36.1 miles, generally from east to west, to its confluence with the Umpqua (see Photo 1-1) . Calapooya Creek stream gradient

[7] On a map of this resolution, one inch equals 8,333.3 feet.
[8] Stream 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.

(steepness) averages 0.4%. Average gradient for tributaries is 5.8%. Among Calapooya Creek's larger tributaries is Pollock Creek (9.4 miles), while Gilbreath Creek is only one mile long.



Map 1-7: Major streams of the Calapooya Creek Watershed.

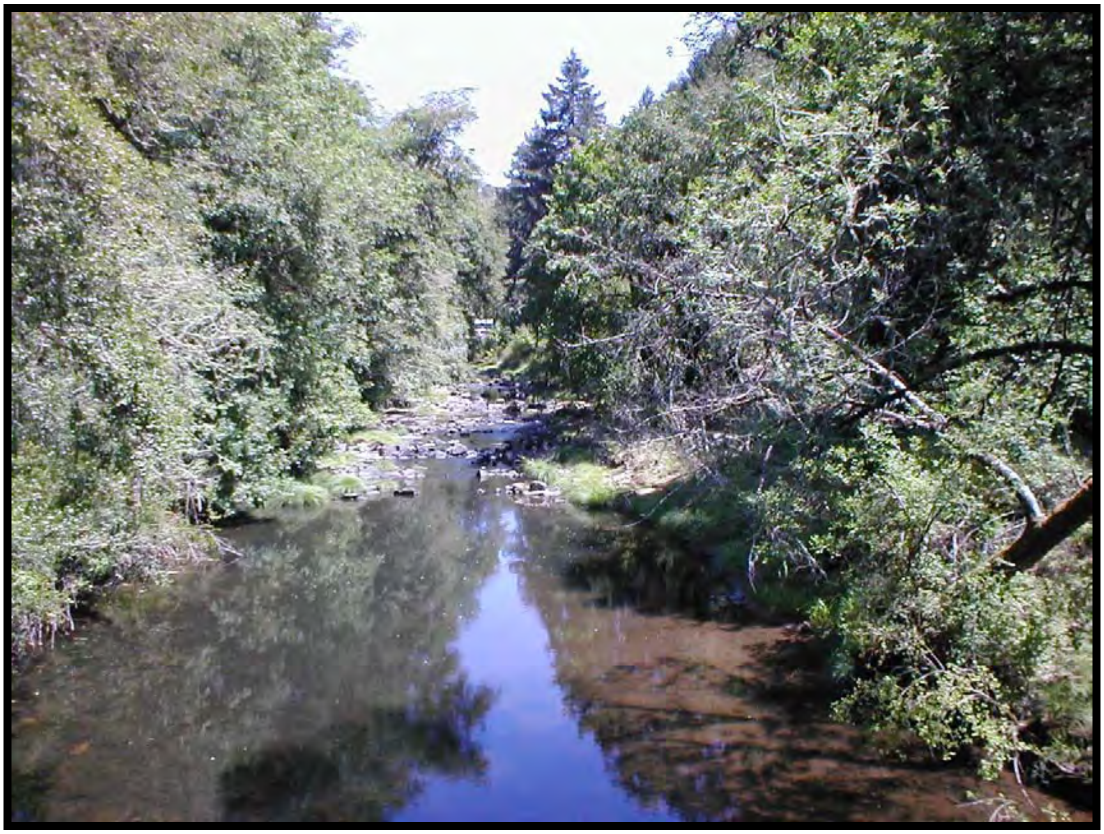


Photo 1-1: Calapooya Creek, the main stem stream within the Calapooya Creek Watershed.[9]

1.2.6. Climate

The Umpqua Interior Foothills Ecoregion has a Mediterranean climate with warm to hot, dry, summers. Precipitation in this ecoregion ranges from 30 to 50 inches. In the Umpqua Cascades Ecoregion, precipitation generally ranges from 50 to 80 inches but can be up to 90 inches in higher elevations.

There is no climate station within the Calapooya Creek Watershed that collects air temperature and precipitation data. The nearest station is located in Winchester (station #359431), which is 11 miles south of the City of Oakland. Winchester temperatures are generally mild. Figure 1-1 shows the average daily minimum and maximum temperature by month from 1961 through 2002. Average daily maximum temperatures in June, July, August, and September are generally in the 70s or low 80s. Average daily minimum temperatures for November, December, January, and February are usually above freezing.

[9] Jenny Allen, Tim Grubert, and John Runyon of BioSystems, Inc., contributed this photograph.

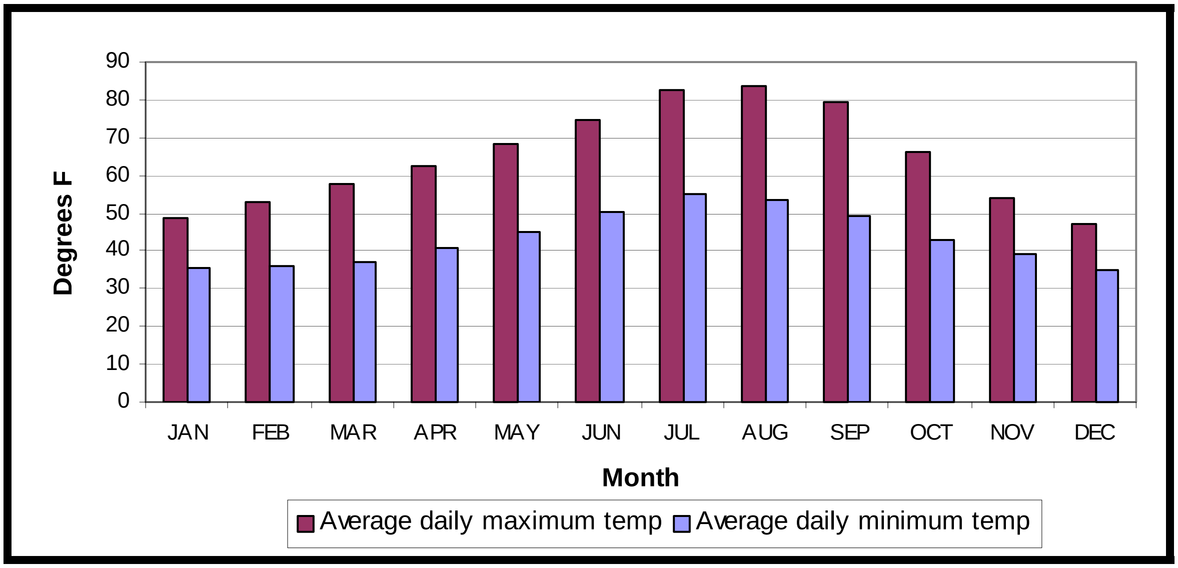


Figure 1-1: Winchester average daily maximum and minimum temperatures by month (station #359461).

Figure 1-2 and Figure 1-3 shows precipitation data from Winchester from 1951 through 2001. Rainfall averages 35.6 inches annually in Winchester, but can vary widely depending upon the year. As is typical of southwest Oregon, most precipitation occurs in the winter months. In Winchester, rainfall averages 5.4 inches per month for November, December, January, and February and 0.7 inches per month for June, July, and August, and September.

In the Calapooya Creek Watershed, approximately 17% of the land base is greater than 2,000 feet in elevation (see Map 1-8). Areas between 2,000 and 5,000 feet in elevation are known as the transient snow zone (TSZ). Rain-on-snow events, in which rain falls on accumulated snow causing it to melt with consequent high runoff, may occur in these areas.

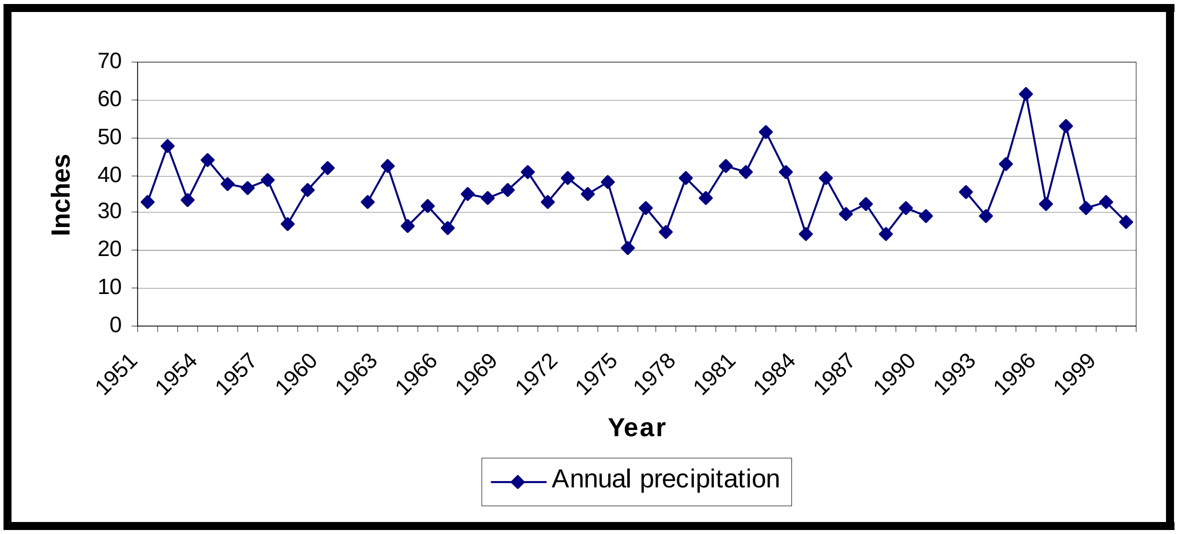


Figure 1-2: Winchester annual precipitation (station #359461).

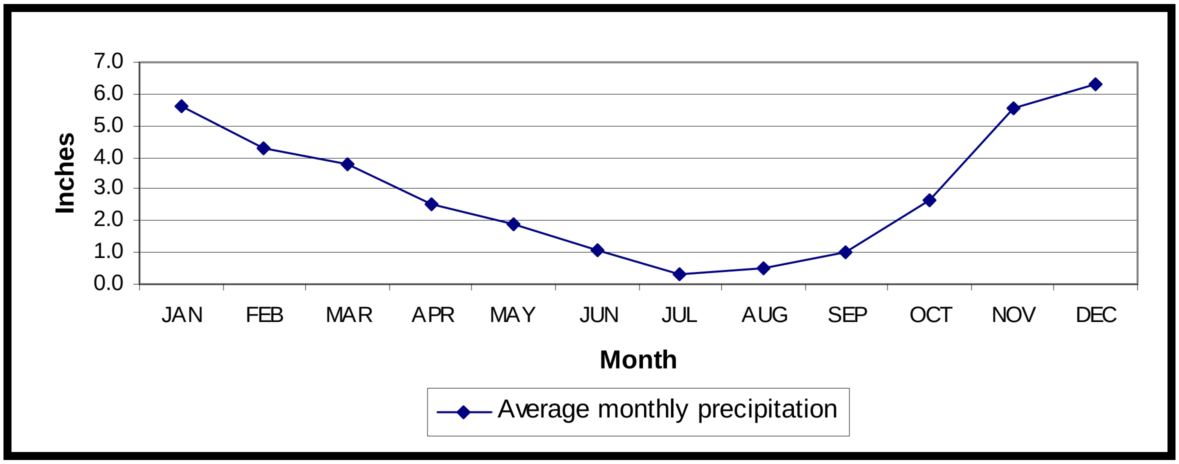
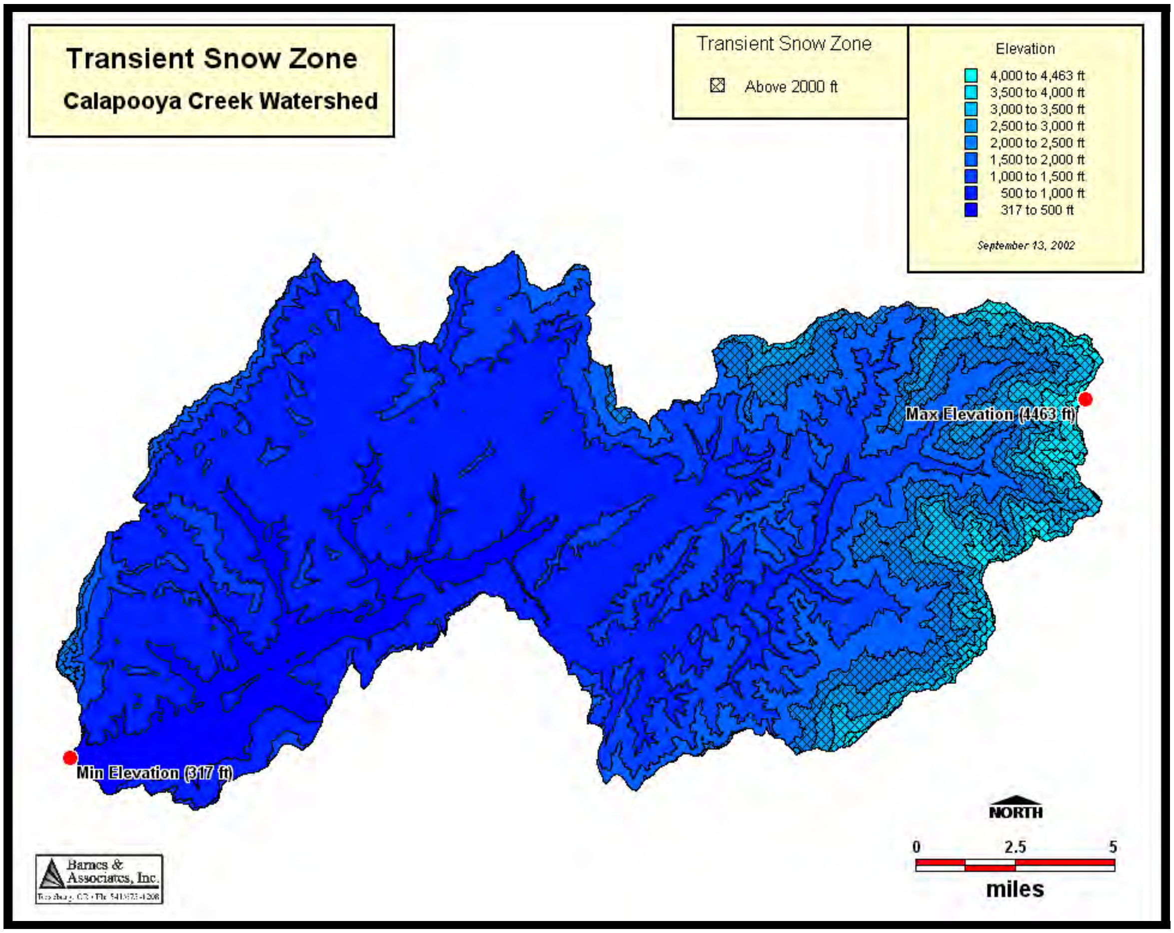


Figure 1-3: Winchester average monthly precipitation (station #359461).



Map 1-8: Transient snow zone in the Calapooya Creek Watershed. [10]

1.2.7. Vegetation

Ecoregion vegetation description

In the Umpqua Interior Foothills Ecoregion, valley bottoms have been converted from native prairie and savanna to urban and rural residential areas, agriculture lands, and grazing lands. Where the soil is favorable and there is sufficient moisture, the uplands support Douglas-fir, madrone, bigleaf maple, California black oak, incense-cedar, and Oregon white oak. Where soils are drier, madrone and oaks are the dominant species, with some Douglas-fir, ponderosa pine, and incense-cedar. Invasive species such as Himalayan blackberry and Scotch broom are common.

The high elevations of the Umpqua Cascades and Mid-Coastal Sedimentary Ecoregions are dominated by Douglas-fir and western hemlock. Overstories also include western redcedar, sugar pine, Pacific yew, grand fir, and white fir. Some madrone is present on warmer south-facing slopes. Canyon oaks can be found on stony soils on all aspects. Understory vegetation includes rhododendron, Oregon grape, salal, golden chinquapin,

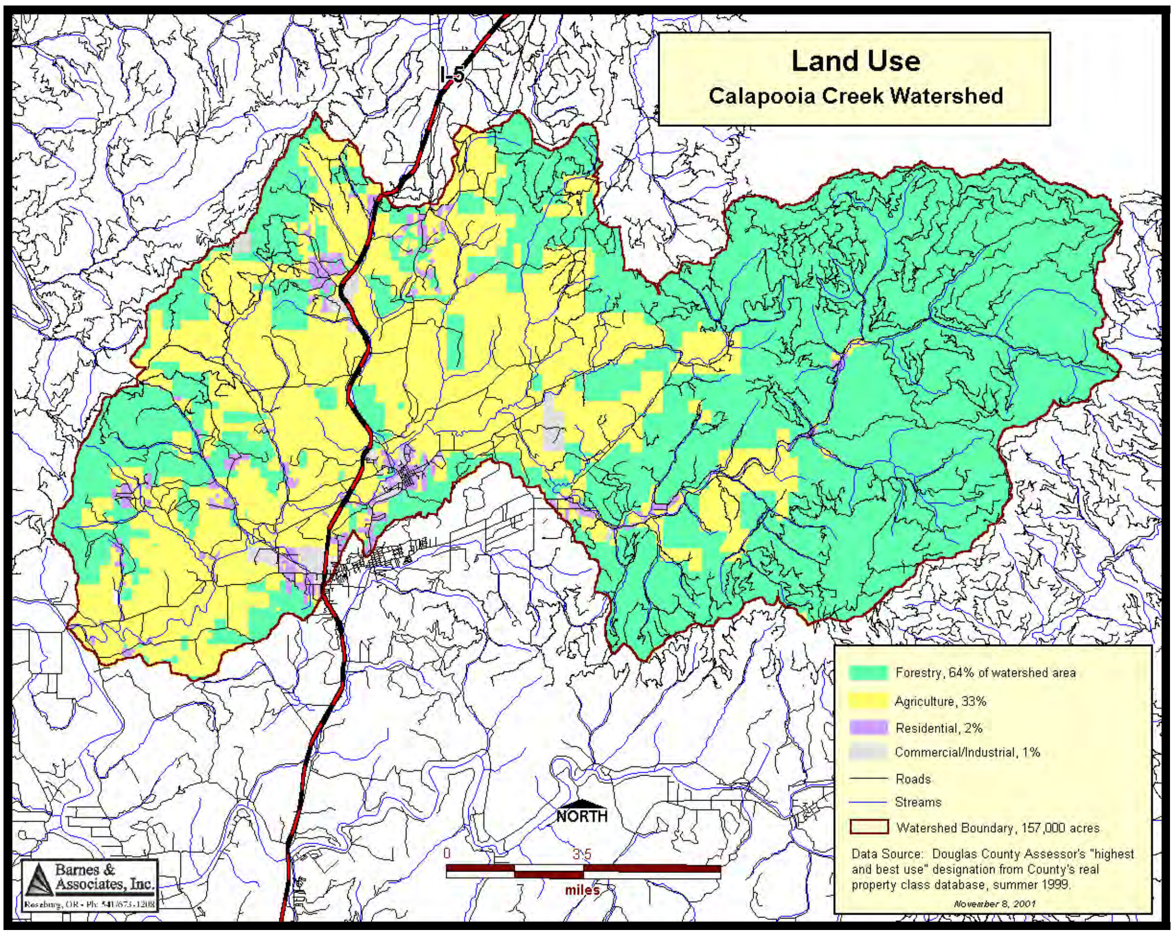
[10] The highest and lowest points on this map are different than shown on Map 1-4. These differences are due to slight variations in the computer technology used to generate the maps.

red huckleberry, western sword fern, and bracken fern. The vegetation in high elevation areas is similar, except the growing season is shorter.

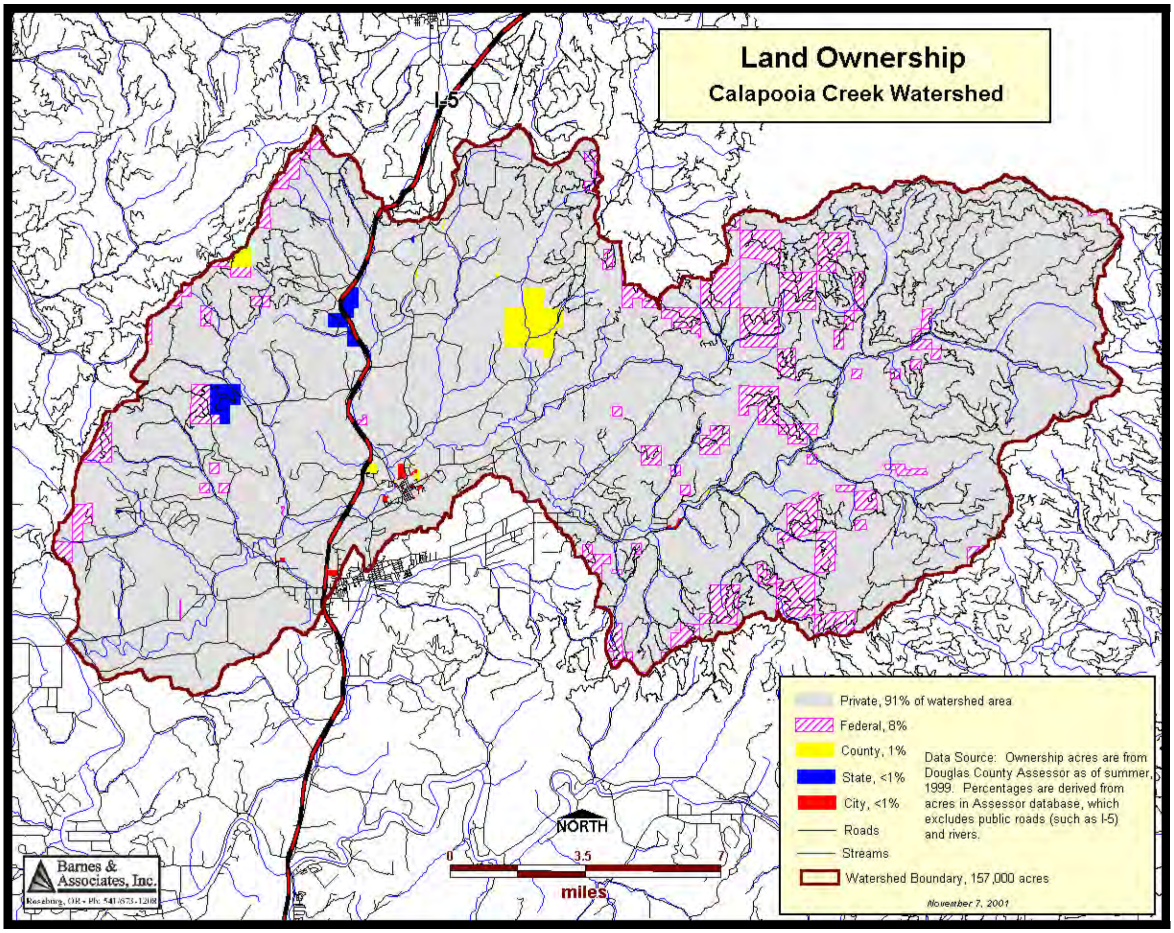
1.3. Land use, ownership, and population

1.3.1. Land use and ownership

The most common land use in the Calapooya Creek Watershed is forestry, with 64% of the land base used for public or private forestry. Agriculture constitutes 33% of the land use, and mostly occurs in the western half of the watershed (see Map 1-9). Land ownership is primarily private (91%), with public ownership mostly administered by the Bureau of Land Management (see Map 1-10).



Map 1-9: Land use in the Calapooya Creek Watershed.

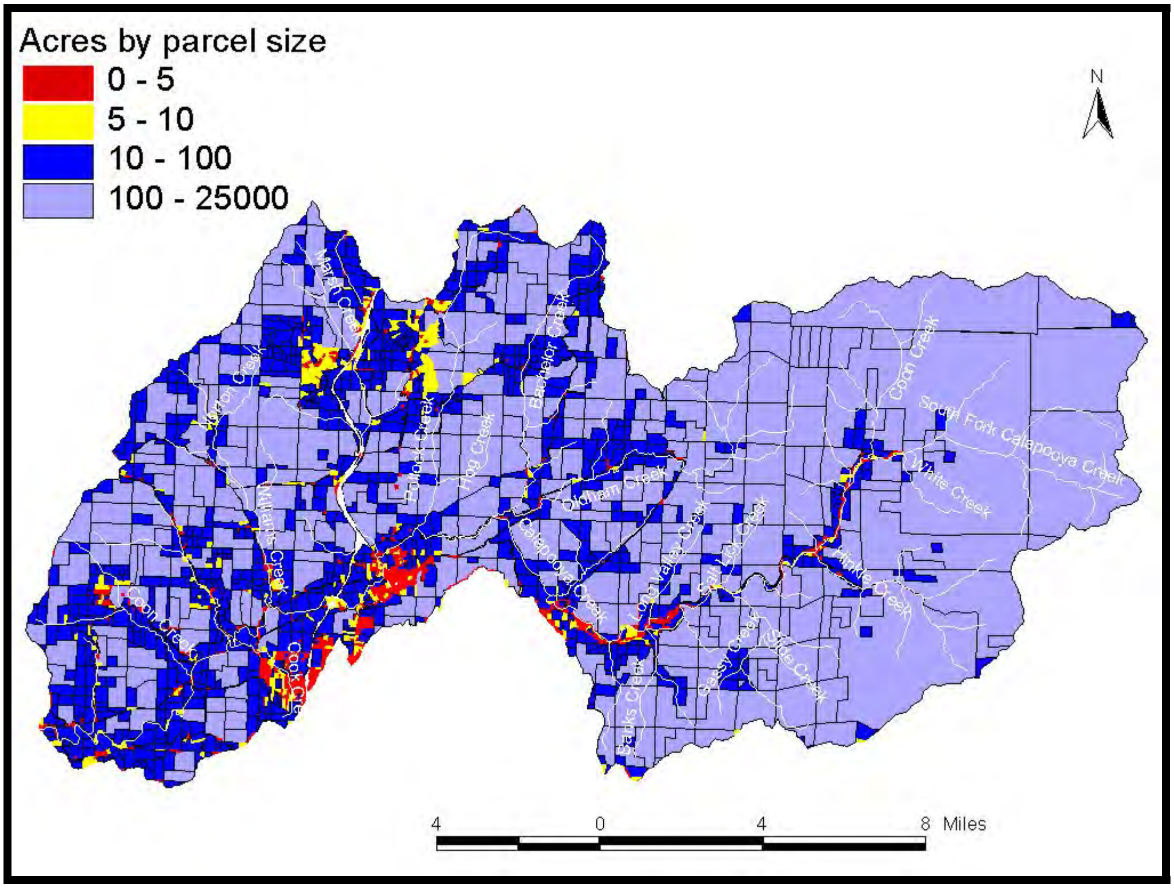


Map 1-10: Land ownership in the Calapooya Creek Watershed.

Map 1-11 and Table 1-3 show parcel size distribution and percent by class for the Calapooya Creek Watershed as of 2001. Almost 70% of the watershed consists of ownership parcels that are over 100 acres. Less than four percent of parcels are less than 10 acres. These are mostly located within and around the cities of Sutherlin and Oakland, around the area known as Rice Hill, and along streams.

Parcel size	Percent
0-5	1.4%
5-10	2.2%
10-100	26.9%
100+	69.5%

Table 1-3: Percent of landholdings by parcel size for the Calapooya Creek Watershed.



Map 1-11: Parcel size distribution for the Calapooya Creek Watershed.

1.3.2. Population and demographics

Areas for which the US Census Bureau has population and demographic information do not correspond with the Calapooya Creek Watershed boundary. All of the City of Oakland and portions of the City of Sutherlin, the Kellogg-Yoncalla census county division (CCD), and the Calapooia CCD are within the watershed.[11,12] Census data for Oakland, Sutherlin, and the Kellogg-Yoncalla CCD are included in this section to provide an overview of the populations that live within the Calapooya Creek Watershed. The Calapooia CCD has been excluded because this census area includes Winchester, Wilbur, and all the areas around the City of Sutherlin, and may not reflect conditions found in the less populated Calapooya Creek Watershed (see maps in Appendix 2).

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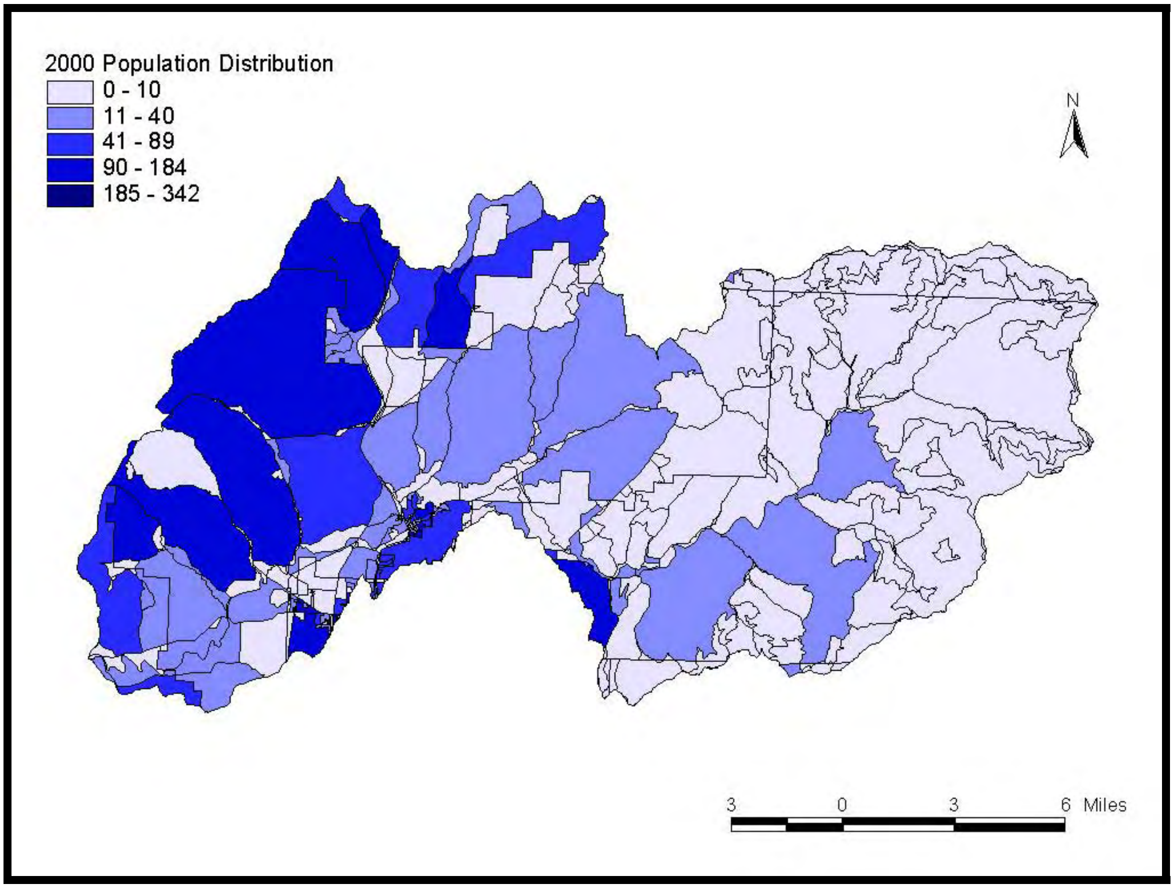
[11] According to the US Census Bureau (http://factfinder.census.gov/servlet/BasicFactsServlet), a census county division (CCD) is "a subdivision of a county that is a relatively permanent statistical area established cooperatively by the Census Bureau and state and local government authorities. Used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

[12] "Calapooya" is frequently spelled "Calapooia" in source documents. Where that is the case, we have used the alternate spelling.

Population

According to the 2000 Census, the population of the City of Oakland was 954 people. Approximately 18% of the city of Sutherlin lies within the Calapooya Creek Watershed. In 2000, the total population of Sutherlin was 6,669 people; therefore approximately 1,200 Sutherlin residents live within the Calapooya Creek Watershed. The total population of the Calapooya Creek Watershed is estimated to be no more than 5,834 people, or an average of 23.7 people per square mile.[13] The relative distribution of people in the watershed is shown in Map 1-12.



Map 1-12: Population distribution within the Calapooya Creek Watershed.

General demographic characteristics and housing

Table 1-4 provides 2000 demographic information for the City of Oakland, the City of Sutherlin, and the Kellogg-Yoncalla CCD. Douglas County data are provided for comparison in Appendix 2. The median ages for all three areas are comparable to those of Douglas County. As with the county, the largest ethnic group in each area is white, with the next largest groups being Hispanic or Latino, and persons of two or more races. In all three areas, average household size is comparable to the county average. Average family size for the City of Sutherlin and the Kellogg-Yoncalla CCD is comparable to the

[13] US Census tracts and blocks do not follow watershed boundaries, so it is impossible to make a precise estimate of the watershed's population.

county average, while the city of Oakland's average is higher. The percent of owner-occupied housing is higher in the Kellogg-Yoncalla CCD than for the cities or the county. The City of Oakland has the lowest percent of vacant housing units.

Parameter	City of Sutherlin	City of Oakland	Kellogg-Yoncalla CCD
Median age (years)	39.5	40.5	43.9
Race			
White	91.4%	91.5%	92.4%
Hispanic or Latino	4.0%	3.4%	1.8%
Asian	0.5%	0.1%	0.6%
American Indian or Alaskan Native	1.5%	2.0%	1.0%
Black or African American	0.1%	0.2%	0.3%
Native Hawaiian or other Pacific islander	0.1%	0.1%	0.2%
Some other race	0.1%	0.0%	0.4%
Two or more races	2.3%	2.7%	3.4%
Households			
Avg. household size (#)	2.46	2.53	2.54
Avg. family size (#)	2.88	3.06	2.88
Owner-occupied housing	72.3%	71.4%	79.8%
Vacant housing units	8.8%	6.7%	9.0%

Table 1-4: 2000 Census general demographic characteristics and housing data for the City of Sutherlin, the City of Oakland, and the Kellogg-Yoncalla CCD.

Social characteristics

Table 1-5 provides information from the 2000 Census for education, employment, and income for the City of Sutherlin, the City of Oakland, and the Kellogg-Yoncalla CCD. Appendix 2 provides the same information for Douglas County. All three areas are comparable to Douglas County for the percent of high school graduates. The City of Sutherlin's percent of people with bachelor's degree or higher is lower than for the other two areas and the county.

The City of Oakland has the highest percent of people in the labor force. The cities of Sutherlin and Oakland have a higher percent unemployment than the county or the Kellogg-Yoncalla CCD. The top three occupations account for around 70% of the labor force for all three areas. The top three industries employ over half of workers, with "manufacturing" accounting for over 20% of jobs in Sutherlin and the Kellogg-Yoncalla CCD. "Educational, health, and social services" accounts for over 20% of all jobs in the City of Oakland. The per capita income and median income for all three areas is lower than for the county. The percent of families below poverty is higher in the cities of

Sutherlin and Oakland than for the county. The Kellogg-Yoncalla CCD's family poverty rate is slightly lower than the county rate.

Parameter	City of Sutherlin	City of Oakland	Kellogg-Yoncalla CCD
Education – age 25 or older			
High school graduate or higher	78.9%	80.1%	81.9%
Bachelor's degree or higher	8.2%	13.6%	12.8%
Employment- age 16 or older			
In labor force	49.8%	58.0%	54.4%
Unemployed in civilian labor force	8.0%	8.5%	6.5%
Top three occupations	Sales and office; Production and transportation, and material moving; Service	Sales and office; Production and transportation, and material moving; Management, professional, and related.	Management, professional, and related; Production and transportation, and material moving; Sales and office
Top three industries	Manufacturing; Education, health, and social services; Retail trade	Manufacturing; Education, health, and social services; Retail trade	Manufacturing; Education, health, and social services Retail trade; Agriculture, forestry, fishing, hunting, mining.[14]
Income			
Per capita income	$13,439	$14,867	$15,563
Median family income	$34,414	$35,795	$34,969
Families below poverty	12.4%	10.1%	9.3%

Table 1-5: 2000 Census information for education, employment, and income for the City of Oakland, the City of Sutherlin, and the Kellogg-Yoncalla CCD.

[14] *Retail trade* and *Agriculture, forestry, fishing, hunting and mining* were tied for the third most common industry (167 people, 10.8% of the population).

2. Past Conditions[15]

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. Sections 2.1, 2.2, 2.3, and 2.4 describe the history of Douglas County. Section 2.5 provides information specific to the Calapooya Creek Watershed. Most of this chapter is based on S.D. Beckman's 1986 book *Land of the Umpqua: A History of Douglas County, Oregon.* Material obtained from other sources will be cited in the text and included in the reference list at the end of the 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 and reached Douglas County in the 1820s. The pre-settlement period was an eye-opener for both the European explorers and the native Indians.

2.1.1. Indian lands

The Indians of Douglas County used fire to manipulate the local vegetation to improve their hunting success. George Hall, Sr., a settler of Douglas County in the 1850s, found the hills in the Oakland area with only a few large fir trees. In the draws were poison oak, small shrubs and abundant deer. "The Indians kept these hills burned off for good hunting" (Chenoweth, 1972, p. 66). In southern Douglas County early white men told of the Indian custom of burning during the late summer months. Burning stimulated the grasses and helped eliminate the undergrowth. "Reports from some of the first white men to see the Cow Creek Valley compared it to a giant wheat field" (Chandler, 1981, p. 2). Grass covering the rolling prairies often was waist high. An expedition in the fall of 1841, funded by the federal government and led by Lt. George F. Emmons, met with

[15] Robin Biesecker of Barnes and Associates, Inc., contributed Chapter Two.

dense, choking smoke as they traveled through the Umpqua Valley. Indians had created the smoky conditions by burning grasslands on the hillsides and along the river.

Accounts of the native Douglas County vegetation reveal extensive prairies and large trees. In June of 1826 David Douglas crossed the Calapooya Mountains and entered Yoncalla. His purpose was to collect specimens of native vegetation for the Royal Horticultural Society of London. Douglas was searching for stands of sugar pine. In the Umpqua Valley he was fortunate to meet and, with the help of beads and tobacco, make friends with an Indian. The Indian pointed to the south after Douglas drew pictures of the sugar pine and its huge cones. The pine stand was located and Douglas later described the largest pine windfall he had found: "57 feet nine inches in circumference; 134 feet from the ground, 17 feet five inches; extreme length, 215 feet" (Lavender, 1972, p. 148). Douglas was very fortunate to live through this experience. He was shooting up into the pine trees to clip cones when eight Indians, attracted by the noise, arrived armed with bows, arrows, and knives. Douglas cocked his gun, backed up and "as much as possible endeavored to preserve my coolness" (Lavender, 1972, p. 148). After an eight to 10 minute staredown the Indian leader requested tobacco. Douglas complied, quickly retreated to his camp and, along with his three sugar pine cones, survived the encounter.

> <u>Origin of the name "Umpqua"</u>
>
> Many ideas exist about the origin of "Umpqua." An Indian 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 Indian interviewed in 1960 believed the term originated when white men arrived across the river from their village and began shouting and gesturing their desire to cross. "Umpqua," she feels means "yelling," "calling," or a "loud noise" (Minter, 1967, p. 16). Another Indian when asked the meaning of "Umpqua" rubbed his stomach, smiled, and said, "Uuuuuump-kwa – full tummy!" (Bakken, 1970, p. 2).

Explorers and early settlers described the trees and other vegetation found in Douglas County. Large cedar trees were found along the South Umpqua River. In 1855 Herman and Charles Reinhart found yellow and red cedars clear of limbs for 30 to 50 feet. The Pacific Railroad Surveys passed through the Umpqua Valley in 1855. The oak groves 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 describe 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). In the present day Glide area, Lavola Bakken (1970) mentions the Umpqua Indian diet of sweet camas bulbs taken from the "great fields of camas" (p. 2). The Cow Creek Indians of southern Douglas County also ate the camas bulb (Chandler, 1981).

The diet of the native Indians also included fish and wildlife. The Cow Creek Indians built dams of sticks across stream channels to trap the fish. 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 Indians along the main Umpqua River. The Lower Umpqua Indians 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 coyotes.

2.1.2. European visitors

The Lewis and Clark Expedition gave glowing reports of the natural riches to be found and proved travel to Oregon was difficult but not impossible. Fur seekers, missionaries, and surveyors of the native geology, flora, and fauna were among the first European visitors to Douglas County. Methodist missionary Gustavus Hines preached to the Indians of the Umpqua in 1840. He concluded "the doom of extinction is suspended over this wretched race, and that the hand of Providence is removing them to give place to a people more worthy of this beautiful and fertile country" (Beckham, 1986, p.59).

Fur trading in Douglas County began in 1791 in the estuary of the Umpqua River. Captain James Baker traded with the Indians 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 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 trapped out and fur trading had ended along the Umpqua River (Schlesser, 1973).

<u>Presettlement timeline</u>

1804 - 1806	Lewis & Clark Expedition
1810	John Jacob Astor establishes Pacific Fur Company in Astoria
1818	Umpqua Massacre – North West Company fur seekers kill at least 14 Indians in northern Douglas County
1826	David Douglas (botanist) travels Douglas County
1828	Smith Massacre – Jedediah Smith's party attacked by Indians at the junction of the Smith and Umpqua Rivers; 14 killed

The travel routes of the trappers and early explorers closely parallel many of Douglas County's current roads. For example, Interstate Five (I-5) is located in the vicinity of an old trade route. The main difference is the original trail followed Calapooya Creek to its mouth and then up the Umpqua and South Umpqua rivers to Roseburg. Interstate Five uses a more direct route from Calapooya Creek to Roseburg via Winchester (Schlesser, 1973). The Umpqua Indian trails followed the major rivers and streams of the county including the main Umpqua and the North and South Umpqua Rivers, Little River, Rock Creek, and Steamboat Creek (Bakken, 1970).

The population of the Umpqua Valley is estimated to have been between 3,000 and 4,000 before the arrival of the white man (Schlesser, 1973). The Europeans brought diseases that reduced the population of Oregon Indians. 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 (Allen, 2001). "The five bands of Athabascan speakers who lived along the Cow Creek were decreased to half their original number due to an epidemic during the severe winter of 1852-53" (Chandler, 1981, p. 9).

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

2.2.1. Early settlement

California's Gold Rush was one factor in the early settlement of the county. First of all, the new miners demanded goods and services. "The California Gold Rush of 1849 suddenly created a market for Oregon crops and employment for Oregonians" (Allan, 2001). Secondly, 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, after the trip to California, 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

<u>Settlement period timeline</u>

1849	California Gold Rush
1850	Donation Land Act
1850s	Indian Wars; Douglas County Indians 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

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 (Allan, 2001; Patton, 1976).

Large numbers of settlers entered Douglas County between 1849 and 1855. Lands were settled along Calapooya Creek, in Garden Valley, at Lookingglass, at the mouth of Deer Creek (Roseburg), in Winchester, and along Myrtle and Cow Creeks. For example, in Cow Creek Valley almost all open lands were claimed by 1855 (Chandler, 1981). The rich bottomland of the Umpqua Valley was very attractive to the emigrants looking for farmland. As the number of settlers increased, the Indian population of the county decreased. Diseases, as mentioned previously, took a toll, as did the Indian Wars of the 1850s. Douglas County Indians were relocated to the Grand Ronde Reservation in the 1850s.

2.2.2. Gold mining

One of the earliest mines in Douglas County was the Victory Mine close to Glendale. The Roseburg Review on November 6, 1893, reported the mine consisted of 800 acres of gold bearing gravel. In order to work the Victory Mine a dam was built across a canyon with a reservoir capable of holding millions of gallons of water.

The early 1850s brought placer mining to the South Umpqua near Canyonville and Riddle. The miners worked many different branches of Cow Creek. Coffee Creek, a tributary of the South Umpqua, was one of the most important mining areas. A minor rush occurred in the Steamboat area – east of Glide - in the 1870s.

In May of 1890 construction was begun on the "China Ditch." This ditch was to bring water from Little River to the Lower South Umpqua River area. The initial purpose was for use in hydraulic mining with future goals of floating logs and irrigating the local fruit orchards. In 1891, 200 Chinese laborers were hired, giving the ditch its name. About 18 miles of ditch were dug before the work was stopped in 1893 by a court order – employees had not been paid. The target destination of Little River was never reached (Tishendorf, 1981).

<u>Mining techniques</u>

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 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, hopefully, gold was washed away and captured downstream.

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 destroyed when the gravels were washed away and the stream bottom was coated with mud. Placer and hydraulic mining may have created spawning areas by washing new gravels into the streams.

2.2.3. Mercury mining

The Bonanza and Nonpareil mines were located about eight miles east of Sutherlin. The Nonpareil mine was discovered in 1860 but was not developed until 1878. By 1880 the smelter was capable of handling 40 tons of ore per day. The Bonanza Mine had some early production in 1887 but the large-scale development did not occur until 1935. The Elkhead Mine, southeast of Yoncalla, began mercury mining and production around 1870.

2.2.4. Nickel mining

Sheepherders discovered nickel near Riddle on Old Piney (Nickel Mountain) in 1864 or 1865. Production was infrequent until 1882 when tunnels (some 320 feet long) and shafts were dug and a series of open cuts completed. Work slowed in the late 1890s and would not increase again until the late 1940s.

2.2.5. 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 nipped by the livestock and diminished in number when the bottomlands were plowed to plant cereal crops. The deer and elk herds were decreased as the settler population increased. Indians were not 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.

2.2.6. Commercial fishing

The bountiful trout and salmon of the Umpqua were first sold commercially in the 1870s. William Rose caught trout and salmon at the confluence of the North and South Umpqua and sold them as far north as Portland. He caught the fish at night with nets and then shipped them out early the next morning. 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 sturgeons 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. Commercial fishing at a much smaller level occurred along the North Umpqua River. The fishermen constructed small dams and breakwaters. These obstructions created eddies and slow-moving water – ideal for capturing fish with gill nets.

2.2.7. 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. An additional market was found in San Francisco for piles for wharfing. 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. Early sawmills were built on South Myrtle Creek, Pass Creek (north of Drain), the main Umpqua River (at Kellogg), Calapooya Creek, and in Canyonville. Dams were created to secure water to drive the mills.

> Splash dams
>
> Loggers created splash dams to transport logs to the mills. A dam was built across the stream creating a large 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 (Beckham, 1990).

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 included loading up the drainages 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 was more difficult (Markers, 2000).

2.2.8. Transportation

Improvements in transportation were key to the economic development and population growth during this time period. The period began with limited transportation options into and through Douglas County. Ships came into the Umpqua estuary and delivered goods destined for the gold mines of California and the remainder of Douglas County. Goods moved from the estuary inland along the Scottsburg-Camp Stuart Wagon Road. Camp Stuart was a temporary military post occupied in 1851 in the Rogue River Valley. This route passed through Winchester and then into California following the Applegate Trail. Congress funded improvements to the Scottsburg-Camp Stuart Wagon Road and to the old Oregon-California Trail (Portland to Winchester) from 1853 through 1879. These road improvements led to the beginning of stage travel from Portland to Sacramento in 1860. The Oregon and California Stage Company began offering daily stages through Douglas County in July of 1860. A daily stage came through the Cow Creek area starting in 1862 (Chandler, 1981). 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 U.S. 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 (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 and the railroad was extended into California.

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 include 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 most important road-building project in the 1950s was Interstate Five (I-5), a four-lane, nonstop freeway, completed in 1966. I-5 was a windfall for cities along its path – Roseburg for example – but difficult for the bypassed cities of Yoncalla, Riddle, and Glendale.

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.

Gyppo loggers came into prevalence in the 1920s. These were loggers and mill owners with limited capital trying to break into the market. The term “gyppo” related to the real possibility that these loggers would “gyp” or not pay their workers. Many of the gyppos operated on the edge, cutting corners and costs whenever possible. Equipment breakdowns, fuel leaks, and accidents were common occurrences. The gyppo loggers searched for valuable logs, such as cedar, left after the initial logging.

Splash dams and log drives were still 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; sports fishermen led the campaign against this form of log transport

1890s to the 1960s timeline

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 Five completed

(Beckham, 1990). Waterways used to transport logs were scoured to bedrock, widened, and channelized. The large woody debris was removed and fish holding pools lost. As more logging roads were built in the 1950s, fish habitat was affected. Landslides associated with logging roads added 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 new wood source 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.

2.3.3. Mercury mining

H.C. Wilmot purchased the Bonanza Mine, approximately eight miles east of Sutherlin, in 1935 and began extensive development. The demand for mercury (quicksilver) for war purposes (World War II) led to a surge in prices to more than $200 a flask.[16] Flasks were made of cast iron and resembled the size and shape of a fruit jar (Oberst, 1985). A vast new deposit discovered in 1939 together with the high mercury demand, resulted in a production of 5,733 flasks by 1940, second highest in the nation. Some of the mineshafts extended more than 1,000 feet deep (Libbey, 1951; Oberst, 1985).

As with many other natural resources, mercury production followed the prices received. Prices fell to $150 per flask in 1949 and then to $70 in 1950, causing the first shutdown since 1936. A price surge in the mid-1950s to $300 a flask reopened the mine. The Bonanza Mine had produced 39,488 flasks by 1960, its final year of operation (Libbey, 1951; Oberst, 1985; Wyant, 1955).

<u>Mining at the Bonanza Mine in 1955</u>

The mine is well-equipped with modern automatic machinery. The trains of cars which bring the ore to the reduction plant, perched on the side of the hill, are powered with electric batteries.

The reduction plant, in principle, is just one giant still. Ore from the mine is fed into a long, revolving kiln, where heat from an oil-fired furnace practically melts the small bits of ore. The mercury vaporizes and is carried into a battery of 24 3-story-high condensers.

The mercury is recovered in rubber buckets at the base of the condensers. The buckets are kept beneath water as a safeguard against escaping mercury vapor which is extremely poisonous.

Dust collects in the form of mud with the mercury. The final step in the recovery process is to allow the "mud" to dry on a sloping tray. Then, the mud is stirred and chopped with a garden hoe and the mercury trickles to a lower corner where it is collected and later stored in squat, 76-pound flasks (Wyant, 1955, p. 1).

[16] A flask is 76 pounds of mercury.

Other mercury mines were also active in the 1900s in Douglas County. The Elkhead Mine, southwest of Yoncalla, operated on and off into the 1960s. The Nonpareil Mine, next to the Bonanza Mine, was active from 1928 to 1932. The Tiller area had two mines, the Buena Vista and the Maud S, both active for short periods in the in the 1920s and 1930s. The Red Cloud Mine in upper Cow Creek was worked between 1908 and 1911 and then sporadically in the 1930s and 1940s.

The Oregon Department of Environmental Quality (DEQ) currently rates the Bonanza Mine as a high priority for further investigation and cleanup. High levels of mercury and arsenic have been found in the area of the old mine. Possibilities exist for movement of mercury into Foster Creek, which flows directly into Calapooya Creek. The site is a considerable risk to aquatic organisms in nearby drainages receiving runoff (Oregon Department of Environmental Quality, 2002).

2.3.4. Nickel mining / copper and zinc mining

M.A. Hanna Company obtained a lease in 1947 and contracted with U.S. government in 1953 to produce nickel. A tramway running almost to the top of Nickel Mountain was completed in 1954. By 1958, 21 million pounds of nickel had been produced. Production continued on Nickel Mountain into the 1990s.

The Formosa Mine is located about seven miles south of Riddle. This copper and zinc mine first opened in the early 1900s with the highest production occurring between 1927 and 1933. Formosa Explorations, Inc. reopened the mine in 1990 (Oregon Department of Environmental Quality, 2002).

2.3.5. Hatcheries

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 1,000,000 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 Little White Salmon. 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.

In the 1910s large amounts of fish eggs were taken from the Umpqua river system. “In 1910 the State took four million chinook eggs from the Umpqua; the harvest mounted 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. “Hatcheries have been essential in maintaining supplies of salmon, whose natural spawning grounds and migration routes have been severely disrupted in many areas by dams, agricultural reclamation and irrigation, and by timber operations” (Patton, 1976, p. 168). In recent years the effect of hatchery fish on the natural fish population has been examined. Flagg et al. (2000) concluded that salmonids raised in an artificial hatchery environment do not respond the same as fish reared in a natural setting. However, they also felt current information was not sufficient to make concrete conclusions about how hatchery fish affect the survival of wild fish.

2.3.6. Agriculture

Crop irrigation was introduced to Douglas County farmers in 1928. J.C. Leady, Douglas County Agent (predecessor of County Extension Agent) gave a demonstration of ditch blasting in the 1928. In the demonstration one ditch in Melrose and one ditch in Smith River were created by blasting. The dimension of the resulting ditch was four feet deep by six feet wide. The report recommended this method of ditch creation in the low lands adjoining the Umpqua and Smith Rivers (Leedy, 1929).

In 1935 Douglas County Agent J. Roland Parker introduced crop irrigation using gas and electric pumps. "The lift necessary to place irrigation water upon most land, laying 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 the applications for water rights and the installation of irrigation systems would double in 1936. In his 1935 Annual Report, Parker listed 21 farms and their proposed irrigation projects. The water sources included the South Umpqua River, Calapooya Creek, Little River, North Umpqua River, Tenmile Creek, Myrtle Creek, Hubbard Creek, and Cow Creek (Parker, 1936).

The appropriation of water rights for agriculture left less water in the streams for fish, especially in the critical late months of summer. In 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. Junior users have water rights obtained at a later date than higher priority users. In periods of low water, the water right holder with the oldest priority date is entitled to the water specified in the senior water right regardless of the needs of junior users.[17]

2.4. Modern era: 1970s to the present

2.4.1. Logging

In 1972 the Oregon Forest Practices Act became effective. Standards were set for road construction and maintenance, reforestation, and streamside buffer strips. 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 relating to stream channel changes. In 1987 riparian protection was increased – specific numbers and sizes of trees to be left in the riparian areas were specified. New rules in 1994 were added to create the desired future condition of mature streamside stands. Landowner incentives were provided for stream

[17] The water rights information was obtained on January 7, 2003, from the Oregon Water Resources Department website http://www.wrd.state.or.us/.

enhancement and for hardwood conversion to conifer along certain streams. (Oregon Department of Forestry, 2002).

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 U.S. 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 reduced the size of many other manufacturing companies in the 1980s and 1990s (Oregon Labor Market Information System, 2002). In 2002 and 2003, increased wood products 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.[18]

1970 to the present timeline

1971	Flood
1972	Clean Water Act
1972	Oregon Forest Practices Act
1973	Endangered Species Act
1974, 1981, 1983	Floods
1987	Hanna nickel mine in Riddle closed
1988	Glenbrook Nickel in Riddle begins production
1994	Northwest Forest Plan results in reduced federal log supplies
1996	Flood
1998	Glenbrook Nickel in Riddle closed
1999	International Paper Mill in Gardiner closed

2.4.2. Mining

The M.A. Hanna Company permanently closed the mine and smelter on Nickel Mountain (near Riddle) in January, 1987. Nickel prices had fallen to below $2 per pound. By March of 1988 average prices rose to between $5 and $6 per pound allowing Glenbrook Nickel to start production. Glenbrook Nickel closed in April, 1998. The M. A. Hanna Company followed by Glenbrook Nickel diligently strived to reclaim Nickel Mountain and to maintain good water quality from the discharge points. Walter Matschkowsky of Glenbrook Nickel Company was named Reclamationist of the Year in 1998 for his career of responsible mining and reclamation. He supervised the Thompson Creek Reclamation project and was successful in converting an area affected by mining into a green, healthy forest (Oregon Department of Geology and Mineral Industries, 2002).

Formosa Explorations Inc. was not as successful in reclamation efforts in the mine south of Riddle. Formosa reopened the Silver Butte Mine in 1990 and produced copper and zinc ore until 1993. Formosa closed the mine in 1994, completed reclamation activities,

[18] 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.

and filed for bankruptcy. In the winter of 1995-96 acidic wastes were detected in Middle Creek and the South Fork of Middle Creek. Middle Creek is a tributary of Cow Creek. Bureau of Land Management fish surveys in the Middle Creek watershed in 1984 indicated the presence of coho salmon and steelhead. These fish have not been observed in upper Middle Creek for several years. The Oregon Department of Environmental Quality and the Bureau of Land Management are working together to clean up the site (Oregon Department of Environmental Quality, 2002).

2.4.3. Dam construction

During the late 1960s through 1980s several dams were constructed in Douglas County. The largest ones are included in Table 2-1 obtained from the Oregon Water Resources Department.

Year completed	Dam name	Creek	Storage (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

Table 2-1: Name, location, and storage capacity of Umpqua Basin dams built since 1960.

Dams have both beneficial and detrimental influences on fish. Water release during periods of low flow in the late summer can assist fish survival. However, Galesville Dam and Berry Creek Dam are complete barriers to fish movement. Cooper Creek Dam and Plat I Dam may be barriers to juvenile fish (see section 3.1.2).

