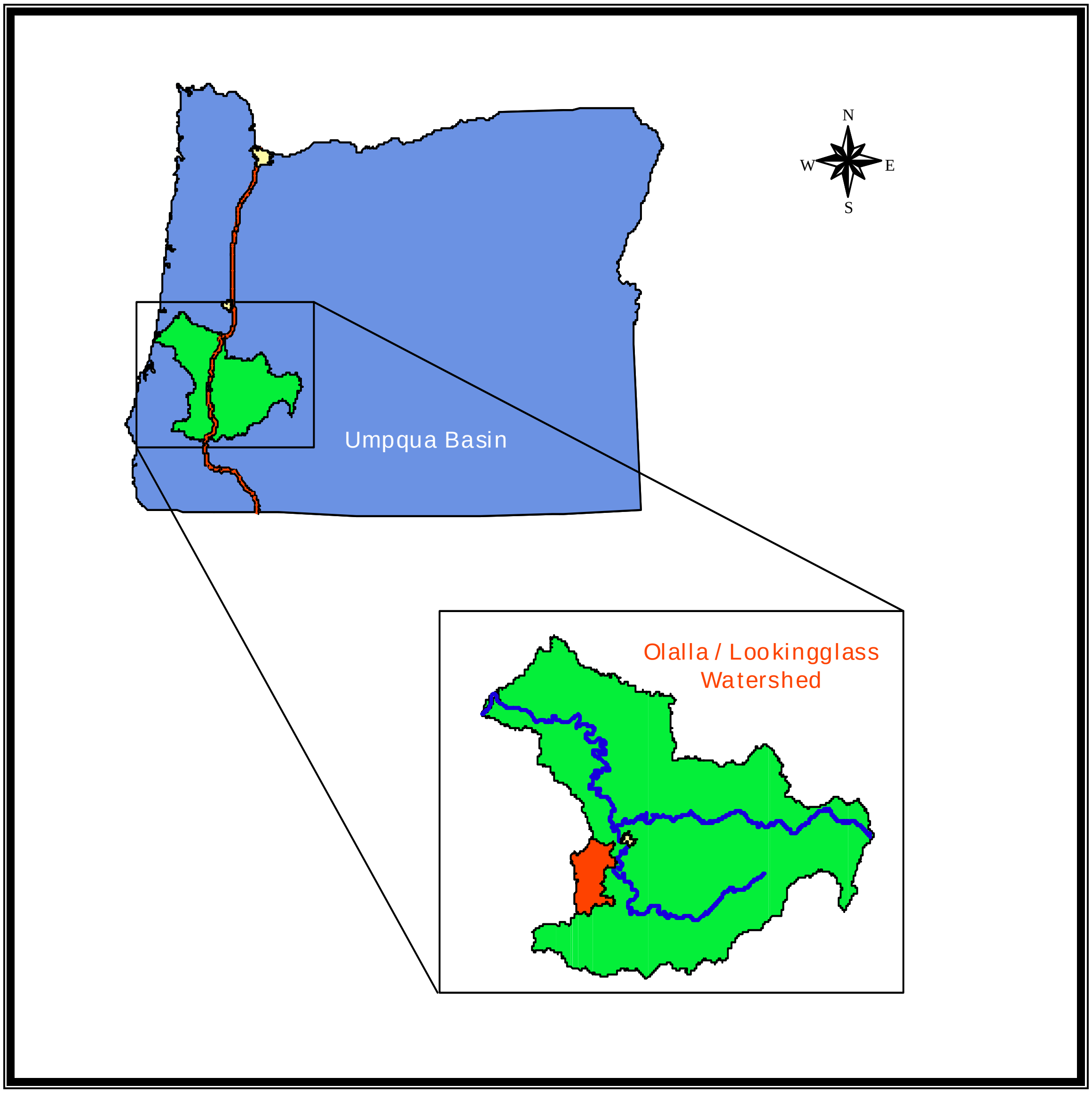
Olalla / Lookingglass
Watershed Assessment and Action Plan



Prepared by Matt DeVore and Nancy A. Geyer for the

Umpqua Basin Watershed Council

August, 2003

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Publication citation

This document should be referenced as DeVore, Matt B. and Geyer, Nancy A. 2003. Olalla / Lookingglass Watershed Assessment and Action Plan. July, 2003. Prepared for the Umpqua Basin Watershed Council, Roseburg, Oregon.

This project has been funded wholly or in part by the United States Environmental Protection Agency under assistance agreement CO-000451-02 to the Oregon Department of Environmental Quality. The contents of this document do not necessarily reflect the views and policies of the Environmental Protection Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

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Acronym List

BLM	Bureau of Land Management
Cfs	Cubic feet per second
Aft	Acre-feet of water
DFPA	Douglas Forest Protective Association
GIS	Geographic information systems
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
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 Olalla / Lookingglass 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 were compiled from the following documents: The Oregon Watershed Assessment Manual, the Olalla / Lookingglass Watershed Analysis, and the Middle South Umpqua Watershed Analysis. 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 Olalla / Lookingglass Watershed and what are its defining characteristics?
- What are the demographic, educational, and economic characteristics of Olalla / Lookingglass 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 Plans

The Olalla / Lookingglass Watershed assessment has two goals:

1) To describe the past, present, and potential future conditions that affect water quality and fish habitat within the Olalla / Lookingglass 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 that 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 Olalla / Lookingglass 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 Olalla / Lookingglass 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 Matt DeVore of the UBWC to review information about the Olalla / Lookingglass Watershed and offer comments and suggestions for improvement opportunities.

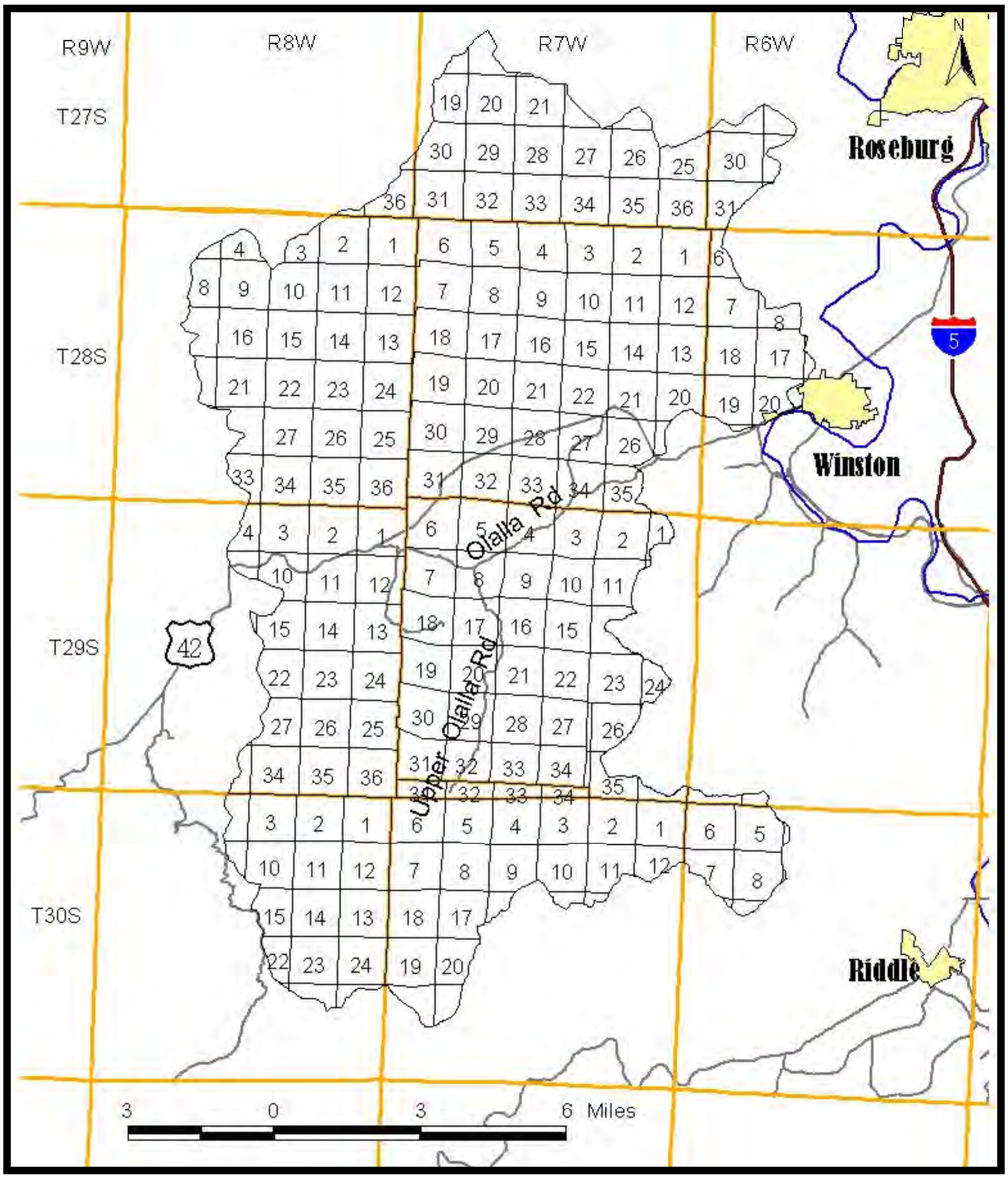
The Olalla / Lookingglass Stakeholders' Group met once a month from October 2002 until June 2003 at the Lookingglass Olalla Water Control District Office. A total of 39 people attended one or more meetings, with an average of 12 participants at each meeting. Meeting participants included farmers and ranchers, family forestland owners, schoolteachers, county employees, and community residents

[3] Unless otherwise indicated, the Umpqua Basin Watershed Council developed all text, tables, maps, and figures.

1.2 Watershed description

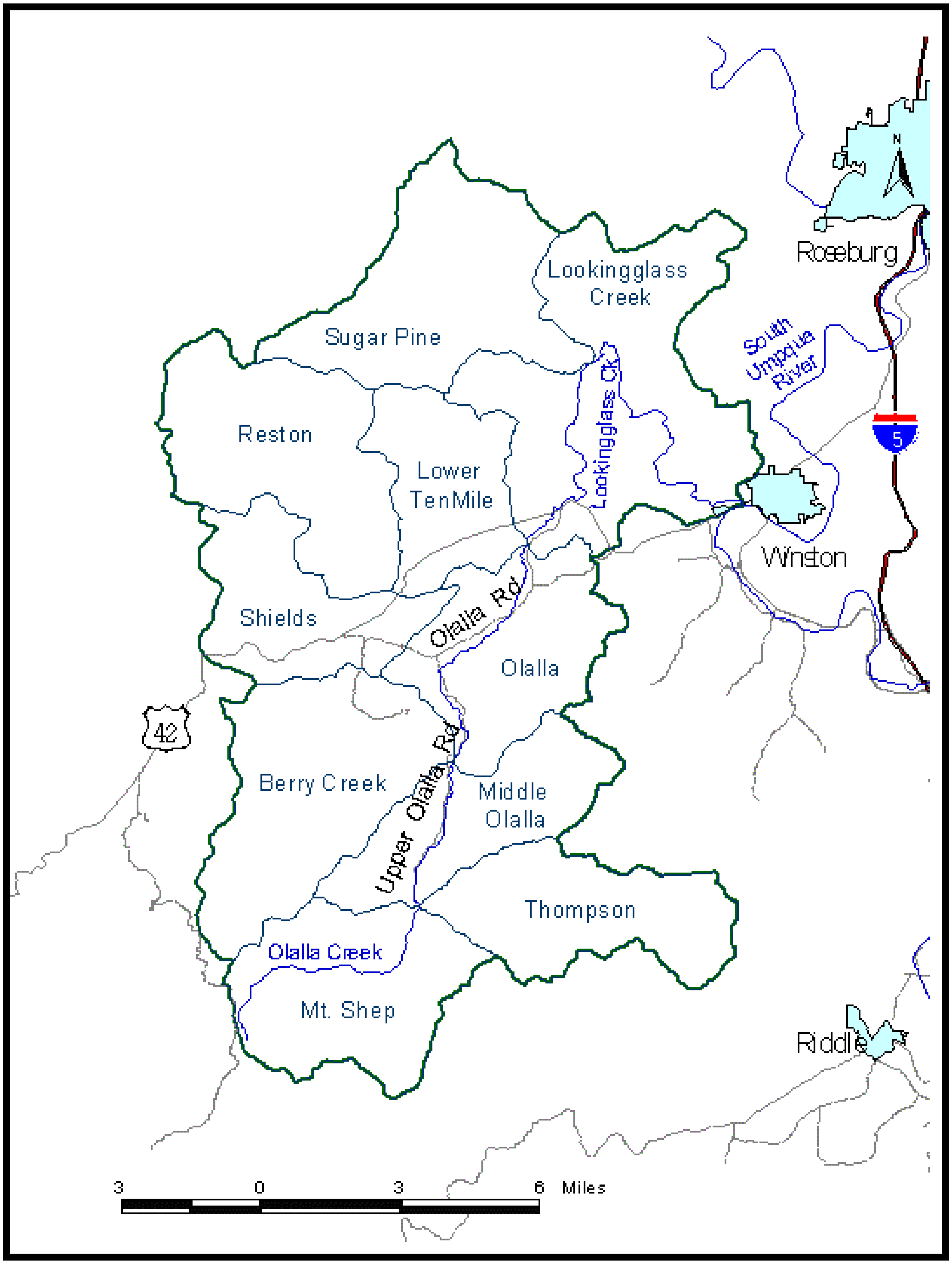
1.2.1 Location, size and major features

The Olalla / Lookingglass fifth-field watershed is located in Douglas County, Oregon, and is approximately 103,000 acres (see Map 1-1). The watershed stretches a maximum of 20 miles north to south and 13 miles east to west. Highway 42 runs east to west through the middle of the watershed. The nearest incorporated city is Winston, just east of the watershed. Rural residential areas within the watershed include Lookingglass, Tenmile, Olalla, and Reston.



Map 1-1: Location of the Olalla / Lookingglass Watershed

The Olalla / Lookingglass Watershed can be subdivided into ten smaller (sixth field) watersheds (see Map 1-2). All of these sixth field watersheds are between 6,000 and 18,000 acres.



Map 1-2: **Sixth field watersheds within the Olalla / Lookingglass Watershed**

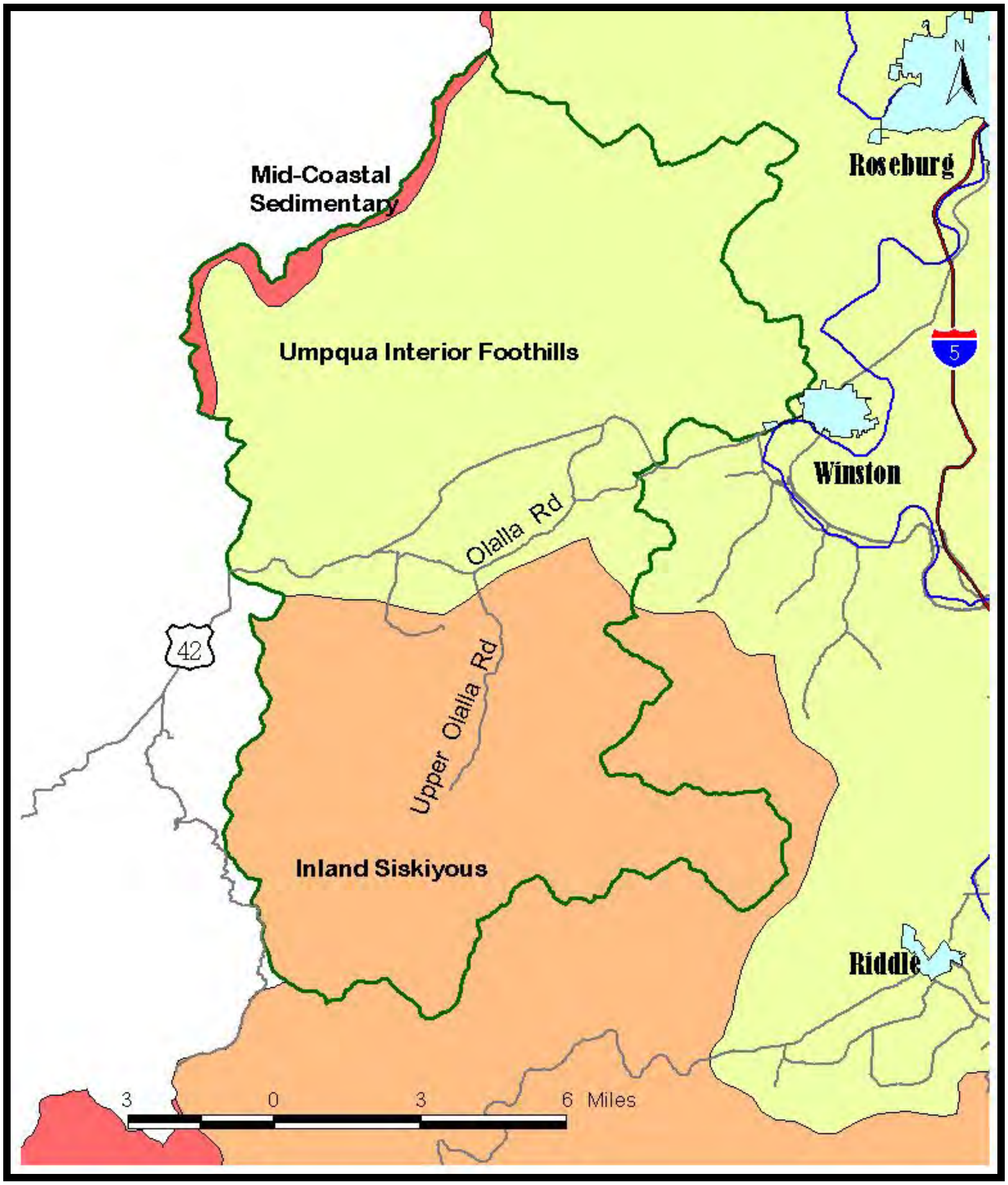
1.2.2 Ecoregions

Ecoregions are areas with similar type, quality, and quantity of environmental resources, including landscape, climate, vegetation, and human use.[4] 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 assessment, ecoregions are used to distinguish three unique areas in the Olalla / Lookingglass Watershed. In some cases, ecoregion information is used to supplement other data.

Map 1-3 and Table 1-1 show the Olalla / Lookingglass Watershed's location, acres, and percent within each ecoregion. Highway 42 nearly divides the watershed into two separate ecoregions. The northern section (57% of the watershed) is the Umpqua Interior Foothills, while the southern section (41%) is the Inland Siskiyous.

Photo 1-1: Lookingglass Valley, view southwestward across agricultural lands[5]

[4] The Environmental Protection Agency (EPA) and the Oregon Natural Heritage Program (ONHP) developed ecoregion boundaries for the State of Oregon.
[5] Photo by Kristin Anderson, BioSystems Consulting; Location UTM 462201/4781399



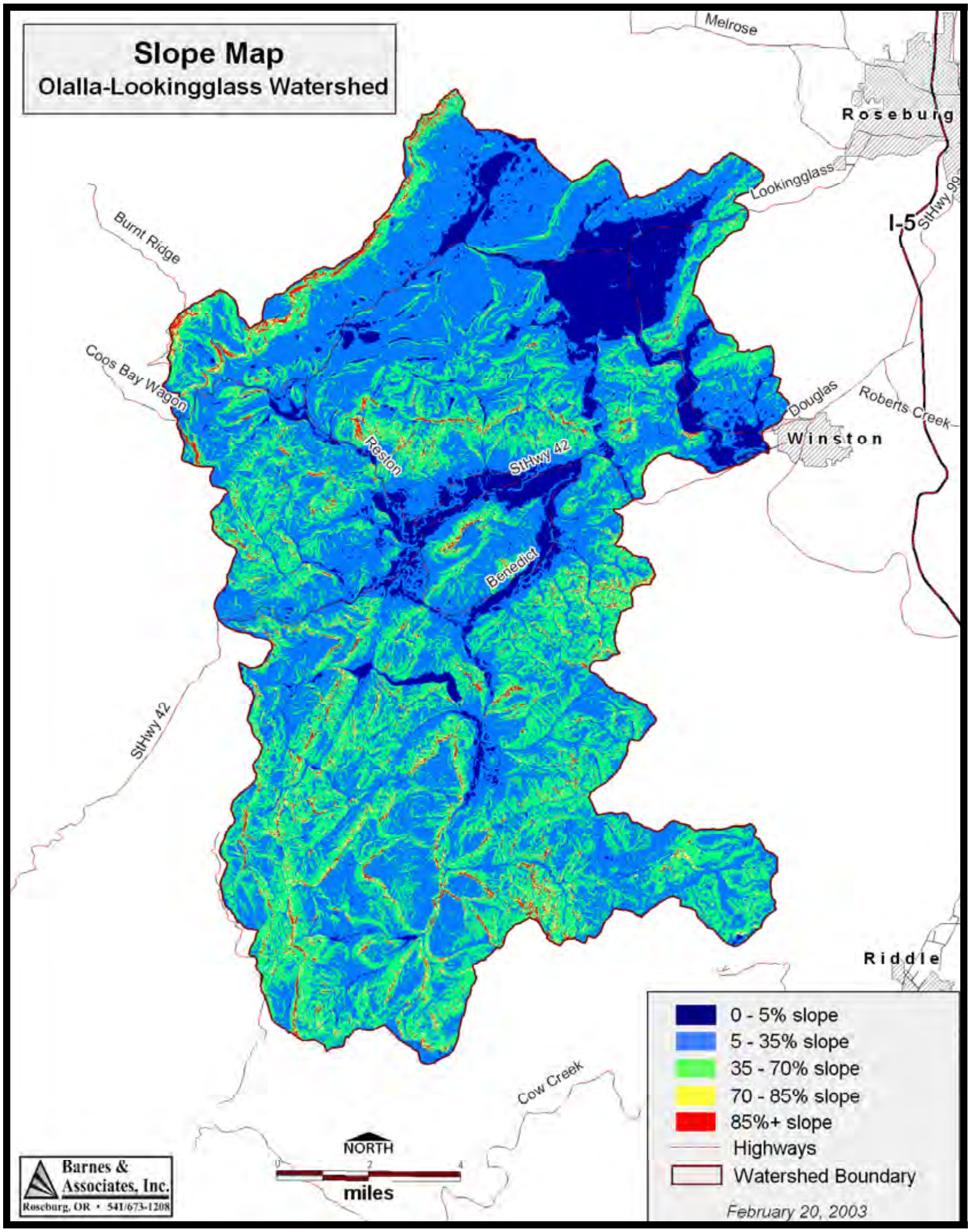
Map 1-3: Ecoregions of the Olalla / Lookingglass Watershed

Ecoregion	Acres	Percent
Umpqua Interior Foothills	58,429.7	56.6%
Mid-Coastal Sedimentary	2,287.4	2.2%
Inland Siskiyous	42,465.5	41.1%

Table 1-1: Acres and percent of the watershed within each ecoregion

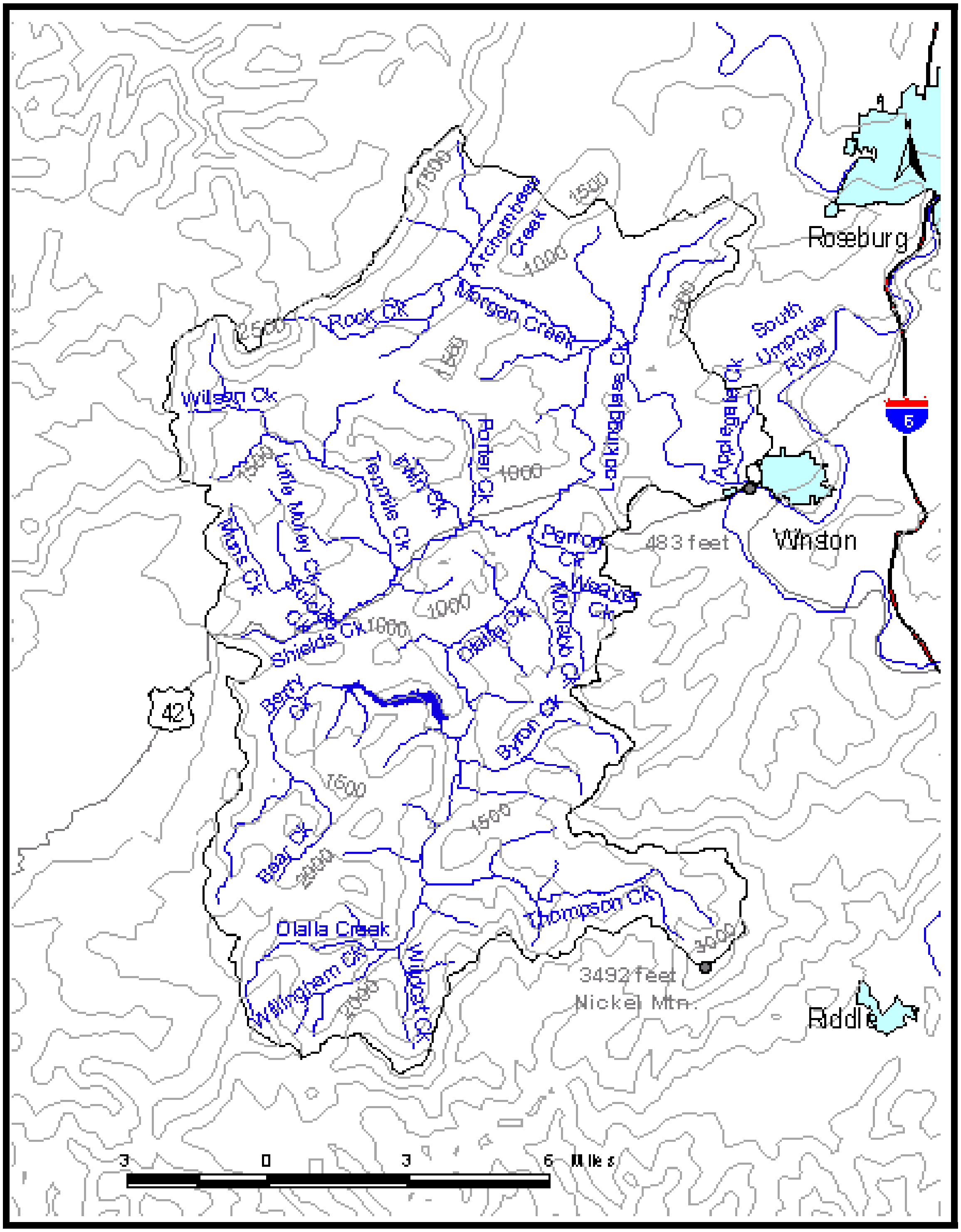
1.2.3 Slope, elevation, and topography

The Umpqua Interior Foothills Ecoregion is characterized by narrow valleys, terraces and steep foothills. The Inland Siskiyous is highly dissected mountains with stream channels that are moderate to high gradient; waterfalls are often present. The northwest strip of the watershed is Mid-Coastal Sedimentary. This ecoregion varies greatly, but in the Olalla / Lookingglass Watershed, it is characterized by headwaters of small streams that are bordered by steep slopes (see Map 1-4).



Map 1-4: Percent slope

The lowest point in the watershed is 483 feet where Lookingglass Creek meets the South Umpqua River, and the highest point is 3,492 feet on Nickel Mountain (see Map 1-5).

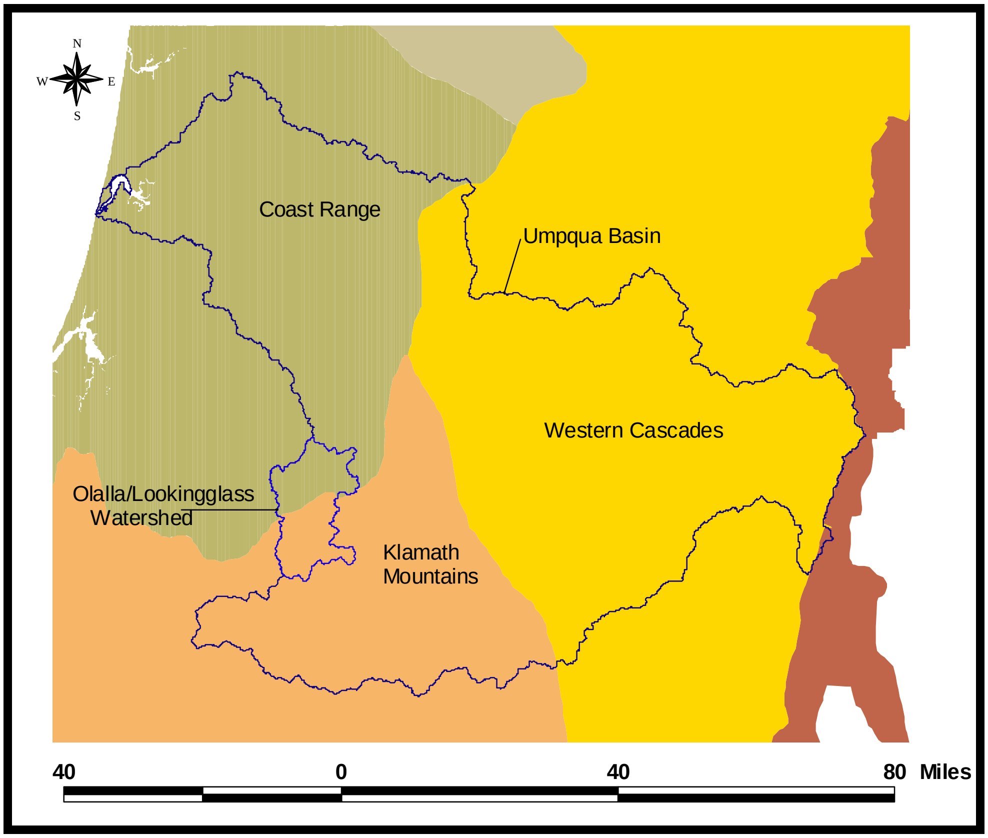


Map 1-5: **Elevation with highest and lowest points**

The long history of tectonic subduction of the floor of the Pacific Ocean with the North American continent as well as a northward movement of the oceanic plate has left the landscape of Oregon riddled with faults. The Olalla / Lookingglass Watershed has several major faults within its boundaries. Most of these faults are in a southwest-northeast orientation, but some smaller faults fall in an orientation nearly perpendicular to this. See Appendix 1 for a complete geologic overview of the Olalla / Lookingglass Watershed.[6]

Physiography[7]

Geologic processes have created many different physiographic provinces, or areas of similar geomorphology, within the state. According to the boundaries of these provinces as delineated by the Oregon/Washington Bureau of Land Management (Bureau of Land Management, 1992), the Umpqua River Basin lies at the intersection of three physiographic provinces—the Coast Range, the Klamath Mountains, and the Western Cascades (see Map 1-6). The northern portion of the Olalla / Lookingglass watershed lies within the Coast Range, while the southern portion lies within the Klamath Mountains. In *The Geology of Oregon*, however, Orr and Orr (2000) show that within the Olalla / Lookingglass Watershed, rocks typical of the Coast Range reach down into the Klamath Province.



Map 1-6: Physiographic provinces of Umpqua Basin (OR/WA BLM)

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[6] Kristin Anderson, BioSystems Consulting, contributed this paragraph.
[7] Kristin Anderson, BioSystems Consulting, contributed this section. See Appendix 1 for more geology information, references and a glossary.

The Coast Range

The Coast Range, because of its location on the west coast of Oregon, receives the highest amount of rainfall in the state, is densely vegetated, and in most places has well-developed soils (Loy, et al., 2001 and Orr and Orr, 2000). The crest of the range has an average altitude of 1,500 feet above sea level, and the highest peaks are east of the middle of the range due to the more intense rainfall and consequent erosion on the western side. The Umpqua is one of three rivers (along with the Columbia and the Siuslaw) that cut entirely through the Oregon Coast Range (Orr and Orr, 2000).

Photo 1-2: Flournoy Valley, view northwestward towards the Tyee Formation scarp[8]

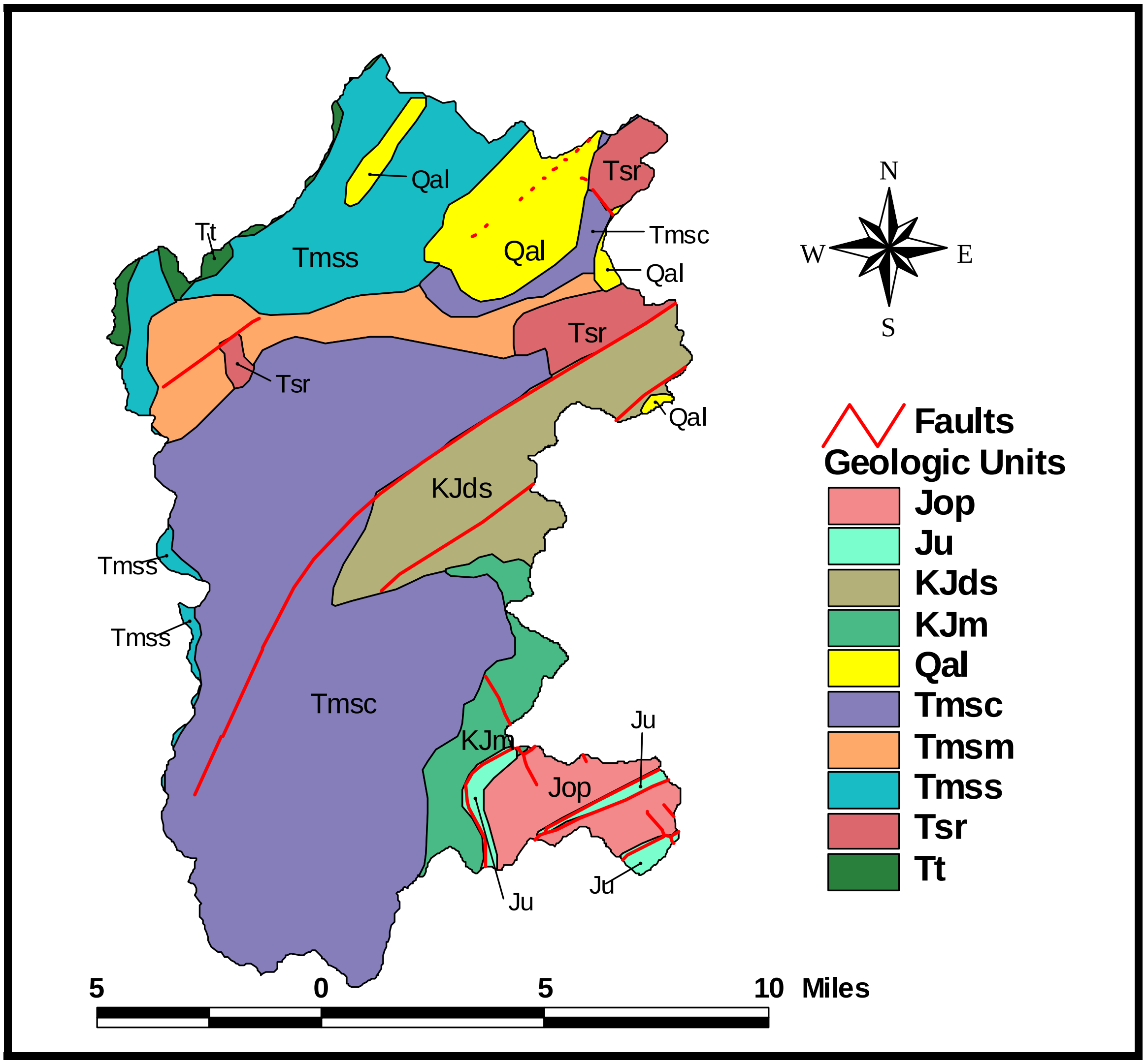
The Klamath Mountains

The Klamath Mountains lie in the southwestern corner of Oregon, and extend south into California as an elongate north-south lying province. The Klamath Mountain area has a varied landscape with some steep narrow canyons and high peaks; yet in most places, it has a fairly even relief. The majority of the province is drained by the Rogue River and its tributaries, but the South Umpqua River and its tributaries extend into the northeastern-most reach of this province (Orr and Orr, 2000). The Chetco and Pistol river systems also drain a portion of the province (Loy, et al., 2001).

[8] Photo by Kristin Anderson, BioSystems Consulting; Location UTM 455035/4781009

The Olalla / Lookingglass Watershed

The Olalla / Lookingglass Watershed exhibits varied relief. Some prominent low-relief features within the watershed are Lookingglass and Flournoy valleys. Lookingglass Valley is a particularly large expanse of a broad and very gently rolling plain that contrasts with the more steep topography of the rest of the watershed. The southern portion of the watershed is a moderately steep landscape with incised streams. A general southwest-northeast trend in the hills is noticeable; this trend is governed by the geology of the area. See Map 1-7 and Appendix 1 for an explanation of the Geologic Units.



Map 1-7: Geologic units and faults in the Olalla / Lookingglass Watershed[9]

9 Walker and MacLeod 1991

Impacts of Geology on Stream Characteristics

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

The composition of rocks can impact the quality of fish habitat and water quality. Generally, granitic rocks are more acidic, while calcareous rocks are more alkaline. Fish prefer neutral to alkaline conditions (Hastings, et al., 2002). Erosion of rocks and subsequent delivery of sediments to streams as well as groundwater inputs delivered to streams through rock units influence the water chemistry of those streams. Within the Olalla / Lookingglass Watershed, most of the geologic units are marine rocks that are likely to have some calcareous character.

The geology of any area also influences sediment inputs to streams. The topography that results from geologic processes helps to shape the steepness of slopes and their likelihood to fail. Topography also influences the local climate, causing, for instance, more rain on the western slopes of large hills than on the eastern slopes. This may influence runoff and sediment inputs locally. Geology largely governs the process of soil formation. Rocks provide the parent material for soil development. The minerals within rocks also influence the organisms that grow and abide within the soil. Relief and climate, both influenced by geology, also impact soil genesis. The characteristics of the resulting soil impact the contribution of sediment to streams. See Section 3.3.7 for more information about sedimentation.

1.2.4 Climate

The Olalla / Lookingglass watershed has a Mediterranean climate with cool, wet winters and hot, dry summers. Temperature data are available from Roseburg. Average monthly temperatures were coldest in December and January, ranging from mid-30s to 50s °F. Temperatures were warmest in July and August, ranging from mid-50s to upper 80s °F. Precipitation data for various sites in the watershed indicate annual precipitation ranges from just under 40 inches in lower elevations of the east to over 50 inches in the higher elevations of the western mountains.

Temperature

The Oregon Climate Services has temperature data available for Roseburg. Average monthly air temperatures from 1997 to present are show in Figure 1-1. According to ecoregion information, the lower elevations remain frost-free for approximately 120 to 180 days per year, while the higher elevations are frost-free for around 80 to 180 days per year.

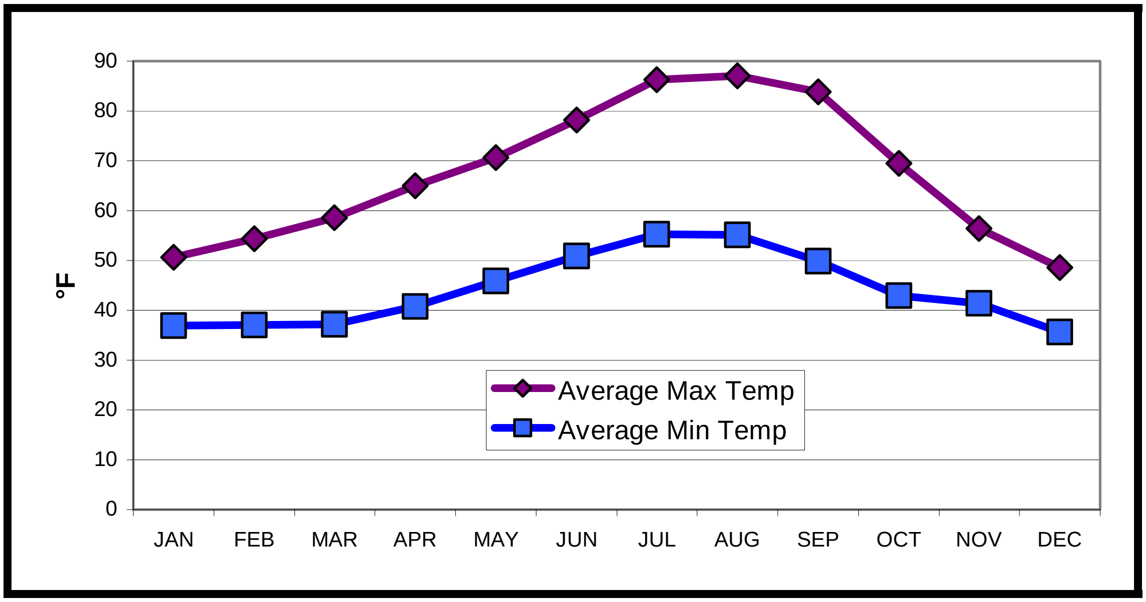


Figure 1-1: Average maximum and minimum air temperatures in Roseburg

Precipitation

The Oregon Climate Services[10] maintains two climate monitoring stations in the Olalla / Lookingglass area. The stations are located in the Reston and Lookingglass areas. Precipitation data are available since 1955 for Reston and since 1978 for Lookingglass (see Table 1-2). Average annual precipitation in the Olalla / Lookingglass area varies largely according to elevation. Reston climate station (890 ft.) reports an average annual rainfall of 49 inches while the Lookingglass climate station (620 ft) reports 39 inches.

Station Name	Station Number	Elevation (feet)	Year	Average Precipitation (inches)
Lookingglass	5026	620	1978-2001	39
Reston	7112	890	1955-2001	49

Table 1-2: Oregon Climate Service data for Olalla / Lookingglass area

The National Oceanic and Atmospheric Administration (NOAA) also maintains monitoring sites in the Olalla / Lookingglass area. Precipitation data are available (see Table 1-3) and includes more areas than does OCS. The higher elevation station (Reston at 890 ft) receives 14 inches more precipitation than the lower elevation station (Lookingglass at 620 ft).

Station Name	Station Number	Elevation (feet)	Year	Mean Precipitation (inches)
Flournoy Valley	352974	700	1979-1996	45
Lookingglass	355026	620	1979-1996	38
Reston	357112	890	1956-1996	52
Upper Olalla	358788	760	1979-1996	41

Table 1-3: National Oceanic and Atmospheric Administration data

[10] The precipitation information was obtained on October 30th, 2002, from the Oregon Climate Services website http://www.ocs.oce.orst.edu

Precipitation occurs primarily in the winter months, with 80-85% collected between October and March (see Figure 1-2). Figure 1-3 shows the fluctuation in annual rainfall from 1955 to 2001. Gaps in Figure 1-3 indicate incomplete data sets.

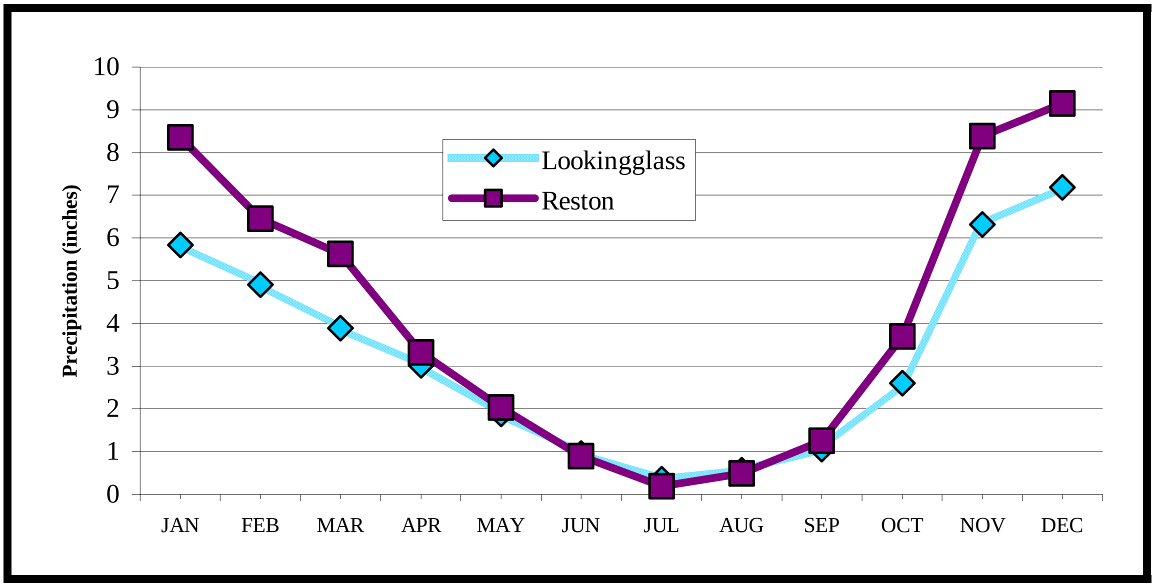


Figure 1-2: Average monthly precipitation

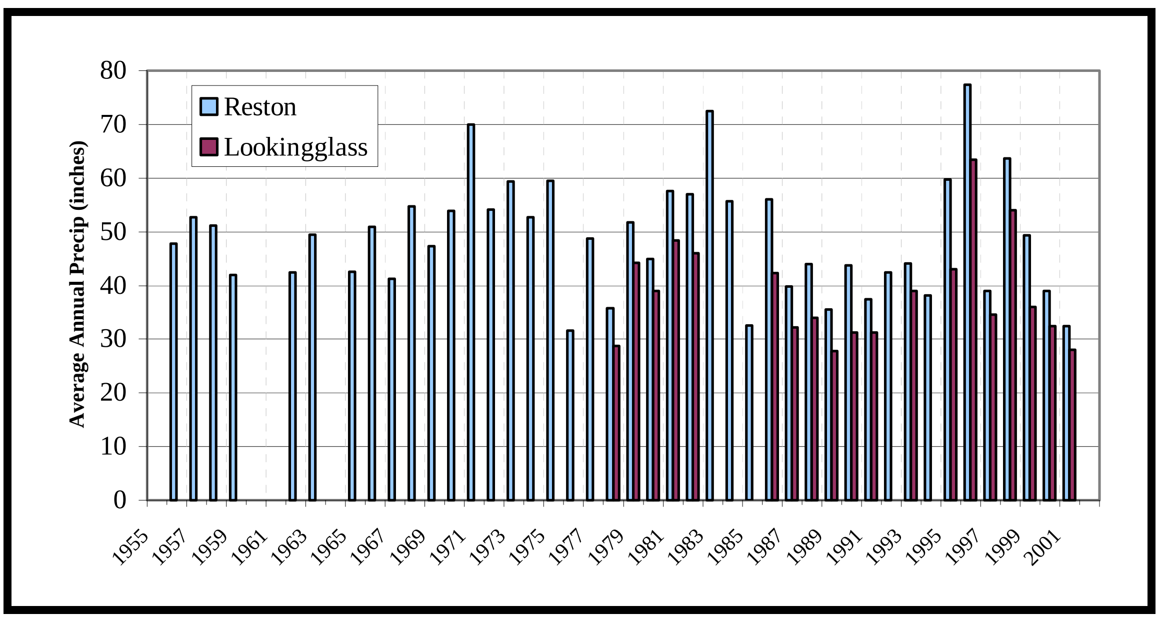
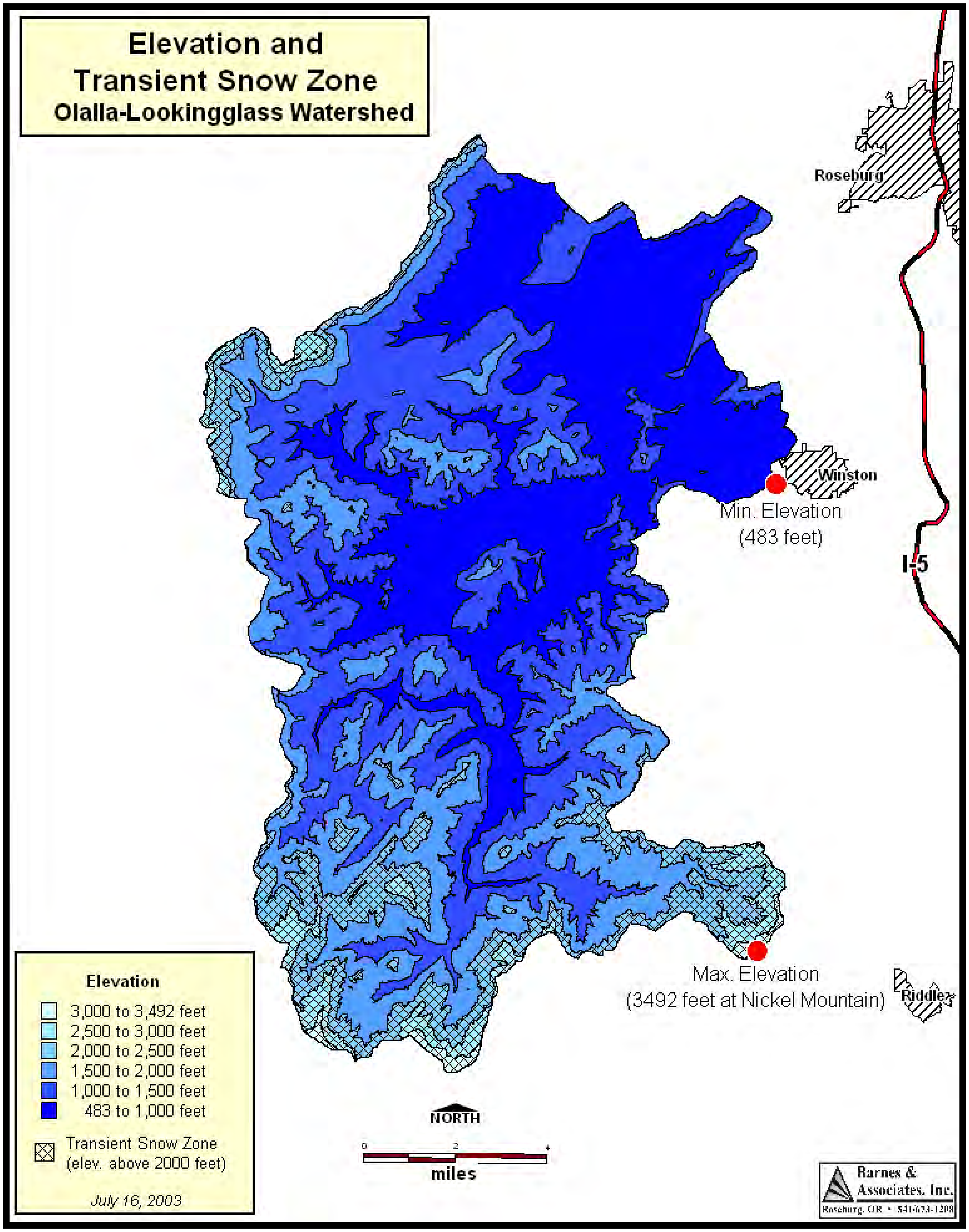


Figure 1-3: Average annual precipitation

Precipitation generally occurs as rain, while snow sometimes collects in higher elevations. The Transient Snow Zone (TSZ) is the area between 2000 and 5000 feet in elevation. Approximately 14% of the Olalla / Lookingglass watershed is in the TSZ (see Map 1-8). Rain-on-snow events, in which rain falls on accumulated snow causing it to melt, may occur in these areas.



Map 1-8: Transient snow zone

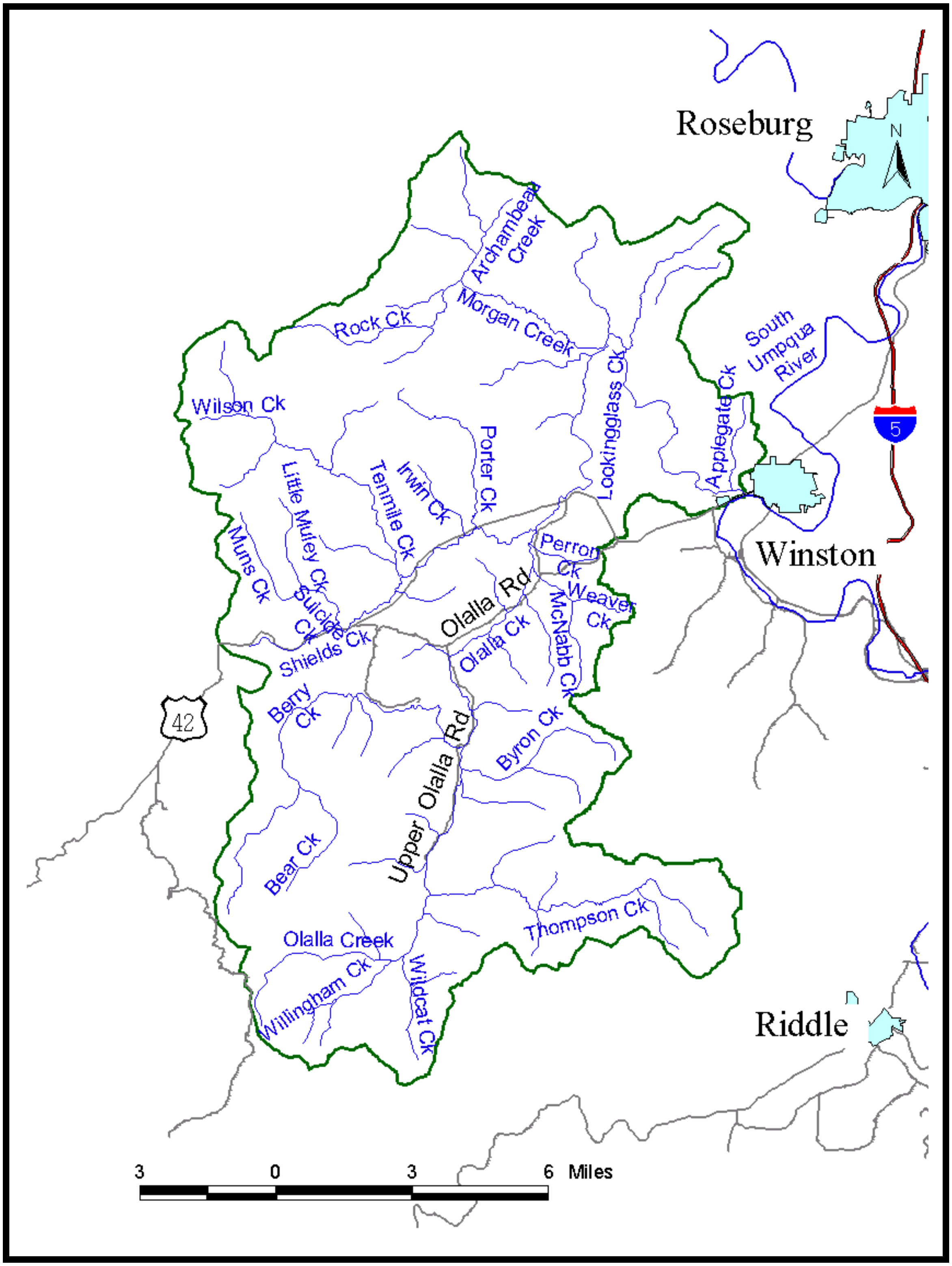
1.2.5 The Olalla / Lookingglass Watershed stream network

Lookingglass Creek (see Photo 1-3) is 11 miles[11] long in total and flows into the South Umpqua River. Olalla Creek is the longest tributary and runs for nearly 22 miles from the headwaters into Lookingglass Creek. Tenmile Creek is a major tributary to Olalla Creek and stretches out for 12 miles into the watershed. Berry Creek, another tributary to Olalla Creek, maintains a constant flow through the summer because of water control at Ben Irving Dam.

