Upper South Yamhill River Watershed Assessment

Yamhill Basin Council (503) 472-6403
Yamhill and Polk Counties, Oregon
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Abbreviations and Acronyms

BOD	Biochemical Oxygen Demand
BLM	Bureau of Land Management
CHT	Channel Habitat Types
CFS	Cubic Feet per Second
CREP	Conservation Reserve Enhancement Program
CREST	Coast Range Equestrian Trail Association
CTGR	Confederated Tribes of Grand Ronde
DBH	Diameter at Breast Height
DEQ	Oregon Department of Environmental Quality
DOGAMI	Department of Geology and Mining Industries (Oregon)
DO	Dissolved Oxygen
DSL	Division of State Lands (Oregon)
EPA	Environmental Protection Agency
ESA	Endangered Species Act
EQIP	Environmental Quality Incentive Program
FEMA	Federal Emergency Management Agency
GIS	Geographic Information Systems
ISWR	Instream Water Rights
LCDC	Land Conservation and Development Commission (Oregon)
LTA	Long Term Agreement
LWD	Large Woody Debris
LWI	Local Wetland Inventory
MIA	Mapped Impervious Area
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goals
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
NPSO	Native Plant Society of Oregon
NRCS	Natural Resources Conservation Service (formerly the Soil Cons. Svc.)
NTU	Nephelometric Turbidity Units
NWHI	Northwest Habitat Institute
NWI	National Wetland Inventory
ODA	Oregon Department of Agriculture
ODFW	Oregon Department of Fish and Wildlife
ODF	Oregon Department of Forestry
OFWAM	Oregon Freshwater Assessment Methodology
ORNHP	Oregon Natural Heritage Program
OPRD	Oregon Parks and Recreation Department
OSUES	Oregon State University Extension Service
OWAM	Oregon Watershed Enhancement Board
OWRD	Oregon Water Resources Department
RM	River Mile
SBR	Sequential Batch Reactor
SCS	Soil Conservation Service (now the NRCS)
SFI	Sustainable Forestry Initiative
SWCD	Soil and Water Conservation District
TCE	Tri-chloro-ethane
TMDL	Total Maximum Daily Load
USDA	United States Department of Agriculture
USGS	United States Geological Survey
WRP	Wetland Reserve Program
YBC	Yamhill Basin Council

"Before us in the fading light stretched a great expanse of ancient forest northwesterly to Haystack Rock twenty miles distant at Pacific City on the ocean, north fifteen miles to Mt Hebo, the highest peak in that part of the Oregon Coast Range, and eastward beyond ten-mile-distant Grand Ronde, past Valley Junction and Willamina to farmland in the Yamhill Valley."—Jane Claire Dirks-Edmunds, Linfield College Biologist, Saddleback Mountain, 1933

CHAPTER 1

Introduction and Watershed Overview

The Upper South Yamhill River watershed assessment is a publication of the Yamhill Basin Council (YBC) and is a reference tool for watershed residents. It contains information gathered from many different sources about past and present conditions in the watershed. The assessment also identifies areas where information is lacking. The purpose of this assessment is to provide watershed residents, landowners, and decision-makers with basic objective information regarding land and water resources in the Upper South Yamhill watershed, which includes all of the drainages to the South Yamhill River upstream of Willamina Creek.

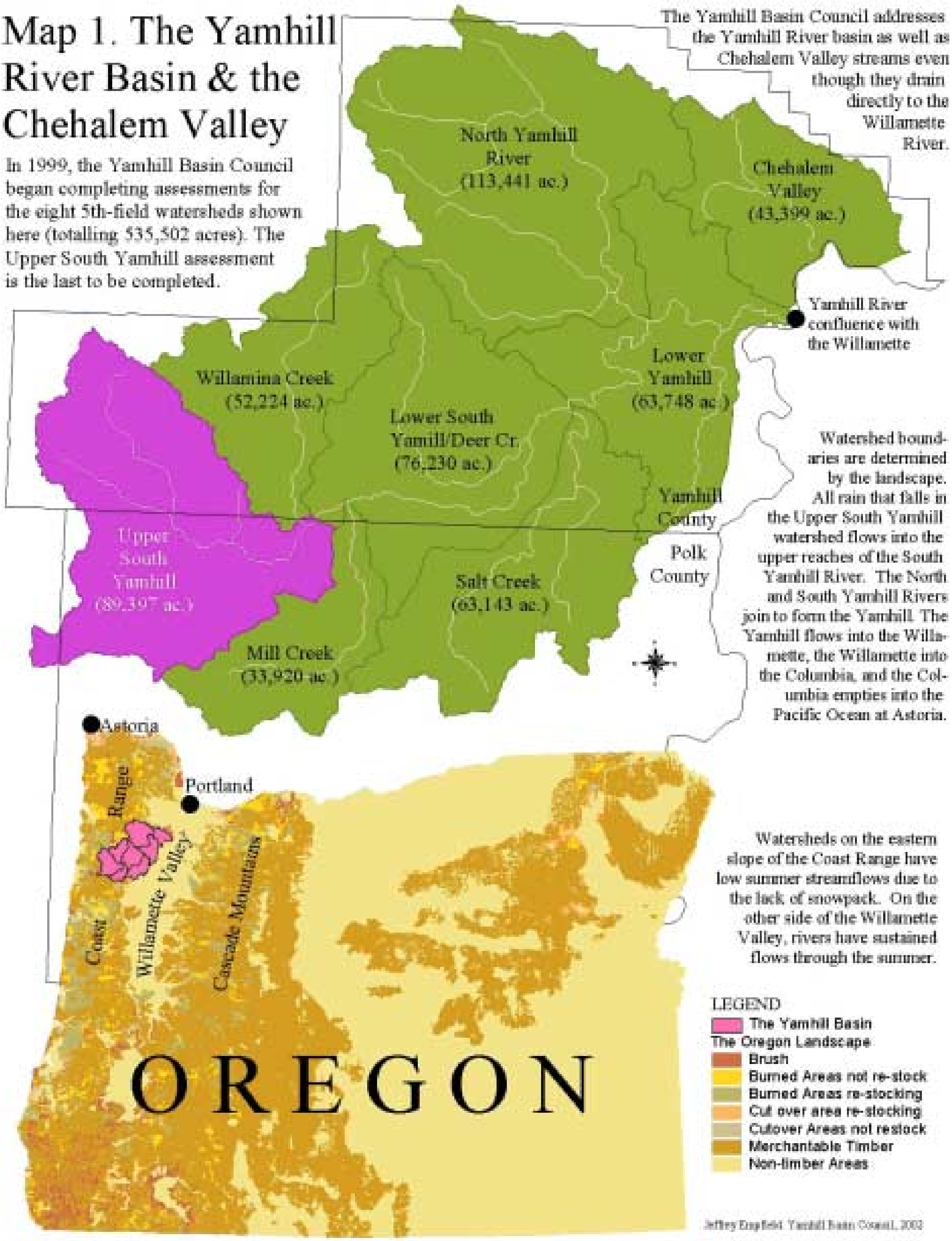
This document may serve as a baseline for designing restoration projects and will aid the Yamhill Basin Council and community members in developing monitoring plans. It is also tied to an ongoing process of community-based land use planning; the information contained will need to be updated as local needs and objectives develop.

When OSU Extension surveyed Yamhill County residents in 1996, over 95% of the respondents felt the county and local municipalities should continue strategic planning for water quality. Over 90% wanted continued planning for watershed management. The Yamhill Basin Council (YBC) is a citizen-based organization that coordinates individuals and groups interested in local water issues.

Guidance for the assessment came from the Oregon Watershed Assessment Manual (OWAM)—a manual developed specifically for assessment of Oregon streams and rivers. The manual provides detailed information on watershed functions and ways to assess them.

Data used in preparing this document came from a wide variety of sources. The Bureau of Land Management's (BLM) Geographic Information System (GIS) "base layers" provided data for many of the maps on which the document is hinged. See Table 1. The Confederated Tribes of Grand Ronde, the Oregon Water Resources Department, the Northwest Habitat Institute, the Oregon Department of Forestry, The Nature Conservancy, and the Federal Emergency Management Administration provided additional "projections" used in the maps. Additional contributors included local residents, The Soil and Water Conservation Districts (SWCD's) in Yamhill and Polk Counties, Polk and Yamhill County employees, local planners, water suppliers, and water treatment facilities.

Scientific information helps public agencies and citizens to better manage natural resources. Increasingly, management of our watershed requires a basic understanding of the link between land use and water quality. The Upper South Yamhill Watershed Assessment attempts to provide a baseline of scientific information relevant to this region.



Map 1. The Yamhill River Basin & the Chehalem Valley
In 1999, the Yamhill Basin Council began completing assessments for the eight 5th-field watersheds shown here (totalling 535,502 acres). The Upper South Yamhill assessment is the last to be completed.
The Yamhill Basin Council addresses the Yamhill River basin as well as Chehalem Valley streams even though they drain directly to the Willamette River.
North Yamhill River (113,441 ac.)
Chehalem Valley (43,399 ac.)
Yamhill River confluence with the Willamette
Lower Yamhill (63,748 ac.)
Willamina Creek (52,224 ac.)
Lower South Yamill/Deer Cr. (76,230 ac.)
Upper South Yamhill (89,397 ac.)
Salt Creek (63,143 ac.)
Mill Creek (33,920 ac.)
Yamhill County
Polk County
Watershed boundaries are determined by the landscape. All rain that falls in the Upper South Yamhill watershed flows into the upper reaches of the South Yamhill River. The North and South Yamhill Rivers join to form the Yamhill. The Yamhill flows into the Willamette, the Willamette into the Columbia, and the Columbia empties into the Pacific Ocean at Astoria.
Astoria
Portland
Coast Range
Willamette Valley
Cascade Mountains
OREGON
Watersheds on the eastern slope of the Coast Range have low summer streamflows due to the lack of snowpack. On the other side of the Willamette Valley, rivers have sustained flows through the summer.
LEGEND
The Yamhill Basin
The Oregon Landscape
Brush
Burned Areas not re-stock
Burned Areas re-stocking
Cut over area re-stocking
Cutover Areas not restock
Merchantable Timber
Non-timber Areas
Jeffrey Engfield. Yamhill Basin Council, 2002

The Yamhill Basin Council is actively trying to gather more scientific data about the Yamhill River Watershed. The YBC began collecting stream temperature data in a number of locations in the basin during the summer of 1998. In the future, the Council will try to gather other scientific information on rivers and streams in the basin. Landowners and resource managers can use this information to develop strategies for improving the health of the watershed.

Because so many factors influence water quality, an assessment can only provide the preliminary footwork for residents. Additional data, maps, and explanations of water issues are available from public agencies, the library, and fellow residents. If one is interested in learning more about any of the topics in the assessment, contact the watershed council, local natural resource agencies, or search the internet (available at the public library).

Computer software called Geographic Information Systems (GIS) provided the tools for producing the maps and many of the statistics included in this document. It is important to remember that what is on the map is an approximation of the actual conditions of the local surroundings. This is the case with all maps, satellite images, and even photographs. The maps are useful for gaining an understanding of the big picture of the surroundings.

Think of the information in this assessment as a new look at watershed conditions rather than the last word. Decide whether the local neighborhood or countryside is as healthy as one would like it to be. Consider what could be improved and how that might be accomplished.

Table 1. Examples of GIS Data Layers

- Watershed boundaries
- Streams
- Roads
- Land-use
- Land ownership
- Urban Growth Boundaries (UGB)
- Historic vegetation
- Current vegetation
- Geology
- Irrigation rights
- Wells
- Floodplain
- Debris flow risk
- Township, range, section lines
- Soil erodibility
- Wetlands, hydric soils

The Upper South Yamhill River watershed

Every square foot of land is part of a drainage basin. The area drained by each stream constitutes a watershed. Puddles and rivulets combine to form headwaters that in turn form small streams, then larger streams, and finally rivers. Boundaries between watersheds are found on high ground. The scale depends on whether one wants to address large areas such as the Willamette Valley or something more local like a nearby stream. When referring to the Willamette, the words *basin* and *watershed* are used interchangeably with *valley* because the size and shape of the Willamette basin approximates the boundaries of one recognizable valley. The words *watershed* and *basin* are fairly synonymous but *basin* is typically used for major rivers. For instance, the Columbia River basin is a huge watershed including thousands of distinct valleys of the Pacific Northwest all the way to the western slope of the Northern Rockies and a portion of Canada. In this document *watershed* refers to the Upper South Yamhill River watershed.

The Upper South Yamhill River watershed is part of the Willamette River basin in the northwestern corner of the Willamette Valley. The 89,400-acre Upper South Yamhill River watershed is a narrow valley with many steep mountain streams. Located in the eastern half of the Coast Range, it is characterized by streams that have a wide range of flow (in terms of volume) during the water year. (A water year is measured from October 1 to September 30 of the following year.) Approximately 55.75% of the drainage lies in Polk County, 42.59% is in

Yamhill County, while the remaining 1.66%—a portion of Rock Creek reaching the crest of the mountains—is in Lincoln County.

The larger streams of the watershed are the Rogue River and Agency, Rock, Rowell, and Cosper Creeks. There are many named tributaries to these major streams as well as many smaller perennial streams.

The Upper South Yamhill River watershed also includes Joe Day, Wind River, Jackass, Yoncalla, Folk, Gold, and Crooked creeks. Many epic characters of the West—Natives, pioneers, shamen, missionaries, soldiers, lumbermen, miners, and scientists—have played a role here. Today water use, land use, and the rise in importance of tourism and environmental health affect the watershed. With area forests rebounding from near depletion half a century ago and the presence of Spirit Mountain Casino—the most-visited tourist attraction in Oregon—a far-sighted vision of the future is needed. Creative re-development and natural resource management will characterize the coming decades. Many decisions with centuries-long impacts will be required.

Recognizing the desirability of local decision making, the Upper South Yamhill River watershed can be further divided into sub-watersheds. This approach not only adds citizens' voices to local and regional politics but also shifts leadership to better-informed, on-site land management. Sub-watersheds can be identified using major drainages and landmarks such as Fort Hill, Rowell/Gold Creeks, Cosper/Klees Creeks, Agency Creek, Rock Creek, Rogue/South Yamhill Rivers, and the Western Headwaters. See Map 2. Identifying one's local watershed may help to address issues shared with neighbors.

Elevations in the watershed range from about 247 feet above sea level just before Willamina Creek joins the South Yamhill River to over 3,400 feet at Rock Creek's headwaters to the south and over 2,900 feet at Agency Creek's headwaters to the north. Landscape features north of the river include Spirit Mountain (1,776 ft), Cherry Mountain (1,613 ft), the Tetons (1,592 ft), Burnt Ridge (2,798 ft), and Little Hebo (2,275 ft). South of the river are Saddleback Mountain (3,004 ft), Condenser Peak (2,855 ft), and Dorn Peak (2,849 ft) on Mill Creek Ridge.