2.4.4. Tourism

The rapid expansion of tourism in Douglas County came after World War II. The improving economy left Americans with an increased standard of living and the mobility of automobile travel. The Umpqua Valley offers scenic attractions and good access roads. Interstate Five and the connecting State Highways 38, 42, and 138, provide access to Umpqua Valley's excellent tourist areas. Tourist destination points include Crater Lake National Park, Wildlife Safari, Salmon Harbor, and the Oregon Dunes National Recreation Area. Tourism is a growing industry in Douglas County.

2.4.5. Settlement patterns and urbanization

Unlike many other Oregon counties, over 50 percent of Douglas County residents lived outside incorporated cities in 1980. The settlement pattern was mostly linear. Population density in 1980 was greatest in the central valley from Riddle to Roseburg to Sutherlin and lowest in the eastern and northwestern areas of the county (Cubic, 1987).

The population of Douglas County in 2000 was 100,399, which is an increase of almost 32,000 since 1960 (see Figure 2-1). Major urban areas have developed along the South Umpqua River to the confluence with the North Umpqua River and around the Umpqua estuary. Water quality along these streams gained protection with the passage of the

Clean Water Act in 1972. The Clean Water Act established pollution discharge levels on point sources such as sewage treatment and wood processing plants.

2.4.6. Douglas County population growth

Figure 2-1 shows population growth data for Douglas County during the settlement period (1840s-1890s), the onset of the modern era (1900-1960s), and the modern era (1970s-present).

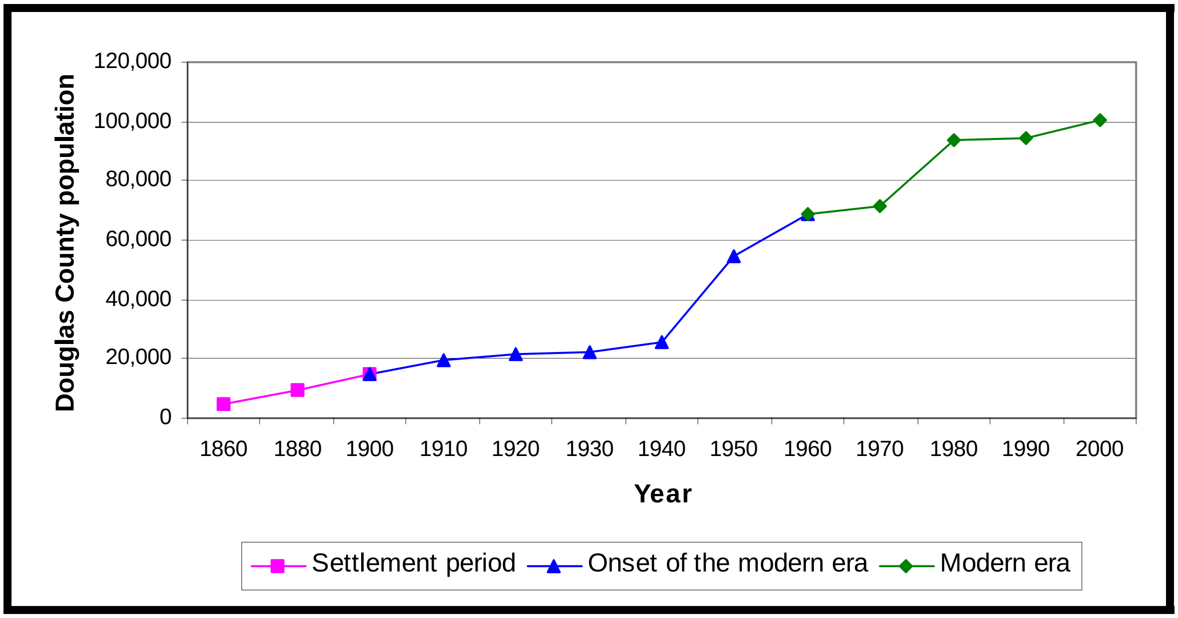


Figure 2-1: Population growth in Douglas County from 1860 through 2000.

2.5. History of the Calapooya Creek Watershed

2.5.1. Calapooya Creek historical timeline

Date	Event	Source
1820s	Thomas McKay, a Hudson's Bay Company trapper, established a trading post near the confluence of Calapooya Creek and the Umpqua River.	(Beckham, 1986; Schlesser, 1972)
1846	The Cornwall family probably built the first home in the watershed on Cabin Creek.	(USDI Bureau of Land Management, 1999)
Late 1840s	"When the early settlers came they took up donation land claims and the grass was so thick you couldn't see the oxen feeding."	(Chenoweth, 1970, p. 21)
1850	Post office established about three miles north of present day location of Oakland. Hull Tower, the	(Chenoweth, 1970)

Date	Event	Source
	first postmaster named the office "Oakland" because of its location within an oak grove.	
1852	Gristmill established on the bank of the Calapooya and was the beginning of the town of Oakland.	(Chenoweth, 1970)
1853	W.R. Powers had a sawmill in the English Settlement. Timber was cut along Calapooya Creek and floated to the mill.	(Chenoweth, 1970)
1853	The low hills around Oakland had just a few large fir trees. The draws had poison oak and small shrubs.	(Chenoweth, 1972)
1854	Felix Starr constructed a sawmill "a dozen or more miles above Oakland on Calapooya Creek." The county seat moves from Winchester to Deer Creek.	(Beckham, 1986, p. 218) (Cubic, 1982)
1860	In November the Umpqua Valley Agricultural Society had the first annual fair in Oakland.	(Chenoweth, 1970)
1860s	"Oakland became the principal trading center for the surrounding area."	(*Oakland, Oregon*, n.d., p. 2)
1872	The Oregon and California Railroad reached Oakland and for six months Oakland was the end of the line. The city of Oakland was moved approximately one mile southwest to be next to the tracks.	(Beckham, 1986; Chenoweth, 1970; *Oakland, Oregon*, n.d.)
Late 1870s – Early 1880s	Nonpareil mercury mine was active.	(Beckham, 1986)
1886	Milton H. Tower established Oakland's first newspaper, *The Enterprise*.	(Chenoweth, 1970)
1892, 1899	Large fires occurred in downtown Oakland.	(*Oakland, Oregon*, n.d.)
Late 1890s	Oakland had a hop yard west of the train depot. A hop drier was located next to the railroad crossing.	(Manning, 1971)
1900	Grey timber wolf invaded the sheep pastures.	(Chenoweth, 1970)

Date	Event	Source
Early 1900	Large amounts of “salmon trout” were caught in Calapooya Creek.	(Chenoweth, 1972)
Early 1900s	The prune industry flourished.	(Chenoweth, 1970)
1905	The Cooper & Drake Sawmill operated in Oakland and produced 500,00 board feet of lumber.	(Beckham, 1986)
1906	Luce Land Company dug an irrigation canal from Nonpareil to within a mile of Fair Oaks.	(Chenoweth, 1970)
1912 – 1928	Farmers cleared land in order to produce more grass. Livestock numbers were increased 25 to 40 percent.	(Chenoweth, 1970)
1917	Heavy snow fell in Oakland and lasted over six weeks.	(Chenoweth, 1970)
1920s	Turkey production was doubled.	(Chenoweth, 1970)
1929	The first annual turkey show was held in Oakland.	(Chenoweth, 1970)
1930s	Turkey production was the core of Oakland’s economy.	(Beckhan, 1986)
1937 to mid 1950s	The Bonanza mercury mine was a major industry in the watershed.	(Oberst, 1985)
1948	The logging camp, Camp Sutherlin, was built in the watershed.	(Weyerhaeuser Company, 1998)
Late 1940s	Weyerhaeuser purchased Roach Timber claims and built 17 miles of railroad along Calapooya Creek.	(Weyerhaeuser Company, 1998)
1950s	Weyerhaeuser began logging in the valley bottoms. Logs were transported by railroad to Sutherlin.	(Weyerhaeuser Company, 1998)
1955	Calapooya Creek flooded near Oakland.	(Douglas County Oregon, 2002)
1958	A logging road network was completed from Cottage Grove to Camp Sutherlin.	(Weyerhaeuser Company, 1998)
1950 – 1980	An extensive system of logging roads was built in the headwaters of the watershed.	(Weyerhaeuser Company, 1998)

Date	Event	Source
1961	Calapooya Creek flooded near Oakland.	(Douglas County Oregon, 2002)
1962	Columbus Day windstorm resulted in uprooted trees and exposed soils.	(Weyerhaeuser Company, 1998)
1963	The last sawmill closed in the Oakland area.	(Beckman, 1986)
1964	Massive flooding in December washed out roads and culverts. Wood, silt, and boulders were transported into creeks.	(Weyerhaeuser Company, 1998)
1968	The Oakland City Council created the Oakland Historic Preservation Commission.	(Beckhan, 1986)
1971, 1974, 1981, 1983	Calapooya Creek flooded near Oakland.	(Douglas County Oregon, 2002)
1996	A flood in November created a large debris jam at the Coon Creek bridge.	(Weyerhaeuser Company, 1998)

2.5.2. Calapooya Creek population

Figure 2-2 shows the population numbers for Oakland and Sutherlin. Oakland was incorporated as a city in 1878 and Sutherlin was incorporated in 1911. The population numbers for 1860, 1880, and 1900 are listed by precinct. Starting in 1900 the population count is by city. The “Calapooia” precinct population counts for 1880 and 1900 are also shown. Calapooia did not incorporate as a city. No population count is listed for the Oakland precinct in 1880 but a population of 1,474 is given for the Calapooia precinct. In 1900 the Calapooia precinct decreased to a population of 764 while the Oakland precinct reappeared and was listed with a population of 730.

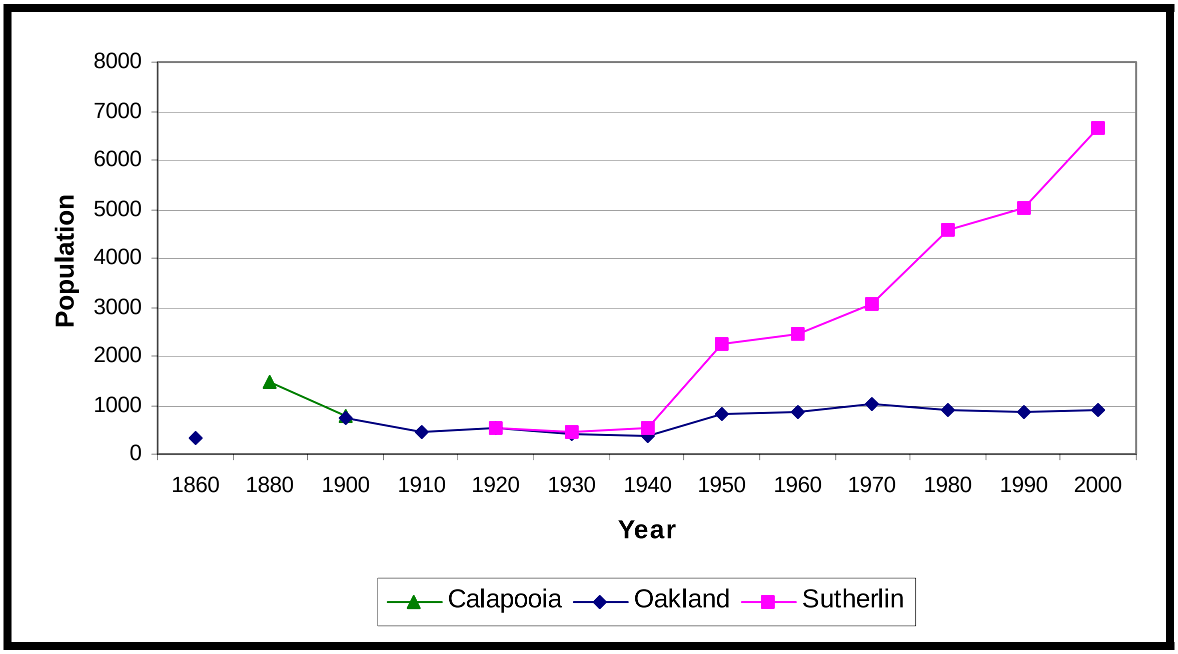
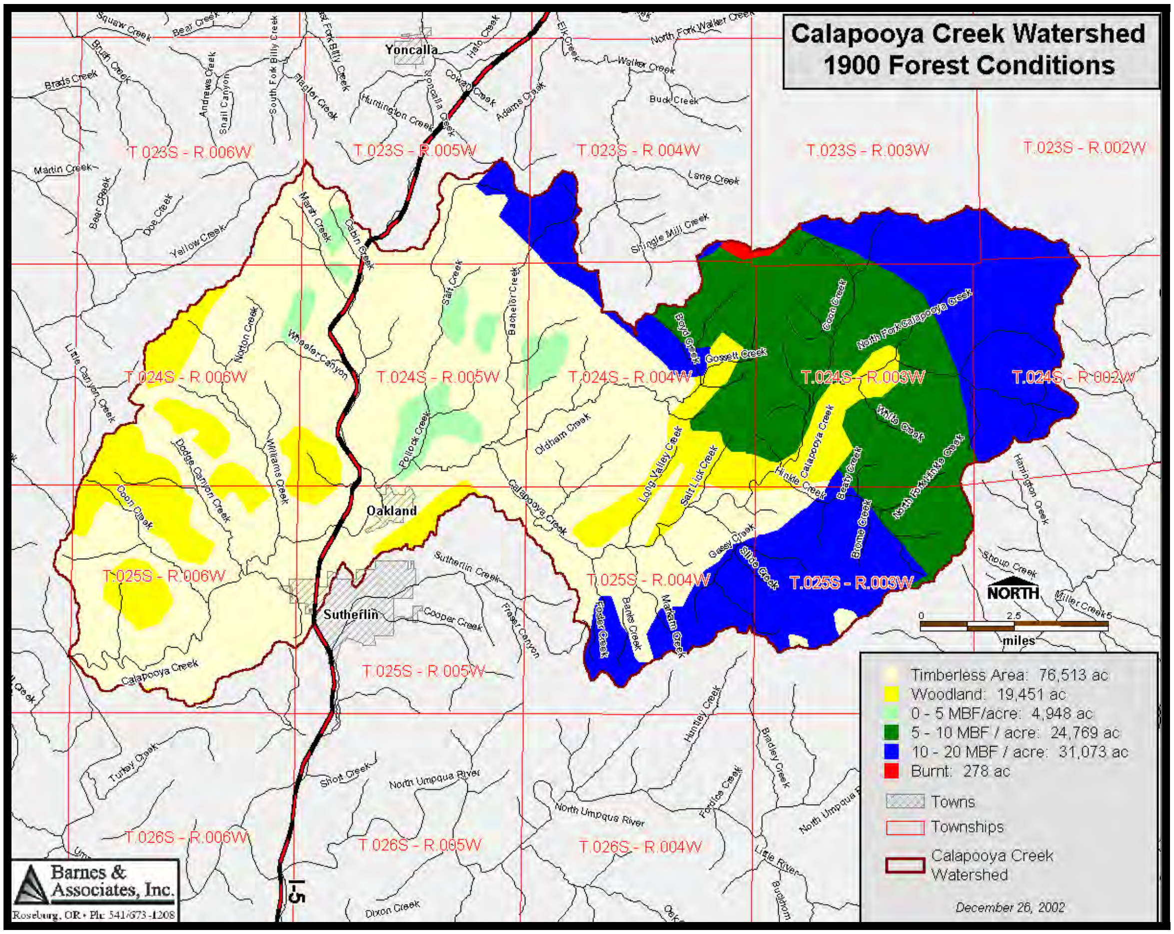


Figure 2-2: Populations for locations within the Calapooya Creek Watershed from 1860 through 2000.

Overall population in the watershed increased from the settlement period of the 1850s through 2000. Sutherlin experienced two notable periods of population growth. The development of the Bonanza Mine in the late 1930s and the housing and timber boom occurring at the end of World War II resulted in a large growth in Sutherlin's population between 1940 and 1950. Another growth spurt occurred between 1990 and 1997 when the population growth in Sutherlin was the second highest in the state. Oakland experienced its largest percentage population increase in the 1940s. Oakland's population has been fairly constant since the 1950s. The overall growth pattern within the watershed was affected by the location of Interstate Five (completed through Douglas County in 1966). The freeway was positioned next to Sutherlin, while Oakland was bypassed.

2.5.3. 1900 forest conditions

Map 2-1 illustrates the vegetation patterns of 1900. The timberless acres include the bottomlands along Calapooya Creek, Williams Creek, Oldham Creek and a few other waterways. Many of these lands probably were being farmed in 1900. The woodland areas were on the lower hillsides and, in the western portion of the watershed, in the upper reaches of the creeks. Scattered patches of zero to five thousand board feet per acre (MBF/acre) are shown in the central part of the watershed. These were areas of young trees or widely scattered older trees, possibly forests that had been recently logged or burned by wildfire. The better-stocked or older forests (five to 10 MBF/acre and 10 to 25 MBF/acre) were found in the upper reaches of Calapooya Creek and along the middle north and southeast edges of the watershed.



Map 2-1: 1900 vegetation patterns for the Calapooya Creek Watershed.

2.5.4. Historical fish use

Historical fish counts were not found for the Calapooya Creek Watershed. Dan Couch of the Roseburg District of the Bureau of Land Management was interviewed on January 2, 2003. He was the team leader of the Calapooya Creek Watershed Analysis (Bureau of Land Management, 1999). He was unaware of any historical fish counts for the watershed. Sam Dunnavant of the Oregon Department of Fish and Wildlife, Roseburg Office (contacted January 2, 2003) had no knowledge of historical fish surveys performed in the watershed.

The information in the following tables was taken from Lauman et al. (1972). Appendix 3 provides 1968 temperature and streamflow data for Calapooya Creek and some tributaries.

	Chinook		Coho	Steelhead		Sea-run
Stream System	Spring	Fall		Winter	Summer	**Cutthroat**
Calapooya Creek	0	0	2,000	2,500	0	1,500

Table 2-2: Estimated number of adult anadromous salmonids (including hatchery fish) for the Calapooya Creek Watershed (1972).

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3. Current Conditions

This chapter explores the current conditions of the Calapooya Creek Watershed in terms of instream, 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 USDI Bureau of Land Management, the Oregon Department of Environmental Quality, the Oregon Department of Fish and Wildlife, the Douglas Soil and Water Conservation District, the US Geological Survey, and the Oregon Water Resources Department.

Key Questions

- In general how are the streams, riparian areas, and wetlands within the Calapooya 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 instream water rights in the watershed, and what are their impacts on water availability?
- What are the flood trends within the watershed?
- What is the distribution and abundance of various fish species, what are the habitat conditions, and where are fish passage barriers?

3.1. Stream function

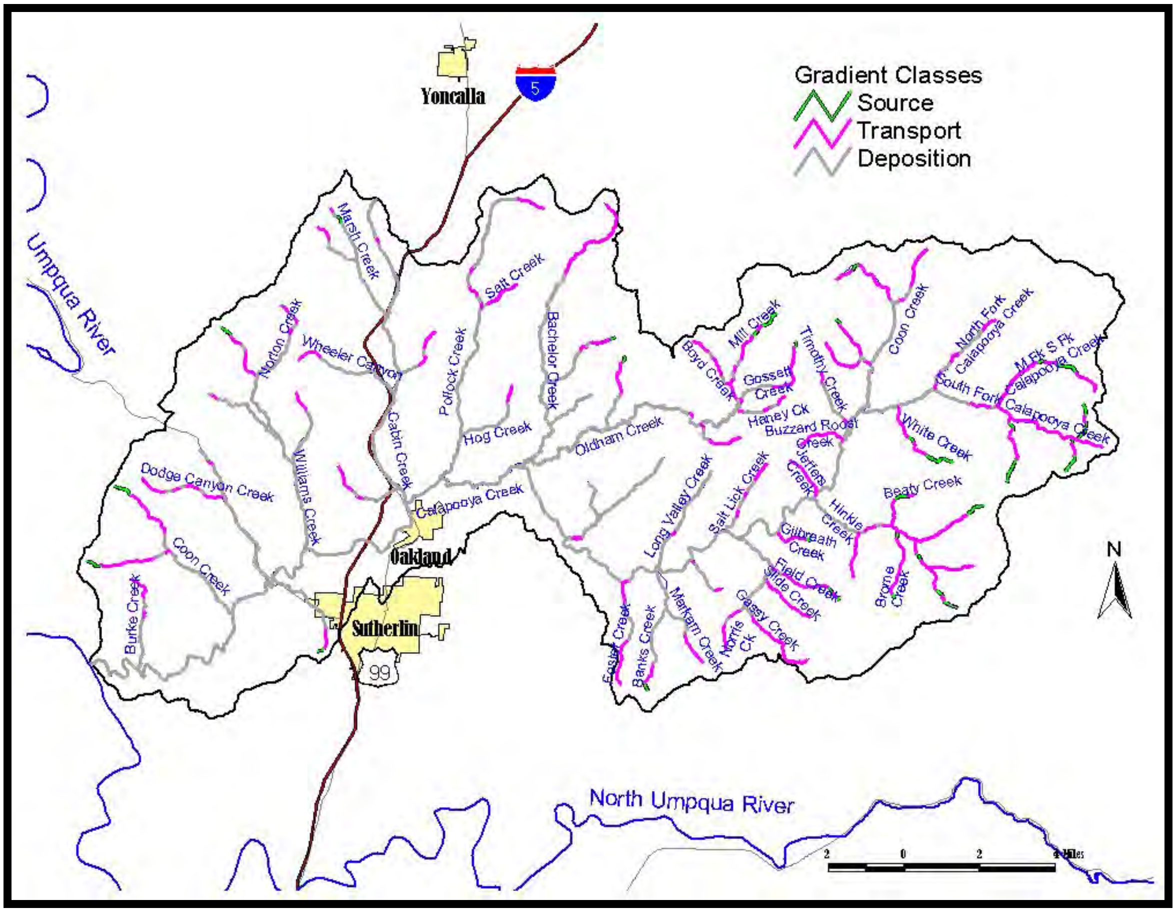
3.1.1. Stream morphology

Channel morphology[19]

The Watershed Assessment Manual was used for classifying streams within the Calapooya Creek Watershed. In general, streams were classified according to channel habitat types based on stream gradient, valley confinement, and stream size. The Oregon Watershed Enhancement Board's (OWEB) manual further classifies and defines streams as source, transport, or depositional streams. Source streams are defined as steep (>16%), confined, mountain streams that are void of a floodplain. These channels are thought to be high-energy streams that carry wood and sediment to the lower reaches. Transport streams generally have a moderate gradient (3% to 16%) and are confined to narrow valleys. These streams may have small floodplains and temporarily store wood and sediment. However, these streams will transport wood and sediment to the downstream reaches during higher flow events. Depositional streams are defined as low gradient streams (<3%); they are low-energy streams that store wood and sediment for long periods of time. These streams are found in valley bottoms and have large

[19] Jenny Allen, Tim Grubert, and John Runyon of BioSystems, Inc., provided the text and Table 3-2 for this section.

floodplains (Ellis-Sugai and Godwin, 2002). This classification scheme is based on the widely held assumption that stream channels possess specific physical characteristics resulting from the interaction of geologic, climatic, and vegetative inputs. Map 3-1 and Table 3-1 show the total stream miles and percent of streams within each gradient class.



Map 3-1: Stream gradients in the Calapooya Creek Watershed.

Gradient class	Stream miles in the watershed	% Total
Source	9.3	4.2%
Transport	69.5	31.0%
Deposition	145.4	64.8%
Total	224.2	100.0%

Table 3-1: Calapooya Creek Watershed stream miles within each gradient class.

The Calapooya Creek Watershed has source streams located in the steep mountain headwaters of the upper reaches. The headwaters of Hinkle Creek, White Creek, and Oldham Creek are examples of these source streams. Several of these tributaries have steep gradients (up to 20%), narrow channels confined by adjacent steep hill slopes with little or no floodplain. Given the steep gradients of these channels, they have a tremendous amount of energy to deliver wood and sediment to the downstream reaches, often in the form of landslides and debris torrents. Given the high-energy, steep gradients, and lack of floodplains, these streams are generally not responsive to restoration enhancement projects. Often these streams do not provide high quality aquatic habitat because the system dynamics are always in a state of transition. Many times these tributaries are located above the anadromous fish zone. The best ways of managing these types of systems may be through management of human activities like grazing and timber harvest. These activities will increase sediment loads in these systems that can impact the lower reaches.

The middle portions of the Calapooya Watershed consist of transport streams such as Hinkle Creek, Coon Creek, and Burke Creek that feed directly into the main stem of the Calapooya. These channels have moderate gradients (3% to 12%) with moderately confined valleys and small floodplains. Many are still considered high-energy streams capable of carrying wood and sediment downstream during high flows. However, wood and sediments may temporarily be stored in these systems, providing cover and shade, promoting pool formations, and helping to dissipate stream energy. Restoration projects within these channels should be carefully considered before implementation due to their wide range of responses. The success of the project will depend greatly on channel gradient, size of floodplain, sediment load from upper reaches, and amount of energy associated with high flows. Goals should be carefully matched to the individual channels for success of restoration projects.

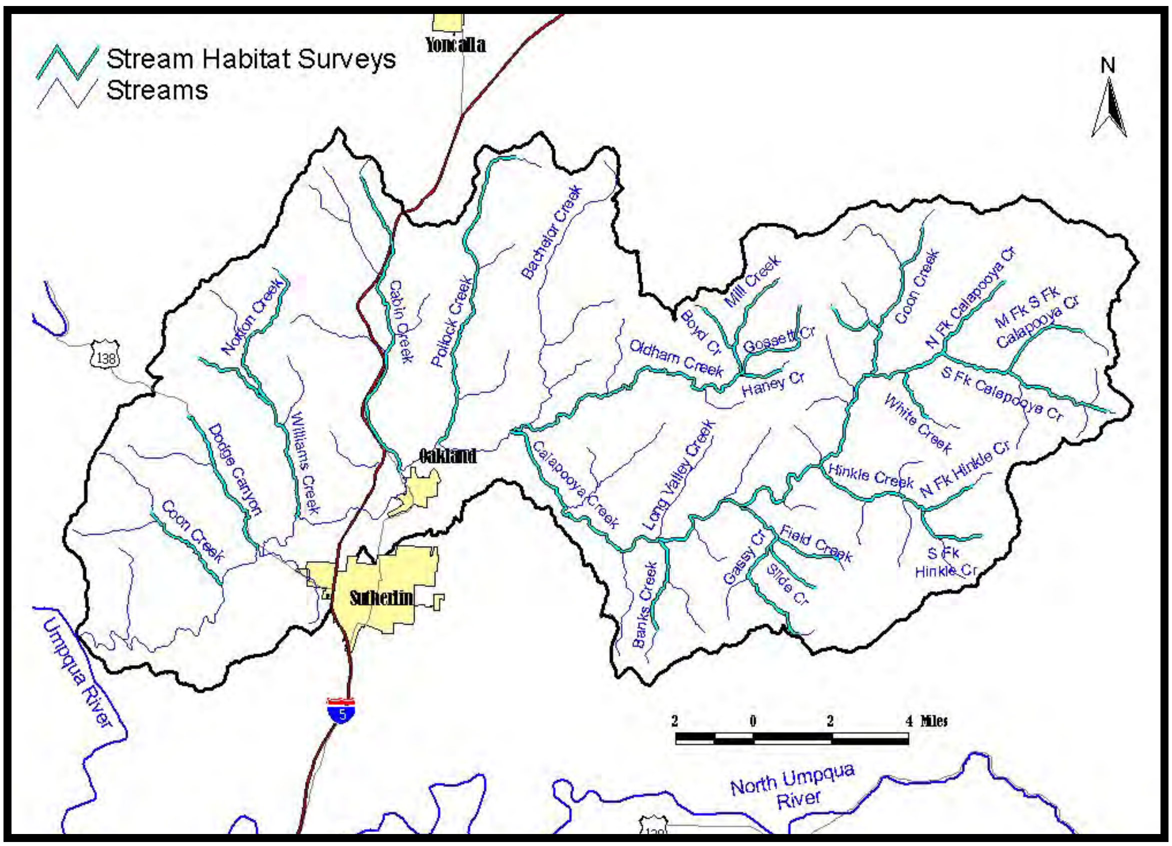
The main-stem of Calapooya Creek and several tributaries from Oldham Creek moving westward to Dodge Canyon Creek are low gradient streams (1% to 3%) with medium to large floodplains associated with them. Sediment and large wood are deposited into these systems for long periods of time providing complex aquatic habitats within the stream network. The large wood and coarse sediments contribute to pool formation, bar formations, and development of side-channels, all affecting aquatic habitat. The large floodplains and low gradients of these streams make them good candidates for restoration projects. The additions of control structures like boulders and large wood can improve fish habitat by increasing pool frequency and depth, promote side-channel development, and dissipate stream energy during high flows. If stream shade or bank stability are issues, riparian plantings can improve bank stability and provide stream shade. Removal of livestock from these areas through fencing may also improve bank stability. Table 3-2 lists the channel habitat types that are found in the area along with examples of streams that fall into each category within the watershed and restoration enhancement opportunities.

Channel Habitat Type	Example within watershed	Restoration opportunities
Low gradient medium floodplain	Calapooya Creek at junction with Bachelor Creek west to confluence with Umpqua River	Because of the migrating nature of these channels, restoration opportunities such as riparian planting projects on small side channels may be the best option for improvement.
Low gradient small floodplain	Pollock Creek, Bachelor Creek, Oldham Creek	Because of the migrating nature of these channels, restoration efforts may be challenging. However, because of their small size, projects such as riparian plantings might be successful at some locations.
Low gradient moderately confined	Coon Creek (west)	These channels can be very responsive to restoration efforts. Adding roughness in forested areas may improve fish habitat, while stabilizing stream banks in non-forested areas may decrease erosion.
Low gradient confined	Hinkle Creek, Gassy Creek lower reaches	These channels are not often responsive; however, shade and bank stability projects may improve water temperature and erosion issues.
Moderate gradient moderately confined	Field Creek	These channels are among the most responsive to restoration projects. Adding large wood in forested areas may improve fish habitat and decrease erosion.
Moderate gradient confined	North Fork and South Fork Calapooya Creek	These channels are not often responsive; however riparian planting projects may improve water temperature and erosion issues.
Moderate gradient headwater	Hinkle Creek headwaters, Oldham Creek headwaters	These channels are often moderately responsive to restoration. Riparian planting projects may improve water temperature and erosion issues.
Moderately steep narrow valley	White Creek headwaters	These channels are not often responsive; however shade and bank stability projects may improve water temperature and erosion issues.

Table 3-2: Channel habitat types and examples within the Calapooya Creek Watershed.

Stream habitat surveys

Since 1992, the Oregon Department of Fish and Wildlife (ODFW) has conducted stream habitat surveys throughout the Umpqua Basin. The purpose of these surveys is to gather basic data about Umpqua Basin streams, and to compare current stream conditions to the habitat needs of salmonids and other fish. In the summers of 1993, 1994, and 1995, ODFW staff conducted stream habitat surveys in the Calapooya Creek Watershed. Approximately 103 stream miles were surveyed in the Calapooya Creek Watershed (see Map 3-2), or about 46% of the total stream miles visible on the map (224.2).[20] Each stream was divided into reaches based on channel and riparian habitat characteristics for a total of 90 reaches averaging 1.1 miles in length. Appendix 4 provides a map detailing the stream reaches.



Map 3-2: Streams surveyed in the Calapooya Creek Watershed.

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 compared to fish habitat needs, the 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 instream woody material. Table 3-3 provides the habitat measurements included in each category.

[20] See section 1.2.5 for more information about the stream map.

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 feet) 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**[21] per 100m (328 feet) of stream length 2. **Volume of wood** (cubic meters) per 100m of stream length	1. > 19.5 2. > 29.5	1. 10.5-19.5 2. 20.5-29.5	1. < 10.5 2. < 20.5

Table 3-3: Stream habitat survey benchmarks.

Stream habitat benchmarks rate the values of the components of the survey in four categories: excellent, good, fair, and poor. For the purpose of this watershed assessment,

[21] Minimum size is six-inch diameter by 10 ft length or a root wad that has a diameter of six inches or more.

"excellent" and "good" have been combined into one "good" category. Table 3-3 provides parameters used to develop the benchmark values.

For this assessment, the UBWC and ODFW staff simplified the stream data by rating the habitat category by its most limiting factor. For example, there are two components that determine the pools rating: percent area in pools and residual pool depth. 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 were 0.4 meters in depth, this reach would have fair residual pool depth. This reach's classification for the pools habitat category would be fair. Most habitat categories need a combination of components to be effective, and therefore are rated by the most limiting factor, in this case pool depth.

The benchmark ratings should not be viewed as performance values, but as guides for interpretation and further investigation. Streams are dynamic systems that change over time, and the stream habitat surveys provide only a single picture of the stream. 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 instream large wood. Closer investigation could uncover that this stream is located in an area that historically never had any large riparian trees. Failing to meet the benchmark for instream large wood may not be a concern because low instream wood levels may be the stream's normal condition. On the other hand, meeting a benchmark does not mean all is well. A stream reach in a historically wooded area could meet its benchmark for large instream wood because a logging truck lost control and dumped its load in the stream. In this example, meeting the large wood benchmark is not sufficient if that stream reach has no natural sources of woody material other than logging truck accidents.

Overview of conditions

Looking at the historical and the proximate conditions is necessary to fully understand the value of each reach's benchmark rating. Conducting this type of study for every reach within the Calapooya Creek Watershed is beyond the scope of this assessment. Instead, it looks for patterns within the whole watershed and along the stream length to provide a broad view and help determine trends that might be of concern.

Within the Calapooya Creek Watershed, ODFW surveyed 48 stream reaches. Of these reaches, three rate as fair or good in all four categories. Seventy-three stream reaches had at least two categories rate as poor. Looking at the stream habitat data in Appendix 4, it is striking that 80% of stream reaches are rated as poor for large woody material. For both riparian areas and ripples, almost two-thirds of reaches are poor. However, over half of stream reaches have good pools, and almost 80% are good or fair.

<u>Banks Creek</u>

Only one reach, which passes through heavy grazing and agricultural lands, was surveyed. This creek is poor for all parameters.

Boyd Creek
Both reaches are in second growth timber. Reach one also has some agricultural land. Riffles are poor for both reaches. Riparian areas and large woody debris are poor or fair.

Cabin Creek
Reaches one through five are in agricultural areas, with light grazing for reaches two, three, five, and six. Reach one has rural residential development and reach four has some mature timber. All reaches have poor large woody material. Reach four has good riffles, but the other reaches are poor. Reaches four and six have fair or good riparian areas, but the rest are poor.

Calapooya Creek
Reaches one, two, four, and five are in heavy grazing, with reaches two and five also in second growth timber. Reaches three and seven are in rural residential areas, and reach six is in agriculture. Reaches eight through eleven are in timber management areas of different age classes. All reaches have poor pools, and poor or fair riffles. All reaches save reach 10 have poor riparian areas. Reaches six and eleven are poor for all parameters, and reaches one, seven, eight, and nine or poor or fair for all parameters.

Coon Creek: 1
There are two Coon Creeks in the Calapooya Creek Watershed. The first Coon Creek is the western-most surveyed stream. Both reaches run through heavy grazing and rural residential lands. Riparian areas and instream large woody material are both poor.

Coon Creek: 2
The second Coon Creek a tributary to upper Calapooya Creek. Coon Creek II has five reaches. The stream passes through rural residential property, then through young forest trees, and the final three reaches are in second growth timber. The first two reaches have poor riparian areas and poor instream large wood. The final two reaches have poor riffles, and the fourth reach has poor riparian areas.

Coon Creek: Tributary 1
The first reach passes through second growth while the second reach is in young timber. Pools are fair, and riffles are poor, and reach two has poor riparian areas.

Dodge Canyon Creek
All reaches are in rural residential development except reach two, which is unclassified. Reaches three and four are also in timber harvests, while reach one has some agricultural land uses and five has second growth. All reaches are poor for large woody material and poor or fair for riparian areas. Reach two is poor for all parameters.

Field Creek
The first reach passes though agricultural land and second growth timberland, and the second reach flows through both second growth and a timber harvest unit. Both reaches have poor pools and poor large woody material.

<u>Gassy Creek</u>
Reaches one, two, four, and five pass though primarily second growth timber (there is no land use classification for reach three). There is also heavy grazing on reach one, light grazing on reach two, and mature timber on reaches four and five. Reaches one through four have poor large woody material, and reach three is poor for all parameters. Reach five is fair for all parameters.

<u>Gossett Creek</u>
Reach one is in agricultural lands, reach two is in second growth, and reach three is in a timber harvest area. All three reaches are poor for riffles and riparian areas. Pools and large woody material are poor or fair.

<u>Haney Creek</u>
Reach one passes through agricultural land and reaches two and three are in second growth timber. All three reaches are fair for pools and poor for riffles. The first two reaches are also poor for riparian area and large woody material.

<u>Hinkle Creek</u>
The first reach is within a rural residential area with some second growth timber, while the other three reaches are within second growth timber only. All reaches are poor for large woody material and riffles. Only reach four is fair for riparian area, with the rest rating as poor.

<u>Middle Fork Calapooya Creek</u>
The first reach is in second growth timber and the second reach is in young timber. Both have poor pools. Riparian areas and large woody material are fair or poor for both reaches.

<u>Mill Creek</u>
All three reaches are in second growth timber. Large woody material and riffles are poor or fair. Reaches one and three also have poor pools.

<u>North Fork Calapooya Creek</u>
Both reaches are in second growth timber. Reaches have poor riparian areas. Riffles and large woody material ranges from poor to fair.

<u>North Fork Hinkle Creek</u>
Both reaches are in second growth timber. Both reaches are poor for pools and riffles. Reach one also has poor large woody material.

<u>Norton Creek</u>
The first two reaches pass through heavy grazing and agricultural lands. The third reach is in second growth timber and rural residential areas, and the last two reaches are in agricultural land and with grazing. All of Norton Creek has poor large woody material.

Reaches one, two, and four have poor riparian areas. Riffles and riparian areas range from poor to good.

Oldham Creek
Except for reach four, which is unclassified, all of Oldham Creek passes through agricultural land. All six reaches have poor large woody material and riparian areas. Riffles are poor except for reach one, which is fair. Reach four is poor for every parameter

Pollock Creek
All seven reaches run primarily through agricultural lands. Reaches one through four also pass thorough light grazing, while reaches five, six, and seven pass through timber harvests, heavy grazing, and second growth, respectively. All seven reaches have poor large woody material. Riffles and riparian areas are mostly poor or fair, except the seventh reach, which is good for riparian areas.

Slide Creek
The first reach passes through agricultural lands, and the other two reaches are in second growth timber. All reaches have poor riffles. Pools and riparian areas are poor or fair.

South Fork Hinkle Creek
Both reaches pass through second growth. The first reach is poor for all parameters. The second reach is poor for pools and riffles and fair for the other parameters.

White Creek
The first two reaches are in second growth timber, and the third reach is in a timber harvest. Reach three is poor for all parameters save large woody material, which is good.

Williams Creek
The first two reaches are in agricultural land with rural residential development. The last two reaches are in heavy grazing and agricultural land. All reaches are poor for riparian areas and large woody material. Riffles range from poor to fair.

3.1.2. Stream connectivity

Stream connectivity refers to the ability of resident and anadromous fish, as well as other aquatic organisms, to navigate the stream network. The stream system becomes disconnected when natural and human-made structures such as waterfalls, log jams, and dams, inhibit fish passage. Although some stream disconnect is normal, a high degree of disconnect can reduce the amount of suitable spawning habitat available to salmonids. This, in turn, reduces the stream system's salmonid productivity potential. Lack of stream connectivity can also increase juvenile and resident fish mortality by blocking access to other critical habitat, such as rearing grounds and cool tributaries during the summer months.[22]

[22] See section 3.3.2 for more information about stream temperature.

For this assessment, fish passage barriers are structures that 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, 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.

Irrigation ditches

Irrigation ditches without fish wheel screens are primarily a problem for juvenile fish.[23] 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 Calapooya Creek Watershed had been identified as significant juvenile fish passage barriers.

Dams

In the central Umpqua Basin, most dams on larger streams are push-up dams used to create pools to pump irrigation water.[24] These dams are only used during the summer months, and 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 is too far for fish to jump.

Whether or not a fish can overcome this distance depends on three factors: the size 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. If the pool is two feet deep, it is generally believed that adult fish can surmount a two-foot high dam or less, while juvenile fish can overcome a height of 0.5 feet or less. As pool depth decreases or height increases, fish have difficulty jumping high enough to pass over.

According to the Oregon Water Resources Department, there is a dam on Bachelor Creek, two structures on a tributary of Bachelor Creek, and a dam on Dodge Canyon Creek. Long Valley Creek has older irrigation dams that are beginning to fail. It is uncertain at this time to what degree these dams and structures are barriers to juvenile or adult fish.

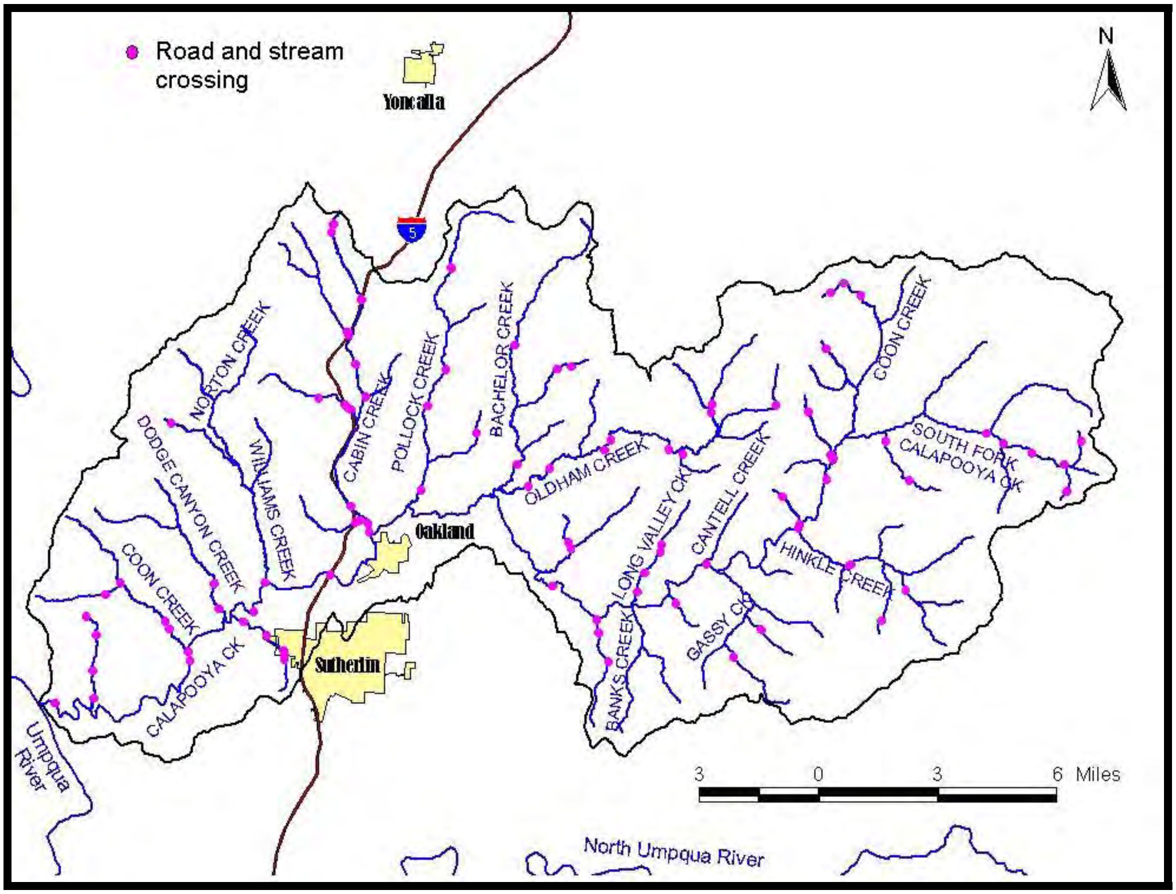
Culverts

Culverts pose the greatest problem for fish passage. Culverts are the most common method of crossing a road over a stream. There are at least 209 road and stream crossings in the Calapooya Creek Watershed (see Map 3-3). Many of these are most likely

[23] Fish wheel screens are self-cleaning screens that prevent fish from entering an irrigation ditch while passing floating debris that may prevent water flow.

[24] Some landowners may have dams on small tributaries to provide water for wildfire control, provide water for livestock, or for landscape aesthetics.

culverts, but it's unknown at this time how many of the culverts are fish passage barriers or obstacles (see The Umpqua Basin Fish Access Team subsection below).



Map 3-3: Road and stream crossings in the Calapooya Creek Watershed.

Culverts can be a barrier or obstacle to fish passage if the distance from the downstream water surface to the culvert outfall (or "drop") is too far for fish to jump. Just as with dams, it is generally believed that adult fish can reach a culvert outlet that is two feet or less from the downstream water, while juvenile fish overcome a height of 0.5 feet or less, if there is a two-foot deep pool at the outfall.

Unlike dams, water velocity within the culvert poses another potential fish passage barrier. 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 additional velocity barriers 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.

It is important to note that culverts may 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 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 impassible.

The Umpqua Basin Fish Access Team

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. This project is in the information gathering stage and does not yet have a list of fish passage-limiting culverts in 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.[25] A document summarizing the results of this project will be available in late 2003.

3.1.3. Channel modification[26]

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 building riprap, dredging, or vegetative bank stabilization. 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 alter the stream's path. As such, instream 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 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.[27] History has shown that channel modification activities are often detrimental to aquatic ecosystems and to other reaches of the same stream. Streams naturally meander, and 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 still be done with a permit, obtaining a permit is a lengthy process.

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[25] See section 3.5.2 for information about anadromous and resident salmonid distribution within the Calapooya Creek Watershed.

[26] Information in section 3.1.3 is primarily from interviews by the author with Douglas Soil and Water Conservation District staff.

[27] 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.

Historical channel modification projects
Quantifying historical channel modification activities is difficult because no permits were issued and the evidence is hidden or non-existent. According to the Douglas Soil and Water Conservation District staff, the majority of past channel modification activities were removing gravel bars from the stream and 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, and during every flood event gravel is washed away and replaced by upstream materials.[28] Consequently, a gravel bar in the same location was often removed every year.

Bank stabilization concerns any material added to the stream's bank to prevent erosion and stream meandering. The term "riprap" refers to bank stabilization done with any handy material including tires, car bodies, railroad ties, rocks, and cement. Other bank stabilization projects involve engineered structures, such as bank "barbs," which are large rocks strategically placed to divert the flow of water away from the bank. Frequently, riprap and engineered structures become buried by sediment only to be exposed years later when a stream alters its path. During the 1996 Douglas County area floods, many past bank stabilization projects were exposed as sediment was washed away. In some cases, entire car bodies used for riprap were found stranded in the middle of streams that had drastically changed course.

Current channel modification projects
In the Calapooya Creek Watershed, there are only two permitted channel modification projects that have been done in the recent past and are still visible. The City of Oakland installed a dam on Calapooya Creek to provide drinking water to the city. In the late 1980s, rock riprap was installed on Calapooya Creek between Field Creek and Hinkle Creek to protect the streambank from erosion.

Landowners and stream restoration professionals report that non-permitted channel 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.

3.1.4. Stream function key findings and action recommendations

Stream morphology and key findings

- Most streams within the Calapooya Creek Watershed have low gradients with few stream miles in the source areas, where most large woody material is recruited into the stream system. This may naturally limit instream large woody material abundance.
- Stream habitat surveys suggest that lack of large woody material, poor quality riffles, and poor riparian area tree composition limit fish habitat in most surveyed streams.

[28] In general, a gravel bar that has no grass or other vegetation is very unstable.

Stream connectivity key findings

- Culverts and, to some degree, dams, reduce stream connectivity, which affects anadromous and resident fish productivity in the Calapooya Creek Watershed. More information about fish passage barriers will be available from UBFAT in 2003.

Channel modification key findings

- Many landowners may not understand the detrimental impacts of channel modification activities or are unaware of active stream channel regulations.

Stream function action recommendations

- Where appropriate, improve pools, collect gravel, and increase the amount of 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.[29]
- 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 areas.
  - 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 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

The vegetation immediately adjacent to a stream is the stream's riparian zone. 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 stream meandering. Trees and limbs that fall into streams can increase fish habitat complexity and can create pools. Insects that thrive in streamside vegetation are an important food source for fish.

What constitutes a "healthy" riparian area, however, is dependent on many factors. Although many large diameter conifers and hardwoods provide the greatest amount of shade and woody debris, many streams flow through areas that don't support large trees or forests. In some areas, current land uses may not permit the growth of "ideal"

[29] Thirty feet is the maximum stream width for which instream log and boulder placement projects are permitted.

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 as a guide for interpretation and further investigation and not as an attempt to qualify riparian conditions.

Riparian zone classification methodology
Digitized aerial photographs were used to determine riparian composition of the Calapooya Creek Watershed. Creek banks are classified separately since conditions on one side of a stream are not necessarily indicative of conditions on the opposite bank. Stream banks are labeled as "left" or "right" from the perspective of standing in the middle of the creek looking downstream. The miles of riparian zone are the combined total of both the left and right banks. This assessment evaluated 74.6 miles of Calapooya Creek streambanks and 373.6 miles of tributary streambanks.

Each side of the stream was divided into reaches based on changes in vegetation type and vegetation width. The reaches were measured and classified using three vegetation composition parameters: dominant vegetation or feature, buffer width, and cover. Table 3-4 outlines the classifications for each parameter. Findings for each parameter for Calapooya Creek and tributaries are discussed below. Appendix 6, Appendix 7, and Appendix 8 have data by percent for Calapooya Creek, combined tributaries, and the following individual tributaries: Dodge Canyon Creek, Cabin Creek, Pollock Creek, Oldham Creek, Gassy Creek, Hinkle Creek, and South Fork Calapooya Creek .[30]

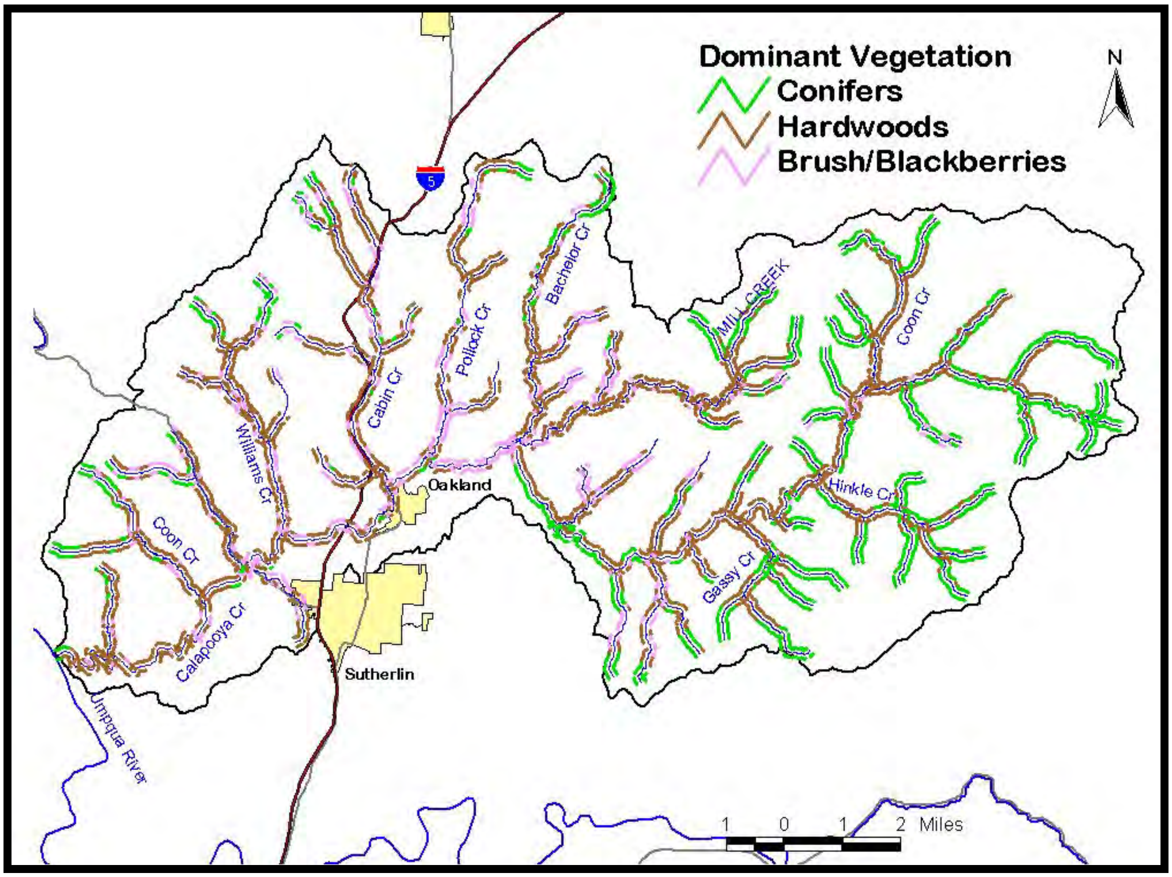
Riparian zone parameters	**Parameter attributes** Stream reaches are classified by the most dominant (>50% cover) characteristic
Dominant vegetation or feature	• Conifer trees • Hardwood trees • Brush/blackberries • Range/grass/blackberries • No vegetation (roads, bare ground, etc.) • Infrastructure (bridges and culverts)
Buffer width	• No trees • 1 tree width • 2+ tree width
Cover	• No cover • <50% cover • >50% cover

Table 3-4: Riparian zone classification for the Calapooya Creek Watershed.

Dominant vegetation or feature
The dominant streamside vegetation or features affect ecological functions by providing different levels of shade and bank stability as well as different types of nutrients and

[30] Combined tributary data include these streams and others.

wildlife habitat. For this assessment, the dominant vegetation or feature was evaluated using six attributes. Trees were split into two groups, conifers and hardwoods. Although all tree types provide shade and large woody debris, large conifers decompose very slowly and are less likely than hardwoods to wash downstream. Brush and blackberries constitute short broad plants. Blackberries were not given a separate category because they are frequently intertwined with other shrubs and difficult to differentiate. Range and grass includes blackberries because in most cases a predominantly range or grass riparian zone has a thin strip of blackberries close to the stream bank. Areas of no vegetation include streamside roads and railroads and non-road related bare ground and rock. Infrastructure indicates areas where the stream passes under a bridge or culvert. Map 3-4 shows the three most common vegetation types for Calapooya Creek Watershed streams. Appendix 6 has the percent of all vegetation or features for Calapooya Creek, the combined tributaries, and specific tributaries.



Map 3-4: Dominant riparian vegetation or feature for the Calapooya Creek Watershed.

Hardwoods are the dominant vegetation type along Calapooya Creek (63.0%, 47.0 miles) and almost half of riparian vegetation on the tributaries (48.9%, 182.6 miles). The second most common vegetation type is brush/blackberry for Calapooya Creek (17.6%, 13.1 miles), and conifers for tributaries (29.6%, 110.7 miles). The third most prevalent vegetation type/feature for Calapooya Creek is conifers (13.6%, 10.1 miles), and brush/blackberry for tributaries (12.4%, 46.4 miles). As seen in Map 3-4 and Appendix 6, brush/blackberry vegetation is more common in the watershed's central and western tributaries than in the eastern tributaries. The riparian vegetation along Gassy Creek, Hinkle Creek, and South Fork Calapooya Creek is over 95% hardwoods and conifers (see Photo 3-1).