Map 1-9 shows all of Olalla / Lookingglass streams that are visible on a US Geologic Survey 100,000 resolution map (166.3 stream miles)[12]

Photo 1-3: Lookingglass Creek, upstream view about 2.5 miles from the mouth[13]

[11] Stream miles measure distance from the mouth by 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.
[12] On a map of this resolution, one inch equals 8333.3 feet.
[13] Photo by Kristin Anderson, BioSystems Consulting; Location: UTM 462603/4775567



Map 1-9: **Major streams of the Olalla / Lookingglass Watershed**

1.2.6 Vegetation[14]

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.

In the higher elevation Inland Siskiyous Ecoregion, Douglas-fir is dominant, with grand fir and white fir on northern aspects but minor or absent on southern aspects. Bigleaf maple, western redcedar, and incense cedar are also present. Hemlock and California black oak can be found where conditions are favorable. Northern aspects favor golden chinquapin, while madrone is prominent on south-facing slopes. For both aspects, the understory consists of salal, Oregon grape, western hazel, ocean spray, and red huckleberry; however, due to insufficient moisture, salal, Oregon grape, and red huckleberry is less common on southern slopes.

In the Mid-Coastal Sedimentary Ecoregion, Douglas-fir is the dominant species. Depending on the soil, western hemlock may also occur. Some areas also include sporadic occurrences of western redcedar, incense cedar, sugar pine, Pacific yew, and white fir. Canyon live oak is found on soils with high amounts of rock fragments. Rhododendron, Oregon grape, salal, chinquapin, and red huckleberry occur in the understory.

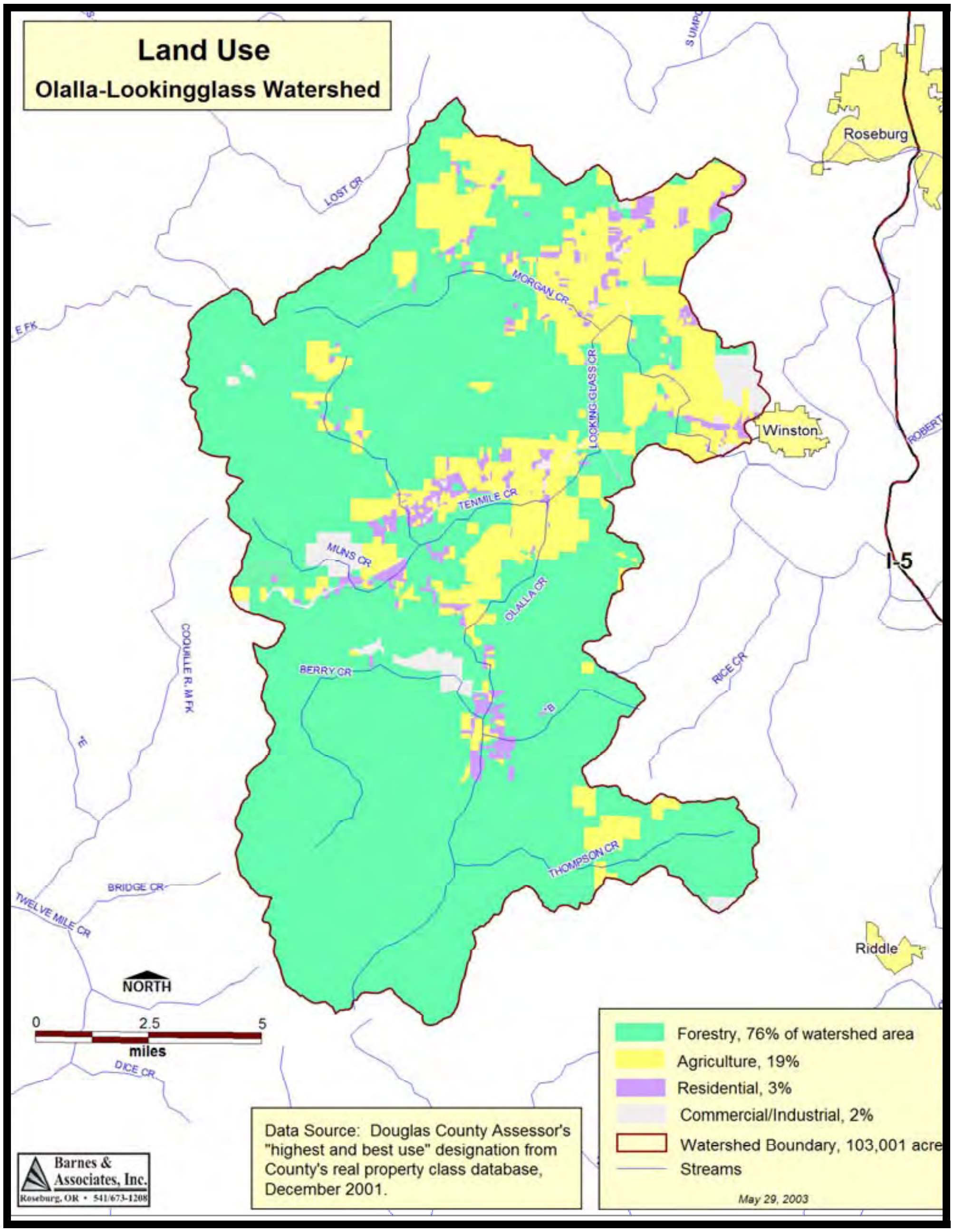
In areas with serpentine soils, the montmorillonite clays formed by the minerals absorb more water than many other types of clays, thus reducing the amount of water available to plants. These unique environmental factors reduce the ability of plants to adapt, which has in turn led to a highly specialized and diverse floral regime with a high percentage of endemic species.[15] Vegetation types occurring in serpentine soil habitats include grasslands, chaparral, woodlands, forest, and serpentine barrens, which are sparsely vegetated by annual and perennial herbaceous plants.[16]

[14] BLM Olalla / Lookingglass Watershed Analysis, Roseburg District
[15] Endemic species are ones that are limited to a particular area.
[16] Tim Grubert and John Runyon of BioSystems Consulting, contributed this paragraph.

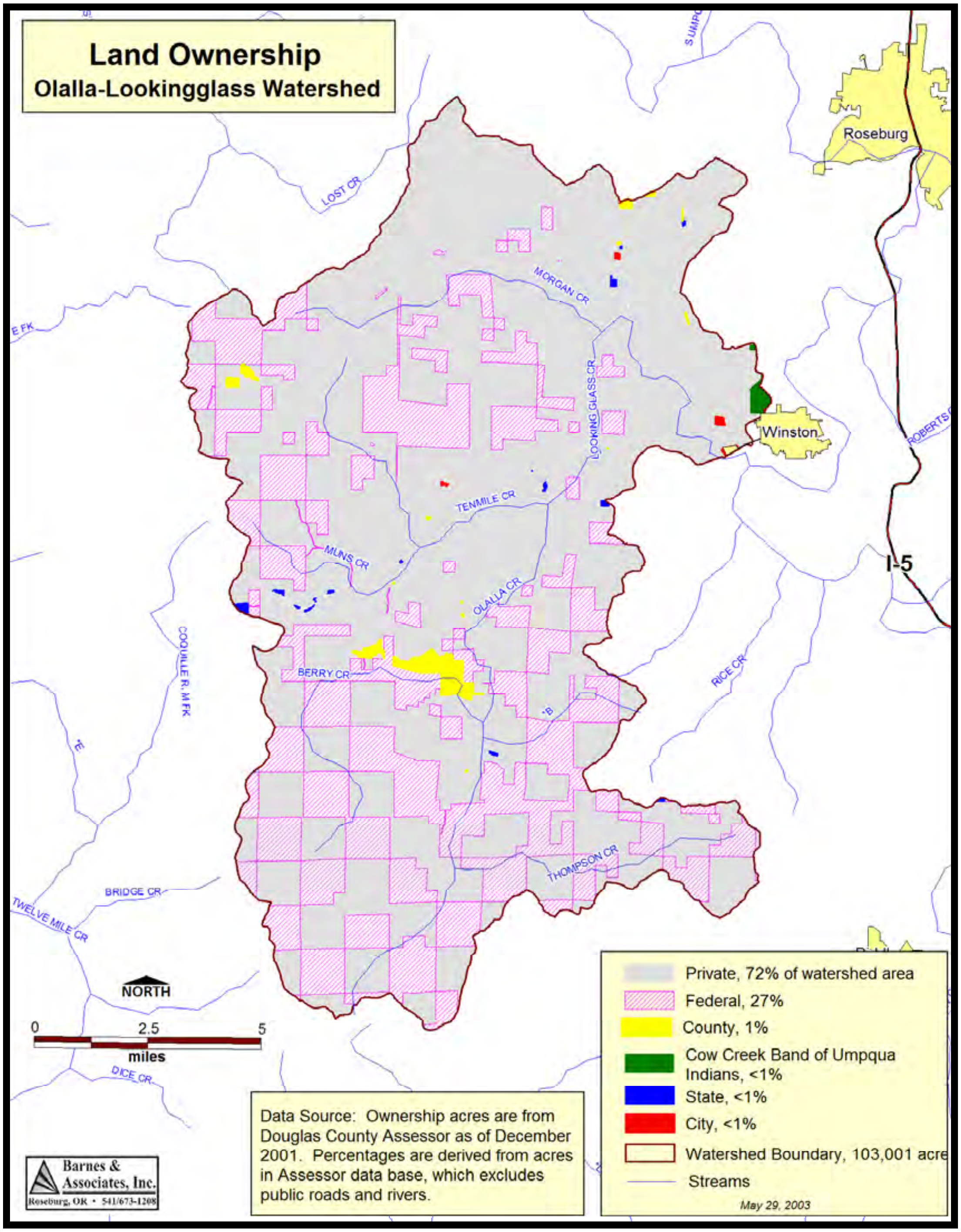
1.3 Land use, ownership, and population

1.3.1 Land use and ownership

The most common land use in the Olalla / Lookingglass Watershed is forestry, with 76% of the land base used for public or private forestry. Agriculture constitutes 19% of the watershed (see Map 1-10). Land ownership is primarily private (72%), with public ownership (27%) administered primarily by the Bureau of Land Management (see Map 1-11).

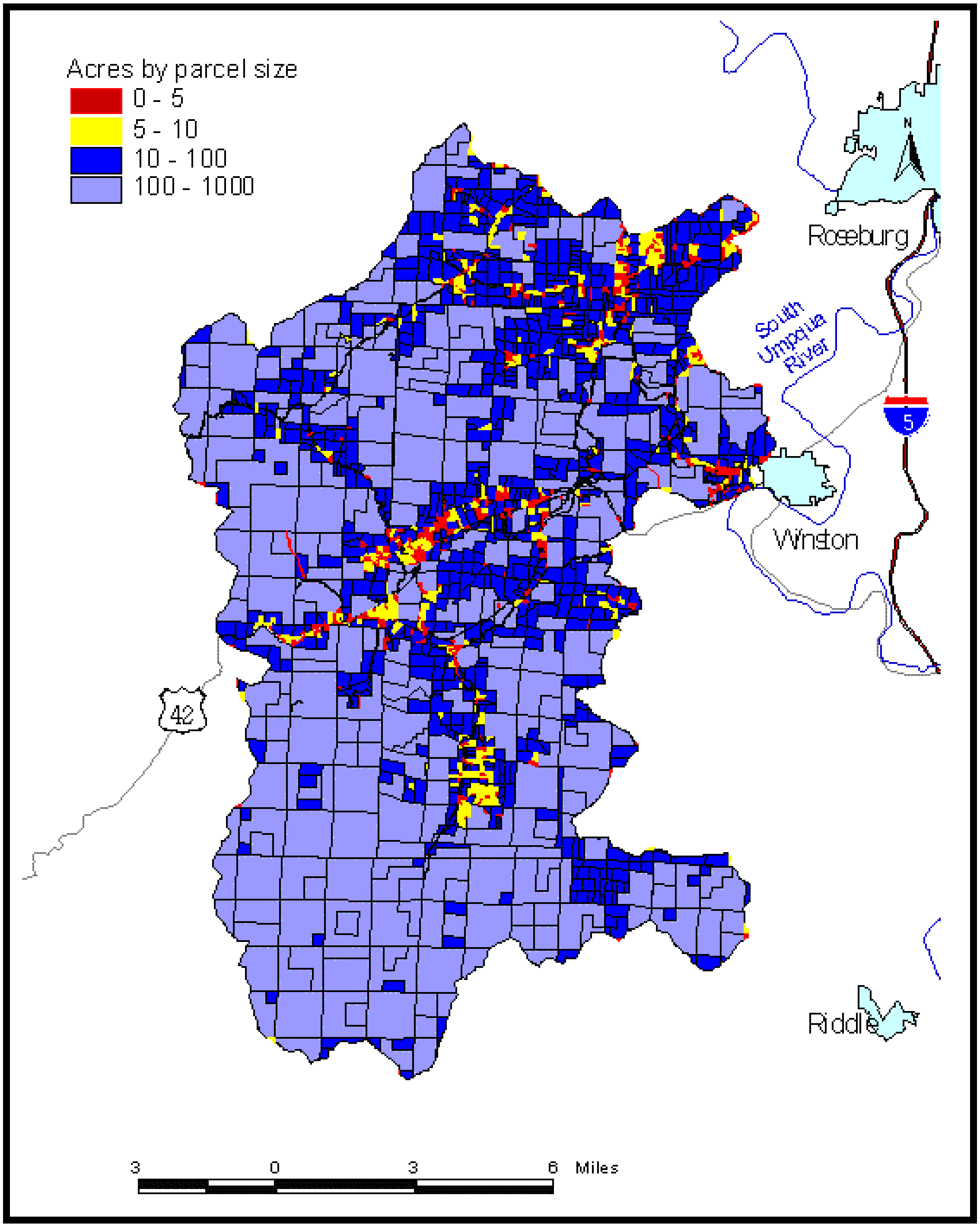


Map 1-10: Land use



Map 1-11: Land ownership

Map 1-12 and Table 1-4 show parcel size distribution and percent as of 2001. Less than 60% of the watershed consists of tax lot parcels that are over 100 acres, of which most are located in upper elevations. Lower elevations are mostly 10 to 100 acres. Just over five percent of the watershed is in parcels less than 11 acres. These parcels are mostly concentrated in and around Lookingglass, Olalla, and Tenmile Creeks.



Map 1-12: Parcel size distribution

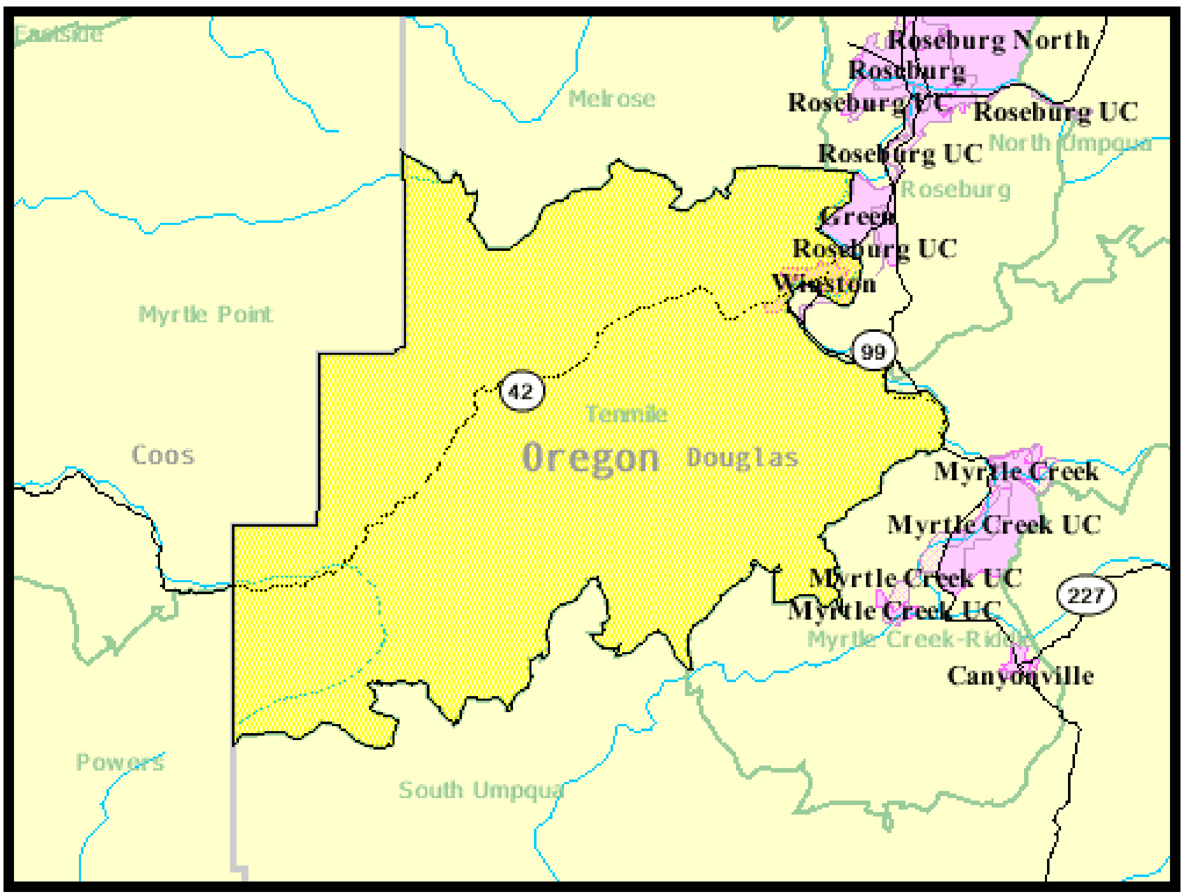
Parcel size	Percent of watershed
0-5	1.7%
5-10	4.0%
10-100	34.7%
100+	59.6%

Table 1-4: Percent of landholdings by parcel size

1.3.2 Population and demographics

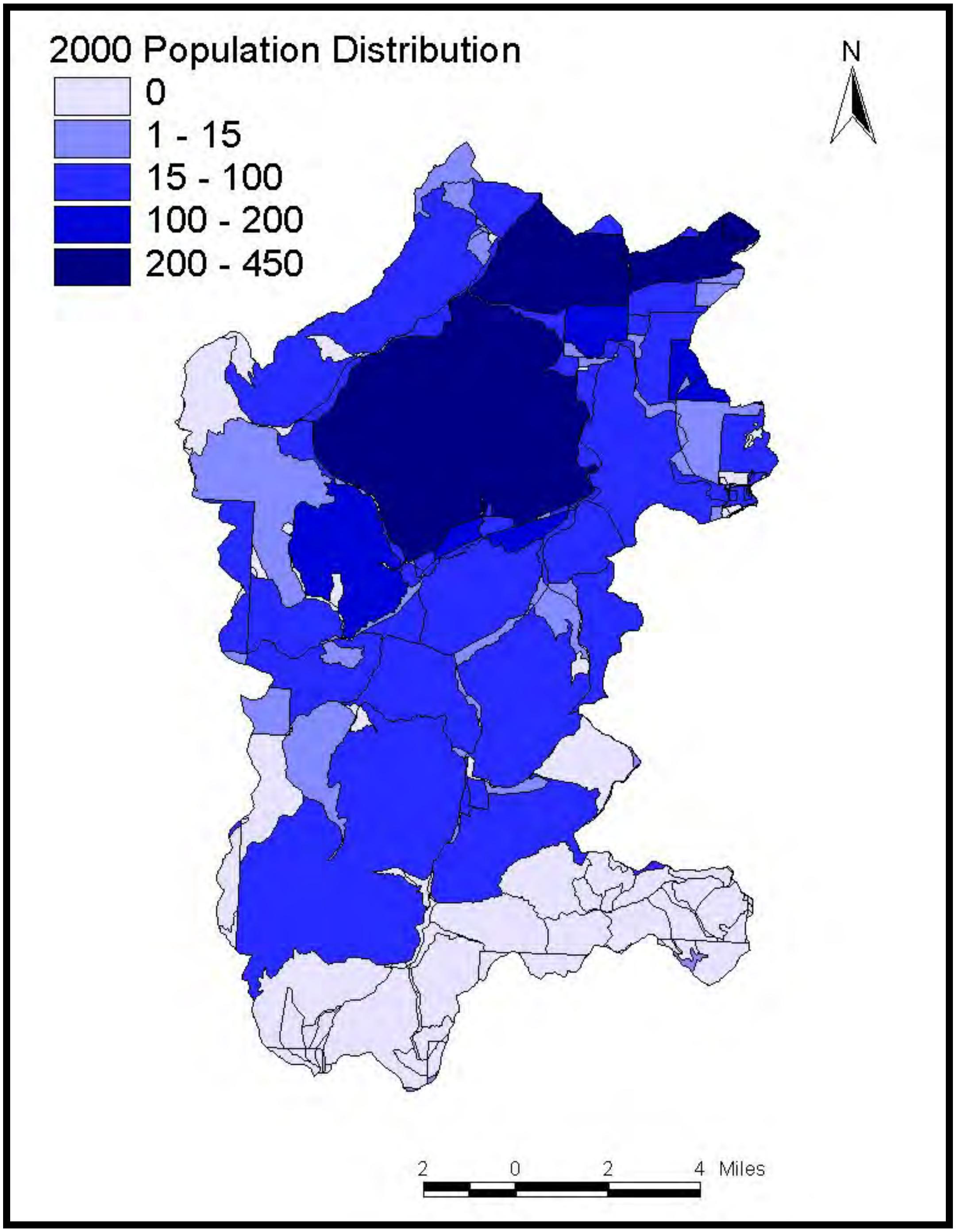
Population

Data from the US Census conducted in 2000 are available for the Tenmile CCD[17] and the City of Winston. The Tenmile CCD is a census survey area that encompasses the Olalla / Lookingglass Watershed (Map 1-13). According to the 2000 census, the total population of the Tenmile CCD is 9,171. Based on this number the maximum population of the Olalla / Lookingglass Watershed can be estimated at 5,165 (Map 1-14). While the total population is difficult to determine, the demographics of the broader area should be representative.



Map 1-13: Tenmile CCD as defined by the US Census Bureau

[17] The Census Bureau defines a CCD as: "Census County Division: A subdivision of a county that is a relatively permanent statistical area established cooperatively by the Census Bureau and state and local government authorities. Used for presenting decennial census statistics in those states that do not have well-defined and stable minor civil divisions that serve as local governments."



Map 1-14: Population distribution based upon 2000 US Census[18]

[18] By adding the maximum population for each census division show on Map 1-6, a maximum watershed population of 5,165 can be estimated.

General demographic characteristics and housing

Information about general demographic characteristics and housing is available from the 2000 US Census for the Tenmile CCD and the City of Winston. Table 1-5 provides demographic information for these areas. Douglas County data are provided for comparison in Appendix 2. The median age for the Tenmile CCD is slightly lower than for Douglas County. As with the county, the largest ethnic group is white, with the next largest groups being Hispanic or Latino, and persons of two or more races. Average household size and average family size are slightly greater than the county average. The Tenmile CCD area has fewer houses occupied by their owners and a lower vacancy rate than does the county.

Subject	**Tenmile CCD**	**Winston**
Population	9,171	4,613
Median age (years)	38.8	34.0
Race		
White	94.5 %	94.6 %
Hispanic & Latino	2.5 %	2.8 %
Asian	0.3 %	0.5 %
American Indian & Alaskan Native	1.6 %	1.4 %
Black or African American	0.1 %	0.2 %
Native Hawaiian & Pacific Islander	0.1 %	0.1 %
Some other race	0.9 %	1.2 %
Two or more races	2.4 %	2.1 %
Households		
Average household size	2.64	2.61
Average family size	2.98	2.99
Owner-occupied housing	70.7 %	61.8 %
Vacant housing units	6.5	7.3

Table 1-5: General demographic characteristics and housing

Social Characteristics

Table 1-6 provides information from the 2000 census for education, employment, and income. Appendix 2 provides the same information for Douglas County. The Tenmile CCD is below Douglas County for the percent of high school graduates and the percent of people with at least a four-year college degree. The percent of unemployed persons in the labor force is lower for the Tenmile CCD than for Douglas County. The top three occupations account for nearly 70% of the Tenmile CCD labor force. The top three industries employ over half of workers. The per capita median income and the median family income are both lower in the Tenmile CCD than in Douglas County. The Tenmile CCD has a higher poverty rate than does the county.

Subject	**Tenmile CCD**	**Winston**
Total 2000 population	9,171	4,613
Education - age 25 or older		
High school graduate	78.2 %	78.1 %
Bachelor's degree or higher	9.5 %	7.3 %
Employment – age 16 or older		
In labor force	60.9 %	64.3 %
Unemployed labor force	5.3 %	5.1 %
Top three occupations	Production, transportation, material moving occupations	
	Sales and office occupations	
	Service occupations	
Top three industries	Manufacturing	
	Educational, health and social services	
	Retail trade	
Income		
Per capita income	14,415	13,299
Median family income	$38,495	$36,006
Family households below poverty	10.6 %	13.7 %

Table 1-6: General education, employment and income characteristics

2 Past Conditions[19]

The Past Conditions Section provides an overview of events since the early 1800s that have impacted land use, land management, population growth, and fish habitat in Douglas County and in the Olalla / Lookingglass Watershed. Sections 2.1, 2.2, 2.3, and 2.4 describe the history of Douglas County. Section 2.5 provides information specific to the Olalla / Lookingglass Watershed. Most of this chapter is based on S.D. Beckham'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.

<u>Key Questions</u>

- 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 and diaries. The information they collected inspired 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 Americans.

2.1.1 Native American lands

The Native Americans 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 Native Americans kept these hills burned off for good hunting" (Chenoweth, 1972, p. 66). In southern Douglas County early white men told of the Native American 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 dense, choking smoke as they traveled through the Umpqua Valley. Native Americans had created the smoky conditions by burning grasslands on the hillsides and along the river.

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[19] Robin Biesecker of Barnes and Associates, Inc. contributed much of chapter 2.

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 Native American. The Native American 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 9 inches in circumference; 134 feet from the ground, 17 feet 5 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 Native Americans, 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 ten minute staredown the Native American leader requested tobacco. Douglas complied, quickly retreated to his camp and, along with his three sugar pine cones, survived the encounter.

> Origin of the name "Umpqua"
>
> Many ideas exist about the origin of "Umpqua." An Native American chief searching for hunting grounds came to the area and said "umpqua" or "this is the place." Other natives refer to "unca" meaning "this stream." One full-blooded Umpqua 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 Native American 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 thirty to fifty 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 Native American diet of sweet camas bulbs taken from the "great fields of camas" (p. 2). The Cow Creek Native Americans of southern Douglas County also ate the camas bulb (Chandler, 1981).

The diet of the Native Americans 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 Native Americans 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 explorers

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 natural resources were among the first European visitors to Douglas County. Methodist missionary Gustavus Hines preached to the Native Americans 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 Native Americans for about ten 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 Native Americans in northern Douglas County
1826	David Douglas (botanist) travels Douglas County
1828	Smith Massacre – Jedediah Smith's party attacked by Native Americans 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 Native Americans. 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" (Allen, 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

<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

The Donation Land Act of 1850 was a further impetus for the settlement of Douglas County. This act specified married couples arriving in Oregon prior to December 1850 could claim 640 acres; a single man could obtain 320 acres. Men arriving after December 1850 were allowed to claim 320 acres if married and 160 acres if single. The patent to the land was secured with a four-year residency. The Donation Land Act was scheduled to end in December of 1853 but was extended 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 Native American population of the county decreased. Diseases, as mentioned previously, took a toll, as did the Indian Wars of the 1850s. Douglas County Native Americans were relocated to the Grand Ronde Reservation in the 1850s.

2.2.2 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. 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 and developed in 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 Native American 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. Native Americans 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 ten years. Those ten 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.

Year	**1860**	**1880**	**1900**
Population	4,412	9,634	14,500

Table 2-1: Population growth in Douglas County from 1860 through 1900.

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 (Oregon Department of Transportation website, 2002). 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 needs of a growing number 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 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. 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, 2002). 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 (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).

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
1950	Flood
1953	Hanna Nickel production
1955	Flood
1962	Columbus Day Storm
1964	Flood
1966	Interstate 5 completed

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.[20] 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).

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.

> Mining at the Bonanza Mine in 1955
>
> *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).

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

[20] A flask is 76 pounds of mercury.

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). See Section 2.4.2 for the affects of mining on the watershed and fisheries.

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.[21]

Year	1900	1910	1920	1930	1940	1950	1960
Population	14,565	19,674	21,332	21,965	25,728	54,549	68,458

Table 2-2: Population growth in Douglas County from 1900 through 1960.

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

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

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 has caused a depression in the local forest products manufacturing industry. In April, 2003, Roseburg Forest Products laid off approximately 400 workers.[22]

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, 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

[22] This information is derived from conversations between Nancy Geyer, Society of American Foresters president and president-elect Jake Gibbs and Eric Geyer, and Dick Beeby of Roseburg Forest Products.

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 2-3 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 2-3: 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.

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 5 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. 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.

Year	1960	1970	1980	1990	2000
Population	68,458	71,743	93,748	94,649	100,399

Table 2-4: Population growth in Douglas County from 1960 to 2000.

2.5 History of the Olalla / Lookingglass Watershed

2.5.1 Olalla / Lookingglass historical timeline

Pre-1800s	• The Upper Umpqua Indians lived along Lookingglass Creek and lower Olalla Creek in seasonal villages. Upper Olalla Creek was a seasonal home for the Cow Creek Band of the Umpqua Indians. The Native Americans burned areas to control brush, aid in hunting large game, and improve forage/fruit production.
1826	• Alexander Roderick McLeod entered the Umpqua Valley under the direction of the Hudson Bay Company (through the Willamette Valley). His party traveled down Elk Creek to the Umpqua River and the coast, then came back up the middle fork of the Coquille River to Camas Valley and over to Lookingglass. McLeod was in search of trapping opportunities and the "Great River" that would offer an alternative to the Columbia River for river travel from the Rockies to the ocean. David Douglas, botanist, joined the expedition in search of sugar pine.
Fall 1846	• Jesse and Lindsay Applegate came into the Lookingglass area searching for a new emigrant wagon route from Fort Hall near the Rockies to the North Willamette Valley.
1846	• Hoy Flournoy entered Lookingglass Valley with Jesse Applegate and named the area after the appearance of the grass.
late 1840s	• The Arrington and Ollivant families settled into Lookingglass area.[23] Between 1849-1855, many settlers moved into the area.
1850	• Lookingglass School District formed, with help of A.L.J. Todd. The first classroom in 1854 was out of Todd's home.
Early 1850s	• Donation Land Claims established by H.B. Flournoy in Flournoy Valley and by Daniel Huntly in Lookingglass Valley.
1850s	• Farms primarily grew oats, wheat, corn, rye and barley. Farming tools were difficult to carry on emigrant trails and often left behind or dumped along the way. First farming efforts used locally made tools or recent purchases from urban areas. Farms increased in number until 1910. • Reverend A.L.J. Todd of Lookingglass ran a pottery mill on his property and often used balls of pine pitch for nighttime lighting. .
1852	• Most of Lookingglass Valley was claimed under the Donation Land Act.
1852-1853	• Winston and surrounding area was attractive to homesteaders for the fertile lands. Land was used for farming and later specialized fruits (nuts, melons, vegetables). The area was one of the most productive agricultural settings in the county. • Local farmers shipped cured pork and tobacco to miners in the Rogue valley using pack trains.[24]
1852-1856	• "Volunteer" companies were organized to remove Native Americans, often by massacre. The Lookingglass volunteer guard was created.

[23] From interview with Don Ollivant, 1/13/03
[24] From interview with Don Ollivant, 6/16/03

1853	• The vote for selecting a county seat took place. Lookingglass received 25 votes, behind Deer Cr. (Roseburg) with 265 votes and Winchester with 90 votes.
1854	• The first Tenmile school was in a log cabin.
mid-1850s	• The first gristmills in Douglas County were constructed. The product was used for baking flour and stock feed; excess was sold, often to miners in the Rogue Valley. • Nearly every community had a gristmill by the 1870s, and they were operated until the 1920s. • Thomas Wilson Newland operated a gristmill in Olalla. • In Lookingglass a gristmill was located on Lookingglass Creek (T28S, R7W, Sec 12). Floods destroyed the gristmill after a few years.[25]
1855-1856	• Surveyors described Lookingglass valley as rolling prairies with hilly oak openings. The timber, located at mid-elevations, was described as fir and cedar with scatterings of sugar pine.
Oct 24, 1855	• Tensions escalated between Native Americans and immigrants. • A peaceful group of Umpqua Indians gave up their firearms to avoid conflict. They camped in Lookingglass, under the protection of J.M Arrington and Rev. ALJ Todd. • The "Volunteer" company attacked the camp before dawn and killed several Umpquas in what became known as the "Lookingglass Massacre." Survivors fled into the night and hid in the Arrington chicken coop.[26]
Dec 1, 1855	• A band of Indians swept through Byron Creek area, and down Rice Creek towards Dillard and attacked the Rice farm. News spread into Tenmile and Olalla where settlers fled their farms. Upon finding the empty farms, the group of Cow Creek Indians burned some buildings and stole some supplies. • The "Volunteers" tracked the Band to a camp on Olalla Creek and attacked the next morning. The surviving Cow Creek Indians fled into the Cow Creek – Rogue River divide.
1856	• Many small groups of Native Americans moved to reservations, but some hostile groups remained. The hostile groups raided and killed "Volunteers." The Bureau of Indian Affairs contracted bounty hunters to capture or kill remaining groups. [27] • The last major battle was in May and by June most Native Americans were in reservations. It was noted that in July, 1856, six or seven Native Americans were still residing on Lookingglass Creek..
1857	• Several dozen Native Americans lived in the Western Foothills and helped settlers to capture a "renegade" band of Cow Creek Indians who had periodically raided farms in Southern Douglas County.
1860	• The first school in Reston was at "Old Beard's" house and was called the Sugar Pine Academy.
1860s	• Sheep and wool were prominent industries in the area until after the 1900s.

[25] From interview with landowners , 6/16/03
[26] From interview with Don Ollivant, 1/13/03
[27] From interview with anonymous landowner, 1/10/03

1863	• The Tenmile school building was replaced and later renovated in 1880.
1864	• Some members of the Cow Creek Band lived above Cow Creek and when faced starvation came into the Upper Olalla Cr. area and raided the Doyle farm.
1864	• Benjamin Simpson (agent of the Siletz Reservation), tried to capture renegade Cow Creek members in Upper Olalla and Cow Creek, but was unsuccessful.
1865	• Sheepherders on Old Piney Mt. (Nickel Mt.) found mineral specimens that contained nickel.
1866	• New building for Lookingglass School opened.
1869	• Congress offered a land grant for companies interested in constructing the Coos Bay Wagon Road from Winston to the coast. Congress offered three square miles of land for every one mile of road built.
By 1870s	• Peter Williams of Lookingglass hosted spectators at his horse race track.
1870	• To raise money for his church, ALJ Todd and his family moved from Lookingglass and opened the Elkhead mercury mine. Through various owners, the mine yielded at least 71 flasks of Mercury and was operated until mercury mining was terminated in Douglas County in 1960s.
1870s	• Agricultural products became a source of income and were not only produced for subsistence. Gristmills and better shipping routes improved agricultural markets.
1871	• The Coos Bay Wagon Road was completed. The road provided a route for stages and mail service between Roseburg, Reston, Sitkum and the coast. • US Postal Services began in Lookingglass. • The Eighteen Mile House in the Lookingglass Valley was a stage facility operated by the Weekleys.
1873	• The "old" Coos Bay Wagon Road was improved, but use was limited. However, the road improvements provided optimism for future development. • The first store in Lookingglass was opened.
1876	• The telegraph system was completed between Roseburg and Coos Bay.
1879	• Lookingglass was assessed with: one post office, two general stores, two saloons, two livery stables, and one hotel.
1880s	• BB Brockway's farm just west of Winston held regular fair events. Exhibits, food, tobacco, and shooting galleries were some events. In 1887, a steam-propelled revolving swing drew crowds.
1880s	• A small group of Umpqua Indians lived on Rice Creek until at least the 1880s.
1880s	• Robert Gurney had interest in several coal deposits in the Lookingglass area. No commercial production was recorded.
1881	• Will Q. Brown began developing and digging tunnels on Nickel Mt. Mining nickel ore began at very small levels.
1883	• Ira Howard carried mail and his wife ran the Lookingglass hotel. • Lookingglass residents numbered between 15-20. • Lookingglass was assessed with: one mercantile store, variety store, hotel, grist mill, wagon shop, blacksmith shop, and two livery stables.

1884	• Lookingglass School was moved to the present site.
July 1888	• While visiting Will Q. Brown at the Nickel mine, Joseph Silas Diller observed fossils and sandstone. In the Buck Mountain-Thompson Creek region of upper Olalla, Diller found Jurassic[28] plant specimens. Diller published extensively on the geology of Douglas County.
1890	• US Postal Services began in Reston.
1890s	• Prunes were the dominant fruit crop; apples, peaches, pears, cherries, strawberries, and grapes were also grown.
1890s-1920s	• Placer and lode claims were staked off Olalla Creek, Coarse Gold Cr, Byron Cr, Thompson Cr, and Bushnell Cr. A ditch was built to collect water from Byron and Bushnell creeks for a mining operation in present Byron Estates. The glory hole is still present.[29]
1890-1893	• Coos Bay, Roseburg & Eastern Railroad Company planned to construct a railroad from Coos Bay to Roseburg, following the Coquille River. The railroad reached Myrtle Point (30 miles) when company's resources were depleted.
1891	• Nickel mine was sold to International Nickel Mining Company. The company constructed a power plant, sawmill and concentrator, but never developed the mines. The mine was sold and bought without further development until 1947.
1892	• Marsh Ranch Barn was built in Lookingglass. It is now on the National Register of Historic Places (just east of Lookingglass store, octagonal barn on North side of the road). It was built by James Wimer as a cattle barn, but converted by George Marsh into a fruit storage barn.
1893	• Idaho Stage Company ran daily stages along the "old" Coos Bay Wagon Road in Concord coaches drawn by four-horse teams. • The "new" Coos Bay Wagon Road began offering an option to travelers. This stage line ran via Olalla, Tenmile and Camas Valley down the middle fork of the Coquille River to Myrtle Point (similar to Hwy 42). One traveler noted 32-hour travel time from Roseburg to the Coquille Valley.
1900	• The Byron limestone quarry was exposed about ¾ mile northeast of Olalla. • The Krogel coal prospect, located east of Camas Valley in the Berry Creek Drainage, was established later.
1900s	• Small lumber mills began to appear in rural communities such as Olalla, Lookingglass, Tenmile and Reston.
1910	• Oil and gas exploration wells were drilled east of Lookingglass and in the Flournoy area. None was found.
1910	• The number of farms steadily increased until this year, then stabilized and slowly decreased in number.
1913	• Upper Olalla school was built.

[28] Terms such as "Jurassic" and "Cretaceous" refer to periods in the geological/evolutionary timetable. Refer to Section 1.2.3 and Appendix 1 for more information on geology and physiology.
[29] From interview with landowners, 6/16/03

1916	• Chamberlain-Ferris Act: Between 1888 and 1902, O&C Railroad Company violated their contract with the US by selling tracts of land larger than 160 acres for more than the agreed $2.50 per acre. • All mis-appropriated and not-yet-appropriated lands were revested to the General Land Office (GLO) for management purposes. Mis-appropriated land under the Coos Bay Wagon Road was also revested to the GLO.
1920-1943	• Lookingglass High School was open on the 2nd floor of the Methodist Church.
1920s-1930s	• Prune production reached a peak. The rich soil provided good conditions for fruit and vegetable production. Produce was sold locally or trucked to markets. • Turkeys and chickens were reared across much of the watershed, for home consumption and markets.
1922-1924	• Pacific Highway 99 was built through Coos Junction (now Winston). It became the first paved route in Douglas County and offered the benefits of an all-weather road. • The "new" Coos Bay Wagon Road via Camas Valley was improved. The route was graded and graveled for all-weather traffic, and several bridges were built. This route became Highway 42 in 1945
1939	• A new modern Tenmile School was built in 1939.
1940s	• Electricity came to rural areas. • Some students in the Olalla area went to high school in Camas Valley.
1944	• Kenneth Ford built the mill at Dillard.
1945	• Highway 42 was built through Tenmile into Camas Valley. It closely followed the new Coos-Bay Wagon Road. The crossroads with the Pacific Highway 99 boosted the economy of Winston, but hurt Dillard.
1947	• Hanna Company bought the nickel mine.
1948	• Hanna Nickel Smelter was constructed on Old Piney Mt. (Nickel Mt.)
1954	• Hanna Company began producing nickel and became the first and only major nickel mine in the US. In 1958, the mine produced 21 million pounds of nickel. • Between 1954-1971, the company mined 25,611,000 crude tons of nickel ore and produced over $1 billion in nickel.
1955	• The City of Winston incorporated.
1966	• Interstate 5 was completed and drew travelers away from Winston.
1980	• Ben Irving Reservoir was created by an earthen dam on Berry Creek.
1987	• Hanna Company closed their mine of Nickel Mountain.
1988	• Nickel prices rose and Glenbrook Nickel began mining on Nickel Mountain.
1998	• Glenbrook Nickel closed.

2.5.2 Population

Before 1900, the census was based on Post Office precincts and every person was counted. Lookingglass and Tenmile both have census data from 1860 to 1900. After 1900, the census was based upon city boundaries and did not include any sites within the Olalla / Lookingglass Watershed. The Tenmile CCD[30] was developed by the Census Bureau to determine the population of rural areas. Data for the Tenmile CCD before 1990 are not available.

Year	Lookingglass	Tenmile	Tenmile CCD	Winston	Roseburg	Douglas Co
1860	279	126		-	789	4,412
1880	774	378		-	800	9,634
1900	392	307		-	1,789	14,500
1910				-	4,738	19,674
1920				-	4,258	21,332
1930				-	4,362	21,965
1940				-	4,924	25,728
1950				-	8,390	54,549
1960				2,395	11,467	68,458
1970				2,468	14,461	71,743
1980				3,359	16,644	93,748
1990			8,416	3,773	17,069	94,649
2000			9,171	4,613	20,017	100,399

Table 2-5: Population - based on urban census starting in 1910

School districts

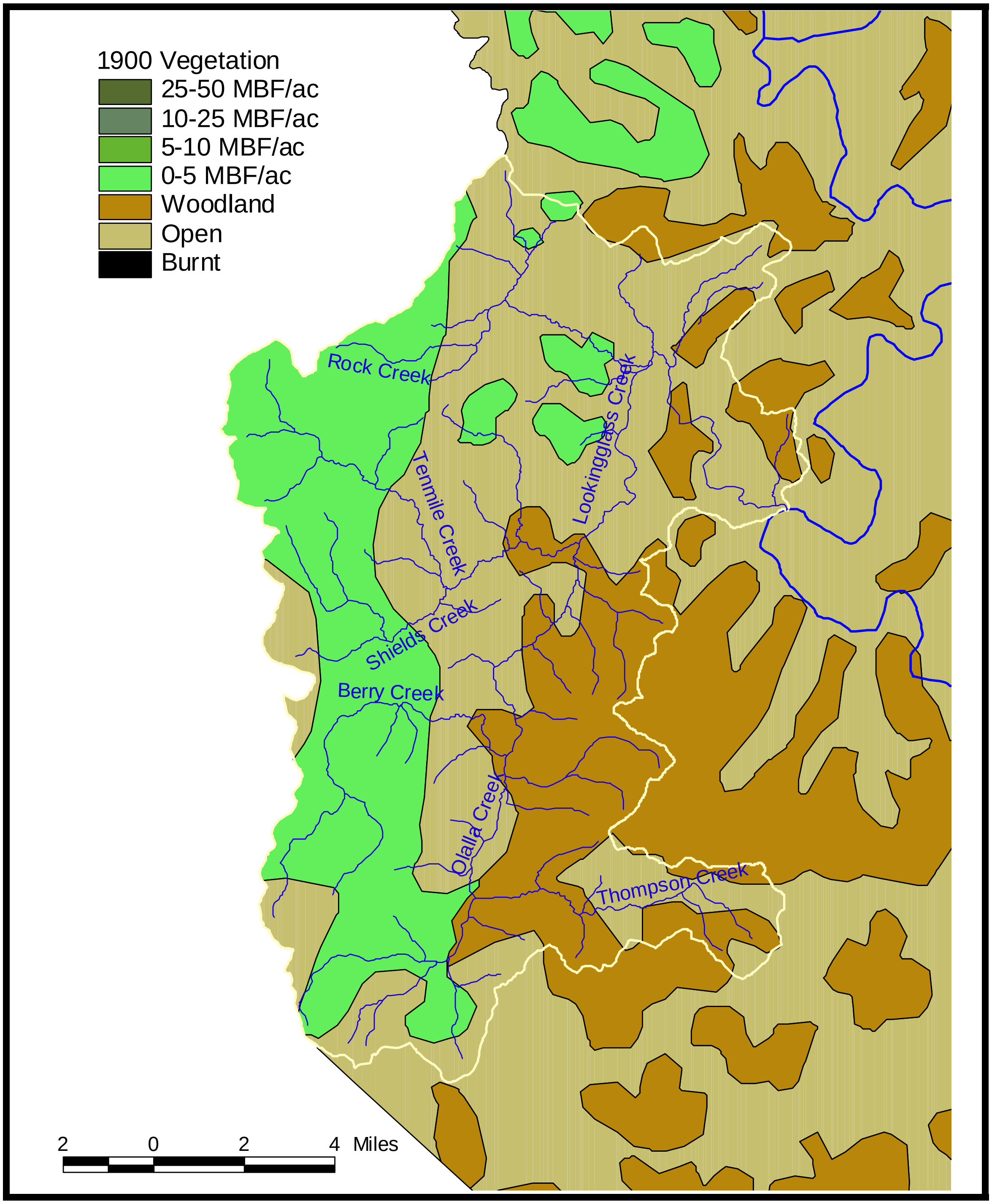
Location	Open	Close/merge	
Lookingglass	9-Jan- 1871	31-Oct-1942	
Olalla	8-Sept-1881	28-Feb-1922	merge with Camas Valley
Brockway	29-Oct- 1896	30-Apr-1956	merge with Winston
Flournoy	20-June-1907	14-Jan- 1908	
Reston	25-Aug-1890	12-Feb-1934	merge with Lookingglass
Tenmile	13-June-1870	unknown	
Winston	13-June-1893	14-July-1903	
Winston	1-July-1948		

Table 2-6: School districts within the Olalla / Lookingglass Watershed

[30] Section 1.3.2 explains that the Tenmile CCD is a census survey area that encompasses the Olalla / Lookingglass Watershed (see Map 1-13)

2.5.3 1900 forest conditions

Map 2-1 illustrates the vegetation patterns of 1900. Large open areas were present, as well as some forested and woodland areas.



Map 2-1: Vegetation patterns for 1900

2.5.4 Historical fish use[31]

The Olalla / Lookingglass Watershed is located within the South Umpqua Basin with all streams of the watershed eventually draining into the South Umpqua River. In 1937 the Umpqua National Forest surveyed portions of the South Umpqua Basin for fish use. Numerous salmon, steelhead, and cutthroat trout were found throughout the South Umpqua River and its tributaries. The riparian zones were typically the old growth forests found throughout the Pacific Northwest with much of the waterway shaded by tall trees.

Historically, this watershed has had naturally low streamflows and warm water temperatures during the summer months but was still able to support abundant populations of chinook and coho salmon, steelhead and cutthroat trout. The 1937 Umpqua National Forest Survey found steelhead runs in the South Umpqua River were strongest in the winter while the chinook were most evident in late spring and summer. Cutthroat trout were observed throughout the surveyed stream segments of the Upper South Umpqua Basin. The Oregon State Game Commission (OSCG) found coho salmon plentiful in the South Umpqua River in 1972 (see Table 2-7).

1972 OSGC Survey	**Chinook**		**Coho**	**Steelhead**		**Sea-run**
	Spring	Fall		Winter	Summer	**Cutthroat**
South Umpqua River	600	1,500	4,000	10,000	0	10,000

Table 2-7: Estimated number of adult salmonids (including hatchery fish).[32]

The Umpqua system was stocked with Alsea River cutthroat from 1961 through the late 1970s. The sea-run cutthroat trout returns have been low since the stocking was eliminated. The addition of the Alsea River cutthroat may have added to the survival problems of the sea-run cutthroat trout native to the Umpqua River Basin.

Between the years of 1989 and 1993, the Umpqua National Forest did a comparative study of the streams originally surveyed in 1937. Stream widening was found in 22 of the 31 segments of streams surveyed. The widening is related to increased peak flows. Peak flows increase when stream channels are simplified; sediment fills the pools leaving a smoother channel surface. Clearing of vegetation from the riparian areas along streams has typically increased erosion along the stream banks and added sediment to the waterways. Timber harvest, road construction, and mining have all played a role in changing the stream channels and riparian zones. Stream channel simplification decreases the number and depth of the pools used for fish rearing.

[31] This section on historical fish use is based on information from the *1998 Olalla Lookingglass Watershed Analysis* completed by the Roseburg District of the Bureau of Land Management.

[32] This information is from the *1972 Fish and Wildlife Resources of the Umpqua Basin, Oregon, and Their Water Requirements* by Jim E. Lauman of the Oregon State Game Commission.

2.5.5 Grange halls

Grange #	Name	Location	Open	Close
420	Rescue	Lookingglass	1910	
460	Evergreen	Winston	1911	
559	Winston	Winston	1917	1919
461	Brockway	Brockway	1911	1913
749	Tenmile	Tenmile	1930	1940
927	Lookingglass	Lookingglass	1949	
913	Olalla	Brockway	1946	1948

Table 2-8: Grange halls in Olalla / Lookingglass

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3 Current Conditions

This chapter explores the current conditions of the Olalla / Lookingglass 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, the Watershed Stewardship handbook, and the Fish Passage Short Course handbook. Additional information and data are from the following groups' documents, websites, databases, and specialists: the 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, the Douglas Forest Protective Association, and the Oregon Water Resources Department.

Key Questions

- In general how are the streams, riparian areas, and wetlands within the Olalla / Lookingglass 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?

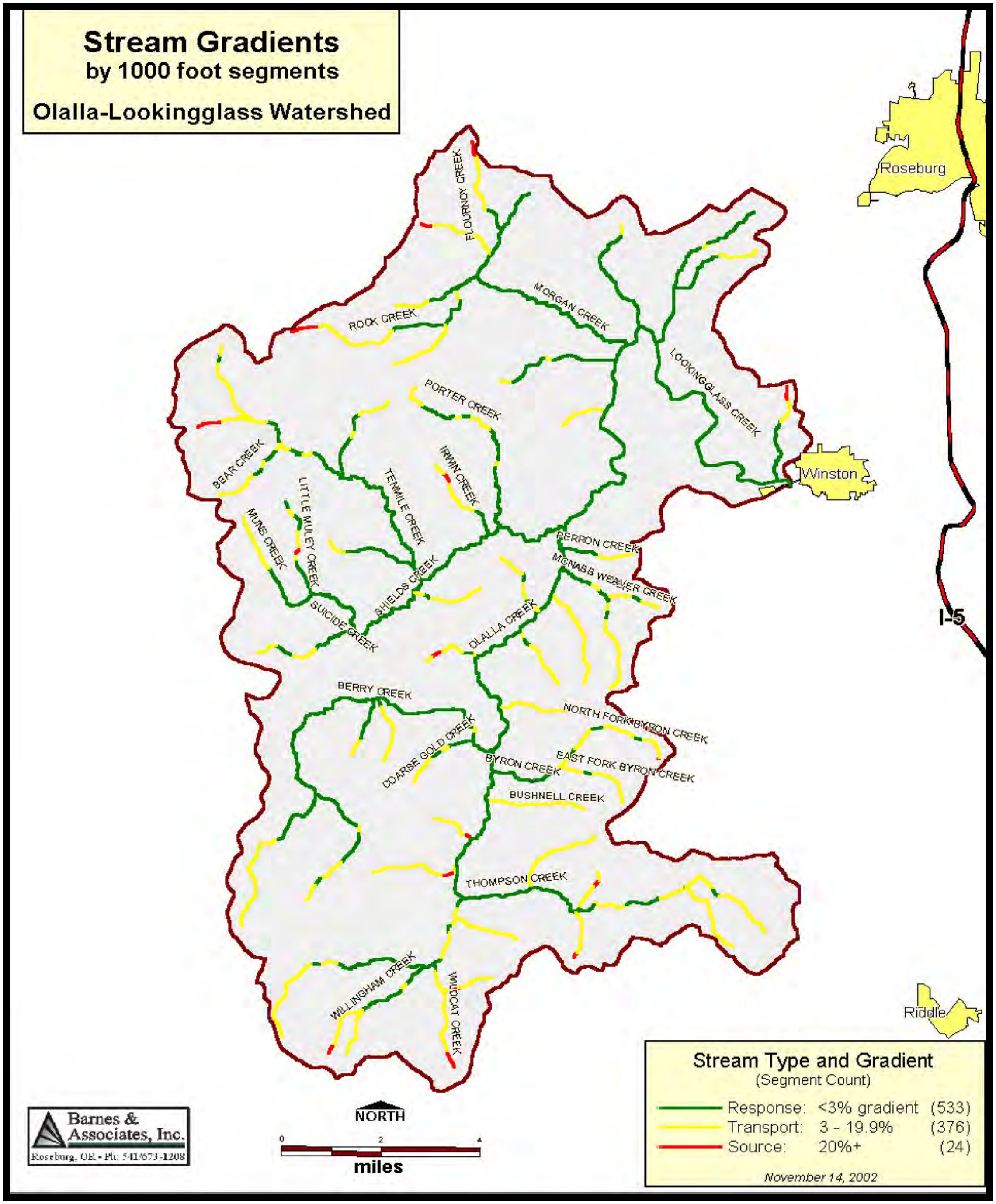
3.1 Stream function

3.1.1 Stream morphology

Stream gradients

The OWEB Watershed Assessment Manual provides a framework for classifying streams based on gradient, valley confinement, and stream size. Streams are classified into three basic categories based on these characteristics: source, transport, and depositional streams. Source streams are mountain headwater streams of high gradient and energy; transfer streams are low elevation streams of moderate to low gradient; and depositional streams are the meandering, low energy and low gradient rivers of the floodplains and valleys in the watershed. 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.[33] Map 3-1 and Table 3-1 show the total stream miles and percent of streams within each gradient class.

[33] Tim Grubert and John Runyon of BioSystems Consulting, contributed this paragraph.



Map 3-1: Stream gradients

Gradient class	Stream miles in the watershed	% Total
Source (30+ %)	0.6	0.4 %
Transport (3-30%)	70.7	41.6 %
Deposition (0-3%)	98.5	58.0 %
Total	169.8	100.0 %

Table 3-1: Stream gradient miles

Source streams are steep with a 30% or greater gradient and are the location for most woody debris and gravel to enter the stream system. Gradients are often too steep for many fish species. Transport streams have gradients ranging from 3% to 30% and are a transitional area for large woody debris and gravel. These materials will settle for a short period and then move further down the stream with high water flows. Fish productivity is moderate. Deposition streams have gradients of less than 3%. Woody debris and gravel become lodged for longer periods in these streams. This is the most productive area for fish because of ample spawning grounds, smolt rearing grounds, and complex habitat with deep pools that provide food and shelter.