Population

Polk County had a population listed at 62,380, and Yamhill County had 84,992 residents in 2000. See Table 2. The population living in the watershed is concentrated in the bottomlands along the South Yamhill River and faces many of the same challenges as urban communities across America. As population growth and development pressures continue at their relatively high rate, planning and far-sighted natural resource management will become more important.

Table 2. Population and Rate of Growth with Projections for Coming Decades

Year	Polk County		Yamhill County	
1900	9,923	**Increase**	13,400	**Increase**
1910	13,469	35.74%	18,285	36.46%
1920	14,181	5.29%	20,529	12.27%
1930	16,858	18.87%	22,036	7.34%
1940	19,989	18.57%	26,336	19.51%
1950	26,317	31.66%	33,484	27.14%
1960	26,523	0.78%	32,478	-3.00%
1970	35,349	33.28%	40,213	23.82%
1980	45,203	27.88%	55,332	37.60%
1990	49,541	9.60%	65,551	18.47%
2000	62,380	25.92%	83,992	28.13%
2010	69,402†	11.26%	101,152†	20.43%
2020	78,502	13.11%	119,589	18.23%
2030	87,307	11.22%	138,095	15.47%
2040	95,479	9.36%	155,779	12.81%

Figures for 1900-2000 are from the U.S. Census Bureau.
† Projections for future decades come from the Oregon Office of Economic Analysis, Dept. of Administrative Services.

The southern quarter of Willamina is located in the Upper South Yamhill River watershed; roughly 160 of Willamina's 565 acres (28%) drain to the South Yamhill River upstream of its confluence with Willamina Creek. Willamina is the only town in the watershed with an Urban Growth Boundary (UGB) and had 1,840 residents as of July 2001. The unincorporated communities west of Willamina (Fort Hill, Valley Junction, and Grand Ronde) are growing more rapidly and have about 3,450 residents combined. On any day of the year, Spirit Mountain Casino constitutes the largest community in the Upper South Yamhill watershed. With 2.5 to 3 million visitors per year, the complex averages 8,219 visitors per day.

There has been an increase in Polk County's population by 25.9% since 1990 while Yamhill County grew by 28.1% over the same decade. The annual growth rate for the state of Oregon is 2%. Polk County is growing at a rate of 2.63% annually, while Yamhill County is growing at a 2.7% clip. For reference, the City of Portland has had an annual growth rate of 2.3%. The communities of the Upper South Yamhill River watershed are growing at about a 2% increase annually.

Local planners use slightly different projections than those shown in Table 2. Polk County Planners accept figures from the Portland State University Center for Population Research. These place the future Polk County population at 80,048 in 2010 and 101,588 in 2020. Yamhill County Planners accept numbers from a private research firm that project 99,925 residents in 2010 and 116,975 by 2014. During the period 1995 to 2015, the population of the Upper South Yamhill River watershed's unincorporated communities is expected to grow by 59% to 7,713.

One of the issues facing planners is how many additional dwelling units—houses and apartments—to plan for over the next 20 years. Creative solutions are needed. According to area planners, the challenge is to establish residential needs through data analysis, public planning workshops, and public hearings. The solution will likely include establishing and intentionally expanding UGBs, which are typically set for 20 years' growth. The solution will also require other appropriate growth management measures such as revising zoning to allow additional residential options.

The Confederated Tribes of Grand Ronde is working on building a total of 325 new dwelling units to accommodate Tribal members returning to the area. Thirty-six lots for manufactured homes were completed and ready for use in November 1996. Thirty-eight new elder units were finished in August 2000 and 36 family units will be completed in 2003. Long-range plans include building 80-100 single dwelling units.

Climate and Topography

The watershed's climate is marine-influenced with extended winter rainy seasons and warm, dry summers. Snow and ice do not accumulate significantly, even at the higher elevations of the watershed. As a result "rain on snow events"—where heavy snow accumulation is followed by intensive rains—are rare. Rain falling on snow greatly increases the speed of runoff resulting in flooding. Pavement has a similar effect. In 1964 and 1996, rain-on-snow events in the Coast Range contributed to record flooding.

Rainfall amounts vary in the watershed depending on location; the higher elevations in the southwestern mountains of the drainage receive more than 160 inches of precipitation annually while the eastern bottomlands receive about 50 inches or less annually. As is typical for the west side of the Cascades, precipitation is not spread evenly over the calendar year but falls predominantly during the fall, winter, and spring months from October to June. Average annual precipitation levels appear on Map 10.

Geology and Soils

The geology of the Upper South Yamhill River watershed helps one understand the topography and history of the landscape as well as the nature of the parent material that forms the soils. It also helps one understand how stream channels formed in the area and how changes in the landscape may lead to further stream bank erosion.

Area soils have both volcanic and sedimentary "parent material" or raw material out of which the soils form. A variety of volcanic basalts intermingle with marine and non-marine shales and sandstones, as well as intrusive rocks resulting in a complex geology. The valley floor has sedimentary rock with deep alluvial deposits overlaying it.

According to area resident Dennis Werth, the Missoula Floods covered everything in the valley up to about 350 ft in elevation. He points out that these huge floods deposited granite, quartzite, and slate in the area from as far away as present-day British Columbia. The floods certainly impacted the area's geomorphology. Sediments appear to have been extensively churned before settling. Logs were buried and preserved in deep sediments later to be discovered in the process of drilling wells. It is likely that the scale of the floods resulted in stream and river channels relocating. According to Dennis, "Cosper Creek…[now] comes out through the basalt gorge at Valley Junction instead of its previous route to the west." Formerly, Cosper flowed through and likely created the valley where Grand Ronde is located (including the route of Hwy 22). The geology of the watershed is illustrated on Map 2 and described in Table 3, below.

Table 3. Geology of the Upper South Yamhill River Watershed

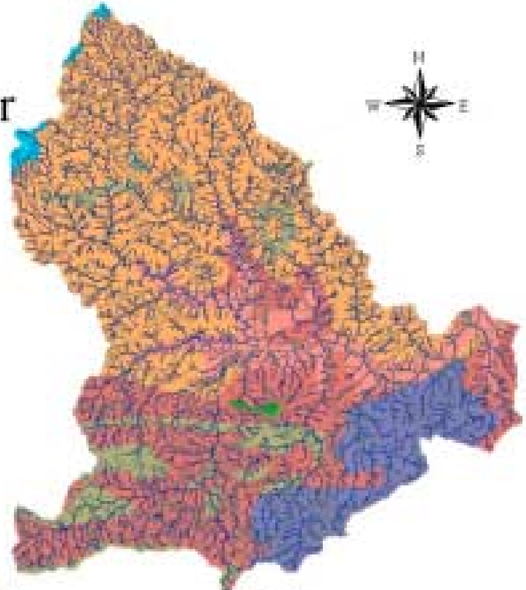
Geologic Name	Description by P-types	Location
Recent Alluvium	**Qal** (Holocene) Alluvial deposits of sand, gravel, and silt forming flood plains and filling present and former channels of streams. In places includes soils containing abundant organic material and thin peat beds.	Floodplain of the South Yamhill River
Landslide and Debris flow Deposits	**Qls** (Holocene and Pleistocene) Unstratified mixtures of fragments of adjacent bedrock. Locally includes slope wash and colluvium. Largest slides and debris flows occur where thick sections of basalt and andesite flows overlie clayey tuffaceous rocks. May include some deposits of late pliocene age.	Isolated slopes and at the base of past landslides
Mafic Intrusions	**Ti** (Oligocene) Sheets, sills, and dikes of massive granophyric ferrogabbro; some bodies strongly differentiated and include pegmatitic gabbro, ferrogranophyre and granophyre. Plagioclase and amphibole from unit yield Potassium-argon ages of about 30 Ma. Exposed section on Saddleback Mountain is over 2,000 feet thick.	Mid and high elevations in Tss and Ty areas
Alkalic Intrusive Rocks	**Tia** (Oligocene and Eocene) Sills, dikes, sticks and irregular intrusion of porphyritic or aphantic camptonite, shonkinite, and nepheline syenite or phonolite. Potassium-argon ages of 32 to 35 Ma obtained on camptonite and nepheline.	Isolated within Ty (Yamhill Formation)
Mafic and Intermediate Intrusive Rocks	**Tim** (Pliocene and Miocene) Dikes, plugs, and sills of basalt, diabase, gabbro, and lesser andesite that fed many of the miocene basalt and andesite flows in units. Some intrusions are rootless and are invasive into sedimentary sequences; includes related breccia and peperite. Includes Depoe Bay and Cape Foulweather dikes, sills, and plugs in the Coast Range. Thicknesses vary.	Higher elevations on the northwestern edge of the watershed
Nestucca Formation	**Tss** (Upper and middle Eocene) Very mixed: volcanic flows, tuffs, marine siltstone, and sandstone. Thick to thin bedded. Fine to coarse grained and at least 2,000 feet thick.	Northern ⅔ of the watershed
Siletz River Volcanics	**Tsr** (Middle and Lower Eocene and Paleocene) Aphitic to Porphyritic, vescular pillow flows, tuff-breccias, massive lava flows and sills of tholeiitic and alkalitic 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 crusts and seamounts. Foraminiferal assemblages referred to the ulitisian and penutian stages. Potassium-argon ages range from 50.7 ± 3.1 to 58.1 ± 1.5 Ma. May be up to 12,000 feet thick in the central Coast Range.	Eastern foothills of the Coast Range transitioning into the Willamette Valley
Tyee Formation	**Tt** (Middle Eocene) Very thick sequence of rhymically 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. Foraminiferal fauna are referred to the ulatisian stage. Groove and flute casts indicate deposition by north-flowing turbidity currents but probable provenance of unit is southwest Idaho. Occurs in thicknesses of 2,000 – 3,000 feet in the area of the Upper South Yamhill.	Higher elevations on the northwestern edge of the watershed
Yamhill Formation and Related Rocks	**Ty** (Upper and Middle Eocene) Massive to thin-bedded concretionary marine siltstone and thin interbeds of arkosic, glauconitic, and basaltic lava flows and lapilli tuff. Foraminiferal assemblages in siltstone referred to the ulatisian and lower narizian stages. Contains thin-bedded siltstone and minor sandstone interbeds. Up to 5,000 feet thick in the Upper South Yamhill basin.	Lower foothills of the Coast Range

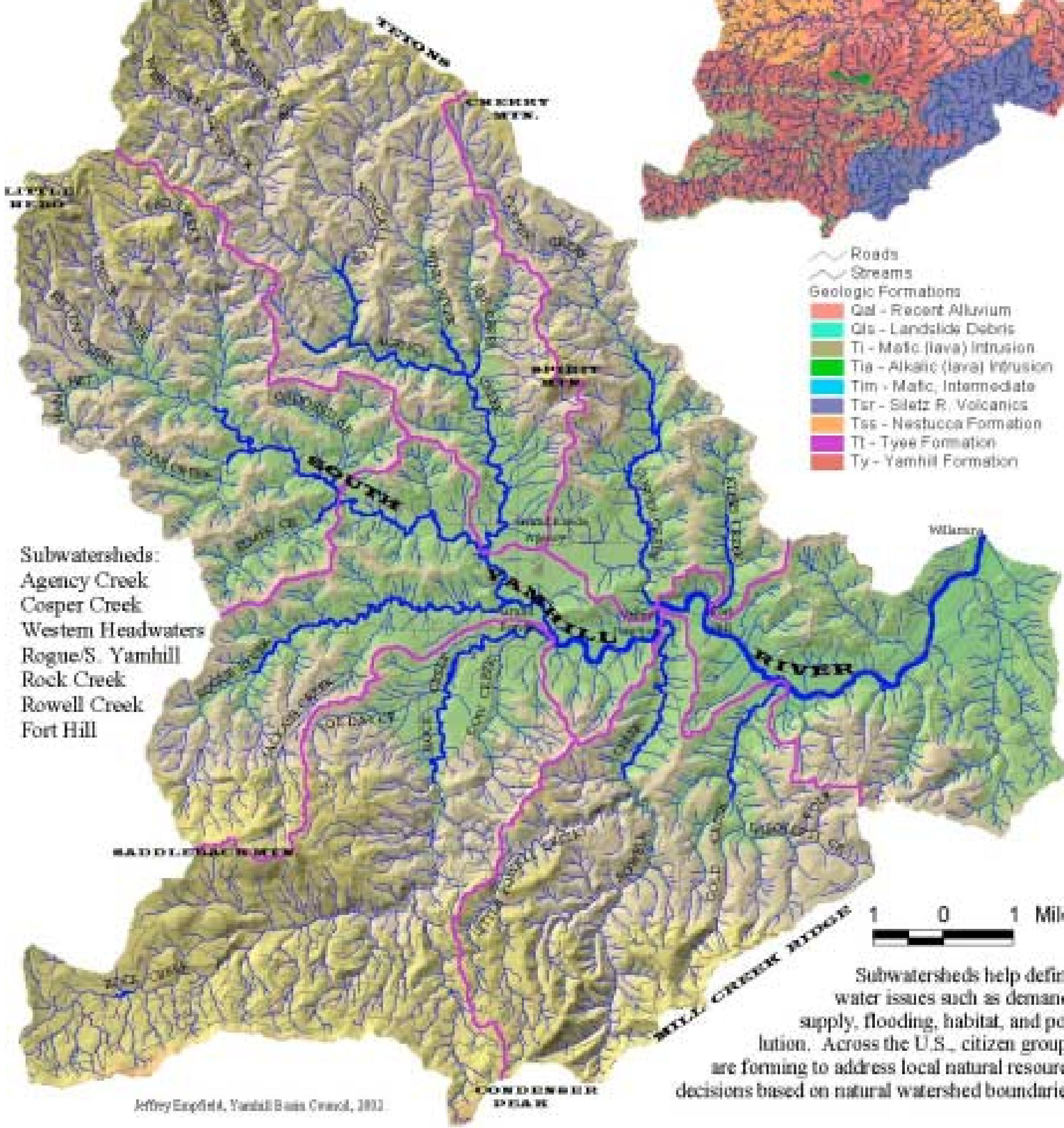
Soils with similar profiles make up a *series* or an *association*. These are useful for understanding the content and major *horizons* (thickness and arrangement) of soils. The Soil Survey of Polk County lists nine main soil associations for the Upper South Yamhill River watershed. The Soil Survey of Yamhill County lists four additional soil associations.

The eastern portion of the watershed includes the south side of Willamina and has Wapato-Cove association soils. These are poorly drained silty clay loams and clays. Along the South Yamhill River between Willamina and Valley Junction and including the area around Grand Ronde are Waldo-McAlpin soils. These are poorly drained and moderately well drained silty clay loams. Just west of Grand Ronde are Chehalis-Cloquato-Newberg soils that are well-drained and

Map 2. Geology and Landscape of the Upper South Yamhill River

Volcanic lava and ash, ocean and freshwater flooding, tectonic uplifting, and erosion have made the Upper South Yamhill a rugged landscape.