Photo 3-1: Tree-dominated Hinkle Creek. [31]

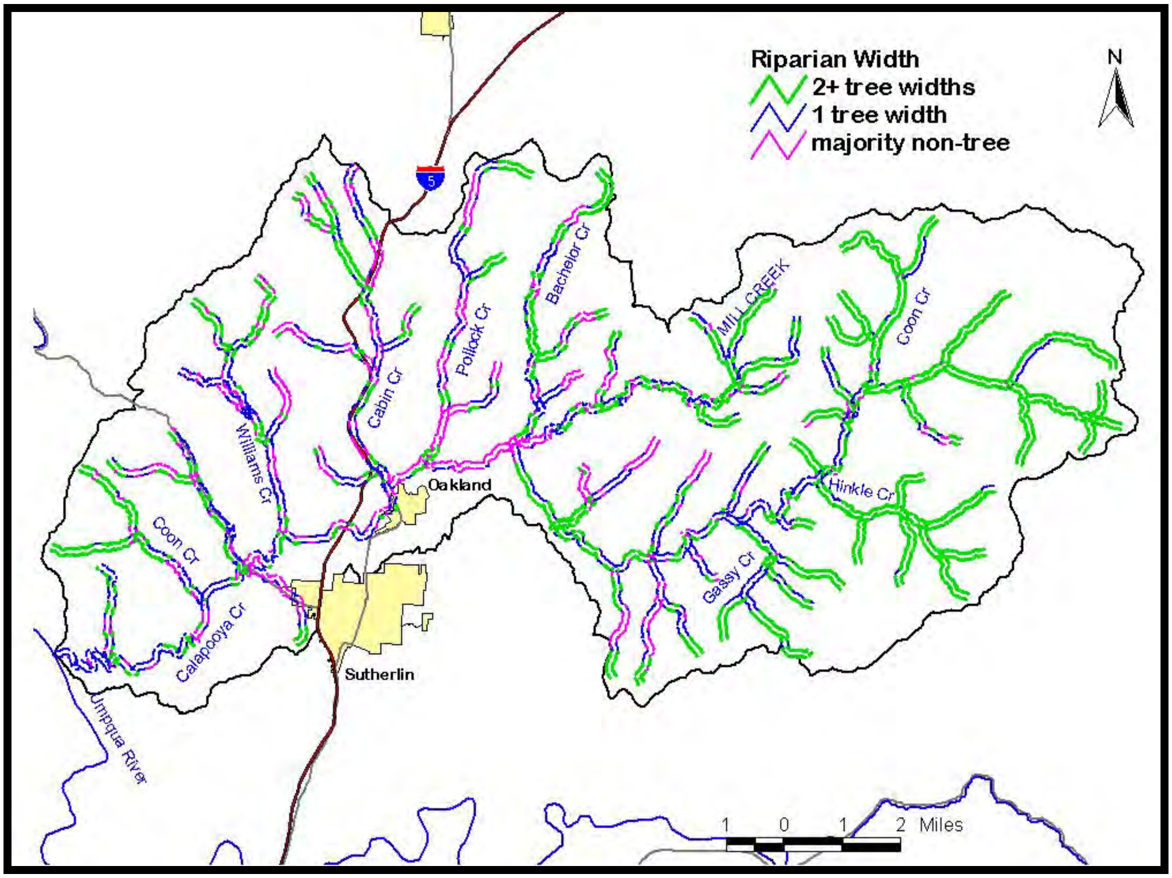
Buffer width

Riparian areas with wide bands of trees provide habitat and migration corridors for wildlife. As the number of trees in proximity to the stream increases, so does the likelihood that some trees will fall into the stream, creating fish habitat and forming pools. Wide tree buffers also increase stream shading, creating a microclimate with cooler temperatures compared to other reaches within the same stream. Buffer width was classified as having no trees, one tree width, or a width of two or more trees. Map 3-5 shows buffer width findings for the Calapooya Creek Watershed. Appendix 7 provides data for Calapooya Creek, combined tributaries, and individual tributaries.

For Calapooya Creek, almost half of riparian zones have buffers that are one tree wide (47.3%, 35.2 miles). Riparian buffers that are two or more trees wide are the second

[31] Jenny Allen, Tim Grubert, and John Runyon of BioSystems, Inc., contributed this photograph.

most common condition for Calapooya Creek (29.4%, 21.9 miles), followed by buffers with no trees (23.4%, 17.4 miles). For tributaries, half of riparian buffers are two or more trees wide (50.1%, 187.1 miles). Buffers that are two or more trees wide are the second most common condition for tributaries (28.4%, 106.2 miles), followed by buffers with no trees (21.5%, 80.3 miles). There is much variation among tributaries. Whereas almost 45% of Pollock Creek has no trees, nearly 99% of South Fork Calapooya Creek has buffers that are two or more trees wide.



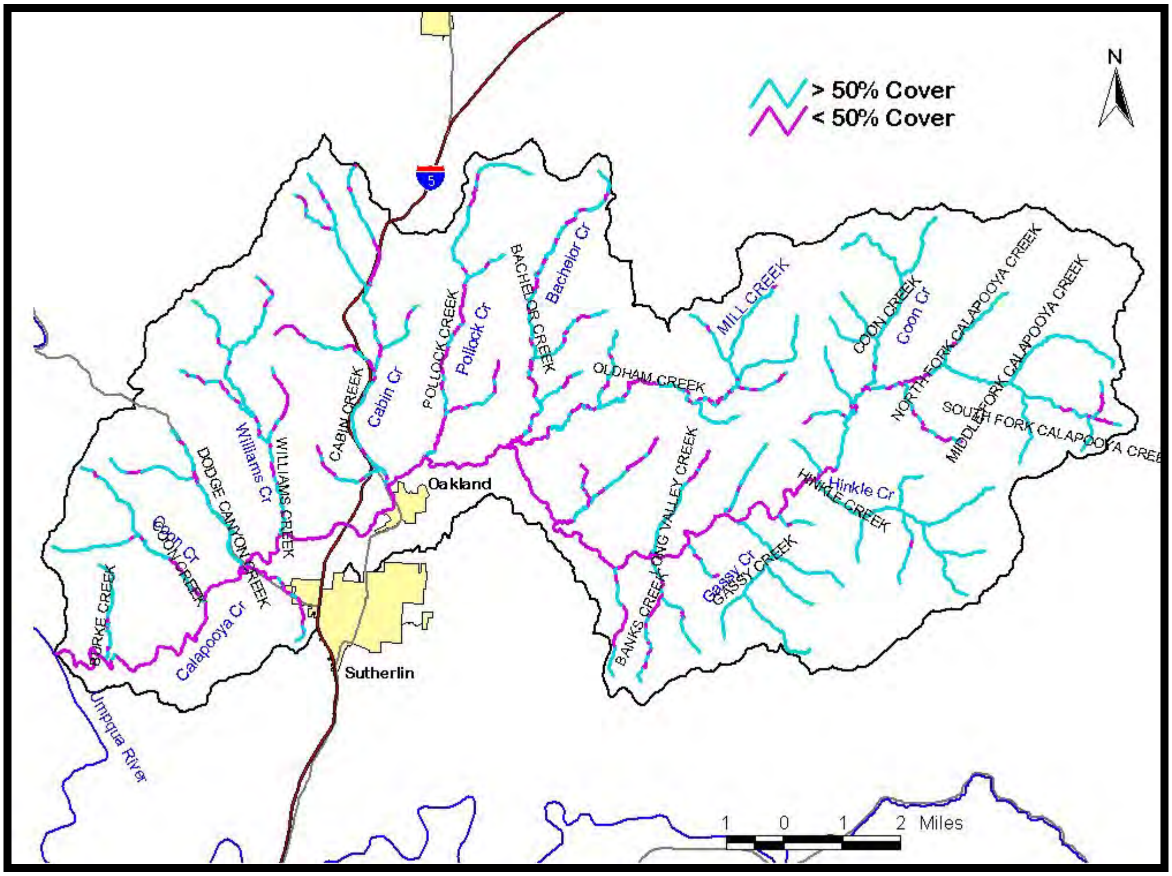
Map 3-5: Riparian buffer widths for the Calapooya Creek Watershed.

Cover

The ultimate source of stream heat is the sun, either by direct solar radiation or by ambient air and ground temperature around the stream.[32] Blocking the amount of direct solar energy reaching the stream surface reduces warming rates. Streams with complete cover receive the least direct solar radiation, and are therefore favored in the Umpqua Basin, where many streams are 303(d) listed for high temperature.[33] Cover is dependent on stream width and riparian vegetation. Shrubs and grasses can provide substantial cover for small, narrow streams. Larger streams can be partially shaded by vegetation and completely shaded by infrastructure. In very wide streams, only bridges provide

[32] See section 3.3.2 for more information about stream temperature.
[33] See section 3.3.1 and Table 3-6 for more information about 303(d) listed streams.

complete coverage. This assessment looks at the percent of the total stream width that is covered by trees or infrastructure. Map 3-6 shows the stream reaches that have greater than 50% cover and less than 50% cover. Appendix 8 shows the percent cover for Calapooya Creek, combined tributaries, and individual tributaries.



Map 3-6: Percent cover for the Calapooya Creek Watershed.

Just over 90% of Calapooya Creek's stream surface is less than 50% covered by vegetation or infrastructure (67.4 miles). Due to the width of Calapooya Creek, only 9.3% (6.9 miles) of the river is mostly covered. Only 0.2% of Calapooya Creek has no cover (0.2 miles). For tributaries, more than three-fourths of streams are mostly covered by vegetation or infrastructure (76.7%, 286.4 miles). Eighty-five miles of tributary streams are less than 50% covered (22.8%). Very few tributaries have no cover (2.2 miles, 0.6%).

3.2.2. Wetlands[34]

The purpose of this analysis is to 1) identify and evaluate historical and current wetlands associated with streams and wetlands surrounded by uplands; 2) identify present and

[34] Brad Livingston and Loren Waldron from Land and Water Environmental Services, Inc., contributed this section.

potential impacts or alterations to these wetlands; and 3) examine potential strategic restoration areas located within the Calapooya Creek Watershed. General wetland functions such as wildlife habitat, water quality improvement, and hydrologic control (storm surge desynchronization and flood water storage) were evaluated.

Overview

Wetlands provide several functions within their respective watersheds that are essential to healthy water resources. Many of the functions can be categorized under the general functions of wildlife habitat, water quality improvement, and hydrologic control. Wetlands provide habitat for terrestrial wildlife, birds, and aquatic wildlife in the form of feeding opportunities, refuge areas, and nesting sites. Wetlands improve water quality by trapping sediments, removing nitrogen, retaining phosphorous, and regulating stream temperatures. Hydrologic control functions reduce peak flows from high water events through retention of high surface water volumes. Wetlands are defined as:

> Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.[35]

Review of the U.S. Fish and Wildlife Service National Wetland Inventory (NWI) maps for the Calapooya Creek Watershed indicates significant wetland resources. The two dominant wetland types are riverine and palustrine. Palustrine wetlands include wetland prairies, slope wetlands, and marshy areas with persistent vegetation. Riverine wetlands are defined as:

> Those that are closely associated with a channel or floodplain, including the active two-year floodplain, sloughs, and riparian areas. Riverine wetlands should include any channel to a depth of 6.5 feet, scoured floodplains, wetlands that comprise entire islands within channels, some ditches, sloughs connected to main channels, river alcoves with seasonally stagnant conditions, and depressions or temporarily ponded areas within active biennial floodplains.[36]

Historical wetlands

Valleys within the Calapooya Creek Watershed were mostly prairie when first settled in the late 1800s. Prairie areas were dominated by tall upland and wetland grasses which provided food and cover for wildlife. Native flora and fauna adapted to conditions in which wetland areas were often dry by late summer.

Historical wetlands within the Calapooya Creek Watershed included mixed conifer and hardwood forested wetlands of various successional stages, scrub/shrub dominated wetlands, emergent wetlands, and wetland prairies. Bottom lands and ravines contained

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[35] Page 13, 1987 U.S. Army Corps of Engineers Wetlands Delineation Manual.
[36] Adamus, P.R., 2001.

vegetation such as Oregon ash, firs, maple, vine maple, and alder with an undergrowth of willow, ninebark, ferns, briars, and vines that were described as “very thick” (1853 County Surveyors Record, Douglas County, OR). Wetland and riparian forests provided woody debris and instream structure, shaded streams, and provided habitat for a variety of fish and wildlife.

Wetland grasses such as tufted hairgrass and red fescue dominated wetland prairies, although many other herbaceous wetland species were typically present. Wetland prairies were a major component of the landscape created by a regime of frequent fire from lightning and thousands of years of occupation by Native Americans, who burned much of the Umpqua Valley almost annually to improve hunting and to maintain populations of wild food plants. After annual burning ceased in about 1855, woody plants invaded many prairies and gradually converted them to shrublands or forests (J. Guard, 1995). Compared with other wetland types, wetland prairies contained the most area within the watershed.

Current wetland status

Many of the wetlands that remain within the watershed are located in low lying areas near the base of slopes, or are contained within active stream channels. Due to widespread development activities, most wetlands have been filled, ditched, drained, or impacted by invasive vegetation and frequent visitation by humans. Frequent visitation by humans can deter wildlife from utilizing wetland areas. Invasive plant species, various hydrologic modifications, and other development activities have reduced the ability of wetlands to function.

Wetlands associated with streams are mostly confined to active channels within the watershed. Wetlands dominated by shrubs are often found on gravel bars, islands, and floodplains associated with Calapooya Creek and tributaries. Forested wetlands are mostly found in association with streams, sloughs, lakes, and ponds where surface water inputs are consistent. Forested wetlands contain Oregon ash, red alder, Oregon white oak, willow, grand fir, and black cottonwood.

Wetlands associated with the active channel of streams include seasonally exposed stream beds, permanent open water less than 6.5 feet deep, gravel beds and beaches, intermittently flooded scrub/shrub wetlands, and wetlands among meander scars and seasonal overflow channels. Tributaries to Calapooya Creek contain wetlands mostly confined to active channels. These wetlands include seasonally saturated hardwood forested areas, permanent open water wetlands, seasonal scrub/shrub wetlands, and seasonally saturated emergent wetlands. Wetland prairies are often separated from streams by forested areas and are frequently interspersed with oak savannahs and marshes.

Wetlands hydrologically driven by precipitation, lateral subsurface flow, seeps and springs, or surface water runoff are typically identified as palustrine wetlands with varying water regimes and special modifiers. These palustrine emergent wetlands may include wetland prairies, slope wetlands, or seep and spring-fed wetlands. Seasonal wetland prairies are abundant in low lying areas with poorly drained clayey soils. Sedges, rushes, most often dominate palustrine wetlands and wetland grasses.

Potential sources of impacts
Many wetlands within the Calapooya Creek Watershed were altered by the placement of fill material, the construction of dikes and berms, clearing of native vegetation near waterways, erosion, the physical alteration of stream morphology, the removal of aggregate resources, and urbanization.

Urbanization is limited to the City of Oakland, and a portion of Sutherlin within the watershed. The process of urbanization often includes road construction, storm water management systems, sewage systems, residential, commercial, and industrial development which impact water resources and wetlands by altering water regimes, water quality, and wildlife habitat. Roads built parallel to a waterway alter natural drainage patterns and restrict terrestrial wildlife access. Roads impact natural water regimes because they require the placement of culverts and ditches which can create a hydrologic obstacle leading to a reduction of slope stability. Storm water management systems and sewage systems create artificial hydrologic cycles, and may deposit water quality limiting substances into natural water bodies. Residential, commercial, and industrial development require land clearing and landscape modifications for the construction of foundations.

Invasive plant species, such as Himalayan blackberry and teasel, impact wetlands by out competing desirable wetland vegetation. Invasive plants are less capable of providing desirable conditions typically provided by wetland plants.

Potential restoration opportunities[37]
Potential wetland restoration areas are abundant within the riparian zones and floodplains of Calapooya Creek and its tributaries. Restoration activities may include planting or seeding native wetland vegetation, restoring wetland hydrology, removing culverts and unused roads, and stream bank stabilization. Expanding the narrow riparian zone along much of Calapooya Creek by planting various tree species will help provide an effective buffer to filter and trap water quality limiting substances. Tributaries to Calapooya Creek located east and west of the City of Oakland could be restored or enhanced to improve over wintering, rearing, and refuge areas for salmon.

Artificially created ponds with persistent water sources may be converted to palustrine wetlands. Unused artificial ponds may require water levels to be reduced to allow wetland vegetation to establish. These areas represent wetland creation opportunities if appropriate conditions, such as suitable soils, are present.

[37] Many restoration activities involving water resources of the state, including wetlands, require permits from the Oregon Division of State Lands and the U.S. Army Corps of Engineers. Considerable penalties are given to violators of rules and laws governing water resources.

Restoration opportunities might also include protecting existing wetlands located near the headwaters of tributaries, enhancing any stream associated wetlands by planting native trees, stabilizing eroding streambanks using various erosion control methods, actively managing weedy vegetation, eliminating livestock access to streams by fencing riparian areas, and using off-channel stock water systems.

Benefits of wetland restoration projects are not limited to physical project boundaries. Improved water quality has a positive effect on downstream areas. Hydrologic control can help reduce impacts of flooding downstream. Regular monitoring and maintenance activities are essential to the long-term success of restored wetland areas.

Wetland references

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3.2.3. Riparian zones and wetlands key findings and action recommendations

Riparian zones key findings

- Hardwoods dominate most Calapooya Creek Watershed riparian zones. Along Calapooya Creek and its tributaries, brush/blackberries and range/grass/blackberries account for approximately 20% of riparian zone miles.
- Almost half of Calapooya Creek riparian zones have buffers that are one tree wide. Over 20% of riparian zones for both Calapooya Creek and its tributaries have no trees or very scattered trees.
- Over 20% of Calapooya Creek tributaries are less than 50% covered by riparian vegetation or infrastructure.

Wetlands key findings[38]

- Wetlands improve water quality by trapping sediments, removing nitrogen, retaining phosphorous, and regulating stream temperatures.
- Predominant wetland types are riverine wetlands confined to active channels, and wetland prairies located within bottomlands.
- Native Americans would regularly burn areas within the interior valleys to improve hunting, and to maintain vegetative food sources, which included wetland plants.

Riparian zones and wetlands action recommendations

- Where canopy cover is less than 50%, establish wide buffers of native trees (preferably conifers) and/or shrubs, depending upon local conditions. Priority areas are fish-bearing streams which more than 50% canopy cover is possible.
- Identify riparian zones dominated by blackberries and convert these areas to native trees (preferably conifers) and/or shrubs, depending on local conditions.
- Investigate methods of controlling blackberries, such as through biological control.
- Where riparian buffers are one tree wide or less, encourage buffer expansion by planting native trees (preferably conifers) and/or shrubs, depending on local conditions.
- Maintain riparian zones that are two or more trees wide and, along tributaries, provide more than 50% cover.
- Provide information to landowners explaining the benefits of restricting livestock access to streams, establishing buffer zones, the importance of wetlands within watersheds, and the effects of instream activities on downstream conditions.
- Promote public involvement in the maintenance of wetland resources by educating members of the local community as to the importance of maintaining natural heritage and diversity.
- Educate policy makers, landowners, and community members on the importance of maintaining wetlands for healthy watersheds, and their educational, recreational, and aesthetic values for the local community.

3.3. Water quality

3.3.1. Stream beneficial uses and water quality impairments

The Oregon Water Resources Department (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 3-5 lists all beneficial uses for streams and rivers within the Umpqua Basin.

[38] Brad Livingston and Loren Waldron of Land and Water Environmental Services, Inc., contributed the wetlands key findings and action recommendations.

Beneficial Uses	
Public domestic water supply	Private domestic water supply
Industrial water supply	Irrigation
Livestock watering	Boating
Aesthetic quality	Anadromous fish passage
Commercial navigation and transportation	Resident fish and aquatic life
Salmonid fish spawning	Salmonid fish rearing
Wildlife and hunting	Fishing
Water contact recreation	Hydroelectric power

Table 3-5: Beneficial uses for surface water in the Umpqua Basin.

The Oregon Department of Environmental Quality (ODEQ) has established water quality standards for the designated beneficial uses. These standards determine the acceptable levels or ranges for water quality standards, including temperature, dissolved oxygen, and pH. Water quality standards set by ODEQ are reviewed and updated every three years. ODEQ monitors streams and stream reaches throughout Oregon, and streams or reaches that are not within the standards are listed as "water quality impaired."[39] The list of impaired streams is called the "303(d) list," after section 303(d) of the Clean Water Act. For each stream on the 303(d) list, ODEQ determines the total maximum daily load (TMDL) allowable for each parameter.[40] 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 3-6 shows the Calapooya Creek streams included in the 2002 draft 303(d) list that require TMDL plans.[41] This table is not a comprehensive evaluation of all water quality concerns in the Calapooya Creek Watershed. There are many streams and stream segments that have not been monitored by ODEQ, or for which additional information is needed to make a listing determination.

To evaluate water quality in the Calapooya Creek Watershed, this assessment explores seven water quality parameters that may be of concern within the watershed. These parameters are temperature, pH, dissolved oxygen, nutrients, bacteria, sedimentation and turbidity, and toxics. ODEQ monitoring data was used and evaluated using ODEQ or OWEB water quality standards.

[39] ODEQ can also use data collected by other agencies and organizations to evaluate water quality.
[40] Total maximum daily loads are limits on pollution developed when streams and other water bodies do not meet water quality standards. TMDL plans consider both human-related and natural pollution sources.
[41] Streams that are water quality limited for habitat modification and flow modification do not require TMDL plans. In the Calapooya Creek Watershed, these streams are: Bachelor Creek (flow), Calapooya Creek (habitat), Coon Creek (flow), Dodge Canyon Creek (habitat and flow), Oldham Creek (flow), Pollock Creek (flow), and Williams Creek (habitat and flow).

Stream	Parameter(s)	Year listed	Stream miles listed	Season
Calapooya Creek	Temperature	1998	0 – 18.7	Summer
	Fecal coliform	1998	0 – 18.7	Winter/Spring/Fall
		1998	0 – 18.7	Summer
	Dissolved oxygen	1998	0 – 18.7	Winter/Summer/Fall
	pH	1998	0 – 18.7	Summer
Cook Creek	Copper	2002	0 – 2.9	All year
	Lead	2002	0 – 2.9	All year
	Iron	2002	0 – 2.9	All year
	Manganese	2002	0 – 2.9	All year

Table 3-6: ODEQ water quality-limited stream segments in the Calapooya Creek Watershed.

3.3.2. Temperature

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 salmonids. When temperature exceeds tolerance levels, cold-water organisms such as salmonids become physically stressed and have difficulty obtaining enough oxygen.[42] Stressed fish are more susceptible to predation, disease, and competition by temperature tolerant species, which in the case of salmonids might be bass. 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 so 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). Temperatures 77°F (25°C) or higher are considered lethal.

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 Calapooya Creek Watershed, Calapooya Creek is 303(d) listed for temperature (see Table 3-6).

In 1999, the Umpqua Basin Watershed Council (UBWC) undertook a study on water temperature for the Calapooya Creek Watershed to determine temperature (the Smith

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

report).[43] Continuously sampling sensors were placed at 29 locations within the watershed. Temperatures were measured between June 18 and September 3, 1999. Figure 3-1 shows the seven-day moving average maximum temperatures for Calapooya Creek.[44] Appendix 9 has similar data for some tributaries.

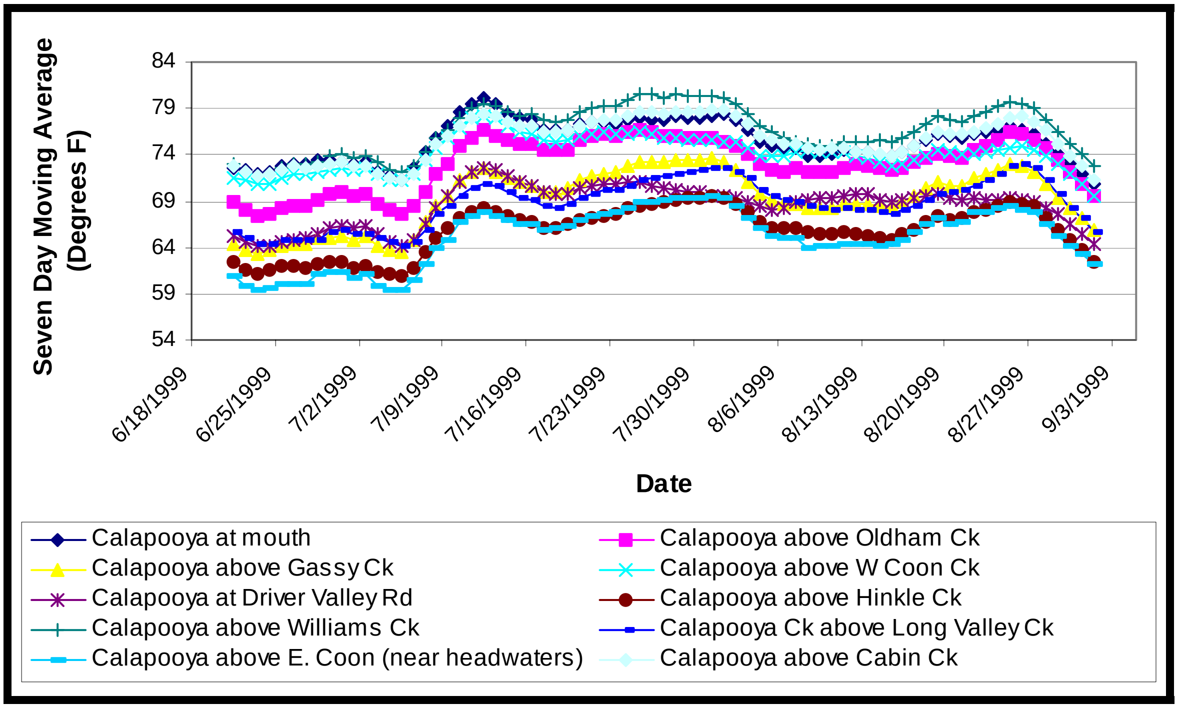

Figure 3-1: Summer temperature trends for Calapooya Creek.

Table 3-7 has the number of days and percent of days for which Calapooya Creek's average maximum temperature exceeded 64°F during the temperature monitoring study. Seven out of 10 sites always exceeded the 64°F standard. Three monitoring sites near the headwaters of Calapooya Creek exceeded the standard at least 73% of the time.

Results of the study show that seasonal seven-day moving average maximums ranged from 82.5° F to 57.5°, with an average of 72.0° F. Eleven monitoring sites on four streams had seven-day moving average maximum temperatures exceeding the 64°F every day the study was conducted. Eight sites on five streams were below 64°F every day.

Tributaries are approximately 10°F cooler than the main stem Calapooya. However, all streams that flow more than three miles from their ridge source frequently exceed the 64°F standard. Charting data with respect to distance from the ridge shows that maximum temperatures of the coldest streams tend to increase 1.25°F per downsteam

[43] Copies of the study "Calapooya Creek Temperature Study of 1999" (January, 2000) are available at the UBWC office.
[44] The seven-day moving average maximum temperature is an average of the maximum temperatures of a given day, the three preceding days, and the three days that follow.

mile. It also appears that many tributaries that are the same size have the potential to be at cooler temperatures.

Sample Site	Days with a max 7-day average temp >64°F	Days monitored	% of total days >64°F
Calapooya at mouth	73	73	100%
Calapooya above W Coon	73	73	100%
Calapooya above Williams Ck	73	73	100%
Calapooya above Cabin Ck	73	73	100%
Calapooya above Oldham	73	73	100%
Calapooya at Driver Valley Rd	73	73	100%
Calapooya Ck above Long Valley Ck	73	73	100%
Calapooya above Gassy	68	73	93%
Calapooya above Hinkle Ck	54	73	74%
Calapooya above E. Coon (near headwaters)	53	73	73%

Table 3-7: Number of days and percent of days for which seven-day moving average maximum temperatures exceeded 64°F in the Calapooya Creek Watershed.

Influences on stream temperature

The ultimate source of stream heat is the sun, either by direct solar radiation or by ambient air and ground temperature around the stream, which are also a result of solar energy.[45] Groundwater has the least exposure to solar energy, and therefore is at the coolest temperature (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 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.

If solar energy were the only influence on stream warming, it would be expected that stream temperature would increase at a smooth and steady rate until the stream was in equilibrium with solar energy inputs. However, stream temperature at a given location is influenced 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 report indicates that when upstream flow enters a reach that is highly exposed to direct solar

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

radiation, the flow in that reach is usually warmer than would be expected from the upstream flow's temperature.

Localized groundwater influx and tributary flow can reduce stream temperatures. As stated earlier, groundwater in the Umpqua Basin is typically 52°F. When groundwater enters a stream, it mixes with the warmer upstream 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 small streams' flow. As a result, cooler flow from small tributaries entering larger streams can, like groundwater influx, reduce stream temperature at that location. In some cases, this may also occur when a tributary is practically dry. Evidence from the Smith report suggests that in some cases tributaries with gravel-dominated streambeds permit cooler subsurface water to pass into the main stem, even when the stream has no surface flow. Smith 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.

The effects of local conditions are evident in Table 3-3, which shows the overall warming trend by stream mile for Calapooya Creek. As would be expected, Calapooya Creek is warmer at the mouth (stream mile zero) than at the headwaters (stream mile 35). However, the stream's temperature changes along the way demonstrate the impact of local conditions. Of particular note are the temperatures recorded at stream mile 6.7 and 23.5, which are much cooler than surrounding monitoring sites on the main stem. Stream mile 6.7 is associated with a canyon, while stream mile 23.5 is associated with a large, slow moving body of water. Shading and high groundwater influx are the most likely contributors to these cooler temperatures.

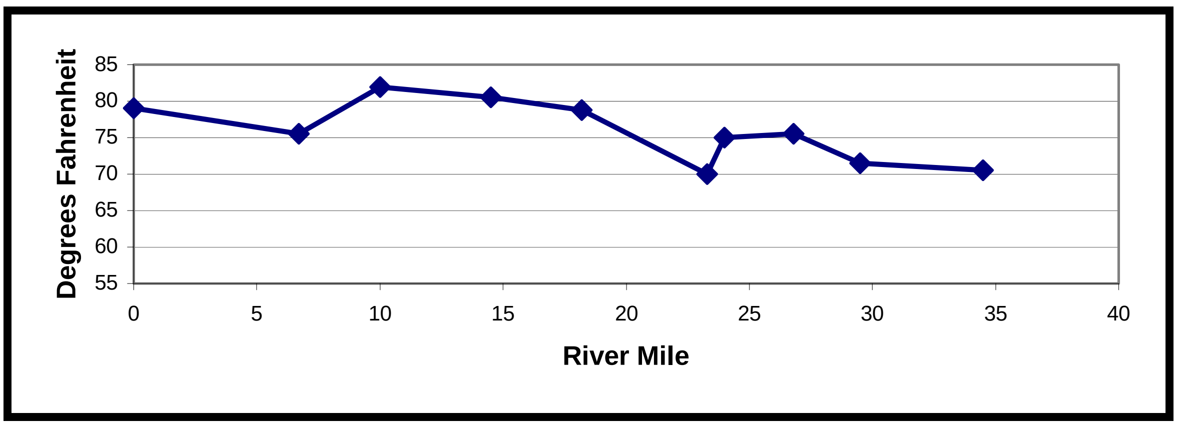

Figure 3-2: Maximum stream temperatures by river mile for Calapooya Creek on August 28, 1999.

Management implications

An important implication of Smith's studies is that prevailing stream temperatures on small streams can be strongly influence by local conditions. Local stream temperature management restoration projects may be very effective in improving stream temperature conditions in many small streams in the Umpqua Basin.[46]

3.3.3. 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 one to 14 measures pH. On this scale, a pH of seven is neutral, more than seven is alkaline, and less than seven is acidic.

The beneficial uses affected by high or low pH levels are resident fish and aquatic life, and water contact recreation. When pH levels exceed the stream's normal range, water can dissolve the protective mucous layer on aquatic organisms such as fish, amphibians, and mollusks. Without a healthy protective layer, 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. This is an issue because metal ions shift to more toxic forms in acidic water, which is a concern for both wildlife and humans.

Physical and biological factors cause surface and groundwater pH to normally be slightly alkaline or acidic. The chemical composition of rocks and rainfall will influence pH. Respiration and photosynthesis are normal metabolic processes of aquatic organisms that change pH. Carbon dioxide (CO_2) is produced during respiration and used for photosynthesis. The level of dissolved CO_2 in a stream raises and lowers pH. Normally, there is a balance between instream metabolic processes and a natural chemical buffering system that prevents streams from becoming too acidic or alkaline from CO_2. However, stream inputs that increase or decrease respiration and photosynthesis by aquatic organisms can indirectly shift pH by changing CO_2 levels. For example, nitrogen and phosphorus from organic matter such as feces and urine, or from inorganic chemicals such as fertilizers, encourage algae growth in the summer and can result in algae "blooms." When a stream's algae population grows, so does the overall consumption of dissolved CO_2. As CO_2 levels drop, pH elevates and can reach detrimental levels.

In an attempt to differentiate between the natural variability of surface water pH and the changes caused by other nitrogen and phosphorus sources, the Oregon Water Quality Standards 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.

In the Calapooya Creek Watershed, Calapooya Creek is 303(d) listed for pH during the summer from the mouth to stream mile 18.7 (approximately the distance to Bachelor Creek). Figure 3-3 shows pH levels for Calapooya Creek at Umpqua (near the mouth) from 1981 through 2000. Out of 49 single summer pH samples, nine were outside the 6.5

[46] From Kent Smith's "Thermal Transition in Small Streams under Low Flow Conditions," 2002.

to 8.5 pH range, which is more than 18% of the samples. Additional monitoring is needed to determine if pH is a concern at other locations within the watershed.[47]

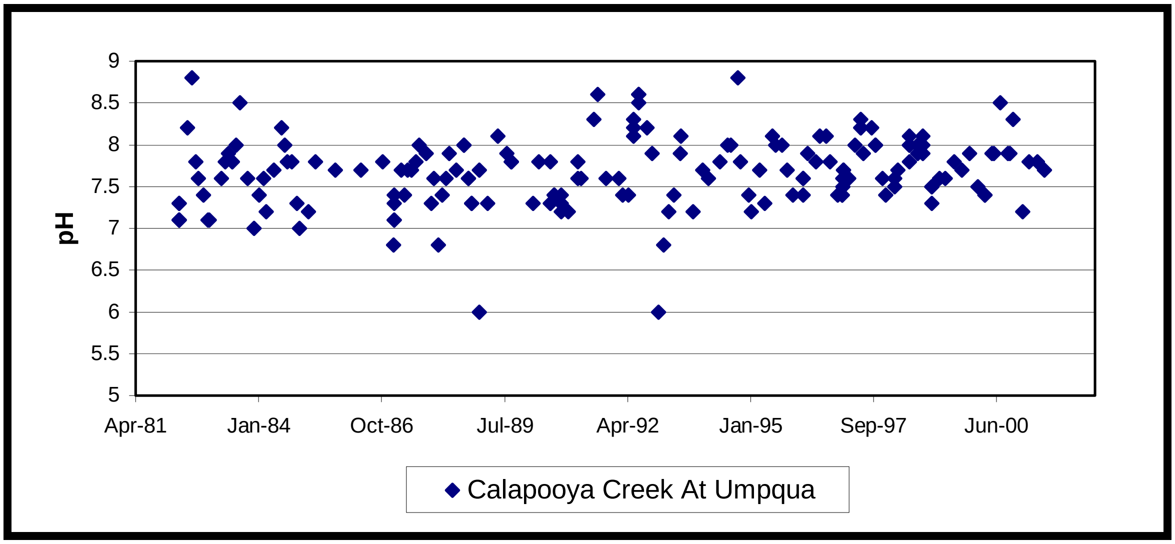

Figure 3-3: pH levels for Calapooya Creek at Umpqua.

3.3.4. Dissolved oxygen

In the Umpqua Basin, cold-water aquatic organisms are adapted to waters with high amounts of dissolved oxygen. Salmonid eggs and smolts are especially sensitive to dissolved oxygen levels. If levels drop too low for even a short period of time, eggs, smolts, and other aquatic organisms will die. Therefore, the beneficial uses most affected by dissolved oxygen 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 dissolved oxygen than still water.[48] Aquatic organisms produce oxygen through photosynthesis and use oxygen during respiration. As a result, dissolved oxygen 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.

Since oxygen content varies depending on many factors, Oregon Water Quality Standards have many dissolved oxygen criteria. The standards specify oxygen content 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

[47] Data are from ODEQ's Laboratory Analytical Storage and Retrievable (LASAR) database. All ODEQ data are available via the website www.deq.state.or.us. Select "water quality" and "Laboratory Analytical Storage and Retrievable Database – Monitoring Data."

[48] As water churns and flows, it makes contact with atmospheric oxygen, of which some dissolves in the water until the stream is saturated.

spawning, ODEQ uses 11 mg/l as the dissolved oxygen standard for Calapooya Creek. For the rest of the year, the standard is eight mg/l.

Figure 3-4 shows the dissolved oxygen content for Calapooya Creek at Umpqua for the summer and winter of 1980 through 2001. Out of 167 samples, 44 were below the 11 mg/l standard (26%). Three samples were below the eight mg/l standard. All of the low dissolved oxygen levels occurred between September 15 and December 31.[49] Calapooya Creek from the mouth to stream mile 18.7 is 303(d) listed for dissolved oxygen during the fall, winter, and summer. Additional monitoring is necessary to determine if dissolved oxygen is limiting water quality elsewhere in the watershed.

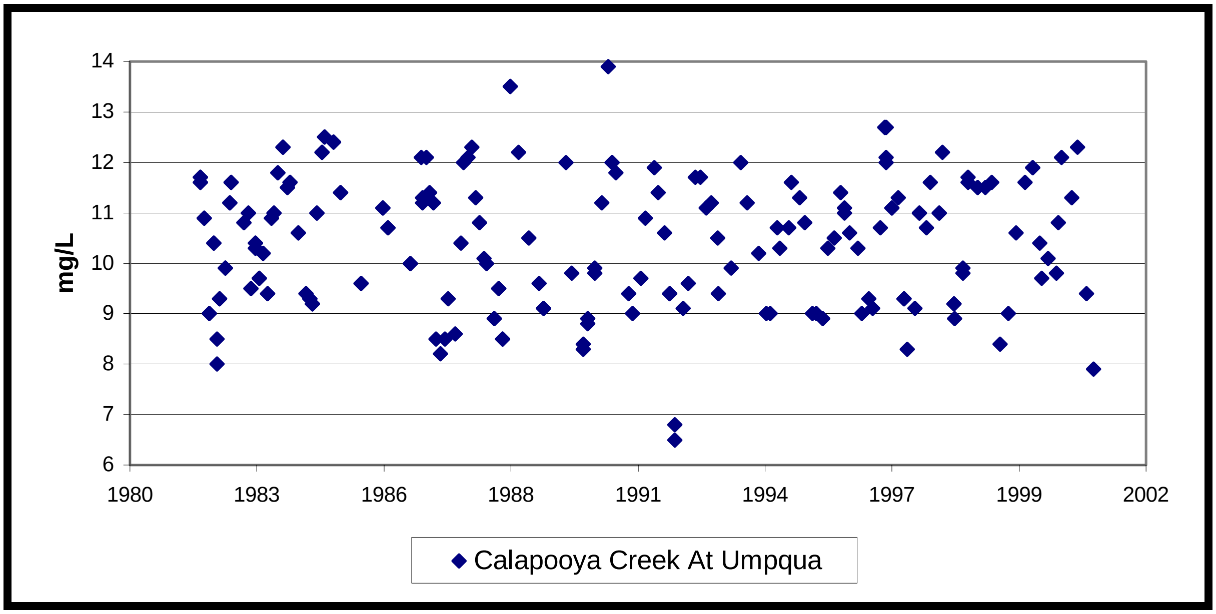

Figure 3-4: Dissolved oxygen levels for Calapooya Creek at Umpqua.

3.3.5. Nutrients

The beneficial uses affected by nutrients are aesthetics or "uses identified under related parameters."[50] This means that a stream may be considered water quality limited for nutrients if nutrient levels adversely affect related parameters, such as dissolved oxygen, that then negatively impact one or more beneficial uses, such as resident fish and aquatic life. As stated earlier, high nutrient levels encourage the growth of algae and aquatic plants. Excessive algal and vegetative growth can result in little or no dissolved oxygen, and interfere with water contact recreation, such as swimming. Also, certain algae types produce by-products that are toxic to humans, wildlife, and livestock, as occurred in Diamond Lake in the summer of 2002.[51]

[49] Data are from ODEQ's Laboratory Analytical Storage and Retrievable (LASAR) database.
[50] From the *Oregon's Approved 1998 303(d) Decision Matrix.*
[51] Diamond Lake is within the Umpqua National Forest in the extreme eastern portion of the Umpqua Basin.

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 Calapooya Creek Watershed. Therefore, this assessment used the OWEB standards for evaluating nutrient levels in the watersheds. The Oregon Watershed Enhancement Board recommends using 0.05 mg/l for total phosphorus, and 0.3 mg/l for total nitrate (including nitrites and nitrates). Just over 8% of samples from Calapooya Creek at Umpqua and 3% of samples from other locations exceeded OWEB's recommendation for nitrates. Over 52.6% of samples from Calapooya Creek at Umpqua and 24% of samples from other locations exceeded OWEB's 0.05 mg/l phosphorus recommendation.[52]

There are many sources of phosphorus and nitrate in streams. Aquatic organisms produce nutrient-rich wastes. Decomposition of organic material also adds nutrients to the stream. Wastewater treatment plant effluent, industrial and home fertilizers, as well as fecal matter from wildlife, domestic animals, and septic systems, can increase stream nutrient levels. Not enough is known about normal nutrient levels for Umpqua Basin streams and rivers to determine whether or not nutrient levels in the Calapooya Creek Watershed are of concern.

3.3.6. Bacteria

Bacteria are present in all surface water. In general, resident bacteria are not harmful to the overall aquatic environment or to most human uses. However, ingestion of fecal bacteria such as *Escherichia coli* (*E. coli*) can cause serious illness or death in humans. The presence of fecal bacteria indicates a potential vector for other human diseases, such as cholera and typhoid. Water contact recreation is the beneficial use most affected by bacteria. Private and public drinking water supplies are not affected because water filtration systems are able to remove harmful microorganisms.

There are many possible sources of *E. coli* and other fecal bacteria in water. These can be divided into "point sources" and "non-point sources." The legal definition of a point source is one for which there is an operational permit, such as the outlet for a wastewater treatment plant. Most stream contamination comes from non-point sources, or ones for which there is no operational permit, such as animal waste. Although septic systems require an installation permit, there is no annual operational permit. These sources are considered non-point even if it is clear that, for example, a single failing septic field adjacent to a stream is causing high fecal bacteria levels. Upland areas with concentrated fecal waste can be non-point sources that contribute significantly to bacteria levels because bacteria are washed down into streams during rain events.

According to the Oregon Water Quality Standards, a stream is considered water quality limited for bacteria when one of two events occurs: 1) 10% of two or more samples taken from the same stream have *E. coli* concentrations exceeding 406 bacteria per 100 ml of water; and 2) the average *E. coli* concentration of five samples taken within a 30-day period exceeds 126 bacteria per 100 ml of water.

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[52] Data are from ODEQ's Laboratory Analytical Storage and Retrievable (LASAR) database.

Figure 3-5 shows the most probable number (MPN) of bacteria from Calapooya Creek at Umpqua. This site was sampled 55 times for bacteria from June 1994 until April 2001. Six of those samples exceeded the 406/100 ml standard (10.9%).[53] Therefore, Calapooya Creek is 303(d) listed for fecal coliform during the summer and during the winter, spring, and fall (see Table 3-6).

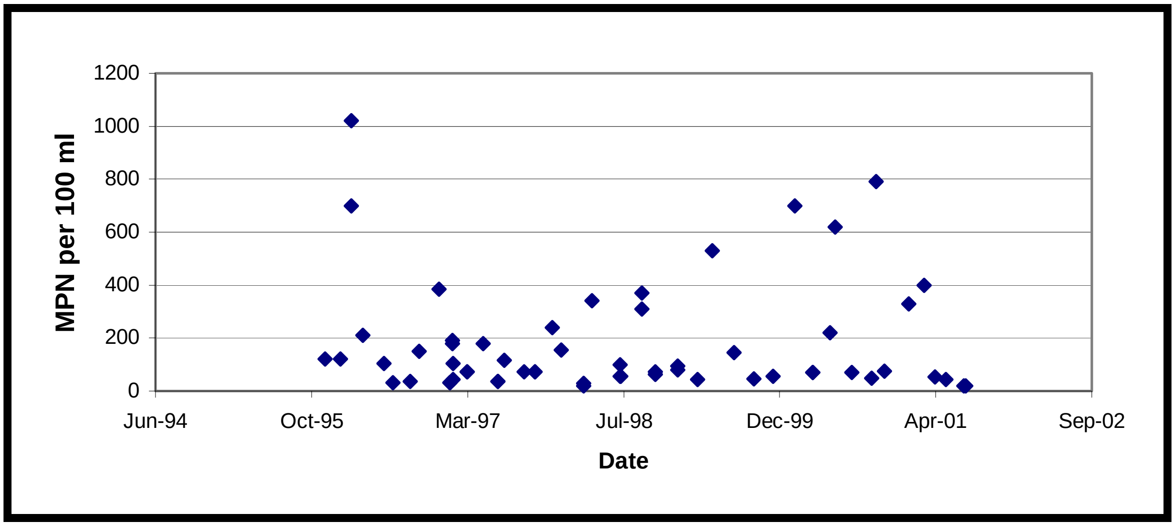

Figure 3-5: Calapooya Creek bacteria levels at Umpqua.

Thirteen other sites within the Calapooya Creek Watershed were measured for fecal bacteria. Map 3-7 shows the sampling locations. Blue dots are sites that had no bacteria samples exceed either the 126/100 ml or 406/100 ml standards. Green dots are sites that exceed the 126/100 ml standard, but which were only sampled once. Yellow dots are sites where there were multiple samples for which one or more had bacteria levels exceed 126/100 ml, but which were not surveyed within a 30-day period. Red dots are sites where bacteria levels exceed 406 per 100 ml of water standard. Additional monitoring is necessary to clarify which of these and other sites, if any, have potentially harmful levels of fecal bacteria.

Upland sources of bacteria

Upland areas with concentrated fecal waste can contribute significantly to *E. coli* levels. During rain events, bacteria are washed down into streams. Figure 3-6 shows bacteria concentration along the length of Calapooya Creek during a storm. In the headwaters of Calapooya Creek, where forestry is the primary land use, bacteria sampled after storm events are close to zero. Further downstream, where land use is predominantly rural residential or agriculture/grazing, there are higher levels of *E. coli* observed.[54]

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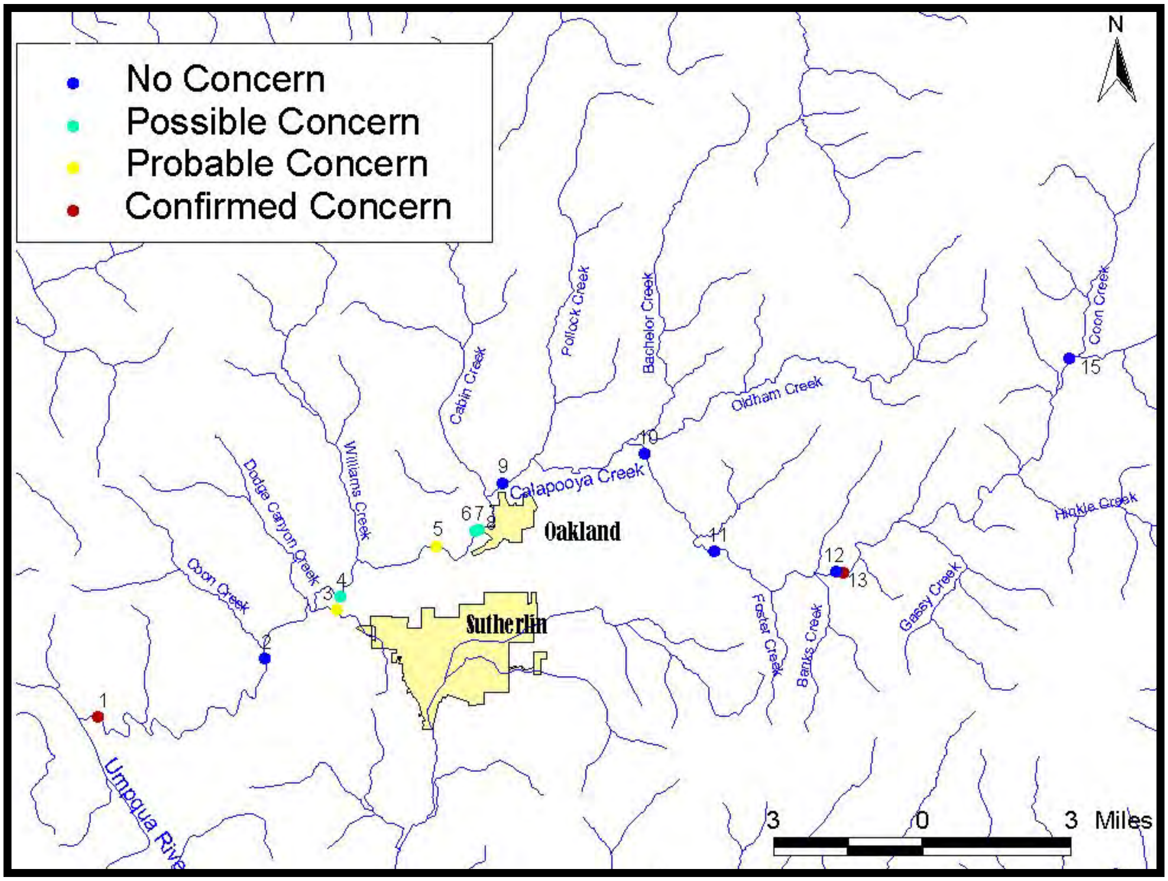
[53] Data are from ODEQ's Laboratory Analytical Storage and Retrievable (LASAR) database.
[54] Data are from ODEQ's Roseburg Office.



Map 3-7: Bacteria sampling locations and level of concern along Calapooya Creek.

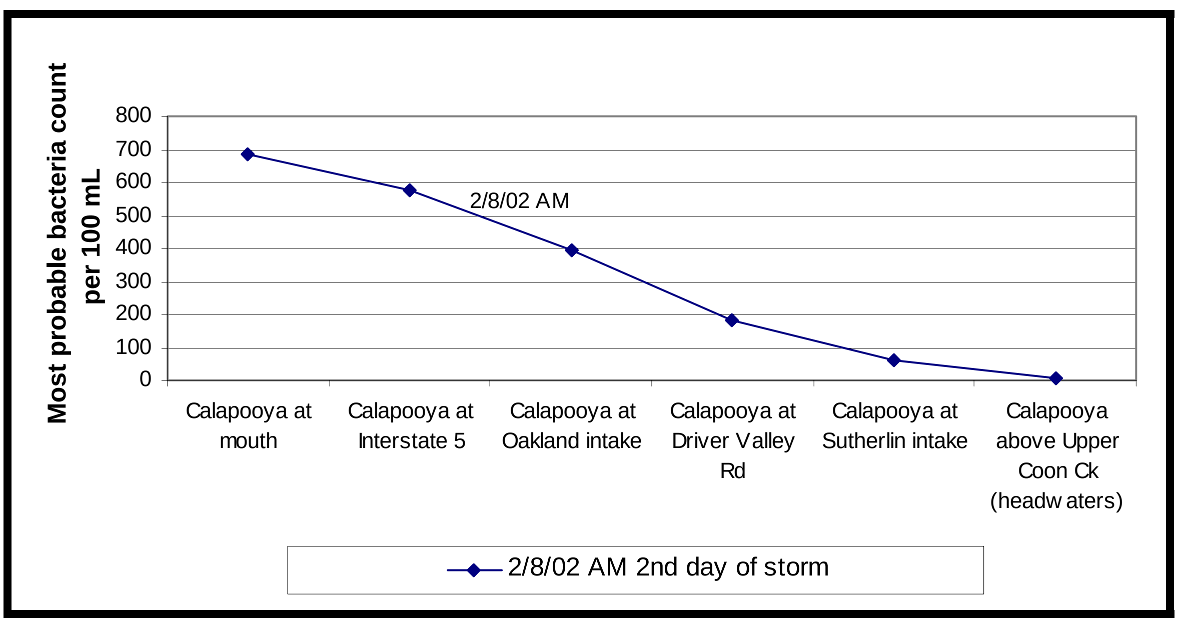


Figure 3-6: Bacteria estimates along Calapooya Creek during a storm.

3.3.7. Sedimentation and turbidity

Sediment is any organic or inorganic material that enters the stream and settles to the bottom. When considering water quality, this assessment is specifically referring to very fine particles of organic or inorganic material that have the potential of forming streambed “sludge.” The beneficial uses affected by sedimentation 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 stream sedimentation does not allow water circulation through the redd and will suffocate salmonid eggs. Although there are many aquatic organisms that require gravel beds, others, such as the larvae of the Pacific lamprey, thrive in sludgy streams.

Turbidity is closely related to sediment because it is a measurement of water clarity. In many cases, high turbidity indicates a large amount of suspended sediment in a stream.[55] Small particles such as silt and clay will stay suspended in solution for the longest amount of time. Therefore, 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 can rise during a storm event. This is because rapidly moving water has greater energy than slower water. During storms, upland material is washed into the stream from surface flow, which adds sediment to the 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. According to the Oregon Watershed Assessment Manual, 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.

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 insects), changes in fish populations, or by using information from non-ODEQ documents that use standardized protocols for evaluating aquatic habitat and fish population data. Currently, ODEQ monitors streams for total suspended solids, which indicates sedimentation. At the writing of this assessment, neither ODEQ nor OWEB has established criteria for these data. There are currently no streams in the Calapooya Creek Watershed 303(d) listed for sedimentation. More data are needed to determine if 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 the Oregon Water Quality Standards, turbidity is water quality limiting when NTU levels

[55] Suspended particles are not chemically mixed with water and will eventually settle to the stream bottom.

have increased by more than 10% due to an on-going operation or activity, such as dam releases or irrigation. To date, there are no streams in the Calapooya Creek Watershed that are 303(d) listed for turbidity.

The Oregon Watershed Assessment Manual recommends using 50 NTUs as the turbidity evaluation criteria for watershed assessments. At this level, turbidity interferes with sight-feeding aquatic organisms and provides an indication of the biological effect of suspended sediment. As shown in Figure 3-7, 15 out of 197 turbidity samples (7.6%) exceeded the 50 NTU turbidity standard.[56] Additional monitoring is necessary to determine if turbidity levels are of concern for other Calapooya Creek locations or for its tributaries.

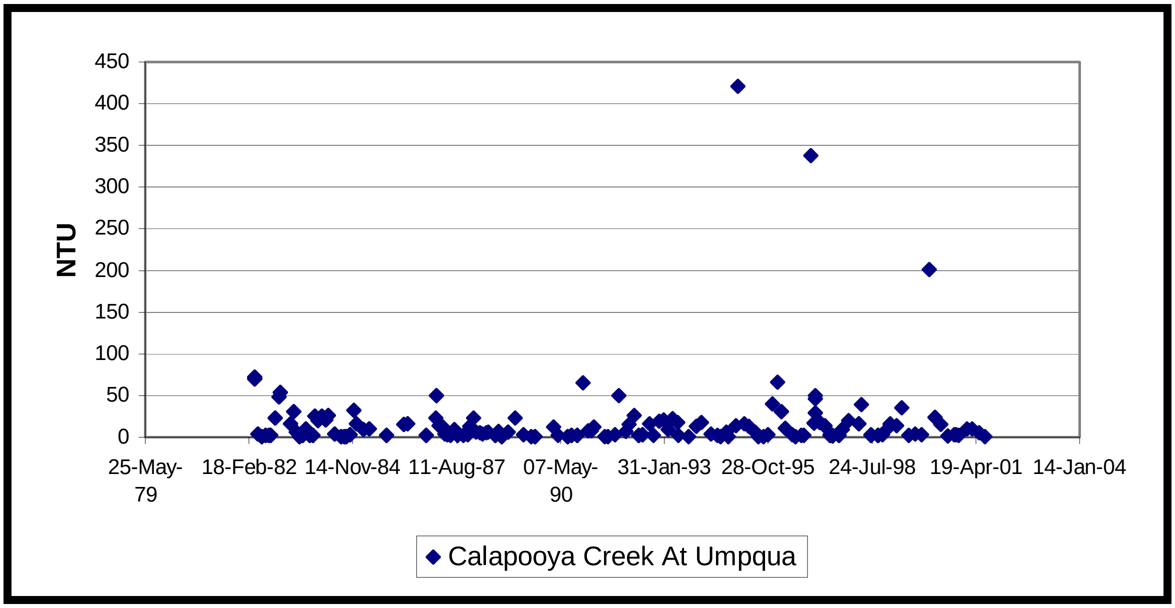


Figure 3-7: Turbidity levels for Calapooya Creek at Umpqua.

Turbidity can become very high after a storm event. Figure 3-8 shows turbidity levels at six sites along Calapooya Creek before, during, and after a storm event. Post-storm turbidity returned to levels that were similar to before the storm. During the storm, turbidity levels were almost four times greater than the 50 NTU limit suggested by OWEB. To date, it is unclear whether or not high turbidity levels for a short period of time impact fish habitat and/or water quality.

[56] Data are from ODEQ's Laboratory Analytical Storage and Retrievable (LASAR) database.