Channel Morphology[34]

Large disturbance events, such as floods, typically dominate stream channel morphology processes. The stream gradient and channel confinement govern the behavior of water flow through the channel in these peak flow events. These characteristics most significantly influence the character of the stream substrate, the stream's ability to maintain fish populations, and the effectiveness of riparian enhancement projects. Narrow valleys and steep slopes force water through channels at high velocities, in which only large particles like gravel, cobbles, and boulders can be deposited. However, confined channels, though they have faster peak flows, maintain a more stable stream position than, for instance, the migrating meandering streams of a large floodplain.

The Oregon Watershed Enhancement Board (OWEB) has developed a system for classifying streams based on their physical attributes that has implications for the ecology of these streams. This system is called the Channel Habitat Type system, and it uses features of stream gradient, valley shape, channel pattern, channel confinement, stream size, position in drainage, and substrate (Watershed Professionals Network, 1999). Table 3-2 lists the channel habitat types that are found in the Olalla / Lookingglass Watershed along with examples of streams that fall into each.

[34] Kristin Anderson, BioSystems Consulting, contributed this section. References and a glossary are included in Appendix 1

Channel Habitat Type	**Example within watershed**	**Restoration opportunities**
Low gradient medium floodplain	Lookingglass Creek	Because of the migrating nature of these channels, restoration opportunities such as shade and bank stability projects on small side channels may be the best option for improvement.
Low gradient small floodplain	Flournoy Valley	Because of the migrating nature of these channels, restoration efforts may be challenging. However, because of their small size, projects at some locations would be successful.
Low gradient moderately confined	Porter Creek	These channels can be very responsive to restoration efforts. Adding large wood to channels in forested areas may improve fish habitat, while stabilizing stream banks in non-forested areas may decrease erosion.
Low gradient confined	Olalla Creek headwaters	Though these channels are not often responsive, riparian planting projects may improve water temperature and erosion issues.
Moderate gradient moderately confined	Bushnell Creek	These channels are among the most responsive to restoration projects. Adding large wood to channels in forested areas may improve fish habitat, while stabilizing stream banks in non-forested areas may decrease erosion.
Moderate gradient confined	Muns Creek	Though these channels are not often responsive, riparian planting projects may improve water temperature and erosion issues.
Moderate gradient headwater	Shields Creek headwaters	These channels are often moderately responsive to restoration. Riparian planting projects may improve water temperature and erosion issues.
Moderately steep narrow valley	Thompson Creek and Wildcat Creek headwaters	Though these channels are not often responsive, riparian planting projects may improve water temperature and erosion issues.
Steep narrow valley and very steep headwater	McNabb Creek headwaters	Though these channels are not often highly responsive, the establishment of riparian vegetation along stable banks may address water temperature problems.

Table 3-2: Channel habitat types

Ellis-Sugai and Godwin (2002) also look at streams in terms of their position in the watershed. Streams in steep headwaters (often 20% slope or greater) are source streams, adding sediment and wood to the stream system. They have high energy flows, no floodplain, and are prone to landslides. Transport streams have medium gradients (often between 3% and 20% slopes). They often have small meanders and floodplains. They carry sediments and wood during times of large flows and store them during low flows. In the downstream reaches of watersheds lie depositional streams. The low gradients, large floodplains, and meanders of these streams dissipate the energy of flows and allow sediments and wood to settle out of low flows and be stored in these reaches of the streams for long periods. These depositional streams are the most sensitive to changes in the watershed. For instance, changes to sediment supply make the biggest impact in these lower reaches (Ellis-Sugai and Godwin, 2002).

The headwaters of most tributaries to Olalla Creek lie in geologic units of Tertiary age. They are often fairly steep (8-16% slope). These are source streams, providing sediment and wood. Most of these streams are above the anadromous fish zone. Shade and other riparian projects may help improve those stream reaches. Most of these headwater streams quickly become moderately sloped (4-8% slope) shortly downstream with confined to moderately confined conditions. These reaches function as transport streams, both storing and delivering sediment and wood downstream. Adding large wood, stabilizing banks by planting trees, and improving shade in these reaches may be helpful for the stream system. Olalla Creek flowing north beyond Olalla opens up in a fairly wide floodplain, narrows when flowing past Alexander Butte, and then broadens again until its confluence with the South Umpqua River. These broad, low-gradient reaches lend themselves to complex aquatic habitat with large wood, coarse sediment, pools, bars, and side channels. However, these reaches are difficult to enhance, as the meandering nature of the streams makes bank stability projects likely to fail, so special care should be given to project selection and planning.

The Tmss geologic unit, with its lower relief, drains mostly into Morgan Creek. Tributaries to Morgan Creek through the Flournoy Valley generally have a moderate slope except in the very headwaters along the contact with the Tyee Formation (unit Tt), where the headwaters are very steep. Tributaries originating within or just outside Lookingglass Valley and flowing into the valley have low to moderate slopes (1-4%) with little to no confinement. As shown in Map 3-13 and Map 3-14, many of these streams are in areas of naturally high soil erodibility and runoff. Planting trees to improve bank stability may be particularly helpful to minimizing erosion in these areas.

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 summer of 1995 and 1996, ODFW staff conducted stream habitat surveys in the Olalla / Lookingglass Watershed. Approximately 51.1 stream miles were surveyed in the Olalla / Lookingglass Watershed (see Map 3-2),[35] or about 30.8% of the total stream miles visible on the map (166.3). Each stream was divided into reaches based on channel and riparian habitat characteristics for a total of 43 reaches averaging 1.2 miles in length. Appendix 3 provides a map and table detailing the stream reaches.

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.

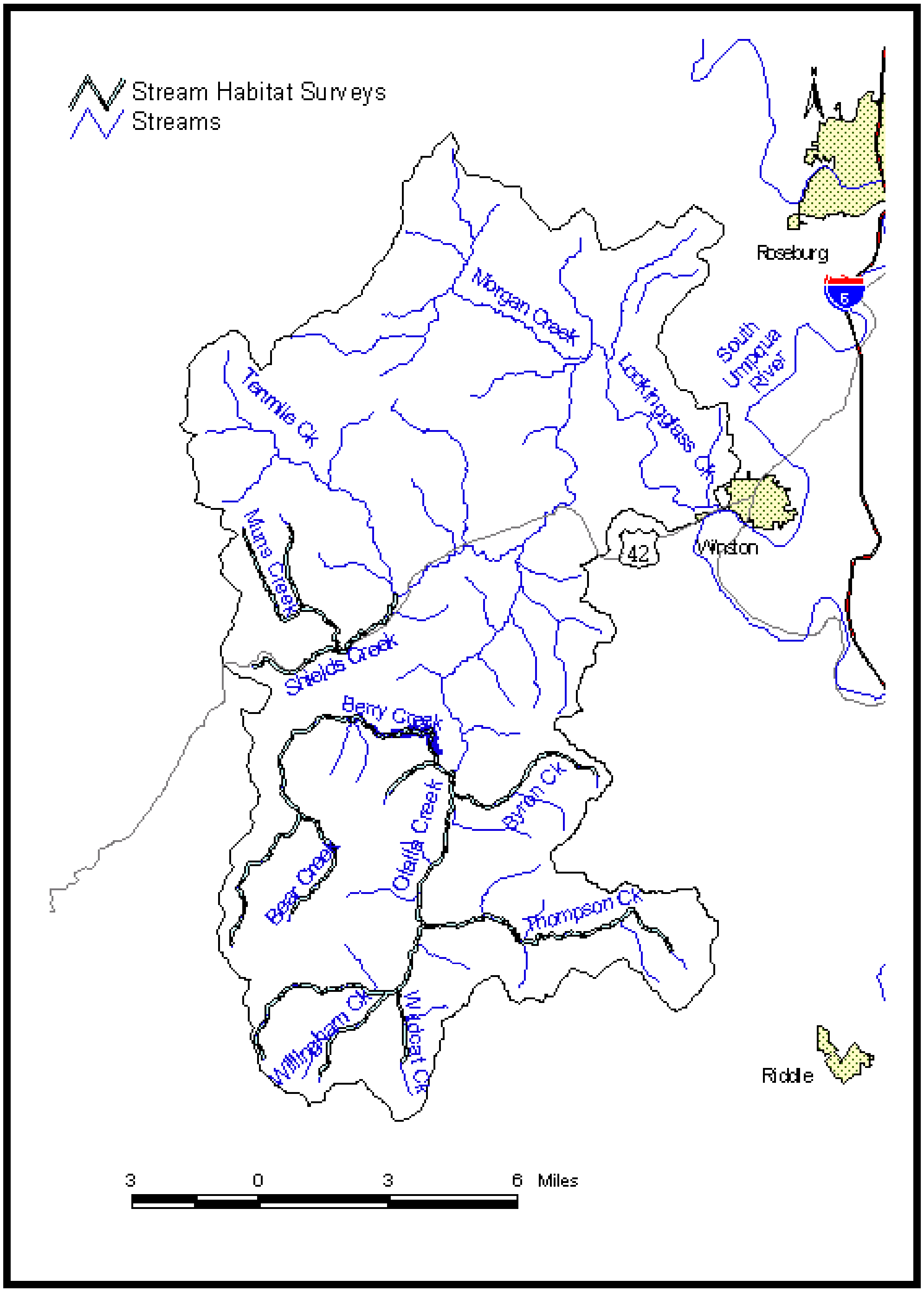
Stream habitat benchmarks rate the values of the components of the survey in four categories: excellent, good, fair, and poor. For the purpose of this watershed assessment, "excellent" and "good" have been combined into one "good" category. Table 3-3 provides parameters used to develop the benchmark 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, the 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

[35] See Section 1.2.5 for more information about the stream map.

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.



Map 3-2: Streams surveyed (bold purple) in the Olalla / Lookingglass Watershed[36]

[36] See appendix for detailed map of stream reaches surveyed

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 < 12 m (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**[37] 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

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

Overview of conditions
Looking at the historic 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 Olalla / Lookingglass Watershed is beyond the scope of this assessment. This assessment 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 Olalla / Lookingglass Watershed, ODFW surveyed 43 stream reaches. Of these reaches, only one (2%) rated as fair or good in all four categories. The majority of reaches (56%) were rated as poor in only one of the four categories. Large woody material and riffles were rated as poor in over half (63% and 51%) of the reaches, while pools and riparian area were rated as poor in about a quarter (21% and 26%) of the reaches.

Stream conditions (1995-1996)
For each reach, the ODFW survey team classified the land use around the streams. A chart with these classifications and their definitions is provided in Appendix 4. Land uses and potential problem areas, which are parameters that were classified as "poor" or a combination of "fair" and "poor," are highlighted below.

Bear Creek
Bear Creek runs through forested areas with some timber harvest occurring. Large woody material is rated poor in all reaches.

Berry Creek
The first reach of Berry Creek travels through land that is mixed residential and agricultural. The second reach is within the Ben Irving Reservoir, and the last three reaches flow through forest areas with some timber harvesting. Each reach was surveyed as excellent/good for pools. Above the reservoir, all reaches are fair to poor in riffles and reaches three and four are poor in riparian areas.

Byron Creek
Byron Creek flows through from forests down to agricultural lands. All reaches are fair or poor in pools and large woody material, and poor in riffles and riparian areas.

Coarse Gold Creek
Reach one is a primarily agricultural and grazing area. Reach two is timber. Both reaches are rated poor in riffles and large woody material and fair to poor in pools.

Little Muley Creek
Both reaches are in timber of various ages. Riffles are rated poor; pools are rated fair and large woody material is rated poor to fair. Riparian area is excellent/good in both stretches.

Muns Creek

Reach one is classified as agricultural and residential. Reaches two and three are timber areas. Large woody material is poor in all stretches. The other categories are fair or better.

Olalla Creek

The first reach is in an agricultural and residential area. The remaining seven reaches are in timber areas with some recent harvest. Reach one is poor in riffles, riparian area, and large woody material, and fair in pools. The first three reaches are poor in large woody material. From reach four to the headwaters, riffles are rated poor.

Shields Creek

Agriculture and heavy grazing are land uses in reach one. Reach two is residential, transitioning to forests in reach three. Riffles are rated poor throughout the creek, and large woody material is rated poor, except for reach three which is rated fair. Pools are rated fair and riparian area is rated fair for reaches one and two.

Thompson Creek

Reach four is a residential area with some agricultural use. All other reaches are forested. Mining is a secondary use on the first two reaches. In all reaches, large woody material is rated poor, with one fair. Along the first three reaches, riffles are rated fair to poor. Reach seven is rated poor in pools, riffles and large woody material, and rated fair in riparian area.

Wildcat Creek

Second growth timber is the primary land use. Pools are rated poor, but all other parameters are rated excellent/good, with one fair.

Willingham Creek

All reaches are used for second growth timber. Pools are rated poor and fair in all reaches. Riffles are rated good at reach one, but fair through the middle reaches and poor in the headwaters. Riparian area is rated poor in reaches one through four. Large woody material is rated poor in reaches one, two, and four.

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.[38]

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.[39] 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 Olalla / Lookingglass 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.[40] 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.

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[38] See Section 3.3.2 for more information about stream temperature.

[39] Fish wheel screens are a form of self-cleaning screen that prevent fish from entering an irrigation ditch and remove debris that may prevent water flow.

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

Berry Creek Dam was constructed from 1978 to 1980 at a "bargain" price of $7.5million.[41] In 1981, the reservoir was filled halfway, then filled completely in 1982. During the mid-80s, the reservoir was drained for dam work and refilled in 1988. At a height of 130 feet with no fish ladder, the dam is a fish passage barrier. Before construction, it was believed that tributary "streams did not have fish runs."[42] However, local residents note steelhead populations in Berry Creek above the dam site prior to construction. Since construction, year round water release has provided cool water influence into the Olalla Creek system. Perron Creek also has a dam that is a fish passage barrier. At the time of construction, no fish runs were known to exist.
As seen in Map 3-3, there are at least 15 other dams in the watershed, though the individual impact on fish runs has not been studied. Human made and beaver made ponds are not distinguished on this map. According to the Oregon Water Resources Department, there is at least one push-up dam active in the Olalla / Lookingglass Watershed, along the Tenmile Creek. This one and others may pose a barrier to juvenile fish passage.

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 41 road and stream crossings in the Olalla / Lookingglass Watershed (see Map 3-3). Many of these are most likely culverts, but it is unknown at this time how many of the culverts are fish passage barriers or obstacles.

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.

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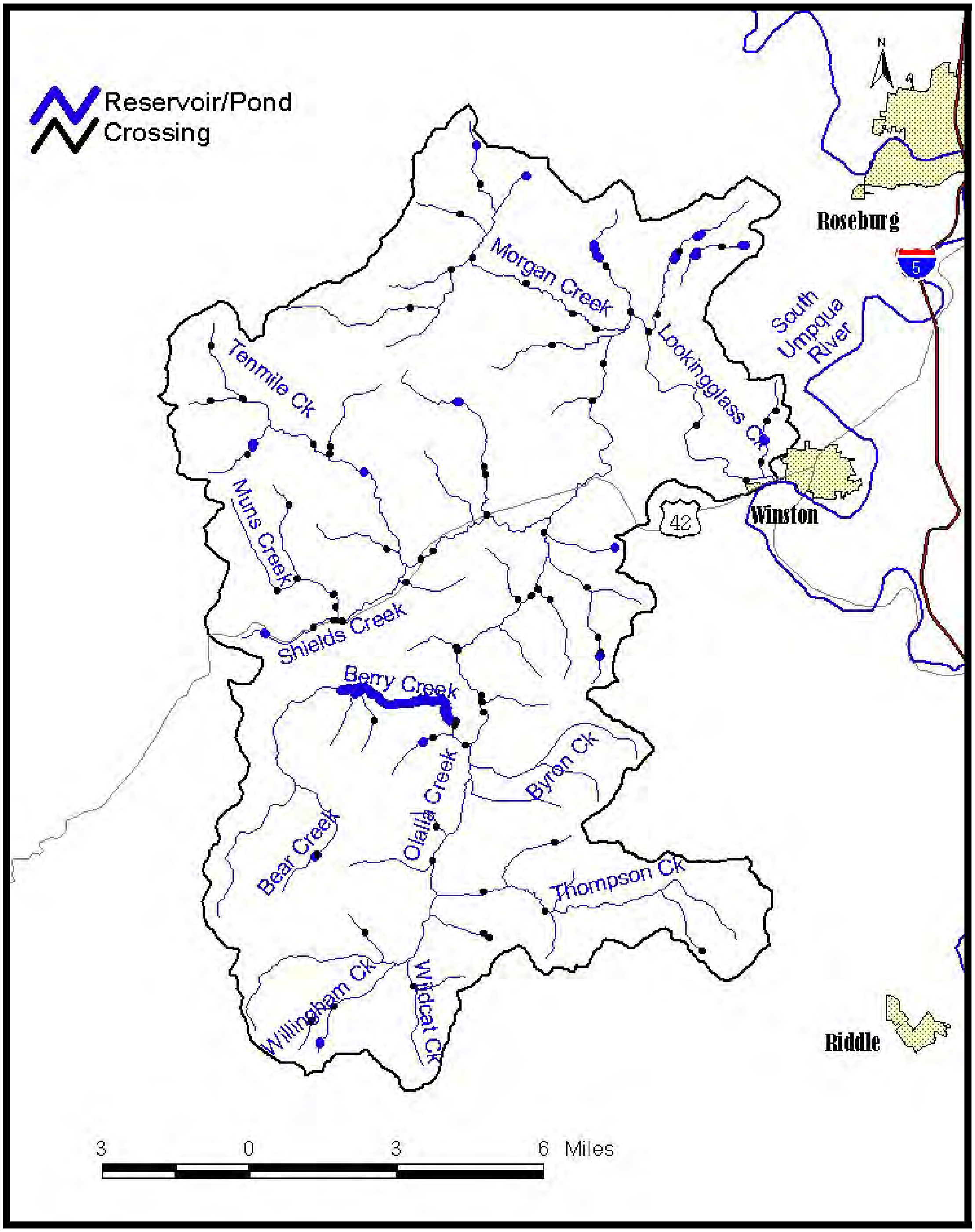
[41] Frank Nielson, director of Douglas County Natural Resources Dept.
[42] According to a discussion with Frank Nielson on December 18, 2002, during an Olalla / Lookingglass Watershed Assessment meeting.

High winter water flows can increase pool size and reduce jumping distance. However, high flows can also increase water velocities, making culverts impassible.



Map 3-3: Road crossings and reservoir or ponds

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 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.[43] A document summarizing the results of this project will be available in late 2003.

Currently, landowner interviews and discussions with stream habitat restoration specialists indicate there are or may be culverts blocking fish passage on

- Lee's culvert on Archambeau (west side of Flournoy Valley)
- Culvert on Upper Tenmile tributary after F. Fork
- Strickland Canyon unnamed tributary – two possible culvert obstacles.

3.1.3 Channel modification

For the purpose of this assessment, "channel modification" is defined as any human activity designed to alter a stream's flow or its movement within the floodplain, such as 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.[44] 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.

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." There is evidence that landowners have used tractors to push gravel bars from the stream channel to the bank for erosion control. Gravel bars are not

[43] See Section 3.5.2 for information about anadromous and resident salmonid distribution within the Olalla / Lookingglass Watershed.

[44] 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.

stationary, and during every flood event gravel is washed away and replaced by upstream materials.[45] 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 done with permits

The majority of permitted channel modification projects in the Olalla / Lookingglass Watershed have been done on Lookingglass Creek. Most of the projects in Olalla / Lookingglass have been done to prevent stream meandering from undermining structures. There are numerous gabion walls and rock riprap to protect against erosion.

Riprap has been placed in several areas along Lookingglass Creek. On one site, riprap was combined with a tree revetment. The tree revetment uses 5-20 foot tall trees along the eroding stream bank. Cables and steel fence posts keep the trees in place. Over time, the trees become clogged with sediment and vegetation grows in the sediment. The trees eventually decay and leave behind the vegetated bank. Two other tree revetments have been done, one along Shields Creek and one along Tenmile Creek.

3.1.4 Stream function key findings and action recommendations

Stream morphology key findings

- The majority of streams within Olalla / Lookingglass 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 limit instream large woody material abundance. Different enhancement opportunities exist for each stream type.
- The low gradient channels with wide floodplains along Lookingglass Creek and the lower reaches of tributary streams are dynamic systems that provide key fish migration, spawning and rearing habitat.
- Depositional environments such as moderately confined channels with small floodplains are vulnerable to reductions in aquatic habitat complexity. In these areas, pools can be filled in and boulders or exposed bedrock buried when the sediment load exceeds the transport capabilities of the stream.
- Stream habitat surveys suggest that poor quality riffles and insufficient large woody material are limiting factors for fish habitat in most surveyed streams. Pools and riparian areas also limit fish habitat, but to a lesser degree.

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

Stream connectivity key findings

- Culverts and dams reduce stream connectivity, affecting anadromous and resident fish productivity in the Olalla / Lookingglass Watershed. More information about fish passage barriers will be available in 2003.

Channel modification key findings

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

Stream function action recommendations

- Where feasible, improve pools, collect gravel, and increase the amount of large woody material by placing large wood and/or boulders in streams with an active channel less than 30 feet wide.
- Encourage land use practices that enhance or protect riparian areas:
  - Protect riparian areas from livestock-caused browsing and bank erosion by providing stock water systems and shade trees outside of the stream channel and riparian zones. Fence riparian areas as appropriate.
  - Plant native riparian trees, shrubs, and understory vegetation in areas with poor or fair riparian 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. For example, culvert replacements should emphasize the low gradient channels (3% or less), especially the lower ends of tributary streams entering Lookingglass Creek.
- Increase landowner awareness and understanding of the effects and implications of channel modification activities.

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. 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 do not support large trees or forests. In some areas, current land uses may not permit the growth of "ideal" vegetation types. Any conclusions about stream riparian zone conditions must 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 Olalla / Lookingglass Watershed. Stream banks were classified separately since conditions on one side of a stream are not necessarily indicative of conditions on the opposite bank. A total of 170 miles of streams were evaluated.

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.

Riparian zone parameters	Parameter attributes
Dominant vegetation or feature (>50%)	• 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

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 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 large bridge or culvert.

Figure 3-1 shows the percent riparian vegetation cover in the watershed as a whole. Of the major streams in the Olalla / Lookingglass Watershed, riparian vegetation was 43.7% hardwood and 38.5% conifer. Riparian vegetation in Lookingglass Creek is primarily hardwood, while in tributaries it is primarily conifer. Appendix 5 shows the percent riparian vegetation cover for specific streams and tributary basins. Berry Creek was evaluated twice: with and without Ben Irving (BI) Reservoir, due to differences in riparian vegetation and cover of lakes and creeks.

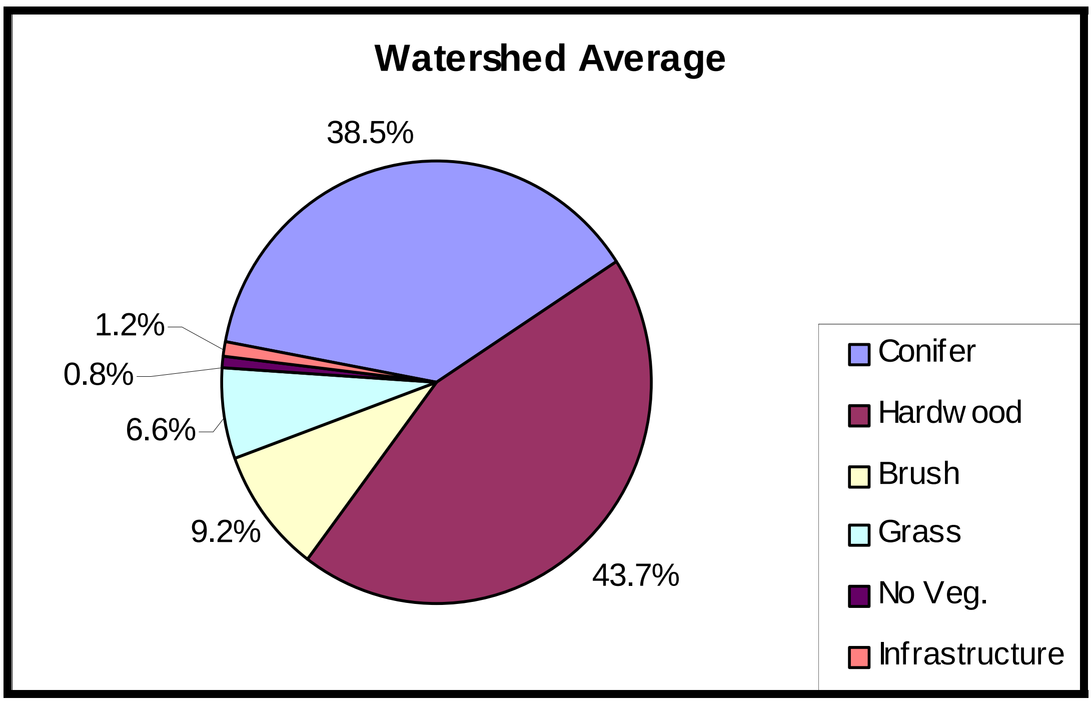
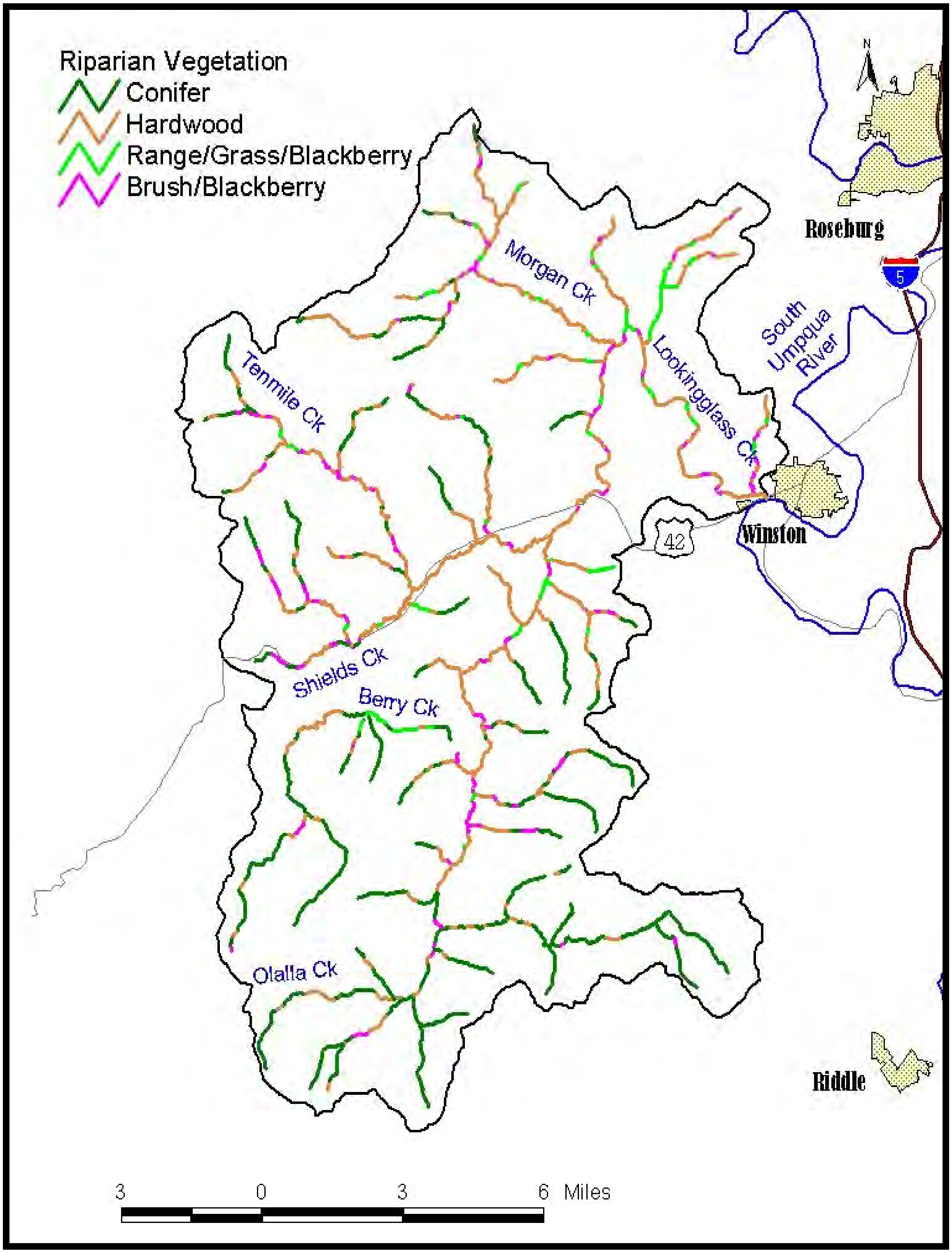


Figure 3-1: Dominant vegetation type

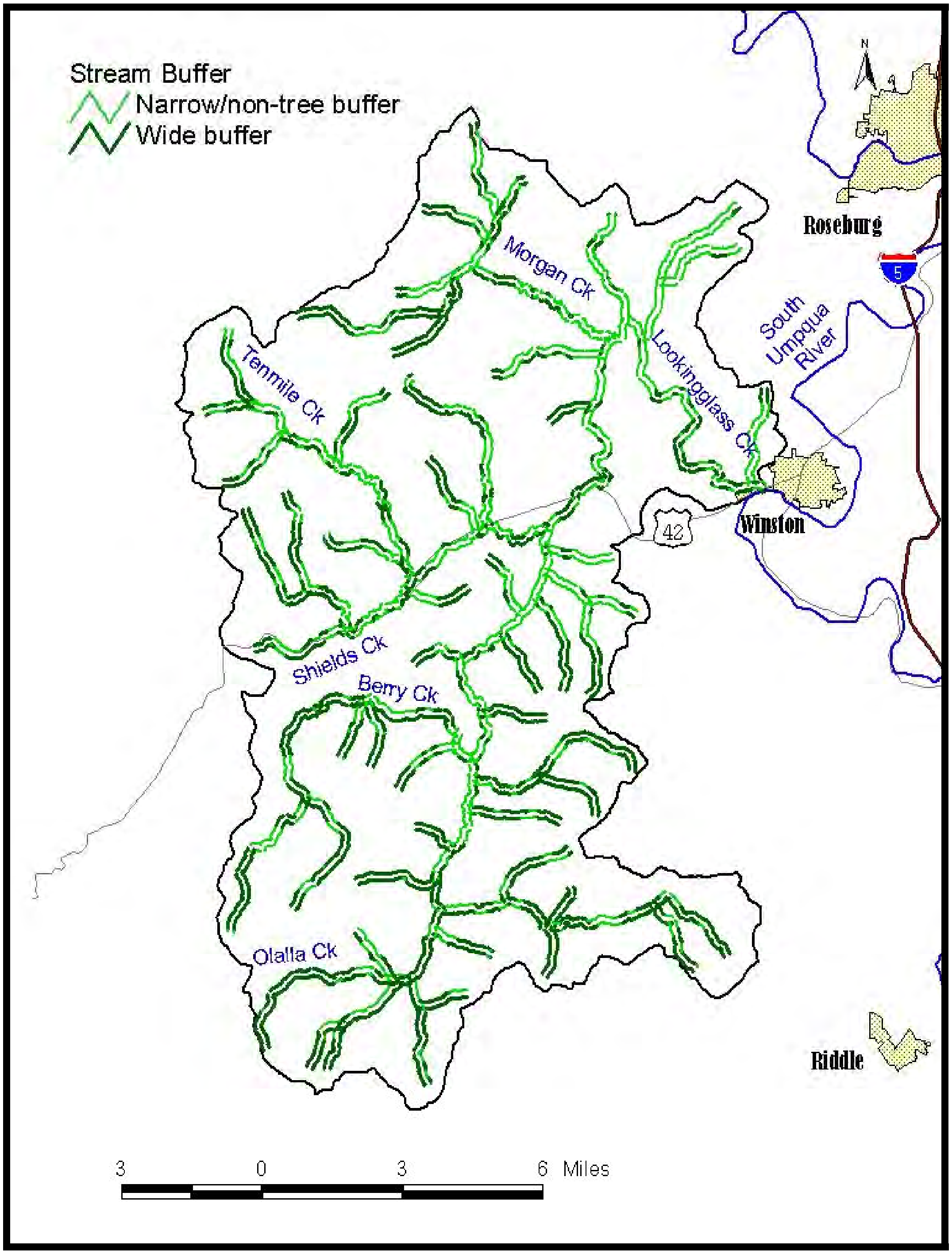
Map 3-4 shows the three most common vegetation types for the Olalla / Lookingglass streams. As would be expected, hardwood and range are more common along the valley portions of Lookingglass, Morgan and Tenmile creeks. Hardwoods are more common in the southern portion of the watershed.



Map 3-4: Dominant riparian vegetation or feature

Buffer width

Riparian areas with a wide band 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 water temperatures compared to other reaches within the same stream. Buffer width was classified as having no trees, one tree crown width, or greater than two tree-crown widths. Map 3-5 shows buffer width findings for Olalla / Lookingglass Creeks and Figure 3-2 displays the data.



Map 3-5: Buffer widths

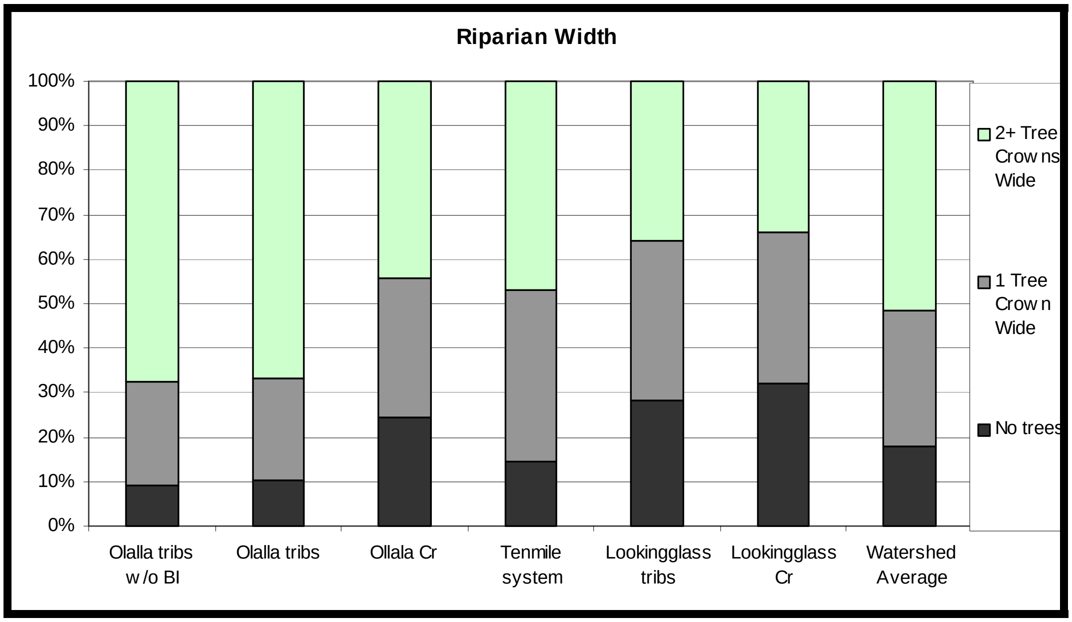


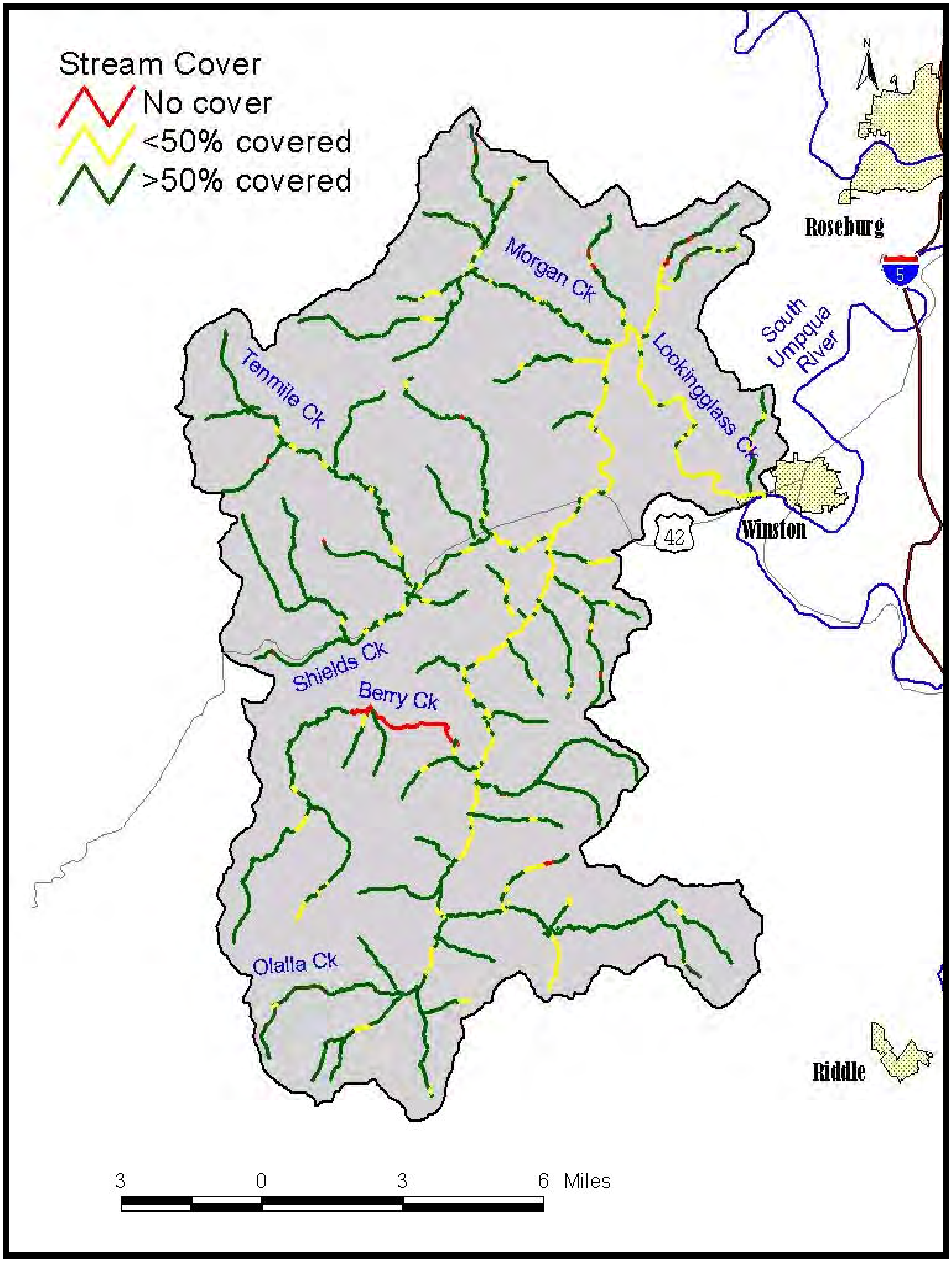
Figure 3-2: Buffer widths by percentage

For the entire watershed, over 50% of the riparian areas are at least two tree-crowns wide. Less than 18% has no trees in the riparian area. Again, Olalla Creek tributaries were split to show the impact of Ben Irving Reservoir. Data for this graph are available in Appendix 6.

Cover

As discussed in Section 3.3.2, the ultimate source of stream heat is the sun, either by direct solar radiation or by ambient air and ground temperature around the stream. 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.[46] 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 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. Figure 3-3 shows the percentages of stream miles with more and less than 50% cover.

[46] See Section 3.3 for more information about 303(d) listed streams.



Map 3-6: Percent stream cover by riparian vegetation

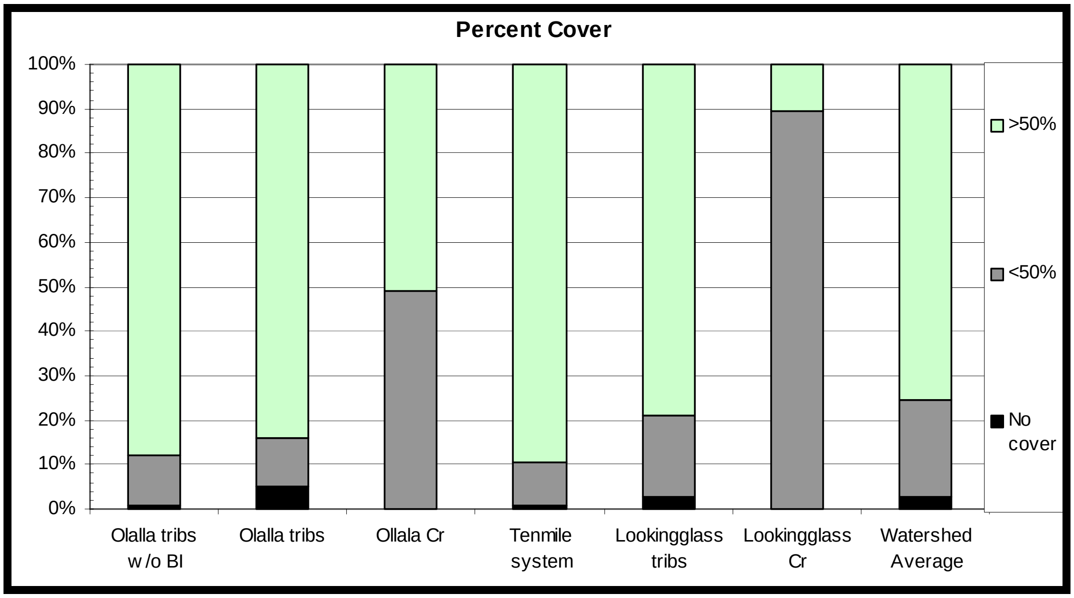


Figure 3-3: Percent of stream coverage

For the entire watershed, over 75% of the streams assessed are more than 50% covered by vegetation. Nearly 90% of Lookingglass Creek is less than 50% covered by vegetation, which should be expected on larger streams. Data for this graph are available in Appendix 7.

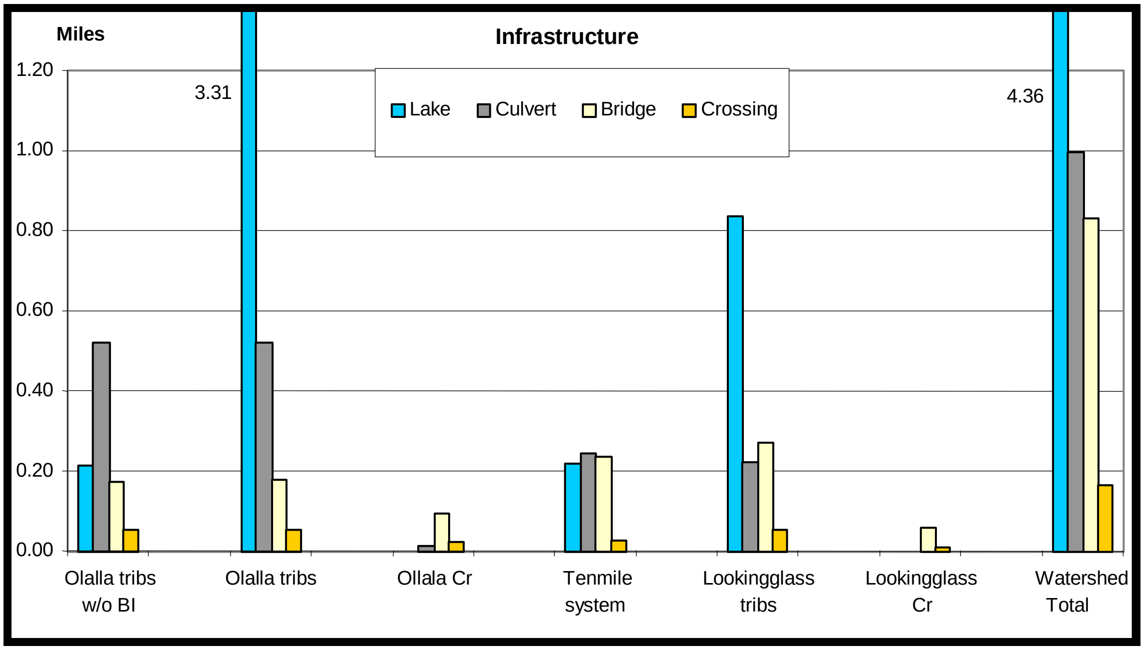


Figure 3-4: Miles of infrastructure in watershed

3.2.2 Wetlands[47]

Overview of wetland ecology

The hydrology of wetlands and stream-associated wetlands is often complex and connected. A watershed-based approach to wetlands assessment is critical to ensure that the whole ecosystem is reviewed. The purpose of this assessment is to review current wetlands locations and attributes, historical wetlands, and opportunities for restoration.

When discussing wetlands, it is helpful to clarify terms and review the ecological functions they perform to facilitate a mutual understanding. The following Section provides a brief description of wetland ecology.

What is a wetland?

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

1. Under normal circumstances there is inundation or saturation with water for two weeks or more during the growing season;
2. The substrate is predominantly undrained hydric soil as indicated by the presence of features such as low or gleyed (gray colors) soils, soft iron masses, oxidized root channels, or manganese dioxide nodules;
3. At least periodically, the land supports predominantly hydrophytic (water-loving) vegetation.

Function and values

In the past, wetlands were regarded as wastelands and considered nuisances. As early as 1849 with the enactment of the Swamp Act, wetlands removal was encouraged. Wetlands were feared to be the cause of malaria and malignant fever. However, research over the years has led to a greater appreciation of the many important ecological functions that wetlands perform.

There are numerous functions and benefits of wetlands. Different functions and values will be important to different communities depending upon their goals for wetland protection and restoration.

Some of the many functions and benefits of wetlands include:

- Flood prevention – wetlands are able to absorb water from runoff during storms and gradually release the water that would otherwise flow quickly downstream.
- Water filtration – wetlands improve water quality by acting as sediment basins. Wetland vegetation is able to filter and reduce nutrients such as phosphorous and nitrogen.
- Ground water recharge –water that is held in wetlands can move into the subsurface soil, thus recharging the groundwater.

[47] Jeanne Lum, Barnes & Associates Inc., contributed this section.

- Stream bank stabilization – wetlands and associated vegetation slow the movement of water and help slow down erosion of stream banks.
- Fish and wildlife habitat – many species depend on wetlands for food, spawning and rearing.

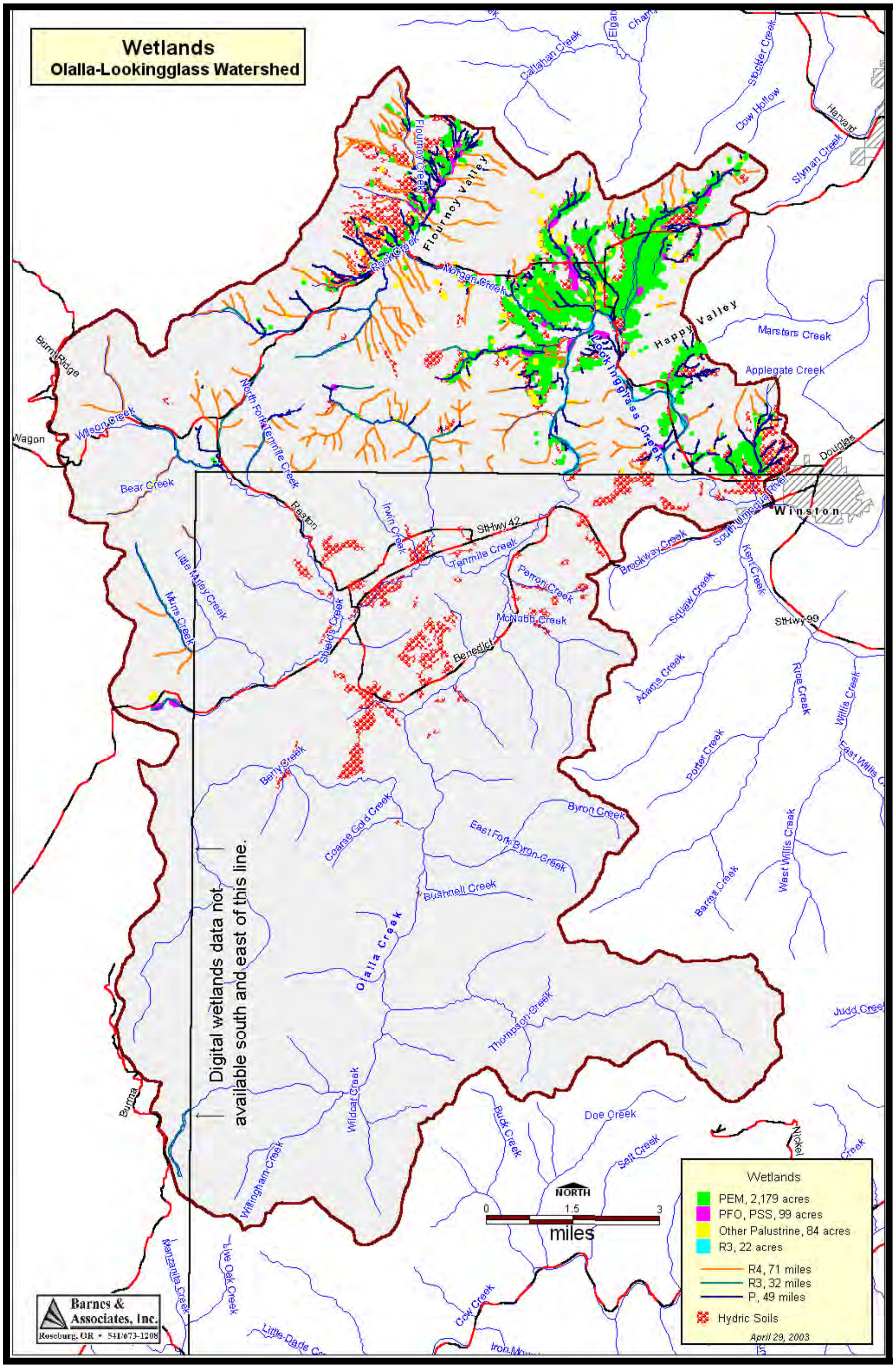
Background on the Clean Water Act and National Wetlands Inventory
Section 404 of the federal Clean Water Act requires that anyone planning to place dredged or fill material into waters of the United States, including wetlands, must first obtain a permit from the U.S. Army Corp of Engineers. Established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

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

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

NWI classifies wetlands based on guidelines established by Cowardin and others (1979). The "palustrine" system classification includes all nontidal wetlands dominated by trees, shrubs, emergents (erect, rooted, non-woody plants), mosses or lichens. It groups the vegetated wetlands traditionally called by such names as marsh, swamp, bog, fen, and prairie. The palustrine wetland also includes the small, shallow, permanent or intermittent water bodies often called ponds. Bodies of water that are lacking such vegetation and are less than 20 acres in size are included in this category.

The "riverine" system classification includes wetlands within a channel, except those dominated by trees, shrubs, and persistent emergents. Wetlands within a channel that are dominated by vegetation are classified as palustrine and appear on the Wetlands map (see Map 3-7) as a line labeled "P." Table 3-5 is a summary of codes and descriptions used in the NWI and displayed in the Wetlands map of the Olalla / Lookingglass Watershed.



Map 3-7: Wetlands and hydric soils

System	Class	Brief description
P=Palustrine	EM=emergent	Dominated by rooted herbaceous plants, such as cattails and grass.
	SS=scrub-shrub	Dominated by shrubs and saplings less than 20 feet in height.
	FO=forested	Dominated by trees taller than 20 feet in height.
	Other	No vegetation evident at the water surface, or mud or exposed soils.
R=Riverine	R3-upper perennial	Channels that flow throughout the year, characterized by high gradient and fast water velocity.
	R4-intermittent	Channels that contain flowing water only part of the year.

Table 3-5: Summary of codes and description used in the NWI

Description of current wetlands in the Olalla / Lookingglass Watershed
A review of the NWI data[48] show the main channels and tributaries of Olalla, Tenmile, Morgan and Lookingglass Creeks are classified as a riverine (stream-associated wetland) system with periodically or continuously contain flowing water. Portions of land adjacent to Lookingglass Creek (below the confluence of Tenmile and Olalla creeks) are seasonally flooded and are designated on the Wetlands map with polygons labeled R3. This area represents 22 acres over 25 occurrences along the creek. Here surface water is present for an extended period, especially early in the growing season, but is absent by the end of the growing season in most years. The water table can vary from saturation at the surface to well below the ground surface after flooding ceases.

Palustrine wetland is the primary type in the watershed, with over 2,362 inventoried acres. Within the palustrine system, PEM, or palustrine with emergent vegetation, has the greatest number of occurrences (239) and acres (2,182). Indicator plants of wet pastures such as rushes (*Juncus spp.*) and sedges (*Carex spp.*) are typically found in this type of wetland.

Most of the PEM acreage is found in large sections in the bottomlands of Lookingglass Valley, extending well beyond any riverine or river-associated wetlands. This area is primarily farmed as wet pasture and for hay production. Smaller and fewer occurrences of PEM are found in Flournoy Valley, the west entrance into Happy Valley, and northwest of the city of Winston in the Applegate drainage.

[48] Only the USGS 7.5 minute quadrangles of Mount Gurney, Reston, Roseburg West, and Camas Valley are available in digital format for this watershed. This “digital” area falls in the northern portion of the watershed, roughly north of Highway 42. Approximately 43,565 acres, or 42% of the watershed area, was analyzed with this digital data. All references to wetlands acreage and occurrences refer specifically to this digital portion of the watershed. The balance of the Olalla / Lookingglass Watershed was analyzed using paper NWI maps from the Oregon Division of State Lands. Incidentally, most of the wetlands occur within the digital area of the watershed.

The PEM wetlands primarily occur in the areas zoned agricultural and residential. This is a common trend in rural valley bottoms as the fertile land was attractive to early settlers and subsequent landowners. Most of the agricultural practices extend right up to the edge of the stream bank or wetland. In addition, these same wetlands occur primarily on private lands.

This palustrine emergent wetland (PEM) would most likely be synonymous with the "Prairie Wetland Communities" as described by the Oregon Natural Heritage Program in Wetland Plants of Oregon and Washington (Guard, 1995):

> *Prairie Wetland Communities are wet grasslands that developed on clay soils in the Umpqua valleys. Wetland prairies are best known for tufted hairgrass (Deschampsia cespitosa). Many other grasses, sedges and herbaceous species are also present. Tufted hairgrass and red fescue prairie was a major component of a landscape created by a regime of frequent fire from lightning and thousands of years of occupation by Native Americans, who burned much of the valley almost every year to improve hunting and to maintain populations of wild food plants. Page 93.*

The remaining palustrine wetlands are farm ponds, typically deep and constructed to hold water year round. Over 84 acres fall in this category of wetlands. Approximately 174 of these ponds are found scattered throughout the valleys where livestock are grazed. These ponds have been diked and dammed and, in some cases, have impacted the flow of water to and from wetlands.