Subwatersheds:
Agency Creek
Cosper Creek
Western Headwaters
Rogue/S. Yamhill
Rock Creek
Rowell Creek
Fort Hill

Subwatersheds help define water issues such as demand, supply, flooding, habitat, and pollution. Across the U.S., citizen groups are forming to address local natural resource decisions based on natural watershed boundaries.

somewhat excessively drained silty clay loams, silt loams, and sandy loams. Both north and south of the South Yamhill floodplain are Bellpine-Suver-Rickreall soils. These are both moderately deep and shallow, well drained to somewhat poorly drained silty clay loams. Further south of Grand Ronde are Salkum-Breidwell association soils that are well-drained silty clay loams and silt loams.

In the southern uplands, south of the South Yamhill River, are a variety of well-drained mountainous soils. In the hills south and west of Grand Ronde are Peavine-Honeygrove-McDuff soils. These are deep and moderately deep, well-drained silty clay loams. Further south are broad bands of Bohannon-Astoria and Kilchis-Klickitat association soils. Bohannon-Astoria soils are moderately deep to very deep, well-drained gravelly loams and silt loams. Kilchis-Klickitat soils are well-drained stony loams and gravelly clay loams with shallow and deep parts. An area midway between Saddleback Mountain and Condenser Peak has Blachly-Kilowan soils. These are deep and moderately deep, well-drained silty clay loams and gravelly silty clay loams. The highest elevations including Saddleback and Condenser Peak are made up of Valsetz-Luckiamute association soils. These are moderately deep and shallow, well-drained stony loams and very shaley loams.

The banks of the South Yamhill River northwest of Grand Ronde are Wapato-Cove association poorly drained silty clay loams and clays. In the northern uplands, north of the South Yamhill River, Peavine association soils are found. These make up the middle elevation slopes of the Coast Range including Spirit Mountain. They are well-drained, gently sloping to steep, silty clay loams over silty clay and they are generally formed over sedimentary rock. At slightly higher elevations are Olyic association, strongly acidic silt loams over silty clay loam. The headwater areas to the north are Hembre-Astoria-Klickitat soils. These are very strongly acidic, silt loams over silty clay loam and silty clay, and stony loams over very gravelly clay loam.

In-depth information on soils, their characteristics, and locations can be found in these publications and documents developed by the Natural Resources Conservation Service (NRCS), formerly the Soil Conservation Service (SCS). To learn more about soils in this region, contact your Soil and Water Conservation District office at the following addresses:

Yamhill SWCD: (503) 472-6403	Polk SWCD: (503) 623-9680
2200 SW 2nd Street	580 Main Street, Suite A
McMinnville, OR 97128	Dallas, OR 97338

Land Use: Forestry, Agriculture, and Mining

Vegetation type is correlated with the geology and soils present in the Upper South Yamhill watershed. In the past, there have been two distinct landscape types corresponding to vegetation: the forested mountains, and a more open mix of vegetation in the valley.

The majority of the watershed's 89,397 acres are privately owned. Land use reflects this in a varied mosaic of forestry, agriculture, industry, and both residential and commercial development. See Table 4. The headwater areas are similar to much of the surrounding mountains where conifer forest dominates with concentrations of hardwood species along streams. The low-lying areas along the South Yamhill River and Highway 18 are a patchwork of relatively small, intensively managed parcels with a highly developed infrastructure. Beyond this band of residential and commercial development, forestry dominates. It accounts for most of the land in the watershed and has resulted in a thorough network of roads.

Table 4. Land Use of the Upper South Yamhill River Watershed

Land Use	Acres	Percentage
Forestry	71,902.21	80.43%
Agriculture/Forestry	15,384.82	17.21%
Low Density Residential	1,644.83	1.84%
Urban/Industrial/ Rural Commercial	464.65	0.52%
Total	89,396.51	100.00%

(ArcView analysis of County zoned uses)

From the time of pioneer settlement until recently, timber has provided the main economy in the Upper South Yamhill River watershed. Through much of the 19th and 20th centuries, a number of small sawmills employed 20 or 30 people for a period of years before being moved or replaced as local timber supplies were depleted. Although logging remains an important part of the local economy, there are now only a few sawmills operated locally.

In past decades, farmers worked hard on small dairies and grain farms nestled in the cool bottomlands of the Upper South Yamhill watershed. More significantly, the growing season is very short. As area farmer Wes Shenk points out, "agriculture is a way of life, but it's not a good living." This is particularly true given the history and climate of this valley. Land ownership in the bottomlands is characterized by many 20 and 40-acre parcels dating from when reservation lands were divided as allotments for Grand Ronde Natives around the turn of the 20th century.

Area farmer Dennis Werth explains that the climate in the Upper South Yamhill is significantly different from conditions present in areas downstream, nearer to the Willamette River. The higher elevations, numerous small valleys that retain cool pockets of air, and the proximity to the Pacific Ocean result in a much later growing season. Planting and harvesting are delayed two to three weeks. Even during the height of summer, there are cool evening breezes coming from the west around three o'clock each afternoon. Very few people make their living from agriculture in the watershed now. Currently, bottomlands in the watershed are mostly in annual and perennial grasses. Many landowners are converting their agricultural land to timber. For a more detailed outline of the area's vegetation, including historic conditions and noxious weeds, see Chapter 3.

Area quarries mine rock and gravel for road construction, fill, asphalt paving, or ready mix concrete. The Grant of Total Exemption Rule, administered by the Division of State Lands (DSL), states that person(s) disturbing less than 5,000 cubic yards and/or less than one acre in a 12-month period need not apply for a permit with the state. That means that small amounts of rock and soil can be moved legally without a permit unless one is near a wetland or body of water. In that case, DSL must be contacted for a permit.

Table 5. Current Quarry Permits Held in the Upper South Yamhill River Watershed

Number	Status	Quarry and/or Permit Holder	Type	Location
27-0002	Permitted	Gold Creek Pit, Hampton Resources, Inc.	Aggregate	6S 7W sec. 28
27-0046	Amended	Thomas Pit, Braxling & Braxling Logging, Inc.	Aggregate	6S 6W sec. 19

(From DOGAMI records office in Albany, Oregon, 2001)

If more than 5,000 cubic yards are being disturbed, a permit must be filed with the Department of Geology and Mineral Industries (DOGAMI) office in Albany, Oregon. This permitting process became law in 1974, making records of mines and quarries before that date unknown or anecdotal. For information on quarries, contact the USGS office in Portland: 10615 SE Cherryblossom Dr., Portland, OR 97216, (503) 251-3200.

Fire Ecology

For at least the past four thousand years and possibly as long as ten thousand years prior to European settlement, humans systematically burned portions of the Willamette Valley and lower elevations in the Upper South Yamhill River watershed. Biological and anthropological evidence suggests this long-established practice played a role in the evolution of valley ecosystems.

The indigenous Che-ahm-ill people of the "Yam Hills" area occupied the Yamhill Valley at the time of European contact. In the 1820s, the first white explorers in the valley reported thick smoke from widespread burning of prairies and oak savannas during the late summer. The newcomers reported that Natives intentionally torched large portions of the landscape for hunting game and encouraging development of desired plant communities. Natives had developed this system of management to help meet their food requirements. If Natives had not conducted burning, much of the prairie would otherwise have supported Douglas-fir forests.

Natural and human-caused wildfires continued to shape the landscape after European settlement, but in different ways. In the 1850s, Coast Range forests burned more than they had in previous decades while valley prairies and savannas burned less and were either turned to field and pasture or grew into young forests. There were large fires in 1902 and 1910. In 1933 the infamous Tillamook burn covered nearly a quarter of a million acres. Since the 1930s, fire suppression crews have become better trained and organized. Despite extensive efforts, wildfires continue to burn each year throughout the West.

Suppression of fire has contributed as much to the current vegetation pattern as intentional burning. The most apparent difference is that the region has less oak savanna and prairie than was present in the middle of the 19th century.

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CHAPTER 2

Historical Conditions

Introduction

This chapter is an overview of historical events that have helped shape the Yamhill River basin. By looking at the environmental history of the area—the mutual influence of nature and human activity over time—one can understand something about human interaction with the landscape. The area's history has bearing both for the area's growth and for efforts to maintain or restore natural functions essential for water quality.

Timeline:

Before Europeans arrived, thousands of Native Kalapuyan people occupied the Yamhill Valley and used small, controlled, low temperature fires as a land-management tool. The Upper South Yamhill River was predominantly forested with significant areas of wetland, upland prairie, and oak savanna.

1775 First impact of Europeans reaching the region was the smallpox epidemic of 1775 that struck coastal and lower Columbia Native populations.

1782 Smallpox entered the Willamette Valley and the Native population severely declined. Intentional burns subsequently decreased.

1812 Pacific Fur Company traders entered the Willamette Valley under the leadership of Donald McKenzie—first documented contact between Kalapuyan and European people.

1830s Severe malaria epidemic plagued Kalapuyan people.

1834 Jason Lee established a mission at Wheatland on the east bank of the Willamette. Early settlers to the Yamhill basin crossed here from French Prairie.

1843 Provisional Government established at Champoeg began regulating land claims.

1845 The Champoeg Fire swept from the Willamette Valley to the Pacific Ocean burning large parts of the Yamhill basin. It encompassed an estimated 1,500,000 acres and is believed to be the largest area of old growth destroyed by a fire in the U.S. Polk County was created from the Yamhill District. At that time, Polk County stretched to the Pacific Ocean and far to the south.

1846 The United States gained Great Britain's claim of the Oregon Territory through a treaty. Natives still have claims to traditional ancestral homelands.

1848 Last large-scale Native-set fires recorded. Nestucca fire burned area forestlands.

1850 Cynthian (Dallas) became the Polk County seat. Census indicates 243 houses in Yamhill County.

1855 Congress ratified treaty with Confederated bands of Grand Ronde.

1856 Kalapuya, Umpqua, and Takelma peoples moved to the Grand Ronde reservation.

1859 Oregon gained statehood.

1861 Large flood estimated to be comparable to 1964 flood levels.

1887 The Southern Pacific Railroad began service through the Yamhill Valley shipping a high diversity of agricultural products. Prior to this only grains could be grown for distant markets; they were shipped by steamboat down the Willamette River.

1908 Grand Ronde Reservation Agency closed. Reservation land divided among remaining tribal members. Native children began attending public schools.

1911 First tractors began to replace animals for farming and gentle slope logging.

1923 Hydraulic sheave mounted to rear of tractors, allowed line logging on steep hillsides.

1929 Southern Pacific Railroad discontinued passenger service through Polk and Yamhill Counties.

1930s The Depression greatly affected agriculture and ended the production of prunes as a major crop. Hops farmers lost their market due to prohibition.

1947 Area forests reported by the Bonneville Power Administration to be "seriously depleted."

1948 Tansy ragwort, an invasive and aggressive plant introduced from Europe, took root in the area; it quickly colonizes areas of disturbance such as cut-over areas, ditches, and overgrazed pastures.

1954 Grand Ronde Reservation officially terminated by federal government. State officials began releasing hatchery coho salmon to area streams.

1856 BIA census report for each tribe at Grand Ronde estimates Kalapuya population at 748.

1964 A large flood damaged agricultural lands. An estimated 20 million tons of loose soil washed into streams. Bridges damaged or destroyed when logjams brought the full force of the water against them.

1980s Stocking of hatchery coho salmon and rainbow trout discontinued after biologists began to question detrimental interactions between wild (native) and stocked populations.

1983 Grand Ronde Reservation re-established.

1996 Large-scale flooding throughout the Willamette basin.

1998 Winter steelhead in the upper Willamette basin listed as threatened under the Endangered Species Act. The Confederated Tribes of Grand Ronde and the Yamhill Basin Council begin stream temperature monitoring on local streams. The Confederated Tribes of Grand Ronde also begin conducting habitat surveys and collecting macro-invertebrate samples on local streams.

Natives

Natives settled in a much colder and drier steppe environment with alpine forests covering uplands. The conditions under which these first Oregonians survived underwent drastic changes over time. During the period from 10,000 to 7,000 years ago, the climate warmed. Local conditions were still quite dry compared with today and fire-resistant ferns proliferated under spruce and oak forests. Today's cool, wet climate has characterized the region for only the past three or four thousand years.

Historian Joseph Taylor points out that Natives "[L]iving in the Willamette Valley above Willamette Falls adapted to a variable environment as the numbers of salmon and other migratory fish dropped off during most of the year." As a result, local Natives began to develop a plant-based subsistence strategy by 3,300 years ago that resembled the Kalapuya of the nineteenth century. As early as 1,800 years ago, Natives relied primarily on local camas roots and also consumed fish.

Warmer conditions following the last Ice Age resulted in a trend from migratory to semi-sedentary settlement patterns. With increasingly specialized bands becoming settled in their own territories, Natives began to rely more on food storage and preservation, household-based subsistence economies, and land management for food resources. This required sophisticated knowledge about when, where, and how often to burn and harvest foods. Despite specialization and settlement, Native food consumption remained flexible. As Taylor points out, historical salmon use by Natives mirrored salmon availability. When salmon populations were low, Natives used other natural supplies.

Anthropologists believe Northwestern Natives' respect for other species, particularly food species, was important for developing careful, knowledgeable use of plants and animals. Their stories and beliefs reflect this orientation.

Natives at the time of Contact

When Lewis and Clark passed through the Columbia Gorge in 1805 they encountered a settled landscape of varied and interconnected Native cultures. They noted a lively trade network across the region in spite of population losses to smallpox that had swept through decades earlier. Many of its victims had not even seen a European person. A well-established system of trade, communication, and social organization evolved here over millennia.

Along the Columbia lived the Chinook tribes whose activity and iconography focused on the river and the bounty of food it provided. Just south of the Chinook villages were the Tualatin people—the northernmost of the Kalapuya tribes living north of the Yamhill basin. They dwelt on the cultural fringe between the Willamette Valley and the Columbia River culture groups. As Kalapuyans, the Tualatins were one of the Penutian-speaking peoples that occupied the Willamette Valley at the time of European contact. The Kalapuya were an inland people whose territory included the Willamette Valley as far north as Willamette Falls (at Oregon City) and south including the headwaters of the Willamette and a small portion of the upper Umpqua River drainage.

Each of the 13 or so Kalapuyan tribes lived as an autonomous group within their own territory—better defined as an area of influence that possibly followed watershed boundaries. Within their area the group had access to most of what they needed in plants, animals, and other resources. Oral histories have indicated that natives shared access to resources and hunting areas, and individual clans and/or families maintained certain harvest areas.

South of Chehalem Mountain, another valley of grass-covered hills was occupied by the Che-ahm-ill Kalapuyans. Here in "Yamhill" country, population density was perhaps lower than along the Columbia or the coast, but still relatively high for western Natives. The economy was less centralized and relied more on plants and seasonal migration in contrast to the settled economy of salmon fishing along the Columbia and lower Willamette.

A significant amount of cultural debris from pre-historic cultures has been collected in the Yamhill basin. More can be learned from the Oregon Museum of Anthropology in Eugene. Interpretations of their significance rely mainly on informed speculation. Basic conclusions include that of a deeply complex culture developed over a time period lasting much longer than the current historic period. More significantly, the prehistoric system co-evolved with the local ecology, relied overwhelmingly on local, renewable resources, supported a large, relatively healthy population, and was rich in leisure time, craft, and both utilitarian and non-utilitarian art.