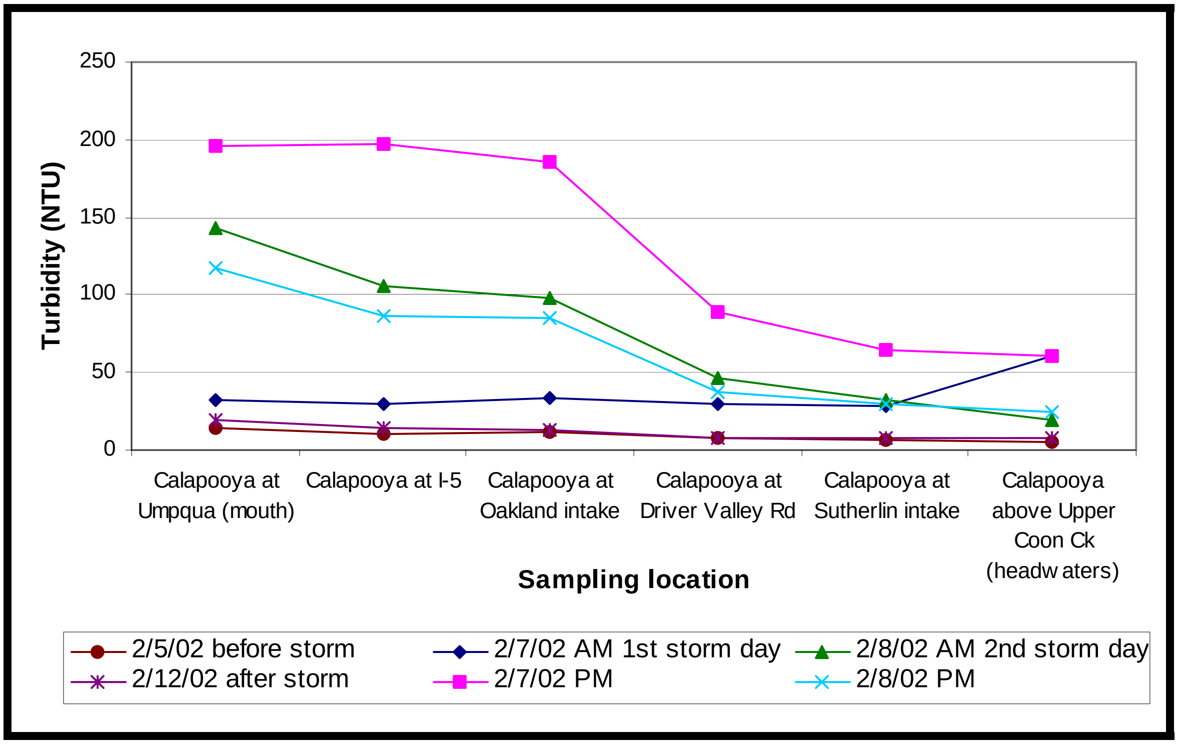


Figure 3-8: Calapooya Creek turbidity levels before, during, and after a February, 2002 storm event.

Sediment delivery processes[57]

Sediment delivery to streams from adjacent floodplains and slopes is a natural process for watersheds. The amount of sediment delivered to the streams will vary over time, with the bulk of sediment delivered during high flows (Watershed Professionals Network, 1999). Streams have an inherent ability to dissipate energy and carry sediments. Aquatic organisms within these systems have also adapted to deal with these natural sediment loads. Problems arise when sediment delivered to the streams exceed natural levels. For instance, human activity, such as runoff from towns, can significantly inflate natural sediment loads within stream networks. If erosion and runoff increase within the watershed, sediments also increase, which can eventually overwhelm the stream's ability to transport this additional build-up. In turn, increased sediment loads may decrease the quality of fish habitat by raising the elevation of the streambed, filling in pools, burying cobbles, boulders, and logs, silting over spawning gravels, and contributing to accelerated erosion of stream banks (Ellis-Sugai and Godwin, 2001). This changes the dynamics of the stream and its ability to dissipate energy and has a domino effect by causing more erosion downstream.

Distinguishing between human-induced erosion and a stream's natural rate of erosion can prove challenging due to the variable nature of natural erosion patterns in addition to the timing and spatial pattern of human-induced erosion. In general, aquatic organisms will

[57] Jenny Allen, Tim Grubert, and John Runyon of BioSystems, Inc., contributed the introductory text for this section.

be affected by an increase in sediment loads for reasons previously mentioned. Increased human use of the watershed may be apparent during times of high sediment loads, causing increased turbidity and accelerated rates of bank erosion within normally stable streams. These factors are indicators of increased sediment moving through the system. Furthermore, human caused changes within the watershed can often be narrowed to a few locations that experience high-use or that pass through developed areas. The Oregon Watershed Assessment Manual is a valuable resource for determining such problem areas within the watershed. It provides the steps necessary to inventory and address increased sediment loads and erosion.

Without further field verification and analysis using GIS, a more in-depth and detailed report on sediment processes within the assessment area is beyond the scope of this screening-level assessment. This assessment reviews five potential sources of stream sedimentation and turbidity in the watershed: roads and culverts, debris flow potential, soil type, urban drainage, and burns.

Roads and culverts

As is the case in many watersheds, sediment delivery from dirt and gravel roads is a leading cause of increased sediment in stream systems. Road sediment production and delivery involves many factors and processes such as road surface type, ditch infeed lengths, proximity to nearest stream channel, condition of road, 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 current state of road types, road to stream proximity and slope, and culverts.[58]

Roads can be divided into two types: surfaced and unsurfaced. Surfaced roads are ones that have been paved or rocked. Unsurfaced roads are dirt roads. Unsurfaced roads are much more likely to erode and fail than surfaced roads. There are 1,101.8 miles of roads in the Calapooya Creek Watershed. These are broken into nine classes (see Table 3-8).

The closer a road is to a stream, the greater the likelihood that road-related runoff contributes to sedimentation. In the Calapooya Creek Watershed, there are approximately 363.1 miles of roads (33% of 1,101.8 total miles) within 200 feet of streams (see Map 3-8). Of these, approximately 322.1 miles (89%) are surfaced roads, 20 miles (5.4%) are unsurfaced roads, and 21.3 miles (5.9%) are unknown or closed.

[58] Tim Grubert and John Runyon of BioSystems, Inc., contributed this paragraph.

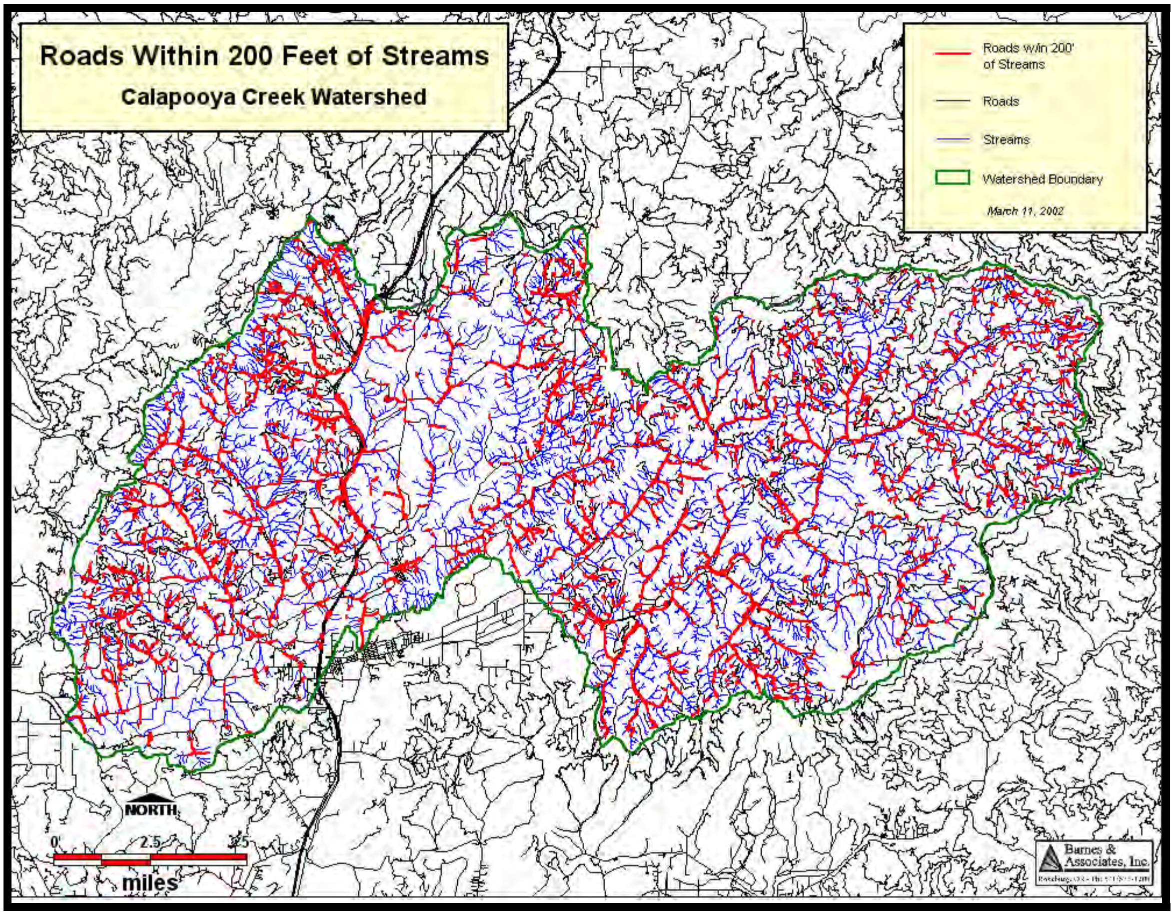
Surface type	**Road Miles**	**% total**
Surfaced		
• Federal roads (paved)	56.6	5.1
• State roads (paved)	7.3	0.7
• County/other (paved)	150.3	13.6
• Major gravel	520.4	47.2
• Minor gravel or spur	245.5	22.3
Total surfaced	**980.1**	**88.9**
Unsurfaced		
• Major dirt road	38.1	3.5
• Minor dirt road	22.6	2.1
Total unsurfaced	**60.7**	**5.6**
Other		
• Unknown	34.3	3.1
• Closed	26.7	2.4
Total other	**61.0**	**5.5**

Table 3-8: Miles and percent of Calapooya Creek Watershed roads by class.

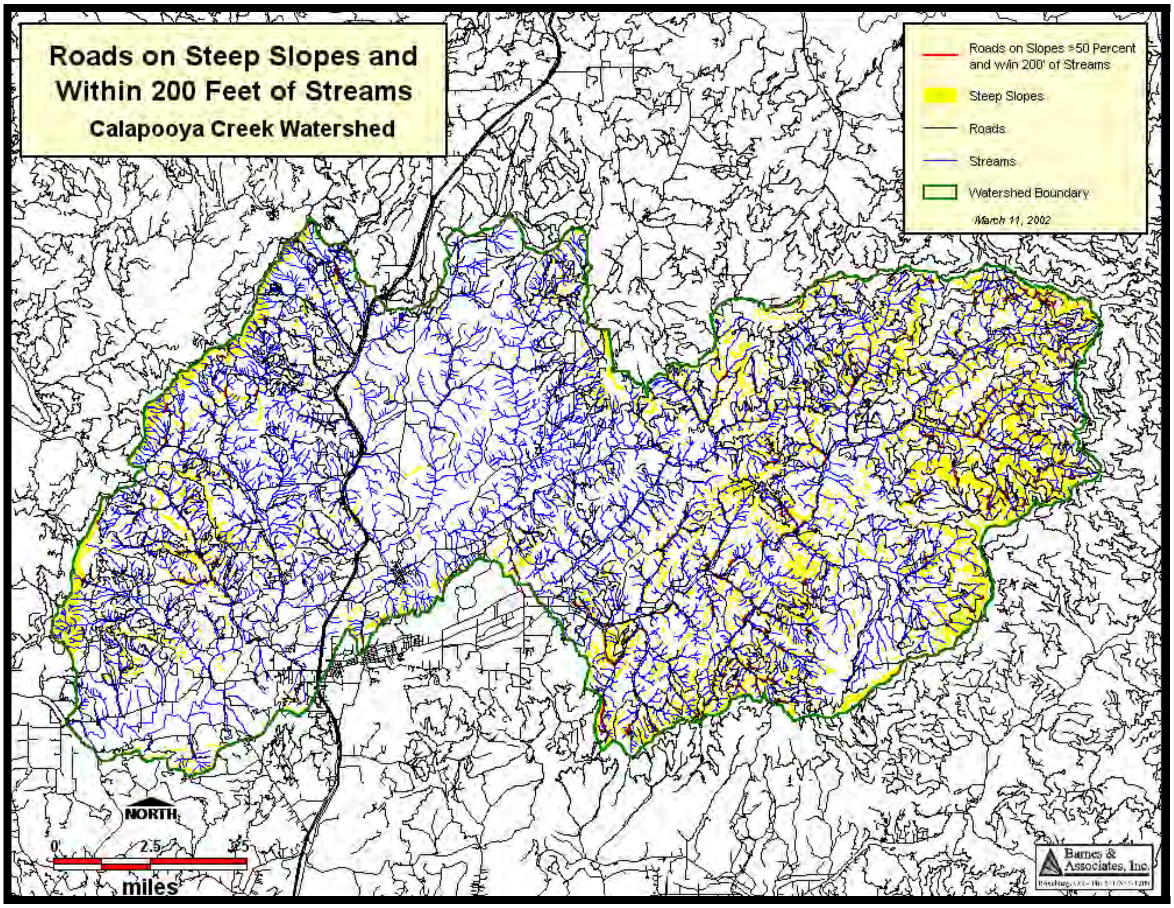
Roads on steep slopes have a greater potential for erosion and/or failure than roads on level ground. There are approximately 36 miles of roads (3.3% of 1,101.8 total miles) located on a 50% or greater slope also within 200 feet of a stream. Most of these are found in the watershed's extreme western and extreme eastern portions (see Map 3-9). Of these roads on steep slopes, 32.2 miles (89.4%) are surfaced, 1.6 miles (4.4%) are unsurfaced, and 2.6 miles (7.1%) are closed or unknown. An analysis of road conditions near streams is necessary to determine how much stream sedimentation is attributable to road conditions.

Like roads, culverts can contribute to stream sedimentation when they are failing. Culverts often fail when the pipe is too narrow to accommodate high stream flows, 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. There are at least 97 stream crossings in the Calapooya Creek Watershed. At this time, it is unknown how many of these crossing are culverts and how many culverts are failing.[59]

[59] See section 3.1.2 for a discussion of current culvert identification and restoration efforts in the Umpqua Basin.



Map 3-8: Calapooya Creek Watershed roads within 200 feet of a stream.



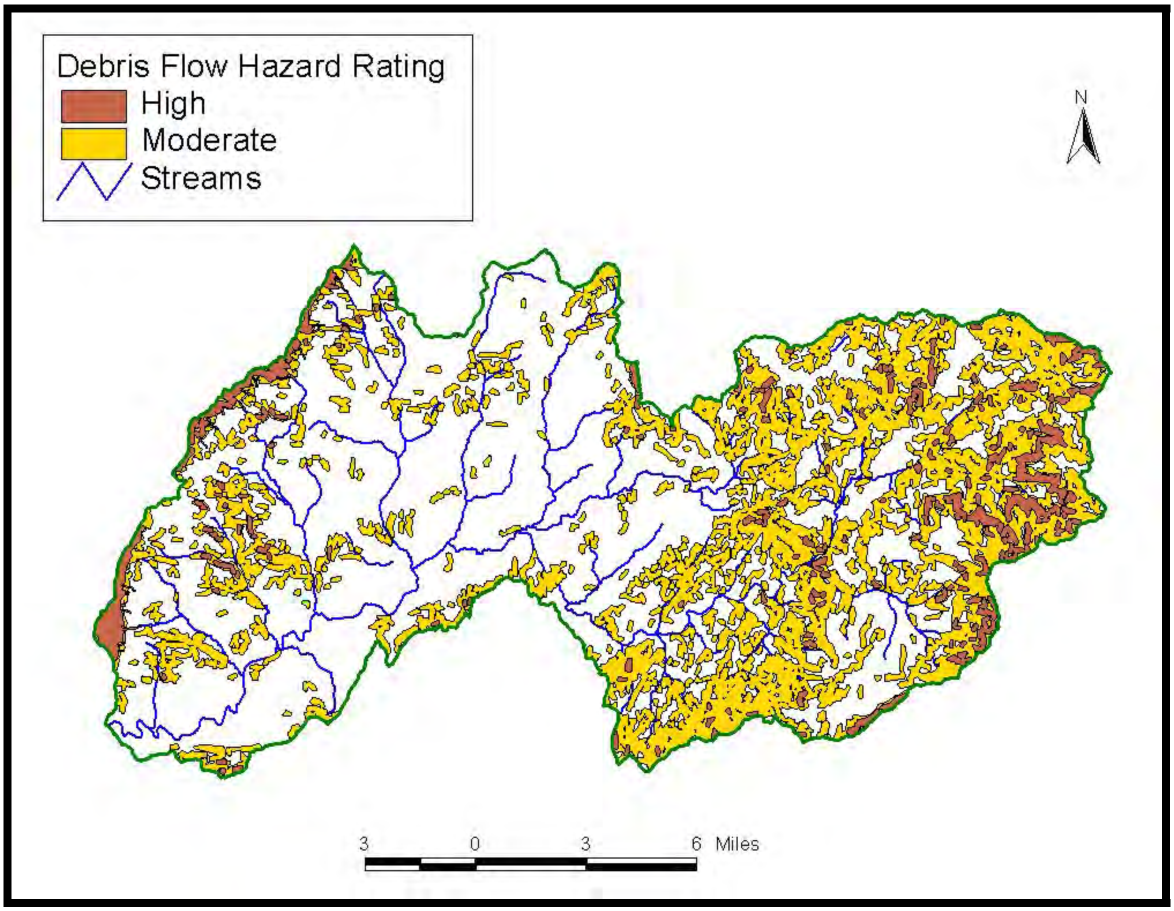
Map 3-9: Calapooya Creek Watershed roads within 200 feet of a stream and on slopes greater than 50%.

Slope instability

In 2000, the Oregon Department of Forestry (ODF) published a debris flow hazard study that is geographically categorized by counties. These data sets were developed by evaluating slope steepness, geologic units, stream channel confinement, fan shaped geomorphology, historical information on debris flow occurrence, and the "ODF Storm Impacts and Landslides of 1996" study. This can be a useful tool for the watershed council to use when evaluating sediment delivery to streams and determining areas at risk for landslides and mass failures. However, this is a coarse scale study, which is primarily designed to assist land managers in locating areas that are naturally prone to debris flows. This model should not be used to make decisions without further investigation of the areas mapped as high risk. The debris flow hazard model for the Calapooya Creek Watershed is shown in Map 3-10. An organization known as Nature of the Northwest is in the process of publishing a similar landslide study that is more refined. The new study has incorporated more variables into the model and refined the scale to make it a more realistic management tool with which land managers can make decisions.[60]

[60] Jenny Allen, Tim Grubert, and John Runyon of BioSystems, Inc., contributed this paragraph.

Of the 157,282 acres within the Calapooya Creek Watershed, 53,381 acres (33.9%) are considered moderate for debris flow potential, and 8,641 acres (5.5%) are high. There are no areas within the watershed classified as having an extreme debris flow potential. Of the 224.2 miles of streams included in Map 3-10, 57.8 miles (25.7%) are within areas of moderate landslide potential, and nine miles (4.0%) are within areas of high landslide potential. Although landslides can contribute significant amounts of stream sediment, they are periodic events and are difficult to predict. At this time, it is unknown how much stream sediment is a result of landslides in the Calapooya Creek Watershed.



Map 3-10: Debris flow potential within the Calapooya Creek Watershed.

Hydrologic soil groups[61]

The Natural Resources Conservation Service (NRCS) classifies soil into four hydrologic soil groups that are based on the soil's runoff potential given similar storm and groundcover conditions. Soil texture, depth to water table, structure, and permeability influence the soil's runoff potential. The hydrologic soil groups are categorized as A

[61] Jenny Allen, Tim Grubert, and John Runyon of BioSystems, Inc., contributed this subsection. Hydrologic soil groups information in this section is from *The Nature and Properties of Soils* (Brady and Weil, 1996).

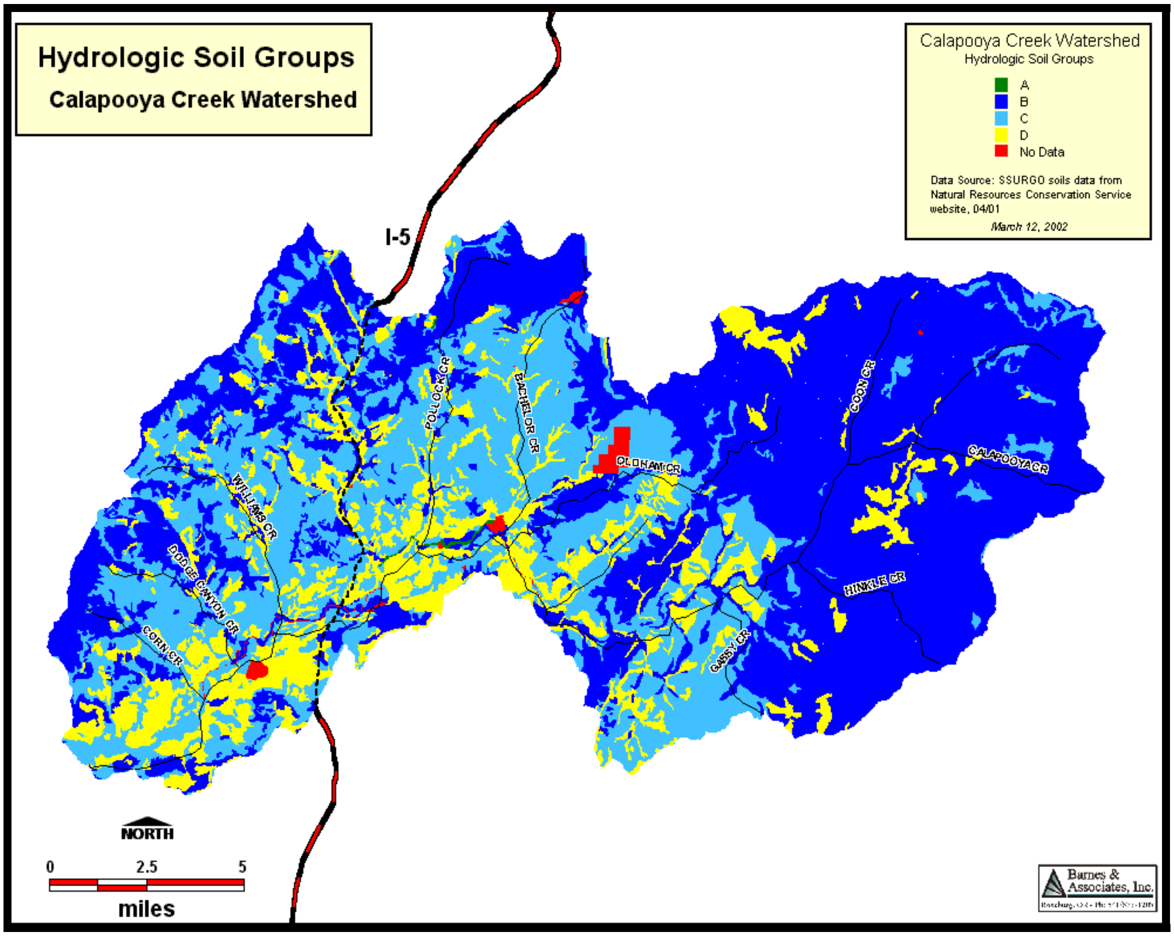
through D, with A having the lowest runoff potential and D having the highest runoff potential (see Table 3-9).

HSG	Soil Description
A	These soils can be sand, loamy sand, or sandy loam. These soils have low runoff potential and high infiltration rates even when thoroughly wetted. They consist chiefly of deep, well to excessively drained sands or gravels and have a high rate of water transmission.
B	This soil type is silt loam or loam. These soils 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.
C	This soil type is sandy clay loam. These soils have a low infiltration rate when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately-fine to fine structure.
D	This soil type is clay loam, silty clay loam, sandy clay, silty clay, or clay. This hydrologic soil group has the highest runoff potential. These soils 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.

Table 3-9: Hydrologic soil groups.[62]

The Calapooya Creek Watershed is comprised of the following hydrologic soil groups: B, C, and D (see Map 3-11). A small percentage of the soils have not been categorized at this time. All soil groups can be found throughout the watershed. However, group B is predominately located in the upper to mid reaches of the eastern portion of the watershed and comprise approximately 35% to 40% of the area. Group C is mainly found in the mid to lower sections of the watershed and comprise approximately 35% to 40% of the watershed. Group D soils are predominately located in the lower reaches of the watershed adjacent to the streams and make up about 15% to 20% of the watershed.

[62]Source: SSURGO soils data from the NRCS website.



Map 3-11: Hydrologic soils map of the Calapooya Creek Watershed.

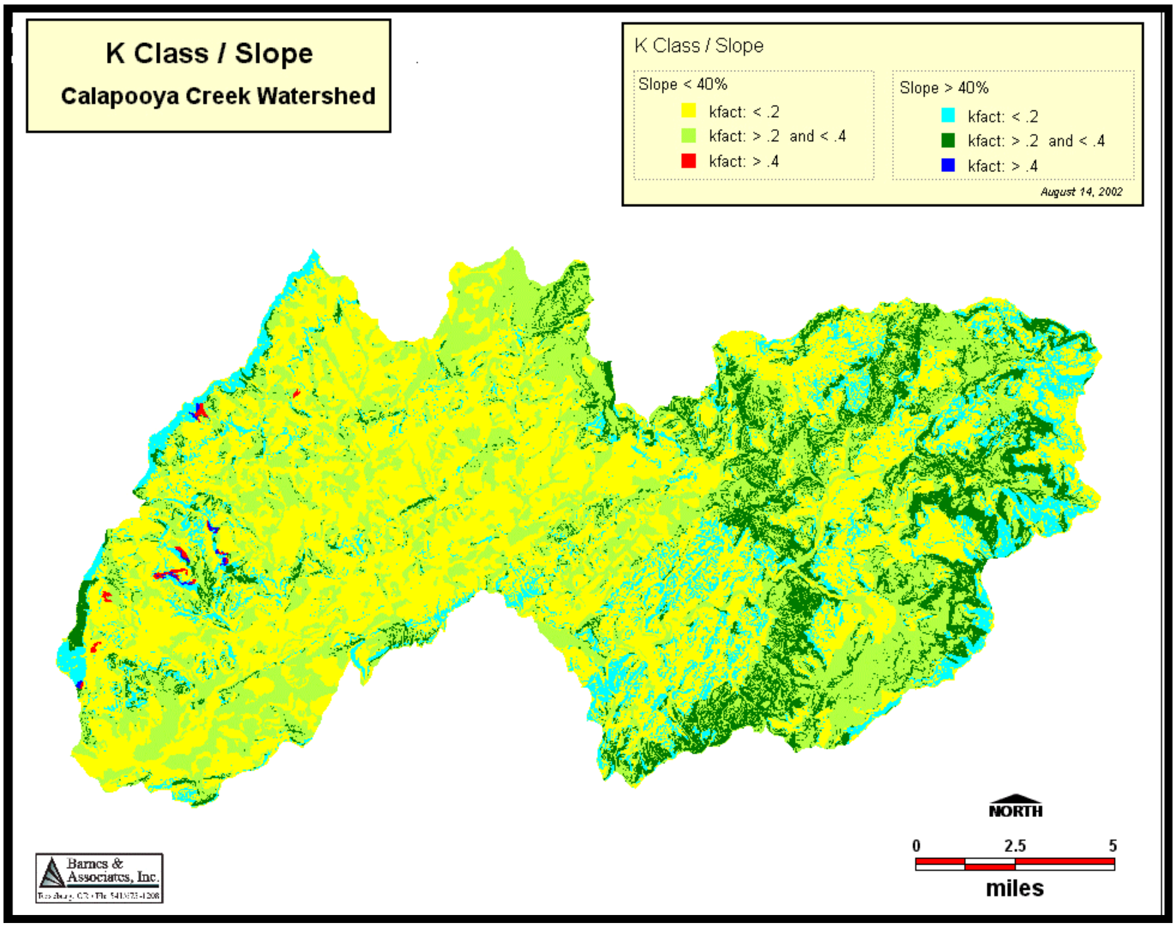
Soil K-factor[63]

Erodibility generally refers to a soil's susceptibility to the erosive force of water running over land and is expressed as a value known as the K-factor. The two major factors that define K-factor are the soil's infiltration capacity and its structural stability. Major influences of a soil's infiltration capacity and structural stability include characteristics such as: the amount of organic matter, soil texture, the kind and amount of swelling clays, soil depth, the presence of impervious soil layers, and the tendency of the soil to crust (Brady and Weil, 1996). K-factor is generally expressed as a value between zero and 0.6. Numbers less than 0.2 are classified as well-drained, sandy soils with high infiltration rates. Soils with a K-factor in the range of 0.2 to 0.4 are considered to have moderate infiltration capacities, while K-factors greater than 0.4 are assigned to soils with low infiltration rates and a high susceptibility to erosion. Slope also influences erosion rates. Since steep slopes are more prone to the erosive force of water, slopes can adversely affect soils that have moderate infiltration rates and levels of erosion potential. On steep slopes, areas with moderate K-factors may still be prone to a high risk of erosion. In

[63] Jenny Allen, Tim Grubert, and John Runyon of BioSystems, Inc., contributed this subsection. Soil K-factor information in this section is from *The Nature and Properties of Soils* (Brady and Weil, 1996).

general, the steeper the slope, the more likely it is to fail; however, some geologic material is more stable than others on varying gradients. For instance, tuffs, breccias, and sediments such as marine deposits, are more prone to erosive forces than harder material such as granite, which is better able to support steep slopes.[64] Map 3-12 illustrates the K-factor and slope distribution of the area.

Most of the soils within the Calapooya Creek Watershed have a low K-factor which means they are well-drained soils with high to moderate infiltration rates. However, small patches of soil found on the western border of the watershed, clustered near the eastern side of the Tyee and Yellow Creek Mountains, have a K-factor greater than 0.4, making them highly susceptible to erosion. Steep slopes and impervious soil groups designate this area as sensitive and slow to recover from disturbance. This area is less than 5% of the watershed.



Map 3-12: K-class and slope for the Calapooya Creek Watershed.

[64] Section 1.2.4 and Appendix 1 provide more information about the geologic units within the Calapooya Creek Watershed.

Urban drainage

In cities and towns, most sediment enters streams from storm water systems. Urban development results in high amounts of impervious surfaces concentrated in a small area.[65] As a result, rainfall is no longer absorbed by the soil or stored in wetlands, leading to heightened peak streamflows and shortened lag times (time from rainfall to peak streamflow) following rain events. To prevent flooding, cities have extensive storm water systems that convey runoff from streets and other paved areas to nearby rivers, streams, and/or lakes.

> Different types of land within an urban setting produce different amounts of sediment. Residential neighborhoods produce the least amount of sediment per square mile. Commercial areas produce moderate loads of sediment, and heavy industrial areas produce even higher amounts. The highest amounts occur in areas that are actively being developed. Earth disturbances and bared surfaces usually makes sediment production the highest within a town, albeit the sediment production usually decreases once the construction is complete (Oregon Watershed Assessment Manual, p. VI-27).

Table 3-10 shows the dominant land use and estimated percent of total impervious surfaces for seven cities in the central Umpqua Basin. "Residential" is the dominant land use for all seven cities. Approximately 40% of the City of Oakland and the City of Sutherlin are impervious areas. More research is needed to determine the degree to which Sutherlin, Oakland, and other cities contribute to stream sediment.

Urban Growth Boundary	% of area commercial, industrial or residential	Dominant type of land use	Estimate of % total impervious area
Drain	76	Residential	36
Myrtle Creek	74	Residential	34
Oakland	88	Residential	38
Roseburg	75	Residential	42
Sutherlin	76	Residential	38
Winston	39	Residential	18
Yoncalla	93	Residential	48

Table 3-10: Dominant land use and estimated percent impervious area for seven cities in the central Umpqua Basin.[66]

[65] Impervious surfaces are ones that do not permit water infiltration, such as roads, roofs, and compacted soil.

[66] Barnes and Associates, Inc., provided the data in Table 3-10.

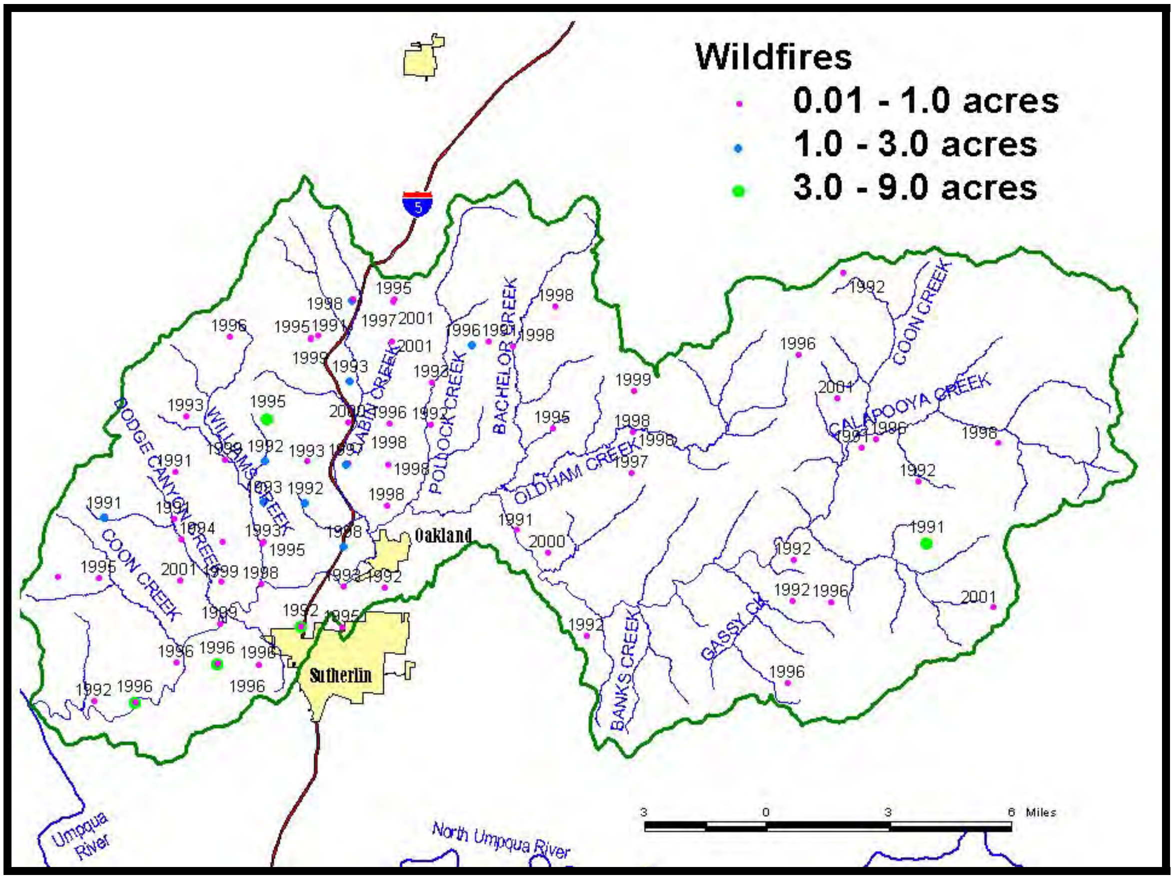
Burns

Burned areas erode more easily than unburned areas because of the lack of vegetative cover and abundance of ash and charred material. In the Calapooya Creek Watershed, the Douglas Forest Protective Association (DFPA) is responsible for issuing burn permits.

Table 3-11 shows the number of acres and piles for which burn permits were issued by DFPA from 1998 through 2001. Map 3-13 shows the location, years, and size of non-permitted (accidental) fires in the Calapooya Creek Watershed from 1991 through 2001. The UBWC was unable to locate quantitative data on burns/stream proximity and it therefore cannot evaluate the potential for stream sedimentation from burns.

Year	**Field acres**	**Debris piles**
1998	3,053.3	54
1999	2,389.0	71
2000	2,610.0	63
2001	1,449.8	86
TOTAL	**9,502.1**	**274**

Table 3-11: Number of acres and burn piles for which permits were issued from 1998 through 2001 in the Calapooya Creek Watershed.



Map 3-13: Wildfire location, year, and size in the Calapooya Creek Watershed.

3.3.8. Toxics

Toxics are a concern for residential fish and aquatic life and for drinking water. A variety of substances can be toxic, including metals, organic chemicals, and inorganic chemicals. Toxics are not defined by substance type, but rather by their effects on humans, fish, wildlife, and the environment. According to the ODEQ:

> Toxic substances shall not be introduced above natural background levels in the waters of the state in amounts, concentrations, or combinations [that] may be harmful, may chemically change to harmful forms in the environment, or may accumulate in sediments or bioaccumulate in aquatic life or wildlife to levels that adversely affect public health, safety, or welfare, [or are detrimental to] aquatic life, wildlife, or other designated beneficial uses (p. 22).[67]

Cook Creek, which flows through the part of the City of Sutherlin, is 303(d) listed for iron, lead, manganese, and copper (see Map 3-14). There is also evidence of mercury

[67] From ODEQ's *Oregon's Approved 1998 303(d) Decision Matrix*.

and arsenic contamination in Banks Creek, Foster Creek, and Calapooya Creek.[68] A general description of these toxics and ODEQ's water quality monitoring findings are provided below. Appendix 10 provides additional information about these toxics.

Metals

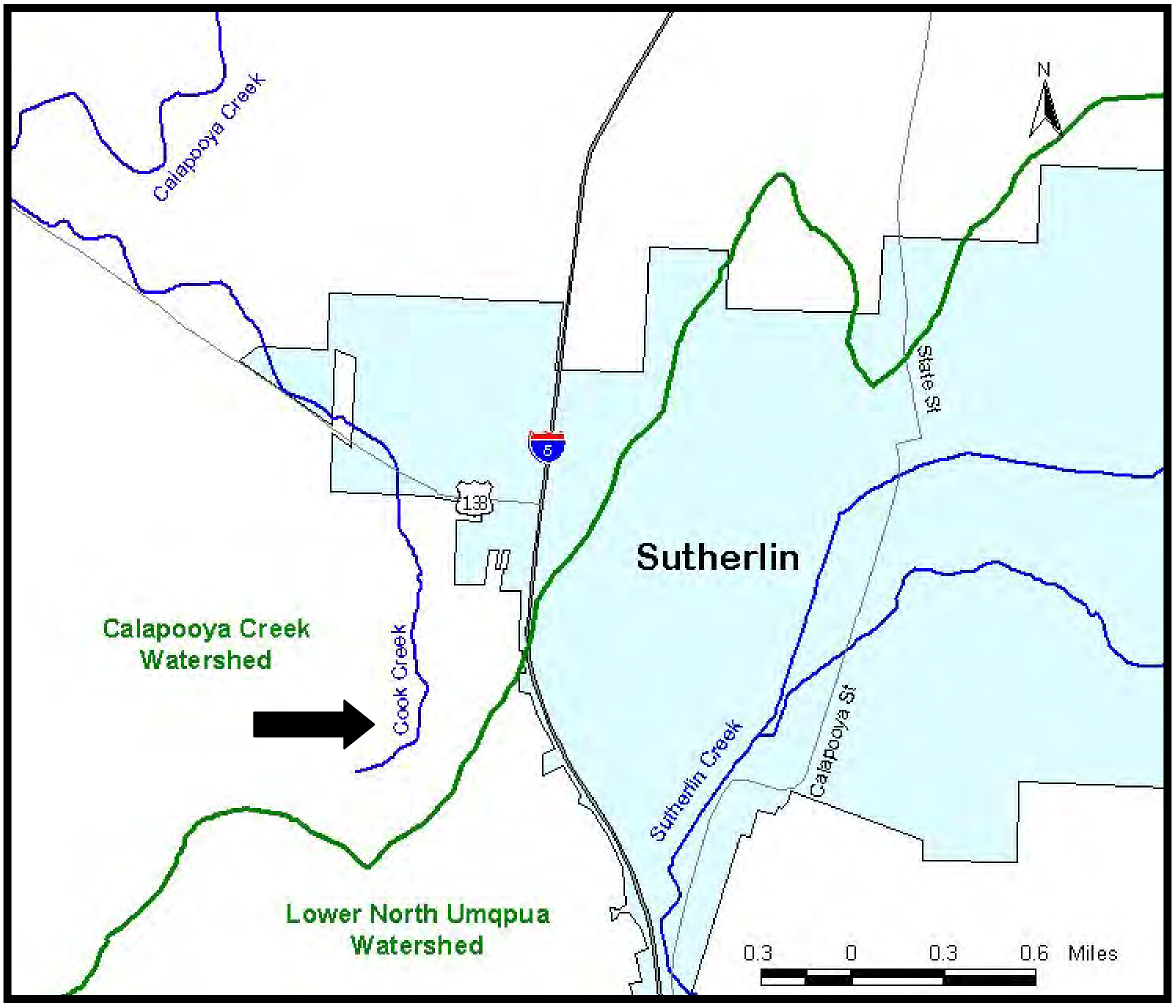
Iron, lead, manganese, and copper are all metals. Iron, manganese, and copper are trace elements required by plants and animals. Lead is not an essential element at any level. The beneficial uses affected by high levels of iron and/or manganese are fishing and drinking water. High levels of lead and/or copper affect resident fish and aquatic life. According to environmental toxicologists Hickey and Golding (2002):

> Metal pollution of streams and rivers is recognized as one of the major concerns for management of freshwaters. Although industrial and mining activities may be the most important sources of dissolved metals, urban runoff is an increasingly significant source. The chemical contaminant composition of urban runoff varies widely, including mixtures of metals and organics (e.g., polycyclic aromatic hydrocarbons), which together with suspended sediments and hydraulic stressors may adversely affect receiving-water communities. In addition, the bioavailability of metals in the receiving water is affected by numerous factors (e.g., pH, water hardness, and dissolved organic matter), which may modify toxicity in situ (p. 1854).

All of five Cook Creek samples exceeded acceptable levels for iron and manganese (300 μg/l and 50 μg/l, respectively).69 Two out of five Cook Creek lead and copper samples (40%) exceeded water quality standards, which are dependant on site-specific water hardness.

[68] Toxics listing criteria are from the ODEQ website http://www.deq.state.or.us. Select "water quality," "303(d)" list," "review the final 2002 303(d) list," and "search 303(d) list by waterbody name, parameter, and/or list date." Query the database by waterbody, parameter, listing status, and listing date.

[69] "μg/l" = micrograms per liter. A microgram is one millionth of a gram.



Map 3-14: Location of Cook Creek within the Calapooya Creek Watershed.

Mercury and arsenic

Mercury and arsenic are metal elements that are highly toxic in small quantities to humans, wildlife, and fish. The beneficial uses affected by mercury levels are fishing and residential fish and aquatic life. High arsenic levels are detrimental to fishing, drinking water, and resident fish and aquatic life.

According to ODEQ, mercury and arsenic occur naturally in Oregon soils, volcanic rocks, and geothermic water sources. Past mining activities appear to be contributing to mercury and arsenic levels in both the Calapooya Creek Watershed and in the neighboring Lower North Umpqua Watershed. In the Calapooya Creek Watershed, there were two mercury mines. The Nonpareil Mine, located on Foster Creek, was active from the late 1800s until 1932. The much larger Bonanza Mine, located on Banks Creek, was active from the late 1800s until 1960. Tailings from the Bonanza Mine were used to construct a Weyerhaeuser railroad grade; the grade is now Red Rock Road, which is not surfaced. Red Rock Road follows Calapooya Creek throughout most of the eastern half of the watershed.[70]

In 2000, ODEQ concluded that the Bonanza Mine is a significant source of mercury and arsenic contamination in Foster Creek, Banks Creek, and Calapooya Creek. Concentrations of mercury and arsenic in the soils at the Bonanza Mine site present a health risk to people living on the property. Red Rock Road's mercury and arsenic concentrations exceed safe levels for residential exposure. The road appears to be a potential source of continuous metal contamination to Calapooya Creek. Arsenic and mercury concentrations in creek sediments exceed water quality standards.

3.3.9. Water quality key findings and action recommendations

Temperature key findings

- Monitoring locations within the watershed indicate that streams within the Calapooya Creek Watershed frequently have seven-day moving average maximum temperatures exceeding the 64°F standard during the summer. High stream temperatures would limit salmonid rearing in these reaches.
- Warmer sites often lack shade. Increasing shade on small and medium-sized streams may improve overall stream temperature.
- Groundwater and tributary flows can contribute to stream cooling. Gravel-dominated tributaries may permit cooler subsurface flows when surface flows are low.
- Fish may find shelter from high summer temperatures in the lower reaches and mouths of small and medium-sized tributaries and in reaches within warm streams that have proportionately high groundwater influx and shade.

Surface water pH, dissolved oxygen, nutrients, bacteria, and toxics key findings

- Temperature and the levels of pH, nutrients, and dissolved oxygen are interrelated. In Calapooya Creek, pH and dissolved oxygen levels do not meet water quality standards. Nutrient monitoring indicates that phosphorus levels may be of concern. It is unknown if these parameters limit water quality in any tributaries.
- Bacteria levels at the mouth of Calapooya Creek do not meet water quality standards, which is a human health concern. Additional monitoring suggests that bacteria levels may also be a concern for other streams and stream reaches with the Calapooya Creek Watershed.
- Toxic metal levels, which are most likely from old mining sites, and urban and industrial runoff, are a concern for resident fish, aquatic life, and human health.

Sedimentation and turbidity key findings

- Turbidity data indicate that usual turbidity levels in Calapooya Creek do not impair sight-feeding fish like salmonids.
- Turbidity levels can be very high after a storm event. It is unknown if high, short-term turbidity levels are detrimental to salmonids or other aquatic life.

[70] From ODEQ Fact Sheets "Bonanza Mine Site November Update" and "Watershed Contamination: Arsenic and Mercury found in the Calapooya/Sutherlin Area."

- Soils prone to high rates of erosion due to low infiltration and high rates of runoff are located in the lower portions of the watershed.
- Developed areas within the watershed may impact water quality (i.e. runoff from roads and roofs). Improperly drained roads and poor land management practices can increase sediment loads to streams. In the Umpqua Basin, more studies are needed to determine the impacts of roads, culverts, landslides, burns, soil type, and urban conditions on sedimentation and turbidity.

Water quality action recommendations

- Continue monitoring the Calapooya Creek Watershed for all water quality conditions. Expand monitoring efforts to include 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 instream conditions by placing logs and boulders within the active stream channel to create pools and collect gravel.
- In very warm streams or where pH and/or dissolved oxygen are a problem, increase shade by encouraging wide riparian buffers and managing for full canopies.
- Identify and monitor sources of bacteria and nutrients in the watershed. Where applicable, reduce nutrient levels through activities such as:
  - Limiting livestock stream access by providing stock water systems and shade trees outside of the stream channel and riparian zones. Fence riparian areas as appropriate.
  - Relocating structures and situations that concentrate domestic animals near streams, such as barns, feedlots, and kennels. Where these structures cannot be relocated, establish dense and wide riparian vegetation zones to filter fecal material.
  - Repairing failing septic tanks and drain fields.
  - Using wastewater treatment plant effluent for irrigation.
  - Reducing chemical nutrient sources.
- Where data show that stream sediment or turbidity levels exceed established water quality standards, identify sediment sources such as urban runoff, failing culverts or roads, landside debris, construction or burns. Take action to remedy the problem or seek assistance through organizations such as the UBWC and Soil and Water Conservation Districts.
- In areas with high concentrations of group D hydrologic soils, encourage landowners to identify the specific soil types on their property and include soils information in their land management plans.
- Obtain comprehensive map coverage of the forest road system within the watershed and prioritize areas of concern based on road type, condition, and proximity to nearest stream. Use this information to target projects for improving road stability and drainage patterns.
- Use the Oregon Department of Forestry's debris flow hazard model to pinpoint areas that are naturally prone to erosion. Obtain the more refined debris flow data from Nature of the Northwest when published.

- Provide landowner education about water quality concerns and potential improvement methods:
  - Improving dirt and gravel road drainage to minimize sediment delivery to streams.
  - Enhancing soil infiltration by leaving vegetation litter on the ground after timber and crop harvests.
  - Planting bio-swales near streams in urban and suburban areas to catch urban runoff.
- Cooperate with the ODEQ as necessary to document and reduce contamination by toxics.

3.4. Water quantity

3.4.1. Water availability[71]

Data from the Oregon Water Resources Department (OWRD) has been used to determine water availability in the Calapooya Creek Watershed.[72] Availability is based on streamflow, consumptive use and instream water rights. The amount of water available for issuance of new water rights is determined by subtracting consumptive use and the instream water right from streamflow. The OWRD has divided the Calapooya Creek Watershed into eight sub-basins (water availability basins, or WABs) for the purpose of analyzing water availability.

Figure 3-9 shows surface water availability for western Calapooya Creek, Coon Creek, Cook Creek, and Burke Creek (WAB #289) in cubic feet per second (cfs). The solid yellow area is the average streamflow. The pink line represents the instream water rights. The dark blue line is the estimated consumptive use. In this watershed, average streamflow exceeds consumptive use all year except for the month of October, when consumptive use equals average streamflow. In other WABs, such as the one including Williams Creek (WAB #374), instream water rights exceeds average streamflow. Surface water availability graphs for other Calapooya Creek WABs are included in Appendix 11.

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[71] David Williams, the Oregon Water Resources Department Watermaster for the Umpqua Basin, contributed the text for section 3.4.1.

[72] Water availability data are available from the Oregon Water Resources Department web site http://www.wrd.state.or.us/.

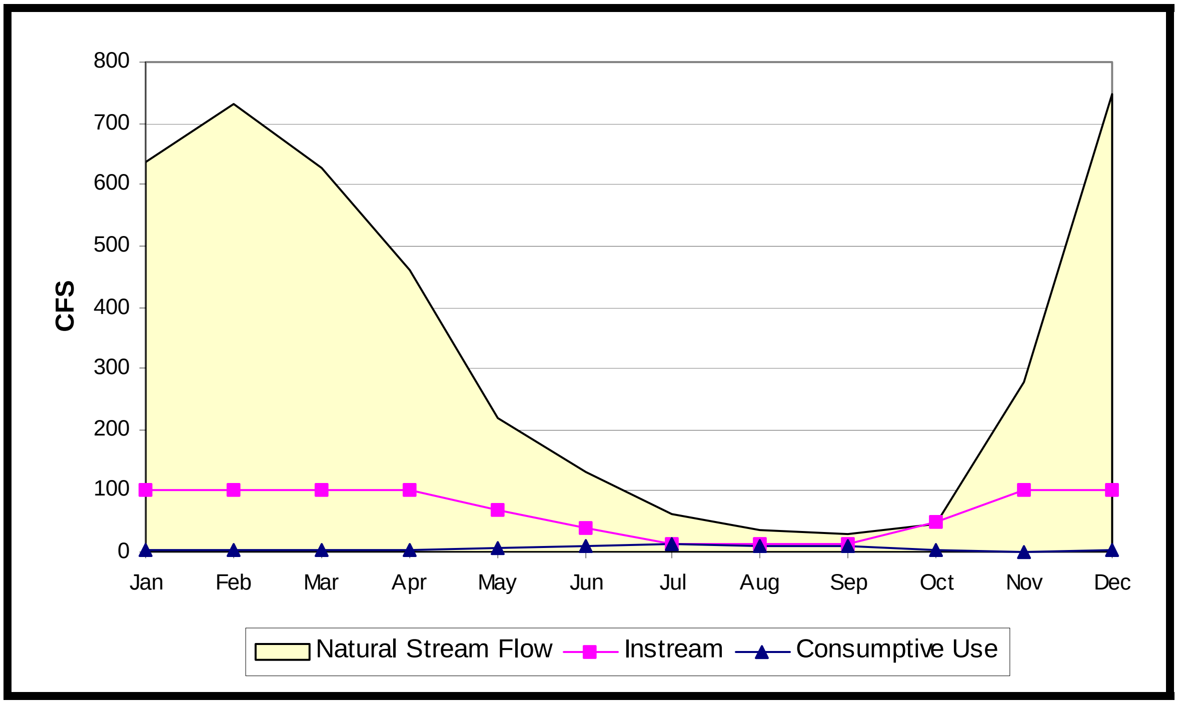


Figure 3-9: Water availability in the western Calapooya Creek WAB (#289).

Oregon law provides a mechanism for temporarily changing the type and place of use for a certificated water right by leasing the right to an instream use. 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 instream use counts as use under the right for purposes of determining forfeiture.

3.4.2. Water rights by use

Table 3-12 shows consumptive use by category for the Calapooya Creek Watershed.[73] Appendix 12 lists the possible uses included in each category. These records show uncanceled water rights and do not indicate actual water consumption.[74] Almost three-fourths of the water volume permitted for consumptive use comes from Calapooya Creek.

Irrigation is the largest use in the entire watershed (79% of total use), followed by municipal use (12%) and miscellaneous (3%). Irrigation is also the largest use for Calapooya Creek (77%), followed by municipal use (16%) and industry (5.5%). Landowners state that the industrial water rights on Calapooya Creek are not active. The largest uses of water for tributaries are irrigation (84%), miscellaneous (9.6%) and domestic (4%).

[73] Water rights data are available from the Oregon Water Resources Department web site http://www.wrd.state.or.us/.

[74] 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.

	Total Use		Calapooya Creek		Tributaries	
Source	Cubic feet/sec	Percent	Cubic feet/sec	% of C. Creek	Cubic feet/sec	% of tribs.
Irrigation	39.66	78.8%	28.12	76.8%	11.54	84.0%
Fish/WL	0.02	<0.1%	0.01	<0.1%	0.01	<0.1%
Agriculture	0.46	0.9%	0.21	0.6%	0.25	1.8%
Industry	2.0	4.0%	2.0	5.5%	0.0	-
Municipal	6.0	11.9%	6.0	16.4%	0.0	-
Domestic	0.8	1.6%	0.28	0.8%	0.52	3.8%
Recreation	0.0	-	-	-	-	-
Misc.	1.42	2.8%	0.1	0.3%	1.32	9.6%
Total	50.36	100.0%	36.63	100.0%	13.73	100.0%

Table 3-12: Water rights by use for the Calapooya Creek Watershed.

3.4.3. Stream flow and flood potential

There are two US Geological Survey (USGS) stream gauges in the Calapooya Creek Watershed. The gauge on Calapooya Creek near Oakland (# 14320700) was active from 1955 through 1973, and then from 1986 until the present. The gauge on Gassy Creek near Nonpareil (# 14319850) has been active since 1988. Figure 3-10 and Figure 3-11 chart the monthly average stream flows for both creeks. Appendix 13 shows minimum and maximum streamflow by month and the dates they occurred. As would be expected from climate data in section 1.2.6, precipitation is greatest during the winter months. During the summer, Calapooya Creek's flow can drop below 10 cfs. Gassy Creek can have zero flow, which means there is no moving surface water, although pools may be present.

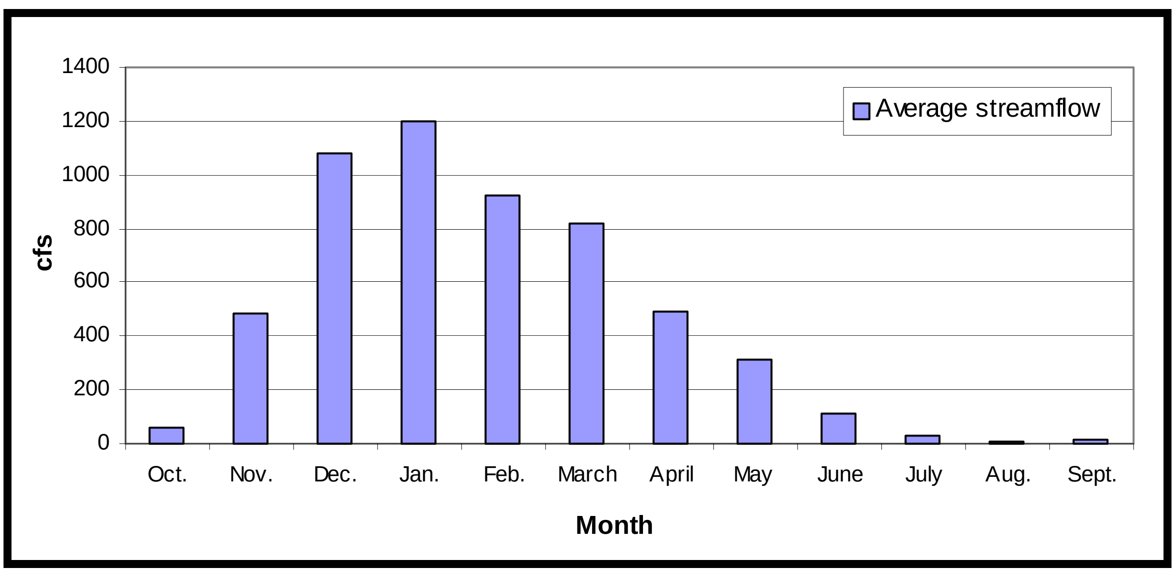


Figure 3-10: Average monthly streamflow for Calapooya Creek near Oakland.