Historical wetlands and changes in the Olalla / Lookingglass Watershed
There is little specific reference in historical records about wetlands in the Olalla / Lookingglass Watershed. However, approximately 38 percent by acre of Oregon's wetlands have been drained, diked or filled since European settlement. Fifty-three percent by acre of western Oregon's wetlands have been lost to development or converted to other uses (Wetlands Conservancy, 2003).

One indicator of possible historical wetlands is the area of hydric soils adjacent to existing wetlands. Hydric soils are formed under conditions of saturation, flooding or ponding of sufficient duration during the growing season to develop anaerobic conditions in the upper part of the soil profile. There are 5,787 acres of hydric soils in the watershed as displayed in the Wetlands map. These soils are represented by eight soil map units and occur on floodplains, terraces, fans, and mountains. In general, the soil units are described as clayey, poorly-drained, with low permeability and a high water table present during late fall, winter and spring.

The NWI data are displayed on top of the hydric soils in the Wetlands map. Based on an assessment of hydric soils, wetlands were historically present primarily in the Lookingglass and Flournoy Valleys and northwest of the city of Winston in the Applegate drainage. NWI designations follow hydric soils quite closely in Lookingglass Valley. However, this is not the case in Flournoy Valley and the Applegate drainage, probably because these hydric soils extend beyond the flat lands onto the slopes. As mentioned earlier, wetland vegetation and certain hydrologic conditions must be present in order to meet the federal and state wetland definitions.

Local residents describe the loss in wetlands as a slow process over the years. Some of the initial loss of wetlands occurred during the 1850s settlement period. Wetlands were tilled and ditched to drain and prepare the soil for crops and pasture. Probably more significant would have been the post-WWII economic boom, when heavy machinery for agriculture, urban development, and road construction became prevalent. The heavy equipment could move more soil at a greater rate than any horse-drawn plow. As grain crop production decreased, tilling of wetlands declined.

Irrigation, and in particular inefficient irrigation, affects wetlands by removing water from its river source. Some of this water subsequently drains into new areas. The construction of 11,250 acre-foot Berry Creek Dam in 1980 made available additional irrigation water. Land that had never been irrigated before included shallow soils with rock bottoms. One resident has observed run-off from this type of soil. In some cases, this run-off has created new wetlands.

Threats to wetlands

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

Approximately half of the Winston Urban Growth Boundary (UGB) falls within the Olalla / Lookingglass Watershed. Much of this land is owned by Wildlife Safari and the Cow Creek Band of Umpqua Tribe of Indians and is unlikely to be developed for residential use in the near future. There are some smaller private holdings adjacent to the current Safari Estates development with pending requests for a zoning change to single family dwellings. Pacific Habitat Services, Inc. is in the final stages of developing a Local Wetlands Inventory for the City of Winston. This more detailed wetlands inventory will identify any wetlands not addressed in the NWI and alert landowners and regulatory agencies to areas which should be protected.

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

Restoration opportunities in the Olalla / Lookingglass Watershed

Ongoing projects

Wetland projects really never end, as monitoring is crucial for measuring the success and functions of the wetland. Establishing reference wetlands in the watershed gives benchmarks for future wetland projects.

One ongoing wetland project is the result of mitigation at Wildlife Safari. In this project, a series of five ponds "polish" the effluent leaving the property before the water enters Applegate Creek. Future plans include pumping Winston-Green effluent into the wetland system to filter pollutants before the water enters the South Umpqua River. Another desired outcome of this project is to have water quality monitoring tools available to local residents and groups to use in the watershed.

"Tell me and I will forget, show me and I will remember, involve me and I will understand." This noteworthy adage applies to the outdoor wetland laboratory named Mervin Marsh at Lookingglass Elementary School. Dedicated in April 2001, this marsh is a good example of a grassroots wetland project. The project was half funded by Partners for Wildlife (USFWS) program and the Cow Creek Umpqua Indian Foundation. The Douglas Soil and Water Conservation District designed the project, and students, teachers and parents provided the labor. Heavy equipment was donated and operated by parents. Even the local Lookingglass Rural Fire Department participated by filling the wetland with water prior to dedication since the wetland was dry at the time.

Possible projects

There are various measures that can be used to restore or change wetland characteristics. Ditches and dams are apparent in much of the wetland pasture throughout Lookingglass Valley. If the goal is to reverse the actions that caused the loss or alteration of a wetland's hydrological characteristics, dams or fill that have elevated the land surface may be removed. Likewise, ditches that have drained the land may be filled in.

The presence of ancient channels can be found along Olalla and Lookingglass Creeks. These were created from stream course changes by natural flooding or human intervention. If the goal is to bring water back to these sites to reestablish the hydrological connection to the flood plain, then one could excavate, shape and contour the site to re-establish the right relationship between the hydrology of the site and its topography.

Opportunities may exist to enhance man-made sites such as abandoned mill ponds and quarries. If the goal is to bring additional water to the site to bolster inadequate water supplies, then measures might include digging channels to bring water in or pumping water in from other sites.

The 25 areas designated as seasonal stream associated wetlands (R3 polygon on the Wetlands map) along Lookingglass Creek could be explored as potential project sites. Bank stabilization and riparian planting can increase habitat value along the targeted creek. Landowner interest, land use, current condition and threats to the site would be considerations to decide which sites have merit as a wetland project.

Opportunities exist for landowners to participate in incentive, cost-share, and/or grant awarding programs that encourage good land stewardship and benefit wetlands. Although each program varies with its incentives and eligibility, landowners share these common concerns:

- Lack of awareness of available programs.
- Overwhelming program choices: "which one is best for me?"
- Concern about hidden agendas and "fine print."
- Anxiety over bureaucracy and contracts: "not worth the effort."
- Fear of the loss of privacy on land or of the discovery of threatened and endangered species on the property.

Some wetland projects are undertaken for the specific purpose of compensating for the damage or destruction to another wetland area. Recent reports shows that nearly two-thirds of all mitigation projects fail to meet performances standards. Planning, monitoring, and long-term management, important for all wetland activities, are especially important for wetland mitigation projects. Lack of measurable goals, monitoring and corrective adaptive management have been identified as some problems with mitigation wetlands in Douglas County.

Future options

Nearly all of the wetlands in the Olalla / Lookingglass Watershed are found on private land and are currently grazed or used for hay production. Landowner "buy-in" and voluntary participation must be fostered if wetland conservation is determined to be a goal in the watershed. The following recommendations can help realize this goal.

<u>Increase Awareness of Wetland Conservation</u>

Develop opportunities to increase awareness of what defines a wetland, its functions and benefits. This is a fundamental step in creating landowner interest and developing landowner appreciation for wetland conservation. Identify or establish various peer related demonstration projects as opportunities to educate stakeholders. The Mervin Marsh and Oregon Natural Resources Research Institute at the Wildlife Safari are already established in the community and should be promoted as a means to reach stakeholders.

<u>Address Landowner Concerns</u>

Establish an approachable "one-stop shop" or clearinghouse to assist landowners in enrolling in programs that can benefit wetlands and meet landowner goals. A friendly and "non-governmental" atmosphere can reduce some of the previously identified landowner concerns. A central site can identify and coordinate partners, streamline landowner paperwork, and facilitate leveraging of money and in-kind services often needed for a successful project. Combining local programs with national programs gives flexibility and maximizes dollars. For example, a landowner could receive a tax exemption under the local Wildlife Habitat Conservation and Management Program, receive technical assistance in planning and cost share from the Natural Resources Conservation Service, and receive grant monies from Partners for Wildlife and Ducks Unlimited.

3.2.3 Riparian and wetlands key findings and action recommendations

Riparian zones key findings

- Throughout the watershed, riparian vegetation is 44% hardwood and 39%. Lookingglass Creek and the Morgan Creek tributaries are around 60% hardwood. The tributaries flowing into Olalla Creek are over 60% conifer. There is much variation among specific tributaries.
- Riparian buffers that are two or more tree widths are most common in Olalla / Lookingglass Watershed. Tributary conditions vary from buffers that are greater than two tree widths over 67% of the Olalla Creek tributaries to over 30% treeless areas along Lookingglass Creek. Olalla Creek and Lookingglass Creek tributaries have approximately a quarter of riparian zones without trees.
- For percent cover, Lookingglass Creek is just over 10%, Olalla Creek is approximately 50% and all other tributaries are close to 80% covered.

Wetlands key findings

- Wetlands improve water quality by trapping sediments, removing nitrogen, retaining phosphorous, and regulating stream temperatures.
- Stream associated wetlands are the dominant type of wetland found within the Olalla / Lookingglass Watershed, and are typically confined to active channels.
- Narrow riparian zones have been maintained along many of the streams in the watershed, although some are more substantial than others.
- Historically, riverine and palustrine wetlands associated with stream channels, floodplains, and riparian zones were abundant in lowland valleys, where they had a hydrologic connection with a nearby stream. Wetlands located within the Olalla / Lookingglass Watershed were very productive, supported a variety of plant and animal life, and were very dynamic ecosystems.

Riparian zones and wetlands and 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 ones for 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.
- Where riparian buffers are one tree width or less, encourage buffer expansion by planting native trees (preferably conifers) and/or shrubs, depending on local conditions.
- Investigate methods of controlling blackberries.
- Maintain riparian zones that are two or more trees wide and 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 impacts 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.

- Increase public awareness of wetland functions that relate to wildlife habitat, endangered species preservation, aesthetic appeal, and water quality.

Wetlands References

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Other information sources

Marnie Albritten, Oregon Department of Fish and Wildlife
Walt Barton, Douglas Soil and Water Conservation District
Rob Burns, US Fish and Wildlife Service
Alex Freadman, resident
Walt Gayner, Douglas Soil and Water Conservation District
Neil Hadley, resident
Cathy Holcumb, City of Winston
Arlene Oatney resident
Carol McKinney, Cow Creek Umpqua Indian Foundation
Don Ollivant, resident
Scott Robbins, USDA Natural Resources Conservation Service
Dr. Leonard J. Schussel, Ph D, Oregon Natural Resources Research Institute at Wildlife Safari

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, which are streams and rivers. Table 3-6 lists all beneficial uses for streams and rivers within the Umpqua Basin. Uses with checks apply to one or more streams within the Olalla / Lookingglass Watershed (OL).

Beneficial use	**OL**	**Beneficial Use**	**OL**
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 3-6: Beneficial uses for streams within the Olalla / Lookingglass Watershed

The beneficial uses of a stream determine its water quality standards. In a stream where "salmonid fish rearing" is a beneficial use, stream temperature is a concern because salmonids need cool water to survive. In a stream where people swim (a water contact recreation), the level of human disease-causing toxins or bacteria would be a concern.

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."[49] 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 is required to determine the total maximum daily load (TMDL) allowable for each parameter.[50] Streams can be de-listed once TMDLs 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.

[49] ODEQ can also use data collected by other agencies and organizations to evaluate water quality.
[50] Total maximum daily loads are limits on pollution developed when streams and other water bodies do not meet water quality standards. TMDLs consider both human-related and natural pollution sources.

Table 3-7 shows the Olalla / Lookingglass Watershed streams and stream segments included in the 2002 draft 303(d) list that require TMDLs.[51] This table is not a comprehensive evaluation of all water quality concerns in the Olalla / Lookingglass 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

Stream or stream segment	**Parameter(s)**	**Year listed**	**Stream miles listed[52]**	**Season**
Thompson Creek	Temperature	2002	0 to 7.6	Summer
Thompson Creek	Temperature	2002	0 to 7.6	Sept 15 - May 31
Olalla Creek	Biological Criteria	1998	0 to 15.6	
Olalla Creek	Temperature	1998	0 to 15.6	Summer

Table 3-7: ODEQ water-quality limited stream segments (Jan 2003)

To evaluate water quality in the Olalla / Lookingglass Watershed, this assessment explores seven water quality parameters that the Oregon Watershed Enhancement Board (OWEB) considers important, which may be of concern within the watershed. These parameters are temperature, pH, dissolved oxygen, nutrients, bacteria, sedimentation and turbidity, and toxics. ODEQ monitoring data were reviewed and assessed using ODEQ or OWEB water quality standards.

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.[53] 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.

[51] Streams that are water quality-limited for habitat modification and flow modification do not require TMDLs.
[52] Stream mile zero is the mouth of the stream.
[53] Cold water holds more oxygen than warm water; as water becomes warmer, the concentration of oxygen decreases.

Stream temperature fluctuates by time of year and 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. In the summer and fall months, water temperature can exceed the 64°F standard and cause streams to be water quality limited. Olalla and Thompson Creeks are 303(d) listed for temperature (see Table 3-7).

In 1999, the Umpqua Basin Watershed Council (UBWC) sponsored a study on water temperature for the entire South Umpqua fourth-field watershed to determine temperature trends for the South Umpqua River and its tributaries, including Olalla and Lookingglass Creeks (the Smith report).[54] Continuously sampling sensors were placed at 119 locations within the Umpqua Basin, of which 14 were within the Olalla / Lookingglass Watershed. Sensors were established at sites between June 24 and 30, 1999, and removed between September 9 and 15, 1999. Figure 3-5 shows the seven-day moving average for Lookingglass and Olalla Creeks. Appendix 8 has the same data for many other tributaries.[55] Map 3-8 shows the locations of temperature monitoring sites.

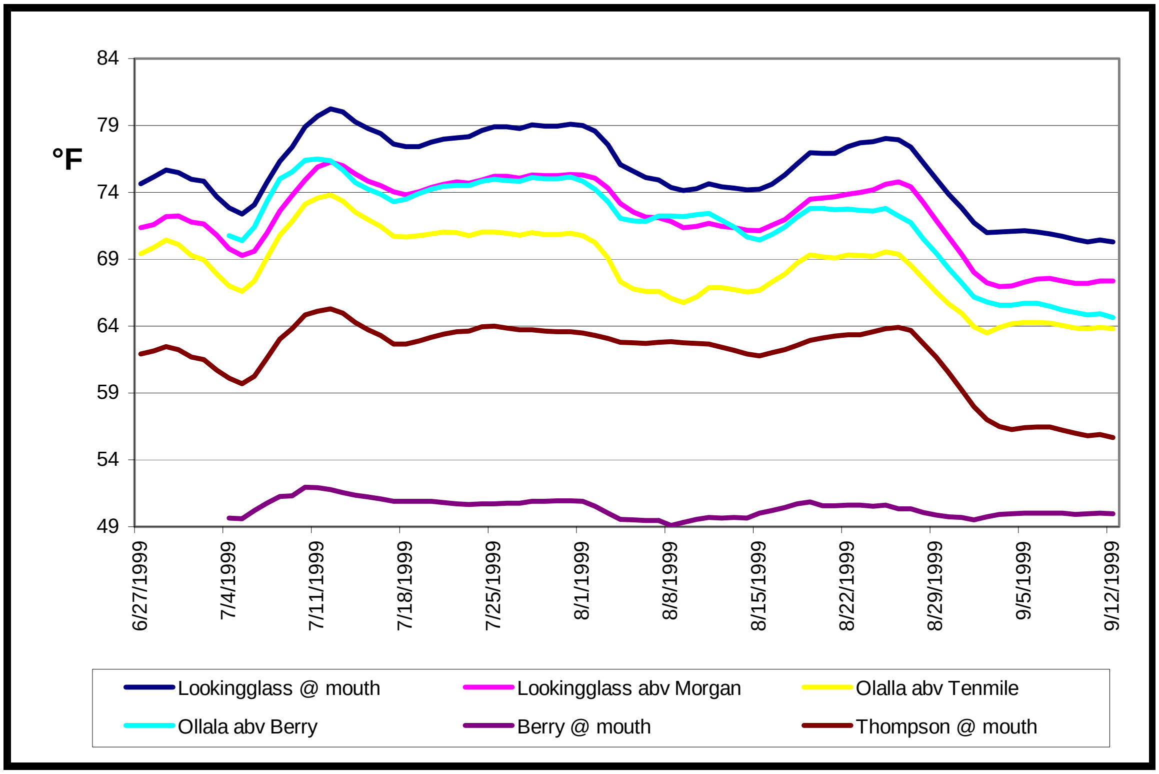
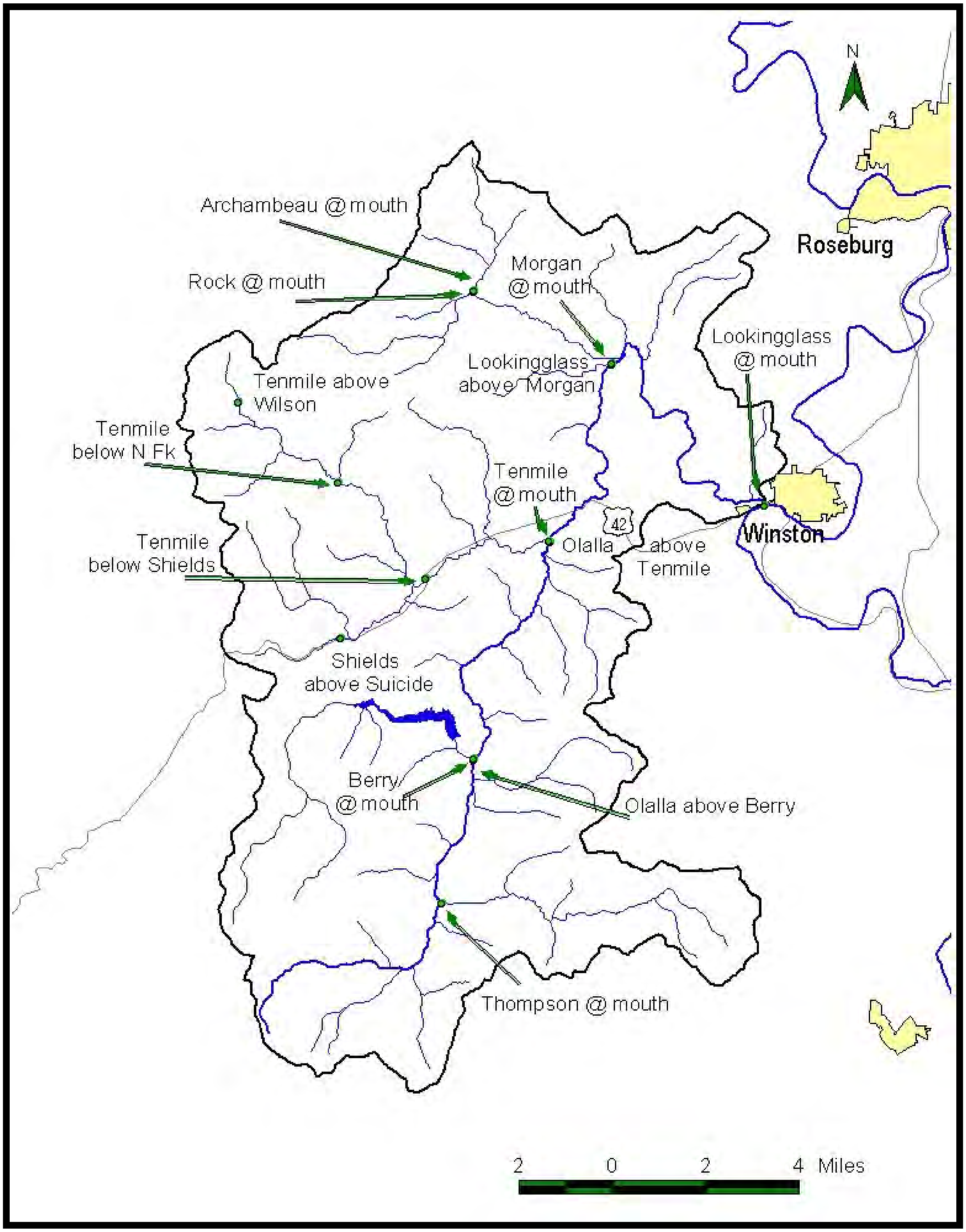


Figure 3-5: Summer temperature trends for Lookingglass & Olalla creeks

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

[55] 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.



Map 3-8: Stream temperature monitoring sites during InSight's 1999 study

The number of days and percent of days for which average maximum temperature exceeds 64°F is displayed in Table 3-8. Six sample sites (43%) exceed the 64°F standard every day the study was conducted. Only two monitoring sites (at the mouth of Berry Creek and on Tenmile Creek) were below 64°F every monitoring day.

Sample Site	Days with a max 7-day average temp >64°F	Days monitored	% of total days temp >64°F
Lookingglass at mouth	78	78	100
Lookingglass above Morgan Cr.	78	78	100
Morgan at mouth	78	78	100
Rock at mouth	58	78	74.4
Archambeau at mouth	34	34	100
Tenmile Cr at mouth	78	78	100
Olalla above Tenmile	71	78	91.0
Tenmile Cr above Tenmile bridge	77	78	98.7
Tenmile below N Fk Tenmile	34	38	89.5
Tenmile above Wilson	0	109	0.0
Shields Ck at 1st bridge	51	71	71.8
Berry Ck at mouth	0	71	0.0
Olalla Ck above Berry	71	71	100
Thompson Ck at mouth	5	109	4.6

Table 3-8: Number of days with 7-day average maximum temp. exceeding 64°F

The highest and lowest seven-day moving average maximum temperatures are displayed in Table 3-9. The temperatures were recorded for the summer months only. Several of the highest or lowest temperatures occurred on the last day of the study; those are noted with an asterisk (*).

Sample Site	Highest Maximum Temperature	Date	Lowest Maximum Temperature	Date
Lookingglass at mouth	80.25 °F	7/12	70.31 °F	9/10*
Lookingglass above Morgan Cr.	76.28 °F	7/12	66.98 °F	9/3
Morgan at mouth	78.36 °F	7/13	66.78 °F	7/5
Rock at mouth	69.31 °F	7/12	57.85 °F	9/12 *
Archambeau at mouth	69.90 °F	7/30 *	64.09 °F	7/5
Tenmile Cr at mouth	78.21 °F	7/12	65.07 °F	9/12*
Olalla above Tenmile	73.83 °F	7/12	63.47 °F	9/2
Tenmile Cr above Tenmile bridge	76.27 °F	7/12	63.89 °F	9/12 *
Tenmile below N Fork Tenmile	70.75 °F	7/31*	63.54 °F	9/6 *
Tenmile above Wilson	59.85 °F	8/26	51.20 °F	10/4
Shields Ck at 1st bridge	69.24 °F	7/12	57.53 °F	9/10
Berry Ck at mouth	51.96 °F	7/10	49.08 °F	8/8
Olalla Ck above Berry	76.48 °F	7/11	64.67 °F	9/12 *
Thompson Ck at mouth	65.32 °F	7/12	48.51 °F	10/1

Table 3-9: Highest and lowest seven-day moving average maximum temperatures

Table 3-9 is expressed graphically in Figure 3-6. The graph compares the fluctuation of 7-day moving average temperatures from various streams. On July 12, 1999, most streams reached the *highest* average maximum and on July 5, 1999, some streams had the *lowest* average maximum. This graphs displays the average temperature difference for several streams. Several streams reached the highest maximum temperature on July 12th, and the lowest maximum temperature on July 5th. The bar graph represents the difference between measures for these two days. Note the large heating effect on Morgan Creek and the minimal heating effect on Berry Creek at the mouth.

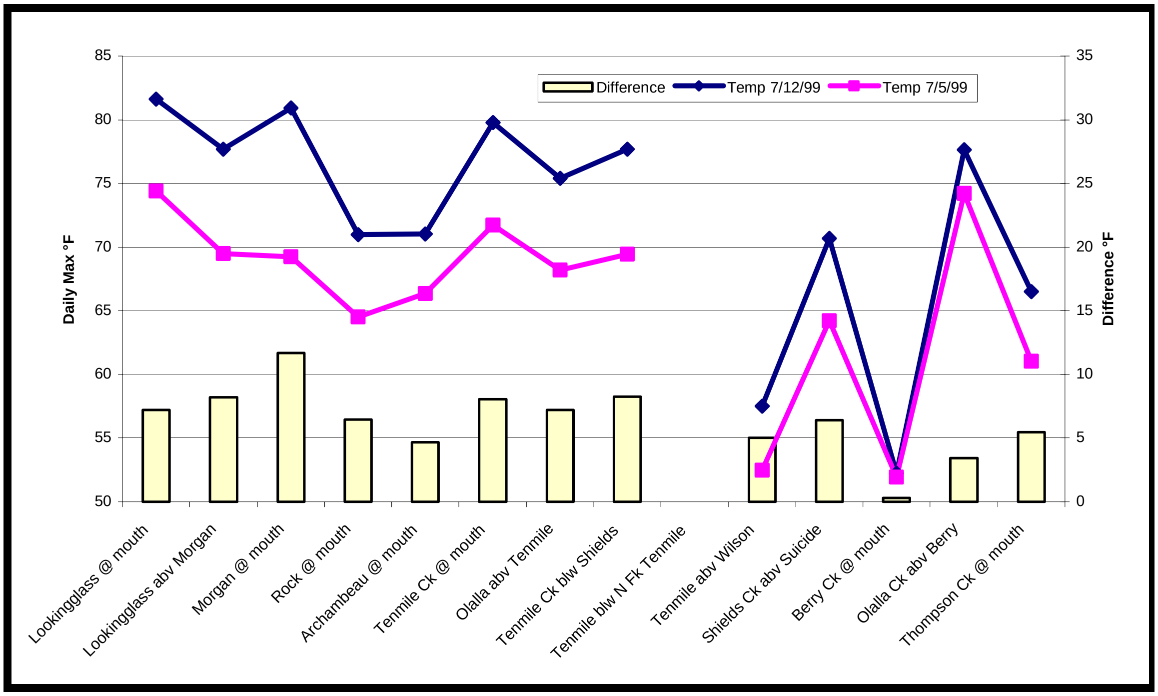


Figure 3-6: Highest maximum temperatures and lowest maximum temperatures

The study conducted by InSight found that throughout the South Umpqua fourth-field watershed study area, tributaries tended to be 10°F cooler than the South Umpqua River. Charting data with respect to distance shows that maximum temperatures of the coldest streams tend to increase 0.58°F per downstream mile. By comparing similarly sized tributaries and their distances from the headwaters, it may be possible to assess the potential to reduce stream temperatures with restoration projects.

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

Localized groundwater influx and tributary flows 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.

Management implications

An important implication of Smith's studies is that prevailing stream temperatures on small streams can be strongly influenced 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.[57]

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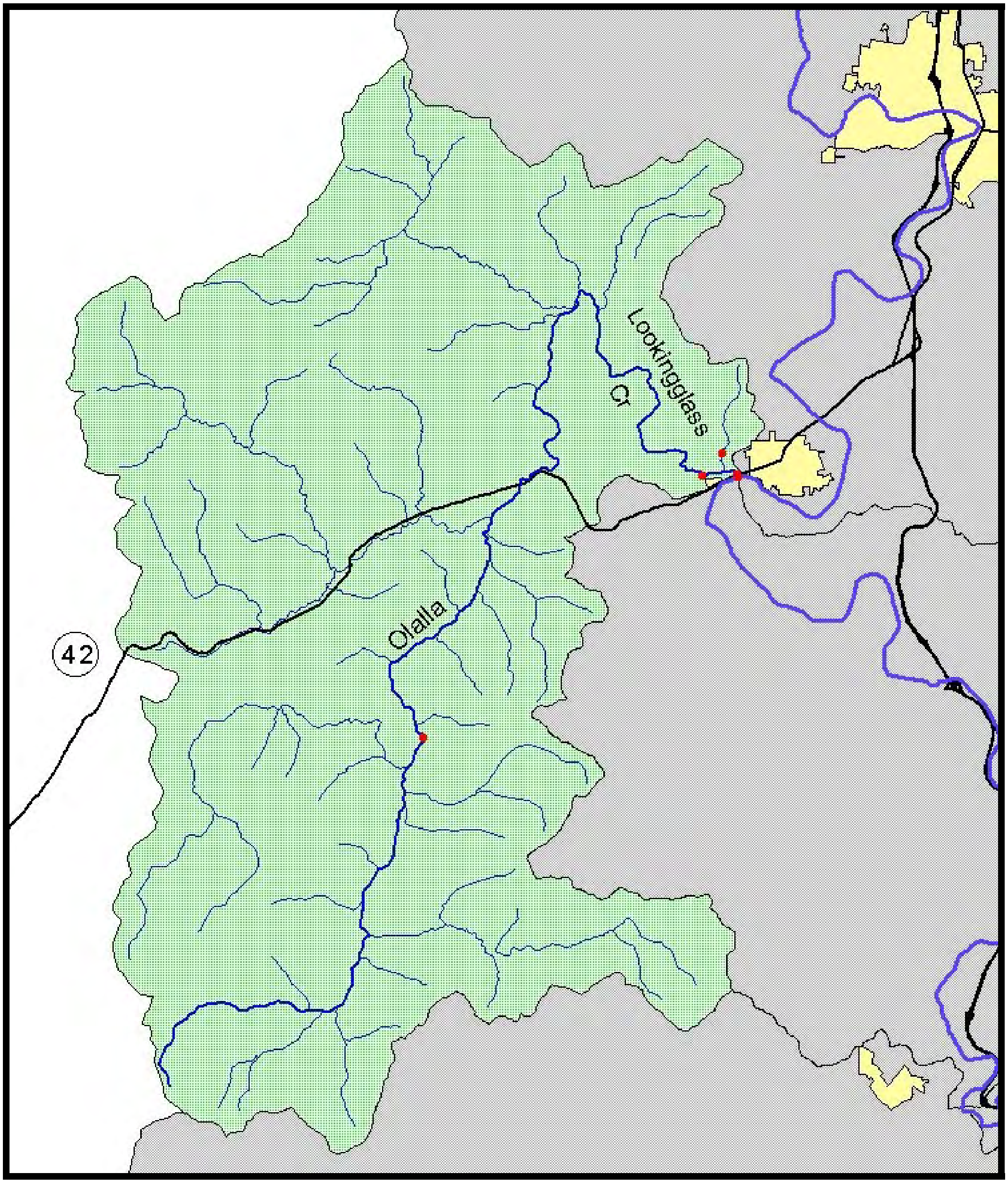
[56] Friction adds a very small amount of heat to streams. Geothermal heat is a minor factor in the Umpqua Basin.

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

For Sections 3.3.3 to 3.3.8, data collected by the Oregon Department of Environmental Quality (ODEQ) are often referred to in order to better assess water quality conditions in the Olalla / Lookingglass Watershed. ODEQ has collected water quality information at four sites in the basin as displayed in Map 3-9.



Map 3-9: ODEQ monitoring sites

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 'eat away' at the protective mucous layer on aquatic organisms such as fish, amphibians, and mollusks. Without a healthy protective layer, fish and other animals are more susceptible to diseases. Also, pH affects nutrients, toxics, and metals within the stream. Changes in pH can alter the chemical form and 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, which can be toxic to humans, fish and wildlife, shift to more soluble forms in acidic water, and are more easily ingested.

Physical and biological factors cause surface and groundwater pH to normally be slightly alkaline or acidic. The chemical composition of rocks and rainfall can influence pH. Respiration and photosynthesis are normal metabolic processes of aquatic organisms that also 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.[58]

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.

[58] Increased nutrient levels in the winter have a smaller effect on pH because cold temperatures inhibit algae growth.

Figure 3-7 shows the pH levels measured by ODEQ in the Olalla / Lookingglass Watershed. Of the seven samples, none was outside the acceptable range. This indicates that pH is not limiting water quality.[59] However, pH could be a concern in other streams or reaches, which can only be determined by additional monitoring.

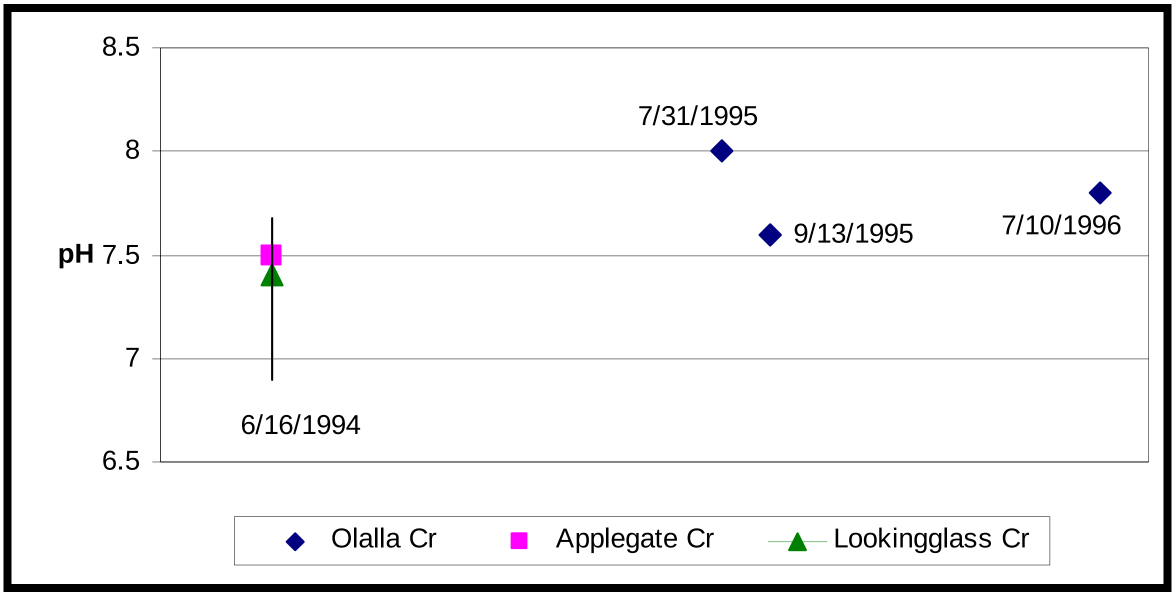


Figure 3-7: pH levels for ODEQ monitoring sites

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, 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.[60] 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 other organisms have used oxygen for respiration.

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[59] 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."

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

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. The Oregon Watershed Enhancement Board states that for the purpose of a watershed assessment, it is appropriate to use 8.0 mg/l as the minimum standard for dissolved oxygen in areas supporting cold-water fish.

Figure 3-8 shows the DO levels for Olalla / Lookingglass Watershed. Of the seven ODEQ samples, only one was below the 8.0 mg/l standard (7.9 mg/l on Lookingglass Creek near Applegate Creek). Since DO levels fluctuate throughout the day, more monitoring should be conducted to determine the potential impact on aquatic life.

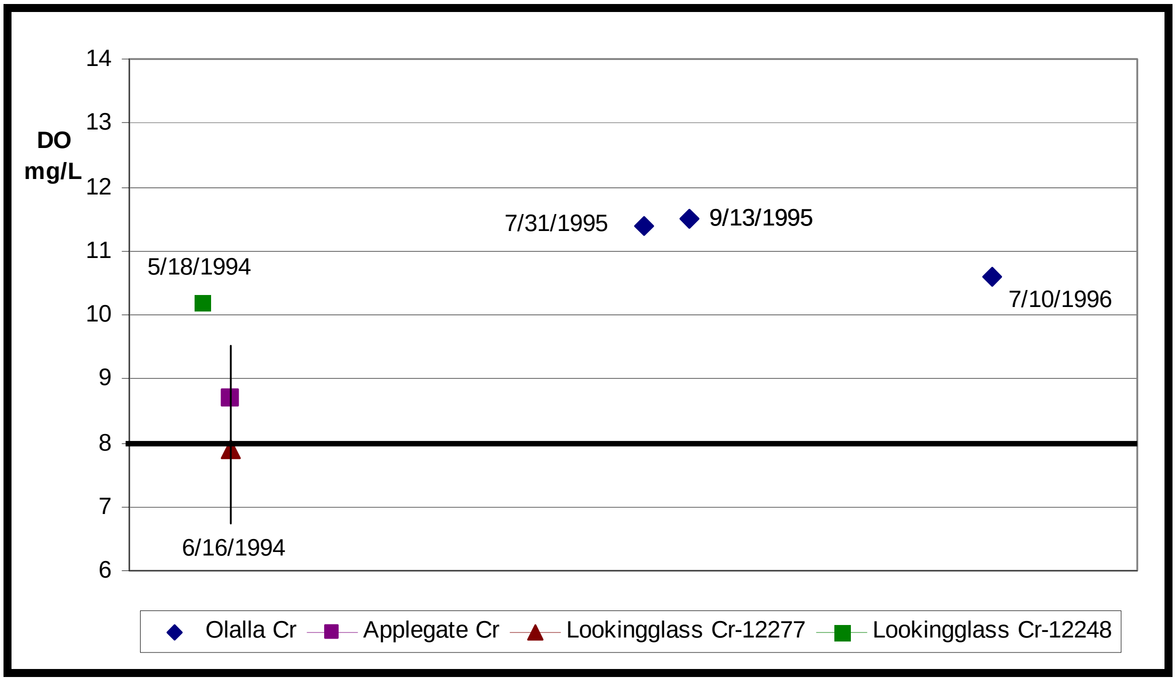

Figure 3-8: DO levels for ODEQ monitoring sites

3.3.5 Nutrients

The beneficial uses affected by nutrients are aesthetics or "uses identified under related parameters."[61] 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.[62]

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

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. Industrial and home fertilizers, wastewater treatment plant effluent, and 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 if nutrient levels in the Olalla / Lookingglass Watershed are of concern. More research is needed to determine if there is a nutrient problem in the Olalla / Lookingglass Watershed, the source of the problem, and possible solutions.

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 Olalla / Lookingglass 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).

Of the 10 samples measured by ODEQ for total phosphorus, none exceeded the 0.05mg/l recommendation set by OWEB. The highest readings were 0.023mg/l.

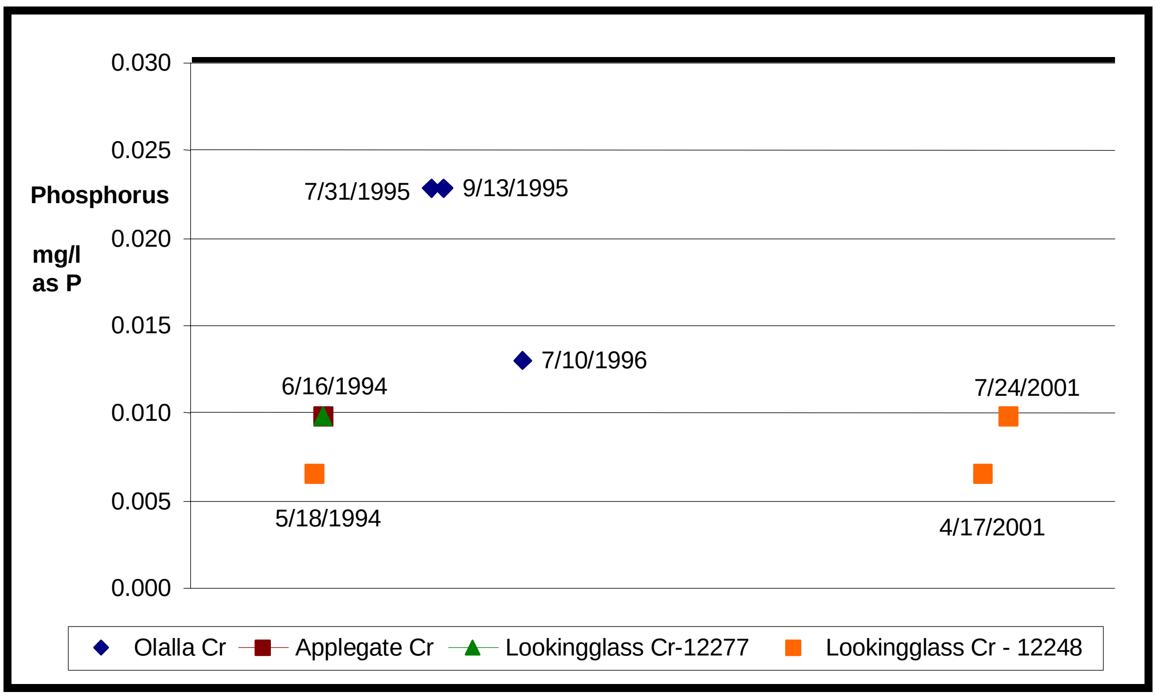

Figure 3-9: Phosphorus levels for ODEQ monitoring sites

Of the 14 samples measured by ODEQ for total nitrates, no samples exceeded the OWEB recommendation. The highest sample was 0.07 mg/l, well below the 0.3 mg/l recommendations.[63]

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

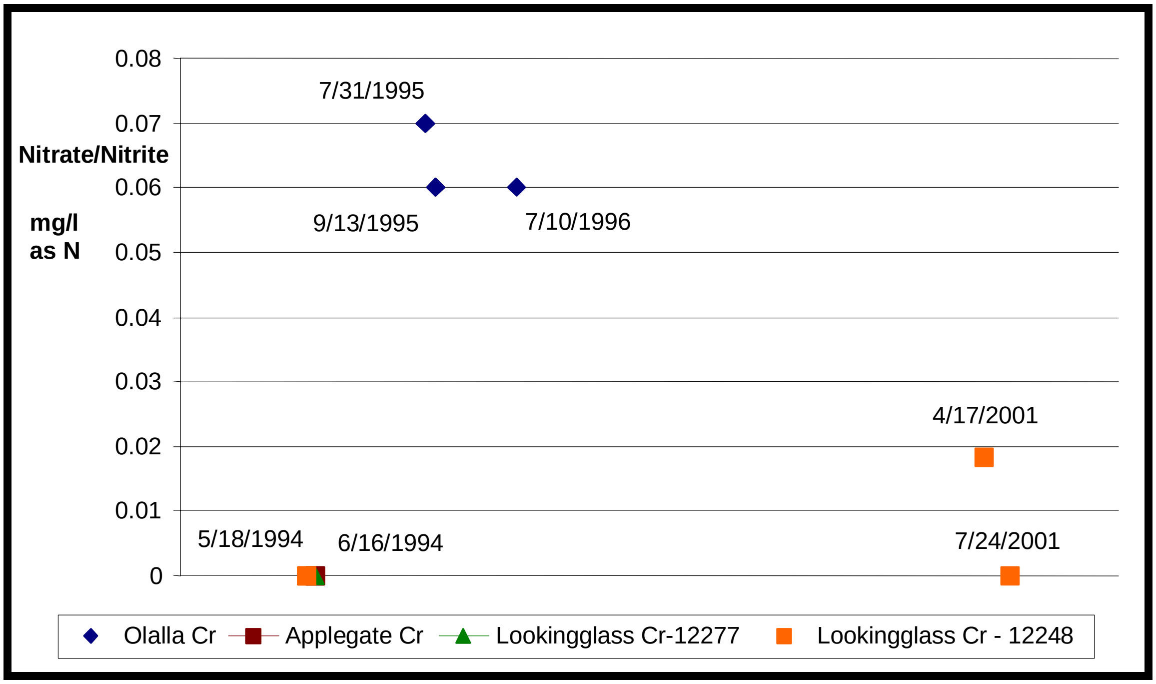

Figure 3-10: Nitrate/nitrite levels for ODEQ monitoring sites

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 serious 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. Stream contamination can also come 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. First, when 10% of two or more samples taken from the same stream have *E. coli* concentrations exceeding 406 bacteria per 100 ml of water. Second, when the average *E. coli* concentration of five samples taken within a 30-day period exceeds 126 bacteria per 100 ml of water. ODEQ has recorded only four samples for coliform. Two samples taken during a high flow event in

March, 2002, exceeded the measurable limit of 2,419/100ml, well over the standard. More monitoring should be done to assess the presence of coliform and the impact on recreation.

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. A layer of sediment does not allow water to circulate through redds and will suffocate salmonid eggs. Although there are many aquatic organisms that require gravel beds, others, such as the larvae of the Pacific and western brook lamprey, thrive in sludgy streams.

Turbidity can be 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.[64] 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 become extremely high during a storm. 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 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 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 Olalla / Lookingglass Watershed on the 303(d) list 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 NTU

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

(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 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 Olalla / Lookingglass Watershed that are on the 303(d) list for turbidity, though landowners often refer to the high turbidity of water released from Ben Irving Reservoir.

The Oregon Watershed Assessment Manual recommends using 50 NTU 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. On Olalla Creek, turbidity samples averaged 31 NTU in July and August of 1995. Applegate Creek and Lookingglass Creek near the mouth of Applegate Creek each measured three NTU for the one-time sample in June 1994. Lookingglass Creek at the mouth averaged 24 NTU with the highest single measurement (duplicate) reaching 52 NTU in March of 2002. More data are needed to determine if sedimentation or turbidity is a problem in the watershed.[65]

Sediment delivery processes[66]

Erosion is a natural process, but it can become a problem in watersheds when it is accelerated by human activities. An increased amount of erosion that fish are not adapted to can be harmful to their populations by decreasing dissolved oxygen levels, decreasing sunlight penetration leading to degraded plant growth, and filling in spawning gravels. Certain human manipulations of the landscape are common causes of increased erosion. These include the construction of roads and their subsequent modification of fluvial (stream) processes, the removal of vegetation, such as timber harvesting, crop and range agriculture, and residential development. All of these human modifications occur in the Olalla / Lookingglass Watershed. With good management, the impact of these practices can be minimized (Watershed Professionals Network, 1999).

The following list summarizes the major sources of erosion and sedimentation potential in the Olalla / Lookingglass Watershed:

- Roads and culverts
- Urban runoff
- Soil type and surface erosion from crops/range land
- Slope instability (landslides, debris flows)
- Large scale fires
- Human activities (timber harvests, mining, river/stream channel modification)

Without further field verification and analysis, an in-depth and detailed report on sediment processes within the assessment area is beyond the scope of this screening-level assessment. Therefore, this assessment reviews five potential sources of stream sedimentation and turbidity in the watershed: roads and culverts, slope instability, soil k factor, hydrologic soil groups, urban drainage, and burns.

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

[66] Kristin Anderson, Tim Grubert and John Runyon of BioSystems Consulting, contributed the introductory text for the sediment delivery processes section. References and a glossary are in Appendix 1.

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.[67]

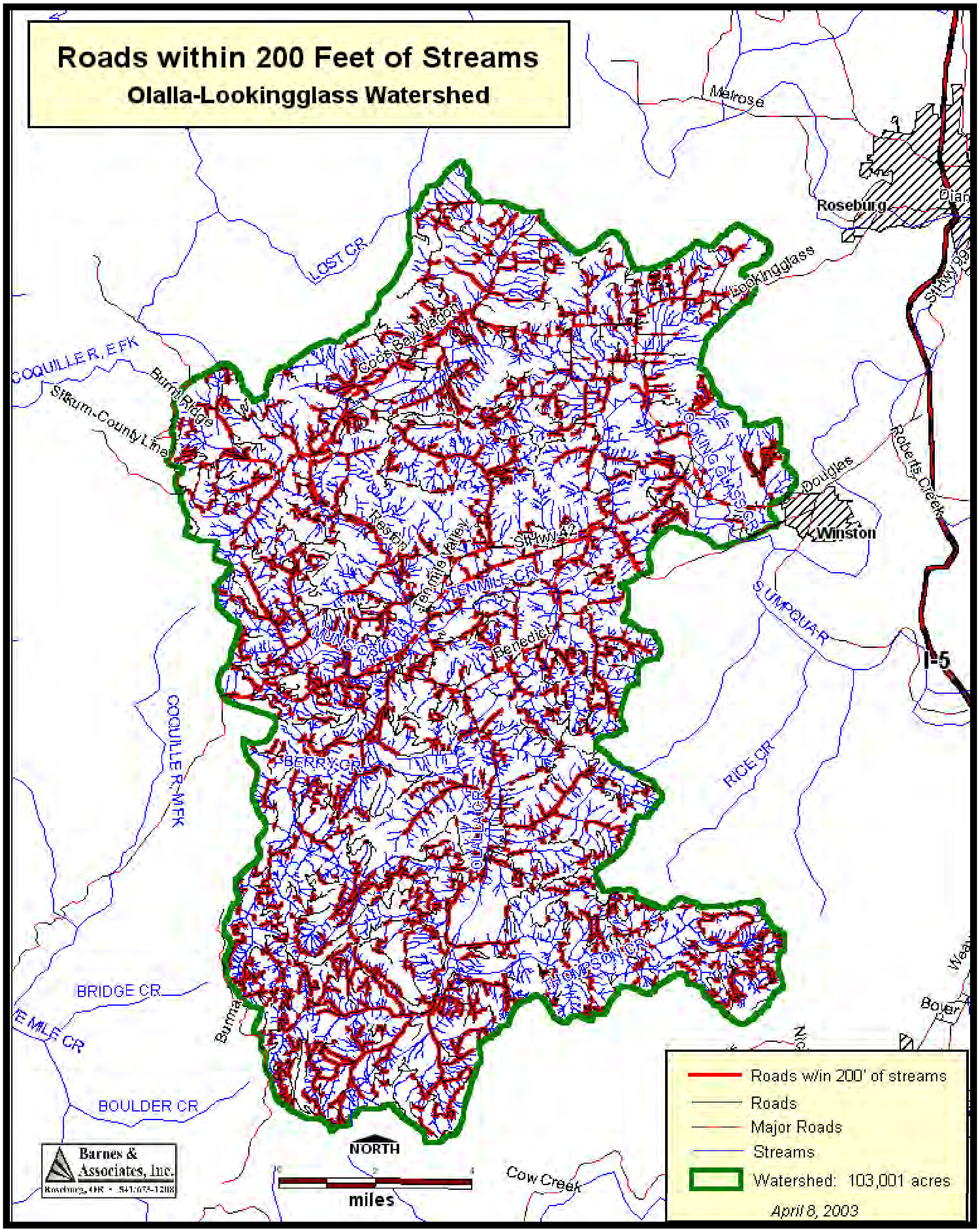
Roads can be divided into two types: surfaced and unsurfaced. Surfaced roads are ones that have been paved or rocked. Unsurfaced roads are dirt roads. Unsurfaced roads are much more likely to erode and fail than surfaced roads. There are 737.2 miles of roads in the Olalla / Lookingglass Watershed, of which over two-thirds are surfaced. Roads are broken into nine classes (see Table 3-10).

Surface Type	**Road Miles**	**% total**
Surfaced		
• Federal roads (paved)	0.0	0.0%
• State roads (paved)	11.5	1.6%
• County/other (paved)	73.8	10.0%
• Major gravel	277.6	37.7%
• Minor gravel or spur	151.1	20.5%
Total surfaced	514.0	69.7%
Unsurfaced		
• Major dirt road	109.0	14.8%
• Minor dirt road	20.2	2.7%
Total unsurfaced	129.2	17.5%
Other		
• Unknown	31.9	4.3%
• Closed	62.0	8.4%
Total other	94.0	12.8%
Total Roads	737.2	100.0%

Table 3-10: Miles and percent miles of roads by class

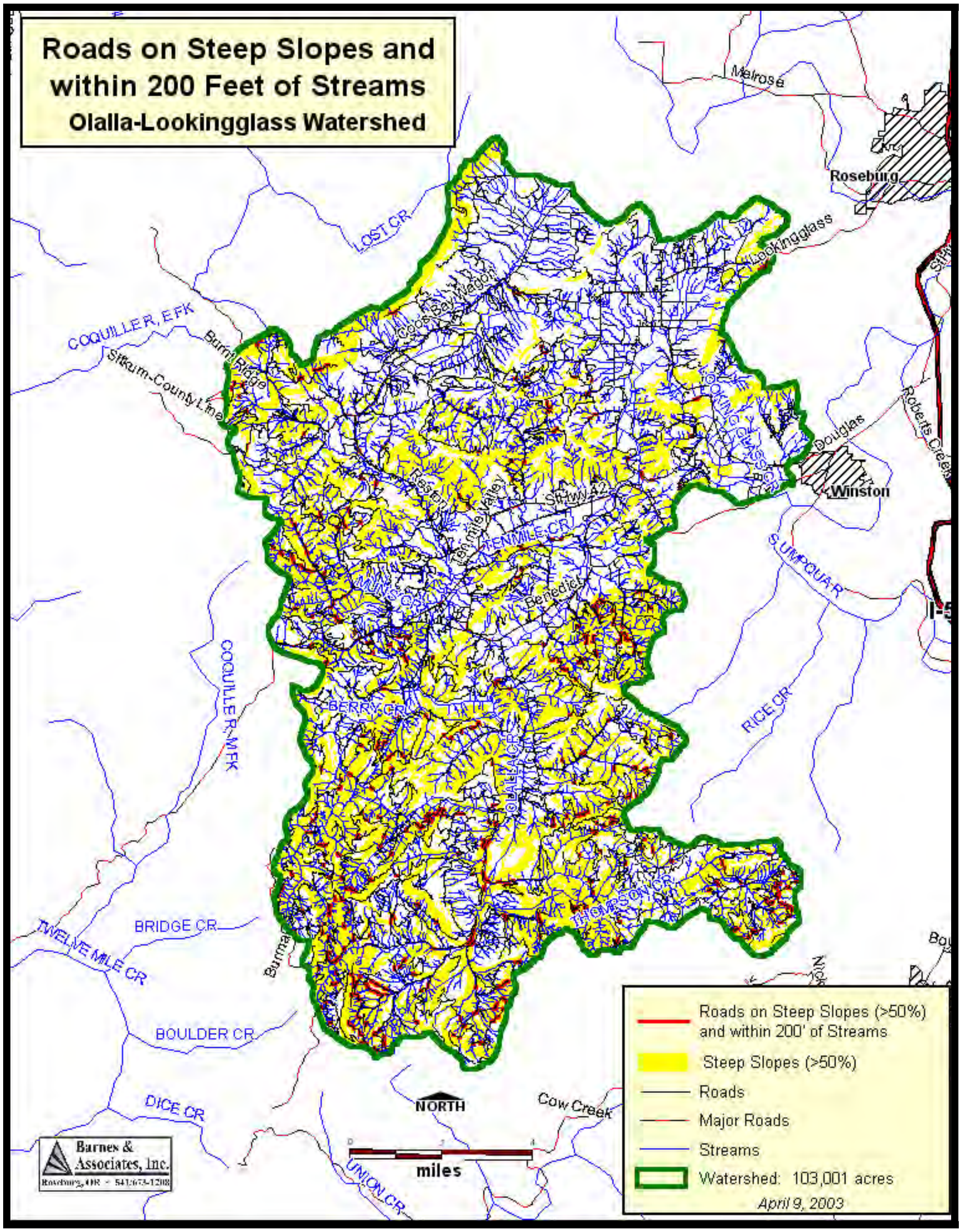
[67] Tim Grubert and John Runyon of BioSystems Consulting, contributed this paragraph.

The closer a road is to a stream, the greater the likelihood that road-related runoff contributes to sedimentation. In the Olalla / Lookingglass Watershed, there are approximately 345 miles of roads (47% of 737 total miles) within 200 feet of streams (see Map 3-10). Of these, approximately 236 miles (68%), are surfaced roads, 57 miles (17%) are unsurfaced roads, and 52 miles (15%) are unknown or closed.



Map 3-10: Location of roads within 200 feet of a stream

Roads on steep slopes have a greater potential for erosion and/or failure than roads on level ground. There are approximately 19 miles of roads (2.6% of 737 total miles) located on a 50% or greater slope and within 200 feet of a stream. Most of these are found in the south part of the watershed (see Map 3-11). Of these roads on steep slopes, 12.7 miles (66%) are surfaced, 2.8 miles (15%) are unsurfaced, and 3.7 miles (19%) are closed or unknown. An analysis of road conditions near streams is necessary to determine how much stream sedimentation is attributable to road conditions.