Willamette Valley people developed Plateau-like subsistence patterns for summer months because local resources were dispersed over a wide area. They migrated during the dry half of the year, possessed less property, and celebrated fewer ceremonies than people in neighboring areas. The relative scarcity of salmon above Willamette Falls and the seasonal nature of subsistence hunter-gathering led to trading as the main strategy for procuring fish. As staple foods, camas and wapato were valuable trade items at centers located at Willamette Falls and on the coast.

Plants accounted for a significant portion of Kalapuyan nutritional intake in addition to meat. Camas was the most important of all plants; they roasted it in pit-type ovens. Other nutritionally important plants were wapato, tarweed seeds, hazelnuts, and various berry species. Natives also cultivated tobacco (*Nicotiana sp*.). They used White oak acorns but these do not seem to have been a major part of their diet. Abundant wildlife was also utilized by the Kalapuya including deer, elk, Canada geese, ground squirrels, jack rabbits, black bear, birds, fish, clams, lamprey, and grasshoppers. After countless generations of harvesting these plants and animals, Natives had learned how to benefit from them without overharvesting.

In *Steelhead's Mother was his Father, Salmon,* Joseph Taylor writes that prior to European contact, Natives "were aware of the limits of exploitation [of natural resources], and in response developed a sophisticated set of social practices and cultural beliefs to moderate their impact." So, in spite of natural fluctuations both from year to year and over long periods of time, Natives established villages and settled economies based largely on salmon and semi-wild root crops without heavy reliance on what one thinks of today as agriculture.

European Contact

When European diseases arrived, crowded winter villages proved a perfect breeding ground for diseases like smallpox and malaria. A severe epidemic plagued area Natives throughout the 1830s especially during the first three years of the decade. At the time known as the "Internment Fever," malaria was the disease that would most reduce Native populations throughout western Oregon. "Between 1830 and 1841," Taylor reports, "losses exceeded eighty-five percent." By the 1840s, when immigrant farmers brought thousands of cattle into the valley, there was little to keep them from over-running and ruining traditional Native food sources. Many Natives hid in the woods and hills to avoid contact with Europeans.

After thousands of years of settlement, the land appeared pristine to European eyes and supported more biodiversity than remains today. When Commodore Charles Wilkes visited the area in 1841 he found a well-cared-for landscape, although the significance of that was likely lost on him. Europeans had trouble seeing the value of Native ways. Like 19th century Yamhill County resident J.C. Cooper, many Europeans regarded the Natives as "neither crafty nor cunning…a quiet, indolent people." Wilkes instead focused on the land, describing the "Yam Hills" as moderate, "the tops are easily reached on horseback, and every part of them which I saw was deemed susceptible of cultivation. The soil is a reddish clay, and bears few marks of any wash from the rains"—a telling observation by someone familiar with the effects of plowing and overgrazing. "These hills are clothed to the very top with grass, and afford excellent pasturage for cattle," Wilkes concluded, and soon they would be put to that purpose. Already in 1841 on the "route through the Yam Hills," Wilkes reported, "we passed many settlers' establishments."

Grand Ronde Reservation

During the early 1850s, various Native groups from around Oregon negotiated treaties to secure small reservations that would have allowed them to remain on their ancestral land. Before ratification took place, however, a large gold rush occurred in southern Oregon leading to the Rogue River wars. Fear swept over the territory. Back in Yamhill County, Joel Palmer hastily set up the Grand Ronde reservation on a narrow prairie in the Coast Range. In July 1855, the remaining Kalapuyans ceded their traditional ancestral homelands, the Willamette Valley, and were moved to the Grand Ronde reservation the following year. By 1857, many of them had died of disease—health conditions were possibly made worse by the damper environment of the Coast Range.

Kalapuyans blended with other Native groups at the Grand Ronde reservation in a mixed society that relied on basic trade words more than their tribal languages. The 1860 census counted 9,000 Natives and 52,288 non-Natives in Oregon. By 1900, the Native population had dropped to 4,951 and non-Native numbers had increased to 417,585. These numbers do not include Natives who were hiding from the Europeans.

On the reservation, the process of cultural replacement continued. The federal agent at Grand Ronde Agency reported that Europeans tried to scare Natives into giving up and leaving by claiming that Natives' land titles were worthless. At the same time, the agent's job was to keep Natives on the new reservation. Historian Joseph Taylor said that Natives from southern Oregon were not familiar with local species and thus relied on annuities promised in the treaties in exchange for the land that they ceded. Molalas, Clackamases, Clowellas and other groups still migrated in the spring and fall to Willamette Falls to fish for salmon. The agent provided some Natives with supplies to fish the Salmon River to prevent them from migrating to and fighting with the Europeans at Willamette Falls.

Under the reservation system, the U.S. President awarded agency posts to those who had served in political parties, civic, or military service. Agents enjoyed wide powers: they hired their own employees, managed financial affairs, and reportedly enjoyed large personal profits through their position. The 1870s brought reform to the system and greater influence by missionary churches. At Grand Ronde, the Irish Catholic agent Patrick Sinnott served from 1872-85. During this period, family farms became the mainstay of the economy, many Natives became citizens, tribal loyalty gave way to reservation loyalty, and leadership shifted from chiefs to elected councils.

In terms of transforming Natives into farmers, Grand Ronde proved to be the Office of Indian Affairs' greatest success story in Oregon. Through a combination of accommodation and strategic access to markets, the Natives were "actively engaged" in agriculture by 1867. That year Grand Ronde farmers earned over $23,000 from plant crops, livestock, and poultry. Part of the acculturation strategy was the privatization of tribal land. In 1873, Natives at Grand Ronde were the first in Oregon to receive individual allotments for farming. By 1879, the agent claimed "as a rule" Natives were living by agriculture.

They accomplished this despite their old seed stock and the fact that both the agent and neighboring settlers considered reservation land "foul" for agricultural purposes. Natives compensated by focusing on the strengths of their land. The high, cool valley was excellent for growing grass so they increased their reliance on livestock. By 1881, most Natives in Grand Ronde reportedly resided on their own land and by the turn of the century the agent claimed they were virtually all independent farmers selling hay, wood, and other items further down the valley.

These reports may be somewhat overstated. Other reports suggest that a mixture of agriculture and traditional hunter-gathering continued through the 19^{th} century. In 1882, officials reported that of 3,448 Natives at Grand Ronde, Siletz, Umatilla, and Warm Springs Reservations, only 824 were actively pursuing farming. The rest "supported themselves by either laboring or subsisting by traditional means." Dennis Werth believes that work off the reservation was common by the 1870s when large numbers of Natives were absent seasonally. He explains that this was necessary "to avoid starvation because of the poor soils, the lousy weather, and the general unsuitability to make it farming in the area."

Attempts to characterize cultural practices likely oversimplify what must have been an ongoing process of compromise between the old ways and the new. In 1875, the agent at Grand Ronde reported that only a few of the oldest members clung to traditional ways. Yet two years later, access to the salmon fishery at Salmon River, game hunting, and berry gathering were listed as important elements of subsistence. Despite efforts to limit their movements, many Natives continued to travel to traditional food harvesting locations such as Willamette Falls. Other traditional practices blended well with the new market economy. In 1899, women at Grand Ronde were harvesting hazel sprouts to produce intricately woven baskets. They sold these to merchants in Portland to help support their families.

European Settlers

The area that now includes Yamhill and Polk Counties was home to many of Oregon's earliest European settlers who began arriving in significant numbers in the 1840s. The greatest proportion were Europeans from eastern states that had already moved to the Midwestern frontier. In many cases, pioneers spent a few years in places such as Kentucky or Ohio before embarking on the Oregon trail. Many were enticed by lavish descriptions of Oregon and the promise of free or cheap land.

There were various rules of the provisional government aimed at limiting single family holdings to a reasonable acreage. Limits were needed due to land speculation. Indeed, some settlers came to Oregon specifically to get rich by speculating on land, a process they believed would take no more than ten years. University of Oregon geographer Jerry Charles Towle writes that "[w]hatever the intention of Congress, there is little doubt that the settlers themselves intended to sell a portion of their grants, and hoped for extremely high returns." Unfortunately for the speculators, a high demand for these excess acres never developed in the 19th century. As late as 1899, for example, some 40,000 arable acres were not in production in Yamhill and Polk Counties.

By 1850, Oregon had an official population of 11,952—nearly all of those counted were residing in the Willamette Valley. Many of these were Natives but undoubtedly not all Natives were counted. Significant numbers of settlers came from all regions of the United States. Consequently, no single agricultural tradition was transplanted to the Willamette Valley. This resulted in a unique system where each farmer held unprecedented numbers of cattle and horses. The relatively large land claims of prairie and savanna made this possible. Area farms of the 19th century were typically over 200 or 300 acres. This was dedicated mostly to woodlots with some field cropping and pasture for cattle, sheep, hogs, and horses. The valleys filled up rapidly with cattle herds pushing into the hills of the Upper South Yamhill River.

Soon after pioneers arrived, they began traveling up the South Yamhill River to cross over into the Nestucca drainage. In 1837, missionaries Jason Lee and Cyrus Shepard and their brides used the Old Elk Creek trail to visit the coast from their mission near present day Wheatland. James Quick and his family were the first Europeans to take this route for the purpose of homesteading. They settled in the Tillamook area in 1852 and were soon followed by others. The Tillamook pioneers initiated an effort to improve the trail; settlers worked on it from both ends.

Use of the trail increased in 1856 as a result of the establishment of the Grand Ronde and Siletz reservations; the U.S. military used the trail—now called "The Road to the Coast"—for patrolling the area and for traveling between the reservations. In 1864, Yamhill, Polk, and Tillamook counties improved the trail and started charging for its use as a toll-road. Even so, the route remained only marginally passable through the early decades of the 20th century. Just west of the Upper South Yamhill River watershed is an area called Boyer Flat, the site of an overnight hotel and toll-gate operated by John and Julia Boyer from 1908 to 1920. In 1930, Oregon completed Highway 18 following the historic trail.

The Forest

Jane Claire Dirks-Edmunds recounts her decades-long research in the headwater forests of the Coast Range in *Not Just Trees: The Legacy of a Douglas-fir Forest.* Dirks-Edmunds first saw the area surrounding her study site on Saddleback Mountain as a sophomore at Linfield College.

> "On that day December 30, 1933, the only visible breaks in all that expanse were tiny clusters of buildings that formed the towns…We had scrambled from the trail nearby to reach this promontory near the top of 3,200-foot Saddleback Mountain and now stood in awed silence, hearing only the sighing of wind-stirred trees."

James Macnab, a research biologist from Linfield College, explained to his students that the coastal forest stretched from San Francisco to Alaska and contained ancient Douglas-firs, hemlocks, spruces, cedars, true firs, and redwoods. "It's a living being," he explained, "sheltering and sustaining a vast array of unknown animals and plants." Though she had been to the forest many times, Jane Claire had never seen such an endless display of huge conifers.

The researchers' earliest observations consisted of ecological inventories in old growth and burnt areas. They tracked where fires had occurred by noting the smaller trees that were only 50 to 100 years old. "The Tillamook fire of last August destroyed a lot of trees like these," Professor Macnab explained, "and studies have shown that similar burns, probably caused by lightning, have long been occurring in these forests." Periodic fires, landslides, windstorms and other natural disturbances are partly responsible for the survival of Douglas-fir-dominated forests of the Coast Range. Douglas-firs often live for hundred of years but their saplings do not do well in the shade of closed-canopy forests.

In 1940, the research site on Saddleback Mountain was clear-cut; over the following decades Jane Claire and others chronicled successive stages of re-vegetation. Their observations are summarized in Chapter 3 on Vegetation. In 1998 there was a new clear-cut on the site, once again favoring pioneer species that thrive on disturbance.

Area forests have improved over the past fifty years. According to a 1947 Department of the Interior report, the forests of the area were "seriously depleted" and the number of jobs in forestry and wood products was expected to drop due to "reduced lumber production resulting from exhaustion of local timber supplies." In 1942 the Forest Service classed 51% of the area as forestland, 48% as agricultural, and 1% as waste. Nearly half of the forestland contained immature conifers in 1947 while only one-fifth represented saw-timber; the rest was cut over or deforested by fire.

Recreation

Historically, Yamhill and Polk Counties have not emphasized establishment of parkland. In 1966, Yamhill had 13 parks totaling less than 60 acres with a budget of $12,000. That's less than 40 cents per resident at a time when other counties in Oregon were spending over $3 per capita on parks. Since then, the Yamhill County Parks acreage has increased to over 81 acres. The budget has increased to an estimated $110,000 annually through an arrangement between the Parks department and the County Corrections department. In 1990, the Polk County Comprehensive Plan reported 16 parks totaling 208 acres. Increasing urbanization and the growth in popularity of recreation have resulted in a growing demand for facilities. Robin DeForest of the Polk County Parks Department explains that the county now manages 17 parks with over 700 acres. Twelve are operational for day use by the public.

Interest in improving the quality of life in the area has increased through recent decades. Designated recreational opportunities remain rare, however, by Oregon standards. Hiking and horse riding trails remain scarce. Recognizing that opportunities exist in the growing outdoor recreation industry, area leaders have established rest areas and parks along roads adjacent to streams.

Basin residents can look forward to having additional recreation outlets in coming years. The Oregon Parks and Recreation Department (OPRD), in cooperation with the Confederated Tribes of Grand Ronde (CTGR), is currently developing historic Fort Yamhill near Valley Junction as a

State Park interpretive center. Completion is slated for 2006 in time for the fort's sesquicentennial celebration. Established in 1856, Fort Yamhill was one of four military posts whose purpose was to both contain and protect Natives at the newly formed reservations. OPRD, the Tribal Council, and casino staff are working together to develop the Fort Yamhill site in the context of ancestral Natives. The site is located approximately 2 miles north of the Spirit Mountain Casino. Over the past decade, OPRD has been developing plans for the state-owned portion (52 acres) of the site. Recently, the Confederated Tribes of Grand Ronde acquired a key parcel (113 acres) that will provide parking and other staging for public access. For more information, contact Kristen Stallman, Oregon Parks and Recreation Department, Master Planning Coordinator, 1115 Commercial St NE, Suite 1, Salem OR 97301, 503-378-4168 x328, kristen.stallman@state.or.us

According to Yamhill County Parks Coordinator David Primozich, efforts are underway for establishing a campground and trail facility just west of McMinnville. The Coast Range Equestrian Trail Association (CREST), a local citizen group, is seeking input from interested parties. Next, an environmental assessment will need to be completed and then the design will need to make its way through the BLM approval process. This process may take as much as five years. If successful, it will mean the first public camping sites in the county and a new 10-mile loop trail.

Each county's share of the Oregon State Parks fund is based on the number of recreational vehicles registered and the number of public campsites available in the county. As a result of having campsites, several counties in western Oregon have parks budgets running up to several million dollars. Not only do they collect fees from campers, but their share of the State Park Fund increases for every campsite in the county. Polk and Yamhill Counties do not currently have any campsites.