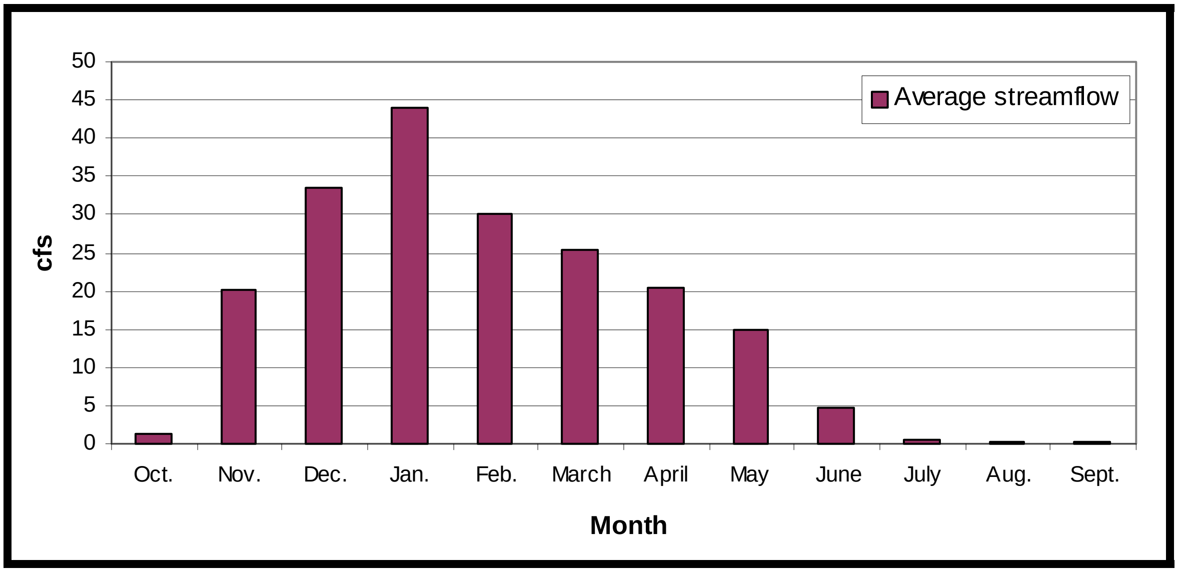


Figure 3-11: Average monthly streamflow for Gassy Creek near Nonpareil.

Figure 3-12 shows the peak flows for data collected from 1955 through 2000 for Calapooya Creek near Oakland. The highest peak events are in 1961 and 1996 (26,600 cfs and 27,100 cfs, respectively). Data has not been collected long enough to determine flood
trends.

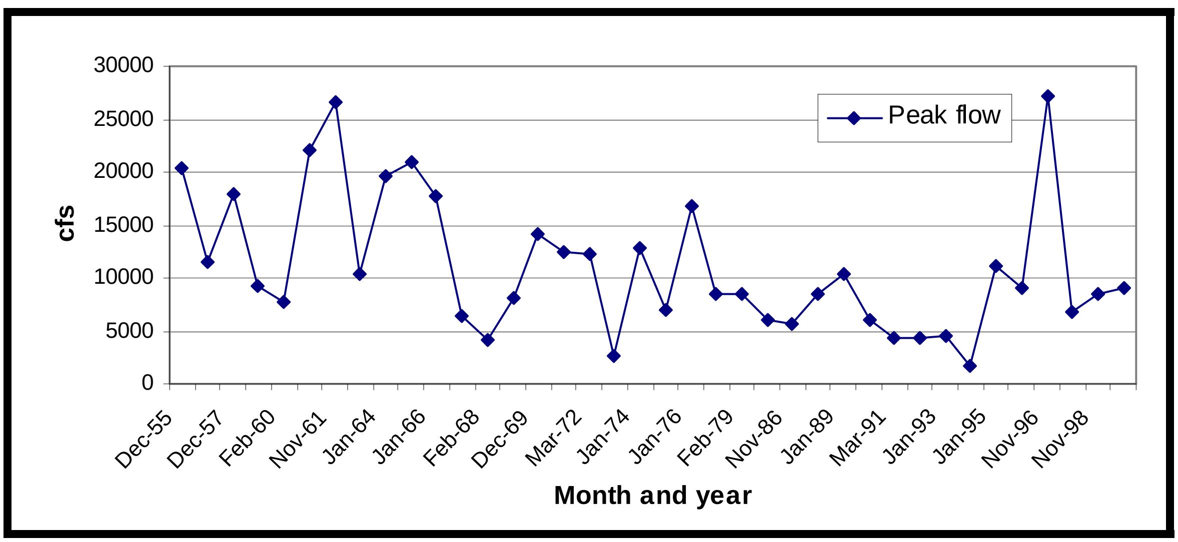


Figure 3-12: Peak flow for Calapooya Creek near Oakland.

Potential influences on flood potential

Approximately 22% of the Calapooya Creek Watershed is within the transient snow zone (TSZ) (see Map 1-8 on page 23). In the TSZ, snow can accumulate in areas with open canopies such as meadows, burned areas, or timber harvest units. When warmer rain falls on the accumulated snow, the snow quickly melts and can result in high runoff levels and peak streamflows. Streams with headwaters in the TSZ zone, such as South Fork Calapooya Creek, are more susceptible to rain-on-snow events than lower elevation streams.

Road density can also influence peak flows. Table 3-13 shows the miles of road per square mile for surfaced and unsurfaced roads. Paved roads are impermeable to water, and rock or dirt roads are somewhat permeable. When it rains or accumulated snow on road surfaces melts, water that is not absorbed will flow off the road. The soil and vegetation surrounding the road may absorb the runoff. If the surrounding area is unable to absorb the excess water, and if the road is close to a stream, then the excess water flows into the stream, resulting in high peak flows. It is important to note that the relationship between roads, streams, and peak flows is dependent on many factors, and the influence of roads on stream flow and peak events is debatable.

Road type	Road miles/ square mile
Paved	1.0
Gravel	3.2
Dirt	0.5
Total	4.7

Table 3-13: Miles of road per square mile for surfaced and unsurfaced roads in the Calapooya Creek Watershed.

3.4.4. Water quantity key findings and action recommendations

Water availability and water rights by use key findings

- In some WABs, instream water rights and consumptive use is close to or exceeds average streamflow during the summer months.
- The largest uses of water in the Calapooya Creek Watershed are irrigation, municipal uses, and miscellaneous uses.
- It is not unusual for Calapooya Creek's flows to be less than 10 cfs. Gassy Creek can have zero flow, which means there is no moving surface water.

Stream flow and flood potential key findings

- No flooding trends can be determined from the records to date.
- The degree to which road density and the TSZ influence flood potential in the Calapooya Creek Watershed is unknown at this time.

Water quantity action recommendations

- Reduce summer water consumption through instream water leasing and by improving irrigation efficiency.
- Continue monitoring peak flow trends in the watershed. Try to determine the role of vegetative cover, flooding, road density, and the TSZ on water volume.
- Educate landowners about proper irrigation methods and the benefits of improved irrigation efficiency.

3.5. Fish populations

3.5.1. Fish presence

Table 3-14 lists the fish species in the Calapooya Creek Watershed that have viable, reproducing populations or annual runs. Warm water fish, including largemouth bass (*Micropterus salmoides),* smallmouth bass (*Micropterus dolomieu*), and yellow perch (*Perca flavescens*) have also been reported in the watershed. These fish are most likely introduced to watershed streams from private ponds, or have migrated into the watershed from the Umpqua River during the summer months. Calapooya Creek stream temperatures generally prevent these species from establishing reproducing populations.

The Oregon Coast coho salmon was listed as a threatened species in 1998 under the Endangered Species Act of 1973. Currently, there are no other threatened or endangered aquatic species in the Calapooya Creek Watershed. In January, 2003, various groups petitioned to protect the Pacific lamprey and western brook lamprey, as well as two other lamprey species, under the Endangered Species Act.

Common Name	***Scientific Name***
Steelhead (winter)	*Oncorhynchus mykiss*
Coho	*O. kisutch*
Chinook (fall)	*O. tshawytscha*
Cutthroat trout	*O. clarkii*
Umpqua chub	*Oregonichthys kalawatseti*
Western brook lamprey	*Lampetra richardsoni*
Pacific lamprey	*Lampetra tridentata*
Umpqua dace	*Rhinicthys cataractae*
Sculpin	*Cottus sp.*
Redside shiner	*Richardsonius balteatus*
Speckled dace	*Rhinicthys osculus*
Umpqua pike minnow	*Ptychocheilus oregonensis*
Largescale sucker	*Catostomus macrocheilus*

Table 3-14: Fish species with established populations or runs within the Calapooya Creek Watershed.

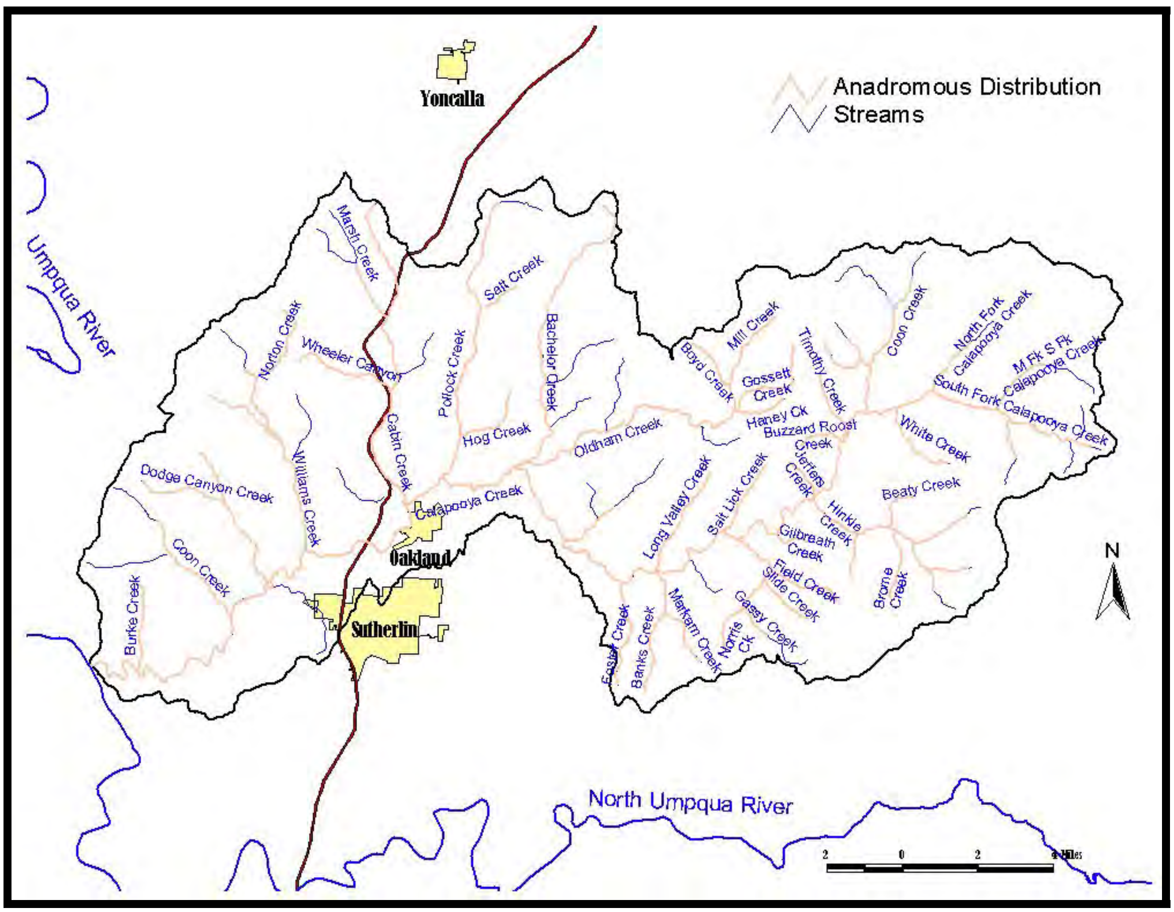
3.5.2. Fish distribution and abundance

Information on fish distribution and abundance within the Calapooya Creek Watershed is limited to salmonids. Although non-salmonid fish species are important as well, there are insufficient accessible data on the location of these types of fish, and they could not be included in the assessment. More information about these species may be available in the future.

Anadromous salmonid distribution

The Oregon Department of Fish and Wildlife (ODFW) has developed anadromous salmonid distribution maps based on fish observations, assumed fish presence, and habitat conditions. Fish observations are the most accurate because ODFW personnel have seen live or dead fish in the stream. With assumed fish presence, streams or reaches are included in the distribution map because of their proximity to fish-bearing streams and adequate habitat. Also included on the map are streams that appear to have adequate habitat for a given salmonid, even if there have been no fish sightings and the stream is not near a fish-bearing stream. As of January, 2002, ODFW was in the process of revising the salmonid distribution maps to distinguish observed fish-bearing streams from the others. It is possible that some streams have been included in the distribution maps that do not have salmonid presence.

According to ODFW, coho and winter steelhead use 170.5 stream miles within the Calapooya Creek Watershed. Map 3-15 shows the distribution of these anadromous salmonids within the watershed and lists the miles of stream used by each species. Total stream miles with anadromous salmonids does not equal the sum of miles used by each species because many species overlap (see Appendix 14). Coho and winter steelhead use many of the same stream reaches but at different times of the year.



Map 3-15: Anadromous salmonid distribution within the Calapooya Creek Watershed.

	Total	Fall chinook	Coho	Winter steelhead
Miles	170.5	24.8	147.9	160.2

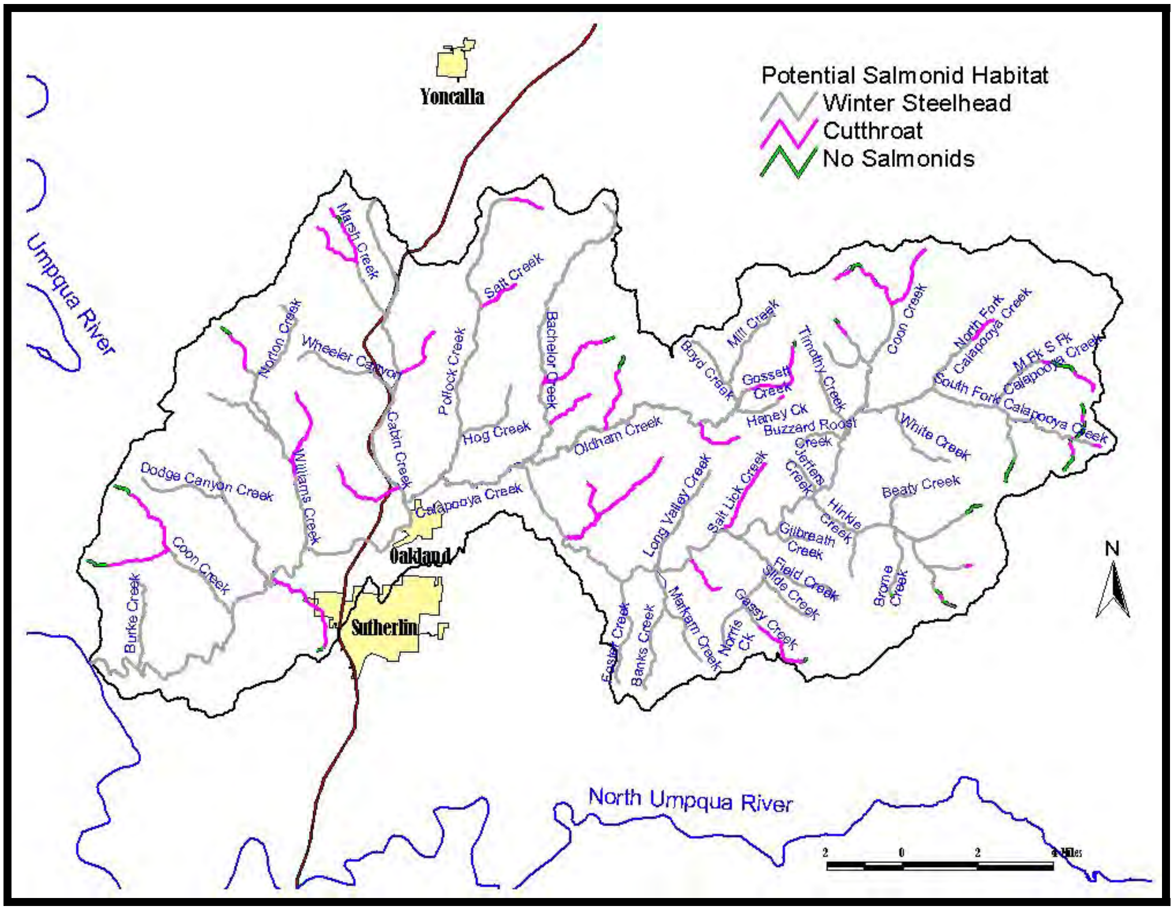
Table 3-15: Miles of stream supporting anadromous salmonids in the Calapooya Creek Watershed.

Resident salmon distribution

There are no comprehensive data about resident salmonid distribution in the Umpqua Basin. ODFW is compiling regional data and will develop maps indicating fish presence by stream. However, the project will not be completed until after this assessment is complete.

The only resident salmonid in the Calapooya Creek Watershed is the cutthroat trout. Although there is much overlap, anadromous salmonids generally prefer streams with a 0% to 4% gradient, whereas resident cutthroat trout prefer streams with a 4% to 15% gradient. Also, cutthroat are generally found beyond the range of winter steelhead.[75] Map 3-16 shows streams with gradients that are less than 15% and are beyond winter steelhead distribution. Streams such as the upper reaches of Marsh Creek may provide suitable habitat for cutthroat trout. However, there are many factors other than stream gradient that determine fish habitat suitability.

[75] From Dave Harris, fish biologist, Oregon Department of Fish and Wildlife, Roseburg District Office.

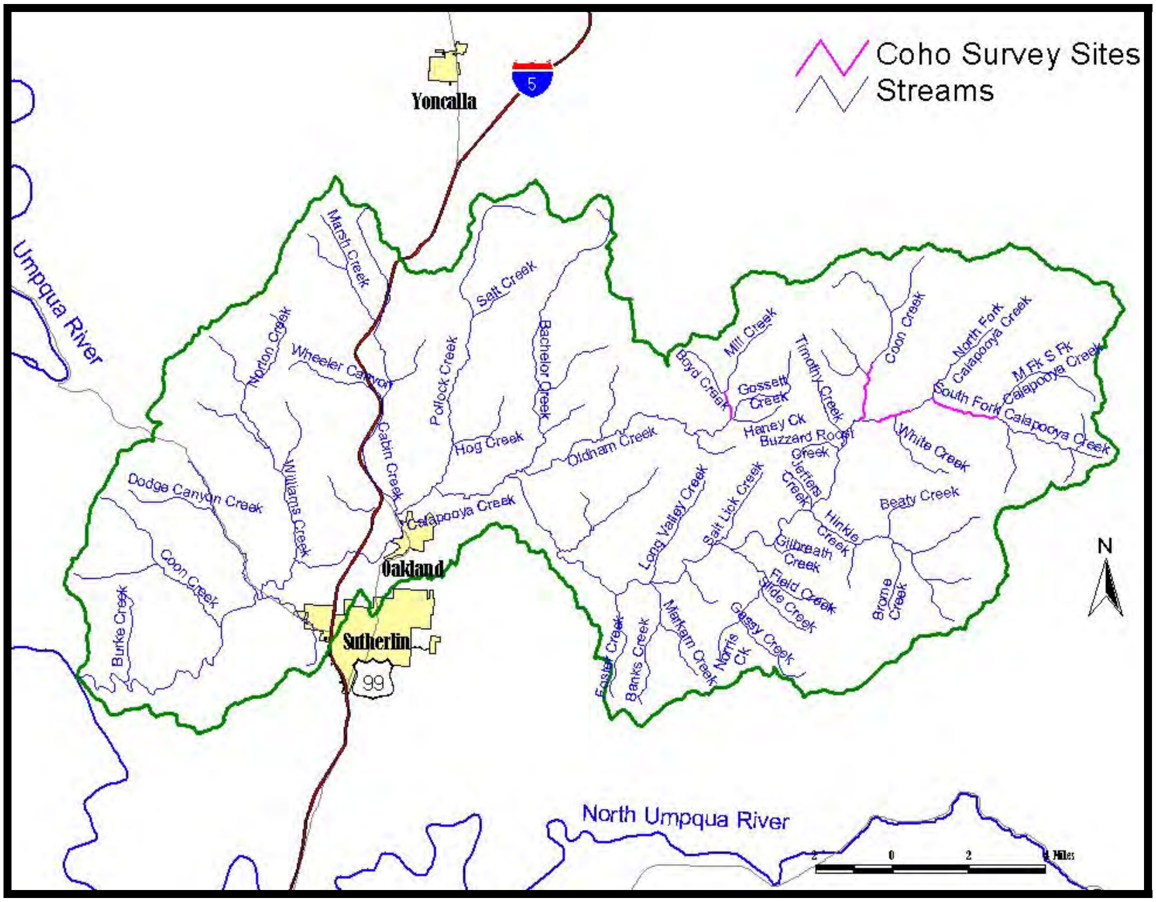


Map 3-16: Potential resident and anadromous salmonid habitat in the Calapooya Creek Watershed.

Coho abundance

Fish abundance is difficult to assess in the Calapooya Creek Watershed. Available data in the Calapooya Creek Watershed focuses on coho spawning. It was not possible to locate abundance data for resident salmonids.

ODFW conducts coho spawning surveys throughout the Umpqua Basin. Volunteers and ODFW personnel surveyed 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. There are coho spawning data for the Calapooya Creek Watershed from 1990 through 1999. Map 3-17 shows the surveyed stream reaches.



Map 3-17: Calapooya Creek Watershed coho spawning survey locations.

Figure 3-13 shows the maximum number of live and dead coho seen per mile on a given day. Volunteers conducted most of the surveys; these are labeled with a "V." ODFW personnel surveyed three streams on different years. For these streams, the estimated total number of coho per mile is included as a red bar next to peak per mile count. These estimates are based on a mathematical formula that has limitations; the total estimated number of adults for Calapooya Creek in 1999 is less than the peak per mile count.

Coho spawning within individual streams fluctuates annually. South Fork Calapooya Creek had no coho observed in 1992 but eight coho per mile in 1996. Coon Creek is the only survey site that had coho every year, whereas surveyors in Norton Creek never saw coho. Note that according to Appendix 14, Norton Creek is within the coho's distribution. Spawning returns fluctuate annually, and it is possible that some coho were present in this stream in years other than the survey years. More monitoring data are needed to draw conclusions about coho spawning in the watershed.

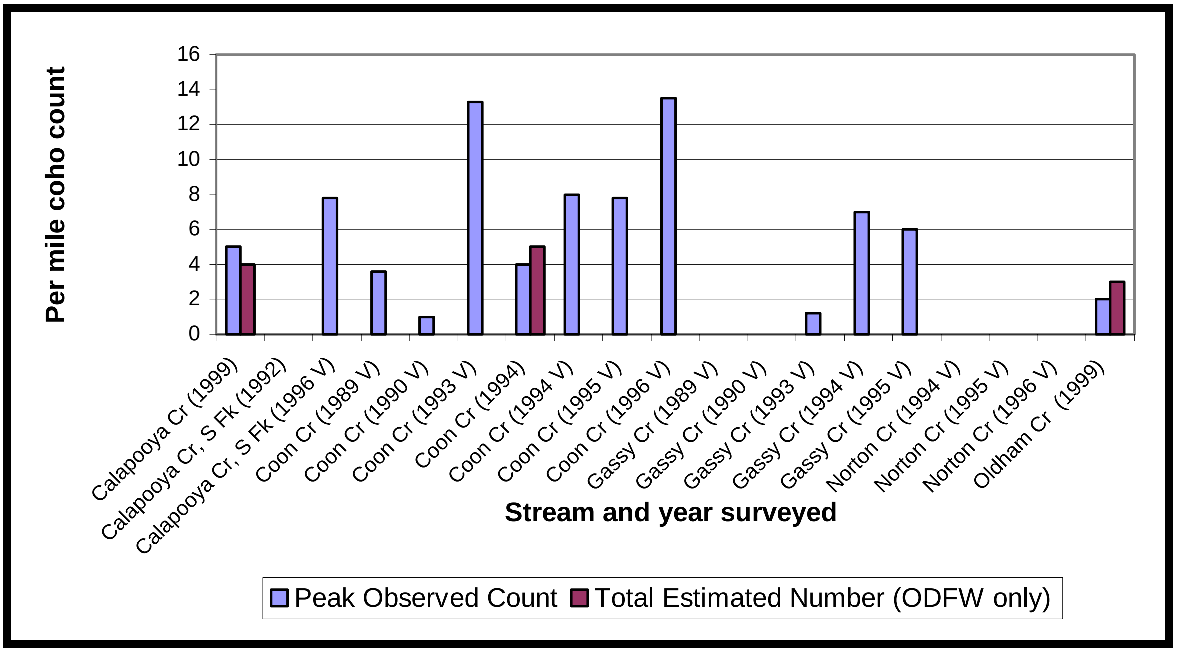


Figure 3-13: Calapooya Creek Watershed coho spawning surveys from 1989 through 1999.

3.5.3. Salmonid population trends

According to Dave Harris of the Oregon Department of Fish and Wildlife, adult salmonid returns throughout the Umpqua Basin have increased from 1998 to 2002. This trend is due 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 favor 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 freshwater events.

Activities that improve freshwater conditions for salmonids will also help increase fish runs. These activities include removing barriers to fish passage, increasing instream flows, and improving critical habitat in streams and estuaries. It is also important to continue gathering data about salmonids and educating the public.

3.5.4. Fish populations key findings and action recommendations

Fish populations key findings

- The anadromous fish species in the Calapooya Creek Watershed are coho, winter steelhead, fall chinook, and lamprey. Although many Calapooya Creek Watershed medium and large tributaries are within the distribution of one or more salmonid species, salmonid ranges have not been verified for each tributary.
- More quantitative data are needed to evaluate salmonid abundance and the distribution and abundance of non-salmonid fish in the watershed.
- Temperature limits largemouth bass, smallmouth bass, and other non-native species to the North Umpqua River, but these species may occasionally enter the mouth of

Calapooya Creek. Other non-natives have been accidentally or intentionally introduced to the watershed, but have not established reproducing populations.

- Umpqua Basin-wide data indicate that salmonid returns have improved. Although ocean conditions are a strong determinant of salmonid run size, improving freshwater conditions will also increase salmonid fish populations.

Fish populations action recommendations

- Work with local specialists and landowners to verify the current and historical distribution of salmonids in tributaries.
- Support salmonid and non-salmonid distribution and abundance research activities in the watershed, especially at the local level.
- 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. The non-industrial private landowners 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[76]

4.2.1. The City of Oakland[77]

The City of Oakland is the only incorporated city located entirely within the Calapooya Creek Watershed. The city's population growth rate has been running between 0.5% and 1.0% per year. According to the 2000 Census, the population of Oakland was 954 people. Assuming a 1.0% growth rate, the 2002 city population is approximately 973 people.[78]

Limiting factors for city growth

Local observation suggests that many central Douglas County residents and newcomers consider Oakland a very desirable place to live. The school district has an excellent reputation, the entire downtown is a National Historical District, and the city is a short drive to Sutherlin and Roseburg. Why doesn't the city have a higher growth rate?

Unlike other surrounding communities, the City of Oakland is not actively pursuing strategies to attract more industries or residents to the area. This is partially due to the topography of the area. There are few large, level building sites available. Currently, the

[76] 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.
[77] This information is primarily from an interview with Paul Tamm, past mayor and former member of the City of Oakland's planning commission.
[78] At a 0.5% growth rate, the city's 2002 population is estimated to be 964 people.

city has one light industrial site and two general industrial development sites within the urban growth boundary (UGB).[79] There are tentative plans to develop one of the general industrial sites into a recreational vehicle (RV) park.

Within the narrow valley where the city is located, residential building sites are small and scattered compared to those available in other neighboring cities. The only new multi-home residential development is to the west of the city, and has sold a small number of lots. The slow sales rate may be due to the development's high lot prices compared to lots available in other cities.

Another factor possibly affecting the growth rate is that the city's wastewater treatment plant and water treatment facilities are near capacity, which limits the number of new connections that can be made each year. Currently, the wastewater treatment plant is being replaced. A new water treatment facility is being designed, but, to date, funding has not been secured for the construction of a new water treatment plant. During low summer flows, some residents within the UGB now have water shortages.

Current trends and future conditions

It is unlikely that a large industry will establish itself in Oakland. However, the city's historical downtown is well known for its antique stores, and tourism in the area is increasing. Although the City of Oakland is not actively trying to encourage tourism, some residents expect that the number of visitors to the city will continue to grow. Should the proposed 53-acre RV park be built, it could attract more long-term visitors to the Oakland area. A large population of temporary visitors may bring more business and services to the area, such as restaurants, specialty shops, another gas station, and the return of a bank.[80]

The City of Sutherlin's proposed Korean car manufacturing plant could bring significant changes to Oakland.[81] Although the proposed plant would be built within Sutherlin's UGB, the plant would be physically closer to Oakland than Sutherlin. There is currently no convenient I-5 route from Sutherlin to the proposed plant site and back. It is very likely that some plant employees would prefer to live in Oakland, where the commute would be short and easy. The City of Oakland would be under no obligation to accommodate an increased housing demand. However, if Oakland would like to take advantage of this potential population influx, and the businesses it would attract, the city will need to upgrade its water treatment facility and consider enlarging the UGB.

Another trend that could impact the City of Oakland is the "home occupation" issue. As with many cities in Oregon, Oakland currently allows only businesses with no employees to conduct activities in a residential zone. Recently, Oakland residents have lobbied to

[79] The corporate city limit is the boundary where the city officially ends. The urban growth boundary delineates the area that sometime in the future will be annexed into the city to accommodate its 20-year projected population growth. Some of the land within the urban growth area has access to city services like water and sewer; however no new developments are being allowed to connect to the City's systems.
[80] Currently, there is no bank and only one gas station within the Oakland UGB.
[81] See section 4.2.2 on page121.

allow businesses with up to four employees to work in residential zones. There are no other cities in Oregon that allow businesses of that size to work in residential areas. As such, it is difficult for Oakland to assess the ramifications of such a change to its zoning code. To minimize impacts on Oakland neighborhoods, the new zoning regulations would limit the types of businesses that could operate in a residential area. There are some residents and city officials who fear that changing the zoning laws in this way is "opening a can of worms," the outcome of which will be difficult to predict.

4.2.2. The City of Sutherlin[82]

The City of Sutherlin was one of the fastest growing cities in Oregon during the last decade. While the official projected growth rate was a relatively quick 2.7% per year, the Center for Population Studies in Portland estimates the city's growth rate was closer to 3.6% per year. According to the most recent US Census, the City of Sutherlin's 2000 population was 6,669 people. Assuming a 2.7% growth rate, the 2002 population is 7,034 people.[83]

Population growth

Interestingly, the City of Sutherlin's rapid growth rate is not a result of increasing job opportunities in the area. Over the past 10 years, the city has experienced only a modest amount of industrial development. Rather, Sutherlin's growth is due to its abundance of relatively inexpensive developable land compared to neighboring cities.[84] As such, Sutherlin has become a popular home for retirees and for people who work in the Roseburg area and, to a lesser extent, Eugene.

Partially due to the growing influx of retirees to the City of Sutherlin, city officials estimate that in 2002 more than 20% of Sutherlin's residents were over 65 years old. Local observation suggests that most of these people are retired, and many are from outside the Douglas County area. As the retired population has increased, so have housing developments that cater to this group. Local observation suggests that developments originally built to attract retirees often end up also housing families with children. In some cases, the developments are not "child-friendly" because they lack access to playgrounds and parks. Some think that Sutherlin's older population precludes the need for more parks. However, the retired population is often commingled with younger families, and some city officials believe that more child-friendly outdoor facilities are needed throughout the city.

The City of Sutherlin expects its population to continue to grow at a relatively high rate. The city will focus on developing within the city boundaries. Currently, there are 250 housing units being developed within Sutherlin that the city expects will be occupied in 10 years or less. However, the city's development community will continue to look

[82] This information is primarily from an interview with Eric Fladagar, Planner for the City of Sutherlin.
[83] At a 3.6%, the city's 2002 population is estimated at 7,158 people.
[84] The Sutherlin area is less hilly than Roseburg, Oakland, and other neighboring cities, which reduces homebuilding costs.

ahead for other potential sites within the city's urban growth boundary (UGB) and beyond.[85]

Industrial development

ATT R&D

The City of Sutherlin is actively trying to attract more industry and businesses to the area. The city has recently included 200 acres in its UGB that are zoned industrial. The new industrial zone is north of the city and west of I-5 and was added as part of the city's negotiations with ATT R&D, a Korean car manufacturing company. If all goes well, ATT R&D will use 100 acres to build factories that produce two types of electric vehicles; cars targeted at consumers in high air-pollution areas and cart-like vehicles for use in airport and large industrial or commercial areas. These new factories would employ up to 600 employees, of which many could be hired locally. When negotiations are finalized, it is very likely that the factories would attract additional business to the Sutherlin area. The remaining 100 acres of industrial land adjacent to the proposed ATT R&D factory site would attract co-location businesses that provide materials or services to ATT R&D.

Sutherlin Enterprise Zone Development and Wetlands Plan

Sutherlin is also trying to attract employers to the city's other industrial site, located in the southern part of the city between I-5 and highway 99. Wetlands are currently a barrier to developing this area, so the city is working to develop a *Sutherlin Enterprise Zone Development and Wetlands Plan*. This plan hopes to:

> …balance the competing demands of economic development and wetlands conservation in the economically distressed community of Sutherlin by designating suitable building sites within a network of created and natural wetlands. By planning for the coexistence of employment growth and wetlands in the industrial and commercial areas of Sutherlin, this innovative plan will allow multiple objectives to be met in a coordinated and cooperative fashion (p. 1).

The plan will coordinate seven projects aimed at increasing economic growth while conserving wetlands and open spaces, creating recreational opportunities, and reducing flood potential in the city. The projects include extending sewer lines within the city's industrial areas, completing a storm water modeling study, mapping proposed development sites, and developing a health and nature trail along Sutherlin Creek. Currently, the City of Sutherlin is seeking grant funding for the different facets of this plan.

City services

The City of Sutherlin has water rights on Cooper Creek, Cooper Creek Reservoir, Calapooya Creek, and the Umpqua River. During the 2002 summer drought, the city did

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[85] The corporate city limit is the boundary where the city officially ends. The urban growth boundary delineates the area that sometime in the future will be annexed into the city to accommodate its 20-year projected population growth.

not pump its full water right from Cooper Creek, primarily due to its higher treatment cost. The city is considering piping water from the Umpqua River to Sutherlin, but there are no designs for this plan.

The city has one wastewater treatment plan and two water treatment facilities (one located in Nonpareil and one near Cooper Creek Reservoir). While the wastewater plant is currently adequate, the water treatment facility at Cooper Creek Reservoir needs to be upgraded to be able to cost-effectively treat the City's full water right out of Cooper Creek. The city is currently working on plans for this project.

The future of Sutherlin
As with other cities, decreasing revenues due to tax-limiting measures will impact the city. All of the city's current, proposed, and future development activities cost money. Without sufficient revenue, it will be difficult for the City of Sutherlin to continue improving the city. Economics will continue to impact the City of Sutherlin. Like much of Douglas County, Sutherlin is considered to be an economically distressed area, and regional or national changes in the economy that result in further job losses would make matters worse.

The outcome of the ATT R&D negotiations will impact the future of the city. Should negotiations fail, the city will try to attract other industries to the area. If the plant goes through, then Sutherlin is looking at a tremendous economic boon for the city. However, should, in the future, the market for ATT R&D's electric cars diminish or disappear, then the city may again find itself in economic distress.

4.2.3. Agricultural landowners[86]

Farmers in the Umpqua Basin/Douglas County area produce a variety of agricultural goods, including corn, beans, alfalfa, peaches, strawberries, filberts, and grapes for wine. Livestock operations mostly raise beef cattle and sheep, with a small number of poultry operations.[87] One-third of the Calapooya Creek Watershed is zoned for agriculture (see Map 1-9 on page 24). Almost all agricultural lands are privately held and most are located in valleys and lowlands.[88] The agricultural community could potentially have the greatest influence on fish habitat and water quality restoration efforts in the Umpqua Basin. Barriers to farmer and rancher participation in fish habitat and water quality activities are limited time, limited money, and in many cases low awareness or understanding of restoration project requirements, benefits, and funding opportunities.

Agricultural producers
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

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[86] The following information is primarily from interviews with Tom Hatfield, the 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.
[87] There are people who raise pigs, dairy cows, horses, llamas, and other animals, but few are commercial operators.
[88] Many farmers and ranchers are also forestland owners (see section 4.2.4).

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 operators are continuing to expand their land base. At the same time, smaller operators who hold outside jobs and agricultural hobbyists are becoming more common.

Factors influencing farmers and ranchers

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.[89] 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 constantly battle weeds every year. As a result, an enormous amount of time, effort, and money is invested for weed management, which reduces profits and can drive smaller operators out of business.

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.[90] Prior to the 1960s, the US Department of Agriculture (USDA) handled all predator management in Douglas County. The county took over all predator control programs in the 1960s until 1999. Now, the USDA once again handles all predator management.

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[89] Tansy ragwort is less common today than ten years ago due to the introduction of successful biological control methods.

[90] 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, which is due, in part, to changes in predator control regulations.[91] 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, which are 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.

Contrary to popular belief, predators do not only kill for food. Local ranchers have lost dozens of sheep and cattle overnight to a single cougar. In these cases, only a few of the carcasses had evidence of feeding, which indicates that the cougar was not killing livestock for food. Small animals like sheep are easy prey, so some ranchers are switching to cattle. However, local observation indicates that cougar, bears, and packs of coyote are quite capable of killing calves and adult cattle as well.

Loss of quality farmland

Due in part to the difficulties facing today's ranchers and farmers, many young people are favoring other careers over agriculture. As a result, many agricultural lands are sold out of the original families. In some cases, the land is purchased by other nearby farmers and ranchers, and remains in production.[92] Local observation suggests that new residents from outside of southwest Oregon purchase some of these agricultural lands. In the case of smaller operations, new owners are often unable to turn a profit. Some residents suggest this may be because the newcomers do not understand local conditions or the specific needs of the property and are therefore unable to manage it profitably. In other cases, family farms and ranches are purchased by developers and divided into smaller lots for hobby farms, or converted into residential developments and taken out of production entirely. Statewide, there were 18.1 million acres of farmland in 1980; this number dropped to 17.2 million acres in 2000. This averages to be a loss of 45,000 acres of Oregon farmland per year.[93]

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

[91] Cougar populations have been increasing since protection laws were passed in the 1960s. Coyote, fox, bobcat, and other predator populations appear to be stable.

[92] The topography of the Umpqua Basin makes this area undesirable to large agricultural conglomerates.

[93] Data are from the 2000-2001 Oregon Agriculture and Fisheries Statistics publication compiled by the US Department of Agriculture. A farm is defined as a place that sells or would normally sell $1,000 worth of agricultural products.

restricted use of pesticides, fertilizers, and other products. More regulations could further increase production costs and reduce profits.

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 no 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 below production costs. As a result, it is very difficult for all but the very largest producers to compete with foreign agricultural goods, unless they are able to circumvent the open market by selling their goods directly to local or regional buyers ("niche" marketing).

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 replace profitable family farms and ranches.

4.2.4. Family forestland owners[94]

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 approximately 100,660 forested acres in the watershed, approximately 35% are non-industrial 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-

[94] 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). For more information about this document, contact Wally Rutledge, Secretary of the Committee for Family Forestlands, Oregon Department of Forestry, 2600 State Street SE, Salem, OR 97310.

aged conifers, hardwood stands, and non-forested areas such as rangeland. Family forestland owners are more likely to manage their property 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 and provide critical spawning habitat for salmonids. As such, issues affecting family forestland property management may impact fish habitat and water quality restoration efforts.

Family forestland owners

Who are Douglas County's family forestland owners? In Oregon, most family forestland owners are older; nearly one in three are 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.

Factors influencing family forestlands

<u>Changing markets</u>

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 reevaluate 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, and so family forestland owners have little financial incentive to grow large diameter trees.

Another aspect of globalization is a growing interest in certified wood products as derived from sustainably managed forests. Many family forestland owners follow the Oregon Forest Practices 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.[95] Should the market for livestock remain low, it is likely that more pastureland will be converted to timber.

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.

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 property 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.

Succession/inheritance

Succession is a concern of many family forestland owners. It appears that most forestland owners would like to keep their 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 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.

[95] 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.

4.2.5. Industrial timber companies[96]

Most industrial timberlands are located in areas that favor Douglas-fir, which tend to be hillsides and higher elevations.[97] Higher gradient streams provide important habitat for cutthroat trout. Riparian buffer zones in stream headwater areas may influence stream temperatures in lower gradients.

In the Calapooya Creek Watershed industrial timber companies own 53,732 acres, which is 53% of the total forested area in the watershed. 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.[98] 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 and are modified 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.

Current land management trends

<u>Land acquisition</u>

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.

<u>Weeds</u>

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, which add 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.

<u>Fire management</u>

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

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[96] 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 and President of the Umpqua Chapter of the Society of American Foresters.

[97] Hillsides and higher elevations are often a checkerboard ownership of Bureau of Land Management administered lands (see section 4.2.6) and industrial timberlands.

[98] 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.

decay. 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.

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, such as replacing failing culverts 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.

Community outreach

The population of Douglas County is growing. Local observation suggests that many new residents are retirees or transfer incomes from urban 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.

Regulations

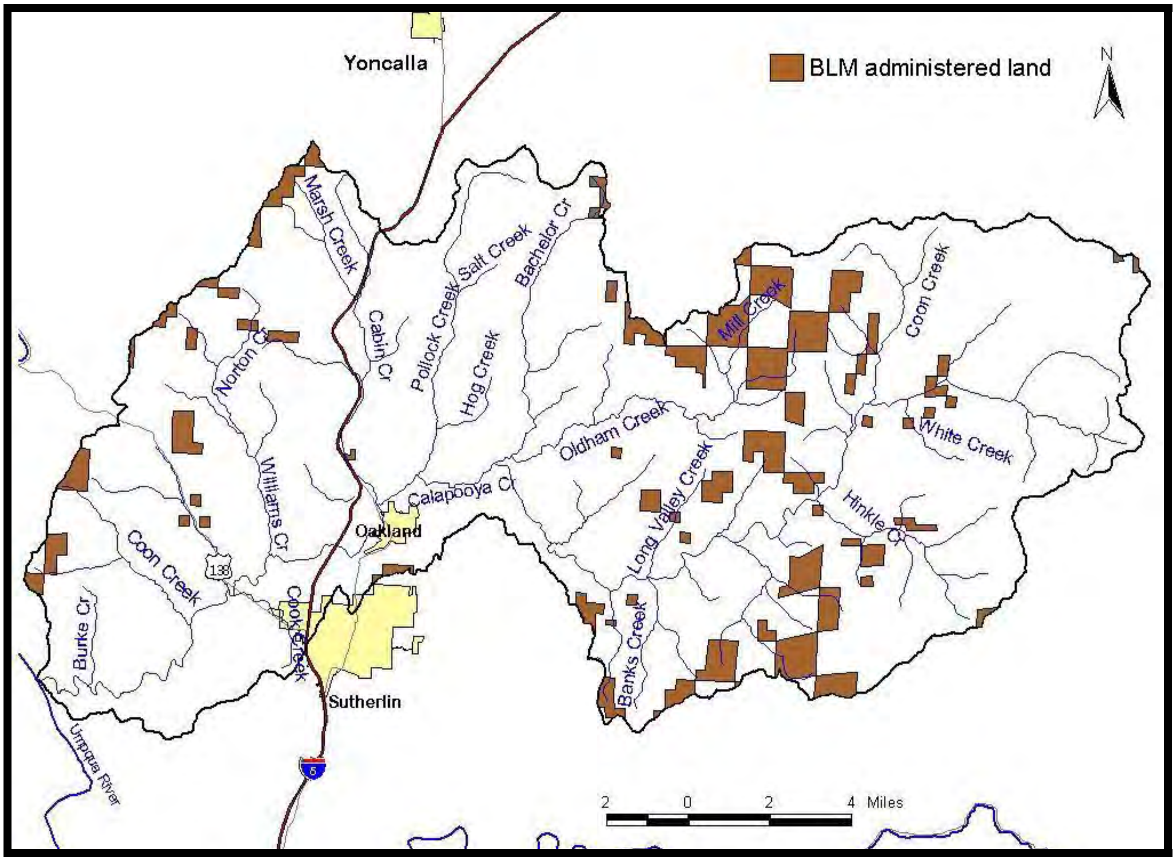
Increased regulations will most likely have the greatest impact on the future of industrial timber companies. Like family forestland owners, most industrial timber companies believe in following sound forest management principles and consider their current management systems sustainable. There is concern 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 most likely move their business elsewhere and convert their forestlands to other uses.

4.2.6. The Bureau of Land Management[99]

The Roseburg District Office of the Bureau of Land Management (BLM) administers a total of 425,588 acres of which most is within the Umpqua Basin and all is within

[99] The following information is from the Roseburg District of the Bureau of Land Management's 1995 Record of Decision and Resource Management Plan and the District's Annual Program Summary and Monitoring Report for fiscal year 2000 to 2001.

Douglas County.[100] In the Calapooya Creek Watershed, the BLM administers approximately 7.6% of the watershed (see Map 4-1).



Map 4-1: Location of BLM administered lands in the Calapooya Creek Watershed.

The Bureau of Land Management 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 Roseburg BLM's District Office developed a Record of Decision and Resource Management Plan in 1995.[101] The plan outlines the on-going resource management goals and objectives for lands administered by the BLM. All of the BLM's activities are guided by the resource management plan, and this assessment summarizes the main points of the document.

General overview

The BLM Roseburg District Office's vision is that the "Bureau of Land Management will manage the natural resources under its jurisdiction in western Oregon to help enhance and maintain the ecological health of the environment and the social well-being of the

[100] Including 1,717 acres of non-federal land with federal subsurface mineral estate administered by the BLM.
[101] For copies of this document, contact the Bureau of Land Management Roseburg District Office at 777 Northwest Garden Valley Road, Roseburg, Oregon 97470.

human population." Ecosystem management is the strategy used by the Roseburg BLM to guide its vision:

> Ecosystem management involves the use of ecological, economic, social, and managerial principals to ensure the sustained condition of the whole. Ecosystem management emphasizes the complete ecosystem instead of individual components and looks at sustainable systems and products that people want and need. It seeks a balance between maintenance and restoration of natural systems and sustainable yield of resources (p. 18).

The BLM manages all its land using two primary management concepts outlined in the Northwest Forest Plan. The first is "Ecological Principles for Management of Late Successional Forests." One goal for this management concept is "to maintain late-successional and old-growth species habitat and ecosystems on federal lands." The second goal is "to maintain biological diversity associated with native species and ecosystems in accordance with laws and regulations."

The second management concept is the "Aquatic Conservation Strategy." This strategy was developed "to restore and maintain the ecological health of watersheds and aquatic ecosystems contained within them on public lands." A primary intent is to protect salmonid habitat on federal lands administered by the Bureau of Land Management and US Forest Service through activities such as watershed restoration and protecting riparian areas.

Land use allocations and resource programs
As part of its strategy, the BLM has four land use allocations that are managed according to specific objectives and management actions/directions that contribute to the two primary management concepts. The first land use allocation is Riparian Reserves. These areas are managed to provide habitat for various wildlife species. The second is Late-Successional Reserves (LSR). These are managed to protect and enhance conditions of late-successional and old-growth forest ecosystems that provide habitat for many species such as the northern spotted owl. Third, Matrix Areas have multiple objectives, which include providing a sustainable supply of timber and other forest commodities, connecting late successional reserves, and providing habitat for organisms associated with young, mature, and older forests. The last land use allocation is Adaptive Management Areas, where the agency develops and tests new management approaches to integrate ecological health with other social parameters, such as economic stability. In the Roseburg BLM District, the Adaptive Management Area is located in the Little River Watershed. The BLM also manages for 20 specific resource programs such as wilderness, timber resources, rural interface areas, and noxious weeds. As with the land use allocations, there are specific objectives and management actions/directions for each of the resource programs that are congruent with the Northwest Forest Plan management concepts.[102]

[102] For specific information about land use allocations and management, see the BLM Roseburg District's Resource Management Plan.

Current trends
A requirement of the Roseburg District BLM's Resource Management plan is to publish a report on its annual activities. This document is called the Annual Program Summary and Monitoring Report.[103] It describes the BLM's accomplishments during the fiscal year, provides information about its budget, timber receipt collections, and payments to Douglas County.

Overall, the Roseburg BLM District is implementing the Northwest Forest Plan. The BLM met its goals for its land use allocations and for many of its resource programs, such as "water and soils" and "fish habitat." However, uncertainty surrounding the Survey and Manage standard, as well as on-going litigation, has affected the BLM's ability to implement some of its program elements.[104] For the third year in a row, the BLM's forest management and timber resource program did not come close to achieving its goal of sustainably harvesting 45 million board feet (MMBF) of timber. During fiscal years 1996 through 1998, the BLM came close to or exceeded its 45 MMBF goal. In 1999, harvests fell to 10 MMBF (22% of goal), and then dropped to 1.4 MMBF in 2000 (3% of goal). In 2001, harvest levels climbed slightly to 2.7 MMBF (6% of goal). Under the Resource Management Plan, more acres of BLM-administered forested lands are approaching late-successional stage than are being managed for timber.

Future of BLM management
The BLM's Resource Management Plan is the guide to all of the BLM's activities and is not subject to casual changes. There are three situations that may result in significant alterations to the current plan. First, major policy changes, such as modifying the Northwest Forest Plan, would require the BLM's Resource Management Plan to be updated so it corresponds with new policies. Second, landscape-wide ecological changes, such as a 60,000-acre fire or a landscape-wide tree disease outbreak, could require changes to the BLM's current plan. Finally, the Resource Management Plan is slated for evaluation in 2005. At that time, the current plan would be evaluated to ascertain if newer information or changed circumstances warranted an amendment or revision of the Resource Management Plan. In all cases, the public has the opportunity to review and comment on an amendment or revision of the plan.

4.2.7. Oregon Department of Environmental Quality[105]

The Oregon Department of Environmental Quality (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;

[103] Copies of the Roseburg District BLM's Annual Program Summary and Monitoring Report from fiscal year 2001 are available through the Roseburg District Office.
[104] The Northwest Forest Plan's Survey and Manage standard requires that all agencies conduct surveys prior to any activities on public lands to identify resident species of which little is known (such as mosses, mollusks, and fungi) and develop appropriate management strategies. Depending on the specific species requirements, surveys for a project can take two years or more to complete.
[105] The following information is primarily from an interview with Paul Heberling, a water quality specialist for the Oregon Department of Environmental Quality in Roseburg.

- 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.

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

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 individual 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 is 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.

Another potential hindrance to ODEQ's work is budget cuts and staff reductions. There are two Healthy Stream Partnership positions assigned to the Umpqua Basin, which is approximately three 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.

Current and potential future water quality trends
Although many Umpqua Basin streams and reaches are water quality impaired, current trends indicate that conditions are improving. In 1998, there were 1,067 streams or stream segments identified as failing to meet one or more of Oregon's water quality standards. Of these, approximately 10% were in the Umpqua Basin.[106] Table 4-1 shows by parameter the number of Umpqua Basin streams failing to meet water quality standards.

Parameter	**# of listed streams or reaches**	**Parameter**	**# of listed streams or reaches**
Ammonia	1	Iron	4
Aquatic weeds/algae	3	Lead	3
Arsenic	4	Manganese	2
Biological criteria	7	Mercury	4
Cadmium	1	pH	14
Chlorine	2	Phosphorus	1
Copper	2	Sediment	7
Dissolved oxygen	7	Temperature	180
E. coli and fecal coliform	14	Total dissolved gas	4

Table 4-1: Number of Umpqua Basin 303(d) listed streams by parameter.

Accordingly, the focus for preservation and restoration efforts is directed toward improving stream temperature and bacterial levels to support the various beneficial uses. Improving stream temperature may provide the greatest cost-benefit ratio because temperature is a major factor in impacting or exacerbating other water quality parameters, including dissolved oxygen, pH, bacteria, and ammonia. Land management activities that reduce the rate of stream warming, such as establishing functional riparian buffers, can also improve other water quality parameters, such as sedimentation. Reducing bacteria levels is also a focus because of the serious human health risks associated with fecal bacteria. There is a clear rationale for activities that reduce bacteria levels, such as fixing failing septic systems and reducing the amounts of fecal wastes reaching streams from livestock, pets, and other sources.

Data from ODEQ long term monitoring sites in the Umpqua Basin indicate that between 1989 and 1998, water quality conditions of many Umpqua Basin rivers and streams improved. The South Umpqua River at Melrose Road, Stewart Park Road, Winston, and Days Creek Cuttoff Road, as well as Cow Creek at the mouth, Calapooya Creek at Umpqua, and the North Umpqua at Garden Valley Road, are listed as sites that have shown significant improvement. From these data, ODEQ believes that continuing to support beneficial uses through water quality improvement activities will insure a bright future for fish habitat and water quality in the Umpqua Basin.

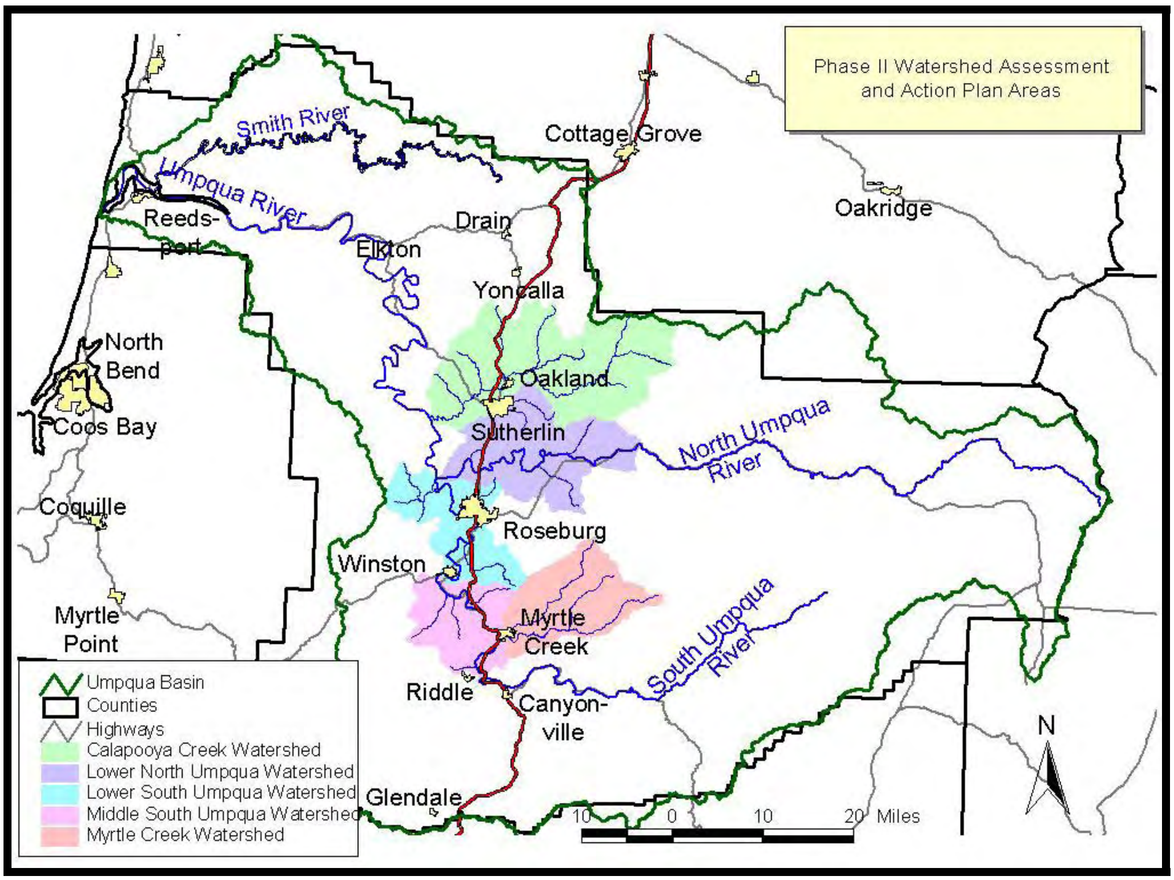
[106] See section 3.3.1 for 303(d) listed streams in the Calapooya Creek Watershed.

5. Landowner Perspectives

This chapter provides insight into the thoughts, opinions, and perspectives of landowners in the Umpqua Basin.

5.1. Overview

The Calapooya Creek Watershed assessment was part of phase II of the UBWC's watershed assessment and action plan program. The document was written during the same general time period as assessments for four other watersheds along I-5: Calapooya Creek, Lower North Umpqua, Lower South Umpqua, and Middle South Umpqua (see Map 5-1).



Map 5-1: Phase II watershed assessment and action plan areas.