Map 3-11: **Roads within 200 feet of a stream and on slope > 50%**

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, and when the pipe is placed too high or too low in relation to the surface of a stream. In these 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 41 stream crossings in the Olalla / Lookingglass Watershed. At this time, it is unknown how many of these crossings are culverts and how many culverts are failing.[68]

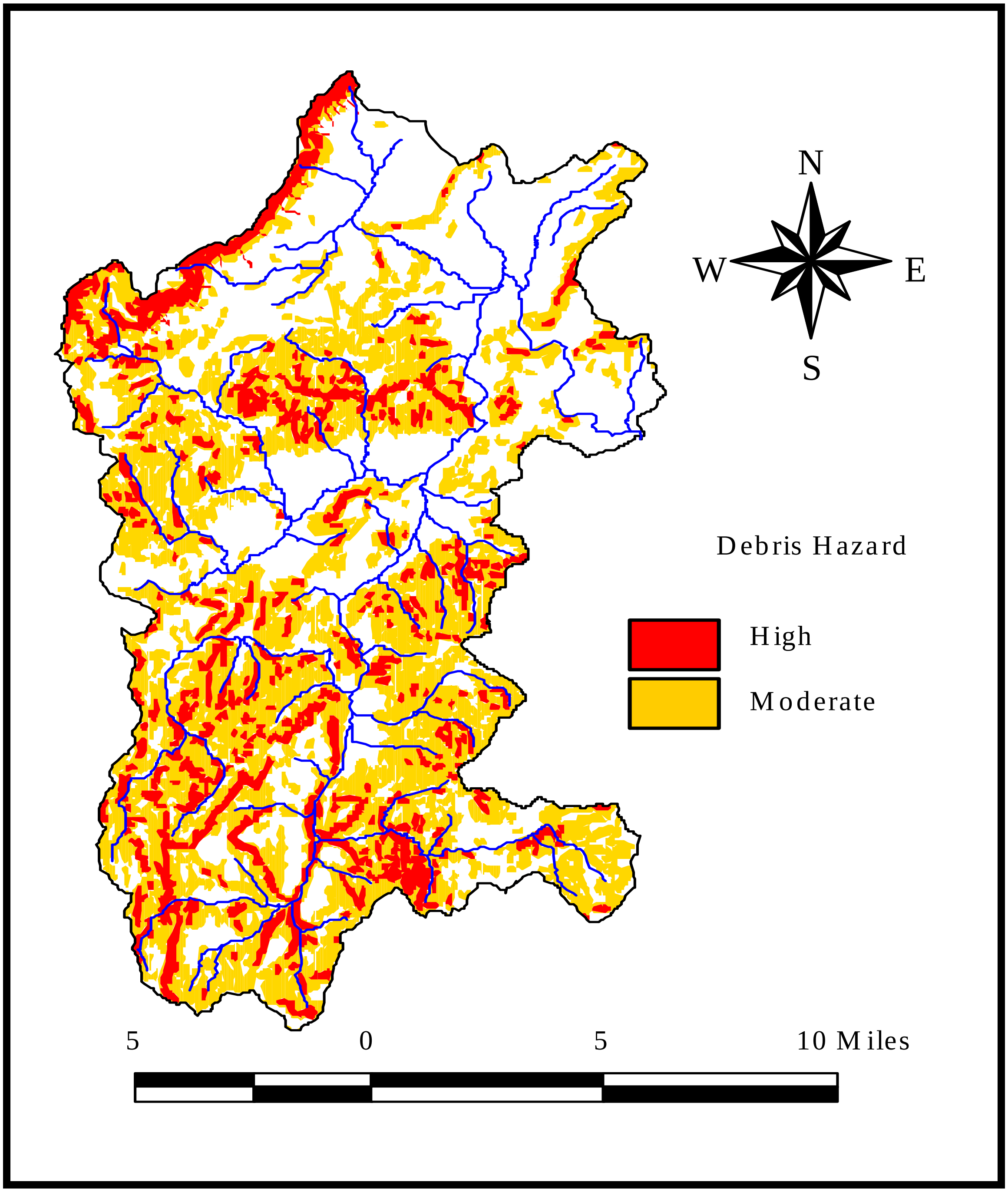
Slope instability[69]

The slope of land will clearly influence the hazards for catastrophic slope failure and mass sediment delivery downslope. Physical characteristics of geologic units have also been shown to influence the occurrence of debris flows (e.g., Graham, 1985, and Lane, 1987). The Oregon Department of Forestry (ODF) identified areas that may naturally be prone to debris flows. Using slope steepness, geologic units, stream channel confinement, geomorphology, and historical information on debris flows, they created coarse scale maps of moderate, high, and extreme natural debris flow hazards. While this information is not intended for localized management decisions, it is a tool to locate areas where further field investigations may be pertinent when determining management plans. Natural debris flow hazards as determined by ODF in the Olalla / Lookingglass Watershed are shown in Map 3-12. This ODF study will very soon be superceded by a much more refined debris hazard mapping effort. For purposes of planning and localized hazard identification, this forthcoming study will be much more valuable. Information regarding this new data will be available at Nature of the Northwest in Portland, Oregon (R.J. Hofmeister, Oregon Department of Geology and Mineral Industries, verbal communication, 2003).

Mass wasting, or the downslope movement of materials, causes significant and sometimes catastrophic sediment delivery to streams. An original, updated mapping study of landslide areas using aerial photos would provide valuable information about past and potential landslides in the watershed.

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

[69] Kristin Anderson, BioSystems Consulting, contributed this section. References and a glossary are in Appendix 1.



Map 3-12:   Natural debris flow hazard areas (ODF)

Soils[70]

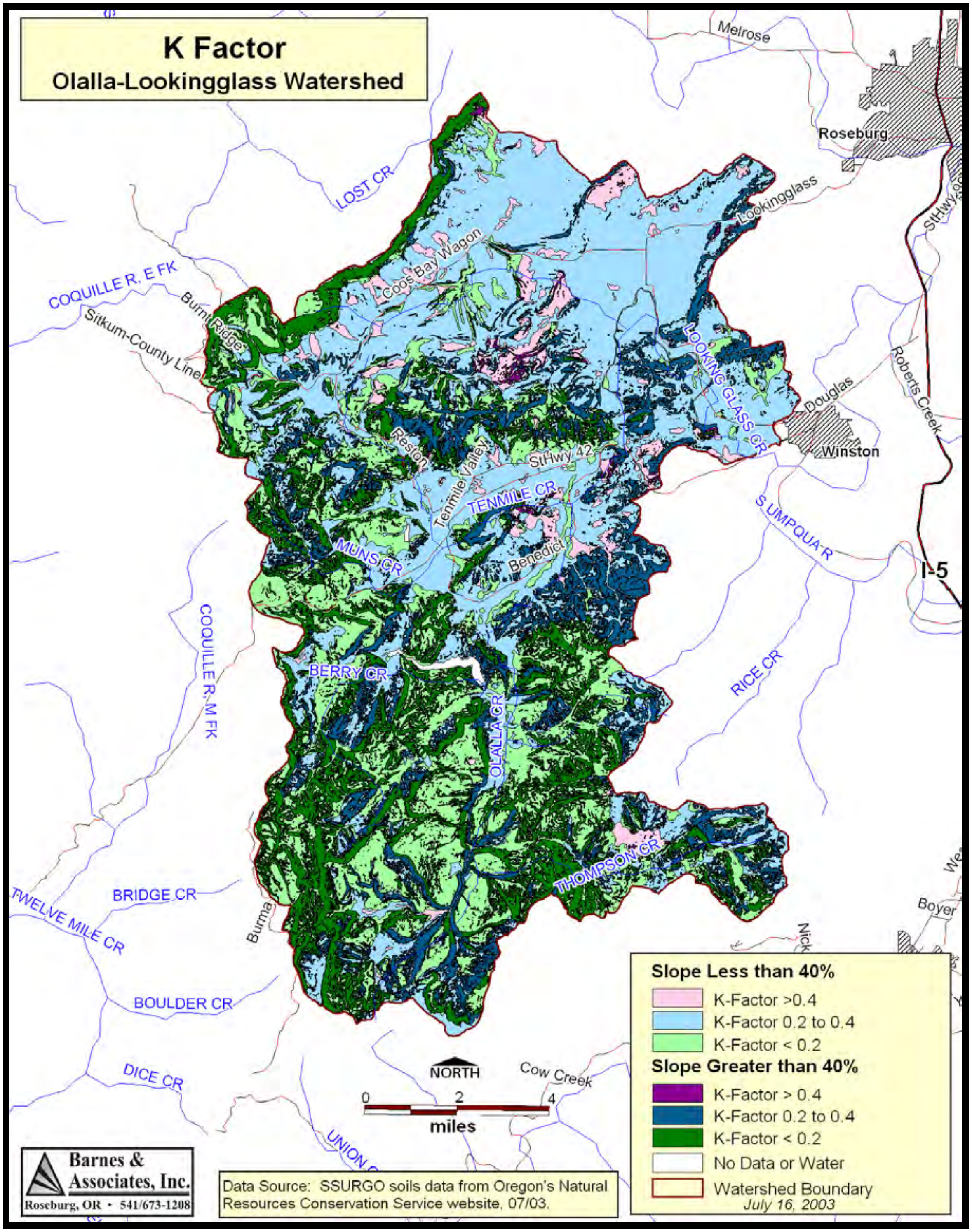
Certain characteristics of soils within a watershed play an important role in erosion and storm runoff, both of which impact watersheds. Rapid runoff from rain events can cause pulses of concentrated pollutants and sediment through stream systems, ultimately impacting fish populations and the overall health and function of stream systems. Both erosion potential and hydrologic soils grouping are qualities of soils that can give some indication of areas prone to experiencing hydrologic processes that may negatively impact stream characteristics.

K Factor

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

Map 3-13 depicts the soils erodibility factor adjusted for the effect of rock fragments of the surface layer of soil within the Olalla / Lookingglass Watershed. Only a small portion of the watershed has a high erodibility rate (>0.4); most of these areas are located in the northern half of the watershed. Like many features related to geology within the watershed, areas of high and moderate to high soil erodibility appear to be oriented in a generally southwest-northeast fashion. Higher erodibility areas are concentrated on the broad slopes of Tmss southeast of its contact with Tt along the northwest border of the watershed. Soils on the eastern flank of the hills separating the Flournoy Valley from the Lookingglass Valley also have relatively high erodibility values. Other concentrated areas of relatively high soil erodibility can be seen on and around the northern border of the KJds geologic unit with the Tmsc.

[70] Kristin Anderson, BioSystems Consulting, contributed this section. References and a glossary are in Appendix 1.



Map 3-13: K factor (soil erodibility)

Hydrologic Soils

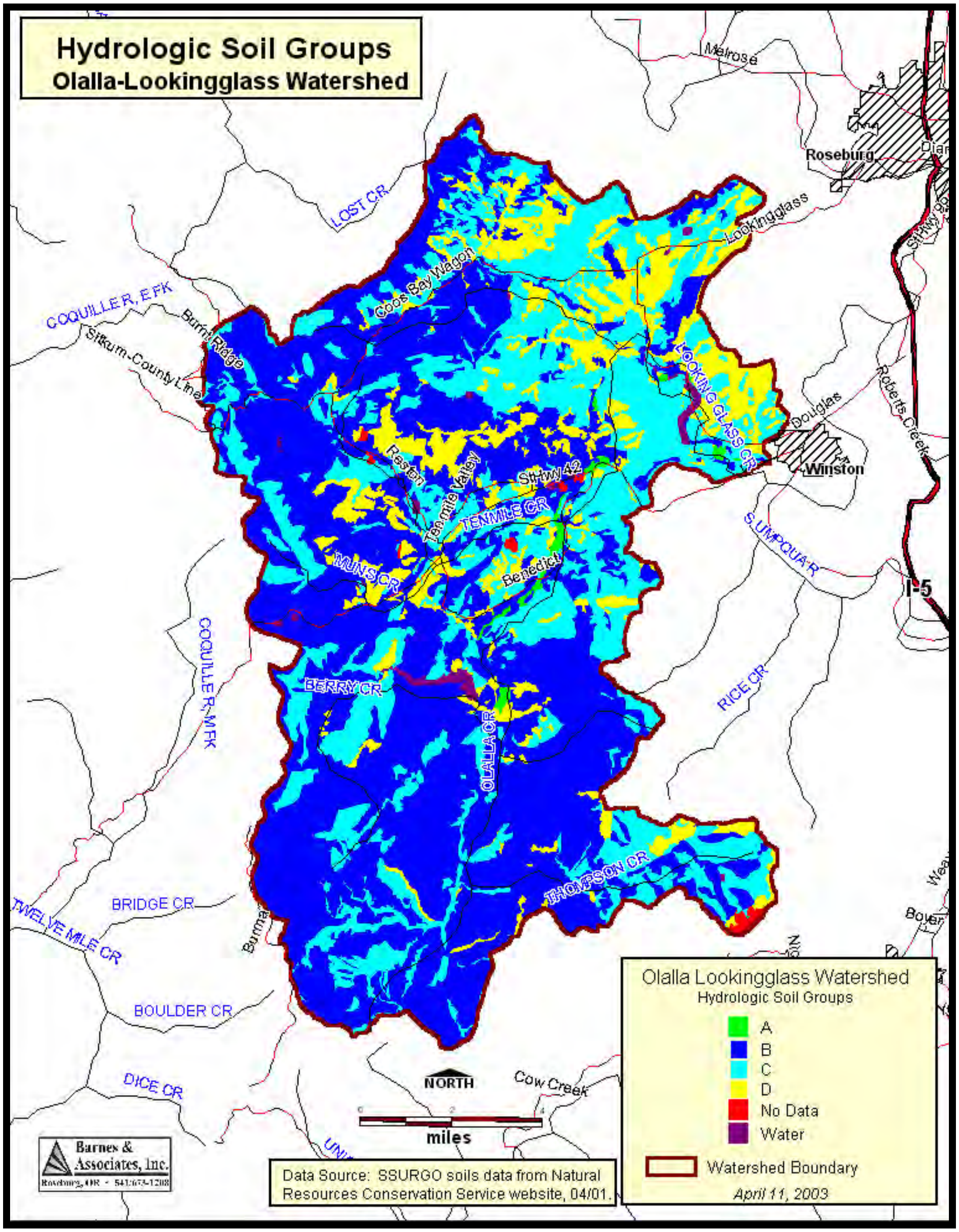
Hydrologic soil groupings are a categorization of soils by their runoff potential and infiltration capacity. In these groupings, group A represents soils with the lowest runoff potential and the highest infiltration rate, while group D is on the opposite end of the spectrum, having high runoff potential and low infiltration rates. The runoff potential and infiltration rate of soils influence runoff from precipitation. With greater amounts of runoff, more erosion and higher peak flows are likely to occur, with the possibility of large pulses of sediment to streams. Table 3-11 provides descriptions of the hydrologic soil groups.

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

Table 3-11: Description of hydrologic soil groups[71]

The northern half of the Olalla / Lookingglass Watershed, or the area primarily drained by Lookingglass and Morgan Creeks, has large areas of soils in the C and D hydrologic soils groups (see Map 3-14). These areas may be more prone to delivering sediment and faster runoff than other areas. Most of the southern part of the watershed, the steeper part of the landscape, falls into the B grouping, indicating a decreased tendency of those soil types to promote erosion. However, the slopes in the southern half of the watershed are steeper. Slopes, as discussed in the following Section, are also important to erosion processes.

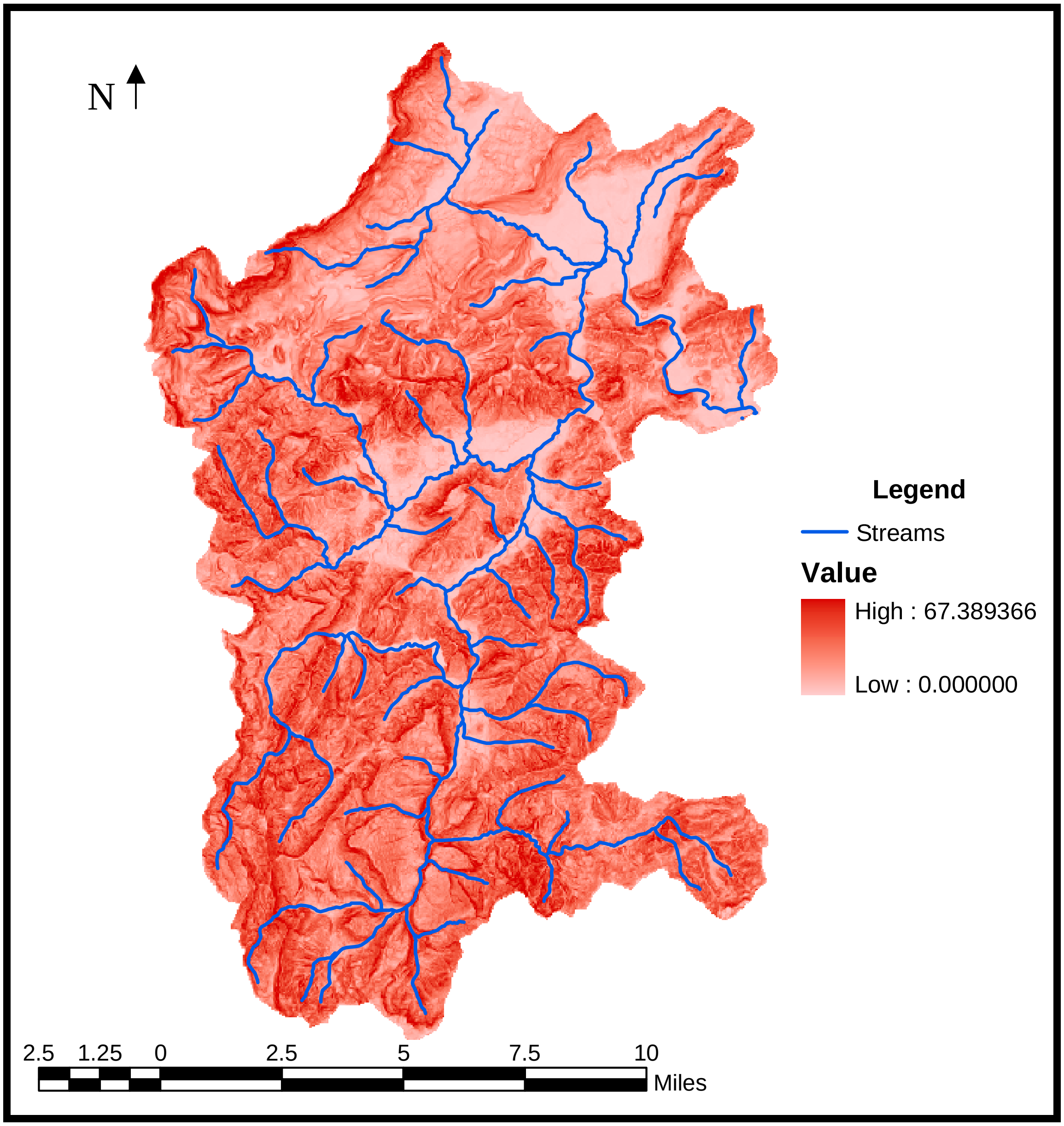
[71] USDA NRCS Conservation Engineering Division Technical Release 55, 1986



Map 3-14: Hydrologic soils groups

<u>Slope</u>

Steep slopes provide greater energy to runoff and therefore supply more sediment that is delivered to streams. Slope is an important consideration to sediment delivery, both in long-term erosion processes and in catastrophic events. Map 3-15 shows the slope throughout the watershed. Relatively steep slopes can be seen throughout the watershed with a generally southwest-northeast orientation. The southern portion of the watershed has consistently steeper sloped areas and fewer floodplains.



Map 3-15: Slope of land as calculated using DEM's (percent slope on scale)[72]

Urban drainage

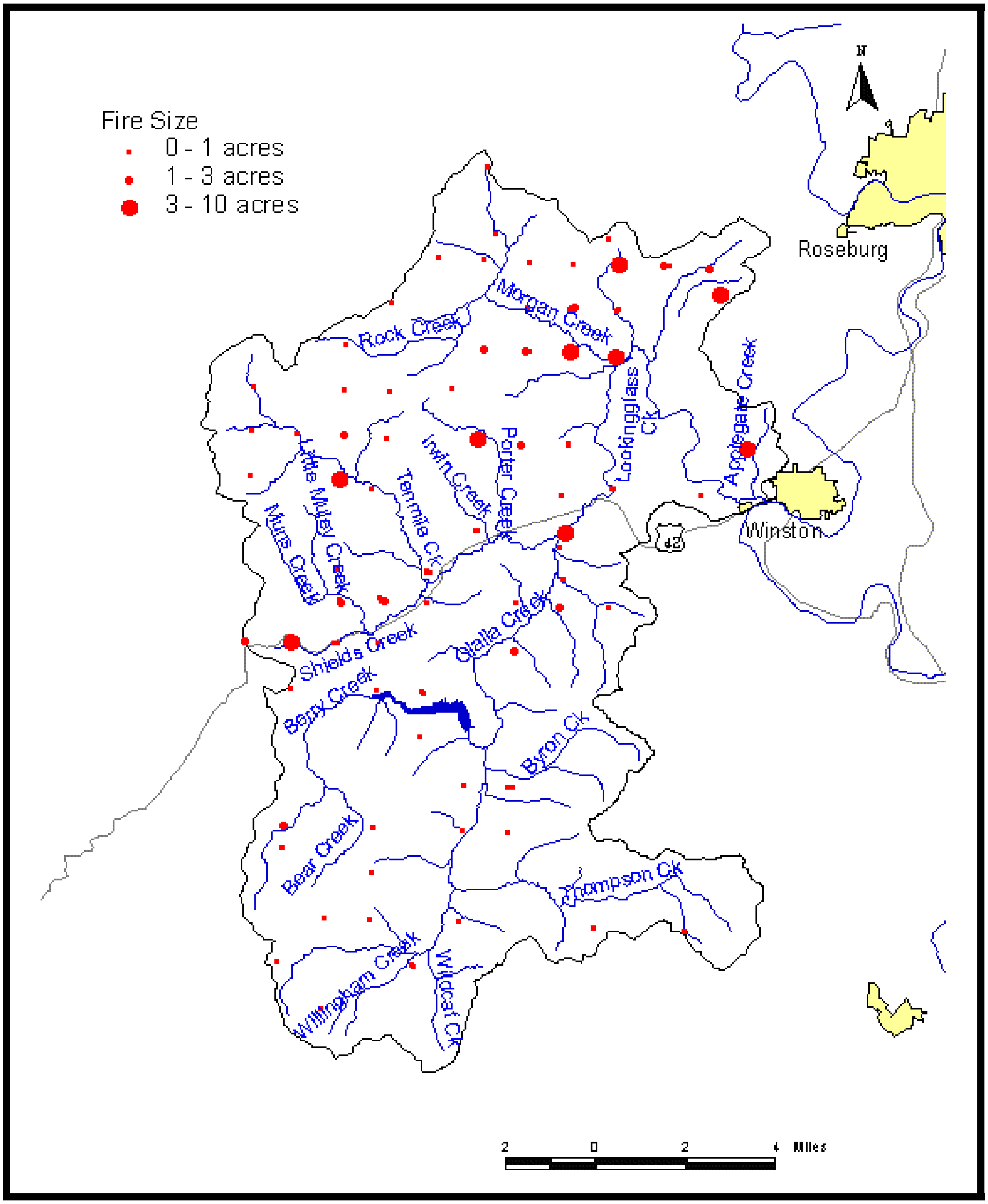
There are no urban areas present in Olalla / Lookingglass Watershed.

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 Olalla / Lookingglass Watershed, the Douglas Forest Protective Association (DFPA) is responsible for responding to forest fires and issuing burn permits. Table 3-12 shows the number of acres burned from 1991 through 2002. Map 3-16 shows the location, years, and size of wildfires in the watershed. This assessment was unable to locate quantitative data on

[72] United States Geological Survey

burns/stream proximity and is therefore unable to evaluate the potential for stream sedimentation from burns.



Map 3-16: Wildfire location by size

Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	Sum
Field Acres	6.3	1.7	1.8	20.0	1.2	4.0	9.6	11.8	15.2	2.2	18.4	13.2	**105.4**

Table 3-12: Number of acres burned in the Olalla / Lookingglass 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).[73]

In 1995, ODEQ tested for Arsenic and found no measurable levels.[74] Continued monitoring is needed to determine if any problem exists for toxics.

3.3.9 Water quality key findings and action recommendations

Temperature key findings

- Monitoring locations within the watershed indicate that some streams within the Olalla / Lookingglass Watershed often have seven-day moving average maximum temperatures exceeding the 64°F standard during the summer. High stream temperatures may 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 would 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 key findings

- Temperature and the levels of pH, nutrients, and dissolved oxygen are interrelated. Available data suggest pH is not a concern.

Dissolved oxygen key findings

- ODEQ data are limited. Of the seven samples, only one was below the 8.0mg/l standard.
- Dissolved oxygen levels fluctuate throughout the day and more monitoring is needed to determine the potential impact on aquatic life.

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

[74] 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.

Nutrients findings
- For total phosphorus and total nitrates, ODEQ samples were below the recommended values set by OWEB.

Bacteria key findings
- Two samples taken during a high flow event in March 2002 exceeded the measurable limit of 2,419/100ml, well over the standard.
- More monitoring should be done to assess the presence of coliform and the impact on recreation.

Sedimentation and turbidity key findings
- Turbidity data evaluated using OWEB standards did not indicate that usual turbidity levels are high.
- Sediment delivery from improperly drained dirt and gravel roads are a primary source of sediment generation within most Oregon watersheds, which may be the case in the Olalla / Lookingglass Watershed. Slope instability, streamside fires, and some land management activities are possible sources for sediment production and delivery.
- Areas of moderate to high soil erodibility and runoff potential lie in a large portion of the northern half of the Olalla / Lookingglass Watershed.
- Steep to moderately steep slopes are found through the watershed, and dominate the topography of the southern half of the watershed.
- The combination of steep slope along with poorly managed, erosion-inducing human modifications such as roads, timber harvesting, agriculture, and residential development can make areas prone to greatly increased erosion.

Toxics key findings
- Very little data are available for toxics in the Olalla / Lookingglass area, however ODEQ has tested for Arsenic and found no measurable levels.
- Continued testing for toxics is needed to determine if any problem exists.

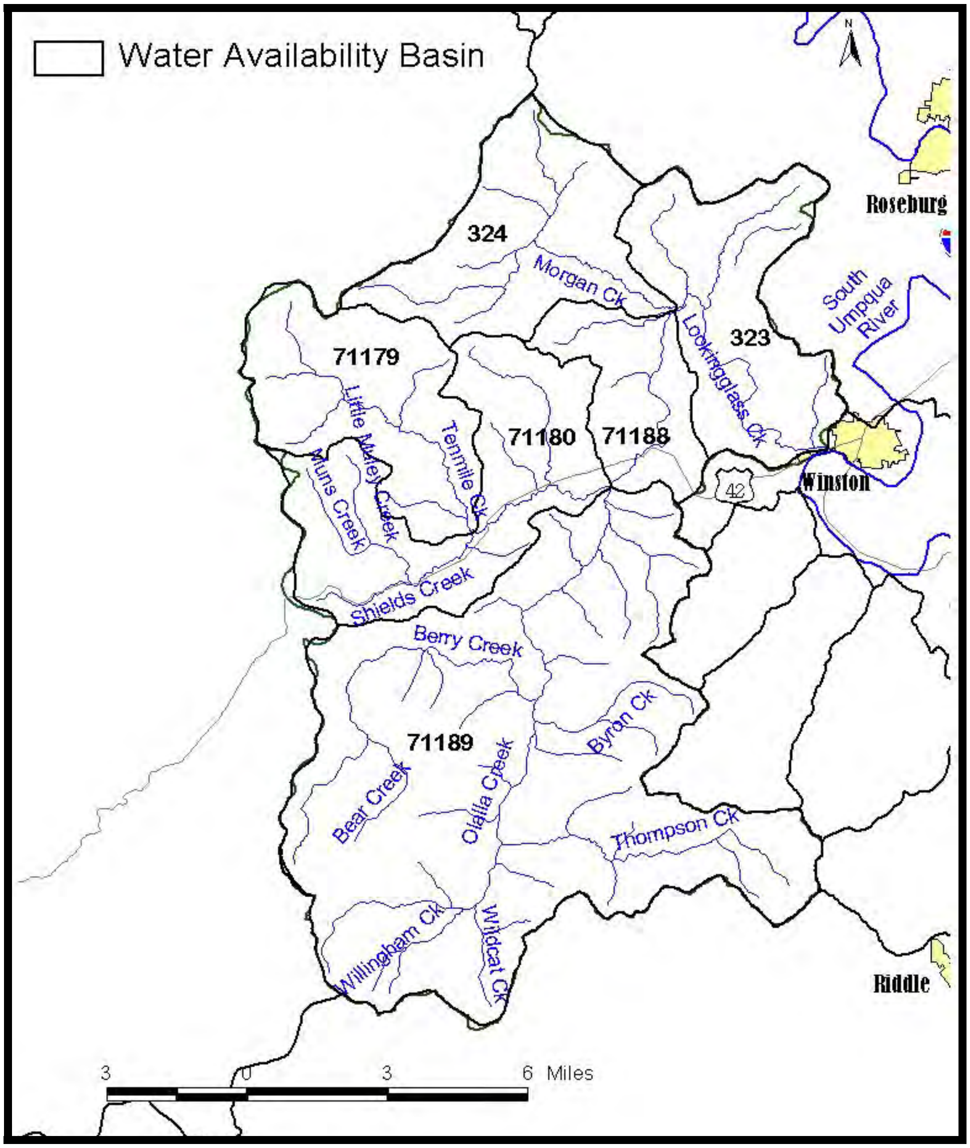
Water Quality action recommendation
- Continue monitoring the Olalla / Lookingglass Watershed for all water quality conditions. Expand monitoring efforts to include tributaries.
- Identify stream reaches that may serve as "oases" for fish during the summer months, such as at the mouth of small or medium-sized tributaries. Protect or enhance these streams' riparian buffers and, if needed, improve in-stream 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 point and non-point 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 observation suggests that stream sediment or turbidity levels are of concern, survey the vicinity to identify possible on-going sediment sources, such as urban runoff, failing culverts or roads, landslide debris, construction, or burns. Take action to remedy the problem if possible.
- Obtain comprehensive map coverage of the 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, especially on dirt and gravel roads.
- Use proper management practices (such as controlling road runoff from improper drainage) to control erosion in sensitive areas of the watershed.
- Complete an original, detailed landslide identification study on time-sequence aerial photography to identify sensitive and disturbed areas.
- Use proper management practices in areas with high debris flow hazards and with soils that have high K factor values and are in the C or D hydrologic group (primarily the northern half of watershed).
- Promote enhancement of native vegetation through restoration and streambank enhancement wherever such projects are feasible.
- Limit stream channel and bank modifications.
- Provide landowner education about water quality concerns and potential improvement methods, such as how to improve dirt and gravel road drainage to minimize sediment delivery to streams.
- Use the refined debris flow hazard data (soon available at Nature of the Northwest in Portland) to identify landslide-sensitive areas.

3.4 Water quantity

3.4.1 Water availability[75]

Data from the Oregon Water Resources Department (OWRD) have been used to determine water availability in the Olalla / Lookingglass Watershed. 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 Olalla / Lookingglass Watershed into six sub-basins (water availability basins, or WABs) for analyzing water availability (see Map 3-17).



Map 3-17: Water Availability Basins (WAB)

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

The surface water availability for the Lookingglass Creek mouth (WAB #323) is shown in Figure 3-11. (for other WAB data, see Appendix 9). The solid yellow area is the average streamflow while the dark blue line represents the instream water right. The red line is the estimated consumptive use. The dashed light-blue line shows average stream flow minus the consumptive use.

During July, August, September and October, the consumptive use is nearly the same as the average streamflow. Instream water rights exceed average stream flow from the beginning of September through most of October.

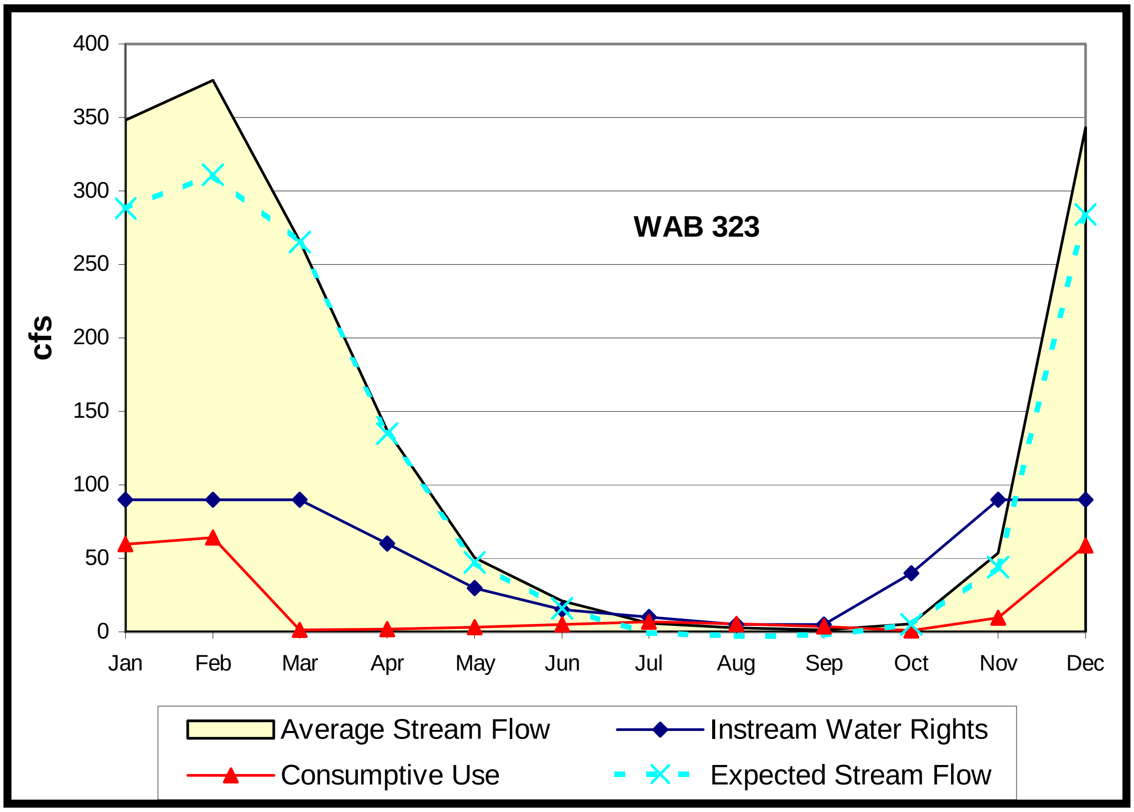


Figure 3-11: Water availability at the mouth of Lookingglass Creek (WAB #323)

The consumptive uses from Figure 3-11 (red line) are divided into several specific categories in Table 3-13. Storage is the dominant use from November to March. From April to October irrigation is the primary use. Data for WAB #323 are listed below; other WAB data are included in Appendix 9.

	Total Consumptive Use (cfs)	Storage	Irrigation	Municipalities	Industry / Manufacture	Commercial	Domestic	Agriculture	Other	Total
Jan	59.65	99%	0%	0%	0%	0%	0%	0%	0%	100%
Feb	64.32	99%	0%	0%	0%	0%	0%	0%	0%	100%
Mar	1.30	62%	11%	0%	9%	0%	12%	7%	0%	100%
Apr	1.64	9%	70%	0%	7%	0%	10%	5%	0%	100%
May	3.15	0%	88%	0%	4%	0%	5%	3%	0%	100%
Jun	4.89	0%	93%	0%	2%	0%	3%	2%	0%	100%
Jul	7.01	0%	95%	0%	2%	0%	2%	1%	0%	100%
Aug	5.65	0%	93%	0%	2%	0%	3%	2%	0%	100%
Sep	3.69	0%	90%	0%	3%	0%	4%	2%	0%	100%
Oct	0.70	0%	47%	0%	17%	0%	23%	13%	0%	100%
Nov	9.41	96%	0%	0%	1%	0%	2%	1%	0%	100%
Dec	58.78	99%	0%	0%	0%	0%	0%	0%	0%	100%

Table 3-13: Consumptive uses

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

The consumptive water rights for the Olalla / Lookingglass Watershed are shown in Table 3-14. Primary consumptive live flow or diversion rights (cubic feet per second, cfs) are listed here. Storage rights (acre-feet, aft) are listed in Appendix 10. These records show uncanceled water rights and do not indicate actual water consumption.[76]

Olalla Creek and Lookingglass Creek were combined and compared to all other tributaries in Table 3-14. Over 60% of the water volume permitted for consumptive use comes from the watershed's various tributaries. Irrigation is the largest use in the watershed (64% of total diversion rights). Over 97% of the rights on Olalla and Lookingglass Creeks contribute to irrigation (15.6 cfs). Mining is the next largest use for the watershed (19% of total use). The only diversion mining right is on Byron Creek for eight cfs. Appendix 10 outlines the possible consumptive uses included in each category.

[76] 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		**Olalla & Lookingglass Creeks**		**All other watershed tributaries**	
Source	Cubic feet/sec	% of Total	Cubic feet/sec	% of O/L Ck	Cubic feet/sec	% of Tributaries
Agriculture	0.000	0.00	0.000	0.00	0.000	0.00
Domestic	0.827	1.99	0.180	1.13	0.647	2.53
Irrigation	26.568	63.93	15.587	97.59	10.981	42.91
Industrial	1.200	2.89	0.050	0.31	1.150	4.49
Recreation	0.270	0.65	0.000	0.00	0.270	10.6
Power	0.000	0.00	0.000	0.00	0.000	0.00
Fish	0.100	0.24	0.000	0.00	0.100	0.39
Livestock	0.615	1.48	0.155	0.97	0.460	1.80
Municipal	0.000	0.00	0.000	0.00	0.000	0.00
Mining	8.000	19.25	0.000	0.00	8.000	31.26
Wildlife	0.000	0.00	0.000	0.00	0.000	0.00
Miscellaneous	3.980	9.58	0.000	0.00	3.980	15.15
Total	**41.560**	**100.00**	**15.972**	**100.00**	**25.588**	**100.00**

Table 3-14: Water rights by cfs use

3.4.3 Stream flow and flood potential

There are three US Geological Survey (USGS) stream gauges in the Olalla / Lookingglass Watershed. The station at Lookingglass Creek at Brockway (USGS 14311500) has been active since 1956. Stations at Tenmile Creek (USGS 14311300) and Olalla Creek (USGS 14311200) have less complete data available. Figure 3-12 charts the average monthly mean streamflow for Lookingglass Creek between 1956 and 2001.

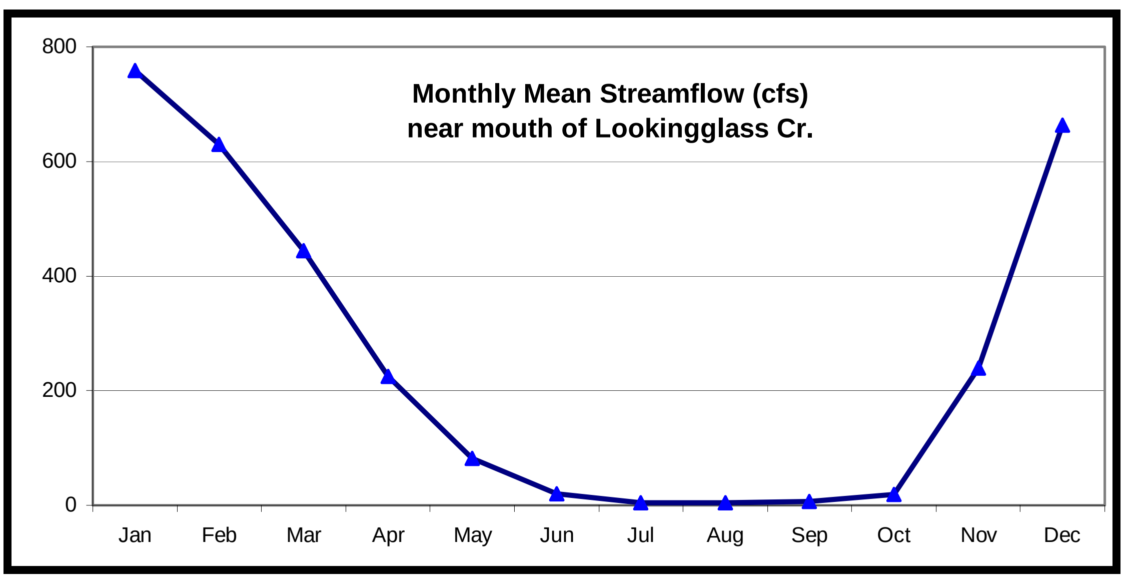


Figure 3-12: Monthly mean streamflow for Lookingglass Cr.

As would be expected from climate information (see Section 1.2.4), the winter months have the greatest average flow due to precipitation. During the summer months, streamflow can drop down to less than five cfs. It is not unusual for stream reaches to have zero flow, meaning that there is no flowing water although there may be standing water. Landowners report that before Ben Irving Dam was built, there were periods of no flow during the summer months. Constant release from the reservoir has increased summer flow rates.

The USGS notes the effect of Ben Irving reservoir starting in 1988. Before the reservoir was installed, winter flow rates were 175 cfs higher (Nov-Mar). The dam was not constructed to serve for flood control and after the reservoir is filled early in the winter, all remaining water runs out the spillway.[77] Summer flow rates have increased an average of seven cfs (June-Sept) since Ben Irving became operational. Appendix 9 displays the change in flow rates pre and post dam installation. The monthly and annual mean streamflow since 1956 is shown in Figure 3-13 and Figure 3-14.

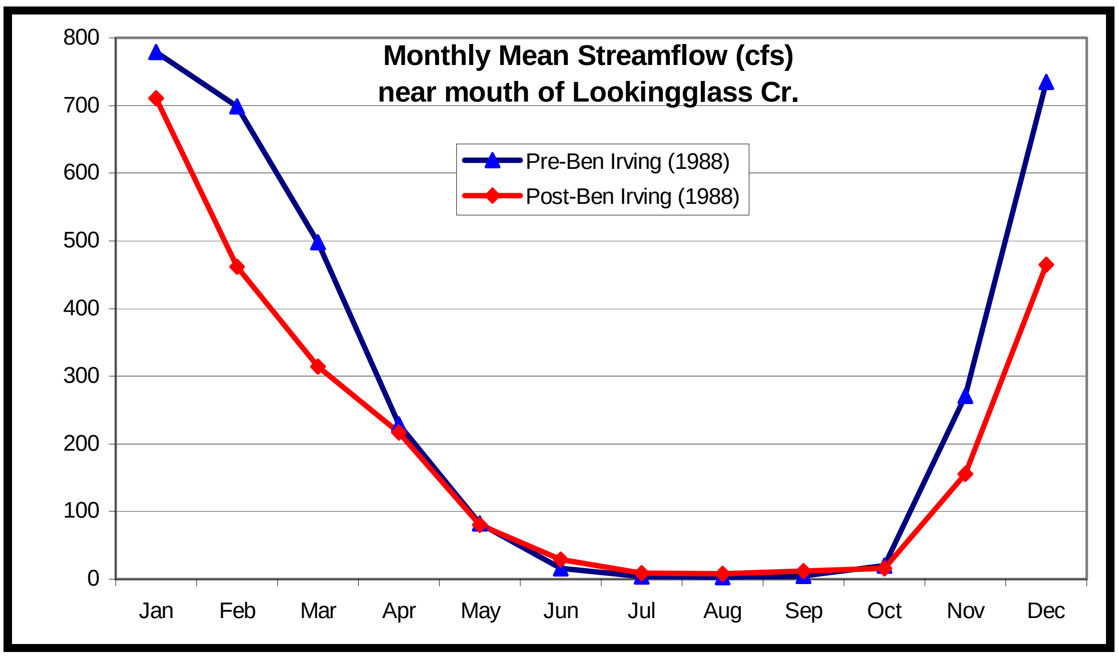


Figure 3-13: Monthly mean streamflow prior to and after Ben Irving Dam

[77] Frank Nielson, Director of Douglas County Natural Resources Dept.

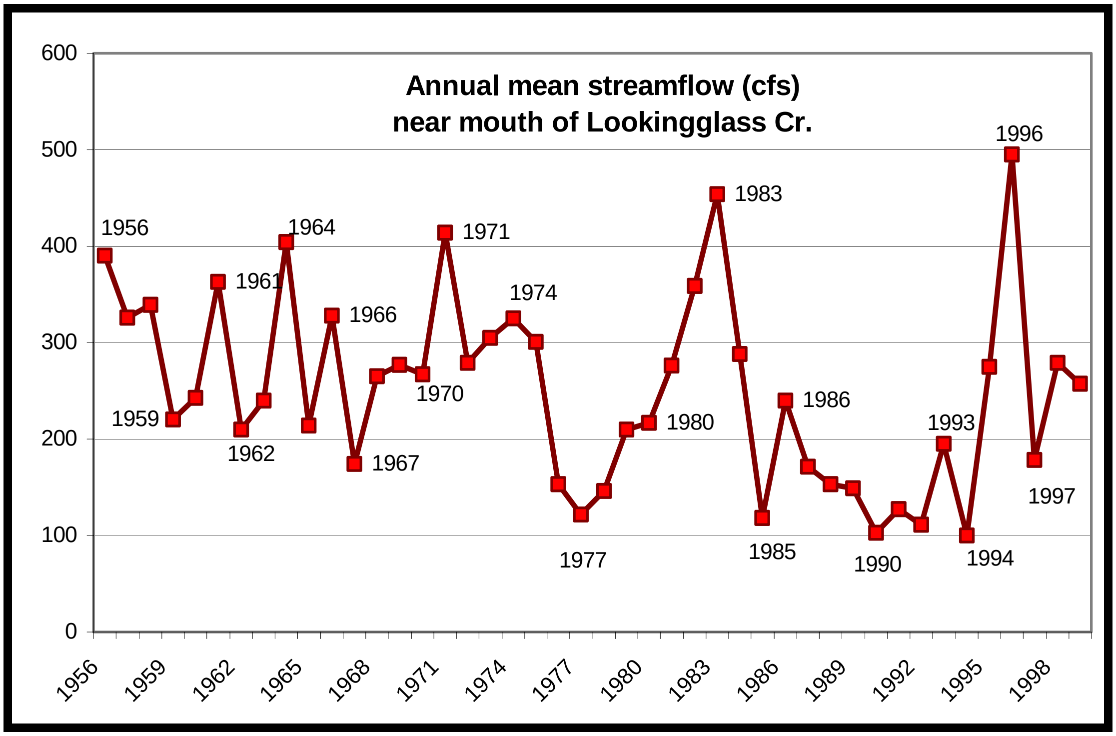


Figure 3-14: Annual mean streamflow for Lookingglass Cr.

Peak flow data collected on Lookingglass Creek from 1956 to present are shown in Figure 3-15. Peak flow data show the highest flow rate recorded for the year. According to the USGS, Ben Irving Reservoir began to influence the peak flow rates in 1988.

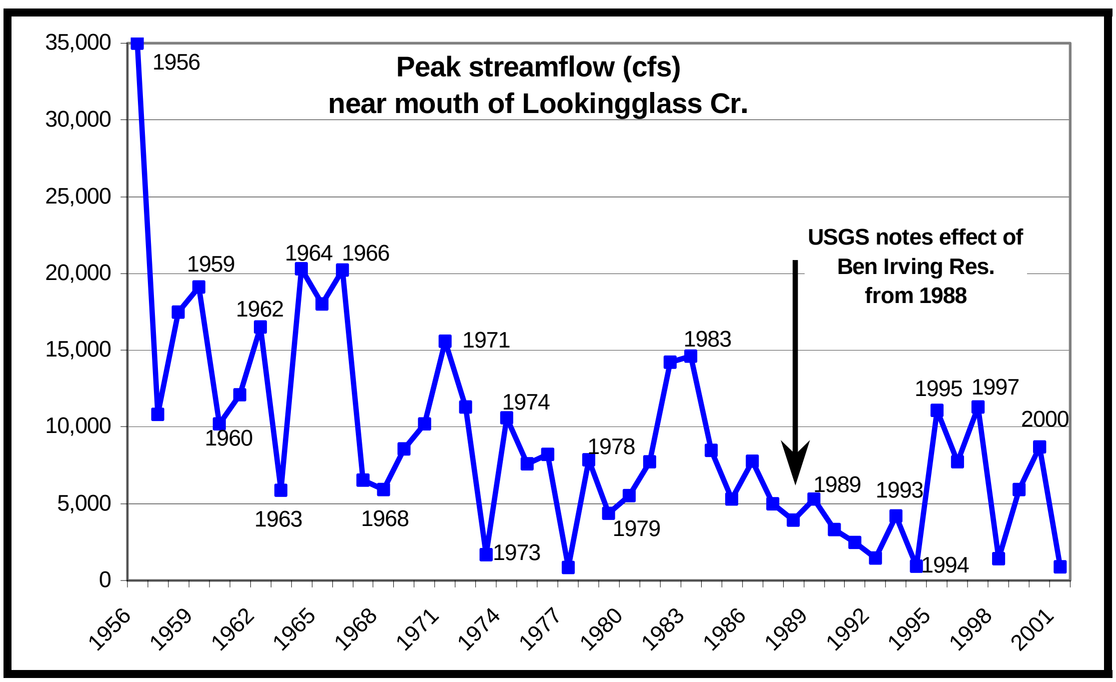


Figure 3-15: Peak streamflow for Lookingglass Cr.

Flood potential
Approximately 14% of the Olalla / Lookingglass watershed is within the transient snow zone (TSZ) (see Map 1-8 in Section 1.2.4). 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. Accumulated snow and rain combine to cause high runoff levels and peak streamflows. Streams with headwaters in the TSZ zone, such as Thompson Creek, may be more susceptible to rain-on-snow events than lower elevation streams.

Road density may also influence peak flows. Table 3-15 shows the miles of road per square mile for surfaced and unsurfaced road. 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 some of the runoff. If the surrounding area is unable to absorb the excess water and the road is close to a stream, 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. The influence of roads on stream flow and peak events is debatable.

Road type	**Road miles/ square mile**
Paved	0.53
Gravel	2.66
Dirt	0.80
Total	4.58

Table 3-15: Miles of road per square mile

3.4.4 Water quantity key findings and action recommendations

Water availability and water rights by use key findings

- During July, August, September and October, the consumptive use is nearly the same as the average streamflow. Instream water rights exceed average stream flow from the beginning of September through most of October.
- The largest uses of water in the Olalla / Lookingglass Watershed are irrigation in the summer and storage in the winter.

Stream flow and flood potential key findings

- During the summer months, streamflow can drop down to less than five cfs. It is not unusual for stream reaches to have zero flow.
- No flooding trends can be determined from the records to date.
- The degree to which road density and the transient snow zone influence flood potential in the Olalla / Lookingglass Watershed is unknown at this time.

Water quantity action recommendations

- Reduce summer water consumption through in-stream 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.

3.5 Fish populations

3.5.1 Fish presence

The Olalla / Lookingglass Watershed is home to many native and non-native fish species. Table 3-16 lists the fish species in the watershed that have viable, reproducing populations or annual runs.[78] Chinook salmon are only reported on Lookingglass Creek.

For non-native fish, brown bullhead (*Ameiurus nebulosus*) has an established population and bluegill (*Lepomis macrochirus*) has been seen. These fish are most likely introduced to watershed streams through private ponds, or have migrated into the watershed from the South Umpqua River. Lookingglass Creek and tributaries are generally too cold for warm water species to establish reproducing populations.

Native Species	
Common Name	***Scientific Name***
Steelhead	*Oncorhynchus mykiss*
Coho salmon	*O. kisutch*
Chinook salmon	*O. tshawytscha*
Cutthroat trout	*O. clarkii*
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 oregonensise*
Largescale sucker	*Catostomus macrocheilus*

Table 3-16: Native fish species with established populations within the watershed

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 Olalla / Lookingglass Watershed. In January, 2003, various groups petitioned to protect the Pacific lamprey and western brook lamprey under the Endangered Species Act.

3.5.2 Fish distribution and abundance

Information on fish distribution and abundance within the Olalla / Lookingglass 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.

[78] From Dave Harris, fisheries biologist for the Oregon Department of Fish and Wildlife, Roseburg District Office.

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 March 2003, ODFW was in the process of revising their 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, chinook, coho and winter steelhead use 97.7 stream miles within the Olalla / Lookingglass Watershed. Table 3-17 lists the miles of stream occupied by each species. Total stream miles with anadromous salmonids does not equal the sum of miles used by species because many species may use the same stretch of water (see Appendix 11 for species-specific maps). Coho and winter steelhead use many of the same stream reaches but at different times of the year. Map 3-18 shows the distribution of these anadromous salmonids within the watershed.