With the opening of Spirit Mountain Casino in 1995, much-needed economic benefits of tourism came to the area along with new challenges related to development, traffic, storm water run-off, and water quality. The mission of the Spirit Mountain Development Corporation is "to establish economic self-sufficiency, develop the local economy, and to create resources for future prosperity of the CTGR, while preserving both the environment and its members heritage and customs." In support of this, future development will need to include measures to sustain watershed health. Transportation is a prominent issue, as the casino receives millions of visits annually.

Additional outdoor-oriented destinations would contribute to a more diverse economy. The area is well-suited to this due to its natural beauty—the dozens of waterfalls for instance—and the burgeoning population of outdoor enthusiasts living in Oregon.

Conclusion

The Native Che-ahm-ill group of Kalapuyan people were part of a distinct upper Willamette Valley culture that had close ties to the people along the Columbia and some contact with coastal and southern Oregon cultures. They relied heavily on plant foods, secondarily on meat, and very little on salmon. Natives managed the watershed, in part, with late summer burning. The majority of the Upper South Yamhill River watershed—nearly 87%—was forested in pioneer times. The remaining 13% was savanna, prairie grassland, and brush.

European settlement brought an end to intentional burns resulting in bottomland areas becoming more heavily forested, mostly by Oregon white oak and Douglas-fir-dominated woodlands. Forestry has been important to the area throughout recent history and will continue to be an important source of jobs. Tourism is increasingly important and should be guided by far-sighted goals to maximize benefits while avoiding the pitfalls of development and economic booms.

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CHAPTER 3

Vegetation

Introduction

This chapter covers the historic and current vegetation in the region. Between 80 and 90 percent of the Upper South Yamhill River watershed is devoted to forestry and is in various stages of re-growth. Historically, the watershed was predominantly old-growth Coast Range forest with a patchwork of burned or windblown areas and intentionally burned areas at lower elevations. The composition of species and plant communities has changed significantly in the bottomlands following pioneer settlement. In forested uplands, native species seem more resilient to repeated harvesting and remain in various stages of development.

Historic Vegetation

Much of what we know about the region's native vegetation comes from accounts by explorers, early newspapers, and letters and diaries of settlers. Early botanical analysis also helps to illustrate historical vegetation patterns. Writing in 1902, J. E. Kirkwood explained that in the 50 years since pioneer settlement, most of the lowland forest had been cleared with the exception of riparian areas. Kirkwood noted that a "remnant of the forest remains along the banks of streams whose location and course may by this means be determined from a distance." Oak forests had already taken on the appearance they have today. "*Quercus* [oak] usually forms groves by itself," Kirkwood reported, "and does not grow so well in the open forest of *Psudotsuga* ["false fir," or Douglas-fir, what Kirkwood called a Douglas spruce] as do some other deciduous trees." The swale areas "possess some peculiarities worth noticing" such as "a luxuriant undergrowth of *Fraxinus* [ash], *Crataegus* [hawthorn], *Spiraea* [hardhack], *Amelanchier* [saskatoon], *Acer* [maple], *Salix* [willow], etc." Native-set fires were important since at least 1647 but ceased after 1848, according to tree ring analysis.

Kirkwood went on to recount the rapid reforestation that occurred after burning ended:

> "It is said by the older inhabitants that before much immigration had taken place, considerable areas of land in the Willamette Valley were covered only by large isolated trees and a luxuriant growth of grass, a condition, as they say, maintained by the Indians. As parts were fenced off by the settlers for cultivation, the rest was neglected and soon sprang up to undergrowth which one sees today as a forest of young trees fifty feet or more in height.
>
> "A tract of land which was under the writer's own observation in 1884, was then almost entirely devoid of undergrowth, the growth having been cleared off and burned a few years previous. In the summer of 1901, however, this tract was…covered with an almost impenetrable growth mostly of *Psudotsuga*, about twenty feet in height."

Although riparian forests had dense undergrowth they were dominated by large Douglas-firs with widely spread branches suggesting the dense undergrowth was not historically present. The growth pattern of the mature Douglas-firs also suggests that there was an open canopy or savanna present in the time prior to pioneer settlement. Kirkwood wrote that small streams, such as those in the Upper South Yamhill River watershed, previously had less dense riparian vegetation. "The valleys of streams tributary to the Willamette that head in the Coast Mountains," he wrote, however, "are flanked in their upper parts by forests."

Table 6. Upper South Yamhill River Watershed Natural Vegetation Patterns

Natural Patterns	Historic Vegetation Categories for the Upper South Yamhill c.1850
Riparian forest 2,011.42 acres, 2.25%	• Ash swamp and ash swale with red alder. • Ash-mixed deciduous riparian forest with red alder and willow. • Swamp, composition unknown. • White oak-ash riparian forest, sometimes with ponderosa pine. • Red alder-mixed conifer riparian forest.
Prairie 8,939.65 acres, 10.0%	• Upland prairie, xeric. • Seasonally wet prairie.
Savanna 13,463.12acres, 15.06%	• White oak savanna, some fir and pine. • "Scattering" or "thinly timbered" white oak woodland, brushy. • Scattering or thinly timbered Douglas-fir-white oak woodland.
Burned/windblown forest 23,627.5 acres, 26.43%	• Closed forest, but burned with scattered trees surviving fire. • Closed forest, storm-damaged (broken limbs, windfall).
Conifer-dominated forest 22,206.09 acres, 24.84%	• Conifer woodland; various combinations with Douglas-fir. • Douglas-fir forest, often with big-leaf maple, grand fir. • Douglas-fir woodland or "timber" often with big-leaf maple, alder. • Mesic (moderately moist), conifer forest, deciduous understory.
Brush 911.84 acres, 1.02%	
Unsurveyed forest 18,236.89 acres, 20.40%	
Total: 89,396.51 acres	

(ArcView analysis of Government Land Office records)

Another indication of pre-settlement vegetation comes from Government Land Office surveys conducted in the 1850s. At that time surveyors were establishing section lines and took notes on the landscape and vegetation they encountered as they crisscrossed the valley. Although some areas were homesteaded with fields planted to crops before the surveys began, most areas were surveyed before or concurrently with settlement. At the end of each mile, the surveyor provided a summary of the vegetation, soil, and geography. When they completed examining each township (36 sections), they wrote an overall description of the area. Douglas-fir was the most common "witness tree" marking corners. Oak, pine, and maple were also common.

Although surveyors' botanical knowledge was imperfect and note taking was not standardized, their descriptions allow people today to reconstruct historic patterns. Map 3 is based on the original survey descriptions now kept at the BLM office in Portland. The map shows the approximate vegetation of the watershed prior to European settlement. Generalizing the vegetation of the watershed can help one understand basic natural patterns; similar descriptions of historic vegetation are combined in Table 6.

There are four main types of natural habitat in the Willamette Valley[1]—riparian forest, prairie (wet and dry), oak savanna, and woodlands. Conifer forest is the dominant habitat type in the Coast Range. These habitats evolved in response to both natural conditions and human presence

[1] The Willamette Valley is a distinct "ecoregion" according to current thinking in the biological sciences. There are nine such regions in Oregon. They are useful for developing best management practices to areas with similar ecology or conversely for understanding how conditions differ from one region to another.

and are currently evolving in response to fire suppression, repeated logging, and development over the last century and a half.

Upland Forest

In prehistoric times, forests of the Upper South Yamhill were different than today. Mature, large conifers typified the watershed even in burned or windblown areas. The primordial forest remained into the early 20th century. Map 3 indicates that dense conifer forest was dominant in the southern uplands of the watershed and in the western headwaters of the South Yamhill River. North of the river, mature Douglas-firs helped form a closed canopy even where the understory had burned prior to 1850. Douglas-fir was common in bottomland stands intermixed with broadleaf trees along rivers and streams. Conifers are still found in riparian areas but are associated more with uplands; they have spread into areas that were formerly prairie and savanna.

In upland conifer stands, common understory plants include sword fern, salal, Oregon grape, and red huckleberry. Gaps in the canopy provide light and moisture for understory species such as shrubs, hardwoods, and herbaceous ground cover. More mature stands generally support less understory vegetation than do both clearcuts and oak-dominated forests; the closed canopy of larger conifers and the high density of young trees established after cutting or intense fires shade out understory plants.

Phellinus weirii is a native root fungus that causes laminated root rot in Douglas-fir trees, eventually killing them. Infected trees are vulnerable to "windthrow" or blowdown due to weakened roots. This is a bigger problem in the more mountainous and heavily forested areas in the Coast Range.

Standing dead trees (snags) provide habitat for many birds and animals as well as eventual coarse woody debris for streams. This is important in many of the larger bottomland riparian forests where more conifers are needed for providing large woody debris.

Jane Claire Dirks-Edmunds, a retired Linfield College biology professor, studied the Upper South Yamhill forest for decades starting in the 1930s. At that point she was a student assisting Professor Macnab with investigating the ecology of the Coast Range. She writes in *Not Just Trees: The Legacy of a Douglas-fir Forest* that significant vegetation changes occurred in her study area after it was clearcut in 1940. Though she lamented the loss of her research forest, she soon realized that the situation offered unique opportunities for further study. She and her assistants observed the plot for years, charting its revegetation and succession. What they learned has relevance for the succession currently occurring on local timber land.

Soon after being clearcut, the research area experienced an intense fire. Jane Claire writes:

> "Though the burning may have been done by the owners, a procedure essentially required in those times due to liability laws, we were told that a thunderstorm had passed across the mountain shortly after the choice logs had been removed. It looked as though a bolt of lightning had struck…the fire had swept upward through much of the study area. It was so intense…that it burned through needles, cones, and tinder-dry debris down to the mineral soil and charred logs, stumps and the bases of ancient trees…as well as…low

> plants and the duff and litter of the forest floor. In all, that fire had heavily burned or at least touched about two-thirds of the study site."

The most intense flames left only a few tiny seedlings and some very small moss plants. Less intensely burned areas and scattered areas that escaped the flames altogether retained their original ground cover but also now had wood groundsel and fireweed taking root among the herbs and shrubs more typical of forested areas.

Jane Claire observed that herbs such as vanilla leaf and sword fern became yellowed from increased exposure to sunshine and general increased dryness of the soil. Remarkably, all the forest species that were present before being logged had survived the first year. She explains:

> "[E]ven after disturbances as devastating as this, forest and other plant communities are capable of eventually returning to a state somewhat similar to their previous successional status through a series of stages during which assemblages of plants gradually replace one another, a process known as plant succession. Still I was amazed at how rapidly the community of life changed as one group of plants followed another."

In 1942, the second year after logging, herbs such as wood groundsel covered the ground—especially in the burned areas. A few seedling red elderberries and thimbleberries also found the more open conditions favorable. Jane Claire called this the "weed stage of succession."

Next came the "weed to weed-brush stage" that characterized the period from three to five years after disturbance. Jane Claire observed thicket lotus replacing the groundsel in many areas. Over the next several years, mostly brushy plants such as ocean spray, alders, thimbleberries, and salmonberries overcame the weeds.

Seven years after disturbance, willows and alders, "some as much as fifteen feet tall," dominated all but the few older "wolftrees" that had survived and were now reseeding the slopes. Young Douglas-firs and hemlocks reached 10 feet in height. "Wherever logging had not disturbed the ground cover," Jane Claire observed, "salal thrived, red huckleberry bushes formed dense patches, and the little hemlocks present before logging made a spurt in growth." The young forest was now passing from the "weed-brush stage into a brush and seedling conifer stage of succession." In the winter of 1947, a storm blew over many of the remaining "forest giants" creating craters where the topsoil was pulled up by the large roots of the trees.

Ten years after logging, a "brush and seedling conifer stage was well established," Dirks-Edmunds recorded. Elderberry bushes, clusters of ocean spray, salmonberry canes, and many blackberry thickets created a mixture of bushy plants under the scattered young conifers. Willows and alders measured about twenty feet high and one bitter cherry was nearly fifteen feet high. "The ancient firs had done a good task of producing seeds," the researchers found. "Their seedlings grew rapidly, after a few years during which root systems became established, some as much as forty inches in a year."

Seventeen years after logging, the "young forest had become impressive," Jane Claire declared, even though it was very different from the mature forest found before logging. Nineteen years after logging, many of the windfall craters and other openings in the canopy were choked with salal and wispy huckleberry. On steep north slopes these openings were more moist and supported mosses, ferns, starflowers, violets, bleeding hearts, and a few other forest herbs. In two large openings, fireweed, bracken and sword ferns, salal, and Oregon grape formed thickets. "Butterflies, bronze flea beetles, and other insects we had never seen there before, as well as some familiar insects were busy on the blossoms," Jane Claire writes.

> "This young forest not only looked different, it felt different and it smelled different. Fragrances of the abundant flowers contrasted with the resinous aroma of conifer boughs. The forest also sounded different—new bird songs regaled us and some familiar songs were missing."

Incomplete understanding of the forest limits the ability to successfully manage it. Even best-intentioned efforts sometimes fail as a result. For instance, the Van Duzer corridor along Highway 18 was set aside as a scenic stretch of old growth in the mid-20th century. Historical photos show truly impressive-sized trees. As local researcher Dorothy McKey-Fender knows, this narrow band of trees was vulnerable from the onset. She writes:

> "…wind-driven rain soaks the forest floor. Rivulets of water course down the furrowed trunks. The storm flails the forest until at last this giant, its overburdened crown, taxed by the extraordinary weight of water-laden branches, its roots in soil already wet from months of rain, now saturated, catches an unusually strong gust and crashes, leaving a scar in the sodden earth and crushing lesser trees which lie in its path."

Unfortunately, managers responsible for the Van Duzer corridor didn't account for the effect of wind on isolated giants. Most of the large trees have blown down and today only moderately sized second growth trees line the roadway.

Dorothy McKey-Fender also assisted with the 1930s research on Saddleback Mountain as a student at Linfield. She explains that the original site was chosen as a typical forest for the region. It was sub-climax, mostly Douglas-fir with some noble fir and hemlock. The coast range, high elevation climax forest would have been mostly noble fir.