The coordinator for the phase II watershed assessments started conducting landowner interviews for the past conditions section as suggested in the Oregon Watershed Assessment Manual. Some interviewees have lived in the Umpqua Basin area for most of their lives and had a wealth of historical knowledge. Other landowners were recent arrivals who knew little about the area's history, but had unique perspectives about land management, fish habitat, life as a "newcomer," and other topics. In the end, the interviews were most valuable because of the insight they provide into the different perspectives, opinions, and thoughts of Umpqua Basin landowners. Therefore, interviews from all five watersheds are included in this chapter.

5.2. Landowner interviews

Mr. and Mrs. A; Lower South Umpqua Watershed
Mr. and Mrs. A are recent residents of the Winston area and own a sheep ranch in Lookingglass, which is managed by one of their children. An unfenced stream flows through their property, but heavy brush and blackberries prevent sheep access. The couple says they have never seen fish in the stream, but they also rarely go down to look.

Although these landowners have not been in Oregon long, they have been farming and ranching their entire lives. The A's feel that farmers and ranchers are often wrongly accused of being the primary contributors to environmental problems. The A's believe that farmers and ranchers are among the best stewards of the earth; they manage their property to produce quality crops while protecting the land. As Mrs. A stated, "a farmer who manages his land poorly is only hurting himself." Mrs. A points out that their heavily grazed 100 acres all have healthy, green grass and there is no evidence of soil erosion, even on steep slopes. This couple rotates their sheep pasture to allow the land to recuperate, as all good ranchers do.

These landowners are very concerned that the "global market" is hurting local agriculture. Mr. and Mrs. A believe that Oregon is, for the most part, capable of feeding itself. Douglas county farmers grow fruits and vegetables and ranchers raise cattle, sheep, and hogs. These landowners feel that Americans need to buy US-grown products. Why purchase New Zealand lamb when Oregon lamb is not only better quality, its purchase supports the community? Mrs. A states that developing countries like Mexico do not have the same environmental standards as the US, and imported agricultural products may be contaminated by US-banned chemicals. This couple feels very strongly that if the global food market continues as it is, US farmers will lose their way of life.

Mr. B; Lower South Umpqua Watershed
A lifetime Winston-area resident, Mr. B has lived more than 60 years on a farm by the South Umpqua River. His father farmed the same property before him. Mr. B had a day job for most of his working life but was able to earn additional income through farming and ranching his 80 acres. We discussed what has changed since his childhood, current issues, and the future of the Winston-Roseburg areas.

Aspects of the river channel have changed since Mr. B was young. A gravel bar located upstream of the Happy Valley bridge has grown at least 100 feet, and many of the stream bank features he vividly remembers as a child are gone. Mr. B believes that the river's features have changed because the direction of flow has shifted and eroded banks. He pointed out full-sized trees in his riparian area that are tipping towards the river, which he said is a sign of bank erosion. When asked why he thinks this happens, he stated that the complexities of stream flow dynamics make it impossible to pinpoint a single culprit.

Erosion has always occurred on the banks of the South Umpqua River to varying degrees. On his own property, Mr. B pointed out slumping on the riverbank. These are recent slumps that did not occur during flood events. Although they are now overgrown with herbaceous plants, Mr. B stated that without trees, these slumps are more susceptible to erosion. He made it clear that bank erosion, like slumping, can occur at any time of the year. Mr. B believes that flood events cause the most damage to stream banks.

Mr. B doesn't think that normal flooding rates or levels have changed. Using Oregon Department of Water Resources data, Mr. B showed that since 1950, the river has been above 26 feet nine times. The floods are random and don't appear to have become more or less severe. However, Mr. B believes that extreme floods are not as severe as in the past. Although he doesn't have exact figures, Mr. B believes the 1964 flood levels were higher than the 1996 flood

When asked why slumping and bank erosion occur (other than because of streamflow changes and flooding), Mr. B suggested that a growing nutria population may be a culprit (he says the beaver population has remained stable). Nutria are an introduced species that burrow into streambanks. Their burrows create weak points on the bank and encourage erosion during high water. Also, livestock are a problem. Where ranchers allow their livestock to drink from the river, the banks are often denuded, and erosion is a problem. Mr. B fenced his riparian area over 35 years ago, and uses a stock water system for his cattle. He has a very lush riparian area.

Mr. B commented on changes in water quality. During his childhood, he regularly drank from the river. Now he would never consider doing so. Not only does he know what's occurring upstream, but algae sometimes grows over a third of the river's surface, and he frequently observes foam floating on the water. When asked what the foam was from, he said he didn't know for sure, but suspected it might originate at one of the upstream mills or wastewater treatment plants. Although the South Umpqua was always turbid right after a storm event, it seems to take longer now for the river to run clean again than when he was younger. Not being much of a fisherman, Mr. B couldn't comment on changes in fish populations. He did say as a child there were catfish in the river and an abundance of bullfrogs. He has not seen a catfish nor heard a bullfrog in over 25 years. When asked why he thought that might be, Mr. B said he suspects that the introduced bass might be the cause.

Except for changes in size and ownership, the primary industries in the Winston-Roseburg area have remained the same. The South Umpqua River supported many mom-and-pop mills and small-scale gravel mines. Since his youth, the many, small mills have been replaced with fewer, large mills. Similarly, aggregate gravel has been mined from the South Umpqua for as long as he can remember. There were always many small commercial mines, and most riverside landowners would freely take the aggregate they needed. Now, the small aggregate mines are gone and have been replaced by large-scale mines. Mr. B has noted that where large-scale gravel mining occurs next to the river, the channel fills with sediment and becomes wider, more shallow, and the river's direction of flow shifts. To make his point, Mr. B provided Photo 5-1 and Photo 5-2 that show how during high flows, the South Umpqua River can inundate gravel mines. This landowner didn't comment on the effects that many small mines had on the river.

Photo 5-1: Gravel mine along the South Umpqua River during high water.

According to Mr. B, the number and size of farms, as well as the types of crops, have changed since his youth. His father, like most farmers, was able to support his family through agriculture alone. Fifty years ago, most farmers had substantial acreage and grew a variety of fruits and vegetables and had pasture for livestock. Much of the Winston area had orchards. Over time, the orchards, especially pears and plums, were replaced with other crops. When asked why this happened, Mr. B said that pears and plums are more labor-intensive than other crops, and as the cost of workers increased, orchards became less profitable. Mr. B stated that the cost of labor has continued to rise, so most farmers are unable to support their families from agriculture alone. Now, farms are smaller and most farmers hold day jobs in addition to growing crops, hay, or grazing livestock. Only very large properties with intensive agricultural practices are able to support a family.

Mr. B commented that overall, people's activities on the land and in the river have improved since his youth. Before, landowners didn't know better and would do things that damaged the environment, like driving tractors into streams. Now we know better and have established laws to protect the river and other natural resources. Mr. B pointed out that unfortunately, there always seems to be ways around the laws. He is very concerned that an adjacent, upstream property purchased by Beaver State will be mined for river aggregate. The site of the proposed mine is prime farmland with excellent soil, and Mr. B believes that prime farmland is supposed to be protected under the law. In addition, Mr. B is downstream of the proposed gravel mine; he is concerned that an aggregate mine will cause the river to change its course and erode his banks and topsoil.

Photo 5-2: Gravel mine by the South Umpqua River during normal flows

Mr. B believes that to ensure economic stability, the Roseburg-Winston area needs to attract diverse industries. In the past, a variety of businesses have come and gone but no big businesses have stayed for any length of time. Mr. B believes that increasing tourism is not the answer. He says that Roseburg, Winston, and other towns along I-5 are places where tourists stop on their way elsewhere, not a place where people stop to visit for a long time. The increase in retirees from California and other states settling in this area has helped some, since retirees spend money and purchase locally grown produce. This landowner states that he is willing to accept the fact that population growth is unavoidable and has an overall affect on the area. However, he would rather not have such growth. Mr. B states that he does not think all growth is from California, and they should not take all the blame or the credit for changes in the area.

When asked what will have the single greatest impact on the future of the Winston-Roseburg area, Mr. B identified the area's population growth. He recognizes that we can't turn the clocks back to 1945. The area's population is growing and Mr. B feels we need to plan appropriately to make the best use of our resources. Across from his house on a hill is a new housing development. Although he is not delighted with the change in view, Mr. B agrees that putting in new housing on poorer, upland soil is much better than filling in the formerly abundant wetlands or subdividing farms to build housing for more people. Mr. B also stated that quality gravel used for cement and roads can be obtained from upland quarries instead of using river aggregate. This landowner is concerned that unless we plan well, the Roseburg-Winston area will have the same fate as the East and the Seattle-Portland areas; money will be in abundance but quality food, water, and air will be limited. Only by managing our area's resources for the best uses will we be able to accommodate a growing population and protect our natural resources.

Like Mr. and Mrs. A, Mr. B believes that North American Free Trade Agreement (NAFTA) and the global market hurts local farmers. He states that US labor is too expensive compared to other nations and farmers can't turn enough of a profit. Therefore, in the future most farmers will be like himself; those who continue to farm because they enjoy the lifestyle and the additional source of income. Mr. B is concerned that today's youth are not interested in farming; they perceive it as requiring too much work for the financial benefit.

Mr. C; Lower South Umpqua Watershed

Mr. C offers an interesting perspective as a newcomer to the Roberts Creek area. He and his wife moved up permanently from southern California a year before the interview. When asked what brought him to the area, he said that they have family on Roberts Creek, and life in southern California was becoming too expensive and hectic. He and his wife wanted to live somewhere peaceful where they could have some property. Their 12-acre parcel has brought them just that. When asked if he faced any hostility from locals because he's from California, he said no. Mr. C believes that most of the anti-California attitude is directed at businesspeople who come to this area and bring with them the fast-paced, high stakes approach to life. Overall, local residents have been very nice to Mr. C, but then he has adapted himself to the slower pace of life along Roberts Creek.

Roberts Creek runs through Mr. C's land, and he pointed out the bare, eroded banks. Mr. C hasn't lived on his property long enough to know the flood trends. However, he reported that the neighbors, who are long-time residents, are very concerned with the stream changing its course and would like Roberts Creek to stay where it belongs. Mr. C didn't mention any activities the neighbors had done, if any, to prevent stream meandering. Mr. C is looking at options to prevent further erosion of Roberts Creek stream banks within his property.

Mr. C reported a stream-related incident that he found curious. Last spring, Pacific Power needed to replace power line poles on either side of the Roberts Creek reach on Mr. C's property. There is no bridge across the stream, but Mr. C has an established crossing that he uses to reach his pasture on the other side of the creek. That pasture can also be accessed via a vacant lot off of Carnes Road. According to Mr. C, the contractors working for Pacific Power created a new stream crossing to reach the other side of Robert's Creek rather than using the Carnes Road access. He also stated that they tore up the active channel doing so. Mr. C told the contractors they needed to return and clean up the mess. The contractors didn't return until December, at which point Mr. C was told the ground was too wet for anything to be done, although they promised to come back when the ground was dry. The UBWC recommended Mr. C contact Pacific Power and report the incident.

Mr. D; Myrtle Creek Watershed
Mr. D is an Oregon native who moved to the San Francisco Bay area and then returned to Oregon. He and his wife have lived on over 100 acres of timberland on a North Myrtle Creek tributary since the late 1970s. Mr. D teaches at a nearby school.

Earlier last century, Mr. D's property was the site of a small mill. In the 1950s, the property was heavily logged and not replanted but did regenerate naturally. Mr. D did a logging operation on his property in 1979. Now, this landowner mostly manages his timber using selective cutting. Using this method, Mr. D can obtain all the firewood he needs and periodically harvest some logs. Mr. D does not have enough property to harvest timber every year, but once every five years or so, he is able to cut enough logs to provide some additional income. Mr. D avoids tree planting by encouraging natural regeneration. He uses hand methods rather than chemical sprays to control competing vegetation. Fifteen years ago, this landowner planted knobcone pine on southern slopes. Unfortunately, they are not doing well. Mr. D speculates that drought may have made these trees susceptible to bark beetle attack.

When asked if his land management method was pretty common in his area, he said that it varies. Mr. D pointed out that most of the timberland in Myrtle Creek is either federally managed or owned by private industrial timber companies. As for small woodland owners, some do little or no active management. These folks are often retirees from other areas. On the other hand, another couple nearby was short of cash and clearcut their entire property. These folks have yet to replant. As such, Mr. D could not generalize on how most small woodland owners manage their property.

Two creeks run through Mr. D's property. Neither stream is fish-bearing. Downstream from Mr. D's property, there are three culverts that may block fish passage. When asked about replacing the culverts, Mr. D said that he, and probably the neighbors as well, would not be interested. Without fish, Mr. D can block off the culvert during the summer months and store 80,000 gallons of water for fighting forest fires. The neighbors can create a small pond in their yard as well. These activities would not be possible if the stream had anadromous fish. Mr. D obtains all of his domestic water from springs further upstream.

As a side note, Mr. D stated that many people claim riparian trees do not reduce stream flow. From his observations, this timberland owner has concluded in large numbers, young alders can take up so much water that the stream flow is reduced to a trickle. As the alders mature, they naturally thin out and take up less stream water while providing shade.

When asked about changes in the streams, Mr. D stated that both of the creeks on his property have remained about the same over the last 25 years. Both creeks have ample riparian habitat, instream wood, and are well shaded. Mr. D has never noticed an erosion problem, although the streams become caramel-colored during “gully-washer” floods. There hasn’t been a really big flood in many years. The only long-term change in the stream that he’s noted is more brush, which is probably due to opening the forest canopy from his selective logging activities. There are probably few snags since Mr. D also occasionally removes dead trees for firewood.

Outside of the stream, Mr. D noted that he is seeing more invasive plant species. Four or five years ago, he started finding tansy ragwort and Scotch broom. To date, Mr. D has not found any gorse on his property, but it is not far away, and he suspects that eventually it will make its way to his area.

When asked about changes in the population, Mr. D noted that there are fewer active farms than before. Business in recent years has remained stable; small companies come and go, but the number of businesses and stores remains about the same. The population of Myrtle Creek is growing some due to an influx of retirees from other areas. This has resulted in more housing construction in the city. When asked what long-time residents feel about the newcomers, Mr. D concurred with Mr. C; attitude is everything.

Mr. D identified three major events in the past 25 years that he believes have changed Myrtle Creek. First, the nickel mine on Nickel Mountain closed, costing many jobs. Second, the reduction in logging from federally managed forests also resulted in a loss of jobs for Myrtle Creek residents. Finally, in the 1970s the state welfare system relocated several people on public assistance to Myrtle Creek because the cost of living was cheaper than in the larger, northern cities. Mr. D believes these events have resulted in Myrtle Creek’s higher than the county average poverty and unemployment rate, and have shaped the culture of Myrtle Creek. According to this landowner, there are a large number of families that have had multiple generations on public assistance, and many people don’t see the value of school. There are few profitable jobs in the area and a large population of high school dropouts. Many people have difficulties earning a living wage and are apathetic. Apathy puts the skids on community growth.

This landowner feels very strongly that a strong vocational education program is critical for Myrtle Creek’s children. Since education is not a high priority, finishing high school is, for some people, their most significant educational accomplishment; they will most likely not continue their education to learn a trade or marketable skill. Mr. D believes that providing high school graduates with marketable skills, such as carpentry, welding, and “mechanicking,” will give them the background needed to seek jobs for skilled laborers.

When asked about the future of Myrtle Creek, this landowner stated that unless timber can be harvested from federal forests, or unless another industry moves into the area, Myrtle Creek is destined to be a bedroom community for Roseburg, Canyonville, and Winston.

Mr. E; Calapooya Creek Watershed

Mr. E moved to the Calapooya Creek Watershed in 1981. Since that time, Mr. E has worked very hard to improve his 100-acre ranch and the 0.25 miles of cutthroat trout-bearing stream that runs through his property. Mr. E has extensively cross-fenced his property. The uplands are planted with various conifers including KMX, which is a cross between knobcone pine and Monterey pine. The trees range from 20 years old to less than two. For each grazing section he has planted triangular clusters of trees to provide weather protection for his livestock. Mr. E also cuts all the Scotch broom and any other invasive plant he finds on his property.

Mr. E has done substantial work on his stream's riparian area. When this landowner purchased the property, cattle had full access to the stream and there were no trees. In the summer, the creek sometimes went dry. Mr. E fenced the riparian area and planted various conifers and hardwoods. Shortly after the cattle were excluded, beaver returned to that section of the creek. When asked why this occurred, Mr. E speculated that cattle discourage beaver because they crush beaver burrows and compete for food. Once the cattle were gone and the stream was once again "safe," the beavers returned. When the beaver returned they built dams that have resulted in deep pools and year-round water. Unfortunately, Mr. E also lost many of his trees. Consequently, Mr. E builds four-foot high wire fabric tubes to protect trees of all ages, because he has noted that beavers can cut trees more than 12 inches in diameter. This landowner still plants trees in the riparian area, which he also protects from competing vegetation using mats made from the Wall Street Journal and through hand control methods.

Today, Mr. E's stream section has many tall trees and willows providing shade; the stream flows slowly through many deep pools that boast both ample cutthroat trout and crayfish. Although there is some bank erosion, Mr. E is not concerned because the downcutting is minimal and most likely a result of the increased flow. Overall, Mr. E's efforts have dramatically improved his stream section, especially compared to the neighboring reaches.

Mr. E's efforts have been very beneficial to the fish in his creek. However, this landowner is very clear that it would be very difficult for people working a full-time job to accomplish what he did. Mr. E is retired and can dedicate much of his time to successfully restoring his stream.

6. Action Plan

The action plan summarizes key findings and action recommendations from all previous chapters, and identifies specific and general restoration opportunities and locations within the watershed. The Umpqua Basin Watershed Council, the Oregon Department of Fish and Wildlife, and the Douglas Soil and Water Conservation District developed the action plan for the Calapooya Creek Watershed.

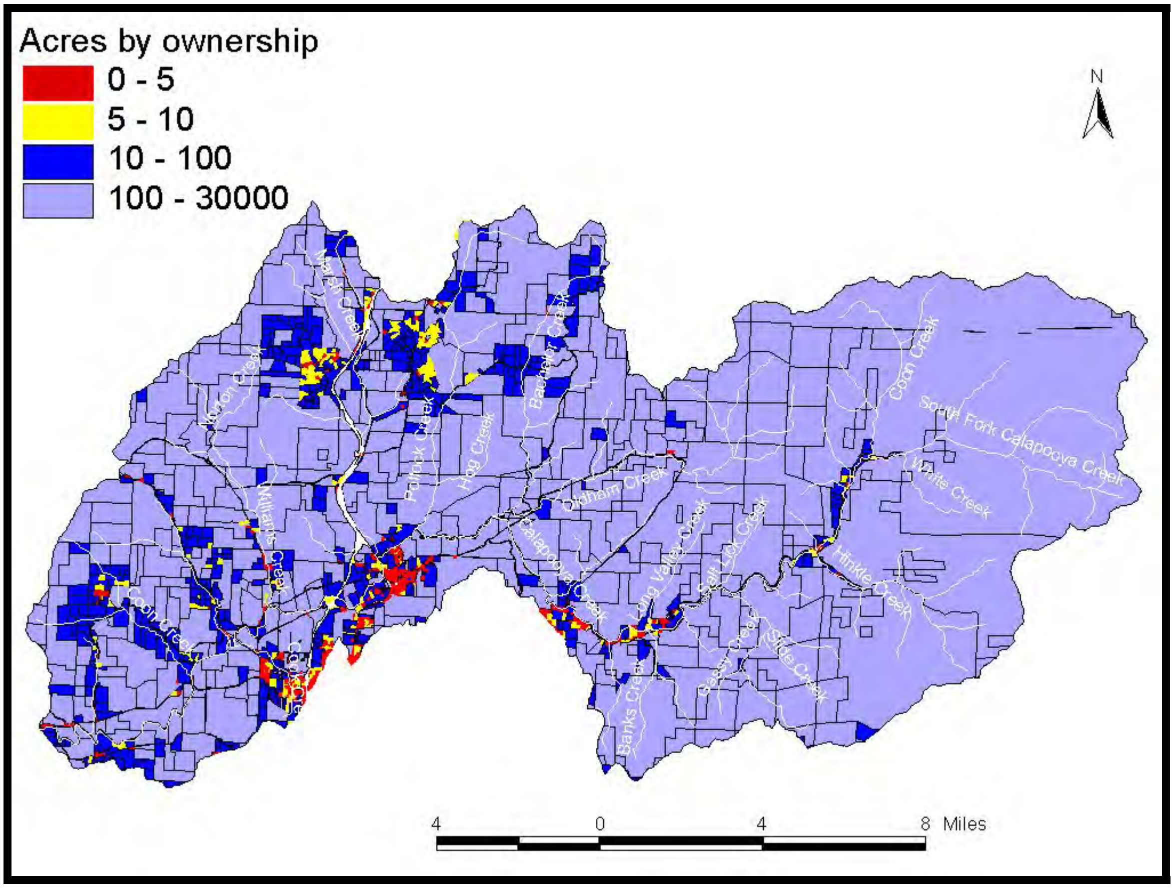
Key Questions

- Where are potential project location sites and activities in the watershed?
- How does property ownership affect restoration potential?

6.1. 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 UBWC, 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.

Map 6-1 shows parcel size in acres by ownership in the Calapooya Creek Watershed. Unlike Map 1-11 in section 1.3, all parcels owned by the same person, family, agency, group, etc., are colored to reflect total ownership size. For example, if a single family owns three five-acre parcels, all parcels will be colored dark blue to reflect the total ownership of 15 acres. This map indicates that many streams and stream segment in the Calapooya Creek Watershed, such as Salt Lick Creek, which mostly run through larger ownerships, and are good candidates for large-scale stream habitat restoration projects. Other streams that mostly consist of smaller ownerships, such as Coon Creek, should be considered for smaller-scale restoration and enhancement activities, and for landowner education programs.



Map 6-1: Ownership size by acre for the Calapooya Creek Watershed.

6.2. Calapooya Creek Watershed key findings and action recommendations

6.2.1. Stream function

Stream morphology and key findings

- Most streams within the Calapooya Creek Watershed have low gradients with few stream miles in the source areas, where most large woody material is recruited into the stream system. This may naturally limit instream large woody material abundance.
- Stream habitat surveys suggest that lack of large woody material, poor quality riffles, and poor riparian area tree composition limit fish habitat in most surveyed streams.

Stream connectivity key findings

- Culverts and, to some degree, dams, reduce stream connectivity, affecting anadromous and resident fish productivity in the Calapooya Creek Watershed. More information about fish passage barriers will be available from UBFAT in 2003.

Channel modification key findings

- Many landowners may not understand the detrimental impacts of channel modification activities or are unaware of active stream channel regulations.

Stream function action recommendations

- Where appropriate, improve pools, collect gravel, and increase the amount of 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.[107]
- 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 areas.
  - 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 fish habitat.
- Increase landowner awareness and understanding of the effects and implications of channel modification activities through public outreach and education.

6.2.2. Riparian zones and wetlands

Riparian zones key findings

- Hardwoods dominate most Calapooya Creek Watershed riparian zones. Along Calapooya Creek and its tributaries, brush/blackberries and range/grass/blackberries account for approximately 20% of riparian zone miles.
- Almost half of Calapooya Creek riparian zones have buffers that are one tree wide. Over 20% of riparian zones for both Calapooya Creek and its tributaries have no trees or very scattered trees.
- Over 20% of Calapooya Creek tributaries are less than 50% covered by riparian vegetation or infrastructure.

Wetlands key findings[108]

- Wetlands improve water quality by trapping sediments, removing nitrogen, retaining phosphorous, and regulating stream temperatures.
- Predominant wetland types are riverine wetlands confined to active channels, and wetland prairies located within bottomlands.

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[107] Thirty feet is the maximum stream width for which instream log and boulder placement projects are permitted.

[108] Brad Livingson and Loren Waldron of Land and Water Environmental Services, Inc., contributed the wetlands key findings and action recommendations.

- Native Americans would regularly burn areas within the interior valleys to improve hunting, and to maintain vegetative food sources, which included wetland plants such as camas.

Riparian zones and wetlands action recommendations

- Where canopy cover is less than 50%, establish wide buffers of native trees (preferably conifers) and/or shrubs, depending upon local conditions. Priority areas are fish-bearing streams which more than 50% canopy cover is possible.
- Identify riparian zones dominated by blackberries and convert these areas to native trees (preferably conifers) and/or shrubs, depending on local conditions.
- Investigate methods of controlling blackberries, such as through biological control.
- Where riparian buffers are one tree wide or less, encourage buffer expansion by planting native trees (preferably conifers) and/or shrubs, depending on local conditions.
- Maintain riparian zones that are two or more trees wide and, along tributaries, provide more than 50% cover.
- Provide information to landowners explaining the benefits of restricting livestock access to streams, establishing buffer zones, the importance of wetlands within watersheds, and the effects of instream activities on downstream conditions.
- Promote public involvement in the maintenance of wetland resources by educating members of the local community as to the importance of maintaining natural heritage and diversity.
- Educate policy makers, landowners, and community members on the importance of maintaining wetlands for healthy watersheds, and their educational, recreational, and aesthetic values for the local community.

6.2.3. Water quality

Temperature key findings

- Monitoring locations within the watershed indicate that streams within the Calapooya Creek Watershed frequently have seven-day moving average maximum temperatures exceeding the 64°F standard during the summer. High stream temperatures would limit salmonid rearing in these reaches.
- Warmer sites often lack shade. Increasing shade on small and medium-sized streams may improve overall stream temperature.
- Groundwater and tributary flows can contribute to stream cooling. Gravel-dominated tributaries may permit cooler subsurface flows when surface flows are low.
- Fish may find shelter from high summer temperatures in the lower reaches and mouths of small and medium-sized tributaries and in reaches within warm streams that have proportionately high groundwater influx and shade.

Surface water pH, dissolved oxygen, nutrients, bacteria, and toxics key findings

- Temperature and the levels of pH, nutrients, and dissolved oxygen are interrelated. In Calapooya Creek, pH and dissolved oxygen levels do not meet water quality standards. Nutrient monitoring indicates that phosphorus levels may be of concern. It is unknown if these parameters limit water quality in any tributaries.

- Bacteria levels at the mouth of Calapooya Creek do not meet water quality standards, which is a human health concern. Additional monitoring suggests that bacteria levels may also be a concern for other streams and stream reaches with the Calapooya Creek Watershed.
- Toxic metal levels, which are most likely from old mining sites, and urban and industrial runoff, are a concern for resident fish, aquatic life, and human health.

Sedimentation and turbidity key findings

- Turbidity data indicate that usual turbidity levels in Calapooya Creek do not impair sight-feeding fish like salmonids.
- Turbidity levels can be very high after a storm event. It is unknown if high, short-term turbidity levels are detrimental to salmonids or other aquatic life.
- Soils prone to high rates of erosion due to low infiltration and high rates of runoff are located in the lower portions of the watershed.
- Developed areas within the watershed may impact water quality (i.e. runoff from roads and roofs). Improperly drained roads and poor land management practices can increase sediment loads to streams. In the Umpqua Basin, more studies are needed to determine the impacts of roads, culverts, landslides, burns, soil type, and urban conditions on sedimentation and turbidity.

Water quality action recommendations

- Continue monitoring the Calapooya Creek Watershed for all water quality conditions. Expand monitoring efforts to include 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 instream conditions by placing logs and boulders within the active stream channel to create pools and collect gravel.
- In very warm streams or where pH and/or dissolved oxygen are a problem, increase shade by encouraging wide riparian buffers and managing for full canopies.
- Identify and monitor sources of bacteria and nutrients in the watershed. Where applicable, reduce nutrient levels through activities such as:
  - Limiting livestock stream access by providing stock water systems and shade trees outside of the stream channel and riparian zones. Fence riparian areas as appropriate.
  - Relocating structures and situations that concentrate domestic animals near streams, such as barns, feedlots, and kennels. Where these structures cannot be relocated, establish dense and wide riparian vegetation zones to filter fecal material.
  - Repairing failing septic tanks and drain fields.
  - Using wastewater treatment plant effluent for irrigation.
  - Reducing chemical nutrient sources.
- Where data show that stream sediment or turbidity levels exceed established water quality standards, identify sediment sources such as urban runoff, failing culverts or roads, landside debris, construction or burns. Take action to remedy the problem or

seek assistance through organizations such as the UBWC and Soil and Water Conservation Districts.
- In areas with high concentrations of group D hydrologic soils, encourage landowners to identify the specific soil types on their property and include soils information in their land management plans.
- Obtain comprehensive map coverage of the forest road system within the watershed and prioritize areas of concern based on road type, condition, and proximity to nearest stream. Use this information to target projects for improving road stability and drainage patterns.
- Use the Oregon Department of Forestry's debris flow hazard model to pinpoint areas that are naturally prone to erosion. Obtain the more refined debris flow data from Nature of the Northwest when published.
- Educate landowners about water quality concerns and potential improvement methods:
  - Improving dirt and gravel road drainage to minimize sediment delivery to streams.
  - Enhancing soil infiltration by leaving vegetation litter on the ground after timber and crop harvests.
  - Planting bio-swales near streams in urban and suburban areas to catch urban runoff.
- Cooperate with the ODEQ as necessary to document and reduce contamination by toxics.

6.2.4. Water quantity

Water availability and water rights by use key findings

- In some WABs, instream water rights and consumptive use is close to or exceeds average streamflow during the summer months.
- The largest uses of water in the Calapooya Creek Watershed are irrigation, municipal, and miscellaneous uses.
- It is not unusual for Calapooya Creek's flows to be less than 10 cfs. Gassy Creek can have zero flow, which means there is no moving surface water.

Stream flow and flood potential key findings

- No flooding trends can be determined from the records to date.
- The degree to which road density and the TSZ influence flood potential in the Calapooya Creek Watershed is unknown at this time

Water quantity action recommendations

- Reduce summer water consumption through instream water leasing and by improving irrigation efficiency.
- Continue monitoring peak flow trends in the watershed. Try to determine the role of vegetative cover, flooding, road density, and the TSZ on water volume.
- Educate landowners about proper irrigation methods and the benefits of improved irrigation efficiency.

6.2.5. Fish populations

Fish populations key findings

- The anadromous fish species in the Calapooya Creek Watershed are coho, winter steelhead, fall chinook, and lamprey. Although many Calapooya Creek Watershed medium and large tributaries are within the distribution of one or more salmonid species, salmonid ranges have not been verified for each tributary.
- More quantitative data are needed to evaluate salmonid abundance and the distribution and abundance of non-salmonid fish in the watershed.
- Temperature limits largemouth bass, smallmouth bass, and other non-native species to the North Umpqua River, but these species may occasionally enter the mouth of Calapooya Creek. Other non-natives have been accidentally or intentionally introduced to the watershed, but have not established reproducing populations.
- Umpqua Basin-wide data indicate that salmonid returns have improved. Although ocean conditions are a strong determinant of salmonid run size, improving freshwater conditions will also increase salmonid fish populations.

Fish populations action recommendations

- Work with local specialists and landowners to verify the current and historical distribution of salmonids in tributaries.
- Support salmonid and non-salmonid distribution and abundance research activities in the watershed, especially at the local level.
- 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.

6.3. Specific UBWC enhancement opportunities

1. Actively seek out opportunities with landowners, businesses, and resident groups in key areas to enlist participation in the following restoration projects and activities:
    - Improved irrigation efficiency and instream water leasing (all streams with water rights, such as Bachelor Creek and Oldham Creek);
    - Instream structure placement (esp. Hinkle Creek and streams above Gassy Creek including Calapooya Creek); and
    - Riparian planting, blackberry conversion, fencing, and alternative livestock watering systems in the following areas:
        - Calapooya Creek from Dodge Canyon to Oldham Creek;
        - Oldham Creek;
        - Pollock Creek;
        - Cabin Creek;
        - Williams/Norton Creek; and
        - Bachelor Creek.

2. Work with interested landowners on a case-by-case basis to on the following project types:
   - Improve instream fish habitat in areas with good riparian zones and an active channel that is less than 30 feet; and
   - Enhance and/or protect riparian zones and wetlands to improve wildlife habitat, fish habitat, and water quality conditions.

3. Develop educational materials and/or outreach programs to educate target audiences about fish habitat and water quality-related issues:
   - Creating educational brochures about bank erosion, the problems associated with channel modification, and the importance of riparian areas. These could be given to new landowners through real estate agents.
   - Developing public service announcements about ways of improving or maintaining riparian and instream conditions, such as the benefits of riparian fencing and how to use fertilizers and pesticides in a stream-friendly fashion.
   - Designing engaging displays about fish passage barriers for community events, such as the Douglas County Fair.
   - Giving presentations at citizen groups about the benefits to landowners and to fish that result from upland stock water systems, off-channel shade trees, and instream water leasing.

4. Support local fish habitat and water quality research:
   - Train volunteers to conduct fish and water quality monitoring and research.
   - Provide equipment necessary for local water quality research and monitoring.
   - Survey long-term landowners and residents about historical and current fish distribution and abundance.
   - Encourage school and student participation in monitoring and research.

5. Enlist landowner participation to remove fish passage barriers as identified.

6. Educate policy makers about the obstacles preventing greater landowner participation in voluntary fish habitat and water quality improvement methods.

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Appendices

Appendix 1: Additional geological information for western Oregon and for the Calapooya Creek Watershed.[110]

Geologic history

The process of plate tectonics, or movement of large plates of solid rock crust on the earth's surface, can result in many different landscape-altering events, such as volcanic activity and mountain building. The collision of the North American continental plate with the Pacific oceanic plate resulted in a collision boundary that has shaped the geologic history of southwestern Oregon. In this case, the Pacific plate has been thrust beneath the continental plate, creating a collision boundary known as a subduction zone (see glossary for definitions of terms). The geologic history of this area has been driven by its location on the western edge of the North American plate adjacent to the Pacific Ocean. The collision of the Pacific plate with the North American plate also resulted in the accretions of islands and small landmasses to the continental plate. The Klamath Mountains and the Coast Range are examples of this process, known as accretionary tectonics. This refers to the addition of exotic crustal deposits, such as island arcs, to a continent through the process of tectonics.

During Mesozoic time, the Pacific plate collided with western North America on several different occasions (Alt and Hyndman, 2001). Refer to Appendix table I for the geologic time sequence. However, it was not until the Tertiary period that the ocean waters began to retreat and the volcanoes of the Western Cascades rose to great heights. This was also a time of intense volcanism for the mountain chain; large volcanic eruptions occurred throughout the Oligocene and into the Miocene. Ash was spread across the Pacific Northwest and into the Pacific Ocean, forming volcanic rock known as tuff. These eruptions of the Western Cascades were driven by a hot spot beneath the ocean. The hot spot formed as a slab of oceanic crust and began to sink within the oceanic trench, sliding beneath the western edge of the North American plate. The slab eventually reached a certain depth at which the superhot water evaporated into steam, which was the driving force behind the intense volcanism of the Western Cascades. The slab continued to sink, until it reached a depth that caused it to break apart from the main body of the oceanic crust, subsequently causing the detached portion to sink into the mantle. Hot mantle rock, lacking the water required to drive the volcanic chains, filled in behind it. This, in addition to the gap created by the broken slab, which cut off the source of magma to the system, ended the intense period of volcanism (Alt and Hyndman, p 223).

The Coast Range was one of the last provinces to form in the Pacific Northwest. Its formation began early in the Cenozoic era with the separation of two oceanic plates. The two divergent plates formed a rift from which magma was released that subsequently formed a chain of undersea volcanic islands arranged in a north-south direction between

[110] Jenny Allen, Tim Grubert, and John Runyon of BioSystems, Inc., contributed the text and tables for Appendix 1. Terms such as "Jurassic" and "Cretaceous" refer to periods in the geologic/evolutionary timetable. However, the UBWC takes no position regarding the time periods with which these terms are associated and is using the terms to refer to natural processes and the relative order in which they occurred.

the two plates. These volcanic islands were subject to eruptions of basalt throughout the Paleocene and Eocene epochs. Furthermore, the chain remained submersed beneath the ocean, collecting marine deposits that later resulted in the creation of the Roseburg, Tyee, and Umpqua Formations. Later in the Eocene, this volcanic chain collided with the North American plate, beginning the formation of the Coast Range. During the Oligocene, an orogeny (mountain building process) occurred that caused the Coast Range to rise out of the ocean. Also during this time, volcanoes of the Western Cascades were erupting frequently and depositing large amounts of ash into the ocean atop the emerging Coast Range, resulting in formations that are included in the Little Butte Series.

Era	**Period**	**Epoch**
Cenozoic	Quaternary	Holocene
		Pleistocene
	Tertiary	Pliocene
		Miocene
		Oligocene
		Eocene
		Paleocene
Mesozoic	Cretaceous	
	Jurassic	
	Triassic	
Paleozoic	Permian	
	Pennsylvanian	
	Mississippian	
	Devonian	
	Silurian	
	Ordovician	
	Cambrian	
Precambrian	Proterozoic	
	Archean	

Appendix table I: Geologic time scale (most recent to oldest – top to bottom).

Geologic units in the Calapooya Creek Watershed[111]

Period	Epochs	Geologic Units	Description of Geologic Units
Quaternary	Holocene	Qal	**Alluvial deposits**: Sand, gravel, and silt forming floodplains and filling channels of present streams. In places includes talus and slope wash. Locally includes soils containing abundant organic material, and thin peat beds.
Quaternary	Holocene & Pleistocene	Qls	**Landslide and debris-flow deposits**: Unstratified mixtures of fragments of adjacent bedrock. Locally includes slope wash and colluvium. May include some deposits of late Pliocene age.
Tertiary	Eocene	Tt	**Tyee Formation**: Very thick sequence of rhythmically bedded, medium- to fine-grained micacous, feldspathic, lithic, or arkosic marine sandstone and micaceous carbonaceous siltstone; contains minor interbeds of dacite tuff in upper part. Foraminiferal fauna are referred to the Ulatisian Stage (Snavely and others, 1964). Groove and flute casts indicate deposition by north-flowing turbidity currents (Snavely and others, 1964), but probably provenance of unit is SW Idaho (Heller and others, 1985).
Tertiary	Middle and Lower Eocene and Paleocene	Tsr	**Siletz River Volcanic and related rocks**: Aphanitic to porphyritic, vesicular pillow flows, tuff-breccias, massive lava flows and sills of tholeiitic and alkalic basalt. Upper part of sequence contains numerous interbeds of basaltic siltstone and sandstone, basaltic tuff, and locally derived basalt conglomerate. Rocks of unit pervasively zeolitized and veined with calcite. Most of these rocks are of marine origin and have been interpreted as oceanic crust and seamounts (Snavely and others, 1968). Foraminiferal assemblages referred to the Ulatisian and Penutian Stages (Snavely and others, 1969.

[111] From Walker and MacCleod, 1991. References cited in Walker and MacCleod are provided at the end of Appendix 1.

Tertiary	Eocene & Paleocene	Tmsm	**Marine sandstone, siltstone, and mudstone**: Rhythmically interbedded sandstone, siltstone, and mudstone with minor conglomerate deposited in deep-sea fan depositional setting on submarine basalts of the Siletz River Volcanics. Contains foraminiferal faunas referred to the Penutian Stage of early Eocene age and locally contains assemblages of probable Paleocene age (McKeel and Lipps, 1975; P.D. Snavely, Jr. and David Bukry, written commun., 1980). Included by Diller (1898) in the Umpqua Formation; Baldwin (1974) and Ryberg (1984) mostly mapped unit as sedimentary rocks of the Roseburg Formation of the Umpqua Group; according to Heller and Ryberg (1983) and Molenaar (1985), may be partly correlative with the Lookingglass Formation of Baldwin (1974). Includes lower Eocene-Paleocene turbidite sedimentary rocks exposed at Five Mile Point, about 11 km north of Bandon, that are considered by Snavely and other (1980) to represent allochtonous terrane.
Tertiary	Miocene and Oligocene	Tu	**Undifferentiated tuffaceous sedimentary rocks, tuffs, and basalt**: Heterogeneous assemblage of continental, largely volcanogenic deposits of basalt and basaltic andesite, including flows of breccia, complexly interstratified with epiclastic and volcaniclastic deposits of basaltic to rhyodacitic composition. Includes extensive rhyodacitic to andesitic ash-flow and air-fall tuffs, abundant lapilli tuff and tuff breccia, andesitic to dacitic mudflow (lahar) deposits, poorly bedded to well bedded, fine- to coarse-grained tuffaceous sedimentary rocks, and volcanic conglomerate. Originally included in Little Butte Volcanic Series (Peck and others, 1964); includes Mehama Volcanics and Breitenbush Tuffs or Series of Thayer (1933, 1936, 1939), Breitenbush Formation of Hammond and others (1982), Mehama Formation of Eubanks (1960), and Molalla Formation of Miller and Orr (1984a). In

			Columbia River Gorge, includes Miocene and older rocks previously assigned to the Skamania Volcanic Series (Trimble, 1963), or to the Eagle Creek Formation (Waters, 1973). Lower parts of unit exhibit low-grade metamorphism with primary constituents altered to clay minerals, calcite, zeolites (stilbite, laumontite, heulandite), and secondary silica minerals. In contact aureoles adjacent to stocks and larger dikes of granitic and dioritic composition or in areas of andesitic dike swarms, both wallrocks and intrusions are pervasively propylitized; locally rocks have also been subjected to potassic alteration. Epiclastic part of assemblage locally contains fossil plants assigned to the Angoonian Stage (Wolfe, 1981) or of Oligocene age. A regionally extensive biotite-quartz rhyodacite ash-flow tuff, the ash-flow tuff of Bond Creek of Smith and others (1982), is exposed in southern part of Western Cascade Range near and at base of unit.
Tertiary	Oligocene & Eocene	Tfe	**Fisher and Eugene Formations and correlative rocks**: Thin to moderately thick bedded, coarse- to fine- grained arkosic and micaceous sandstone and siltstone, locally highly pumiceous, of the marine Eugene Formation; and coeval and older andesitic lapilli tuff, breccia, water-laid and air-fall silicic ash of the continental Fisher and Colestin Formation; upper parts of the Fisher Formation apparently lap onto and interfinger with the Eugene Formation. Megafauna in the Eugene Formation were assigned an Oligocene age by Vokes and others (1951) and foraminifers have been assigned to the upper part of the lower Refugian Stage (McDougall, 1980), or of late Eocene age.

Tertiary	Pliocene, Miocene, & Oligocene	Tib	**Basalt and Andesite intrusions**: Sills, plugs and dikes of basaltic andesite, basalt, and andesite. Mostly represents feeders, exposed by erosion, for flows and flow breccias of units Tba and Trb. Includes a few dikes of hornblende and plagioclase porphyritic andesite, commonly altered, and aphyric basaltic andesite that probably were feeders for parts of unit Tub.
Tertiary	Eocene	Tss	**Tuffaceous siltstone and sandstone –** Thick- to thin-bedded marine tuffaceous mudstone, siltstone, and sandstone; fine to coarse grained. Contains calcareous concretions and in places, is carbonaceous and micaceous.

Glossary of terms[112]

Accretion- A tectonic process by which exotic rock masses (terranes) are physically annexed to another landmass after the two collided.

Alluvial- Refers to all detrital deposits resulting from operation of modern rivers, thus including the sediments laid down in riverbeds, flood plains, lakes, fans at the foot of mountain slopes, and estuaries.

Andesite- A volcanic rock type intermediate in composition between rhyolite and basalt.

Arkosic (sandstone) - Containing 25% or more feldspar usually derived from coarse-grained silicic igneous rock.

Basalt- Fine-grained, dark, mafic igneous rock composed largely of plagioclase feldspar and pyroxene.

Breccia- A clastic rock composed of mainly large angular fragments.

Clastic Rock- Sedimentary rock formed from particles that were mechanically transported.

Colluvium- Deposits of unstratified debris deposited by means of physical or chemical weathering.

Conglomerate- A sedimentary rock made up of rounded pebbles and cobbles coarser than sand.

Diorite- A coarse-grained, volcanically intruded rock similar in composition to granite but containing a higher percentage of potassium feldspar.

Ecoglite- A metamorphic, semi-precious, pink-hued stone consisting of ruby, zoisite, muscovite, and quartz.

Fault- A crack or fracture in the earth's surface across which there has been relative displacement. Movement along the fault can cause earthquakes or--in the process of mountain-building--can release underlying magma and permit it to rise to the surface.

Feldspar- A common rock-forming silicate mineral and one of the most abundant minerals in the earth’s crust.

[112] These definitions were compiled from dictionaries of geologic terms at http://www.geotech.org/survey/geotech/dictiona.html, http://www.tc.umn.edu/~smith213/newpage1.htm, http://volcano.und.nodak.edu/vwdocs/glossary.html, and in Press and Siever (1986), Jackson (1997), Orr, Orr, and Ewart (1992) and Orr and Orr (1996). Additional definitions not included in this glossary can be found at the websites and sources given above.

Formation- A body of rock identified by lithic characteristics and stratigraphic position and is mappable at the earth's surface or traceable in the subsurface.

Geomorphology- The science of surface landforms and their interpretation on the basis of geology and climate.

Granite- Coarse-grained, intrusive igneous rock, composed of quartz, orthoclase feldspar, sodium-rich plagioclase feldspar, and micas.

Graywacke- A poorly sorted sandstone containing abundant feldspar and rock fragments, often in a clay-rich matrix.

Group- Two or more formations in a stratigraphic column that formed by similar events or processes.

Igneous- A rock type formed by the crystallization of molten material called lava (volcanic) or magma (intrusive).

Island Arcs – A linear or arcuate chain of volcanic islands formed at a convergent plate boundary. It is formed in the overriding plate from rising melt derived from the subducted plate and from the asthenosphere above that plate.

Landslide- The rapid downslope movement of soil and rock material, often lubricated by groundwater, over a basal shear zone; also the tongue of stationary material deposited by such an event.

Limestone- A bedded sedimentary deposit consisting largely of calcium carbonate, sometimes containing fragments of seashells or fossils.

Mass Wasting- The rapid movement of colluvial materials downslope.

Metamorphic- Type of rock, which has been altered or deformed through heat and/or pressure.

Micaceous- Containing a high percentage of the mineral muscovite (muscovite), a shiny, sheetlike, opaque mineral that separates from a parent body in thin sheets.

Montmorillonite- A term referring to a type of clay mineral characterized by its chemical composition and molecular structure which gives it greater plasticity and swelling capacity.

Morphology- The form, structure, or arrangement of features within a landscape.

Mudstone- The lithified equivalent of mud, a fine-grained sedimentary rock similar to shale but more massive.

Ophiolite- A sequence of ocean crust beginning with ultramafic rocks at the base, grading upward to sheeted dikes, pillow lavas, and deep-sea muds.

Orogeny- The tectonic process, in which large areas are folded, thrust-faulted, metamorphosed, and subjected to plutonism. The cycle ends with uplift and the formation of mountains.

Peridotite- A coarse-grained ultramafic rock consisting of olivine and pyroxene with other accessory minerals. Peridotite is thought to make up much of the earth's mantle, and when altered is called serpentenite.

Pillow lava**-** A general term for those lavas displaying pillow structures (globs of lava with curved tops and "pinched" bottoms) and considered to have formed under water.

Plate tectonics- The movement of large segments (plates) of the earth's crust and the study of their interrelationship.

Pluton- A large igneous body (such as a batholith) formed within in the earth's crust consisting of Ultramafic- Dark colored igneous rocks high in magnesium and iron and low in silica, such as serpentenite and peridotite.

Rhyolite- Fine-grained volcanic or extrusive equivalent of granite, light brown to gray and compact.

Rift- A narrow crevice or fissure in rock produced by splitting due to tension.

Sandstone- A consolidated sedimentary rock consisting of rock and mineral fragments ranging in size between 0.0625 to 2.0 mm in diameter and cemented together with silica, calcium carbonate, or iron oxide.

Sedimentary- Rock type comprised of weathered particles of other rocks and minerals and cemented together by calcium carbonate, silica, or iron oxide. Limestone is a sedimentary rock comprised of calcium carbonate compound becoming insoluble in water and hardening into various types of rock forms.

Shale- A very fine grained detrital sedimentary rock composed of silt and clay.

Shearing- The motion of surfaces sliding past one another.

Silica- A crystalline compound consisting of silicon and oxygen.

Siltstone- A consolidated sedimentary rock made up of fragments ranging between sizes smaller than sand grains and larger than clay grains.

Slopewash- Debris carried down a slope surface by one or more physical weathering processes.

Stratigraphy- The study of stratified layered rocks.

Subduction- The sinking of an oceanic plate beneath an overriding plate.

Subduction zone: A dipping planar zone descending away from a trench and defined by high seismicity, interpreted as the shear zone between a sinking oceanic plate and an overriding plate.

Talus- A deposit of large angular fragments of physically weathered bedrock, usually at the base of a cliff or steep slope.

Tectonics – The study of the movements and deformation of the crust on a large scale.

Terrane- A suite of rocks bounded by fault surfaces that has been displaced from its original point of origin.

Tonalite- A dark, igneous mafic rock containing rock containing the minerals hornblende, plagioclase, clinopyroxene, biotite, and quartz.

Tuff- A rock composed of volcanic ash with particles smaller than four millimeters in diameter.

Ultramafic- A magnesium-rich igneous rock with less than 45% silica (silicon dioxide); typical composition of the earth's mantle.

Vitric Ash- Volcanic ash that has cooled slowly enough to form a glassy texture in its matrix.

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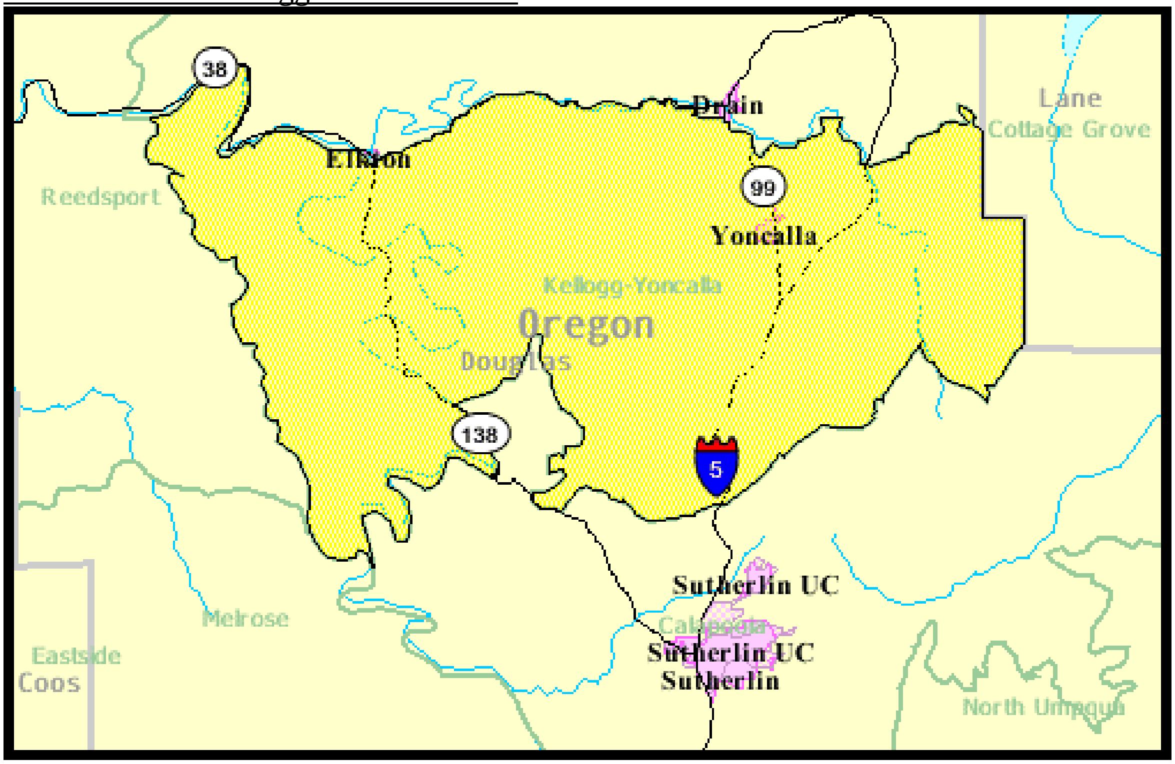
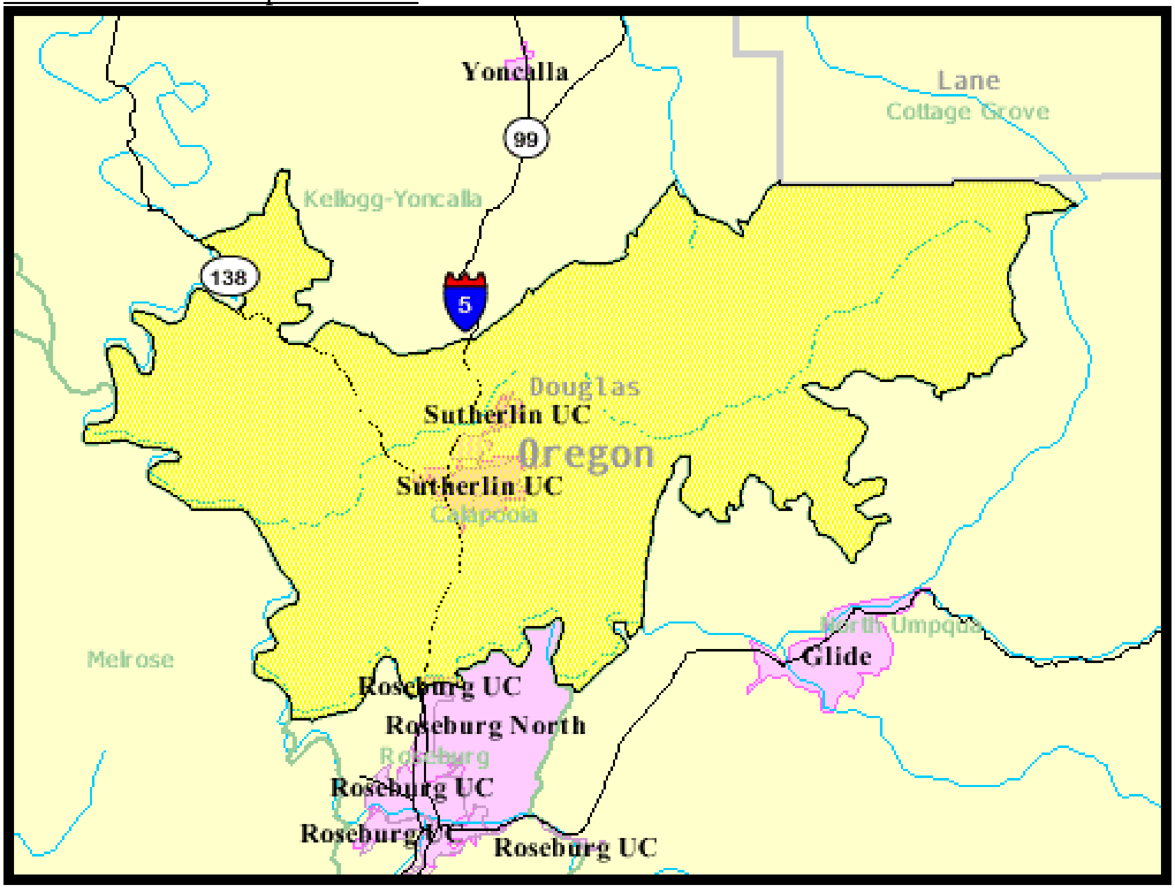
Appendix 2: Census area locations and Douglas County data

Location of the Kellogg-Yoncalla CCD.



Location of the Calapooia CCD.