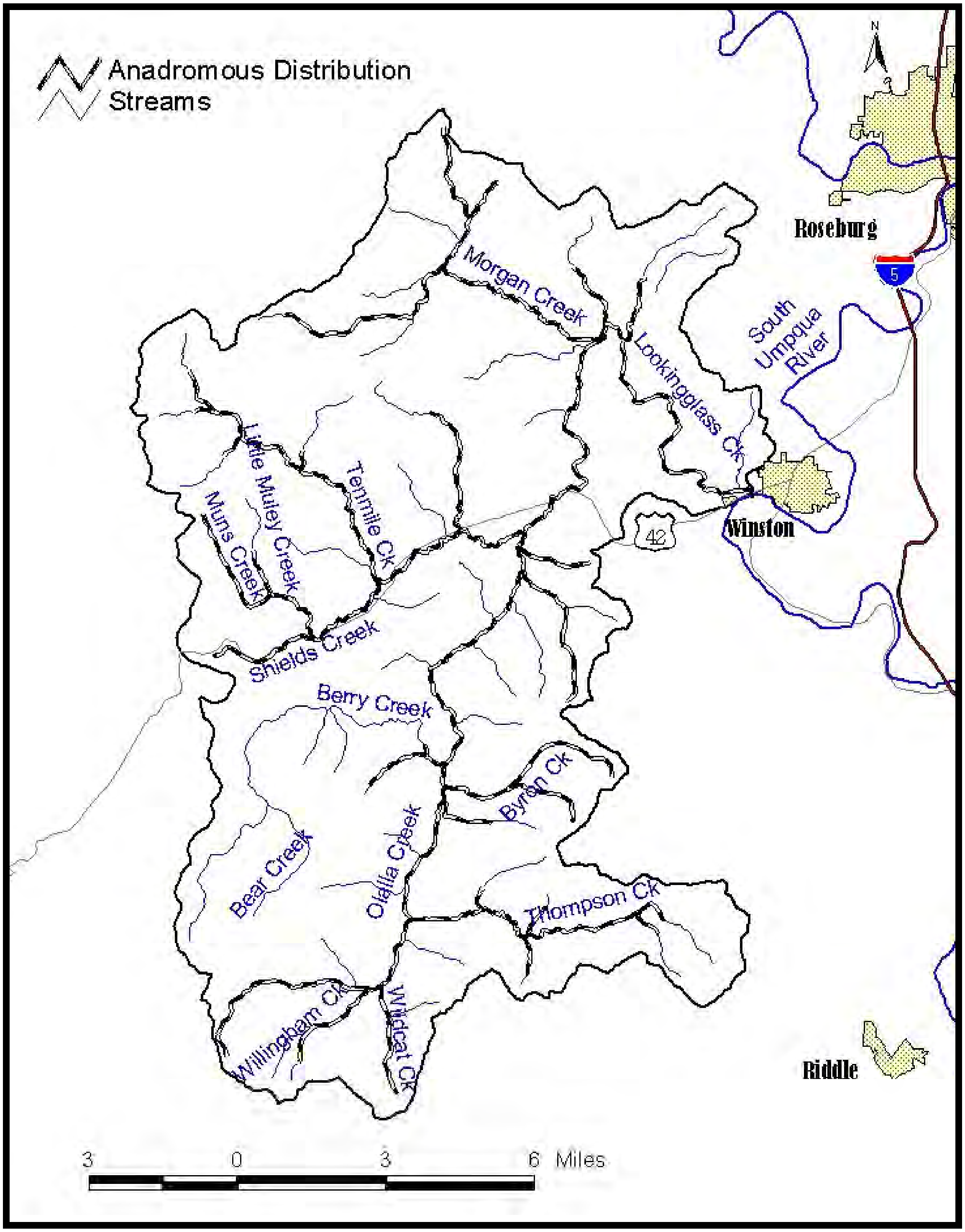
Total Potential in Watershed		Total Anadromous	Winter Steelhead	Coho	Fall Chinook
Miles	166.3	97.7	93.1	73.7	12.7
Percent	100 %	58.7 %	56.0 %	44.3 %	7.7 %

Table 3-17: Miles of stream potentially supporting anadromous salmonids

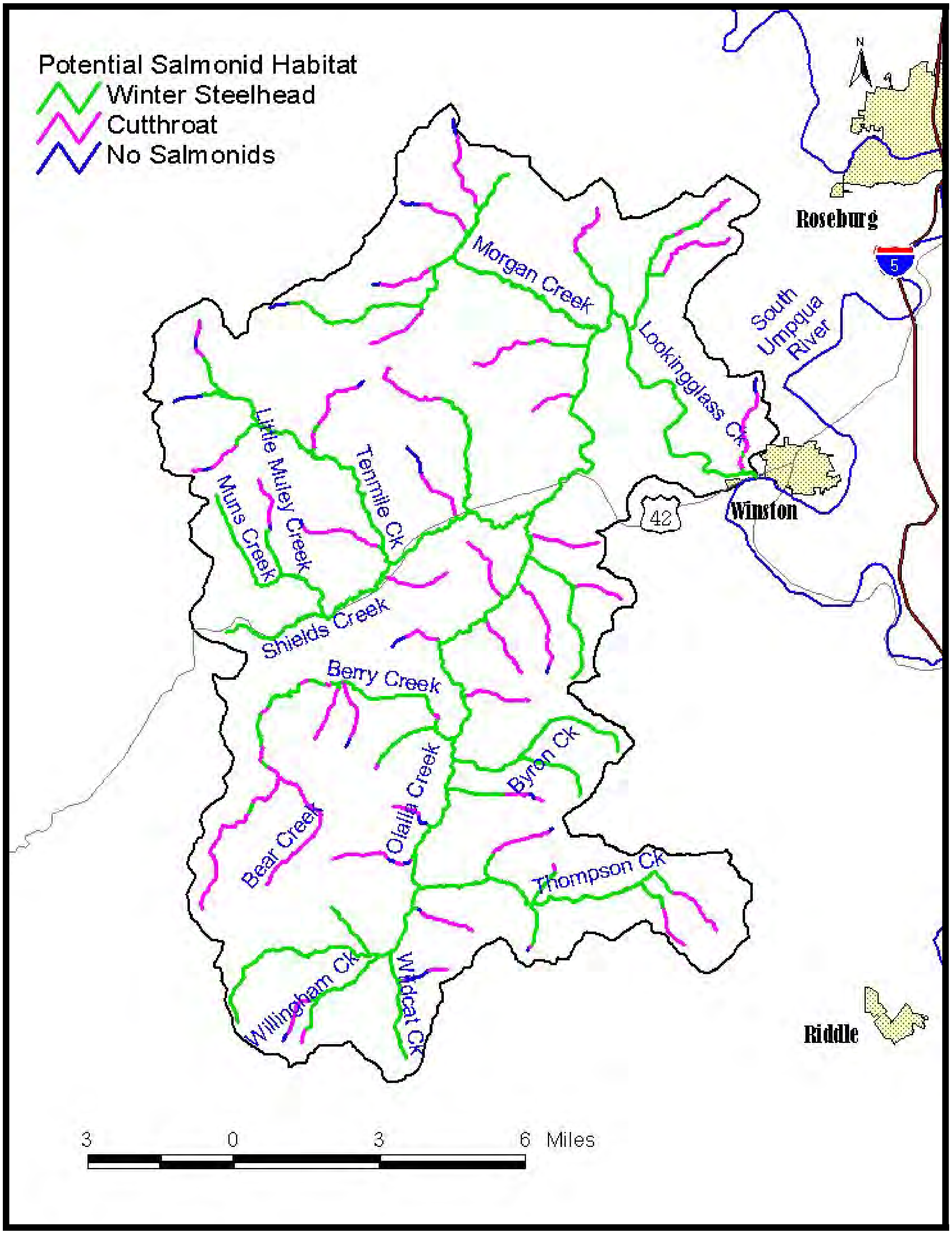
Resident salmonid distribution
There are no comprehensive data about resident salmonid distribution in the Umpqua Basin. ODFW is compiling regional data and will develop maps indicating fish presence by stream. However, the project will not be completed until after this assessment is complete.

The only resident salmonid in the Olalla / Lookingglass Watershed is the cutthroat trout. Although there is much overlap, anadromous salmonids generally prefer streams with a zero to 4% gradient, whereas resident cutthroat trout prefer gradients between 4% and 15%. Also, cutthroat are generally found beyond the range of winter steelhead.[79] Map 3-19 shows stream gradient and the associated salmonids within the Olalla / Lookingglass Watershed. Map 3-19 and Map 3-18 do not completely agree because there are many factors other than stream gradient that determine fish habitat suitability. Map 3-19 identifies only potential cutthroat trout habitat, such as the upper reaches of Thompson Creek.

[79] From Dave Harris, fisheries biologist for the Oregon Department of Fish and Wildlife, Roseburg District Office.



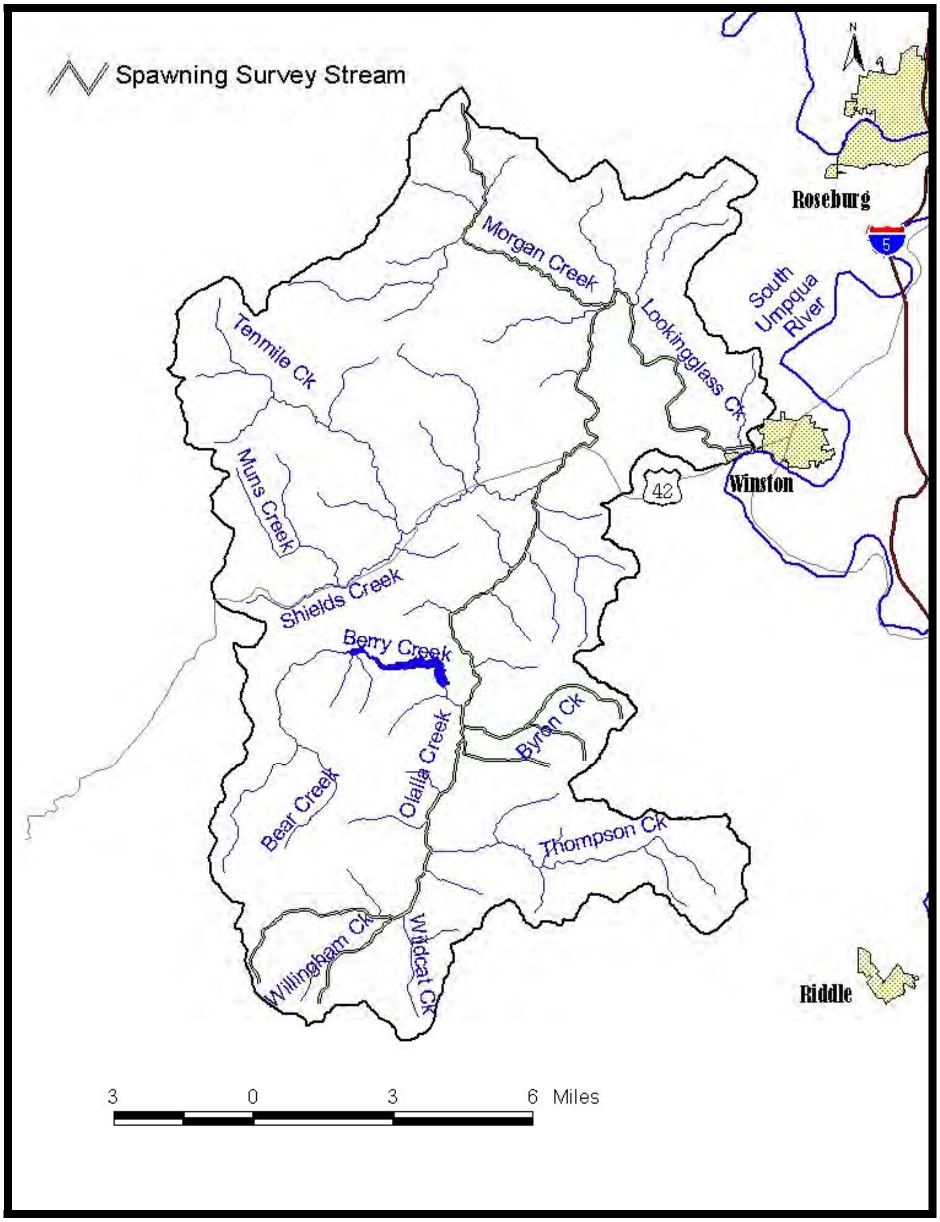
Map 3-18: Anadromous salmonid distribution1



Map 3-19: Potential resident and anadromous salmonid habitat

Salmonid abundance
Fish abundance in the Olalla / Lookingglass watershed is difficult to assess. Available data focus on coho spawning and juvenile salmonid migration abundance. It is not possible to locate abundance data for resident salmonids.

Coho spawning surveys
ODFW conducts coho spawning surveys throughout the Umpqua Basin. Volunteers and ODFW personnel survey pre-determined and randomly selected stream reaches and count the number of live or dead coho. The same person or team usually conducts surveys every ten days for two or three months. There are coho spawning data for the Olalla / Lookingglass Watershed from 1990 through 2001. Map 3-20 shows the surveyed stream reaches.



Map 3-20: Coho spawning survey locations

Figure 3-16 and Figure 3-17 show the maximum number of live and dead coho seen per mile on a given day. The estimated total number of coho per mile is included as a red bar next to peak per mile count.

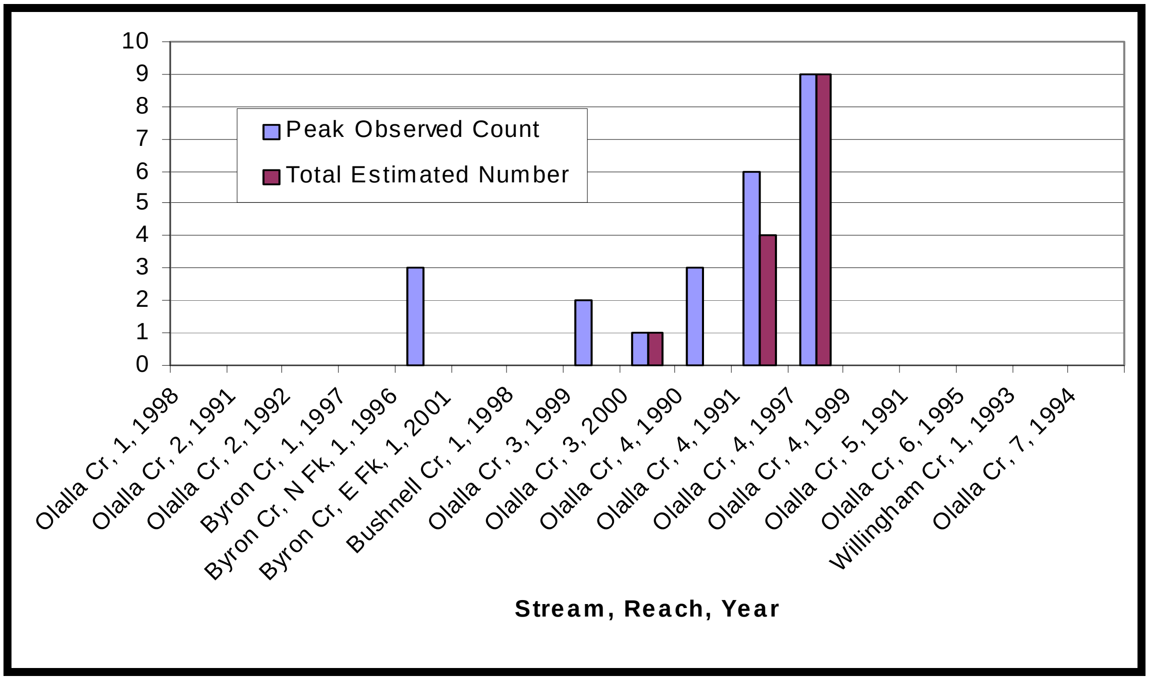


Figure 3-16: Coho spawning surveys Olalla Cr. and tributaries

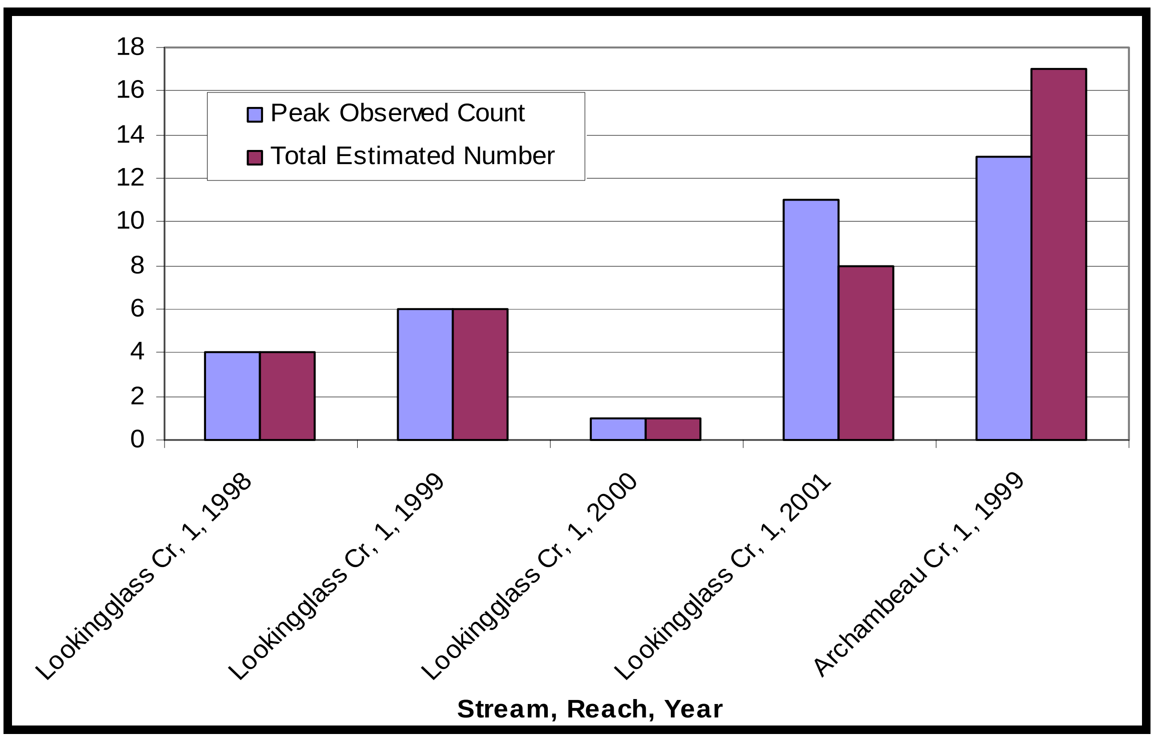


Figure 3-17: Coho spawning surveys for Lookingglass Cr. and tributaries

Within a given year, streams can have very different coho spawning populations. Lookingglass Creek and Olalla Creek both have reaches that have been surveyed four times. Observed counts range from zero to around 10 depending upon the year. More survey data are needed to draw conclusions about coho spawning in the watershed.

Migrating juvenile populations

The US Forest Service (USFS), the Bureau of Land Management (BLM), and ODFW are working together to collect long-term information on the movements of juvenile salmonids out of their natal streams.[80] Juvenile salmonid data are primarily collected with five-foot rotary screw traps, which capture small fish. From data collected during trap operation, fisheries biologists can estimate the number of juvenile fish passing by the trap during the summer-long outward migration.

The BLM operated a screw trap on Lookingglass Creek between 1998 and 2000. The trap operated during the late spring (early March until late May or June). Figure 3-18 shows by age class the estimated number of coho, chinook, and steelhead passing the Lookingglass Creek rotary trap during their outward migration. On the figure, “0+” indicates fish less than one year old, “1+” are fish between their first and second year, and so on.

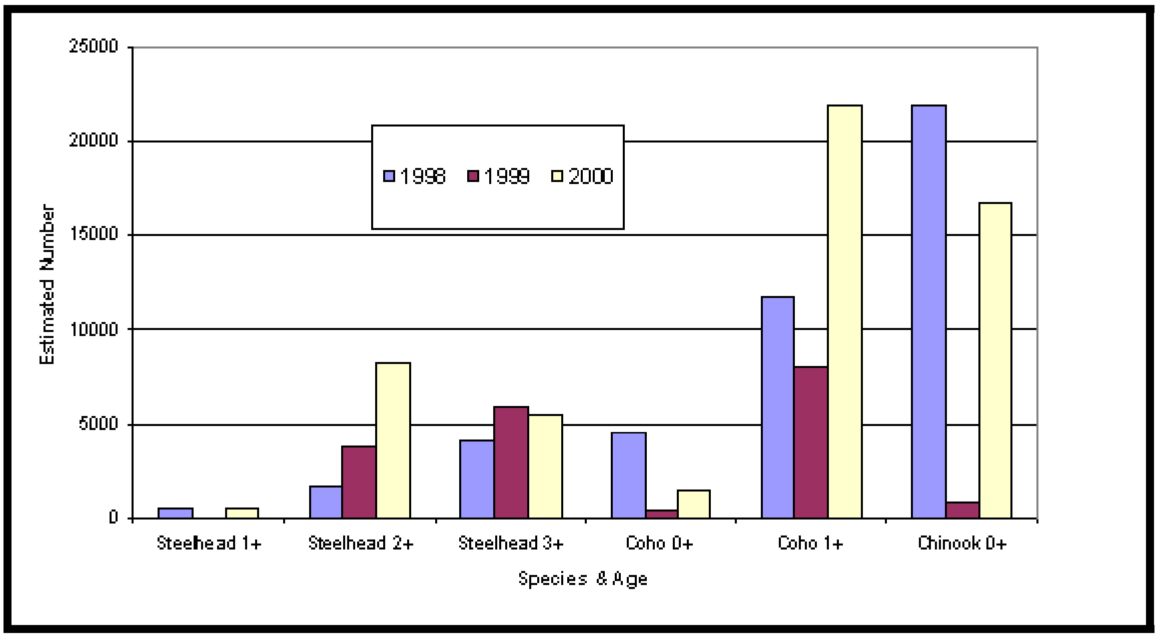


Figure 3-18: Estimated number of out-migrating salmonids

Population estimates can only be made when at least four fish have been trapped, marked, and recaptured. Although steelhead 1+ were captured in 1998, there were insufficient recaptures to estimate out-migrating populations. It appears from Figure 3-18 that there is tremendous fluctuation in juvenile salmonid out-migrating populations. More annual data are needed to determine any trends within the watershed.

[80] Natal streams refer to the streams where juvenile salmonids hatched.

3.5.3 Salmonid population trends

According to Dave Harris of the Oregon Department of Fish and Wildlife, adult salmonid returns to the South Umpqua River system have increased from 1998 to 2002. This trend may be attributed 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 population key findings and action recommendations

Fish populations key findings

- The anadromous fish species in the Olalla / Lookingglass Watershed are steelhead, coho salmon, chinook salmon, cutthroat trout, and lamprey. Although many medium and large tributaries are within the distribution of one or more salmonid species, 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 South Umpqua River, but these species may occasionally enter the mouth of Lookingglass 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 are also struggling 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[81]

4.2.1 The City of Winston[82]

The City of Winston's estimated population growth rate is 2.5% per year. According to the 2000 US Census, Winston's population was 4,613 people. Assuming a 2.5% growth rate, Winston's 2003 population is 4,968 people.

Population growth

Over the past 10 years, the City of Winston's population has increased by 25%. Job opportunities within the city have not increased at the same rate. City officials believe that Winston's growth is due to inexpensive housing costs and an abundance of flat, developable land compared to Roseburg and other nearby cities. This has made Winston an affordable place for people to purchase, rent, or build homes. Enrollment in Winston public schools has not followed the same growth trend as the city. This supports local observation that many of the newcomers to Winston are retirees.

Even with the influx of retirees, it is believed that approximately 50% of Winston's residents are low or moderate income, which means that half of the city's population earns less than 80% of the area's median income. As such, there is a strong need for affordable housing, such as manufactured homes, apartments, duplexes, and townhouses.

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[81] 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.

[82] This information is primarily from an interview with Bruce Kelly, City Administrator for the City of Winston.

Some groups are building affordable housing complexes in Winston, but many developers are focusing on upscale homes to attract higher-income retirees. Although bringing higher-income people to the city is desirable, the reality is that Winston needs more affordable housing. The city is working to increase the number of developments that cater to its low and moderate-income population.

Local observation suggests that many of Winston's young adults do not stay in the city. Officials believe that Winston’s manufacturing, retail, and service-oriented job market is not attractive to young adults, so they leave to find better opportunities elsewhere. Many people believe that Winston's older population is growing, while the number of young adults is decreasing.

Economic development

Although Winston is economically depressed, officials do not believe it is in the city's best interest to increase industrial development within its urban growth boundary. Winston officials support the efforts of groups like the Umpqua Economic Development Partnership, and believe the city's residents will benefit from industrial development in Roseburg and along I-5. Winston also highly prizes its small-town atmosphere, close-knit neighborhoods, and slower pace. Officials believe that increasing heavy or light industry within the urban growth or corporate city boundaries would reduce the quality of life the city's residents enjoy.

Winston officials would like to increase retail and tourism-related businesses within the city. Winston has an abundance of second-hand shops, but has few stores that deal in new clothing, kitchenware, and other household goods. Despite less costly rents compared to Roseburg, it is difficult for Winston-area stores to compete with stores in its larger neighbor, since most residents are accustomed to shopping in Roseburg. City officials believe that specialty retail stores could be very successful in Winston. For example, the city currently has a shop that specializes in decorative rubber stamps and stamping-related products. Stamping is a popular hobby, and this business attracts many customers beyond the city limits. Winston officials believe that other specialty stores could find equal success in their city.

Winston is probably best known as the location of Wildlife Safari, which attract upwards of 150,000 visitors per year. The access road to Wildlife Safari is on the eastern edge of town; few tourists to the game park travel the extra distance to visit Winston, possibly because there are no attractions within the city. Winston is also on a main route to the coast, but the lack of tourist-oriented businesses results in few of these travelers spending money in the city. Winston officials believe the city could capitalize on the large number of people that visit the area every year by providing more tourist-oriented attractions. The city is opportunistically pursuing a variety of options, including supporting the establishment of an old-fashioned metal and glass foundry.

City services

Compared to other Douglas County cities and towns, Winston is very young. The city was incorporated in 1953, but the Winston-Dillard Water District predates the city. The community's water source is from water rights from the South Umpqua River. In the summer, water availability is a problem for the community, but the district purchases additional water from Ben Irving Reservoir and has the ability to purchase water from Galesville Reservoir. The Water District plans to acquire additional water from the reservoirs over the next several years. Within the next five years, the Water District plans to upgrade the water treatment facility.

In 2000, the Winston-Green wastewater treatment plant completed over six million dollars worth of upgrades in anticipation of stricter water quality standards. However, the upgrades did not increase the plant's wastewater treatment capacity. Should the City of Winston continue to grow at its current rate, in ten years the wastewater treatment plant will need to be expanded.

Winston officials are hoping to increase the number of parks within the city limits to create more green space. Along the South Umpqua River south of Highway 42, the city would like to establish a park that could also serve as a floodway. If possible, the city will build a bike path along parts of the river as well as benches and picnic tables. Officials believe that creating more green space through this and other parks will provide more recreational opportunities and therefore improve the overall quality of life in the city.

The future of Winston

Twenty years from now, the City of Winston expects its population to reach 10,000 residents. At that time, the city hopes that it will have successfully increased its green space and have a community center. Officials also hope to improve transportation choices by expanding the sidewalk system and building a network of bike paths. Officials would like to eventually establish and maintain a citywide public transportation system, which would reduce older and low-income residents' need to drive.

When asked what factors would most likely have the greatest impact on the city, officials identified economics and population changes. Like many other economically depressed cities, Winston relies heavily on state-shared revenues, such as those that come from liquor and cigarette taxes. These funds are distributed based on population. Should these funds decrease or become unavailable to Winston, the city would face financial hardships and would be unable to continue to provide some services to its residents.

The city would also struggle if it had a sudden change in population. For example, if Roseburg Forest Product's mill in Dillard closed, many city residents would move elsewhere, since the mill is a primary employer in the area. This type of sudden population drop could turn Winston into a ghost town. A sudden boom in population would also be hard to manage. The city's urban growth boundary and development activities are sufficient to manage its current growth rate for the next 20 years. However, in the event of a sudden, high demand for housing in the area, the city would have difficulties providing the necessary services. Table 4-1 displays the population of Winston, since incorporation in 1953.

Year	Winston
1960	2,395
1970	2,468
1980	3,359
1990	3,773
2000	4,613

Table 4-1: Winston population

4.2.2 Agricultural landowners[83]

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.[84] There are 20,030 acres of land (19% of the watershed) zoned for agriculture. Almost all agricultural lands are privately held and most are located in valleys and lowlands.[85] 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 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.

[83] The following information is primarily from 2002 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.

[84] There are people who raise pigs, dairy cows, horses, llamas, and other animals, but few are commercial operators.

[85] Many farmers and ranchers are also forestland owners (see Section 4.2.3).

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 twenty years ago, including gorse, Himalayan blackberry, a variety of thistles, and Scotch broom.[86] 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.[87] 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.

The populations of cougar and bear appear to be on the rise, which is due, in part, to changes in predator control regulations.[88] These species are territorial animals. As populations increase, the 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

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

[87] 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.

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

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.[89] 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.[90]

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, which may be attributed to increased standards and restricted the 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

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

[90] 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 $1000 worth of agricultural products.

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.

4.2.3 Family forestland owners[91]

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. Approximately 76% of the watershed is forested. Private non-industrial managers own just over 47% of the watershed. Family forestlands most likely constitute a slightly smaller percent of the private non-industrial forests.

Family forestlands differ from private industrial forests. Industrial timber companies favor expansive stands of even-aged Douglas fir. Family forestlands are more often located in lower elevations, and collectively provide a mixture of young and medium-aged conifers, hardwood stands, and non-forested areas such as rangeland. Family forestland owners are more likely to manage their 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 connected to the timber industry through their jobs or are recent arrivals to the area. The impression is that that many of the latter group left above-average paying jobs in

[91] The following information is from a 2002 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." 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.

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 inherited their properties or have unusually large incomes, since the cost of forestland and its maintenance is beyond the means of people just starting their careers.

Factors influencing family forestlands

Changing markets

There are very few small private mills still operating in Douglas County, so timber from family forests is sold to industrial timber mills. Timber companies are driven by the global market, which influences product demand, competition, and production locations. As markets change, so do the size and species of logs that mills will purchase. Family forestland owners must continually 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 certifying 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.[92] 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

[92] "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.

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 properties due to riparian buffer protection laws. Although most family forestland owners support sound management practices, laws that take more land out of timber production would further reduce the landowners' profit. 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.

4.2.4 Industrial timber companies[93]

Most industrial timberlands are located in areas that favor Douglas-fir, which tend to be hillsides and higher elevations.[94] 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 watershed, industrial timber companies own 25,900 acres, which is 25% of 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.[95] 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.

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[93] The following information is primarily from a 2002 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.

[94] Hillsides and higher elevations are often a checkerboard ownership of Bureau of Land Management administered lands (see Section 4.2.5) and industrial timberlands.

[95] 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.

Current land management trends

Land acquisition

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

Weeds

Noxious weeds are a concern for industrial timber managers. As with family forestlands, species such as Scotch broom, hawthorn, and gorse increase site maintenance costs. Weeds can block roads, 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.

Fire management

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

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, and 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.

4.2.5 The Bureau of Land Management[96]

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 Douglas County.[97] In the Olalla / Lookingglass Watershed, the BLM administers approximately 27,400 acres (27% of the watershed). Map 4-1 shows the location of BLM lands.

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 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."

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[96] 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.
[97] Including 1,717 acres of non-federal land with federal subsurface mineral estate administered by the BLM.

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.

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.[98] 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.

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 land use allocation 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. 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 BLM 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.[99]

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.[100] It describes the BLM's accomplishments during the fiscal year, provides information about its budget, timber receipt collections, and payments to Douglas County.

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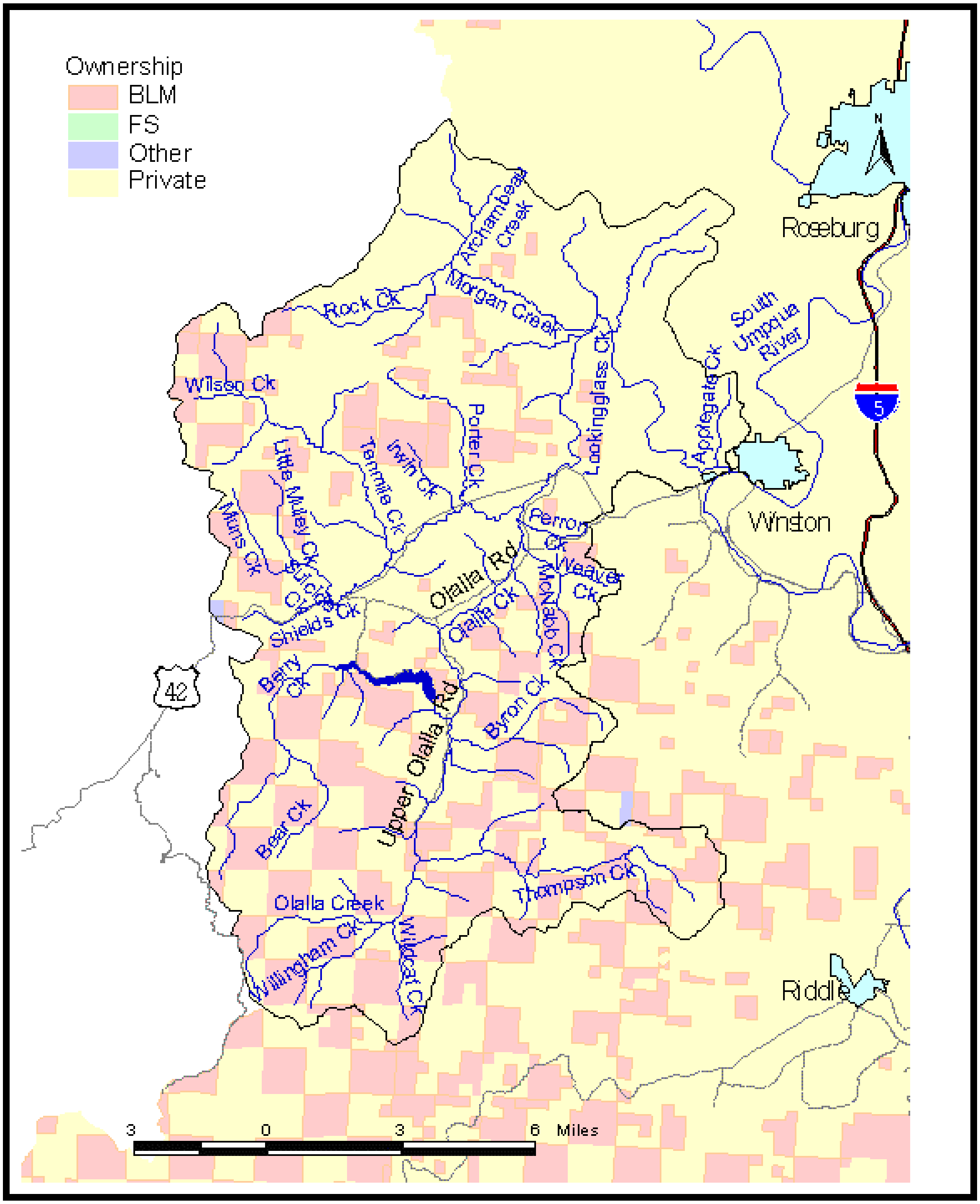
[98] For copies of this document, contact the Bureau of Land Management Roseburg District Office at 777 Northwest Garden Valley Road, Roseburg, Oregon 97470.

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

[100] Copies of the Roseburg District BLM's Annual Program Summary and Monitoring Report from fiscal year 2001 are available through the Roseburg District Office.



Map 4-1: Location of BLM administered land

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.[101] 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.

4.2.6 Oregon Department of Environmental Quality[102]

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;
- 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.

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[101] 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.

[102] The following information is primarily from a 2002 interview with Paul Heberling, a water quality specialist for the Oregon Department of Environmental Quality in Roseburg.

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.[103] Table 4-2 shows by parameter the number of Umpqua Basin streams failing to meet water quality standards.

[103] See Section 3.3 for 303(d) listed streams in the Lower South Umpqua Watershed.

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 4-2: 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. Everyone understands the 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.

5 Landowner Perspectives

In 2002, 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, this Section will be included in the current and future watershed assessments as Landowner Perspectives (Section 5).

5.1 Landowner interviews

Mr. A, Lookingglass Valley

Mr. A's great-great grandparents came into Lookingglass in 1849 from Virginia. His great-great grandfather established a land claim that extended from Lookingglass Cr. into Happy Valley. Their neighbor was Reverend A.L.J. Todd who settled the land from Lookingglass Cr. to the west. This donation land claim is still a part of the family's current farm. His other great-great grandparents settled into the Tenmile area at some point just before the other half of the family arrived.

<u>Native Americans</u>

Most likely there were two distinct cultural groups in the area, based upon different projectile points. The majority of the Native Americans were moved to the Siletz Reservation. The few who were unable to make the move were left behind and camped near Mr. A's family's house. People from the French settlement came and massacred the remaining Native Americans (Lookingglass Massacre). Mr. A's great-grandmother saw the event, but would not discuss it to any extent. One young woman with a baby escaped the massacre and hid in the chicken house. She was probably the only survivor.

<u>Development</u>

At the height of development, Lookingglass had two stores, a barbershop, blacksmith and a saloon. The area of Deer Creek (now Roseburg) became more developed due in part to Aaron Rose's gift of land to the county and churches. From the 1880s through the 1890s, Reston was a stage stop on the Coos Bay Wagon Road. Schools were located in Lookingglass, Tenmile, Reston, Olalla and Upper Olalla.

<u>Agriculture</u>

Earliest crops were grain and hay to feed horses; excess was used for cattle or sold. As horses were used for farming and transportation, feed crops served a similar purpose as gasoline serves today. Cured meats, ham and bacon were used for winter stocks and could be stored through the summer. To raise hogs, some farmers used slash and burn to clear vegetation, and then sowed wheat. The hogs were turned out on the mature wheat, and ate acorns in the fall. The selected hogs were butchered in the fall and cured or sold.

Early settlers brought tobacco seeds over from Virginia and planted them in Lookingglass. The crops were sold, mostly to miners. A.L.J. Todd made pottery (plates, cups, etc.) for sale. Most commodities went to mining camps in the south.

After the 1900s, horticultural ideas came into the area. Prune orchards were one source of income. Once the prunes were dried, they were stored or shipped out in gunnysacks. Vegetable crops were popular in the 1940s to the 1980s. Broccoli, cauliflower, and some melons were grown.

Up until the end of WWII, horses were the primary source for plowing. Mr. A remembers his dad's last work-horses were gone by the early 1950s. He kept one saddle horse until the early 1960s. After the war, steam engines and huge gas engines were more common for threshers and separators. The large machines needed big crews to move and operate, so farmers worked together to get crops processed.

Sheep and angora goats were the main stock up to the 1960s. Sheep were raised for wool and mutton, while angora goats were raised for the valuable coat. Cattle were introduced when settlers first came into the area. There were not many, but always some. In the late 1950s – early 1960s, there was a shift from sheep to cattle. Cattle required tougher fences. At one time, there were three dairy farms (two in Lookingglass and one in Tenmile), but due to new environmental laws, the dairy farms did not survive.

In the late 1940s, early 1950s, many people began to favor small acreage farms with just a few head of stock. Large, industrial ranches started decreasing and small hobby farms began to show up.

<u>Timber</u>

After WWII (1945-1960), the timber industry became a big part of the watershed. Mr. A. joked, there was a "little sawmill behind every stump!" Logs were yarded to a nearby sawmill where the sawdust collected in huge piles. Diesel engines ran the mills, and in the early 1950s diesel trucks were used to transport logs. Most of the lumber was shipped to markets outside of Oregon. Behind Mr. A's house, the trees began growing between 1870 and 1880. In the 1950s, they were logged and now the trees are mature enough to harvest again.

<u>Fires</u>

Prior to European settlers, fires were very common in the valley. Lookingglass and Olalla areas have been pretty lucky as there have been no major fires. West of Archambeau Creek, there was a large crown fire in the early 1950s. The fire was quickly contained. The next year, the Hubbard Creek burn swept through the Coast Range up to the Archambeau fire. Since the area had just burned, the potential of a severe fire sweeping into the valley was avoided.

<u>Erosion</u>

Erosion has decreased greatly over the years because farmers no longer plow their fields. Permanent pastures that do not require plowing have taken over the valley. Erosion from logging and road building is not as extreme as years past. County and private roads are much more common and must cause some sedimentation. Olalla and Tenmile Creeks have always been muddy streams; that is the geology and soil of the headwaters.

Sediment loads in the stream have not changed much over the years. For appearances, Lookingglass is a nicer stream now than years past because there is more water (Berry Cr. Reservoir), less plowing and run-off, and the livestock waste is spread over a large area. When they were operating, the dairies and hog farms probably caused some water pollution.

Natural landslides have always followed major rain events. In alluvial soils where the stream slows down, creeks can change course and move a lot of sediment when flows are high.

Flooding is a normal occurrence that is not a big issue for most people in the valley, other than requiring a few fence repairs. Flooding has not been nearly as big a problem since the early-mid 1950s. The course of Lookingglass Creek has widened out, allowing it to drain more water. Flooding can undercut riparian trees and cause some to fall into the creek, which can re-route the creek and create large sediment loads. In general, flooding is much less of a problem now than it was in the past.

Streamflow

Lookingglass has always dwindled down to near nothing in the summer. Mr. A asked his dad if he could remember if the creek ever stopped flowing over the gravel bars and he could remember a few times. Due in part to increased irrigation withdrawals, low flow levels are more common.

Ben Irving Dam was designed for flood irrigation into the Tenmile and Lookingglass Valleys. The first choice for locating the dam was on Olalla Creek at Dickerson Rocks. This site was rejected because of the residential population in upper Olalla and the high costs of buying their land. By the time the dam was installed, farms had been broken into such small acreages that the irrigation water could not be delivered into the valley. Instead, the irrigation water is now used to run sprinklers.

Wildlife

Mr. A noted little change in the fish populations over his memory. Fall chinook have always been up and down in numbers; there have always been some steelhead, coho, and never much cutthroat.

In the late 1930s to mid-1940s, there was a plague of digger squirrels (ground squirrels) on the farm. Grain fields were slowly consumed from the borders towards the center, but never completely lost. Over-hunting of coyote, bobcat, owls, hawks, etc. caused a significant decrease in the predator population and allowed the digger squirrels to prosper, much to the dismay of farmers. A plague of jackrabbits was also noted. Mr. A remembers his mom going to the grain field at dusk to shoot them. Now the numbers of digger squirrels and jackrabbits are down to the point that they are a rarity.
Current deer numbers are similar to numbers from a few decades ago. Five years ago the deer populations were very high, though. Some conditions that impact deer numbers

were cougars moving into area, parasites from sheep and cattle spreading to deer (liver fluke), and specific diseases for deer. Elk were never seen when Mr. A was a kid, but recently some have been seen traveling across the ranch. Geese were also never seen, but now they are all over the fields. In general, most wildlife populations have increased. Before the 1940s, people depended upon wild fish and game for protein. Wildlife was not taken only for the sport, but also to supplement family diets.

Mr. B, Lookingglass Valley

In 1942, Mr. B's family moved to Douglas County from Minnesota. Soon after moving to the area, his family moved onto property on Lookingglass Creek. In 1954, the family bought property on Lookingglass Creek and established a sheep ranch.

<u>Changes</u>

The new road was built through their property around 1962-1964. The road changed the river course, caused lots of erosion and moved trees into the creek. The new road was higher and did not flood as easily. Mr. B planted willows along the new stream bank in the 1960s to help stabilize the exposed soil. The creek and tributaries have been straightened for better drainage. When he first moved into the area, there were only about 30 houses, while now there are around 500 places.

<u>Ben Irving Reservoir</u>

When the dam was installed, fish were allowed access throughout the year. Before the dam, the creek near his house would dry up to bedrock. Irrigation from Lookingglass Creek flows back into the creek providing additional year-round flow. Summer water from the dam also keeps the riparian grasses and trees growing on the banks. Before the dam, Mr. B noted that the banks were bare along much of Lookingglass Creek. Now there is more riparian vegetation due to irrigation. Increased vegetation helps to prevent erosion. Blackberries growing along the stream bank also help to control erosion. Now most of the banks on his property are stable.

<u>Industry</u>

Cattle ranching is new within the last ten years. Sheep have been the main livestock in the area and used to be more plentiful than now. Mr. B has raised sheep since 1978. He now has about 140 head. Sheep are better for the streams than are cows, since they do not cause much erosion. At one time, prune orchards were located near the hill slope, but commercial production fell as profits declined. Some of those farms moved to grains and hogs.

Mr. B also noted that in the past, he saw whole trees floating down Lookingglass Creek. These were probably trees cut by loggers incidental to a profitable harvest. In 1964 he remembers many logs floating down with the high flood waters. Now trees of that size are harvested and used, not left for waste.

<u>Pollution</u>

In past years, dairy farms would wash out their barns, and the waste flowed by Mr. B's house. Regarding fertilizer, he mentioned that soil tests have shown that fertilizer stays within the top six inches of soil and needs to be re-applied regularly as plants use it.

Nitrogen needs to be reapplied every 60-90 days. Potash sticks in the soil and really does not move. Today, more pollution per square acre comes from urban fertilizers and herbicides. Urban parking areas and roads contribute more to pollution than agriculture. He also noted that single tests for water quality are insufficient. Several years of information should be considered to determine water quality.

Wildlife

Mr. B noted that he rarely sees trout or salmon after June, until the fall rains. The temperature does not matter during the summer, since the fish are not here. The only time he was able to catch anything was during the out-migration in the Spring. Salmon populations have gone up and down. He feels the real problem with salmon populations is the harbor seals. He noted that the salmon thrived before the dam was in place when there was no summer flow and hot temperatures. Summer conditions are better since the dam was installed. Therefore, the current low flow and warm temperatures on Lookingglass Creek cannot be detrimental to salmon populations.

Beavers build a dam along Lookingglass Creek near his house every year, still to this day. Mr. B noted that since the 1950s, the deer populations have increased, but in the last 10 years the populations have decreased. In the last five years, coyotes are much worse than they have ever been. Mountain lions are spotted in the area now. A few have been killed in recent years, while nearly none had been here in the last 50 years.

Mr. C, Olalla Valley

Mr. C and his family have lived on Hoover Hill since 1958.

History

Olalla is the Chinook language for “berry” or “food.” At one time, there was an Olalla Reservation, but the Umpqua Indians pushed them out. A friend of Mr. C’s grandfather was able to buy his farm with bounty money from killing Olalla Indians (~1870s).

During the 1870s and 1880s, the community of Horse Prairie existed above Upper Olalla. Mr. C showed us a glory hole off of Byron Creek Road. Chinese miners washed out the area looking for gold. Now a large pond covers the area. The stage line ran up the hill along where the present Hoover Hill road runs today, with a stage stop at the bottom of the hill, near Highway 42.

In some places, Olalla Creek has been scoured down to bedrock by early misuse. In the 1820-1830s, the Hudson Bay trappers stripped beavers out of the area. Without beaver dams, water moved through the system more quickly and gravel remained suspended until well downstream. Another misuse was cofferdams. A cofferdam was established on Thompson Creek for mining. Cofferdams slow down water velocity upstream, but allow miners to remove all of the cobble and gravel in their search for minerals.

Mr. C tells a story of landowner Charlie Wilson on McNabb Creek. Mr. Wilson was raised in the town of Upper Olalla and drove a stage coach up Hoover Hill Road at the turn of the century. His family caught silvers in the 1920s and 30s with hay hooks until their arms were too sore to lift a spoon for dinner. The fish were cleaned and smoked.

The heads, tails, and guts were spread across the prune orchards for fertilizer. Mr. C noted some log placement work done along Berry Creek near Dave Menard's property. ODFW probably conducted the project.

One option for dam placement was on Olalla Creek just below Berry Cr. This site was rejected because of a settlement on Upper Olalla and the unstable conglomerate rocks. This dam proposal was in the 1950s and 60s and was abandoned when the Byron Creek Estates subdivision was made in the early 1970s. At that time, there was interest in a 274-foot high earth-filled dam on the South Umpqua at Day's Creek. When that site fell through, the county went back to Olalla Creek. The project was scaled back to what is now the Berry Creek Dam.

<u>Present conditions</u>

The Interspace family lives in an area at the headwaters of Thompson Cr. They have managed to maintain a unique community over the years and practice alternative methods in building designs. This area was an old homestead, the Culver Ranch. It was subdivided and a loose assortment of "hippies" moved up there. It has endured as a community because people can manage their own properties. This provides an adjustment mechanism.

In order to improve watershed health, clear-cuts should be smaller and kept out of draws. Thinning should be used as an option to clear-cutting. The future of forestry will be a few large companies that run everything. Some small two-man operations will still exist.

Mr. D, Olalla valley

Mr. D has lived along the upper reaches of a tributary to Olalla Creek since 1972. His property was part of a government land grant that was settled in 1892 by Richardson. There are still some prune trees on the property. Between 1950 and 1972, there were eight different owners. Since the land is outside of the power grid, he relies on alternative energy systems and springs.

<u>Timber</u>

His land adjoins timber company lands, non-timber private lands, and BLM lands. Some of the BLM land is reserved to connect spotted owl habitat, while a portion of the BLM land is designated as matrix land and was last harvested in 1987. Of the land around him, he recalls 17 large clear-cuts in the last 30 years. In general, he feels that the BLM lands today are managed well, but were poorly managed in the 50s. During that time, clear cuts as large as a section (640 acres) were acceptable. Those practices probably damaged fish habitat and facilitated population declines. Most of the forests in the watershed have been cut over at least once. Burning slash piles in the spring is also a common practice of industrial timber harvest. Most big mills have been re-tooled and can no longer process large diameter trees. Sustainable harvest certification from the Forest Stewardship Council / Smartwood is an option for timber companies. This international group reviews many biological and socioeconomic factors to determine if the timber harvesting process is sustainable.

Private industrial timberland is harvested too intensively and replanted with only Douglas fir, rather than diverse site-specific selections. Small landowners are able to selectively harvest smaller units and replant a variety of trees. When Mr. D harvests timber on his property, he is careful to keep some shade on young trees. He also tries to follow site-specific planting plans that are diverse in species. Industrial timber companies strive for the most profit and often look to Douglas fir; this is not possible in some areas, though. Currently, the Forest Practices Act has led to a decrease in the amount and size of clear cuts. Rules require buffers on streams, while some buffers were cut before the act.

Fire

Mr. D has found Native American artifacts on his property. There is also evidence of regular fires. Some of the trees are old (oak five feet in diameter and Douglas fir trees between 350 and 500 years old) and show several years of fire scars. In the last 30 years, there have been no big fires. Fuel loads are too high in the forest. In 1987, a forest fire started from lightening and came near to his house. Fire breaks and fuel reduction kept the fire from getting too close. Mr. D is worried that other homeowners down Byron Creek are not aware of the hazards from living so close to the forest. One home even had shake shingles for roofing up until the last few years. More education and funding are needed on methods to reduce the risk of forest fires.

Fish

Mr. D notes that cutthroat up Byron Creek are more abundant now than years past. Anadromous fry have been found as far up as three miles from Olalla Creek. He led the effort on an instream restoration project in an attempt to recruit gravel, improve spawning and rearing habitat. He had USFWS funds and support from local stakeholders. One local timber company offered free root wads to the project. Of the 14 landowners involved, only four were very interested and the others were hesitant. The 10-year commitment required by USFWS combined with a concern for blown out bridges led to the indefinite postponement of this project.

Upper Thompson Creek is a unique area due to the serpentine rock. The Culver Ranch was developed on Upper Thompson Creek in1904 and later sold to several individuals.

Riparian Vegetation

With the growth of Byron Creek estates, some trees have been removed to create pasture. However, most of the residential changes have been small scale. In general, riparian vegetation has improved. Noxious weeds are a concern in the area. He has been trying to remove fescue that was once planted to provide pastureland. To control fescue, he has burned the grass and wetlands in the winter. More landowner education is needed to control invasive species, expand riparian vegetation, and conserve water.

Mr. E, Lookingglass Valley

Mr. E has lived in the Lookingglass area for 14 years and owns about 40 acres, some of which is along a tributary to Lookingglass Creek. He has preserved a riparian buffer along the creek. Over the last 16 years, only two summers were so dry that there was no flow in the creek; these were the last two summers. Pools of water are still present throughout the dry summers and provide habitat for juvenile salmonids. There are always small fry in the creek, and neighbors have seen a few adults spawning. The gravel bars seem to be getting better. A few years ago, there were many pools created by beavers. The pools provided summer habitat and cool water. The flood of 1996 caused some bank cutting on his property, but the vegetation and gravel bars are coming back. The flood came into his field and reached the highest level many of his neighbors had seen.

Summer flow, ponds

The biggest water problem Mr. E sees is the summer low flow rate and high temperatures. There is some high sediment and turbidity, but the water is generally clean and free of contamination. Some small water impoundments that could release water throughout the summer would offer better summer habitat for salmon. The impoundments should be placed on private land that is held by the landowner without plans for immediate timber harvesting. For land that is intensively managed for timber, impoundments are probably not practical. Reducing the amount of water used for irrigation really is not a feasible option.

If city water were available, there would be less strain on minor creeks. The Umpqua Basin Water District has discussed bringing water out to the area. Each time the topic came up, the user prices got higher. Before long, landowners felt prices were too high and trust was too low for any progress. Now, the best option would be for a group of landowners to meet and find grant money for the project. Many landowners are interested in getting city water, but feel that without some outside funding, the costs are too high. There was some talk of pumping water from Ben Irving Reservoir over to the Flournoy Valley area. The project would have cost around one million dollars, but fell through.

Project prioritization

For future culvert projects, organizations should focus on the first culverts salmon come across. Rather than replacing culverts high up in a stream, organizations should start at the main stem and work their way up to the headwaters.

Timber

About four years ago, the regulations and permit process for cutting trees changed, and many landowners took the opportunity to harvest trees before the changes. As a result, lots of forests were cut. If policies that limit tree cutting on public lands continue, the price of wood is going to go so high that many small woodland owners will start to harvest. Rural areas would then provide the main source of timber, while public forests remain intact. This could impact the water and streams. There has been some logging on Weyerhaeuser land above Flournoy Valley in the Callahans. That harvest has not seemed to cause any water quality problems.

Development

Mr. E has noticed the development of residential areas in Lookingglass. Land that was not highly productive was subdivided into lot sizes of five acres. There has not been much development other than this area. Some of the farms that were once subsistence agriculture have been sold and turned into hobby farms (the owner works in urban areas and keeps farmland and stock as a hobby). Many people are small woodland owners also. Near his home, there are not many houses along the creek and they do not contribute much to stream pollution. Residents use septic systems and have large plots of land to filter possible pollutants. There is very little fertilizing carried out that could pollute the water. Riparian planting, especially with conifers, throughout the entire Lookingglass valley could help water temperature.

Many local landowners are suspicious of government agencies. Some landowners will not even let government employees on their property. Years of broken promises have created the present situation.

For agency officials to work with a landowner, they must offer the landowner a way out. If someone is forced into a situation, collaborative work will not be accomplished. Mr. E has allowed ODFW staff to conduct salmon spawning surveys, with conditions. If those conditions are not met, he will exclude ODFW staff from his property in the future. Both parties could agree to this, and it gives the landowner a way to get out of the situation. The spawning surveys continue without problem, even though ODFW has not yet shared their findings with local landowners.

Mr. F, Lookingglass Valley

In 1972, Mr. F bought some property in Lookingglass Valley that had been a sheep pasture in the 1950s. There were few conifer trees and many hardwood trees (especially oak and madrone). There are some apple trees on his property that may have been from a settler who spread apple seeds throughout the valley. He began converting the land to a conifer woodlot and planted trees on his property. He began constructing roads to access and better manage his property in 1976, and a barn for storage in 1995. Even though he has a great view, he plans to keep his land as a woodlot and does not plan to develop a home site. Professionally, Mr. F has worked in various positions focused on managing natural resources and forests.

<u>Vegetation</u>

Mr. F is a very active woodlot manager. He deals with noxious weeds (including Scotch broom, thistle and blackberry) through manual pulling, spraying and mowing. Trees that have been planted include ponderosa pine, KMX pine (knobcone pine and Monterey pine cross), incense cedar and Douglas fir. The riparian area on his property is protected from livestock by a 1400-foot fence funded by the UBWC and ODFW. Beavers nearly caused some problems by falling trees across the future fence line. Erosion along the stream is a big problem. The streambank on one side of his property (about 420 feet) is a vertical wall of dirt about 15 feet high. When waters rise and churn, more soil slides into the creek. He is working with the Douglas Soil and Water Conservation District to develop an erosion control project.

<u>Road decommissioning</u>

Mr. F has professional experience and a clear view of road construction and maintenance in forest areas. Roads are vital for management of land. Looking at the finances, decommissioning roads makes no sense. The BLM has invested $40,000 per mile of rocked road. In order to decommission that same road it may cost from $20,000 to

$100,000 per mile. If unpaved roads are constructed and maintained appropriately, many problems can be prevented. Natural slide areas should be considered when constructing a road. Water bars are an important part of the road and need to be maintained to remove the sediment that fills them in. The outfall needs to be maintained to ensure that the bank is not being cut away and eating into the road. A crew with several workers and one road engineer could easily conduct maintenance in the wintertime. There are only two or three storms a year that cause problems. Rather than spending the increased money to decommission a road, land managers can keep roads in good shape through proper maintenance, water control, and traffic control in muddy conditions. However, without timber sales on federal land, there is little money available to maintain roads. Mr. F noted that BLM roads are not public property, but are often misused by the public. One common issue associated with roads is compaction, but it is very difficult to compact a road to the point that a tree could not grow. Another common issue is the sediment load, but 80% of the sediment in a stream is from the streambank. Roads are a minor contributor.