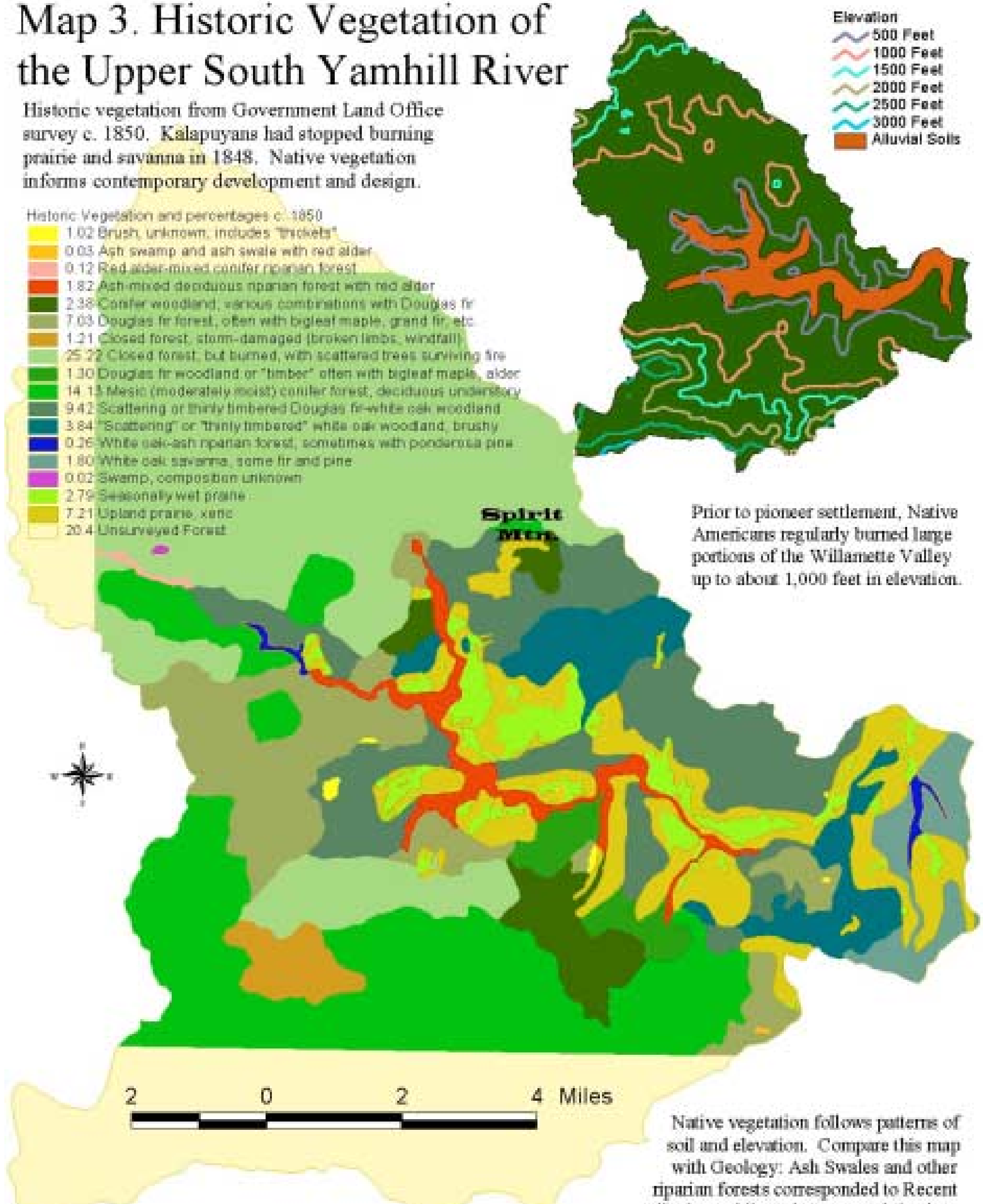
Riparian Forests

Nearly all bottomlands in the Upper South Yamhill River watershed are residential, agricultural, or forested lands. Major creeks of the watershed drain these more level lands. Although these areas no longer contain their historical diversity of species, they still provide essential habitat for fish and wildlife. Vegetation reduces the velocity of surface runoff and filters water before it enters streams, essentially creating buffer zones between land uses. Riparian corridors also create continuous strips of open space running considerable distances through residential and agricultural areas.

In the past, area streams and rivers had extensive floodplains with closed-canopy forests of deciduous Oregon ash, alder, black cottonwood, big-leaf maple, and conifers such as Douglas-fir, and grand fir. Western red-cedar may have been present occasionally but since it is a fire sensitive species, it would not have been common. Regular burning by natural and human-set fires would have affected riparian forests but the higher levels of soil and plant moisture likely made them resistant to intense burning. Riparian forests extended over large parts of the floodplain and transitioned into wet prairies.

Map 3. Historic Vegetation of the Upper South Yamhill River

Historic vegetation from Government Land Office survey c. 1850. Kalapuyans had stopped burning prairie and savanna in 1848. Native vegetation informs contemporary development and design.



Prior to pioneer settlement, Native Americans regularly burned large portions of the Willamette Valley up to about 1,000 feet in elevation.

Native vegetation follows patterns of soil and elevation. Compare this map with Geology: Ash Swales and other riparian forests corresponded to Recent Alluvium while Oak Savanna thrived on well drained marine sediments.

Bottomland areas have been intensively managed for agriculture and development. Riparian forests now typically consist of narrow strips along streams. In many areas, non-native Himalayan blackberry and Scotch broom dominate, exacerbating the problems of diminished biodiversity, habitat, and understory growth. Once they are established, it is very difficult to remove them and re-establish native vegetation. Where large woody plants are present, the dominant species are usually red alder, big-leaf maple, and willow intermixed with second or third-growth conifers.

Historically in the hilly parts of the watershed, riparian tree species included alder, maple, and Douglas-fir. Steeper stream gradient and less frequent fires characterized the higher elevations where mixed-forest riparian corridors have been logged. These areas are now primarily red alder and other pioneer species that thrive on disturbance. Scotch broom is particularly problematic in the upland parts of the Coast Range especially along roadsides and within clearcuts.

Under natural conditions, streams in relatively flat valley bottoms develop a meandering pattern that changes over time and includes sections of braided channels. Where beavers are present, their dams slow the water and trap sediment. As beaver ponds fill, new channels typically form carrying the current around the obstructing dam. This also leads to the creation of multiple side-channels and a variety of habitats. Other obstructions such as fallen trees slow and reroute the water, forming multiple shallow channels. Log jams and dense riparian vegetation slow and spread floodwaters over the floodplain. Sediments then have time to settle out and accumulate, enriching floodplains. Seasonal inundation of floodplains also serves to recharge groundwater. This is beneficial because groundwater is the main source for summer flows where there is a lack of snowmelt. These conditions are prevented in many parts of the Yamhill basin due to downcutting and straightening of streambeds, artificial drainage, and beaver removal.

Forested riparian areas, especially those with large conifers, provide shade to keep stream temperatures cooler as well as providing large woody debris for slowing flow and increasing habitat complexity. Unfortunately, forest cover is now absent from portions of the watershed and the trees that occupy riparian corridors are often too young to provide adequate woody debris in stream channels.

Prairie, Wet and Dry

Prairies dominated the Willamette Valley in prehistoric times and reached up the South Yamhill River as far as Grand Ronde Agency. Approximately one third of the prairie was described as "wet prairie" in surveyors' notes. The tall perennial tufted hairgrass (*Deschampsia cespitosa)* is a good example of a native prairie species; it is well adapted to both periodic fires and wetland or "hydric" soils—soils that are inundated for a significant part of the year. Hairgrass was an important source of forage for animals when it was more common. Today it remains only in isolated remnants of prairie and where it has been reintroduced in restoration projects. Numerous species in the lily family co-evolved with Natives in the valley. Natives cultivated them in semi-wild settings for centuries. In addition to benefiting from periodic weeding and selection, the lilies became well adapted to the annual burning practices of the Kalapuyan people. The fires knocked back the more competitive grasses and released nutrients that allowed the lilies to flourish. Although many members of the lily family were utilized, the primary edible species were common camas (*Camassia quamash*) and great camas (*Camassia leichtlinii*).

Camas forms bulbs that Natives harvested and processed as a staple food that could be stored through the winter.

The Kalapuya burned prairies throughout the valley and into the foothills of the Coast Range to elevations of 1000 feet. See inset on Map 3. Author Robert Boyd has reconstructed a likely scenario for burning:

"In late spring and early summer the Indians were probably concentrated at "primary flood plain" sites in the wet prairies, where root crops such as camas were collected and processed. There was no burning at this time. During midsummer (July and August) the focus shifted to the dry prairies, and "narrow valley plain" sites were more intensively occupied. Burning in July and August was apparently sporadic, most likely occurring after the harvesting of seasonally and locally available wild foods (grass seeds, sunflower seeds, hazelnuts and blackberries), in limited areas. The intermediate effect of the early burns would be a "cleaning up" process; the long-term result would be to facilitate the re-growth, in future seasons, of the plants involved. In late summer fire was used, on the high prairies, as a direct tool in the gathering of tarweed and insects. This was followed, in October, by firing of the oak openings after acorns had been collected. Finally, from the "valley edge" sites, the Kalapuya initiated large-scale communal drives for deer, which provided a winter's supply of venison. The sequence ended as they returned to their sheltered winter villages along the river banks."

(Robert Boyd, *Strategies of Indian Burning in the Willamette Valley*.)

In both wet and dry prairies, shrubs and small trees such as hazel, serviceberry, and cascara were present. These plants are also well-adapted to burning which consumes the woody, above-ground parts of the plant encouraging a burst of sprouts the following spring. This re-growth was likely a major source of fiber for Native clothing, shelter, and baskets.

Oak Forests and Oak Savanna

The Oregon white oak (*Quercus garryana*) is found on drier soils in many parts of western Oregon (covering about one million acres) from lower elevations in the Coast Range to the western slopes of the Cascade Mountains. It is slow-growing compared to other deciduous trees and thrives where conifers are limited by low soil moisture. Clear evidence of this can be seen by comparing the geology of the Upper South Yamhill River watershed with its historic vegetation patterns. White oak dominated (and in many areas still dominates) hilly areas with well-drained volcanic and marine substrates. See Maps 2 and 3.

Oregon white oak occurs in two forms: forest and savanna. The majority of existing trees developed under forest conditions. These "forest-form" trees are relatively tall, seldom exceed 60 centimeters (23.62in.) in diameter measured at breast height (dbh), and have ascending branches clustered near the crown. Their crowns form a closed canopy. The average age of mature forest-form trees (in 1968) was 90 years with an age range of 47—135 years.

Scattered through the forest and remaining in some fields are a few large relic Oregon white oaks developed by centuries of controlled burns in non-forest conditions. These "savanna-form" trees generally exceed one meter (39.37 in.) dbh and their boles are short in relation to the total height of the tree. They have massive branches and spreading crowns and are usually spaced so the crowns do not touch. There is an average of 17 savanna-form Oregon white oaks per hectare (2.471 acres) in remnant oak savanna forests of the region. In 1968, their annual growth rings indicated an age range of about 260—310 years. Other studies indicate Oregon white oak may live over 500 years and reach 90cm (35.43 in.) dbh at only 250 years of age.

Many lower elevations of the Upper South Yamhill River watershed currently have forests dominated by both oak and Douglas-fir. Pacific madrone, another dry-soil tree, often occurs in large stands within oak-dominated forests. Western poison oak is common in the understory. Oak forest animals such as acorn-loving western scrub jays and western gray squirrels are often present.

Historically, oak savanna covered a large portion of western Oregon and at least 15 percent of the Upper South Yamhill River watershed. It remains today primarily in isolated remnants on wildlife refuges or in thin bands where more dense oak woodlands transition into agricultural and residential areas. Savanna is characterized by mixed grasslands covering rolling hills with large, spreading white oaks as the dominant tree. Black cottonwood, red alder, and Oregon ash are also sometimes present. The open canopy has since closed in to create oak-fir woodlands.

Older, dead, or dying Oregon white oak trees provide more "cavity" habitat than any other vegetation in the area. Twenty-eight bird species, including the white-breasted nuthatch and the black-capped chickadee, seek out these cavities.

A newly discovered oak disease called "sudden oak death" has been gaining attention for attacking a variety of oak species in northern California and southern Oregon. University of California at Davis plant pathologist David Rizzo points to a novel fungus related to the organism that caused the Irish potato famine of 1845-50 and the recent deaths of Port Orford cedar trees in the Northwest.

The fungus produces enzymes that dissolve trees' bark. As the disease progresses into the wood, the tree becomes vulnerable to bark beetles. The fungi move around by spores that can easily travel in infected wood and soil, on tires, hikers' shoes, and on animals' feet. "Preventing the movement of soil and wood will be critical to slowing the spread of the fungus to other oak woodlands," Rizzo says. "In particular, firewood and soil should not be moved from [potentially infected] areas." Any wood already moved elsewhere should be burned.

Current Vegetation

Current land use in the watershed and vegetation in the eastern portion of the drainage are shown on Map 4. Current zoning designations appear on the large map; acreages and percentages for these categories appear in Table 7, below. The basis for the inset is a 1998 study conducted by the ODFW Ecological Analysis Center and the Northwest Habitat Institute (NWHI). They mapped 90% of the Willamette Valley through field surveys and the remaining 10% using aerial photos. Their estimated accuracy is 85% for Polk County and 83% for Yamhill County.

Historic conditions provide a benchmark for the scale of change resulting from modern land management. "Wet prairie" or wetlands, for example, are now increasingly rare. Much of the watershed's wetlands were previously located in bottomlands—what is now developed or cultivated land—and have been tiled or paved over the past century and a half. The lack of fire has allowed Douglas-fir to expand its range into lowlands while upland forests are more mixed with many large patches of even-aged stands.