2000 Douglas County census information

Age, race, and housing	
Population	100,399
Median age (years)	41.2
Race	
White	91.9%
Hispanic or Latino	3.3%
Asian	0.6%
American Indian or Alaskan Native	1.4%
African American	0.2%
Native Hawaiian and Pacific islander	0.1%
Some other race	0.1%
Two or more races	2.4%
Housing	
Avg. household size (#)	2.48
Avg. family size (#)	2.90
Owner-occupied housing	71.7%
Vacant housing units	8.0%
Education, employment, and income	
Education – age 25 or older	
High school graduate or higher	81.0%
Bachelor's degree or higher	13.3%
Employment – age 16 or older	
In labor force	56.9%
Unemployed in labor force	7.5%
Top three occupations	Management, professional and related occupations; Sales and office; Production, transportation, and material moving.
Top three industries	Educational, health, and social services; Manufacturing; Retail
Income	
Per capita income	$16,581
Median family income	$39,364
Families below poverty	9.6%

Appendix 3: 1968 streamflow and temperature measurements[113]

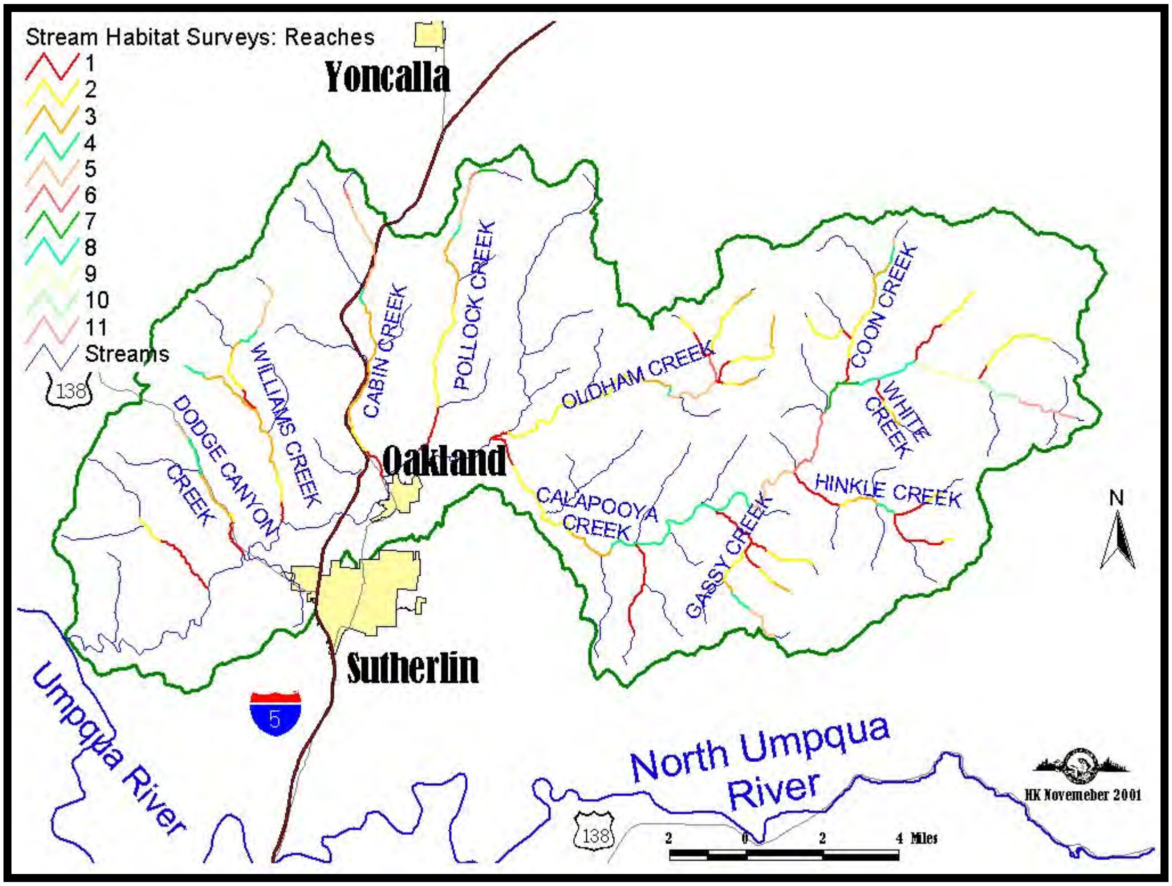
Stream	Location	Date	Degrees F.	Flow (cfs)
Calapooya Creek	0.3 mi. below Williams Creek	4/26/68	49	106
		5/13/68	--	54
		5/22/68	58	146
		6/7/68	--	89
		6/26/68	73	34
		7/24/68	68	15
		8/29/68	66	51
		9/30/68	60	30
		10/25/68	53	105
		11/5/68	51	205
Calapooya Creek	0.2 mi. below Gassy Creek	4/26/68	50	79
		5/22/68	51	133
		6/7/68	--	80
		6/26/68	67	38
		7/24/68	62	19
		8/29/68	60	43
		9/30/68	56	30
		10/23/68	48	144
		11/5/68	49	182
Calapooya Creek	1.5 mi. above Hinkle Creek	5/16/68	50	26
		6/7/68	--	53
		11/5/68	49	107
Williams Creek	Mouth	4/26/68	52	4.7
		5/22/68	54	1.5
		6/26/68	67	0.1
		7/24/68	--	Intermittent
		8/29/68	--	Intermittent
		9/30/68	--	Intermittent

[113] The information in the following table was taken from Lauman et al., 1972. This document is cited in section 2.6.

Stream	Location	Date	Degrees F.	Flow (cfs)
Williams Creek continued		10/23/68	52	0.6
		11/10/68	--	52
		11/13/68	50	97
		11/15/68	49	39
		11/20/68	50	23

Appendix 4: Stream habitat surveys

Stream reaches surveyed by the Oregon Department of Fish and Wildlife



Calapooya Creek Watershed ●●● = Good; ●● = Fair; ● = Poor

Streams highlighted in yellow are ones for that rate fair or good in all four categories.

Stream	Reach	Pools	Riffles	Riparian Area	Large Woody Material
COON CREEK	1	●●●	●●	●	●
COON CREEK	2	●●●	●●	●	●
COON CREEK	1	●●●	●●	●	●
COON CREEK	2	●●●	●●	●	●
COON CREEK	3	●●●	●●	●●	●●●
COON CREEK	4	●●	●	●	●●●
COON CREEK	5	●●	●	●●●	●●●
FIELD CREEK	1	●●	●	●●	●
FIELD CREEK	2	●●	●	●●	●
GASSY CREEK	1	●●●	●●	●●	●
GASSY CREEK	2	●●●	●●	●●	●
GASSY CREEK	3	●	●	●	●
GASSY CREEK	4	●●	●●	●●	●

Stream	Reach	Pools	Riffles	Riparian Area	Large Woody Material
GASSY CREEK	5	••	••	••	••
HANEY CREEK	1	••	•	•	•
HANEY CREEK	2	••	•	•	•
HANEY CREEK	3	••	•	••	•••
HINKLE CREEK	1	••	•	•	•
HINKLE CREEK	2	••	•	•	•
HINKLE CREEK	3	••	•	•	•
HINKLE CREEK	4	•••	•	••	•
MIDDLE FORK CALAPOOYA CREEK	1	•	••	••	•
MIDDLE FORK CALAPOOYA CREEK	2	•	•••	•	••
MILL CREEK	1	•	•	••	•
MILL CREEK	2	•••	•	••	••
MILL CREEK	3	•	••	••	•
NORTON CREEK	1	•••	•	•	•
NORTON CREEK	2	•••	••	•	•
NORTON CREEK	3	•••	•••	•••	•
NORTON CREEK	4	•••	••	•	•
NORTON CREEK	5	•••	•	•••	•
OLDHAM CREEK	1	•••	••	•	•
OLDHAM CREEK	2	•••	•	•	•
OLDHAM CREEK	3	•••	•	•	•
OLDHAM CREEK	4	•	•	•	•
OLDHAM CREEK	5	•••	•	•	•
OLDHAM CREEK	6	•••	•	•	•
POLLOCK CREEK	1	•••	••	•	•
POLLOCK CREEK	2	•••	•	•	•
POLLOCK CREEK	3	•••	••	•	•
POLLOCK CREEK	4	•••	•	••	•
POLLOCK CREEK	5	•••	•	•	•
POLLOCK CREEK	6	•••	•	•	•
POLLOCK CREEK	7	•••	•	•••	•
SLIDE CREEK	1	••	•	•	•
SLIDE CREEK	2	•	•	••	••
SLIDE CREEK	3	•	•	••	•••
S. FK. HINKLE CREEK	1	•	•	•	•
S. FK. HINKLE CREEK	2	•	•	••	••
WHITE CREEK	1	••	•••	•	•
WHITE CREEK	2	••	•••	••	••
WHITE CREEK	3	•	•	•	•••
WILLIAMS CREEK	1	•••	••	•	•
WILLIAMS CREEK	2	•••	••	•	•
WILLIAMS CREEK	3	•••	•	•	•
WILLIAMS CREEK	4	•••	•	•	•
COON CREEK TRIB. #1	1	••	•	•••	••
COON CREEK TRIB. #1	2	••	•	•	•••
NORTH FORK CALAPOOYA CREEK	1	•••	•	•	••
NORTH FORK CALAPOOYA CREEK	2	••	••	•	•

Stream	Reach	Pools	Riffles	Riparian Area	Large Woody Material
NORTH FORK HINKLE CREEK	1	•	•	•••	•
NORTH FORK HINKLE CREEK	2	•	•	•••	•••
GOSSETT CREEK	1	••	•	•	•
GOSSETT CREEK	2	••	•	•	•
GOSSETT CREEK	3	•	•	•	••
BOYD CREEK	1	••	•	••	••
BOYD CREEK	2	•••	•	•	•
BANKS CREEK	1	•	•	•	•
DODGE CANYON CREEK	1	•••	••	•	•
DODGE CANYON CREEK	2	•	•	•	•
DODGE CANYON CREEK	3	•••	••	••	•
DODGE CANYON CREEK	4	•••	••	••	•
DODGE CANYON CREEK	5	•••	•••	••	•
CABIN CREEK	1	•••	•	•	•
CABIN CREEK	2	•••	•	•	•
CABIN CREEK	3	•••	•	•	•
CABIN CREEK	4	•••	•••	•••	•
CABIN CREEK	5	•••	•	•	•
CABIN CREEK	6	•••	•	••	•
CALAPOOYA CREEK	1	••	•	•	•
CALAPOOYA CREEK	2	•••	•	•	•
CALAPOOYA CREEK	3	•••	•	•	•
CALAPOOYA CREEK	4	•••	•	•	•
CALAPOOYA CREEK	5	•••	•	•	•
CALAPOOYA CREEK	6	•	•	•	•
CALAPOOYA CREEK	7	••	•	•	•
CALAPOOYA CREEK	8	•	••	•	•
CALAPOOYA CREEK	9	••	••	•	•
CALAPOOYA CREEK	10	••	••	•••	•
CALAPOOYA CREEK	11	•	•	•	•

Appendix 5: Land use classifications for the ODFW stream habitat surveys

The Oregon Department of Fish and Wildlife classified the land use for each reach surveyed within the Calapooya Creek Watershed. All categories have been included below, even those not applicable to the Calapooya Creek Watershed.

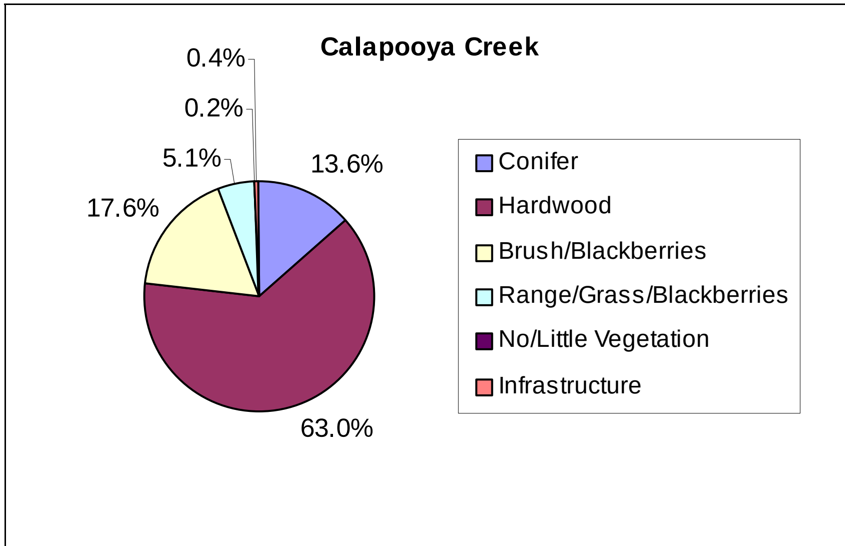
AG Agricultural crop or dairy land.
TH Timber harvest: active timber management including tree felling, logging, etc. Not yet replanted.
YT Young forest trees: can range from recently planted harvest units to stands with trees up to 15 cm dbh.
ST Second growth timber: trees 15-30 cm dbh within generally dense, rapidly growing, uniform stands.
LT Large timber: 30 to 50 cm dbh.
MT Mature timber: 50 to 90 cm dbh.
OG Old growth forest: many trees with 90+ cm dbh and plant community with old growth characteristics.
PT Partial cut timber: selection cut or shelterwood cut with partial removal of large trees. Combination of stumps and standing timber.
FF Forest fire: evidence of recent charring and tree mortality.
BK Bug kill: eastside forests with >60% mortality from pests and diseases.
LG Light grazing pressure: grasses, forbs, and shrubs present. Banks not broken down, animal presence obvious only at limited points such as water crossing. Cow pies evident.
HG Heavy grazing pressure: broken banks, well established cow paths. Primarily bare earth or early successional stages of grasses and forbs present.
EX Exclosure: fenced area that excludes cattle from a portion of rangeland.
UR Urban
RR Rural residential
IN Industrial
MI Mining
WL Wetland
NU No use identified

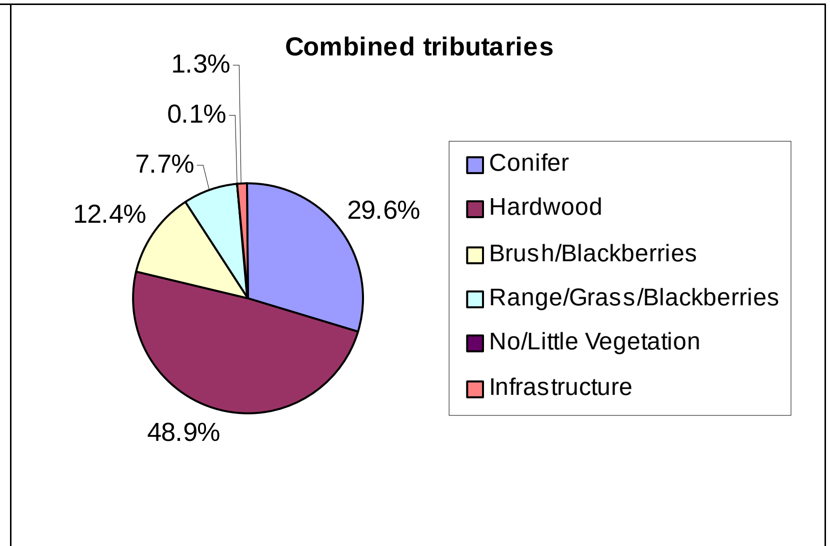
Creek	Reach	Primary land use	Secondary land use
COON CREEK: 1	1	HG	RR
COON CREEK: 1	2	HG	RR
COON CREEK: 2	1	RR	-
COON CREEK: 2	2	YT	-
COON CREEK: 2	3	ST	-
COON CREEK: 2	4	ST	-
COON CREEK: 2	5	ST	-
FIELD CREEK	1	AG	ST
FIELD CREEK	2	ST	TH

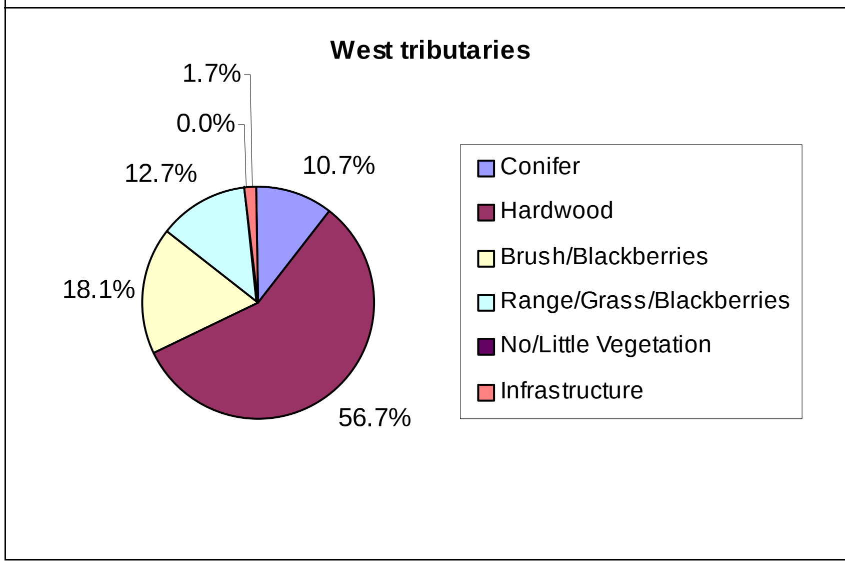
Creek	Reach	Primary land use	Secondary land use
GASSY CREEK	1	ST	HG
GASSY CREEK	2	ST	LG
GASSY CREEK	3	-	-
GASSY CREEK	4	ST	MT
GASSY CREEK	5	ST	MT
HANEY CREEK	1	AG	-
HANEY CREEK	2	ST	-
HANEY CREEK	3	ST	-
HINKLE CREEK	1	RR	ST
HINKLE CREEK	2	ST	-
HINKLE CREEK	3	ST	-
HINKLE CREEK	4	ST	-
MIDDLE FORK CALAPOOYA CREEK	1	ST	-
MIDDLE FORK CALAPOOYA CREEK	2	YT	-
MILL CREEK	1	ST	-
MILL CREEK	2	ST	-
MILL CREEK	3	ST	-
NORTON CREEK	1	HG	AG
NORTON CREEK	2	HG	AG
NORTON CREEK	3	ST	RR
NORTON CREEK	4	AG	LG
NORTON CREEK	5	AG	LG
OLDHAM CREEK	1	AG	-
OLDHAM CREEK	2	AG	-
OLDHAM CREEK	3	AG	-
OLDHAM CREEK	4	-	-
OLDHAM CREEK	5	AG	-
OLDHAM CREEK	6	AG	-
POLLOCK CREEK	1	AG	LG
POLLOCK CREEK	2	AG	LG
POLLOCK CREEK	3	AG	LG
POLLOCK CREEK	4	AG	LG
POLLOCK CREEK	5	AG	TH
POLLOCK CREEK	6	AG	HG
POLLOCK CREEK	7	AG	ST
SLIDE CREEK	1	AG	-
SLIDE CREEK	2	ST	-
SLIDE CREEK	3	ST	-
S. FK. HINKLE CREEK	1	ST	-
S. FK. HINKLE CREEK	2	ST	-
WHITE CREEK	1	ST	-
WHITE CREEK	2	ST	-
WHITE CREEK	3	TH	-
WILLIAMS CREEK	1	AG	RR
WILLIAMS CREEK	2	AG	RR
WILLIAMS CREEK	3	HG	AG

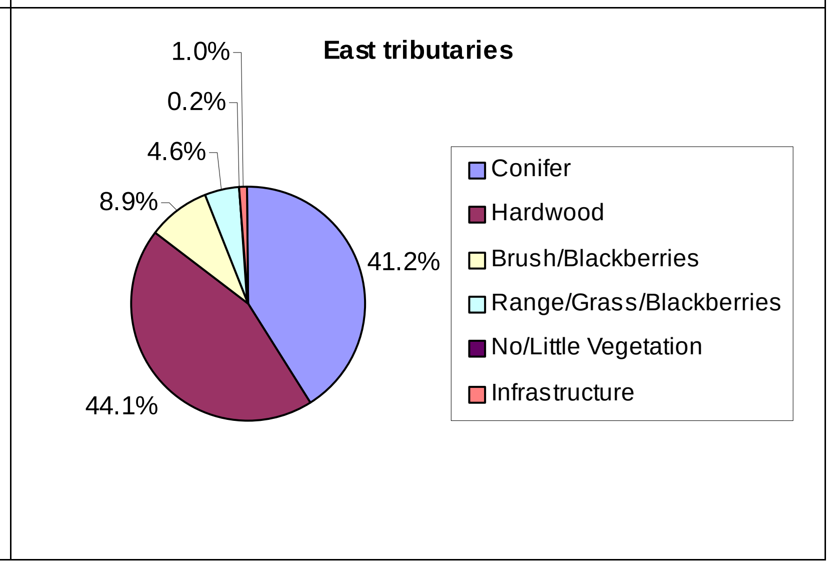
Creek	Reach	Primary land use	Secondary land use
WILLIAMS CREEK	4	HG	AG
COON CREEK TRIB. #1	1	ST	-
COON CREEK TRIB. #1	2	YT	-
NORTH FORK CALAPOOYA CREEK	1	ST	-
NORTH FORK CALAPOOYA CREEK	2	ST	-
NORTH FORK HINKLE CREEK	1	ST	-
NORTH FORK HINKLE CREEK	2	ST	-
GOSSETT CREEK	1	AG	-
GOSSETT CREEK	2	ST	-
GOSSETT CREEK	3	TH	-
BOYD CREEK	1	ST	AG
BOYD CREEK	2	ST	-
BANKS CREEK	1	HG	AG
DODGE CANYON CREEK	1	RR	AG
DODGE CANYON CREEK	2	-	-
DODGE CANYON CREEK	3	RR	TH
DODGE CANYON CREEK	4	RR	TH
DODGE CANYON CREEK	5	RR	ST
CABIN CREEK	1	AG	RR
CABIN CREEK	2	AG	LG
CABIN CREEK	3	AG	LG
CABIN CREEK	4	AG	MT
CABIN CREEK	5	AG	LG
CABIN CREEK	6	RR	LG
CALAPOOYA CREEK	1	HG	-
CALAPOOYA CREEK	2	HG	ST
CALAPOOYA CREEK	3	RR	-
CALAPOOYA CREEK	4	HG	-
CALAPOOYA CREEK	5	HG	ST
CALAPOOYA CREEK	6	AG	-
CALAPOOYA CREEK	7	RR	-
CALAPOOYA CREEK	8	YT	ST
CALAPOOYA CREEK	9	ST	-
CALAPOOYA CREEK	10	LT	-
CALAPOOYA CREEK	11	ST	-

Appendix 6: Riparian vegetation and features

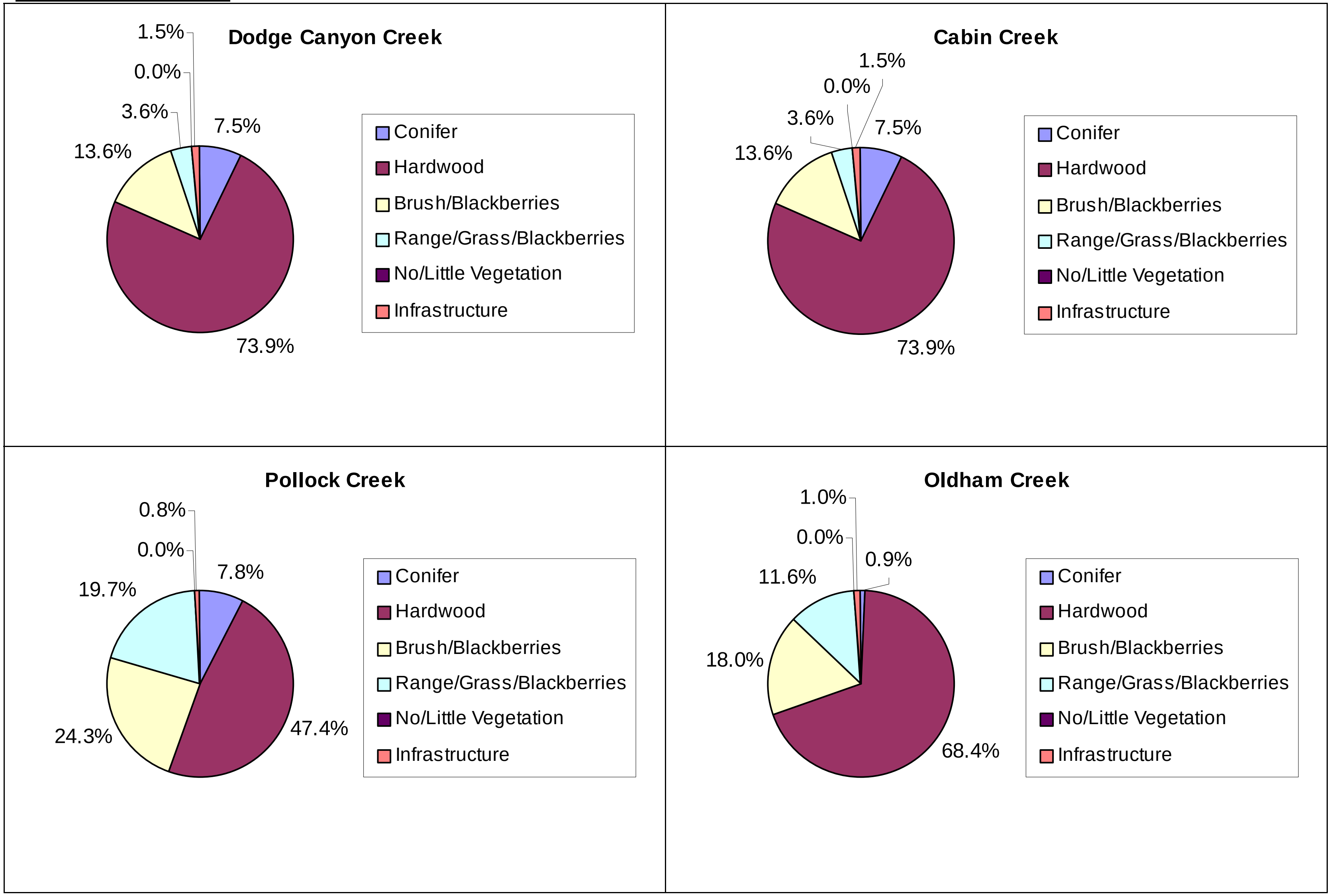


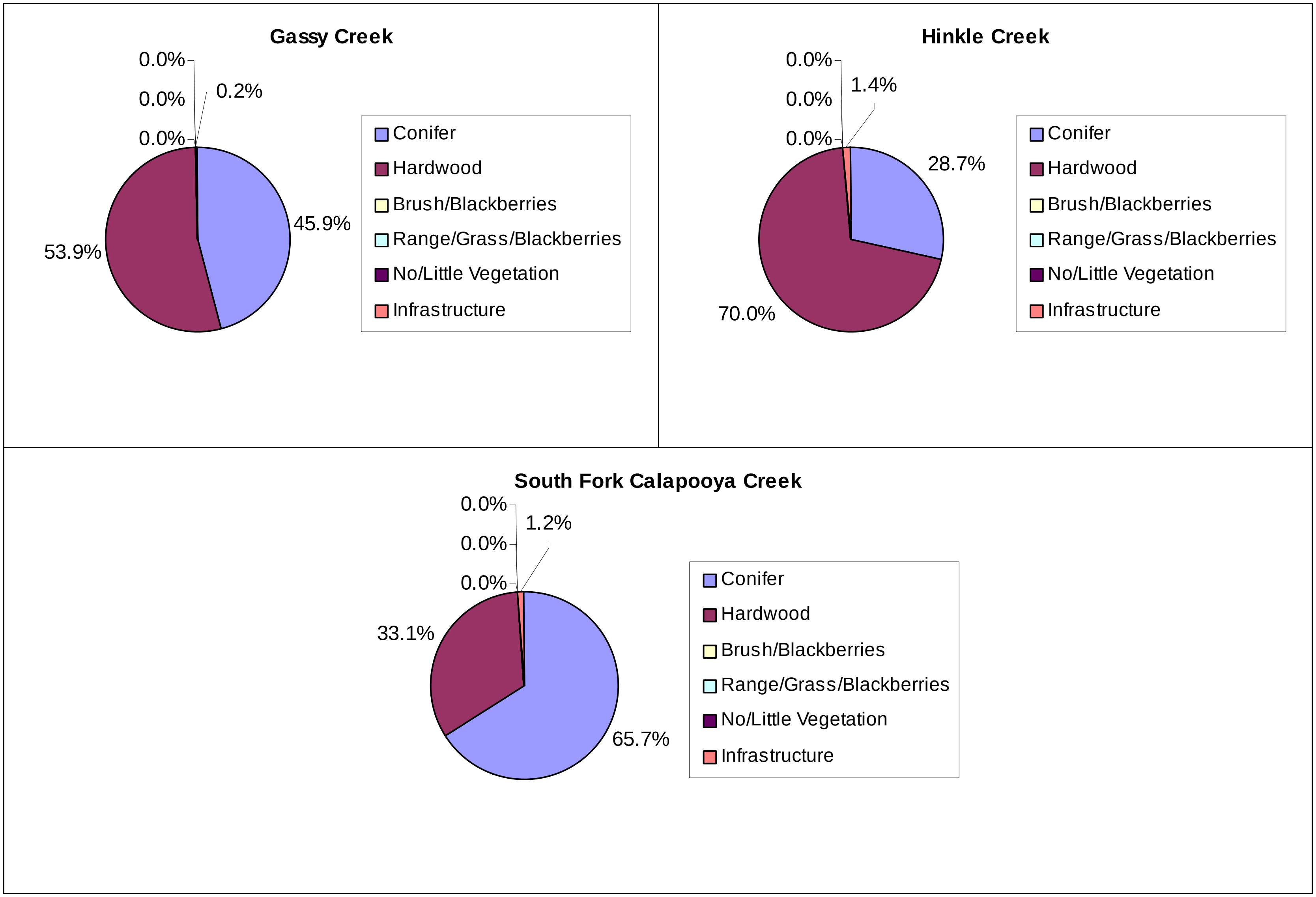




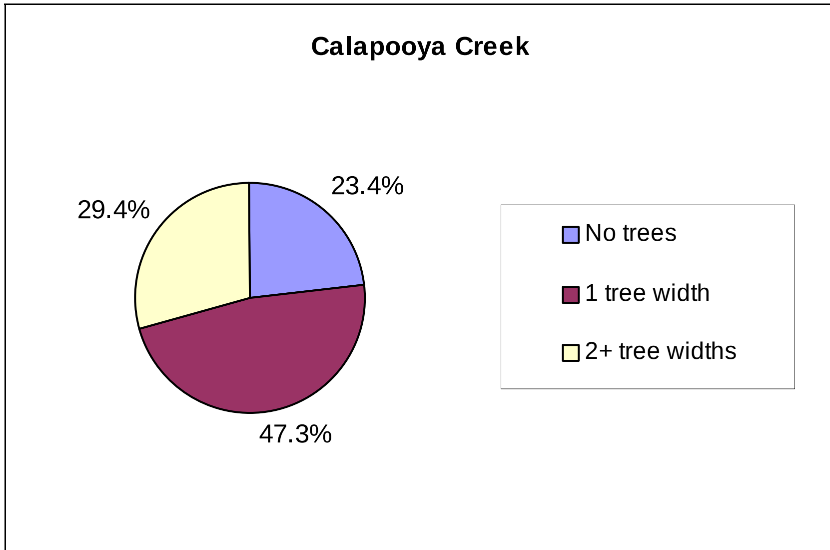


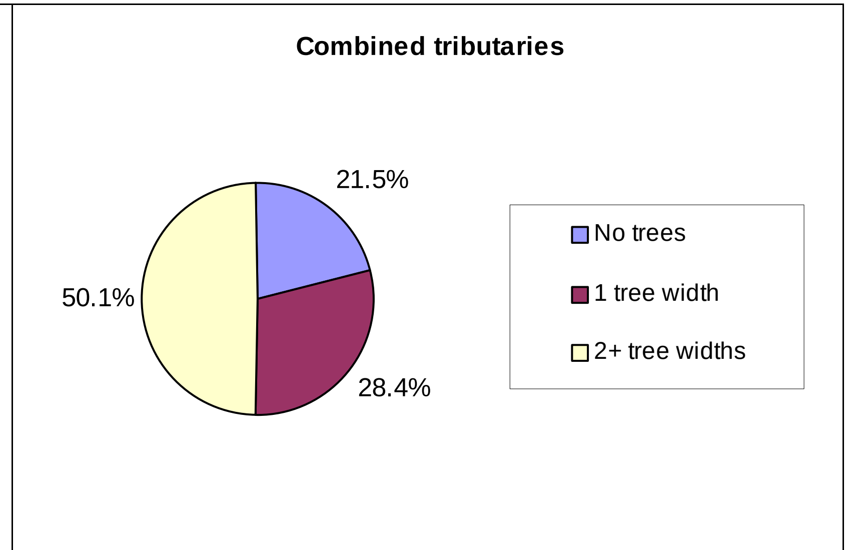
Individual tributaries

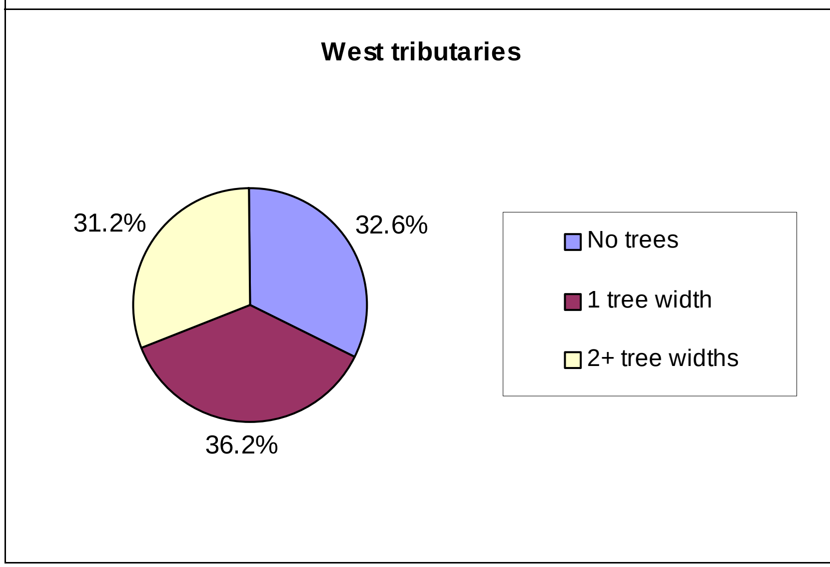


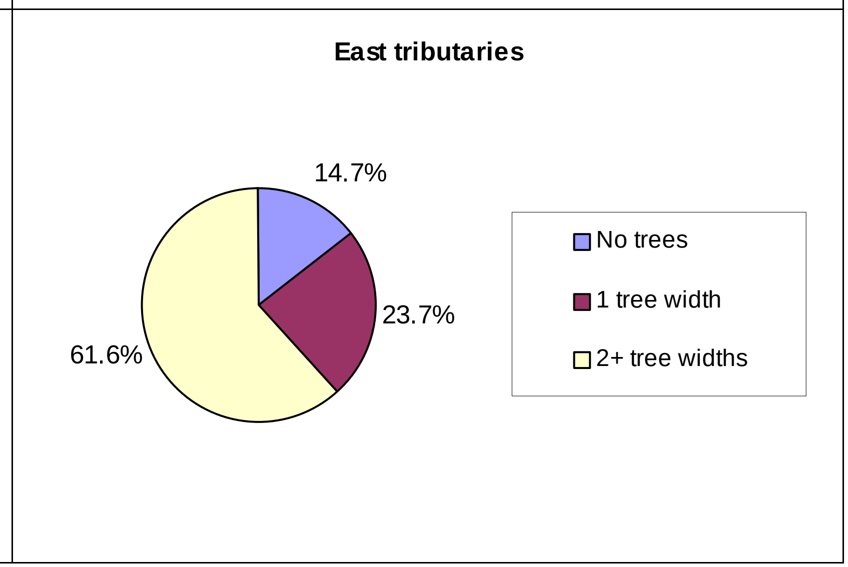

Gassy Creek
0.0%
0.0%
0.0%
0.2%
45.9%
53.9%
Conifer
Hardwood
Brush/Blackberries
Range/Grass/Blackberries
No/Little Vegetation
Infrastructure
Hinkle Creek
0.0%
0.0%
0.0%
1.4%
28.7%
70.0%
Conifer
Hardwood
Brush/Blackberries
Range/Grass/Blackberries
No/Little Vegetation
Infrastructure
South Fork Calapooya Creek
0.0%
0.0%
0.0%
1.2%
33.1%
65.7%
Conifer
Hardwood
Brush/Blackberries
Range/Grass/Blackberries
No/Little Vegetation
Infrastructure

Appendix 7: Buffer width

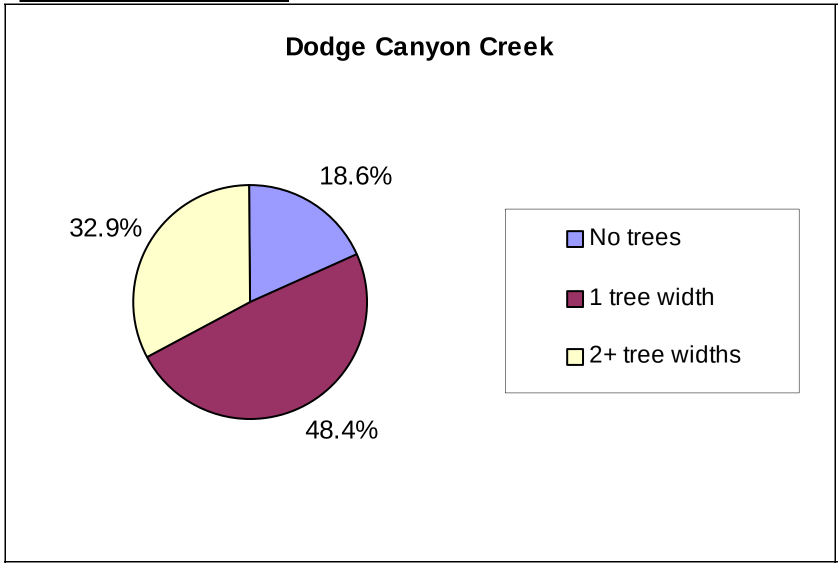


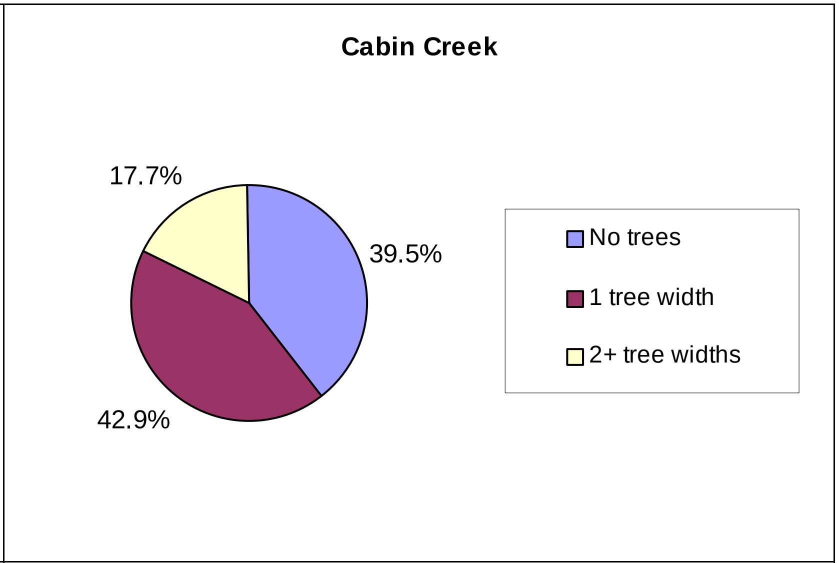


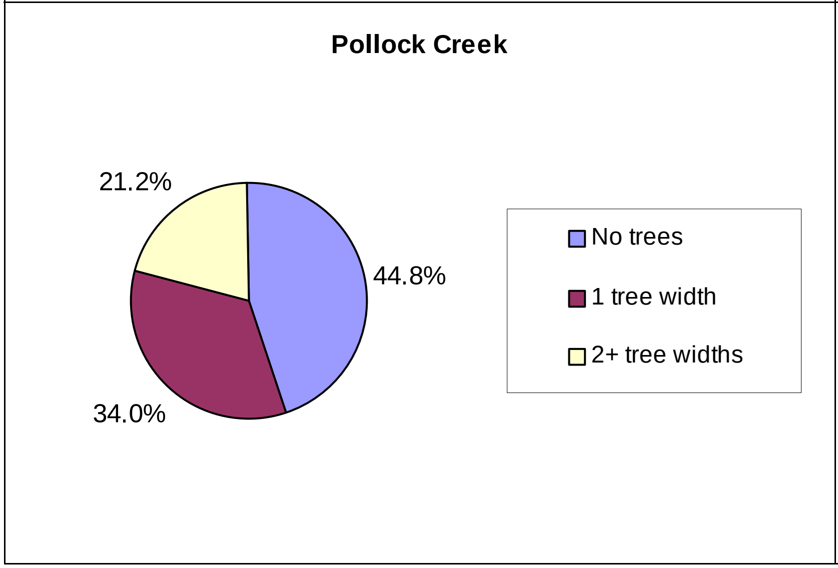


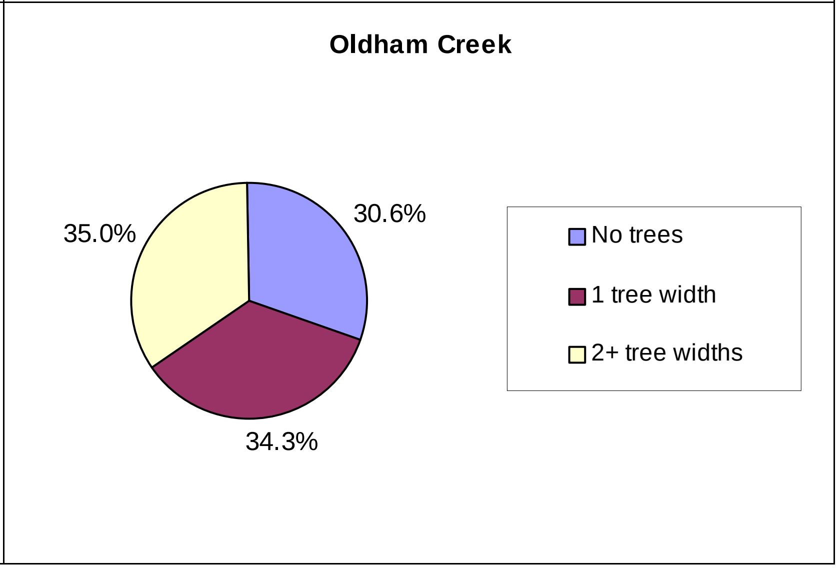


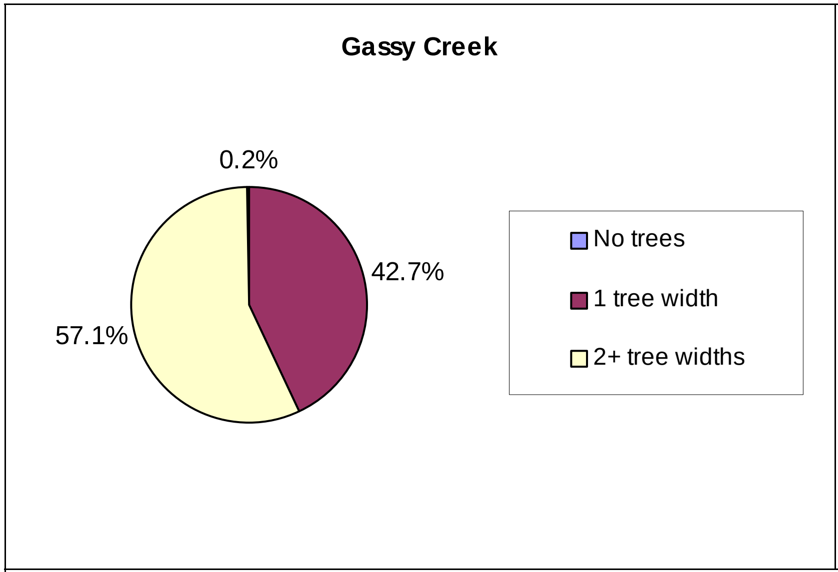
Individual tributaries

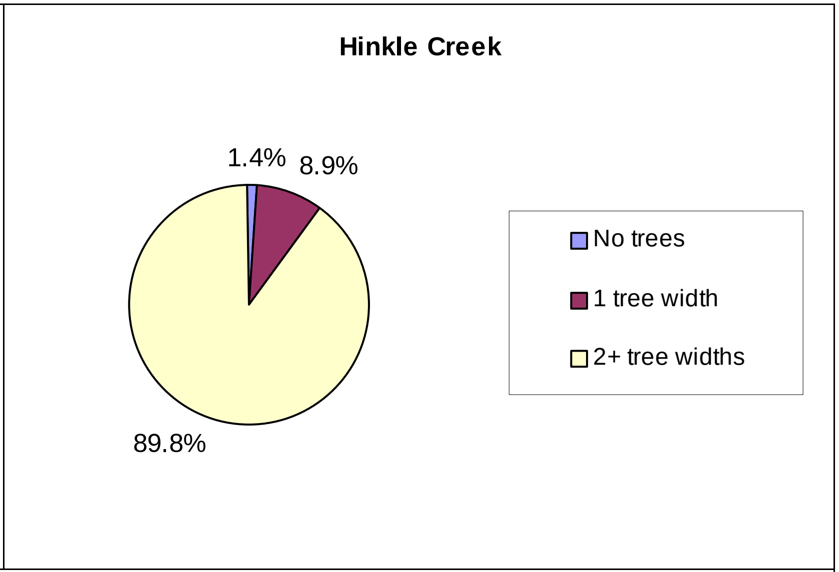


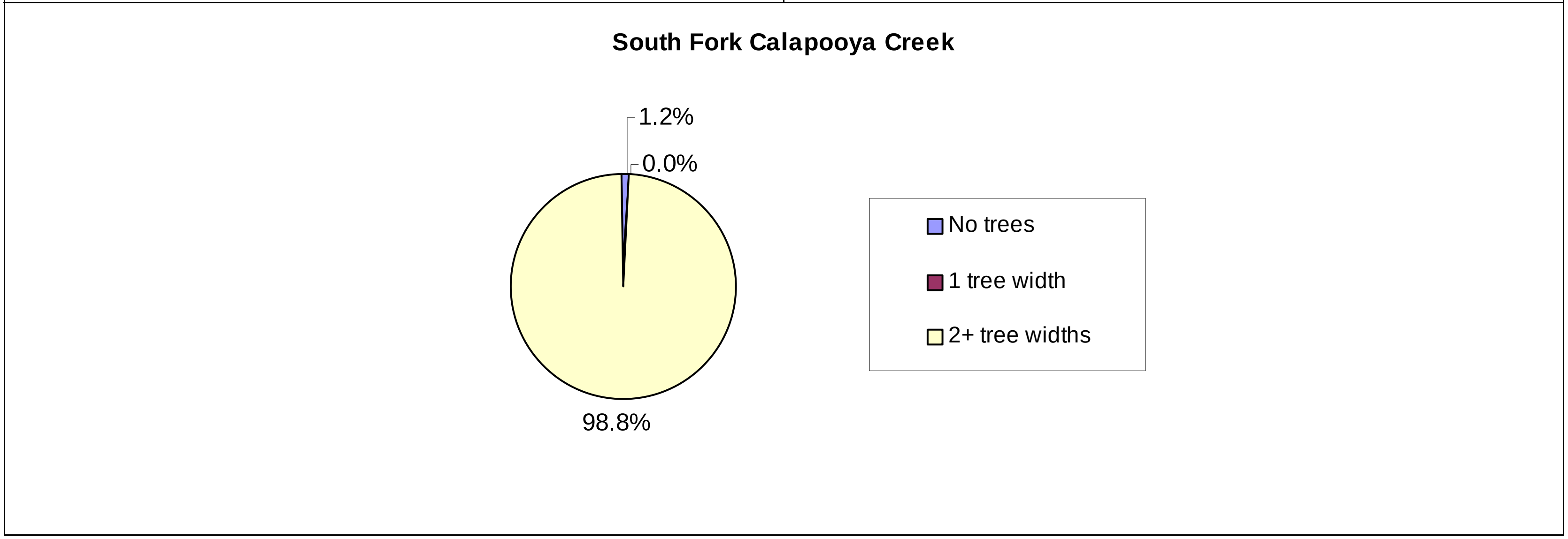






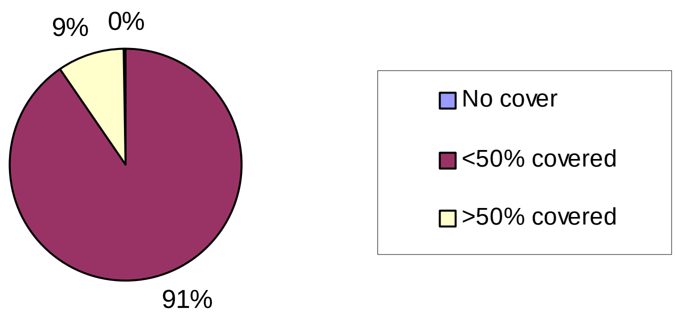

Gassy Creek
0.2%
42.7%
57.1%
No trees
1 tree width
2+ tree widths


Hinkle Creek
1.4%
8.9%
89.8%
No trees
1 tree width
2+ tree widths

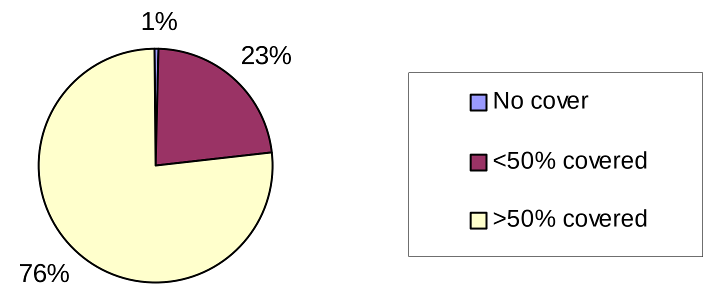

South Fork Calapooya Creek
1.2%
0.0%
98.8%
No trees
1 tree width
2+ tree widths

Appendix 8: Riparian cover

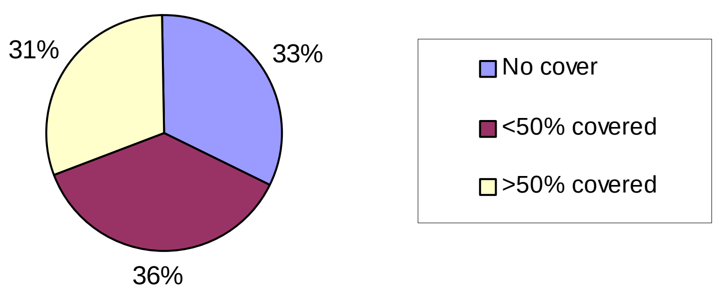
Calapooya Creek



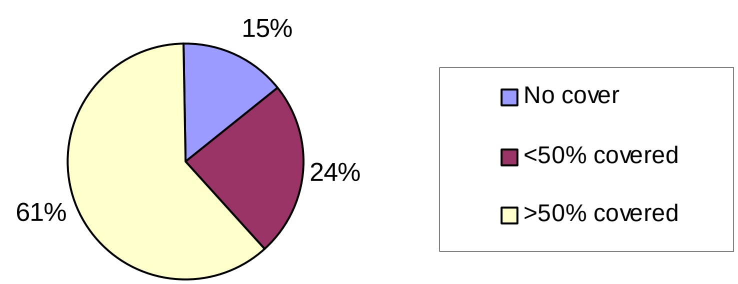
Combined tributaries



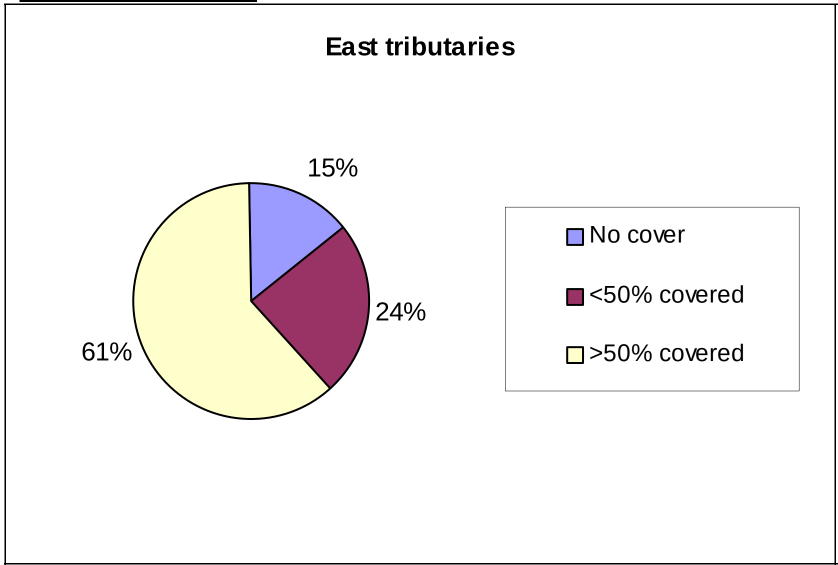
West tributaries

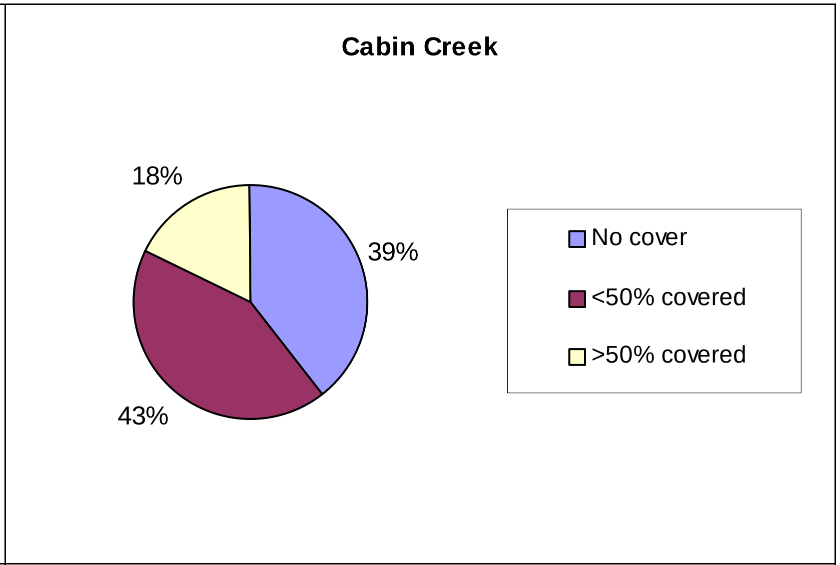


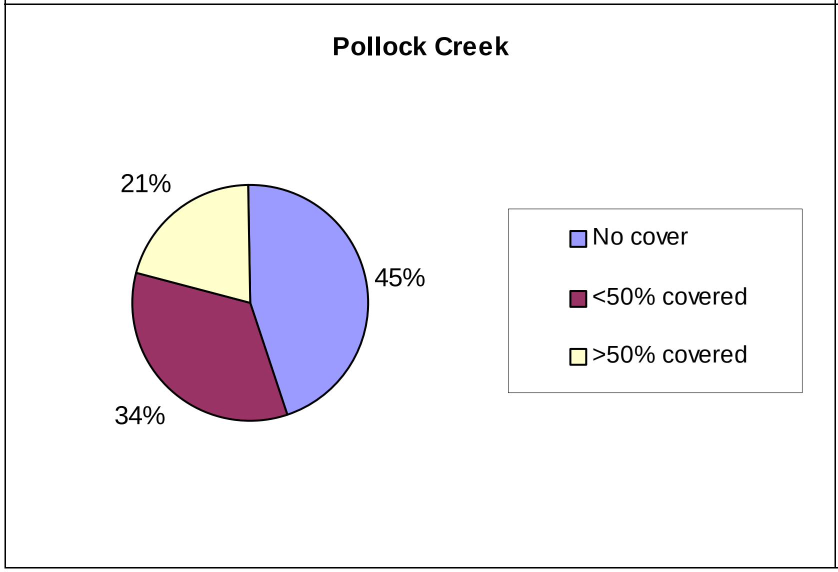
East tributaries

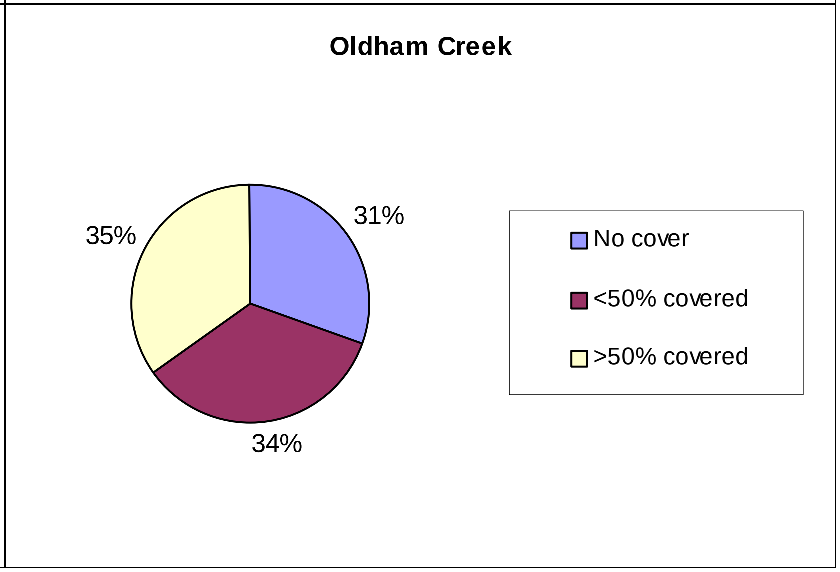


Individual streams

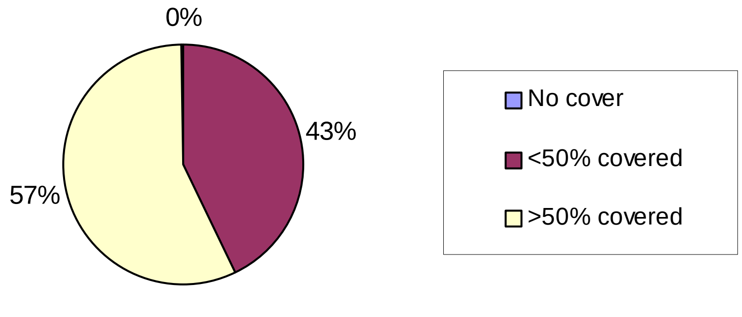




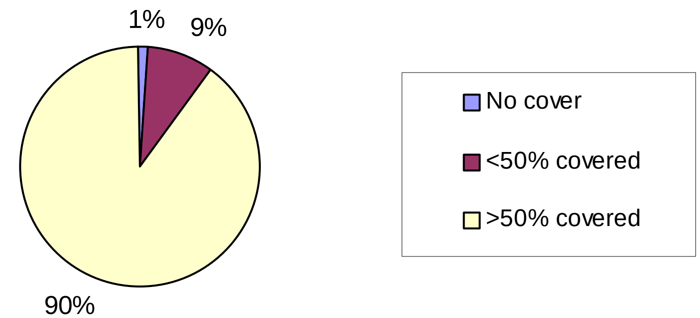




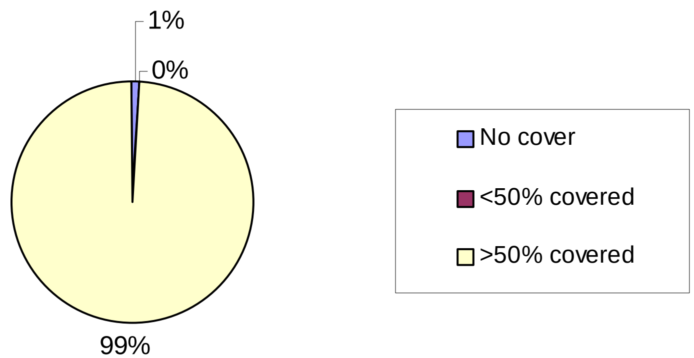
Gassy Creek



Hinkle Creek



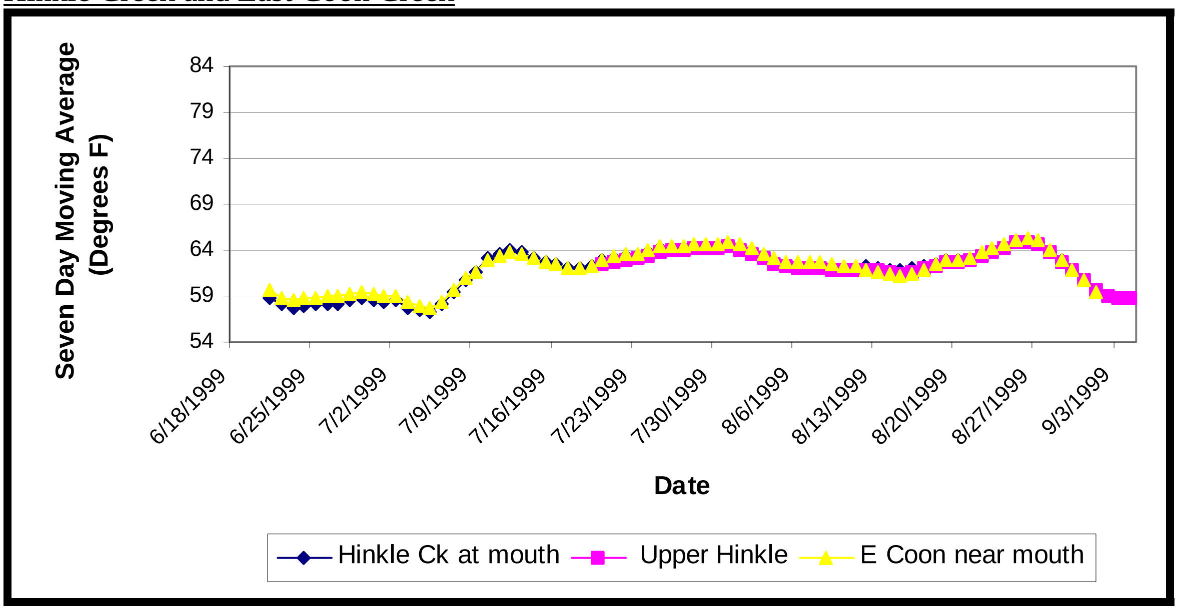
South Fork Calapooya Creek



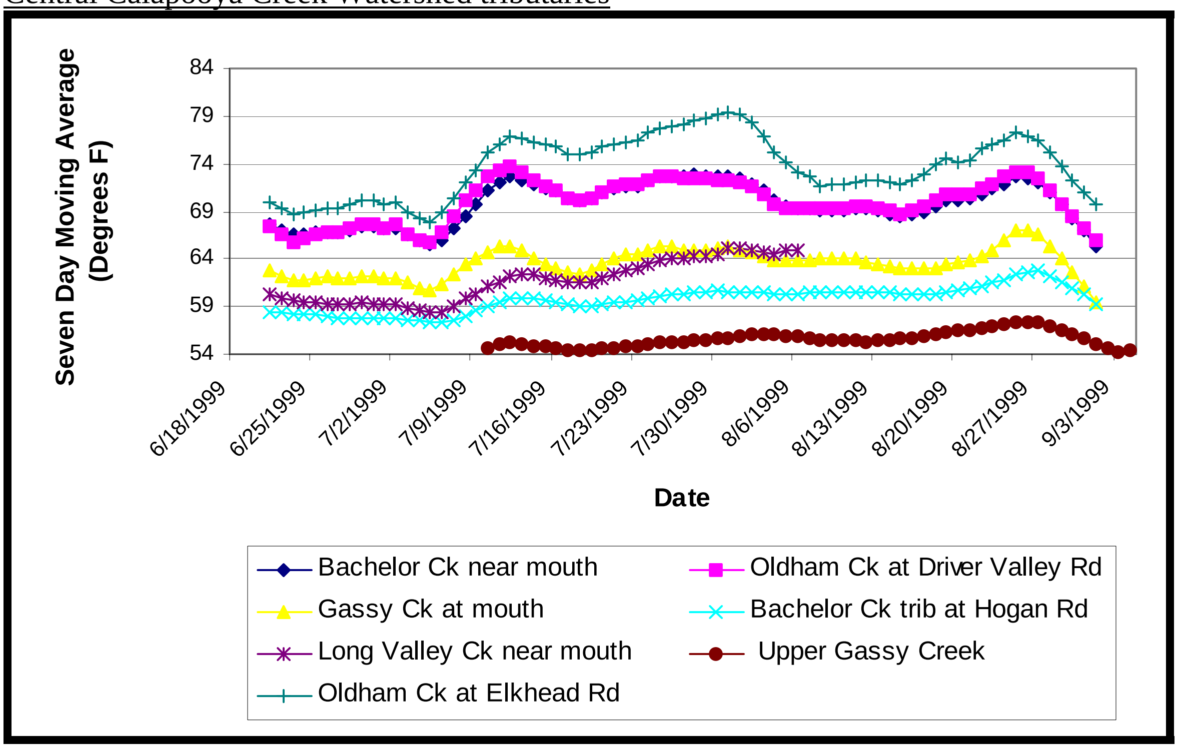
Appendix 9: Calapooya Creek Watershed tributary temperature trends

(From K. Smith, 1999).