When Mr. F was working on his property roads, he had an excavator available and wanted to build a pond. The pond would have held water year-round and been available for fire suppression and wildlife. A permit application was filed, but an environmental group in Portland filed a complaint, which led to postponement of the project. The fee to file a complaint was only $25 at the time. Environmental groups could file dozens of complaints before taking the time to consider each project. Now the fee to file a complaint against an application is $200. Groups that file complaints are more likely to focus on the merits of a project and not file blindly. The process and the lost opportunity of the excavator have deterred him from trying to revisit the project.

Future

In the future, cattle should be fenced out of the creeks and feedlots should be moved well away from creeks. Streambank erosion is a problem which needs to be addressed. There is also still some junk left in Olalla Creek from previous erosion control efforts that needs to be cleaned up. DEQ standards are not realistic for all streams and too rigid to account for geographic variations. The overall watershed conditions should be evaluated to more accurately determine the limiting factors of a stream. Large wood in a stream is not always a good thing, and the effectiveness needs to be evaluated. Future projects should have measurable results and should be evaluated.

Mr. G, Olalla Valley

Mr. G's family moved to their property on a tributary to Olalla Creek in 1934. A home was previously constructed on the property in 1919. To get vehicles up to the house, Mr. G's parents built an improved road by hand with a pick and shovel. His parents brought walnuts from Kansas and planted trees, which still survive. They also ran about 135 sheep, 40 goats and cows in later years on open range. Mr. G recalls stories of three mines on a drainage near his property. They used water from his tributary in a ditch over to the mine. In the 1930s to 50s, there were sawmills along many of the creeks, including Olalla Creek. Many of the forests that some people considered "old growth" are actually forests that were clear-cut and replanted in the 1950s. Mr. G noted that the land downstream, plus a ranch in the valley was subdivided around 1973-74. Some people that moved into the area did not understand the issues of living in rural areas.

Logs jams were removed from the creek in the past. Now, Mr. G is allowing the branches and logs to stay in the creek and even adding branches to the jams. He has found that white fir and alder deteriorate more quickly than the Douglas fir in log jams. Log jams are effective at collecting new gravel behind the jams. Some of the older gravel bars are now covered with vegetation. In the 1960s and 1970s, beavers worked their way up the tributary and destroyed many trees. Mr. G remembers large log jams with big pools along the tributary. One summer, a log jam near his house held a good-sized steelhead. The floods of 64-68 cleaned most of the remaining logs out.

Summer drought

Over the last two years, the tributary has stopped flowing during the summer. Small pools remained in some areas, but there was no flow between them. These two summers are the only in the family's memory where the water has been so low. The first year of the drought, Mr. G's family moved one trout from a shrinking pool to a larger nearby pool. Before the drought, there were many trout, but he has not seen any in a while. The drought has caused a decline in the number of crawdads and snails. The drought has also led to the death of many trees throughout the drainage. Alder and willow along the creek and fir trees further up the hill are dying. OSU extension agents say the cause is drought conditions allowing insects and disease to spread. So far this spring, the moss and snails seem to be returning.

The impact of rain in the upper drainage is significantly different compared to the valley. When two to three inches of rain fall over a short period, the small creeks flood and the streambanks erode, while the valley really does not notice a change. However, when there is a long, steady rainfall, the small creeks do not seem to be impacted, while the valleys flood.

Wildlife

Mr. G has no stock now, but wants to start running some goats. There are many raccoons, some elk traveling through, and a neighborhood bear. Deer numbers have dropped in the last five to ten years. There have been some cougar tracks around. Coyote used to be more common. A virus in 1972 (shared with dogs) has wiped out the coyotes. There are more birds around now, but he admits to giving them a good supply of food! He does not remember fish carcasses up to his house. Neighbors downstream see coho spawning every year.

Future conditions

Mr. G is concerned about the blackberries that are spreading across the property. As more urban people move into the forested areas near his property, he is more worried about a fire sweeping up the drainage. He is also concerned with erosion and has planted willow along the creek.

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.

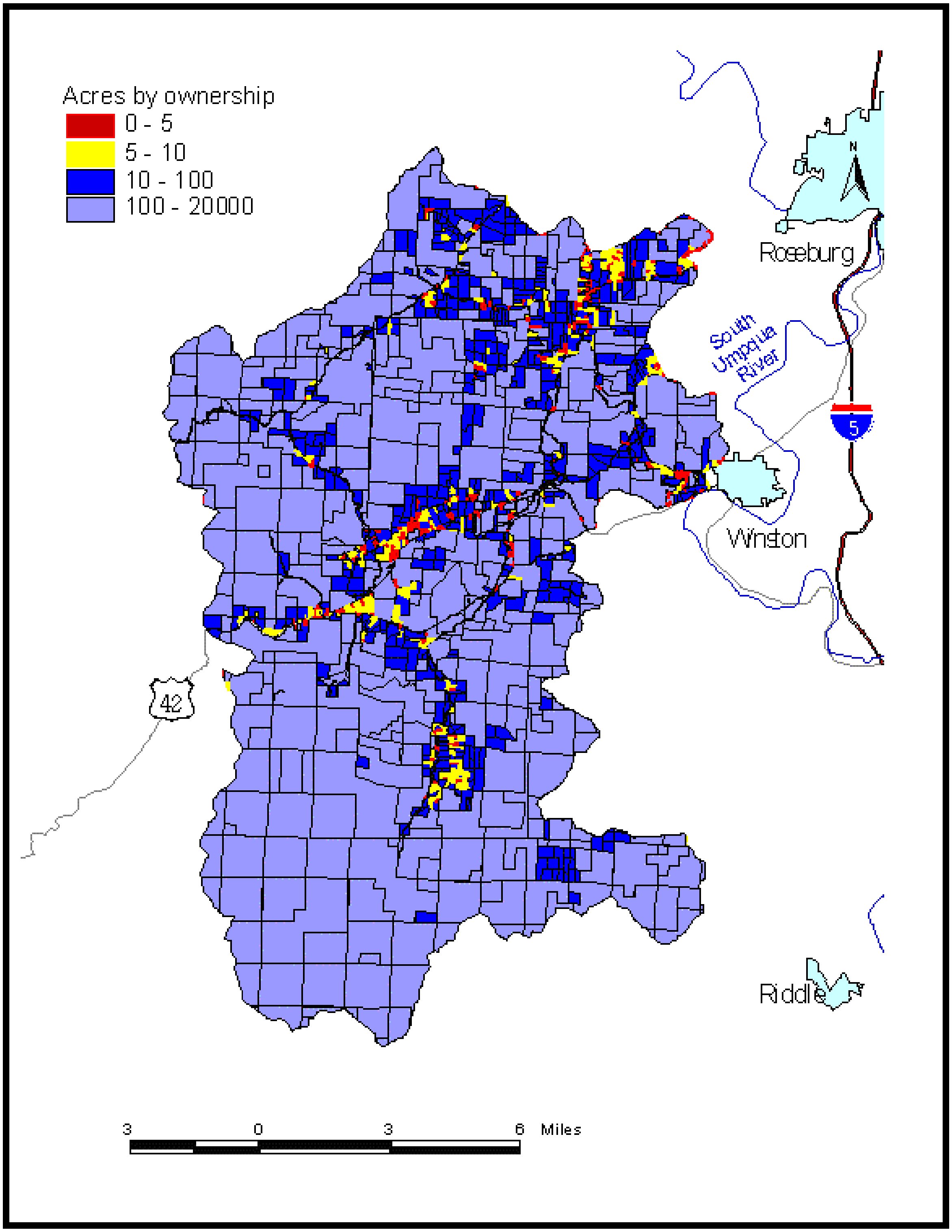
Key Questions

- 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 does not 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 as the length of the stream included in the project increases. 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 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 Olalla / Lookingglass Watershed. Unlike Map 1-12 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 Olalla / Lookingglass Watershed, such as Morgan Creek and upper Tenmile Creek, which mostly run through larger ownerships, maybe good candidates for large-scale stream habitat restoration projects. Other streams that mostly consist of smaller ownerships, such as lower Tenmile Creek, should be considered for smaller-scale restoration and enhancement activities, and for landowner education programs.



Map 6-1: **Ownership size by acres**

6.2 Key findings and action recommendations

6.2.1 Stream functions

Stream morphology key findings

- The majority of streams within Olalla / Lookingglass 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 limit instream large woody material abundance. Different enhancement opportunities exist for each stream type.
- The low gradient channels with wide floodplains along Lookingglass Creek and the lower reaches of tributary streams are dynamic systems that provide key fish migration, spawning and rearing habitat.
- Depositional environments such as moderately confined channels with small floodplains are vulnerable to reductions in aquatic habitat complexity. In these areas, pools can be filled in and boulders or exposed bedrock buried when the sediment load exceeds the transport capabilities of the stream.
- Stream habitat surveys suggest that poor quality riffles and insufficient large woody material are limiting factors for fish habitat in most surveyed streams. Pools and riparian areas also limit fish habitat, but to a lesser degree.

Stream connectivity key findings

- Culverts and dams reduce stream connectivity, affecting anadromous and resident fish productivity in the Olalla / Lookingglass Watershed. More information about fish passage barriers will be available in 2003.

Channel modification key findings

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

Stream function action recommendations

- Where feasible, improve pools, collect gravel, and increase the amount of large woody material by placing large wood and/or boulders in streams with an active channel less than 30 feet wide.
- Encourage land use practices that enhance or protect riparian areas:
  - Protect riparian areas from livestock-caused browsing and bank erosion by providing stock water systems and shade trees outside of the stream channel and riparian zones. Fence riparian areas as appropriate.
  - Plant native riparian trees, shrubs, and understory vegetation in areas with poor or fair riparian 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. For example, culvert replacements should emphasize the low gradient channels (3% or less), especially the lower ends of tributary streams entering Lookingglass Creek.

- o Increase landowner awareness and understanding of the effects and implications of channel modification activities.

6.2.2 Riparian zones and wetlands

Riparian zones key findings

- Throughout the watershed, riparian vegetation is 44% hardwood and 39%. Lookingglass Creek and the Morgan Creek tributaries are around 60% hardwood. The tributaries flowing into Olalla Creek are over 60% conifer. There is much variation among specific tributaries.
- Riparian buffers that are two or more tree widths are most common in Olalla / Lookingglass Watershed. Tributary conditions vary from buffers that are greater than two tree widths over 67% of the Olalla Creek tributaries to over 30% treeless areas along Lookingglass Creek. Olalla Creek and Lookingglass Creek tributaries have approximately a quarter of riparian zones without trees.
- For percent cover, Lookingglass Creek is just over 10%, Olalla Creek is approximately 50% and all other tributaries are close to 80% covered.

Wetlands key findings

- Wetlands improve water quality by trapping sediments, removing nitrogen, retaining phosphorous, and regulating stream temperatures.
- Stream associated wetlands are the dominant type of wetland found within the Olalla / Lookingglass Watershed, and are typically confined to active channels.
- Narrow riparian zones have been maintained along many of the streams in the watershed, although some are more substantial than others.
- Historically, riverine and palustrine wetlands associated with stream channels, floodplains, and riparian zones were abundant in lowland valleys, where they had a hydrologic connection with a nearby stream. Wetlands located within the Olalla / Lookingglass Watershed were very productive, supported a variety of plant and animal life, and were very dynamic ecosystems.

Riparian zones and wetlands and action recommendations

- o 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 ones for which more than 50% canopy cover is possible.
- o Identify riparian zones dominated by blackberries and convert these areas to native trees (preferably conifers) and/or shrubs, depending on local conditions.
- o Where riparian buffers are one tree width or less, encourage buffer expansion by planting native trees (preferably conifers) and/or shrubs, depending on local conditions.
- o Investigate methods of controlling blackberries.
- o Maintain riparian zones that are two or more trees wide and provide more than 50% cover.
- o Provide information to landowners explaining the benefits of restricting livestock access to streams, establishing buffer zones, the importance of wetlands within watersheds, and the impacts 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.
- Increase public awareness of wetland functions that relate to wildlife habitat, endangered species preservation, aesthetic appeal, and water quality.

6.2.3 Water quality

Temperature key findings

- Monitoring locations within the watershed indicate that some streams within the Olalla / Lookingglass Watershed often have seven-day moving average maximum temperatures exceeding the 64°F standard during the summer. High stream temperatures may 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 would 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 key findings

- Temperature and the levels of pH, nutrients, and dissolved oxygen are interrelated. Available data suggest pH is not a concern.

Dissolved oxygen key findings

- ODEQ data are limited. Of the seven samples, only one was below the 8.0mg/l standard.
- Dissolved oxygen levels fluctuate throughout the day and more monitoring is needed to determine the potential impact on aquatic life.

Nutrients findings

- For total phosphorus and total nitrates, ODEQ samples were below the recommended values set by OWEB.

Bacteria key findings

- Two samples taken during a high flow event in March 2002 exceeded the measurable limit of 2419/100ml, well over the standard.
- More monitoring should be done to assess the presence of coliform and the impact on recreation.

Sedimentation and turbidity key findings

- Turbidity data evaluated using OWEB standards did not indicate that usual turbidity levels are high.
- Sediment delivery from improperly drained dirt and gravel roads are a primary source of sediment generation within most Oregon watersheds, which may be the case in the

Olalla / Lookingglass Watershed. Slope instability, streamside fires, and some land management activities are possible sources for sediment production and delivery.
- Areas of moderate to high soil erodibility and runoff potential lie in a large portion of the northern half of the Olalla / Lookingglass Watershed.
- Steep to moderately steep slopes are found through the watershed, and dominate the topography of the southern half of the watershed.
- The combination of steep slopes and poorly managed, erosion-inducing human modifications such as roads, timber harvesting, agriculture, and residential development can make areas prone to greatly increased erosion.

Toxics key findings
- Very little data are available for toxics in the Olalla / Lookingglass area, however ODEQ has tested for Arsenic and found no measurable levels.
- Continued testing for toxics is needed to determine if any problem exists.

Water quality action recommendation
- Continue monitoring the Olalla / Lookingglass 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, if needed, improve in-stream 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 point and non-point 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 observation suggests that stream sediment or turbidity levels are of concern, survey the vicinity to identify possible on-going sediment sources, such as urban runoff, failing culverts or roads, landslide debris, construction, or burns. Take action to remedy the problem if possible.
- Obtain comprehensive map coverage of the 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, especially on dirt and gravel roads.
- Use proper management practices (such as controlling road runoff from improper drainage) to control erosion in sensitive areas of the watershed.

- o Complete an original, detailed landslide identification study on time-sequence aerial photography to identify sensitive and disturbed areas.
- o Use proper management practices in areas with high debris flow hazards and with soils that have high K factor values and are in the C or D hydrologic group (primarily the northern half of watershed).
- o Promote enhancement of native vegetation through restoration and streambank enhancement wherever such projects are feasible.
- o Limit stream channel and bank modifications.
- o Provide landowner education about water quality concerns and potential improvement methods, such as how to improve dirt and gravel road drainage to minimize sediment delivery to streams.
- o Use the refined debris flow hazard data (soon available at Nature of the Northwest in Portland) to identify landslide-sensitive areas.

6.2.4 Water quantity

Water availability and water rights by use key findings

- During July, August, September and October, the consumptive use is nearly the same as the average streamflow. Instream water rights exceed average stream flow from the beginning of September through most of October.
- The largest uses of water in the Olalla / Lookingglass Watershed are irrigation in the summer and storage in the winter.

Stream flow and flood potential key findings

- During the summer months, streamflow can drop down to less than five cfs. It is not unusual for stream reaches to have zero flow.
- No flooding trends can be determined from the records to date.
- The degree to which road density and the transient snow zone influence flood potential in the Olalla / Lookingglass Watershed is unknown at this time.

Water quantity action recommendations

- o Reduce summer water consumption through in-stream water leasing and by improving irrigation efficiency.
- o 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.

6.2.5 Fish populations

Fish populations key findings

- The anadromous fish species in the Olalla / Lookingglass Watershed are steelhead, coho salmon, chinook salmon, cutthroat trout, and lamprey. Although many medium and large tributaries are within the distribution of one or more salmonid species, 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 South Umpqua River, but these species may occasionally enter the mouth of Lookingglass 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:
    - Improving irrigation efficiency and encouraging instream water leasing on Lookingglass Creek, Olalla Creek, Morgan Creek, and Tenmile Creek.
    - Developing projects on the following streams:
        - Applegate Creek – plant riparian areas, monitor high nutrient loads (lower half), encourage WQ monitoring underway by Wildlife Safari (no anadromous fish above Heart Lake).
        - Archambeau Creek – fence and plant riparian areas, inventory barriers, provide educational opportunities on management of stock (especially horse) wastes.
        - Bear Creek – research erosion and sediment load issues (no anadromous fish).
        - Berry Creek – research erosion and sediment load issues (no anadromous fish above dam).
        - Berry Creek Reservoir – research effect of turbidity on fish, provide educational opportunities on the cause/effect of turbidity (no anadromous fish).
        - Bushnell Creek – enhance stream with woody debris, inventory barriers, work with community group on culvert replacements.
        - Byron Creek – enhance stream with woody debris, fence and plant riparian areas (lower half), monitor impact of past instream projects.
        - Byron Creek, North & East Fork – enhance stream with woody debris, inventory barriers.
        - Coarse Gold Creek – enhance stream with woody debris, monitor water quality at mouth, inventory barriers, determine fish presence (BLM and RFP owned).
        - Flournoy Creek – fence and plant riparian areas, promote off-channel stock management, convert blackberry to riparian vegetation (lower half).
        - Larson Creek – determine fish presence, fence and plant riparian areas, inventory barriers, restore natural meander of creek.
        - Little Muley Creek – enhance stream with woody debris, inventory barriers.

- Lookingglass Creek – fence and plant riparian areas, promote off-channel stock management, convert blackberry to riparian vegetation, establish erosion control measures, provide educational opportunities on stock management.
- Lookingglass Creek, unnamed tributary at northernmost bend – determine fish presence, inventory barriers and channel modification, fence and plant riparian areas, monitor water quality.
- McNabb Creek – fence and plant riparian areas, convert blackberry to riparian vegetation (lower half), promote off-channel stock management, inventory barriers.
- Morgan Creek – fence and plant riparian areas, convert blackberry to riparian vegetation (lower half), promote off-channel stock management.
- Muns Creek – determine fish presence (upper half).
- Olalla Creek – fence and plant riparian areas, promote off-channel stock management, inventory barriers, convert blackberry to riparian vegetation (lower half), enhance stream with woody debris (upper half).
- Perron Creek – fence and plant riparian areas, promote off-channel stock management, convert blackberry to riparian vegetation (no anadromous fish, wheelchair accessible pond for fishing).
- Porter Creek – inventory barriers, fence and plant riparian areas, promote off-channel stock management, convert blackberry to riparian vegetation (lower quarter), enhance stream with woody debris (upper three-quarters).
- Rock Creek – enhance stream with woody debris, inventory barriers, fence and plant riparian areas (include tributaries with planting).
- Shields Creek – fence and plant riparian areas, promote off-channel stock management, inventory barriers, convert blackberry to riparian vegetation (lower half), enhance stream with woody debris (upper half).
- Strickland Canyon unnamed tributary (3&4) – fence and plant riparian area (lower 1/3), inventory barriers.
- Suicide Creek – partner with youth groups on projects and education events (portion owned by Boy Scouts of America), inventory barriers, determine fish presence, monitor BLM culvert replacement project (upper half).
- Tenmile Creek – determine fish presence, inventory barriers, fence and plant riparian area, promote off-channel stock management, establish erosion control measures, convert blackberry to riparian vegetation (lower half), enhance stream with woody debris (upper half).
- Thompson Creek – promote as a significant and unique watershed, protect traditional wetland areas, plant riparian areas with conifers, enhance stream with woody debris, inventory barriers (natural barrier with isolated fish population in upper half).
- Wildcat Creek – inventory barriers.
- Willingham Creek – inventory barriers.

2. Working with interested landowners on a case-by-case basis on the following project types:
- Improving instream fish habitat in areas with good riparian zones and an active channel that is less than 30 feet; and
- Enhancing and/or protecting riparian zones and wetlands to improve wildlife habitat, fish habitat, and water quality conditions; and
- Conducting landowner interviews and writing a comprehensive historical account of the Olalla / Lookingglass Watershed.

3. Developing 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.
- Providing educational materials at Ben Irving Reservoir explaining the causes of turbidity in water.
- Creating an educational outreach program targeted at livestock owners to encourage management of stock waste.
- 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.
- Promoting the benefits of wetlands through outreach.
- 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. Supporting local fish habitat and water quality research:
- Training volunteers to conduct fish and water quality monitoring and research.
- Providing equipment necessary for local water quality research.
- Continuing water temperature studies and attempting to correlate temperature to fish presence.
- Inventorying fish passage barriers and presence/absence in all streams.
- Surveying long-term landowners and residents about historical and current fish distribution and abundance.
- Encouraging school and student participation in monitoring and research.

5. Enlisting landowner participation to remove other fish passage barriers as identified. Work with landowners to eliminate barriers to fish passage at the following locations:
- Lee’s culvert on Archambeau (west side of Flournoy Valley)
- Bushnell Creek culvert identified by community group
- Culvert on Upper Tenmile tributary after F. Fork
- Strickland Canyon unnamed tributary – two possible culvert obstacles.

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Appendices

Appendix 1: Geologic overview, references, and glossary[104]

The geologic history and current setting of any watershed is critical to understanding natural resource issues within it. In Oregon, geologic processes have created a unique and varied landscape throughout the state. In southwestern Oregon, the history of the landscape is dominated by the collision of western North America with the floor of the Pacific Ocean and fragments of Earth crust lying on it. This report summarizes the geology and geomorphology of the Olalla / Lookingglass Watershed.

Geologic History

Overview of Plate Tectonics

The geologic history of southwestern Oregon is dominated by plate tectonics. The crust of the Earth is a thin veneer of solid rock material that rides on partially molten rocks (the mantle) beneath it that flow as a result of convection heat cycles caused by the radiation of heat from the core of the Earth. The crust is composed of continental crust and oceanic crust. Continental crust is relatively lighter than oceanic crust due to its mineralogical characteristics, and thus floats higher on the mantle relative to oceanic crust, resulting in its position above sea level. The crust is broken up into plates, and these plates can move apart, collide, or shear against one another at their borders (Press and Siever, 1994). As one could imagine, the movement of such large plates of earth often results in many local-scale complexities that are difficult to understand without an appreciation for the large-scale processes. Geologic processes that occur at the boundaries of crustal plates result in certain characteristic geologic formation types. At colliding boundaries like that along the northwest coast of the United States, geologic processes result in the rise of coastal mountains, the formation of a volcanic chain approximately 100 miles inland, and accretion of islands to the edge of the continent (Alt and Hyndman, 2001; see glossary for definitions of terms). These processes result in a varied landscape and an often highly deformed and sometimes confounding set of rock formations. The geologic story of the Umpqua Basin follows the plot of a typical collision of the ocean floor with a continent, with its own unique elements.

Setting the Stage for Continental Collision

In the late Triassic and early Jurassic (**Error! Reference source not found.** for relative time scale), the North American continent started moving westward across the Earth, and in doing so, collided with the oceanic crust underlying the Pacific Ocean. This began the long process of subduction that has been occurring ever since. As oceanic crust collides with a continent, the oceanic crust descends, or subducts, beneath the continental crust due to its greater density. At the collision point, a trench forms, creating the setting for a great deal of deformation of sediments. As the ocean floor subducts, continental shelf and slope sediments that had been deposited off the shore of the continent are scraped off the underlying ocean crust and shoved into the edge of the continent. Islands or other belts of rocks that were associated with the oceanic plate collide into the continent and, because they will not sink, accrete to the edge of the continent (Alt and Hyndman, 2001).

[104] Kristin Anderson, BioSystems Consulting, contributed this Appendix. Terms such as “Jurassic” and “Cretaceous” refer to periods in the geological/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.

Geologic timeframe from most recent (top) to oldest (bottom)

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		

Klamath Mountains History

The Klamath Mountains of Oregon were formed by the collision of many different belts of rocks, or terranes, into the continent over time ranging from the late Triassic to the late Cretaceous. Some of these rocks formed in an open oceanic environment, while others formed in a coastal environment. Volcanic islands crashed into the continent. Sediment that was constantly being deposited by rivers onto the continental shelf and slope were just as constantly being shoved onto the edge of the continent as they rode east on top of the oceanic floor. This accretion of many terranes and the intense faulting that occurs at the plate collision boundary makes the geology of the Klamath Mountains highly complex. Each terrane has distinct rocks and fossils. In the Olalla / Lookingglass Watershed, metamorphic rocks and a chunk of oceanic crust of Jurassic age were incorporated in the landscape. Younger marine sedimentary rocks of Jurassic/Cretaceous age were later accreted onto the edge of the continent and now lie in a part of the watershed. In the beginning stages of the formation of the Klamath Mountains, the province was located much farther east than it is today. It rotated into its current position by the early Cretaceous, and has been relatively stable since. Today, the contacts between the terranes are orientated in a southwest-northeast trend (Orr and Orr, 2000).

Coast Range History

The Coast Range began with a core of volcanic rocks that had likely formed as a volcanic island chain, and then collided with the continent. The Tertiary age Siletz River volcanics in the Olalla / Lookingglass Watershed are part of these core rocks. The accretion of these volcanics with North America added about a 50 mile width of land to the continent, and created a forearc basin between the volcanic chain an the continent that received vast amounts of sediment deposited in a marine setting during the Eocene and

Oligocene epochs. Ash from the forming Cascades to the east was also deposited in the basin. The subduction of the ocean floor beneath the continent was displaced westward, where a new trench was created after the old one was abandoned; this new trench is the modern trench today. In the Miocene, the sea retreated and the coastal mountains uplifted, as a large thickness of lighter sediments had accumulated (Orr and Orr, 2000). In the Olalla / Lookingglass Watershed, most of the geologic units are marine rocks formed by deposition in the forearc basin.

Resulting Geologic Units within the Olalla / Lookingglass Watershed

According to Walker and MacLeod (1991), there are ten geologic units within the Olalla / Lookingglass Watershed, ranging in age from Jurassic to Quaternary (see Map 1-7). The Tertiary age units are typical of Oregon Coast Range rock formations, while the Cretaceous and Jurassic units are typical of Klamath Mountain rocks (Orr and Orr, 2000). The oldest rocks in the watershed are rocks of the Klamath Mountains. Jurassic ophiolite sequences (Ju), or oceanic crust incorporated into the continent are found in the far southeast reach of the watershed. The Jurassic Otter Point Formation (Jop) is also found in that same area, consisting of highly sheared graywacke, mudstone, siltstone, and shale with some greenstone, limestone, chert, blueschist, and serpentine pods. Rocks of the late Jurassic and early Cretaceous are found to the west and north of units Ju and Jop. The Myrtle Group (KJm) consists of conglomerate, sandstone, siltstone, and limestone, and the Dothan Formation sedimentary rocks (KJds) consist of sandstone, conglomerate, graywacke, and rhythmically banded chert lenses. The bulk of the remainder of the watershed is composed of rocks of Tertiary age. The Siletz River Volcanic rocks (Tsr) of late Paleocene and early Eocene age are part of the core volcanic rocks of the Coast Range and include tuff-breccias, pillow lava, and basalt. The remainder of the Tertiary units in the watershed are of marine origin, having formed in the forearc basin between the Coast Range mostly in the Eocene as described earlier. The Tmsm is a rhythmically bedded marine sandstone, siltstone, and mudstone of the late Paleocene and early Eocene epochs. The Tmsc of early Eocene age consists of cobble and pebble conglomerate, sandstone, siltstone, and mudstone deposited on the continental shelf and slope off shore. The Tmss of middle Eocene age is a marine sandstone and siltstone at least partly of deltaic origin. The Tyee Formation (Tt) of the middle Eocene is a thick sequence of rhythmically bedded marine sandstone and siltstone. Photo 1-2 shows a photograph of the scarp of the Tyee Formation looking west from the Flournoy Valley. The youngest geologic units in the watershed are alluvial (stream) deposits of sand, gravel, and silt, mostly in floodplains and channels (Qal). Large areas of Qal exist in the Lookingglass and Flournoy valleys (Walker and MacLeod, 1991).

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Geology Glossary:

These terms are mostly compiled from Allaby and Allaby (1999), Challinor (1978), Jackson (1997), and Orr and Orr (2000).

Accretion: The addition of continental material to a pre-existing continent, usually at its edge and by the processes of convergent and transform motion.

Alluvial: Pertaining to the environments, actions, and products of rivers or streams.

Alluvium: An unconsolidated terrestrial sediment composed of sorted or unsorted sand, gravel, and clay that had been deposited by water.

Banding: Bedding produced by deposition of different materials in alternating layers.

Basalt: A fine-grained, dark, mafic, extrusive igneous rock composed largely of plagioclase feldspar and pyroxene. It is the major rock of ocean basins.

Bedding: The arrangement of sedimentary rocks in layers of varying thickness and character.

Blueschist: A metamorphic rock that has undergone regional metamorphism at low temperatures and high pressures; contains abundant blue amphibole (ferromagnesian silica minerals); usually associated with destructive plate boundary environments.

Breccia: A coarse-grained, clastic rock composed of angular and broken rock fragments in a finer-grained matrix. It is usually sedimentary in origin, but may also be igneous (volcanic breccia).

Calcareous: Any rock which has enough carbonate material so that it reacts with hydrochloric (or any other strong) acid, producing bubbles of carbon dioxide. Usually, the carbonate material is calcite.

Chert: A sedimentary form of amorphous or extremely fine-grained silica, partially hydrous, found in concretions and beds.

Clay: Mineral particles less than four micrometers in diameter.

Conglomerate: A coarse-grained clastic sedimentary rock composed of rounded or sub-rounded fragments larger than two millimeters in diameter and cemented together.

Continental shelf: That part of the continental margin that is between the shoreline and the continental slope. Usually it extends vertically to a depth of about 600 feet. It is the zone where sunlight penetrates and is the most productive area of marine life in the ocean. It is characterized by its very gentle slope.

Continental slope: That part of the continental margin that lies between the continental shelf and the bottom of the ocean. Sunlight does not penetrate this area, and mostly it is home to scavengers. It is characterized by a relatively steep slope.

Convection: Bodily movement of material from one place (usually hotter) to another (usually colder). Often in sub-circular patterns called "convection cells."

Crust: The outermost layer of the Earth. It includes the oceanic crust (about 5-10 miles thick) and the continental crust (50-75 miles thick). The bottom of the crust is the Mohorovicic Discontinuity ("Moho").

Debris avalanche: A fast downhill mass movement of soil and rock.

Deformation: Any change in shape or structure of a rock unit as a result of Earth forces, on any scale.

Delta: A body of sediment deposited in an ocean or lake at the mouth of a stream.

Deltaic: Formed in a delta setting.

Drainage basin: A region of land surrounded by divides and crossed by streams that eventually converge to one river or lake.

Epoch: One subdivision of a geologic period, often chosen to correspond to a stratigraphic series.

Era: A time period including several periods, but smaller than an eon. Commonly recognized eras are Precambrian, Paleozoic, Mesozoic, and Cenozoic.

Erosion: The set of all processes by which soil and rock are loosened and moved downhill or downwind.

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.

Flood plain: A level plain of stratified alluvium on either side of a stream; submerged during floods.

Fluvial: Pertaining to streams and river deposits; produced by the action of flowing water.

Forearc basin: A sedimentary basin, usually elongate, lying between the volcanic arc and the shelf break in a convergent plate boundary zone.

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: A coarse-grained, intrusive igneous rock composed of quartz, orthoclase feldspar, sodic plagioclase feldspar, and micas. Also sometimes a metamorphic product.

Gravel: Sediment grains with diameters between two and 60 millimeters.

Graywacke: A quartz sandstone which includes noticeable amounts of mud and/or mica. Sometimes called a "dirty sandstone."

Greenstone: Compact dark green altered or metamorphosed basic igneous rocks.

Group: Two or more formations in a stratigraphic column which formed by similar events or processes.

Hydraulic conductivity: A measure of the ability of a rock, sediment, or soil to permit fluids to flow through it.

Igneous: Rock or mineral crystallized from partly molten material, i.e. magma.

Intrusion: The process of emplacement of magma in pre-existing rock. Also, the term refers to igneous rock mass so formed within the surrounding rock.

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.

Lava: Magma that has reached the surface through a volcanic eruption. The term is most commonly applied to streams of liquid rock that flow from a crater or fissure. It also refers to cooled and solidified rock.

Limestone: A sedimentary rock composed principally of calcium carbonate ($CaCO2$), usually as the mineral calcite.

Lithology: The systematic description of rocks, in terms of mineral composition and texture.

Lithosphere: The zone of brittle rock between the Earth's surface and the asthenosphere (a zone of ductile deformation about 200 km below the surface). The lithosphere consists of the entire crust and a small portion of the uppermost mantle. It has an ultramafic igneous composition (mostly magnesium, silicon, and oxygen). The lithosphere forms the "plates" of plate tectonics.

Mafic: An igneous rock composed chiefly of one or more dark-colored minerals.

Magma: Molten rock material that forms igneous rocks upon cooling. Magma that reaches the surface is referred to as lava.

Mantle: The main bulk of the Earth, between the crust and core, ranging from depths of about 40 to 3480 kilometers. It is composed of dense mafic silicates and divided into concentric layers by phase changes that are caused by the increase in pressure with depth.

Mass movement: A downhill movement of soil or fractured rock under the force of gravity.

Metamorphic rocks: Rocks altered by heat and pressure causing recrystallization and loss of original characteristics.

Mudstone: A hardened mud; a blocky or massive fine-grained sedimentary rock in which the proportions of clay and silt are approximately equal.

Ophiolite sequence: An assemblage of mafic and ultra-mafic igneous rocks with deep-sea sediments supposedly associated with divergent zones and the sea-floor environment.

Period: A major, worldwide, geologic time unit corresponding to a system such as the Cambrian Period.

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 theory that the Earth's crust is broken into about 10 fragments (plates), which move in relation to one another, shifting continents, forming new ocean crust, and stimulating volcanic eruptions.

Relief: The vertical difference between the summit of a mountain and the adjacent valley or plain.

Rhythmic sedimentation: Cyclic deposition of sediments involving a circuitous sequence of conditions.

Runoff: The amount of rain water directly leaving an area in surface drainage, as opposed to the amount that seeps out as groundwater.

Sand: Mineral particles between 1/16 mm and two mm in diameter.

Sandstone: A detrital sedimentary rock composed of grains from 1/16 mm to two mm in diameter, dominated in most sandstones by quartz, feldspar, and rock fragments, bound together by a cement of silica, carbonate, or other minerals or a matrix of clay minerals.

Schist: A medium- to coarse-grained, foliated (layered) metamorphic rock created by regional metamorphism to medium or high temperatures and shearing pressures. Commonly, schists include quartz, feldspars, and micas, but mineral composition is not an essential factor in its definition. Schists are strongly foliated, with well-developed parallelism of more than 50% of the minerals present.

Sedimentary rock: A rock formed by the accumulation and cementation of mineral grains transported by wind, water, or ice to the site of deposition or chemically precipitated at the depositional site.

Sedimentation: The process of deposition of mineral grains or precipitates in beds or other accumulations.

Serpentine: Rock-forming minerals derived from alteration of magnesium-rich silica minerals; have a greasy or silky luster, a slightly soapy feel, are usually compact, and are commonly greenish in color.

Shale: A very fine-grained, thinly layered sedimentary rock composed of clay and/or silt grains. Shales break easily along their layering, especially along weathered surfaces. They feel smooth to the touch, not gritty.

Shearing: The motion of surfaces sliding past one another.

Silt: Mineral particles between four and 62 micrometers in diameter.

Siltstone: A fine-grained, layered sedimentary rock composed primarily of grains between 1/256 mm and 1/16 mm in size. Siltstones contain hard thin layers. They feel grittier than shales or mudstones.

Subduction: The process of consumption of a crustal plate at a convergent plate margin with one crustal plate descending beneath another.

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.

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

Topography: The shape of the Earth's surface, above and below sea level; the set of landforms in a region; the distribution of elevations.

Trench: A narrow, elongate depression of the deep-sea floor, having steep sides and oriented parallel to the trend of an adjacent continent. It lies between the continental margin and the abyssal plain. Usually it forms the surficial trace of a subduction zone.

Tuff: A consolidated rock composed of pyroclastic (from a volcanic explosion) fragments and fine ash. If particles are melted slightly together from their own heat, it is a "welded tuff."

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

Volcanic arc (also island arc): A curved chain of volcanic islands rising from the deep-sea floor and near to a continent caused by subduction processes and occurring on the continent side of the subduction zone. Its curve generally is convex toward the open ocean.

Volcano: A vent in the surface of the Earth through which magma and associated gases and ash erupt; also, the form or structure (usually conical) that is produced by the ejected material.

Descriptions of geologic units from Walker and MacLeod (1991).
For explanation of terms within this table, refer to Jackson (1997).

Map symbol	Age	Geologic Unit Description
Qal	Holocene	**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.
Tt	middle Eocene	**Tyee Formation**: Very thick sequence of rhythmically bedded, medium- to fine-grained micaceous, feldspathic, lithic, or arkosic marine sandstone and micaceous carbonaceous siltstone; contains minor interbeds of dacite tuff in upper part.
Tmss	middle Eocene	**Marine sandstone and siltstone**: Thin- to thick-bedded, cross bedded, well-sorted, fine- to medium-grain sandstone, siltstone, and mudstone; characterized by sparse fine white mica; shallow marine depositional setting at least partly of deltaic origin. Contains foraminiferal and molluscan faunas of early middle Eocene age.
Tsr	middle and lower Eocene and Paleocene	**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).
Tmsc	lower Eocene	**Marine siltstone, sandstone, and conglomerate**: Cobble and pebble conglomerate, pebbly sandstone, lithic sandstone, siltstone, and mudstone; massive to thin-bedded; shelf and slope depositional setting. Contains foraminiferal faunas referred to the Penutian Stages of early Eocene age.
Tmsm	lower Eocene and Paleocene?	**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.
KJds	Lower Cretaceous and Upper Jurassic	**Dothan Formation and related rocks**: Sedimentary rock, sandstone, conglomerate, greywacke, rhythmically banded chert lenses.
KJm	Lower Cretaceous and Upper Jurassic	**Myrtle Group**: Conglomerate, sandstone, siltstone, and limestone. Locally fossiliferous.
Jop	Upper Jurassic	**Otter Point Formation of Dott (1971) and related rocks**: Highly sheared greywacke, mudstone, siltstone, and shale with lenses and pods of sheared greenstone, limestone, chert, blueschist, and serpentine. Identified as mélange by some investigators.
Ju	Jurassic	**Ultramafic and related rocks of ophiolite sequences**: Predominantly harzburgite and dunite with both cumulate and tectonic fabrics. Locally altered to serpentinite. Includes gabbroic rocks and sheeted diabasic dike complexes.

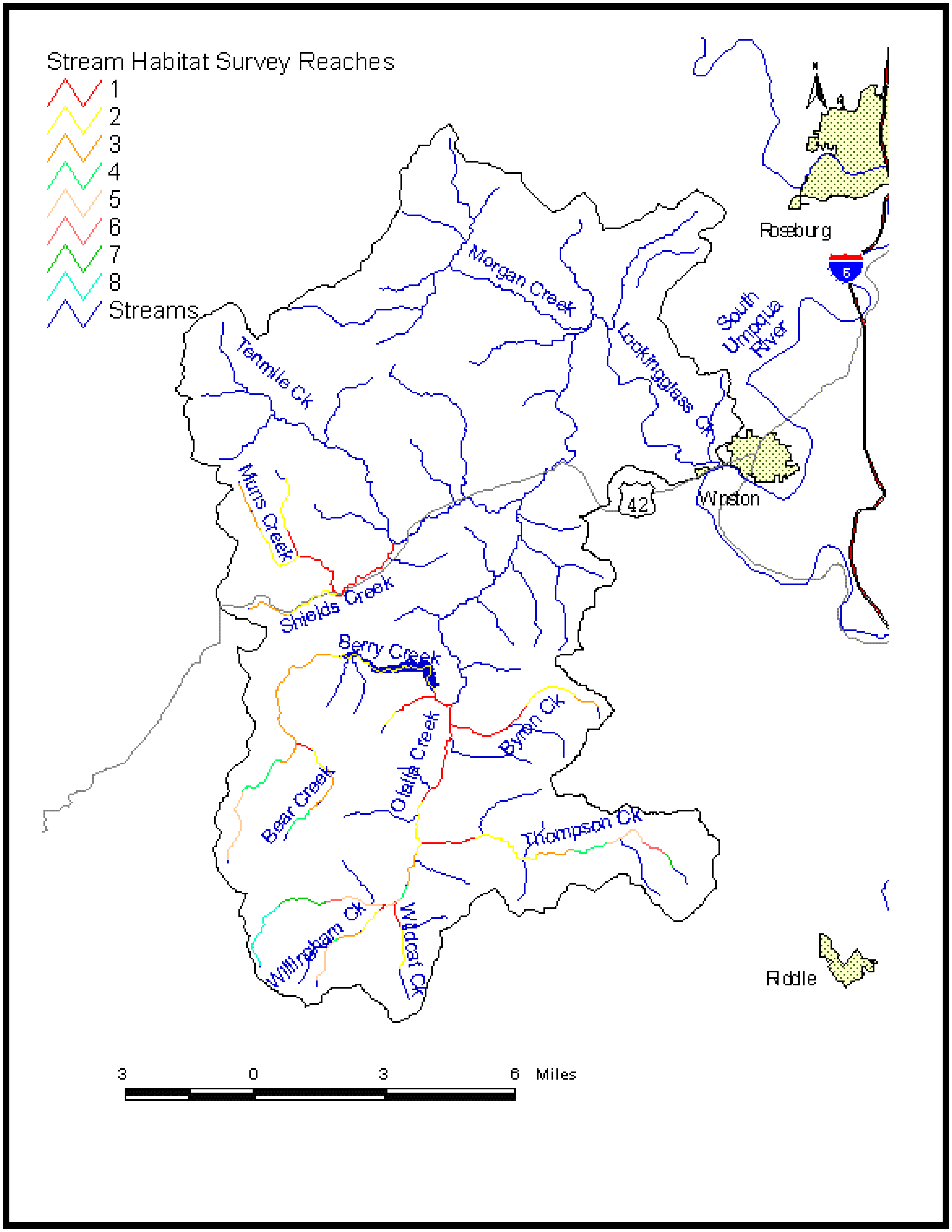
Appendix 2: Douglas County census information

Douglas County 2000 Census information is listed below for age, race, housing, education, employment, and income.

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: Stream habitat surveys

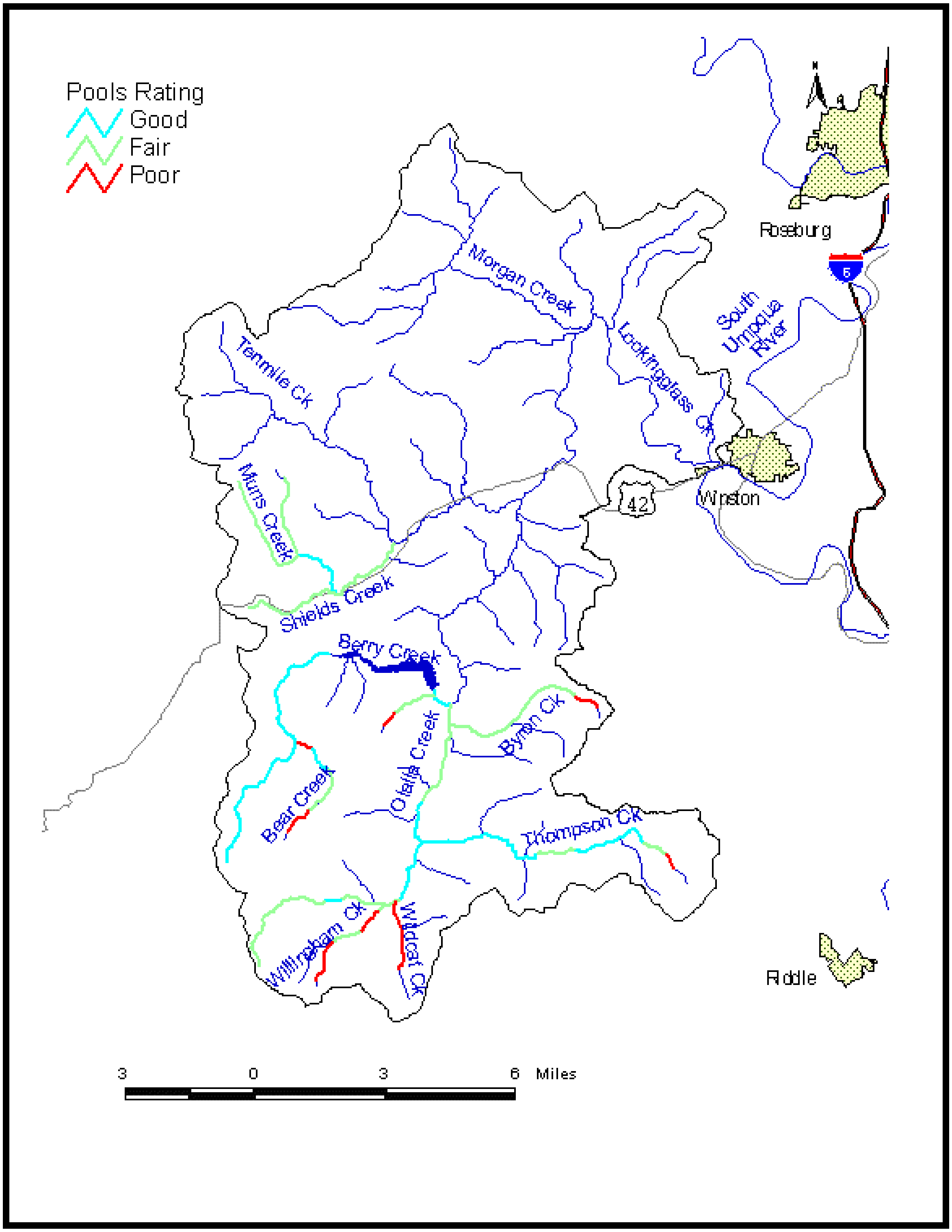
Stream reaches surveyed by the Oregon Department of Fish and Wildlife (1995-1996)



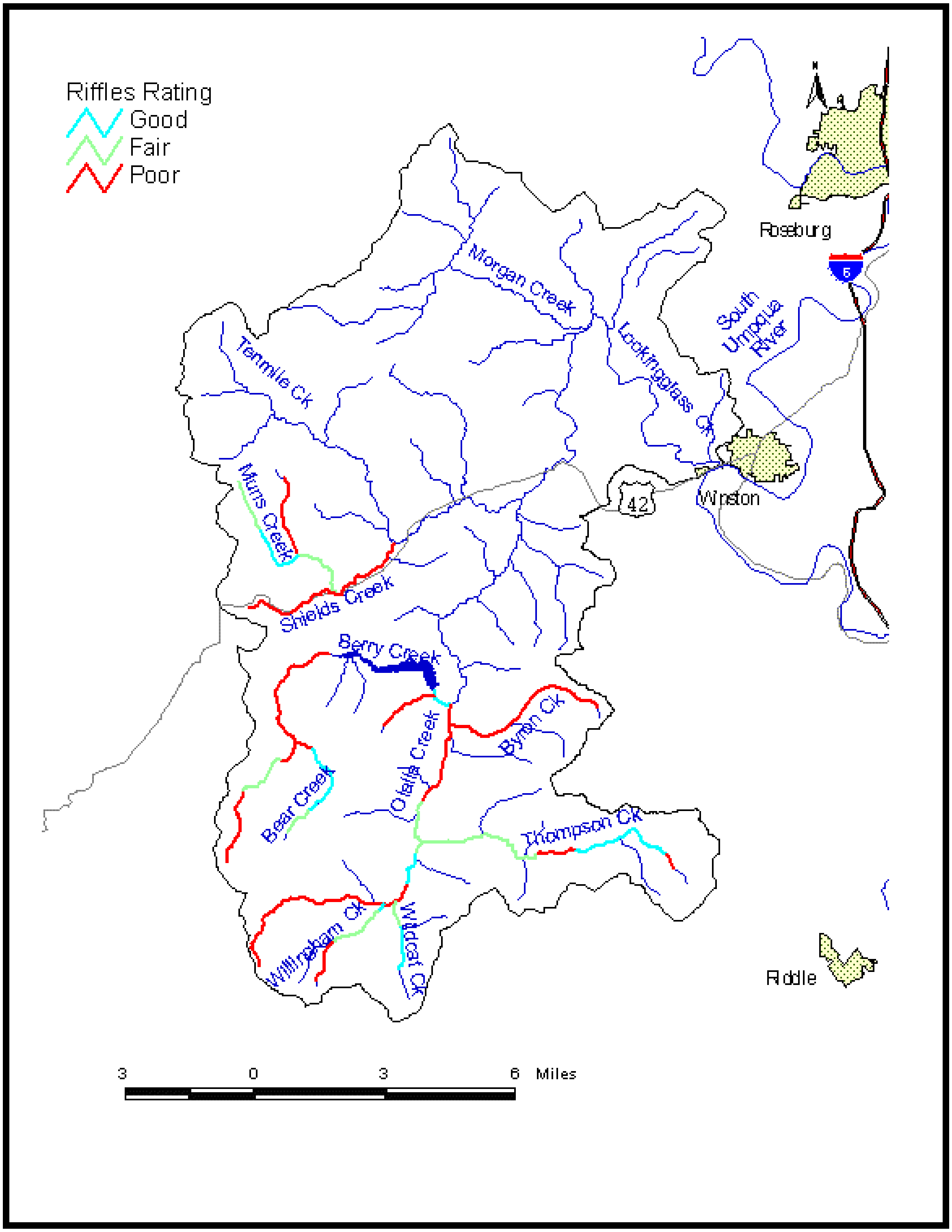
Olalla Creek reach surveys by ODFW ●●●excellent/good ●● fair ● poor

Stream	Reach	Pools	Riffles	Riparian Area	Large Woody Material
BEAR CREEK (BERRY)	1	●	●	●●●	●
BEAR CREEK (BERRY)	2	●●●	●●●	●●●	●
BEAR CREEK (BERRY)	3	●●	●●●	●●	●
BEAR CREEK (BERRY)	4	●	●●	●	●
BERRY CREEK	1	●●●	●●●	●●	●
BERRY CREEK (Reservoir)	2				
BERRY CREEK	3	●●●	●	●	●●
BERRY CREEK	4	●●●	●●	●	●●●
BERRY CREEK	5	●●●	●	●●●	●●
BYRON CREEK	1	●●	●	●	●
BYRON CREEK	2	●●	●	●	●●
BYRON CREEK	3	●	●	●	●
COARSE GOLD CREEK	1	●●	●	●	●
COARSE GOLD CREEK	2	●	●	●●●	●
LITTLE MULEY CREEK	1	●●	●	●●●	●
LITTLE MULEY CREEK	2	●●	●	●●●	●●
MUNS CREEK	1	●●●	●●	●●	●
MUNS CREEK	2	●●	●●●	●●	●
MUNS CREEK	3	●●	●●	●●●	●
OLALLA CREEK	1	●●	●	●	●
OLALLA CREEK	2	●●●	●●	●●●	●
OLALLA CREEK	3	●●●	●●●	●	●
OLALLA CREEK	4	●●●	●	●●●	●●
OLALLA CREEK	5	●●	●	●●●	●●
OLALLA CREEK	6	●●●	●	●●	●●●
OLALLA CREEK	7	●●	●	●●●	●●●
OLALLA CREEK	8	●●	●	●●●	●●●
SHIELDS CREEK	1	●●	●	●●	●
SHIELDS CREEK	2	●●	●	●●	●
SHIELDS CREEK	3	●●	●	●●●	●●
THOMPSON CREEK	1	●●●	●●	●●●	●
THOMPSON CREEK	2	●●●	●●	●●●	●
THOMPSON CREEK	3	●●	●	●●●	●
THOMPSON CREEK	4	●●●	●●●	●●●	●
THOMPSON CREEK	5		●●●	●●●	●●
THOMPSON CREEK	6	●●	●●●	●●	●
THOMPSON CREEK	7	●	●	●●	●
WILDCAT CREEK	1	●	●●	●●●	●●●
WILDCAT CREEK	2	●	●●●	●●●	●●●
WILLINGHAM CREEK	1	●●	●●●	●●	●
WILLINGHAM CREEK	2	●	●●	●●	●
WILLINGHAM CREEK	3	●●	●●	●	●●●
WILLINGHAM CREEK	4	●●	●●	●	●
WILLINGHAM CREEK	5	●	●	●●●	●●

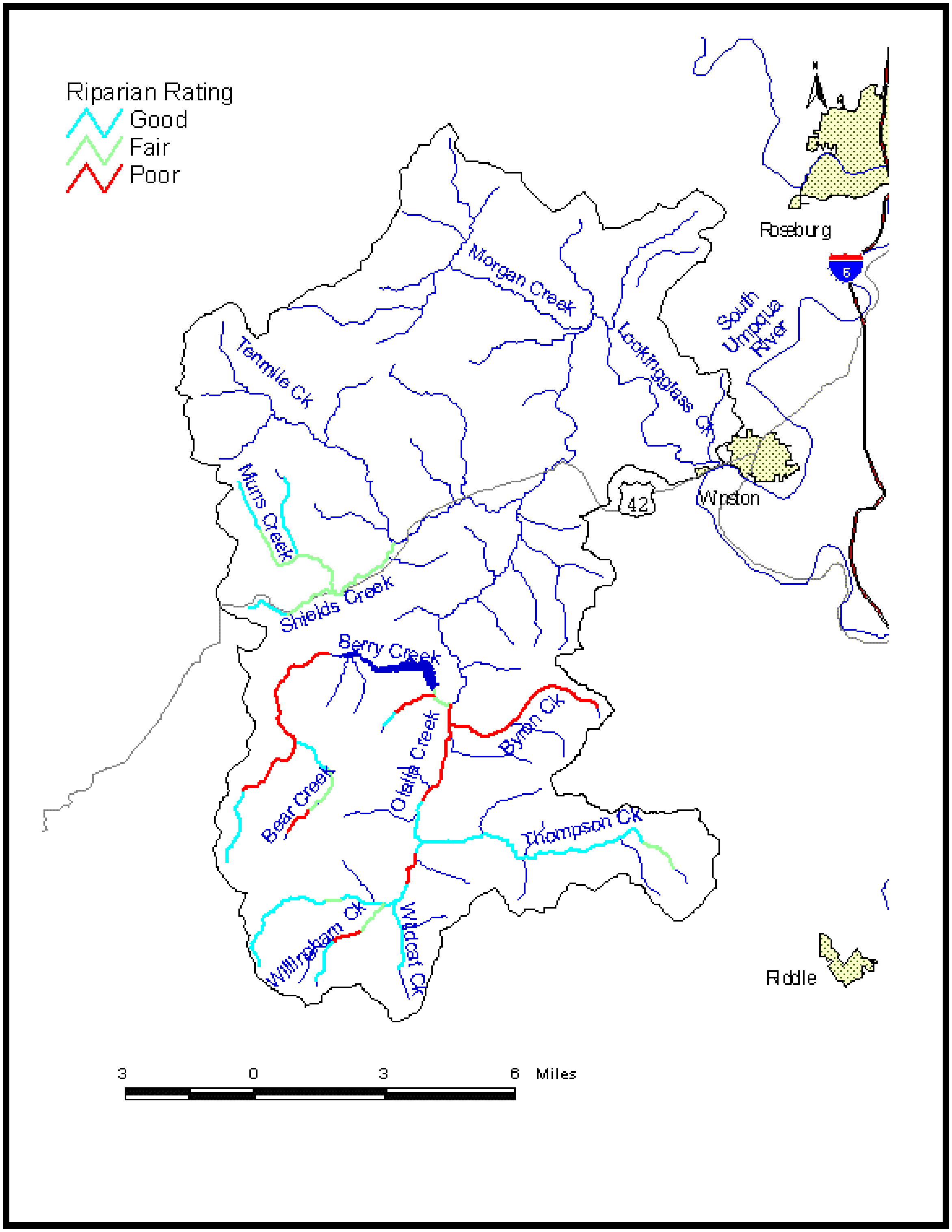
Pool rating for ODFW Stream Habitat Survey



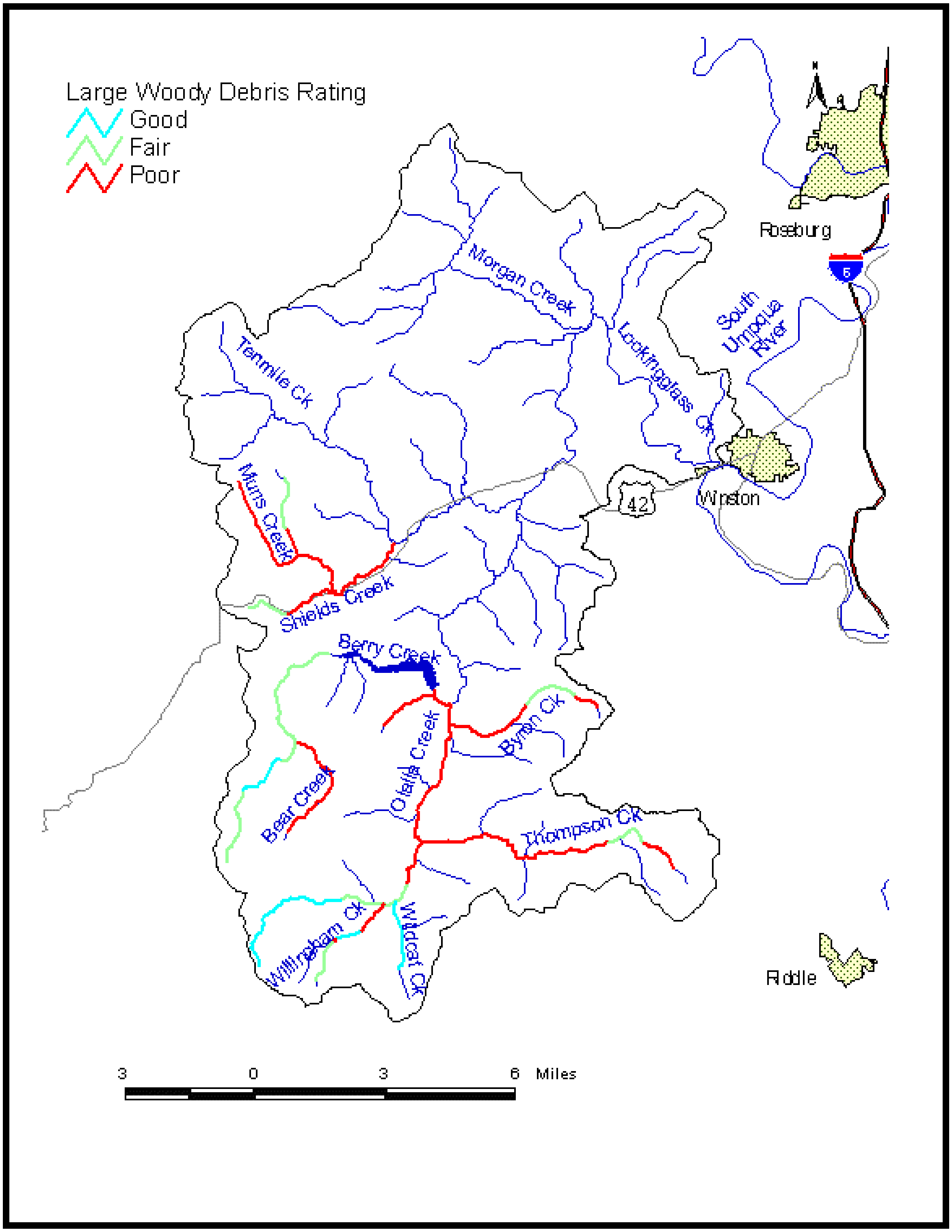
Riffle rating for ODFW Stream Habitat Survey



Riparian rating for ODFW Stream Habitat Survey



Large Woody Debris rating for ODFW Stream Habitat Survey



Appendix 4: Land use classification for the ODFW stream habitat surveys

The Oregon Department of Fish and Wildlife classified the land use for each reach surveyed. All categories have been included below, even those not applicable to the Olalla / Lookingglass watershed.