Table 7. Current Land Use in the Upper South Yamhill River Watershed

Zoned Land Use	Acres	%	Zoned Land Use	Acres	%
Ag-Forest 10	1,587.09	1.77	Acreage Residential 5	1,584.27	1.77
Ag-Forest 20	2,240.29	2.51	Fort Hill	51.25	0.05
EFU-40	93.46	0.11	Grand Ronde	34.34	0.03
Exclusive Farm Use	4,925.04	5.51	Valley Junction	40.81	0.05
Farm Forest	6,538.94	7.31	Willamina UGB (partial)	146.32	0.16
Forest 40	34,070.27	38.12	Very Low Density Residential	60.56	0.06
Forest Conservation	36,349.93	40.67	Rural Commercial	10.18	0.01
Timber Conservation	1,482.01	1.66	Industrial	181.75	0.21
			TOTAL	89,396.51	100%

(Arcview analysis of Polk, Yamhill, and Lincoln County zoning)

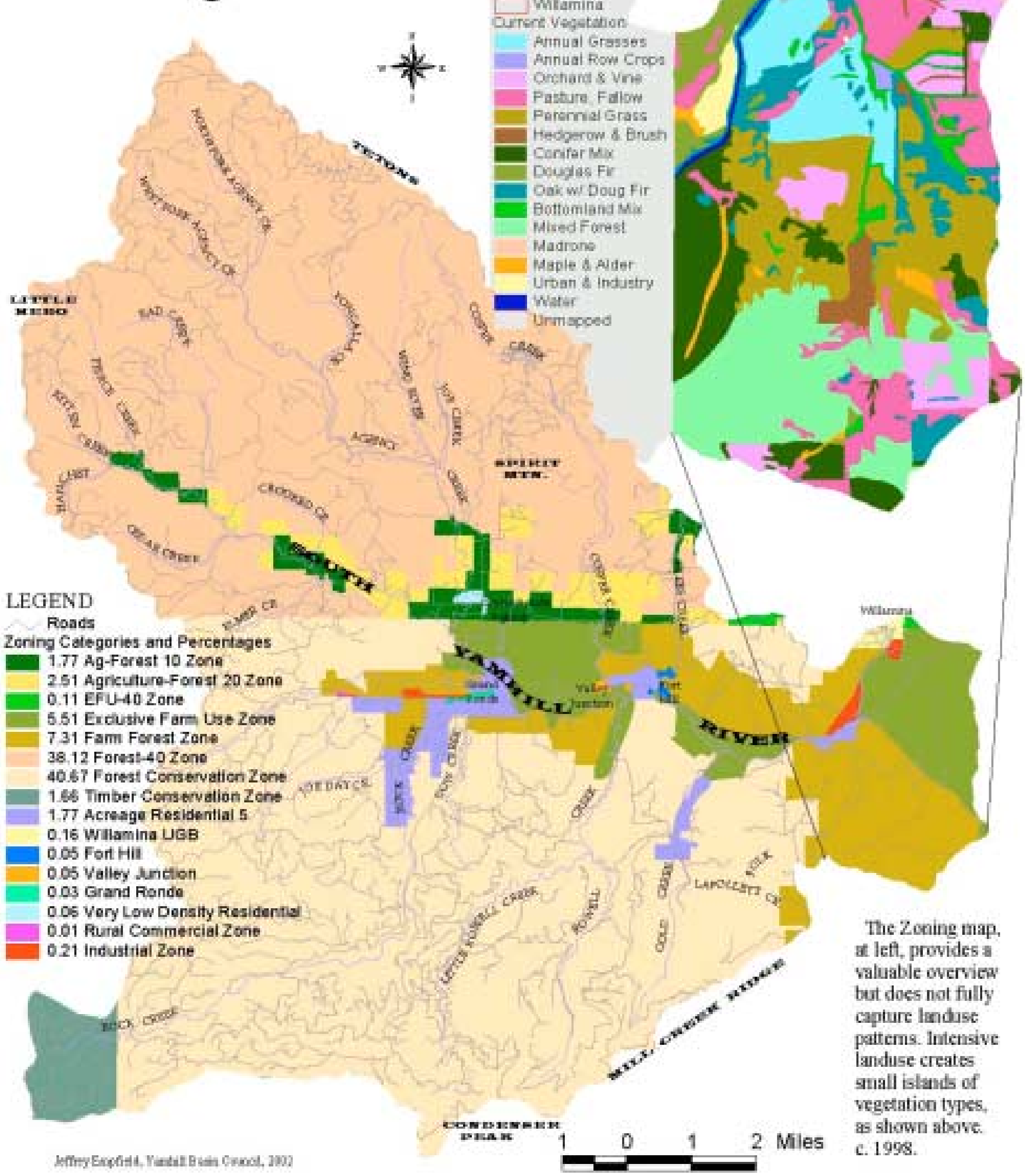
According to David Like of Hampton Resources, Inc., Douglas fir and hemlock are the primary tree species used at their area mills. Logs are milled into dimensional lumber, bark is sold for landscaping, and log ends are chipped for use in paper manufacturing. Hampton forester Mark Vroman explains that all stages of timber growth are spread throughout Hampton's 18,000 acres in the western portion of the Yamhill River basin. Activities include logging, planting, fertilizing, herbicide spraying, and prescribed burning. Only a handful of full-time employees are needed for managing local tree farms but they oversee work for hundreds of contractors who periodically log, build roads, drive trucks, spray, and plant trees. Hundreds more work at Hampton's Fort Hill and Willamina sawmill facilities.

Stimson Lumber Company operates in the watershed and, like Hampton, is a participant in the American Forest & Paper Association's Sustainable Forestry Initiative (SFI) program. The SFI program is a national program designed to encourage landowners, loggers, foresters and others to promote and support sustainable, environmentally sound forestry practices.

Willamette Industries owns about 28,000 acres in the Yamhill basin and is currently reorganizing after recently being acquired by the Weyerhaeuser Timber Company. Dan Upton, who represented Willamette Industries, reports that the land is ideal for growing and managing timber. Douglas fir is the most common tree species in combination with grand fir, western red cedar, western hemlock, red alder, and big leaf maple. After being logged, Dan explains, trees are sorted by species, size, and value for specific uses and milling destinations. The milling operation is a "vertical integration process" utilizing the entire log. Lumber and plywood are the primary products. "Residuals," including bark and wood scraps, can be burned in boilers to generate electricity. They are also chipped for use as pulp and in particleboard manufacturing.

"Reforestation is the number one priority after logging is completed," Dan reports. Forestry workers intensively manage newly planted seedlings to promote survival and growth. The work includes "slash piling and burning, vegetation management, pre-commercial thinning, and aerial fertilization." The age structure for logged and replanted areas ranges from new seedlings to 35 year old stands. Many contract workers "annually plant, spray, and provide fire protection for the timber investment in the Yamhill basin," according to Dan.

Map 4. County Land Use Zones and Selected Current Vegetation



The Zoning map, at left, provides a valuable overview but does not fully capture landuse patterns. Intensive landuse creates small islands of vegetation types, as shown above. c. 1998.

Native and Non-native Plants

Native plants are valuable and important because they have evolved with local conditions and because they are best suited to local conditions. Not only are native species locally adapted, but communities or groups of native plants have co-evolved in relation to one another. Evolution is the result of interactions between many environmental factors including soil, aspect, slope, elevation, moisture, temperature, and competition. For more information contact the local chapter of the Native Plant Society of Oregon (NPSO) at (503) 843-4338 or your Soil and Water Conservation District (SWCD):

Yamhill SWCD: (503) 472-6403
2200 SW 2nd Street
McMinnville, OR 97128

Polk SWCD: (503) 623-9680
580 Main Street, Suite
Dallas, OR 97338

Non-native species, or "exotics", have been introduced from other regions of North America or from other continents. Often exotics do not grow well because they have evolved under different conditions and are not adapted to the local climate. In other cases they do extremely well and become invasive. When this happens, native species often have no adaptation to compete with the invasive species. There is ample documentation of how agriculturists and entrepreneurial land managers have relocated plants and animals around the world only to lose control of them causing unwanted and unforeseen consequences. The definition of "weed" is an unwanted or problematic species. Furthermore, many of today's "weeds" were intentionally introduced before everyone had a sufficient understanding of their impacts. In some cases, species introduced in an attempt to correct earlier weed problems have become weeds themselves.

The Oregon Department of Agriculture (ODA) identifies noxious weeds as plants having the potential to cause economic losses. It is very costly to eliminate weeds once they are established, and it commonly involves intensive herbicide application. Many people prefer mowing, but this strategy also involves an investment of time, money, and energy and creates air and noise pollution. Bio-control methods are available for some weed species, but these are just being developed and often require a lot of knowledge, attentive fine-tuning, and commitment.

The BLM identifies Scotch broom (*Cytisus scoparius*) and tansy ragwort (*Senecio jacobaea*) as species of major concern in the area. Scotch broom is listed due to its ability to take over land quickly, and tansy ragwort is listed due to its toxicity to cattle.

The Native Plant Society of Oregon lists 37 noxious invasive species for the region. Gardeners sometimes cultivate weeds, unaware of their status. Invasives are sometimes even sold by local nurseries. Most commonly, exotics are introduced accidentally through means such as vehicles, clothing, or animals. The current list of noxious weeds compiled by the Yamhill Soil and Water Conservation District includes several new additions. Himalayan blackberry and Reed canarygrass typically invade disturbed areas and form monocultures making regeneration of native species very difficult.

Table 8. Yamhill County Priority Noxious Weed List

Common Name	Scientific Name	ODA Noxious Weed Classification	List/Add Date
County "A" List High Priority For Control			
Italian Thistle	*Carduus pycnocephalus*	B	1-29-90
Meadow Knapweed	*Centaurea pratensis*	B	8-13-90
Purple Loosestrife	*Lythrum salicaria*	B	2-26-91
Japanese Knotweed	*Polygonum cuspidatum*	B	5/28/02
County "B" List Important To Control			
Milk Thistle – *Agric.*	*Silybum marianum*	B	11-13-89
Canada Thistle	*Cirsium arvense*	B	11-13-89
Tansy Ragwort	*Senecio jacobaea*	B, T	11-13-89
Scotch Broom	*Cytisus scoparius*	B	11-13-89
Gorse	*Ulex europaeus*	B, T	1-29-90
Field Bindweed - *Agric.*	*Convolvulus arvensis*	B	2-26-91
Large Crabgrass - *Agric.*	*Digitaria sanguinalis*	-	2-26-91
Blackgrass - *Agric.*	*Alopecurus myosuroides*	B	3-26-97
Velvetleaf - *Agric.*	*Abutilon theophrasti*	B	3-26-97
Field Dodder - *Agric.*	*Cuscuta pentagona*	B	3-26-97
Himalayan blackberry	*Rubus discolor*	B	5/23/00
Reed Canarygrass	*Phalaris arundinacea & aquatica*	Not on list	5/23/00
English Ivy	*Hedera helix*	B	5/02/01
Spurge laurel	*Daphne laureola*	Not listed	5/02/ 01
Small Broomrape	*Orobanche minor*	B	5/28/02

(Yamhill County SWCD, updated May 2002)

Yamhill SWCD Definitions:
"A" List Weeds - a weed of known economic importance which occurs in the county in small enough infestations to make eradication/ containment possible; or is not yet known to occur, but its presence in neighboring areas makes future occurrence in the county seem imminent.
"B" List Weeds - a weed of economic importance which is regionally abundant, and needs to be controlled where found.
"T" List Weeds - a priority noxious weed designated by the Oregon State Weed Board as a target weed species on which the Department of Agriculture will implement a statewide management plan.
Agric. - Denotes weed as primarily a problem for agricultural production.

English ivy is a recent addition to the ODA and the Yamhill SWCD Noxious Weed lists. It is one of the few exotics that can become established and grow in deep shade. English ivy forms thick carpets on the forest floor and chokes out native vegetation, including tree seedlings. It creeps up trees into the canopy, flowers, and forms berries. Birds eat the berries and disperse seeds to other locations. Seedlings emerge and start new infestations. The vines weigh down tree branches causing them to break. English ivy is a threat to the integrity of area forests. To suppress ivy one can cut vines from trees. To eradicate it, stems and roots on the ground must be pulled and then monitored for re-sprouting.

Sensitive Species

The Federal government and the state of Oregon list nine species native to the watershed as rare, threatened, or endangered. See Table 9. These species have been field-verified by the Oregon Natural Heritage Program (ONHP, 1998). Additionally, the BLM lists 16 species as special status species and seven species as sensitive species that may be present in the watershed. See Tables 10 and 11.

The Oregon Natural Heritage Program (ONHP) lists approximately 90 sensitive species that have potential habitat in the Upper South Yamhill River watershed. To learn more, contact The Oregon Natural Heritage Program (821 SE 14th Avenue, Portland, OR 97124-2531, (503) 731-3070 ext. 335 or 338) or the U.S. Fish and Wildlife Service website.

Historically, these species were much more widespread than they are today. The importance of preserving their habitat and working to ensure their future survival is important generally for preserving Oregon's natural heritage. Early conservationist Aldo Leopold pointed out over fifty years ago that if humans are going to tinker with the system they should at least be careful to keep all the parts. He wrote "[w]hat of the vanishing species…[t]hey helped build the soil, in what unsuspected ways may they be essential to its maintenance…who knows for what purpose cranes and condors, otters and grizzlies may some day be used." With the loss of any species—whether it is a plant, fungus, bird, fish, mammal, amphibian, insect, or soil bacterium—a valuable piece of the ecosystem on which humans depend on is lost.

A complete list of all animal species thought to occur on the western side of the Willamette River basin at the time of European arrival has been compiled by Hulse et al. for the Muddy Creek sub-basin of the Marys River watershed. This list includes 234 amphibian, reptile, mammal, and bird species. Eight vertebrate species are listed as *extirpated* (extinct locally) from the sub-basin: grizzly bear, California condor, lynx, gray wolf, white-tailed deer, yellow-billed cuckoo, black-crowned night heron, and the spotted frog. Several sources suggest jack rabbits have been extirpated from the Valley Junction area. The following lists indicate species that are in danger of disappearing from the watershed or from the state.

Conclusion

One-hundred and fifty years ago, vegetation patterns in the Upper South Yamhill River watershed varied considerably from today. The valley bottom historically had more prairie and savanna while uplands were dominated by large, mature, conifers. Today, relatively young conifers are found in riparian areas and in upland areas intermixed with deciduous trees and in small pure stands.

Vegetation in the watershed varies from being forested at higher elevation areas to a patchwork of residential development, agricultural, and forestry parcels in the bottomlands. There are four main types of native habitat in the watershed—upland forest, riparian forest, prairie (wet and dry), and oak savanna. These habitats evolved with natural and human-caused fire and likely are now stressed and evolving in response to harvesting and fire suppression.

Table 9. Endangered and Threatened Species of Oregon

E = Endangered, T=Threatened
Species in **Bold** are likely native to the Upper South Yamhill River watershed

E Short-tailed albatross (*Phoebastria albatrus*)
E **Fender's blue butterfly** (*Icaricia icarioides fenderi*)
T **Oregon silverspot butterfly** (*Speyeria zerene hippolyta*)
E Chub, Borax Lake (*Gila boraxobius*)
T Chub, Hutton tui (Hutton) (*Gila bicolor ssp*.)
E **Chub, Oregon** (*Oregonichthys crameri*)
T Foskett speckled dace (*Rhinichthys osculus ssp*.)
E **Columbian white-tailed deer** (*Odocoileus virginianus*)
T **Bald eagle** (*Haliaeetus leucocephalus*)
T Fairy shrimp, vernal pool (*Branchinecta lynchi*)
T **Aleutian Canada goose** (*Branta canadensis leucopareia*)
T **Canada Lynx** (lower 48 States) (*Lynx canadensis*)
T **Marbled murrelet** (*Brachyramphus marmoratus*)
T **Northern spotted Owl** (*Strix occidentalis caurina*)
E Brown pelican (*Pelecanus occidentalis*)
T Western snowy Plover (*Charadrius alexandrinus*)
T **Salmon, chinook** (*Oncorhynchus tshawytscha*)
T Salmon, chum (Columbia R.) (*Oncorhynchus keta*)
T Salmon, coho (OR, CA pop.) (*Oncorhynchus kisutch*)
E Salmon, sockeye (*Oncorhynchus nerka*)
T Sea turtle, green (locally endangered) (*Chelonia mydas*)
E Sea turtle, leatherback (*Dermochelys coriacea*)
T Sea turtle, loggerhead (*Caretta caretta*)
T Steller Sea-lion (eastern pop.) *Eumetopias jubatus*)
T Steelhead (Snake R. Basin) (*Oncorhynchus mykiss*)
T Steelhead (lower Columbia R.) (*Oncorhynchus mykiss*)
T Steelhead (middle Columbia R.) (*Oncorhynchus mykiss*)
T **Steelhead** (upper Willamette R.) (*Oncorhynchus mykiss*)
E Sucker, Lost River (*Deltistes luxatus*)
E Sucker, shortnose (*Chasmistes brevirostris*)
T Sucker, Warner (*Catostomus warnerensis*)
T **Bull trout** (lower 48 states) (*Salvelinus confluentus*)
T Lahontan cutthroat (*Oncorhynchus clarki henshawi*)
E humpback whale (*Megaptera novaeangliae*)

Plants

E **Marsh sandwort** (*Arenaria paludicola*)
E Applegate's milk-vetch (*Astragalus applegatei*)
T **Golden paintbrush** (*Castilleja levisecta*)
E **Willamette daisy** (*Erigeron decumbens decumbens*)
E Gentner's fritillary (*Fritillaria gentneri*)
T **Water howellia** (*Howellia aquatilis*)
E Western lily (*Lilium occidentale*)
E **Bradshaw's lomatium** (*Lomatium bradshawii*)
T **Lupine, Kincaid's** (*Lupinus sulphureus kincaidii*)
T Four-o'clock, MacFarlane's (*Mirabilis macfarlanei*)
E Popcornflower, rough (*Plagiobothrys hirtus*)
T **Nelson's checker-mallow** (*Sidalcea nelsoniana*)
E Malheur wire-lettuce (*Stephanomeria malheurensis*)
T Howell's spectacular thelypody (*Thelypodium howellii spectabilis*)

Species of concern listed by ESA

Tall bugbane (*Cimicifuga elata*)
Oregon giant earthworm (*Megascolides macelfreshi*)
Long-eared bat (*Myotis evotis*)
Southern torrent salamander (*Rhyacotriton variegatus*)
Western pond turtle (*Clemmys marmorata*)

State of Oregon candidate for listing as endangered or threatened

Willamette Valley larkspur (*Delphinium oreganium*)
Meadow checker-mallow (*Sidalcea campestris*)

Table 10. Special Status Species Native to the Upper South Yamhill River Watershed.