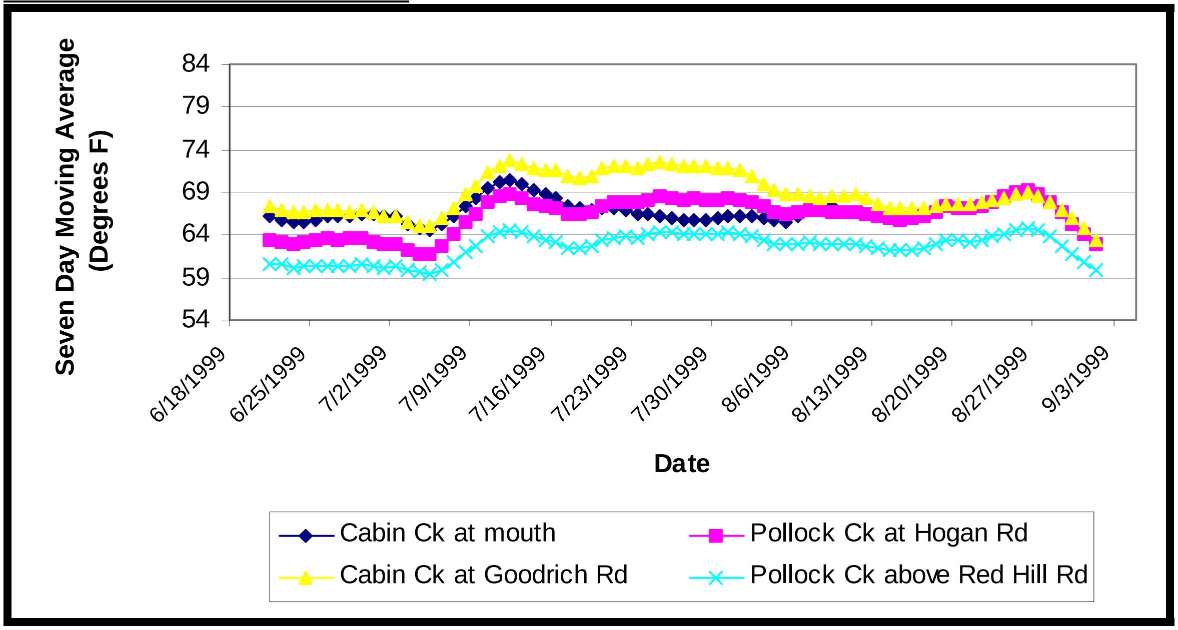
Hinkle Creek and East Coon Creek



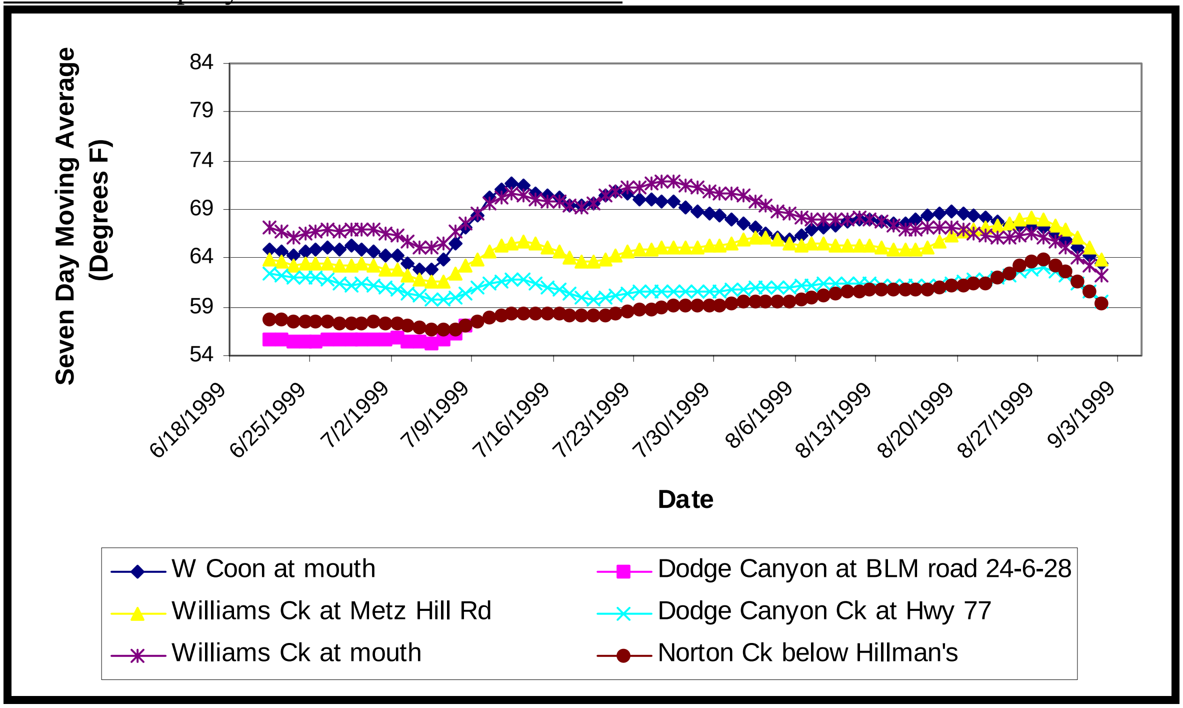
Central Calapooya Creek Watershed tributaries



Cabin Creek and Pollock Creek



Western Calapooya Creek Watershed tributaries



Appendix 10: Additional information about iron, lead, manganese, copper, arsenic, and mercury.

Information about the following toxics was taken from web pages by the Kentucky Department of Natural Resources' River Assessment Monitoring Project and the Environmental Bureau of Investigation:

- Iron: http://water.nr.state.ky.us/ww/ramp/rmfe.htm
- Lead: http://water.nr.state.ky.us/ww/ramp/rmlead.htm
- Manganese: http://water.nr.state.ky.us/ww/ramp/rmmag.htm
- Copper: http://www.e-b-i.net/ebi/contaminants/copper.html
- Arsenic: http://www.e-b-i.net/ebi/contaminants/arsenic.html

Information about mercury is compiled from the following web pages by the US Geological Survey and the Oregon Public Health Services:

- http://water.usgs.gov/wid/FS_216-95/FS_216-95.html
- http://www.ohd.hr.state.or.us/esc/docs/fishfact.htm

Iron
Iron is the fourth most abundant element, by weight, in the earth's crust. Natural waters contain variable amounts of iron depending on the geological area and other chemical components of the waterway. Iron in groundwater is normally present in the ferrous or bivalent form (Fe++), which is soluble. It is easily oxidized to ferric iron (Fe+++) or insoluble iron upon exposure to air. This precipitate is orange-colored and often turns streams orange.

Iron is a trace element required by both plants and animals. It is a vital part of the oxygen transport mechanism in the blood (hemoglobin) of all vertebrate and some invertebrate animals. Ferrous (Fe++) and ferric (Fe+++) ions are the primary forms of concern in the aquatic environment. Other forms may be in either organic or inorganic wastewater streams. The ferrous form Fe++ can persist in water void of dissolved oxygen and usually originates from groundwater or mines that are pumped or drained. Iron in domestic water supply systems stains laundry and porcelain. It appears to be more of a nuisance than a potential health hazard. Taste thresholds of iron in water are 0.1 mg/l for ferrous iron and 0.2 mg/l for ferric iron, giving a bitter or an astringent taste. Water to be used in industrial processes should contain less than 0.2 mg/l of iron. Black or brown swamp waters may contain iron concentrations of several mg/l in the presence or absence of dissolved oxygen, but has little effect on aquatic life. Iron can have toxic effects on aquatic life in concentrations that are less than 1.0 mg/l.

Lead
The primary natural source of lead is in the mineral galena (lead sulfide). It also occurs as carbonate, as sulfate and in several other forms. The solubility of these minerals and also of lead oxides and other inorganic salts is low. Major modern day uses of lead are for batteries, pigments, and other metal products. In the past, lead was used as an additive in gasoline and

became dispersed throughout the environment in the air, soils, and waters as a result of automobile exhaust emissions. For years this was the primary source of lead in the environment. However, since the replacement of leaded gasoline with unleaded gasoline in the mid-1980s, lead from that source has virtually disappeared. Mining, smelting and other industrial emissions and combustion sources and solid waste incinerators are now the primary sources of lead. Another source of lead is paint chips and dust from buildings built before 1978 and from bridges and other metal structures.

Lead is not an essential element. In humans it can affect the kidneys, the blood and, most importantly, the nervous system and brain. Even low levels in the blood have been associated with high blood pressure and reproductive effects. Lead is stored in the bones. Lead reaches water bodies either through urban runoff or discharges such as sewage treatment plants and industrial plants. It also may be transferred from the air to surface water through precipitation (rain or snow). Toxic to both plant and animal life, lead's toxicity depends on its solubility and this, in turn, depends on pH and is affected by hardness.

Manganese

Manganese is a transition element that is gray, white, or silver in color. It is soft and ductile if pure, but usually occurs in compounds. In natural waters it rarely exceeds 1.0 mg/l. At 0.1 mg/l, taste and staining problems may occur. Manganese forms a number of salt compounds. These compounds can include $KMnO_4$ (potassium permanganate) and K_2MnO_3 (potassium manganate). Frequently manganese salts will occur in association with iron salts. The primary uses of manganese are in metal alloys, dry cell batteries, and micronutrient fertilizer additives.

Manganese is a vital micronutrient for both plants and animals. When not present in sufficient quantities, plants exhibit a yellowing of leaves (chlorosis) or failure of the leaves to develop properly. Inadequate quantities of manganese in domestic animal food result in reduced reproduction and deformed or poorly maturing young. In humans, very large doses of ingested manganese can cause some diseases and liver damage, but these are not known to occur in the United States. Permanganates have been reported to kill fish in eight to 18 hours at concentrations of 2.2 to 4.1 mg/l, but they are not persistent. Manganese is not known to be a problem in water consumed by livestock. No specific criterion for manganese has been proposed for agricultural waters. Consumer complaints arise when high levels of manganese are found in drinking water or domestic water because of the brownish staining of laundry and objectionable tastes in beverages that may occur.

Copper

Copper is a commonly occurring element in natural water. At low concentrations it is an essential element for both plants and animals. At slightly higher concentrations it is toxic to aquatic life. The toxicity of copper and its compounds to aquatic life varies with the physical and chemical conditions of the water. Factors such as water hardness, alkalinity, and pH influence copper toxicity.

Copper and its compounds have high acute and chronic toxicity to aquatic life. Acute toxic effects may include the death of animals, birds, or fish, and death or low growth rate in plants. Chronic toxic effects may include shortened lifespan, reproductive problems, lower fertility, and changes in appearance or behavior. The concentration of copper found in fish tissues is expected to be considerably higher than the average concentration of copper in the water from which the fish was taken.

Arsenic

Elemental arsenic is a heavy metal that occurs to a limited extent in nature as a steel-gray metal insoluble in water (solubility is less than 1mg/l). It also occurs in black and yellow amorphous (non-crystal) forms. Inorganic arsenic (usually in the As_2O_3 form) is naturally present in many kinds of rock, particularly in copper and lead ores. When heated, these ores release the arsenic as a fine dust that can then be collected and purified. Arsenic is highly reactive and can easily undergo many chemical transformations. Most arsenic compounds can dissolve in water. Arsenic is easily adsorbed by iron and manganese and reacts with clay particles, which explains why it is often found in sediments. Some fish and shellfish can accumulate arsenic in their tissues, but mostly in a form non-toxic to humans.

Arsenic is acutely toxic to animals and may cause death. In animals, the effects of chronic exposure may include shortened life expectancy, decrease in reproduction, and behavioral effects. Arsenic appears to be more toxic to aquatic species than land animals. Studies in animals show that doses of arsenic that are large enough to cause illness in pregnant females may cause low birth weight, fetal malformations, or even fetal death.

Mercury

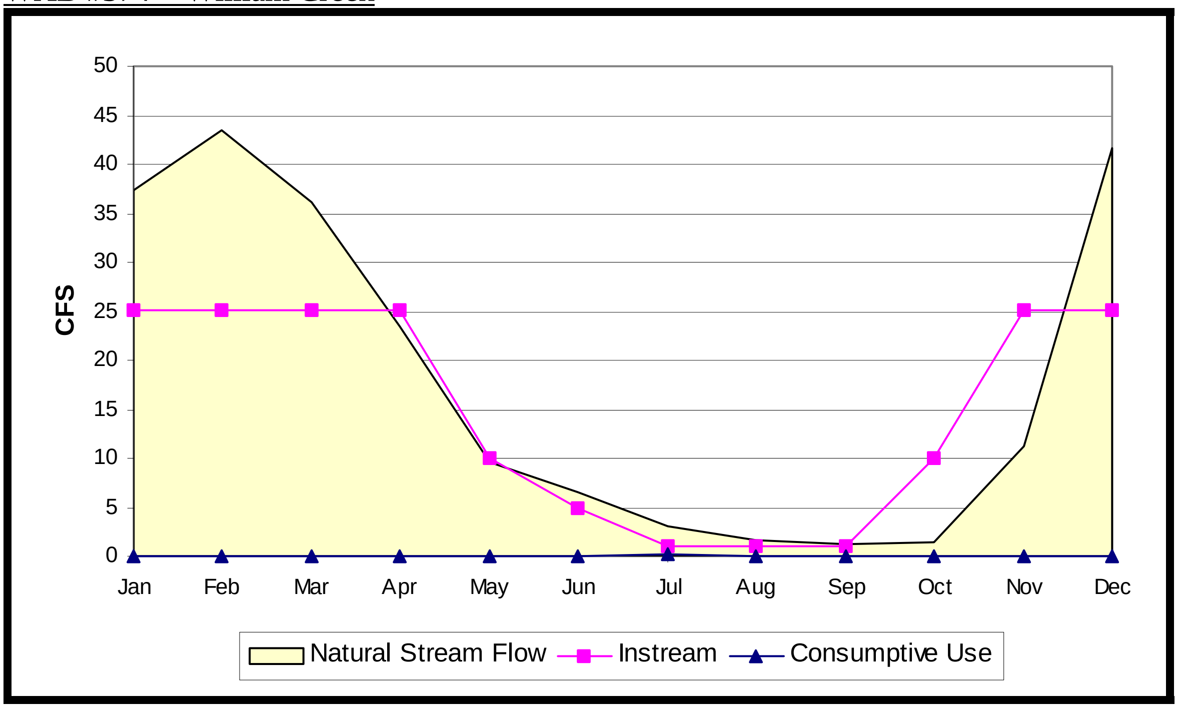
Mercury is poisonous to the human body when it reaches certain concentrations in specific organs. The nervous system (brain, spinal cord, and nerves) is especially sensitive. Fetuses and nursing babies are at high risk because their bodies and nervous systems are developing rapidly and are more vulnerable to damage. Excessive exposure can result in tremors, loss of sensation in the extremities, vision and hearing loss, and developmental and behavioral abnormalities.

When mineral mercury enters a stream system and accumulates at the bottom, bacterial activity transforms it into methylmercury, which is readily absorbed by plants and small animals. Methylmercury is a bioaccumulator, which means that any animals feeding on methylmercury-containing aquatic organisms develop high concentrations of mercury in their systems. The concentrated methylmercury levels are passed on to whatever preys on the aquatic organism. As a result, fish can have very high levels of methylmercury, even when mineral mercury is at low or undetectable levels in the stream. Older, resident fish, such as smallmouth bass, have the highest mercury concentrations. Since salmonids live most of their lives at sea, methylmercury in them comes mostly from oceanic sources, which may be a human health concern but is not an indication of a watershed-specific problem.

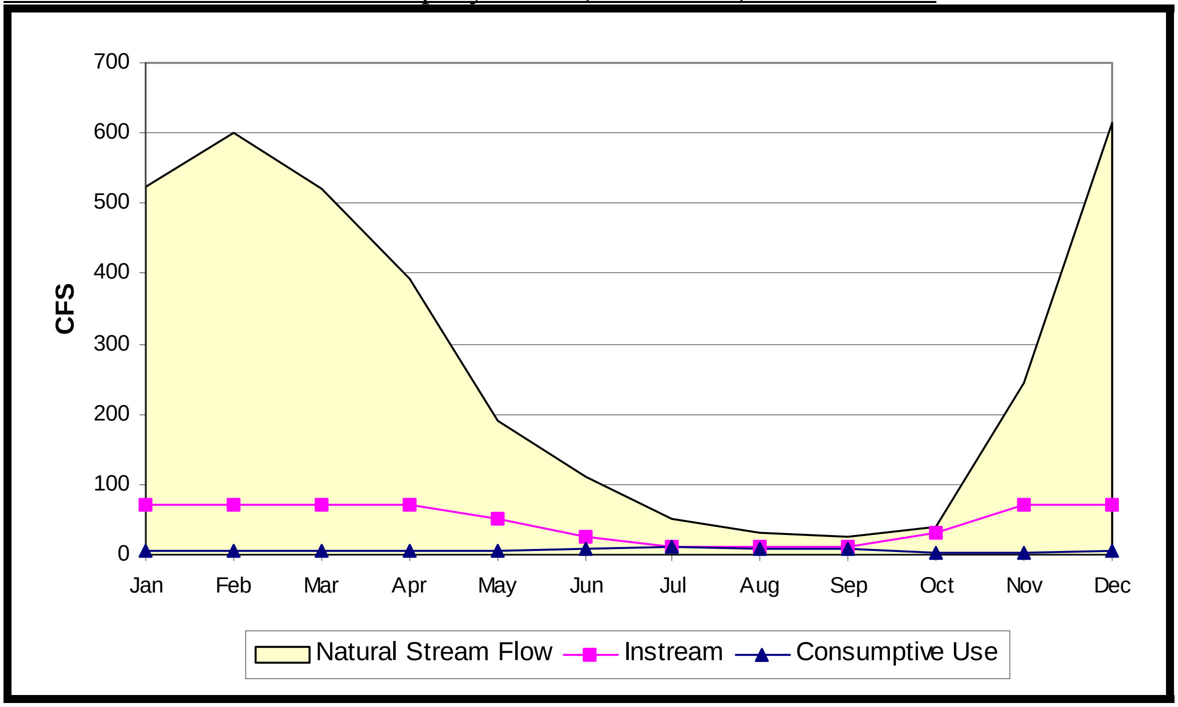
Appendix 11: Water availability graphs

Below are water availability charts for the Water Availability Units (WAB) within the Calapooya Creek Watershed. The WAB number and the major creeks involved are listed for each figure. Gassy Creek is not included because there are no consumptive water rights on this creek.

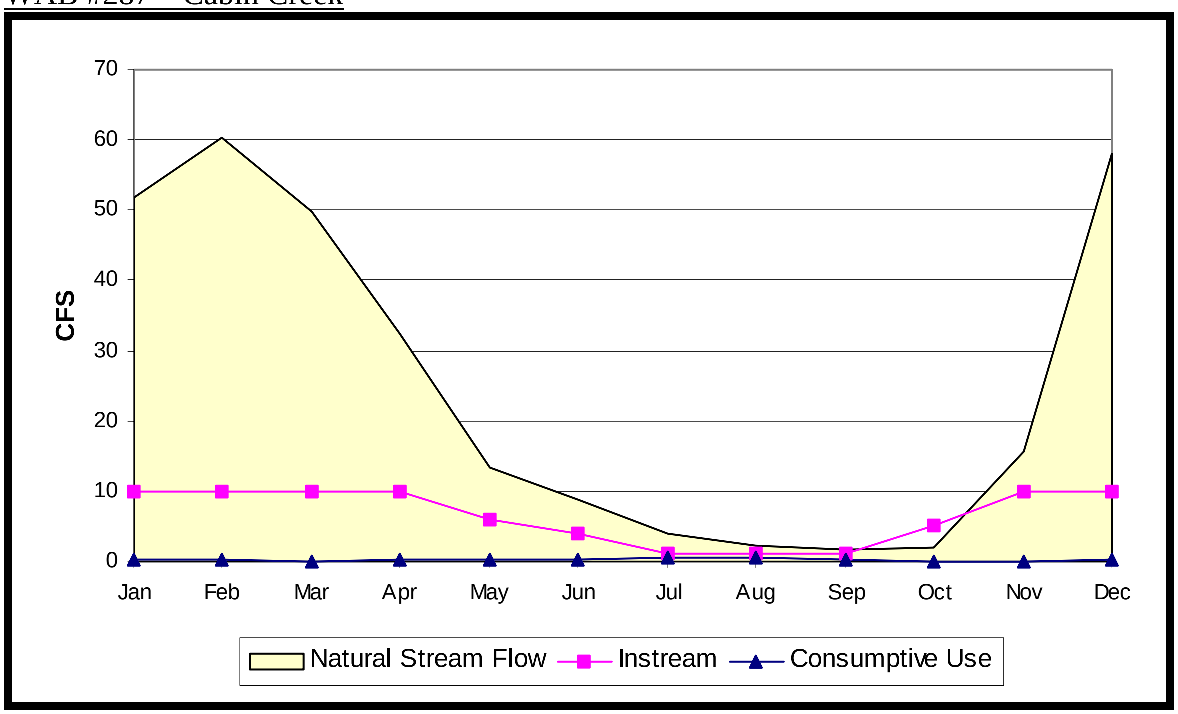
WAB #374 - William Creek



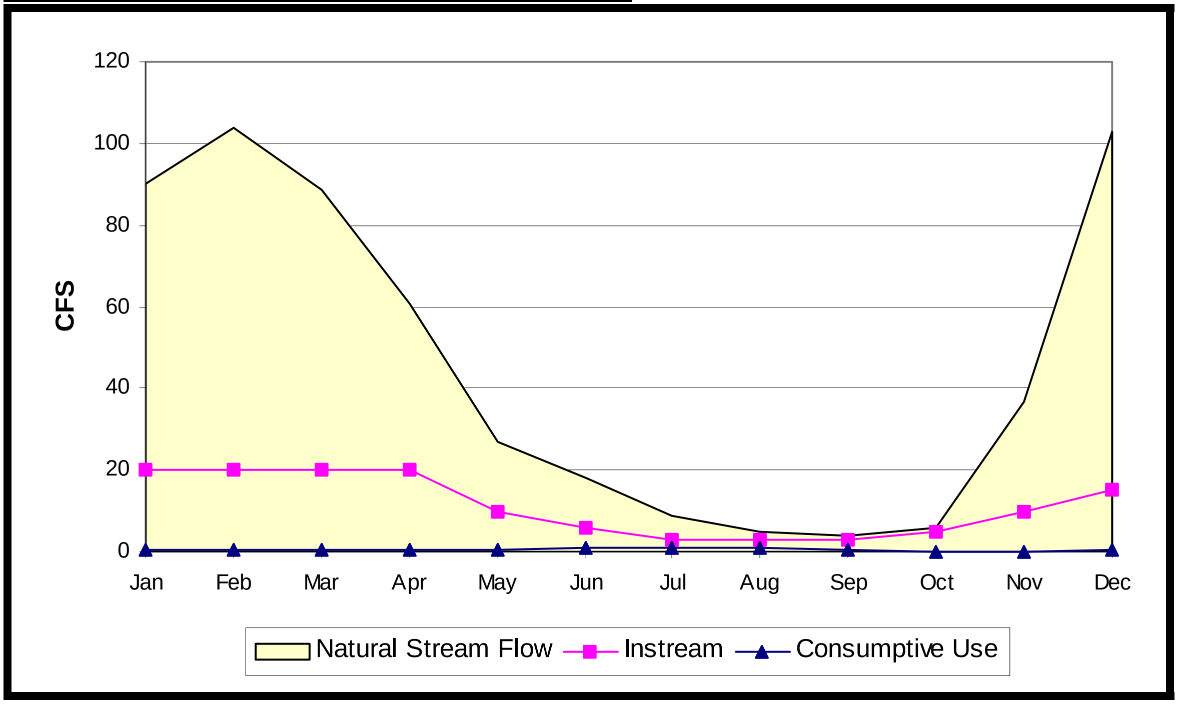
WAB #290 – South-central Calapooya Creek, Oak Creek, Pollock Creek



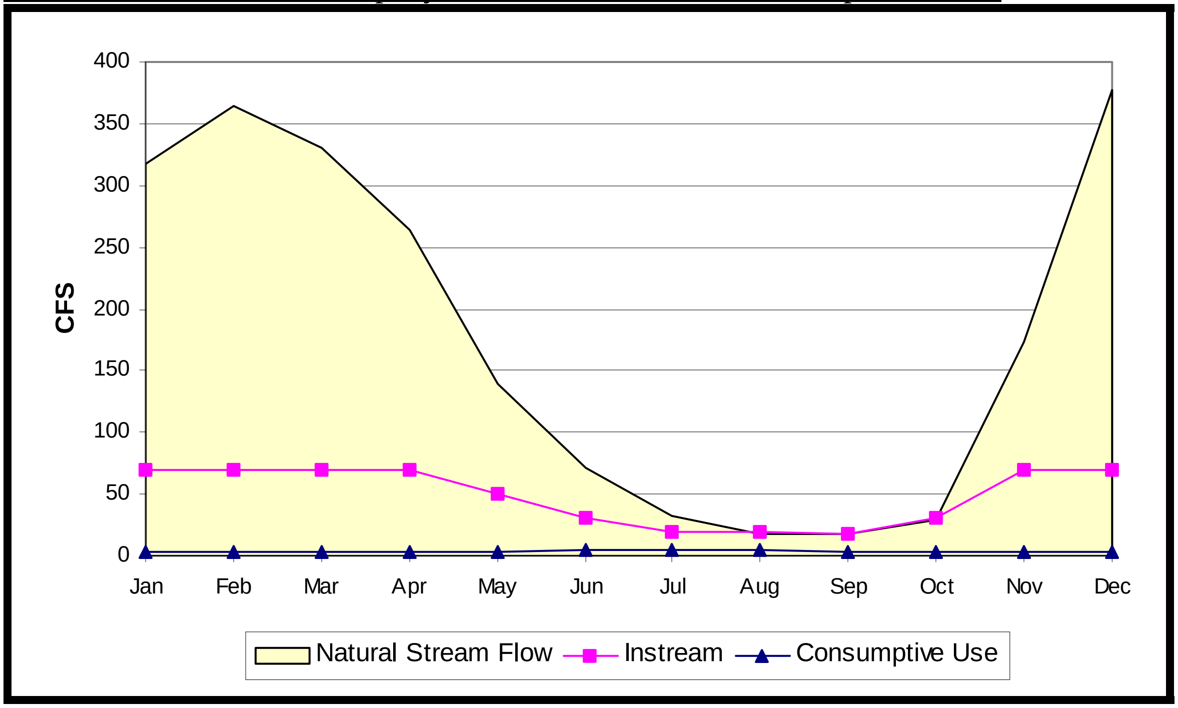
WAB #287 – Cabin Creek



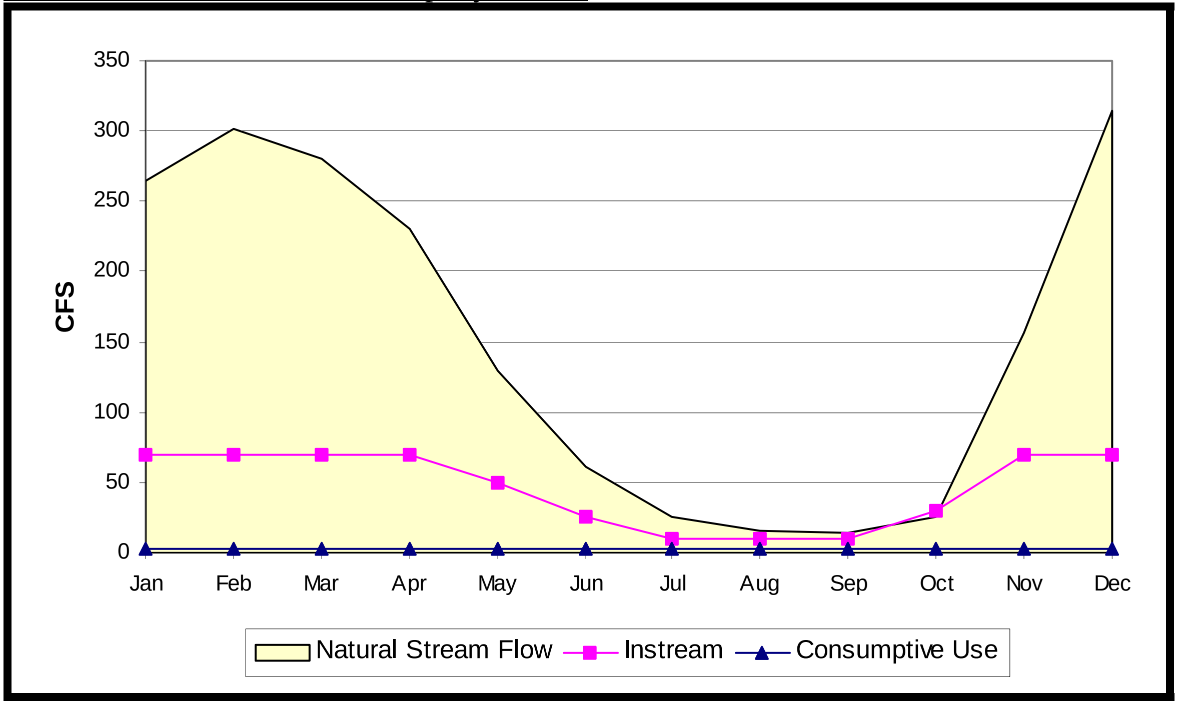
WAB #341 – Oldham Creek and Bachelor Creek



WAB #71181 – Central Calapooya Creek, Banks Creek, and Nonpareil Creek



WAB #31630317 – Eastern Calapooya Creek



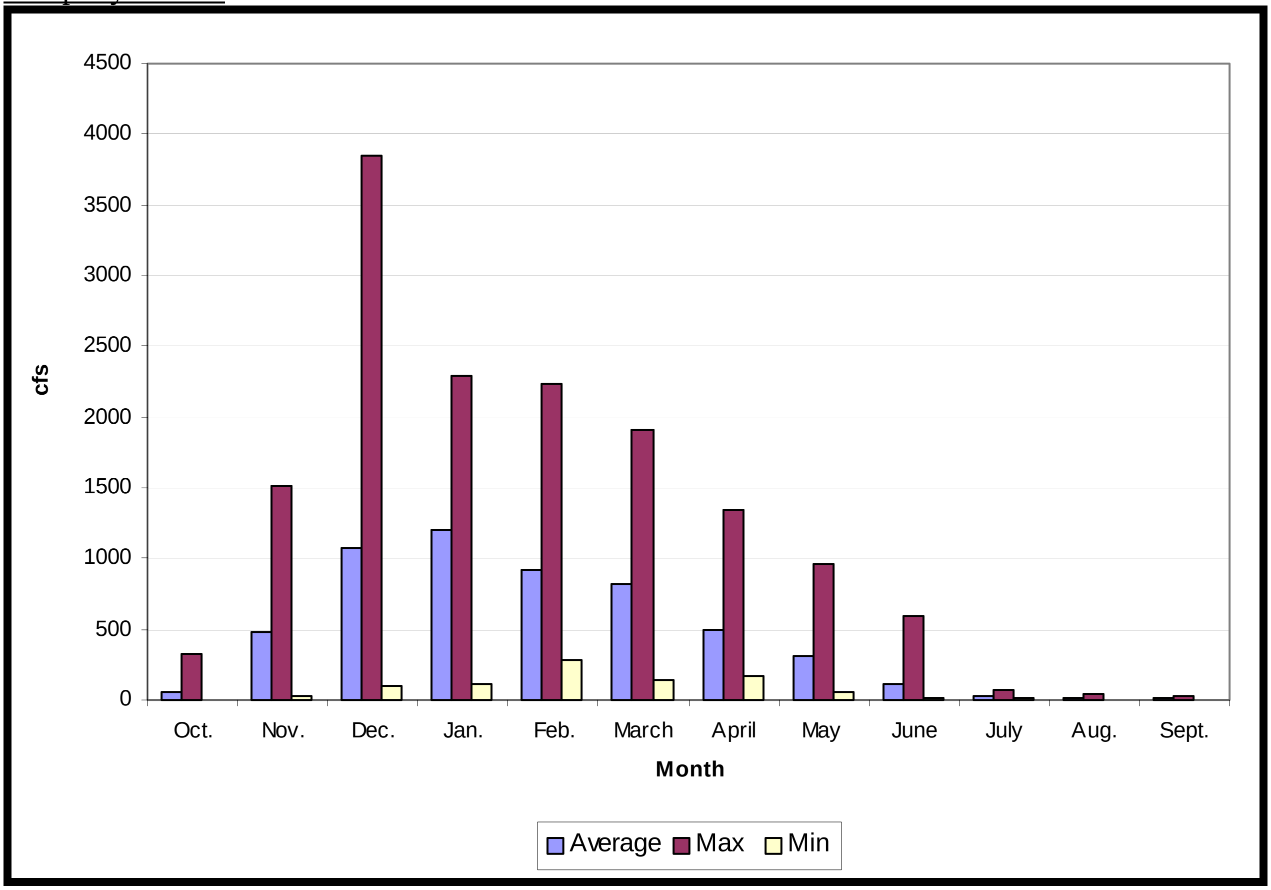
Appendix 12: Water use categories

There are eight general water use categories in the Calapooya Creek Watershed. The table below lists the Oregon Water Resources Department uses that are included in each category. Not all uses occur in the Calapooya Creek Watershed.

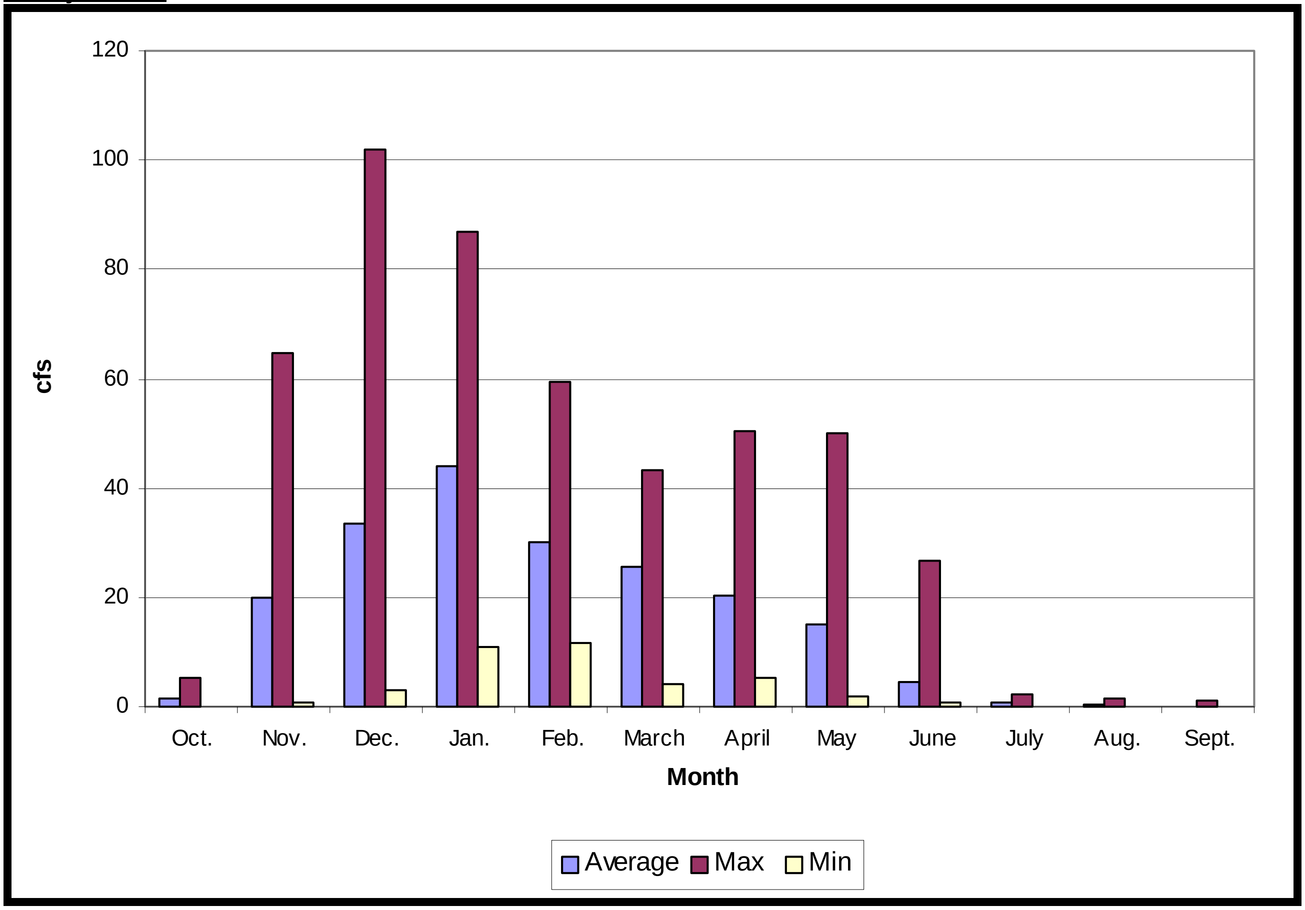
Irrigation	**Industrial**	**Domestic**
Primary and supplemental	Geothermal	Domestic
Irrigation	Manufacturing	Lawn and garden
Supplemental	Sawmill	Non-commercial
Cranberries	Shop	Stock
Irrigation, domestic & stock	Log deck	Group domestic
Irrigation & domestic	Commercial	Restroom
Irrigation & stock	Laboratory	School
Fish and Wildlife	**Municipal**	**Recreation**
Aquaculture	Municipal	Campground
Fish	Quasi-municipal	Recreation
Wildlife		School
Agriculture	**Miscellaneous**	
Agriculture	Air conditioning	
Cranberry harvest	Aesthetic	
Flood harvesting	Forest management	
All cranberry uses	Fire protection	
Temperature control	Groundwater recharge	
Dairy barn	Pollution abatement	
Frost protection	Road construction	
Greenhouse	Storage	
Mint still		
Nursery use		

Appendix 13: Average, maximum, and minimum streamflow by month for Calapooya Creek and Gassy Creek.

Calapooya Creek



Gassy Creek

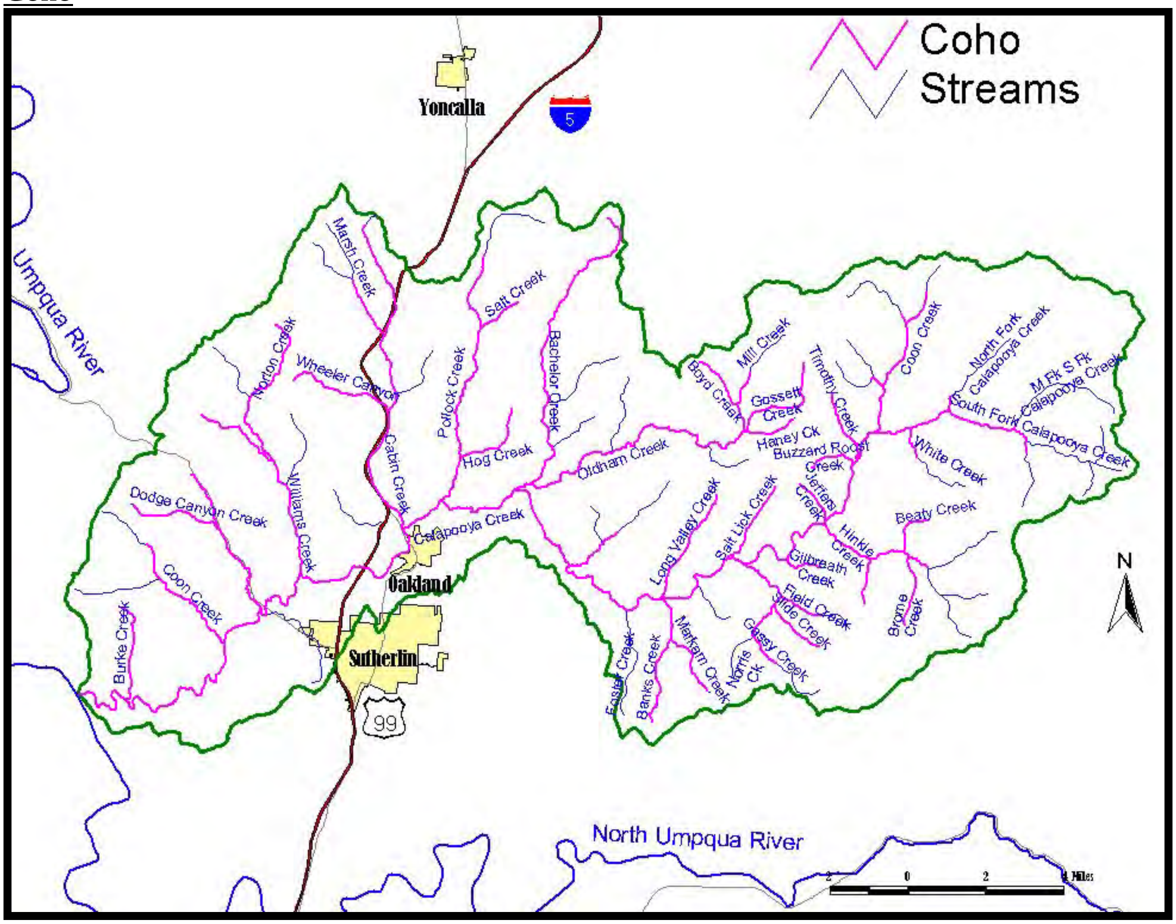


Dates that maximum and minimum streamflow occurred

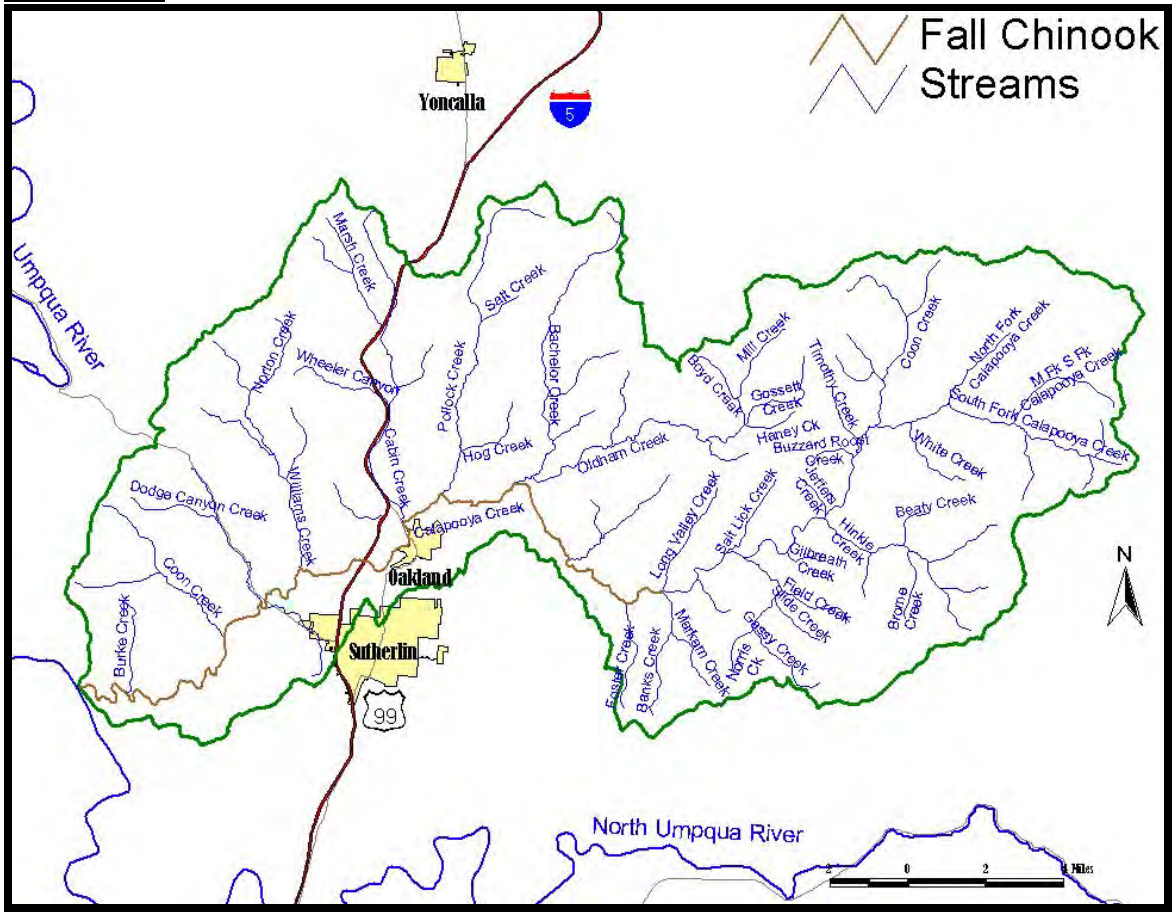
	Calapooya Creek near Oakland		Gassy Creek near Nonpareil	
Month	Maximum Flow year	Minimum Flow year	Maximum Flow year	Minimum Flow year
Oct.	1957	1988	1997	1989
Nov.	1997	1994	1999	1994
Dec.	1956	1990	1997	1990
Jan.	1956	1963	1996	1992
Feb.	1961	1973	1999	1992
March	1961	1992	1989	1992
April	1963	1987	1993	1990
May	1998	1966	1998	1992
June	1993	1992	1993	1992
July	1993	1973	1993	1994
Aug.	1993	1994	1993	1992
Sept.	1971	1991	1997	1992

Appendix 14: Anadromous salmonid distribution by species.

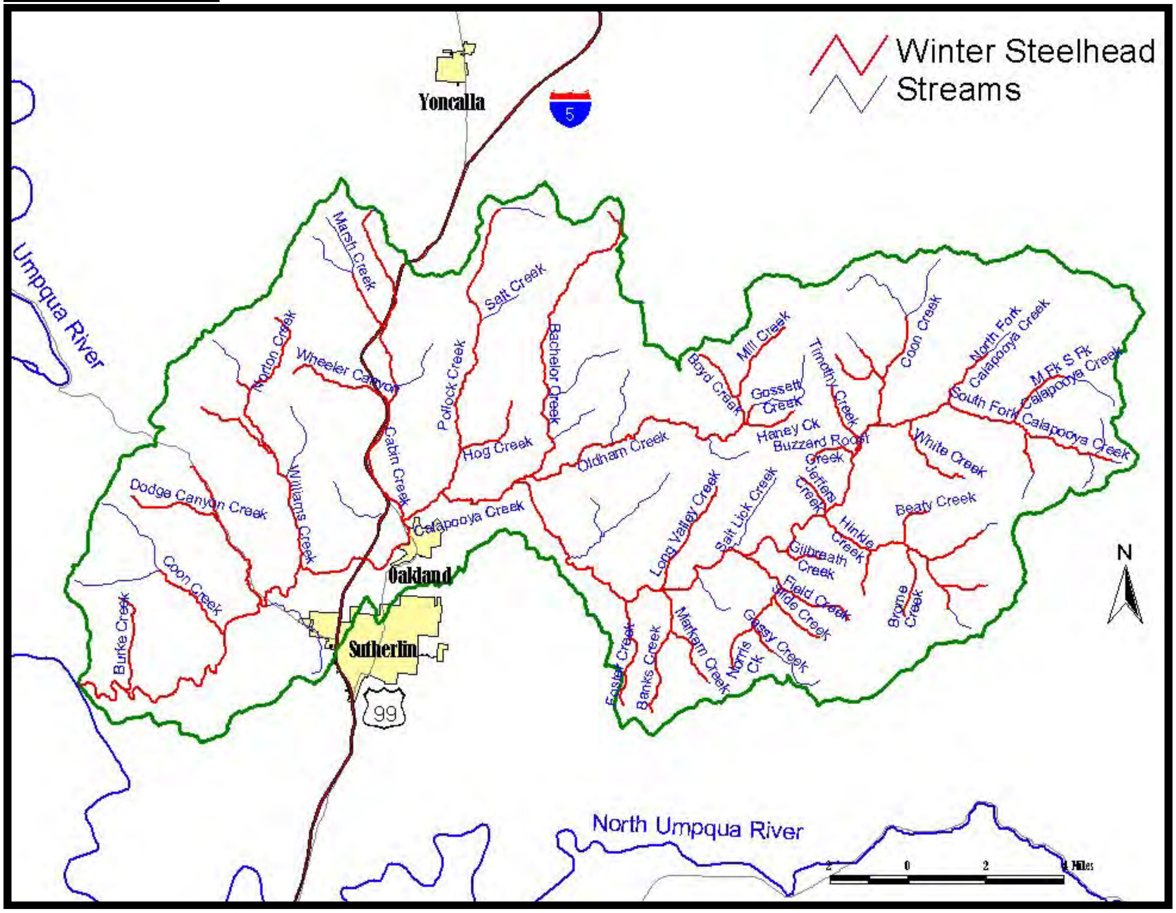
<u>Coho</u>



Fall chinook



Winter steelhead



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I am also grateful for the assistance of the following individuals and groups:

- Janice Green, Leonard Schussel, and Stan Vejtasa for reviewing the document and offering suggestions for improvement.
- The landowners interviewed in Chapter Five, "Landowner Perspectives."
- The staff of the Douglas Soil and Water Conservation District, Oregon Department of Environmental Quality, Oregon Department of Fish and Wildlife, and Oregon Water Resources Department who answered many questions and provided much of the assessment's quantitative and qualitative data.
- The resource professionals who agreed to serve as guest speakers at our monthly watershed assessment meetings:
    - Paul Heberling, ODEQ;
    - Dave Harris, ODFW;
    - Dave Williams, OWRD;
    - Kent Smith, InSight Consultants;
    - Sam Dunnavant, ODFW; and
    - Walter Gayner, Douglas Soil and Water Conservation District.

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