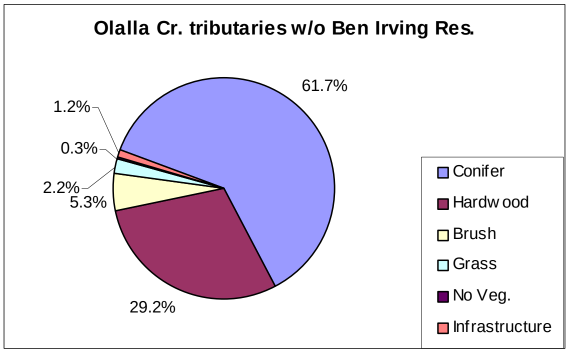
AG	Agricultural crop or dairy land.
TH	Timber harvest. Active timber management including tree felling, logging, etc. Not yet replanted.
YT	Young forest trees. Can range from recently planted harvest units to stands with trees up to 15 cm dbh.
ST	Second growth timber. Trees 15-30 cm dbh in generally dense, rapidly growing, uniform stands.
LT	Large timber thirty to fifth cm dbh.
MT	Mature timber. Fifty to ninety 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

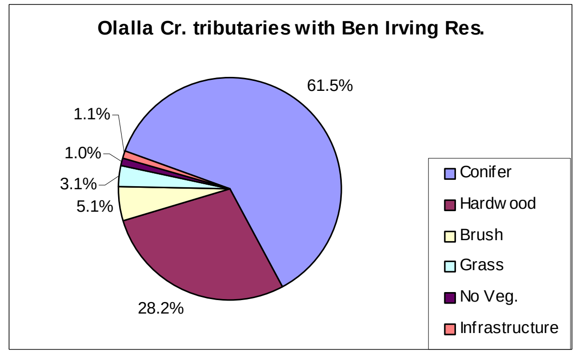
Land use classification for ODFW Stream Habitat Surveys

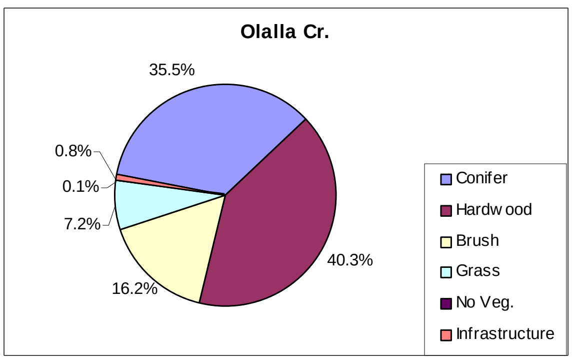
Stream	Reach	Primary Land Use	Secondary Land Use
BEAR CREEK (BERRY)	1	LT	MT
BEAR CREEK (BERRY)	2	LT	ST
BEAR CREEK (BERRY)	3	TH	ST
BEAR CREEK (BERRY)	4	TH	YT
BERRY CREEK	1	AG	RR
BERRY CREEK (Reservoir)	2		
BERRY CREEK	3	TH	ST
BERRY CREEK	4	TH	YT
BERRY CREEK	5	ST	YT
BYRON CREEK	1	AG	RR
BYRON CREEK	2	AG	ST
BYRON CREEK	3	MT	YT
COARSE GOLD CREEK	1	AG	LG
COARSE GOLD CREEK	2	LT	MT
LITTLE MULEY CREEK	1	ST	YT
LITTLE MULEY CREEK	2	ST	LT
MUNS CREEK	1	AG	RR
MUNS CREEK	2	ST	YT
MUNS CREEK	3	ST	YT
OLALLA CREEK	1	AG	RR
OLALLA CREEK	2	LT	ST
OLALLA CREEK	3	TH	YT
OLALLA CREEK	4	MT	LT
OLALLA CREEK	5	ST	LT
OLALLA CREEK	6	MT	LT
OLALLA CREEK	7	LT	MT
OLALLA CREEK	8	ST	LT
SHIELDS CREEK	1	AG	HG
SHIELDS CREEK	2	RR	ST
SHIELDS CREEK	3	ST	YT
THOMPSON CREEK	1	MT	MI
THOMPSON CREEK	2	MT	MI
THOMPSON CREEK	3	MT	LT
THOMPSON CREEK	4	RR	AG
THOMPSON CREEK	5	MT	LT
THOMPSON CREEK	6	ST	YT
THOMPSON CREEK	7	ST	
WILDCAT CREEK	1	ST	NU
WILDCAT CREEK	2	ST	NU
WILLINGHAM CREEK	1	ST	NU
WILLINGHAM CREEK	2	ST	NU
WILLINGHAM CREEK	3	ST	NU
WILLINGHAM CREEK	4	ST	NU
WILLINGHAM CREEK	5	ST	NU

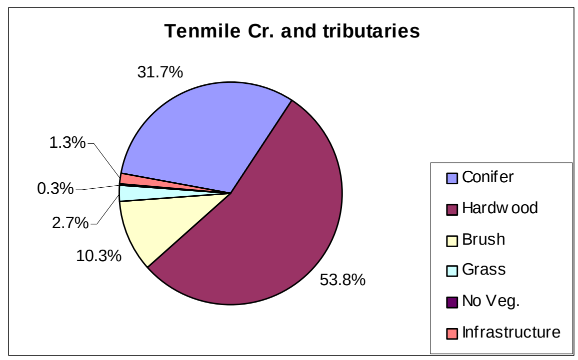
Appendix 5: Riparian vegetation

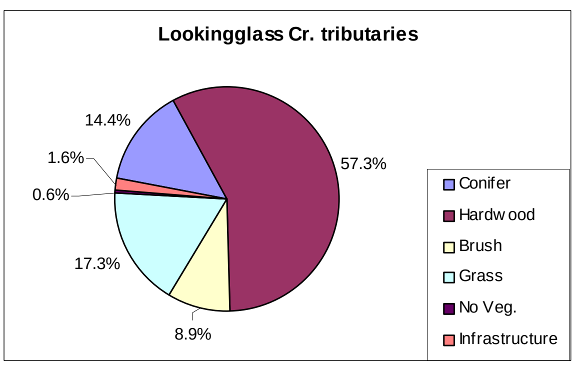
Dominant Vegetation Type

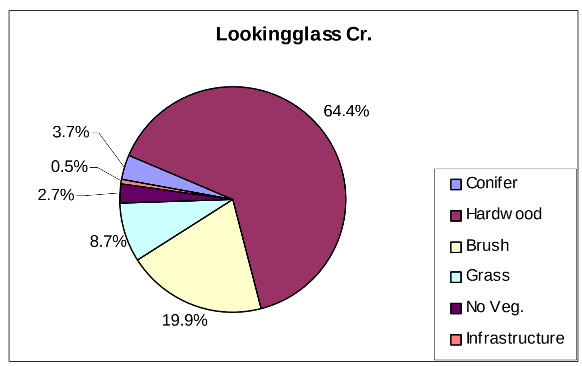












Dominant Vegtype	Olalla tribs w/o BI	Olalla tribs	Olalla Cr	Tenmile system	Lookingglass tribs	Lookingglass Cr	Watershed Average
Conifer	61.7%	61.5%	35.5%	31.7%	14.4%	3.7%	38.5%
Hardwood	29.2%	28.2%	40.3%	53.8%	57.3%	64.4%	43.7%
Brush	5.3%	5.1%	16.2%	10.3%	8.9%	19.9%	9.2%
Grass	2.2%	3.1%	7.2%	2.7%	17.3%	8.7%	6.6%
No Veg.	0.3%	1.0%	0.1%	0.3%	0.6%	2.7%	0.8%
Infrastructure	1.2%	1.1%	0.8%	1.3%	1.6%	0.5%	1.2%

Appendix 6: Riparian buffer width

Riparian width (2+ Tree-crown, 1 tree-crown, no riparian trees)

Riparian Width	Olalla tribs w/o BI	Olalla tribs	Olalla Cr	Tenmile system	Lookingglass tribs	Lookingglass Cr	Watershed Average
No trees	9.0%	10.3%	24.3%	14.6%	28.3%	31.9%	17.8%
1 Tree Crown Wide	23.6%	22.8%	31.4%	38.4%	35.8%	34.2%	30.7%
2+ Tree Crowns Wide	67.4%	66.9%	44.4%	47.0%	35.8%	33.9%	51.5%

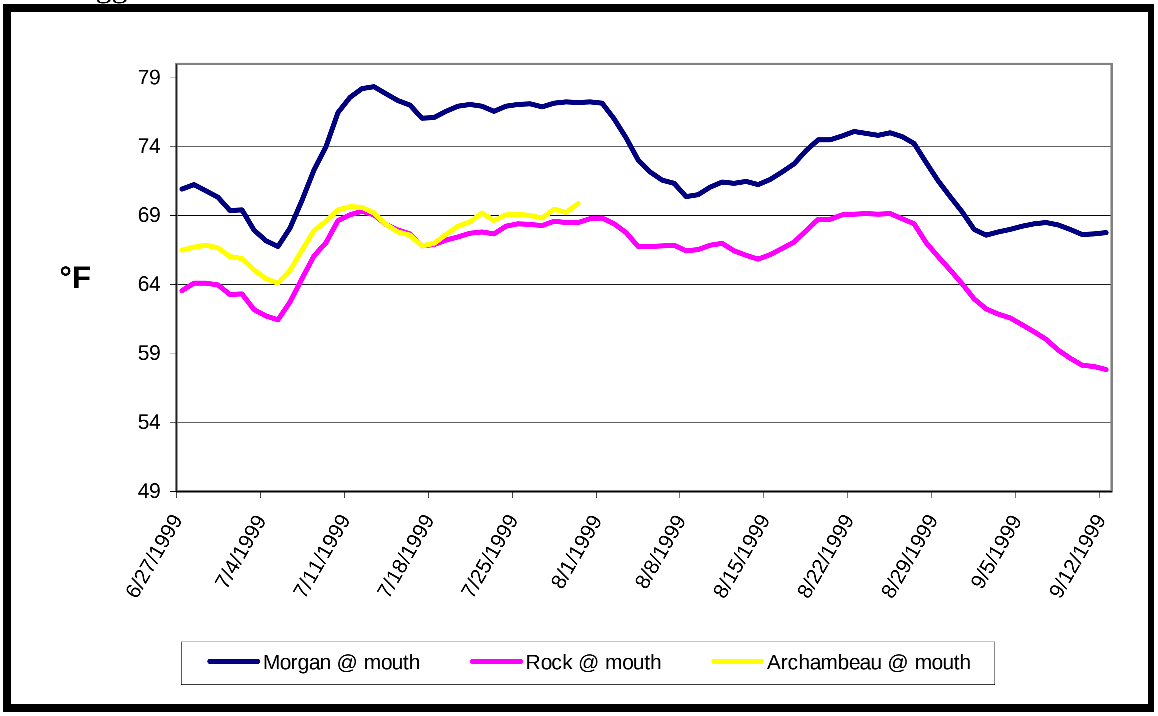
Appendix 7: Riparian area percent cover

Percent cover (>50% or <50%)

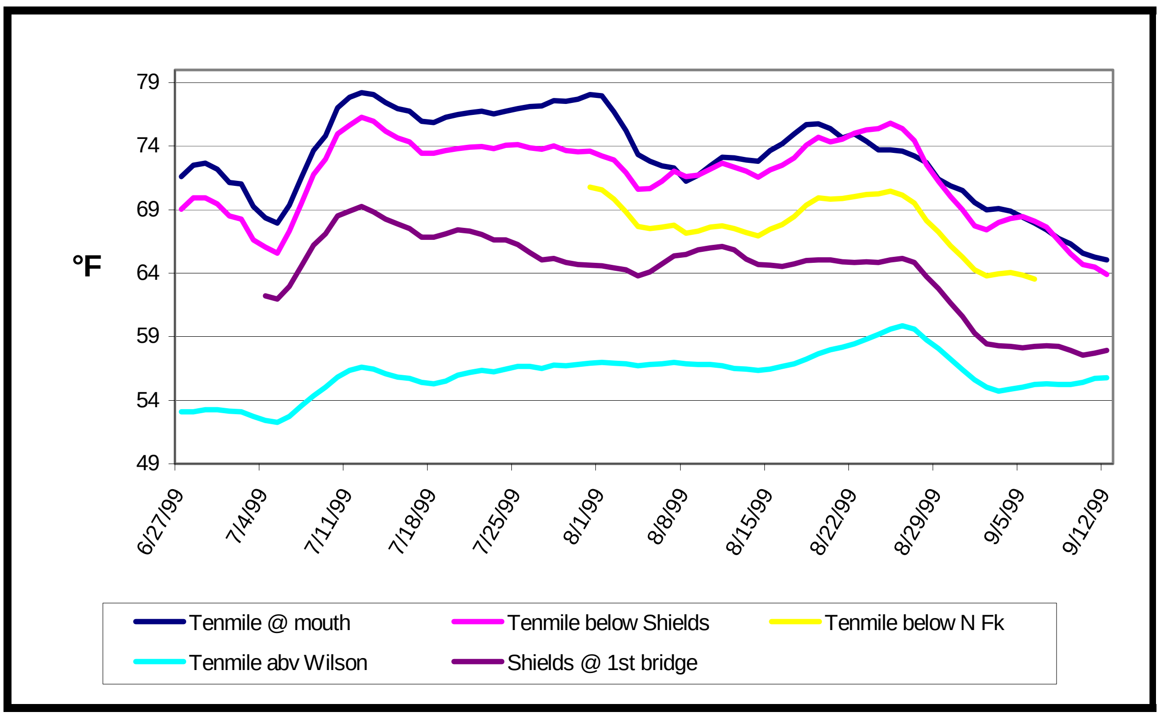
Percent Cover	Olalla tribs w/o BI	Olalla tribs	Olalla Cr	Tenmile system	Lookingglass tribs	Lookingglass Cr	Watershed Average
< 50 %	12.0%	16.0%	48.9%	10.6%	21.2%	89.5%	24.5%
> 50 %	88.0%	84.0%	51.1%	89.4%	78.8%	10.5%	75.5%

Appendix 8: Lookingglass / Olalla Watershed tributary temperature trends
(from K. Smith, 1999)

Lookingglass Tributaries

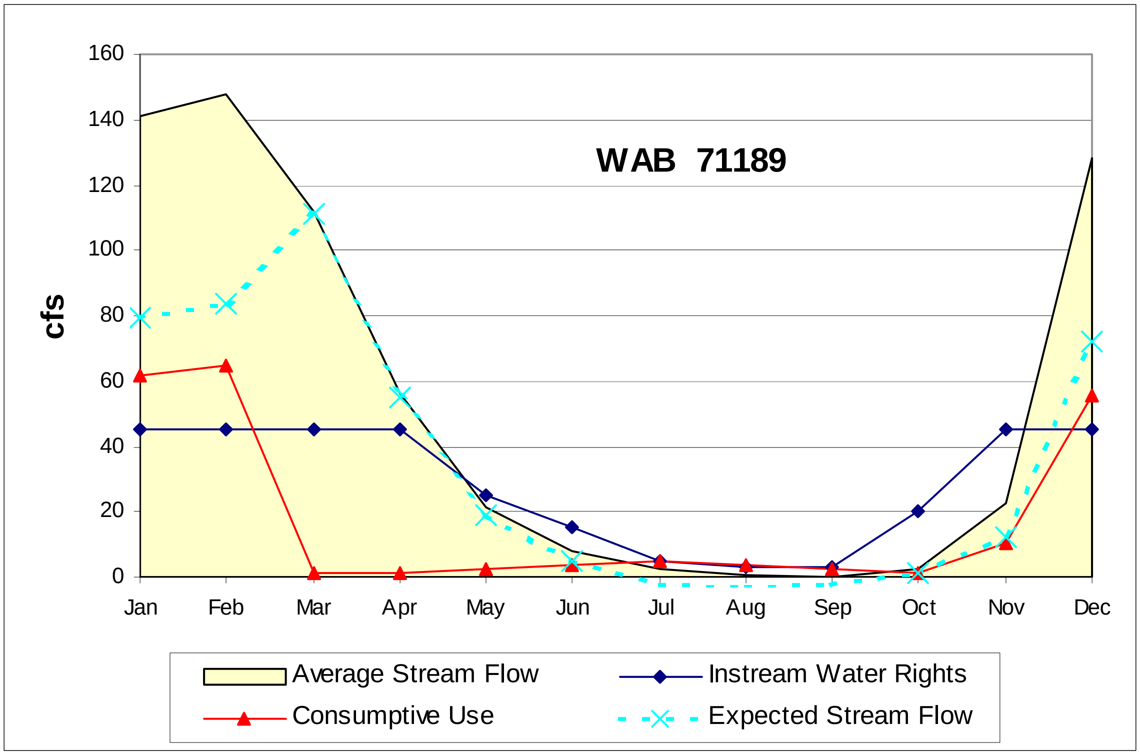


Tenmile Creek and Tributaries

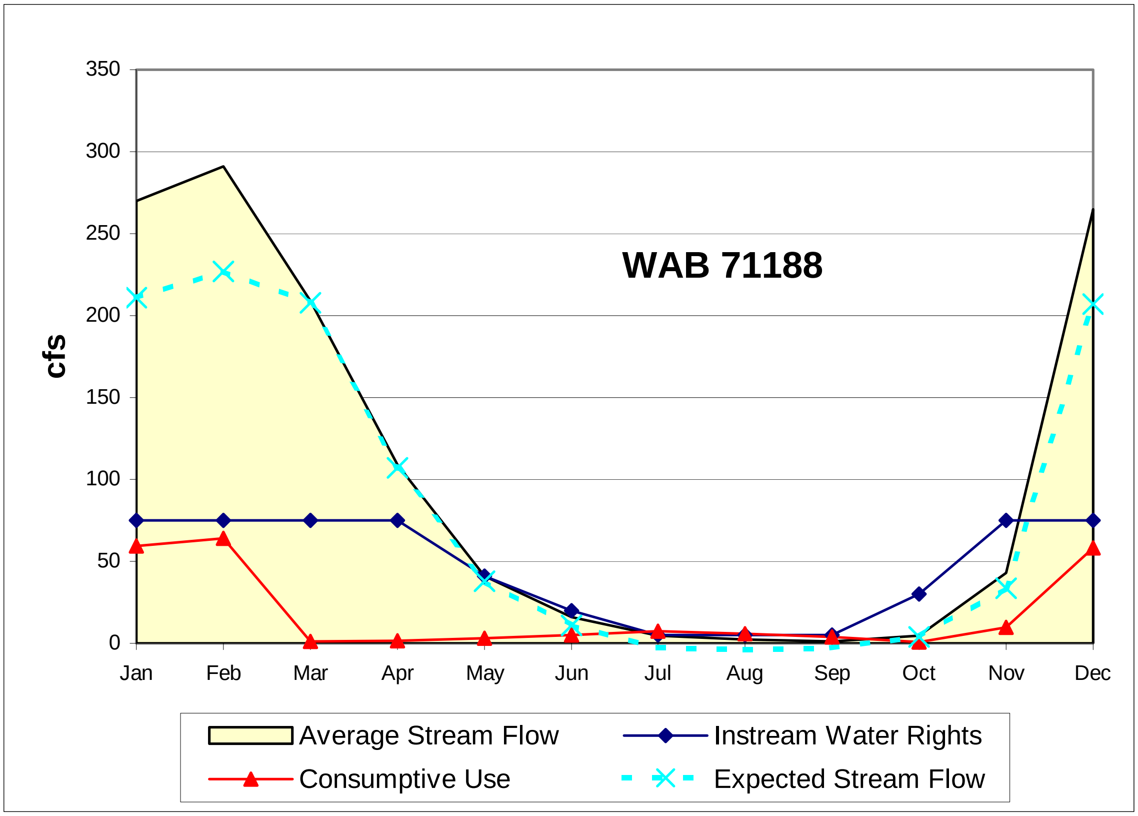


Appendix 9: Water availability graphs

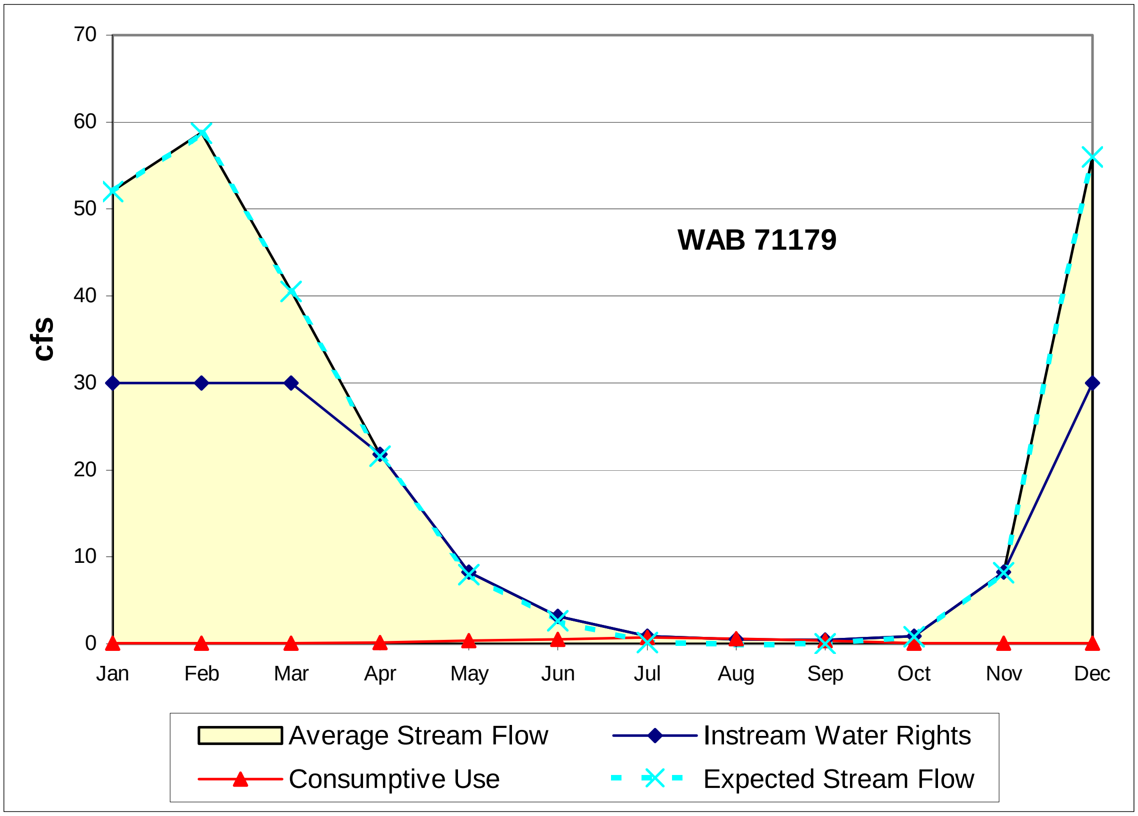
Water availability graphs and consumptive use summaries for the other five water availability units (WAB) within the Olalla / Lookingglass watershed are listed below.



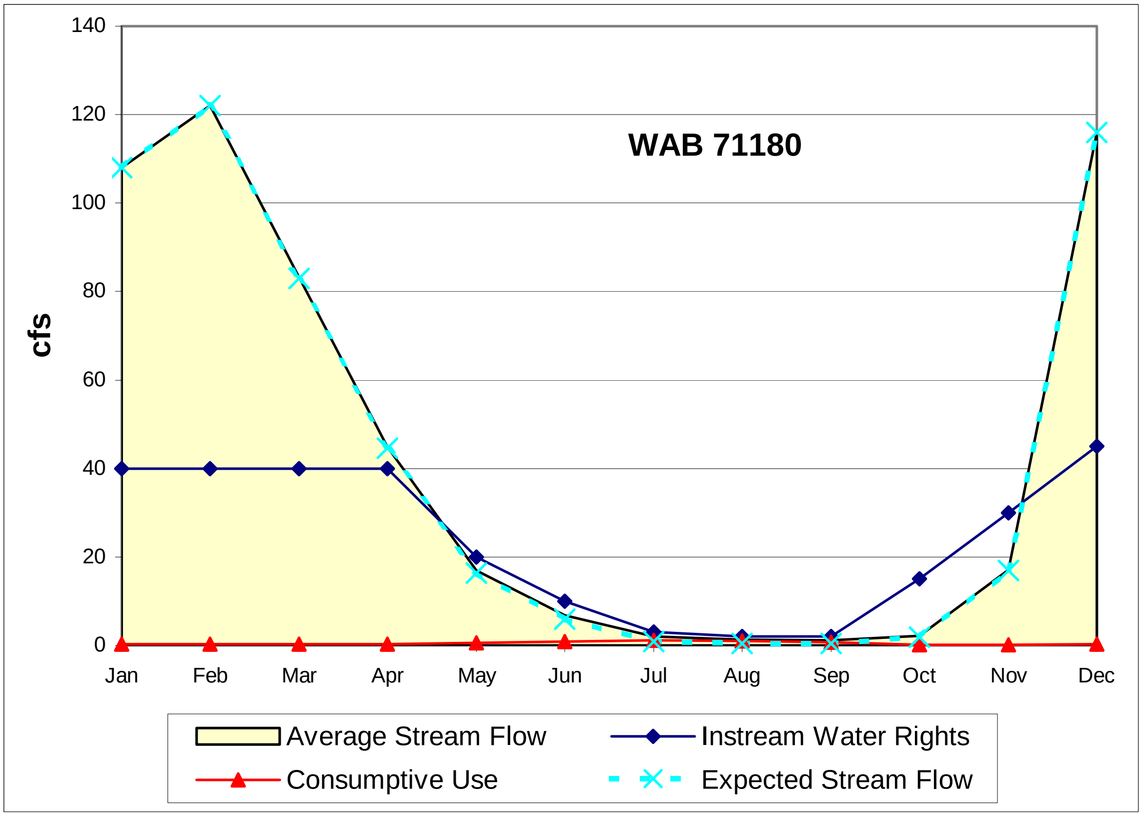
	Total Consumptive Use (cfs)	Storage	Irrigation	Municipalities	Industry / Manufacture	Commercial	Domestic	Agriculture	Other	Total
Jan	61.50	99%	0%	0%	0%	0%	0%	0%	1%	100%
Feb	64.60	99%	0%	0%	0%	0%	0%	0%	1%	100%
Mar	1.46	44%	5%	0%	0%	0%	1%	1%	48%	100%
Apr	1.44	7%	42%	0%	0%	0%	1%	1%	49%	100%
May	2.36	0%	69%	0%	0%	0%	1%	0%	30%	100%
Jun	3.40	0%	78%	0%	0%	0%	1%	0%	21%	100%
Jul	4.64	0%	84%	0%	0%	0%	0%	0%	15%	100%
Aug	3.84	0%	81%	0%	0%	0%	1%	0%	18%	100%
Sep	2.69	0%	72%	0%	0%	0%	1%	0%	26%	100%
Oct	0.93	0%	22%	0%	0%	0%	2%	1%	75%	100%
Nov	10.50	93%	0%	0%	0%	0%	0%	0%	7%	100%
Dec	55.90	99%	0%	0%	0%	0%	0%	0%	1%	100%



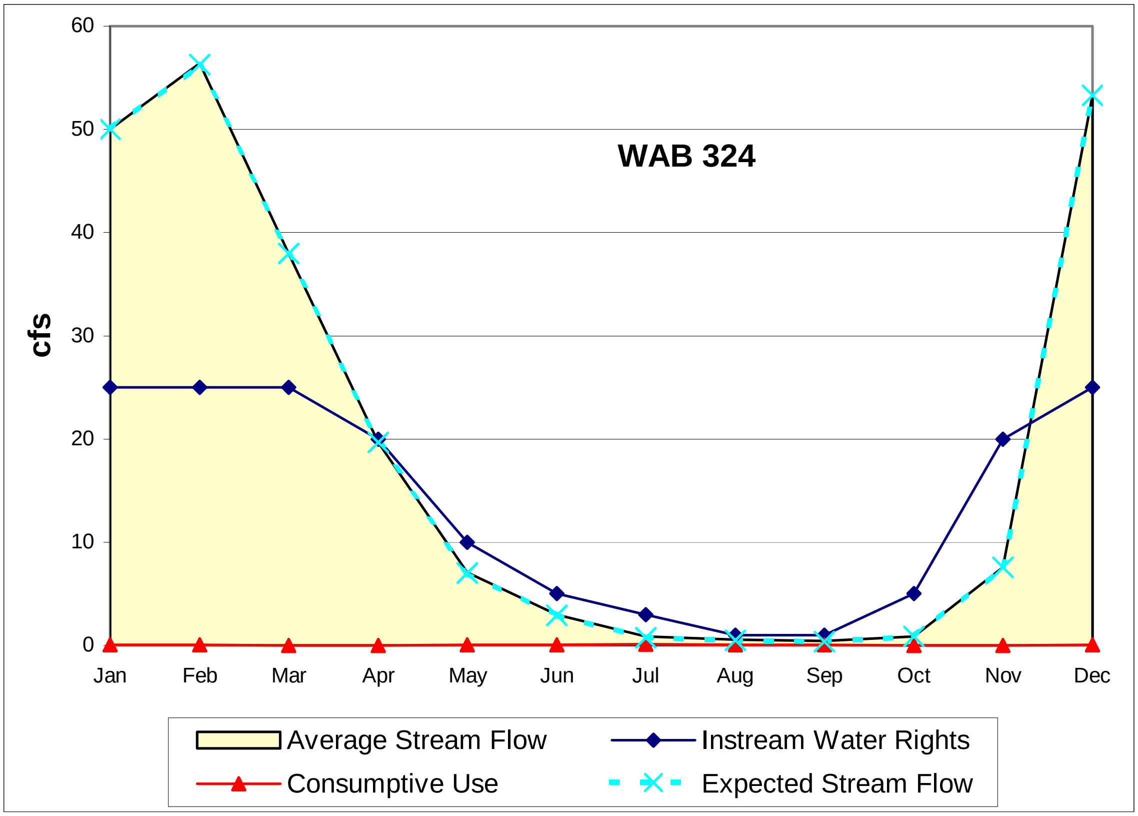
	Total Consumptive Use (cfs)	Storage	Irrigation	Municipalities	Industry / Manufacture	Commercial	Domestic	Agriculture	Other	Total
Jan	59.50	99%	0%	0%	0%	0%	0%	0%	0%	100%
Feb	64.10	99%	0%	0%	0%	0%	0%	0%	0%	100%
Mar	1.23	59%	11%	0%	10%	0%	12%	8%	0%	100%
Apr	1.58	7%	70%	0%	8%	0%	9%	6%	0%	100%
May	3.30	0%	89%	0%	4%	0%	5%	3%	0%	100%
Jun	5.17	0%	93%	0%	2%	0%	3%	2%	0%	100%
Jul	7.41	0%	95%	0%	2%	0%	2%	1%	0%	100%
Aug	5.97	0%	94%	0%	2%	0%	3%	2%	0%	100%
Sep	3.89	0%	90%	0%	3%	0%	4%	3%	0%	100%
Oct	0.72	0%	49%	0%	17%	0%	21%	14%	0%	100%
Nov	9.73	96%	0%	0%	1%	0%	2%	1%	0%	100%
Dec	58.30	99%	0%	0%	0%	0%	0%	0%	0%	100%



	Total Consumptive Use (cfs)	Storage	Irrigation	Municipalities	Industry / Manufacture	Commercial	Domestic	Agriculture	Other	Total
Jan	0.09	11%	0%	0%	44%	0%	22%	11%	0%	100%
Feb	0.09	11%	0%	0%	44%	0%	22%	11%	0%	100%
Mar	0.09	0%	11%	0%	44%	0%	22%	11%	0%	100%
Apr	0.18	0%	56%	0%	22%	0%	11%	6%	0%	100%
May	0.35	0%	77%	0%	11%	0%	6%	3%	0%	100%
Jun	0.52	0%	85%	0%	8%	0%	4%	2%	0%	100%
Jul	0.73	0%	89%	0%	5%	0%	3%	1%	0%	100%
Aug	0.59	0%	86%	0%	7%	0%	3%	2%	0%	100%
Sep	0.40	0%	80%	0%	10%	0%	5%	3%	0%	100%
Oct	0.11	0%	27%	0%	36%	0%	18%	9%	0%	100%
Nov	0.08	0%	0%	0%	50%	0%	25%	13%	0%	100%
Dec	0.09	11%	0%	0%	44%	0%	22%	11%	0%	100%



	Total Consumptive Use (cfs)	Storage	Irrigation	Municipalities	Industry / Manufacture	Commercial	Domestic	Agriculture	Other	Total
Jan	0.26	42%	0%	0%	15%	0%	35%	4%	0%	100%
Feb	0.29	46%	0%	0%	14%	0%	32%	4%	0%	100%
Mar	0.23	26%	9%	0%	17%	0%	39%	4%	0%	100%
Apr	0.32	3%	50%	0%	13%	0%	28%	3%	0%	100%
May	0.58	0%	74%	0%	7%	0%	16%	2%	0%	100%
Jun	0.85	0%	82%	0%	5%	0%	11%	1%	0%	100%
Jul	1.18	0%	87%	0%	3%	0%	8%	1%	0%	100%
Aug	0.97	0%	85%	0%	4%	0%	9%	1%	0%	100%
Sep	0.67	0%	76%	0%	6%	0%	13%	1%	0%	100%
Oct	0.20	0%	24%	0%	19%	0%	43%	5%	0%	100%
Nov	0.16	0%	0%	0%	25%	0%	56%	6%	0%	100%
Dec		41%	0%	0%	15%	0%	33%	4%	0%	100%



	Total Consumptive Use (cfs)	Storage	Irrigation	Municipalities	Industry / Manufacture	Commercial	Domestic	Agriculture	Other	Total
Jan	0.04	100%	0%	0%	0%	0%	0%	0%	0%	100%
Feb	0.05	100%	0%	0%	0%	0%	0%	0%	0%	100%
Mar	0.02	100%	0%	0%	0%	0%	0%	0%	0%	100%
Apr	0.02	0%	100%	0%	0%	0%	0%	0%	0%	100%
May	0.05	0%	100%	0%	0%	0%	0%	0%	0%	100%
Jun	0.08	0%	100%	0%	0%	0%	0%	0%	0%	100%
Jul	0.12	0%	92%	0%	0%	0%	0%	0%	0%	100%
Aug	0.09	0%	100%	0%	0%	0%	0%	0%	0%	100%
Sep	0.06	0%	83%	0%	0%	0%	0%	0%	0%	100%
Oct	0.01	0%	100%	0%	0%	0%	0%	0%	0%	100%
Nov	0.01	0%	0%	0%	0%	0%	0%	0%	0%	100%
Dec	0.05	80%	0%	0%	0%	0%	0%	0%	0%	100%

Appendix 10: Water use categories and water storage rights

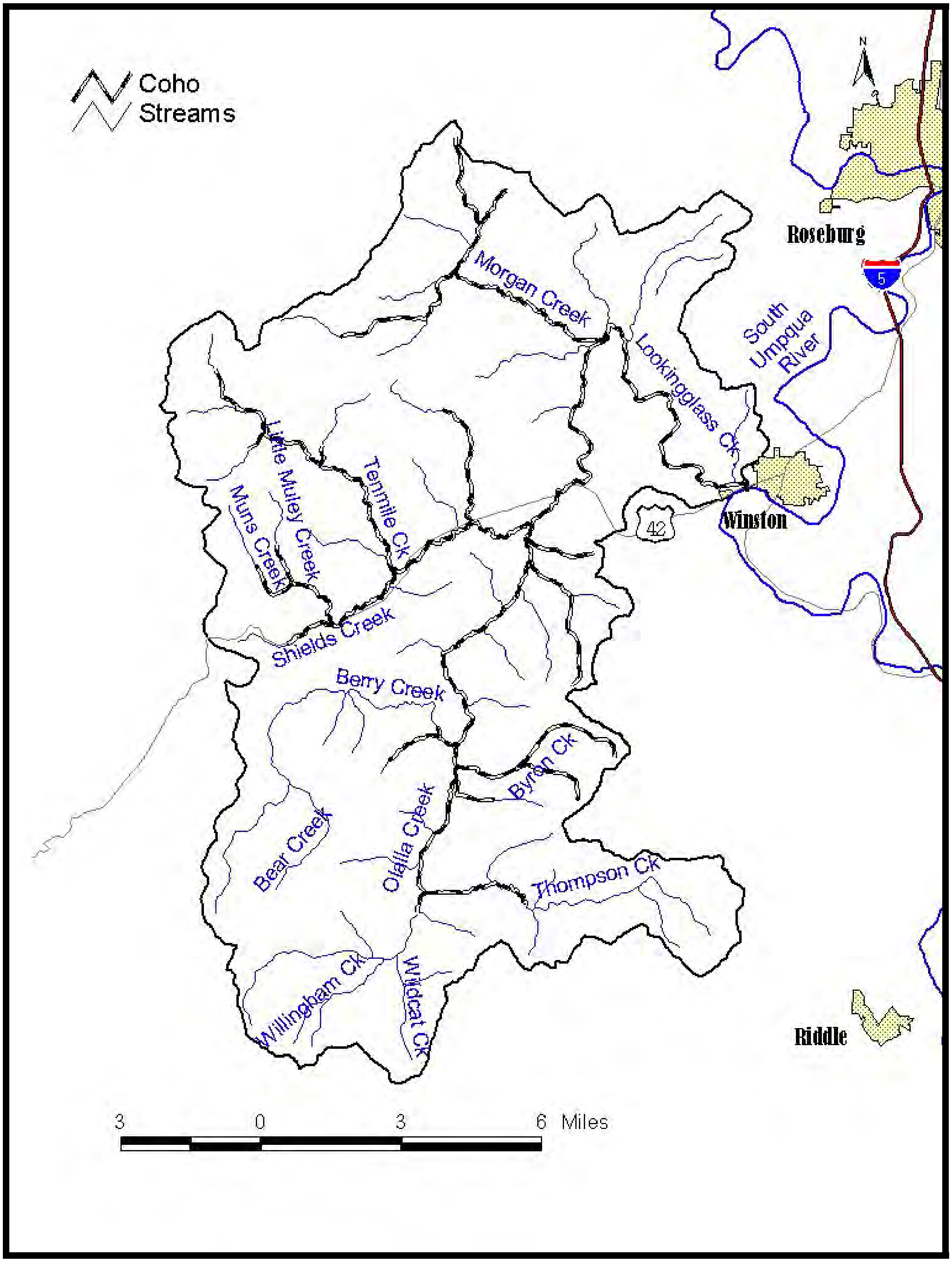
There are eight general water use categories. The table below lists the Oregon Water Resources Department uses that are included in each category. Not all uses occur in the Olalla / Lookingglass Watershed.

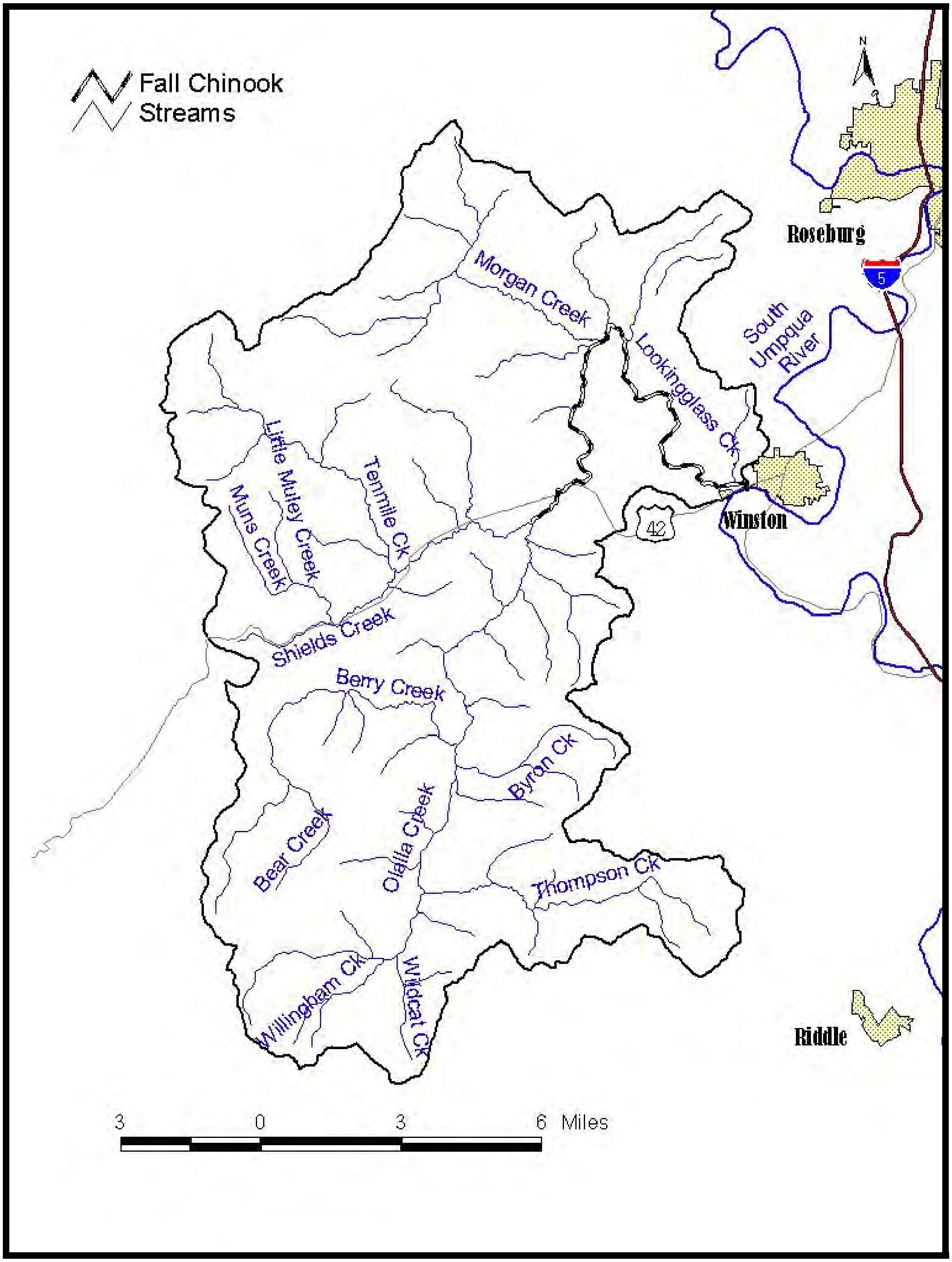
Irrigation	**Industrial**	**Domestic**
Primary and supplemental	Geothermal	Domestic
Irrigation	Manufacturing	Lawn and garden
Supplemental	Sawmill	Non-commercial
Cranberries	Shop	Stock
Irrigation, domestic & stock	Log deck	Group domestic
Irrigation & domestic	Commercial	Restroom
Irrigation & stock	Laboratory	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		

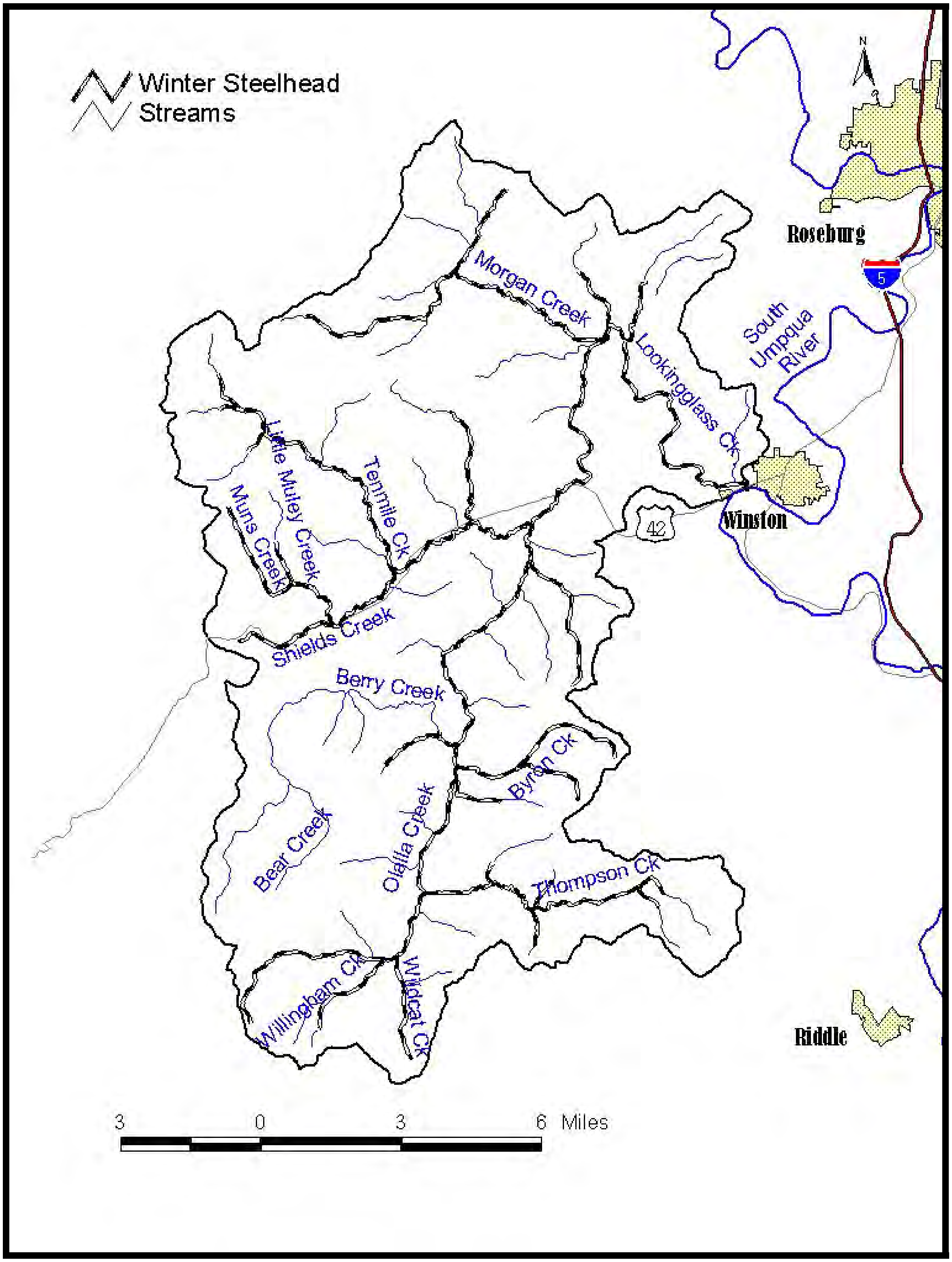
Water rights have been issued for diversion on the basis of cubic feet per second (cfs) and for storage on the basis of acre-feet (aft). Listed below are the storage (aft) water rights. One noticeable change from the diversion rights is the Municipal water right on Berry Creek, for 3,750.00 aft.

	TOTAL		**Olalla & Lookingglass Creeks**		**All other watershed tributaries**	
Source	Acre-Feet	% of Total	Acre-Feet	% of O/L Ck	Acre-Feet	% of Tributaries
Agriculture	8.14	0.04	0.00	0.00	8.14	0.04
Domestic	134.40	0.66	2.10	0.75	132.30	0.66
Irrigation	15,371.88	75.22	229.60	81.79	15,142.28	75.13
Industrial	8.50	0.04	8.50	3.03	0.00	0.00
Recreation	55.50	0.27	0.00	0.00	55.50	0.28
Power	0.00	0.00	0.00	0.00	0.00	0.00
Fish	803.53	3.93	3.22	1.15	800.31	3.97
Livestock	235.96	1.15	27.53	9.80	208.44	1.03
Municipal	3,750.00	18.35	0.00	0.00	3,750.00	18.61
Mining	6.00	0.03	0.00	0.00	6.00	0.03
Wildlife	16.86	0.08	4.97	1.77	11.89	0.06
Miscellaneous	45.03	0.22	4.82	1.72	40.21	0.20
Total	20,435.82	100.00	280.74	100.00	20,155.09	100.00

Appendix 11: Salmonid distribution maps




Fall Chinook
Streams
N
Roseburg
5
South Umpqua River
Morgan Creek
Lookingglass Ck
Little Muley Creek
Tenmile Ck
Muns Creek
42
Winston
Shields Creek
Berry Creek
Byron Ck
Bear Creek
Olalla Creek
Thompson Ck
Willingham Ck
Wildcat Ck
Riddle
3
0
3
6 Miles


Winter Steelhead
Streams
Roseburg
5
South Umpqua River
Morgan Creek
Lookingglass Ck
Winston
42
Little Muley Creek
Tenmile Ck
Muns Creek
Shields Creek
Berry Creek
Byron Ck
Bear Creek
Olalla Creek
Thompson Ck
Willingham Ck
Wildcat Ck
Riddle
3 0 3 6 Miles

Acknowledgments

This assessment would not have been possible without the help of community volunteers. We are very grateful to the landowners, residents, and UBWC directors and members who attended the monthly watershed assessment meetings and offered their critical review and insight. Their input and participation has been invaluable.

We are also grateful for the assistance of the following individuals and groups:

- Mr. Bruce Kelly, City Administrator for the City of Winston, who served as the UBWC's contact within the City of Winston, provided information about potential future conditions of the Winston area.
- The Lookingglass Olalla Water Control District for allowing us to hold monthly assessment meetings.
- Dr. Janice Green and Dr. Leonard Schussel for reviewing the document and offering editorial comments.
- 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 Olalla / Lookingglass Watershed Assessment meetings:
    - Bobbi Lindberg, ODEQ;
    - Dave Harris, ODFW;
    - Dave Williams, OWRD;
    - Frank Nielson –Douglas County Natural Resources Dept;
    - Kent Smith, InSight Consultants;
    - Sam Dunnavant, ODFW; and
    - Walter Barton, Douglas Soil and Water Conservation District.