Clouded salamander (*Aneides ferreus*)
Marbled murrelet (*Brachyramphus marmoratus*)
Northern goshawk (*Accipiter gentilis*)
Pileated woodpecker (*Dryocopus pileatus*)
Red tree vole (*Arborimus longicaudus*)
Long-eared bat (*Myotis evotis*)
Fringed bat (*Myotis thysanodes*)
Long-legged bat (*Myotis volans*)
Silver-haired bat (*Lasionycteris noctivangans*)
Columbia torrent salamander (*Rhyacotriton kezeri*)
Southern torrent salamander (*Rhyacotriton variegatus*)
Red-legged frog (*Rana Aurora*)
Tailed frog (*Ascaphus truei*)
White-footed vole (*Phenacomys albipes*)

Table 11. Sensitive Species Possibly Native to the Upper South Yamhill River Watershed.

Howell’s bentgrass (*Agrostis howellii*)
Golden paintbrush *Castilleja levisecta*)
Tall bugbane (*Cimcifug elata*)
White rock larkspur (*Delphinium leucophaeum*)
Peacock larkspur (*Delphinium pavenaceum*)
Queen-of-the-forest (*Filipendula occidentalis*)
Painted turtle (*Chrysemys picta*)

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CHAPTER 4

Riparian Areas and Wetlands

Introduction: Riparian Conditions

"Riparian" is from the Latin *ripa* meaning "stream bank." Riparian areas generally have higher moisture levels than adjacent land. Their elevated moisture levels support a more diverse and productive ecosystem. The riparian zone generally includes the stream or river and the land adjacent to it. Ecologically, riparian areas may include not only streams and their surrounding areas, but also wetlands connected to the area.

Riparian zones may also be defined by regulatory standards, which are set by agencies such as the Oregon Department of Forestry to protect streams. These zones are delineated by a certain measurement of distance from a stream. The Oregon Forest Practices Act defines riparian areas for the purposes of regulating forestry activities adjacent to streams.[2]

Riparian areas serve as a buffer because vegetation and soil function as filters for pollutants collected as rainfall flows over roads, lawns, and fields. The beneficial effects of riparian vegetation on aquatic life include cooling of the stream, balanced water chemistry, and nutrient assimilation.

Riparian vegetation influences fish habitat and water quality in a variety of ways:

- Provision of shade to help prevent extreme daily fluctuations in water temperature and provide fish cover from predation.
- Stabilization of stream banks to decrease erosion and prevent downcutting of banks.
- Maintenance of habitat for insects and macro-invertebrates, a food source for fish.
- Supply of organic litter which adds nutrients to the stream.
- Source of large wood to increase channel and habitat complexity and to provide fish cover.

The Importance of Large Woody Debris

The presence of logs or "large woody debris" (LWD) in streams, which only a few decades ago was considered detrimental to stream health, is now recognized as beneficial. Throughout the Willamette Valley, streams lack woody debris. Large trees that fall into streams are beneficial for a variety of reasons. They increase pool depth, reduce erosion, and are a source of in-channel habitat diversity.

The transfer of wood from land into rivers is referred to as "LWD recruitment." If a riparian area is lacking older trees, it is more difficult for trees to be "recruited" into the stream to provide structure and habitat. The size and diameter of the trees necessary to perform this function is

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[2] ""Riparian area" means the ground along a water of the state where the vegetation and microclimate are influenced by year-round or seasonal water, associated high water tables, and soils which exhibit some wetness characteristics. "Riparian management area" means an area along each side of specified waters of the state within which vegetation retention and special management practices are required for the protection of water quality, hydrologic functions, and fish and wildlife habitat." (Oregon Department of Forestry website, Oregon Forest Practices Program)

directly related to the size of the stream. Streams with higher flows and wider streambeds need larger trees for the wood to remain in place during winter storms.

Logs in streams retain much of the gravel and finer sediments on their upstream side. This in turn slows the downstream transport of sediment and creates terraces, meanders, a pool and waterfall pattern, and slower, less concentrated floods. The pools are formed on the downstream side of large logs; water accelerates to flow past the obstruction and scours the streambed for a short distance. Pools provide swimming space, water storage, and cool habitat. The relocated sediment creates beneficial water spaces and habitat in sand and gravel bars.

Farmers' Historical Use of Creeks

According to Sam Sweeney, a farmer in the Yamhill Basin based in Dayton, landowners in the area historically depended on creeks and riparian areas for several farm operations. Livestock grazing in the past was nearly always confined to riparian areas, he explains. Farmers wanted to use the more level tillable acreage for grain and other cash crops. "Not wanting to waste tillable crop land," farmers "would fence and keep their livestock in the riparian areas close to the creeks." These areas not only provided pasture and shade, but also stock water.

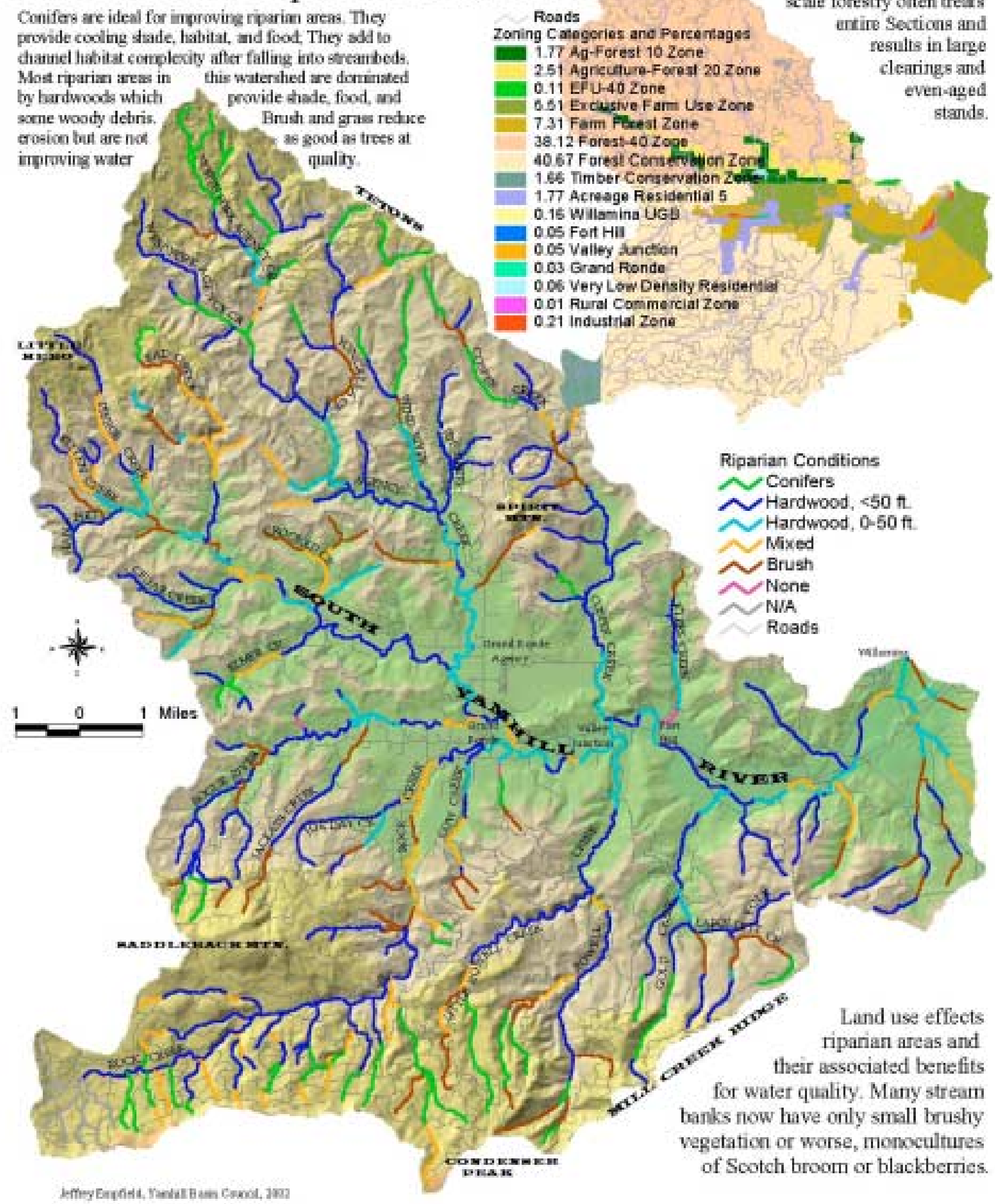
Landowners also used riparian areas as a source of forest products. Wood lots would often be close to the creek or within the riparian areas. These lots were considered a "nest egg" that landowners could use during hard times or to meet a particular need for lumber. This is still true today, Sam points out. A significant difference was that in the past, the forest would re-seed itself. "The area did not have the blackberries that would take over," Sam says, "and hold back the growth of the seedlings." People rarely took an active role in replanting trees until the 1940s when foresters introduced the idea.

Map and Photo Analysis

Map 5 indicates the dominant vegetation type for major streams in the Upper South Yamhill River watershed. The four dominant vegetation categories are conifer, hardwoods (narrow and wide bands along streams), brush, and "mixed". "Mixed" is represented by either brush or grass interspersed with broadleaf and/or conifer trees. The red segments indicate areas where riparian benefits are effectively non-existent with little or no riparian vegetation. In these few areas, the streambed itself has been altered to a high degree. Although these streams are shown on topographical maps, they no longer exist as natural waterways with associated vegetation. A more widespread problem in the watershed is that forest clearings often leave streams exposed to sunlight and invasive weeds. Even where native species persist, many areas do not receive adequate shade and woody debris.

Black and white aerial photographs from the Farm Service Agency offices in Dallas and McMinnville served as the primary source for evaluating riparian conditions. Periodically the Department of Agriculture makes a new series of aerial photos covering croplands. The most recent series for the area dates from 1994 and illustrates summer conditions. Photos for the southern portion of the watershed are not available in print form; for those areas, aerial photos were viewed on a computer. Habitat survey descriptions completed by employees of the forest industry and the CTGR over the last decade also helped identify riparian vegetation types.

Map 5. Upper South Yamhill River Land Use and Riparian Conditions



USGS topographical maps were helpful for locating landmarks and stream channels in the photos.

Current riparian conditions can be compared with likely historical conditions. Table 12 gives the miles of stream identified for various riparian vegetation types. The majority of streams surveyed are bordered by a wide band of hardwoods. Note that nearly 14% of the riparian areas surveyed are now non-existent or vegetated primarily by brush; these areas provide marginal benefits for water quality. Ideally, riparian zones would include mature and standing dead conifers. Hardwoods decompose more easily in Oregon's moist conditions and do not provide structure and complexity in the stream for as long or as well as conifers.

Table 12. Riparian Vegetation in the Upper South Yamhill

Riparian type	Miles*	Portion of total
Conifers	40.14	14.76%
Hardwoods, >50 ft.	121.04	44.51%
Hardwoods, 0-50 ft.	30.77	11.32%
Mixed	35.81	13.17%
Brush	36.72	13.51%
Non-existent	0.89	0.33%
N/A	6.54	2.4%
Total	271.91	100%

* Includes all blue line streams and in-stream wetlands. Smaller streams and most intermittent streams were not assessed.

Introduction: Wetlands

There are many different types of wetland, but they all share three characteristics: water, hydric soils, and wetland plants.

- *Water*—Usually in abundance from either a high water table, rain water "perched" over impervious layers in the soil, frequent flooding, or a groundwater seep. It can also include areas with saturation in the top 12 inches of soil. One point of wetland determinations that many find difficult to understand is that there does not need to be visible water year round. Water levels vary from year to year and season to season. Since many wetlands appear dry at times, water levels are only one of three components to be examined.
- *Hydric soils*—Developed under mostly saturated conditions. Soil scientists have established criteria for identifying soils that have historically been saturated for a period of time on an annual basis. These soils are closely associated with wetlands.
- *Wetland plant community*—Called *hydrophytes*, these plants have special adaptations for life in permanently or seasonally saturated soils.

Wetlands can be dry during summer months and still be a wetland. Sometimes wetlands are referred to as swamps, marshes, or bogs. They can also be called wet meadows, swales, seasonal seeps, and sometimes even ditches if there is standing water part of the time and other conditions are right to support wetlands. To be considered a wetland for legal purposes, land must meet the three criteria listed above unless it is farmed. Agricultural areas are assessed for only two of these: hydrologic conditions and soils. Cultivation typically precludes wetland vegetation. A wetland does not have to be mapped by the state or otherwise designated to have wetland protection under state and federal regulations.

The Oregon Division of State Lands defines wetlands for removal-fill permits as:

> "…those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions."

Wetlands play numerous roles in the health of the watershed. Their benefits include:
- Connecting upland and aquatic ecosystems, necessary for many species.
- Connecting lakes, streams, rivers, and riparian areas with one another.
- Capturing sediment from erosion runoff.
- Consuming nitrogen from agricultural runoff.
- Recharging groundwater by retaining water that percolates into the ground.
- Maintaining steady flows to streams by slowing peak flows.
- Mitigating floods by slowing peak flows.
- Providing habitat for wildlife including rare and endangered species.
- Providing open space, outdoor recreation, education, and aesthetics.

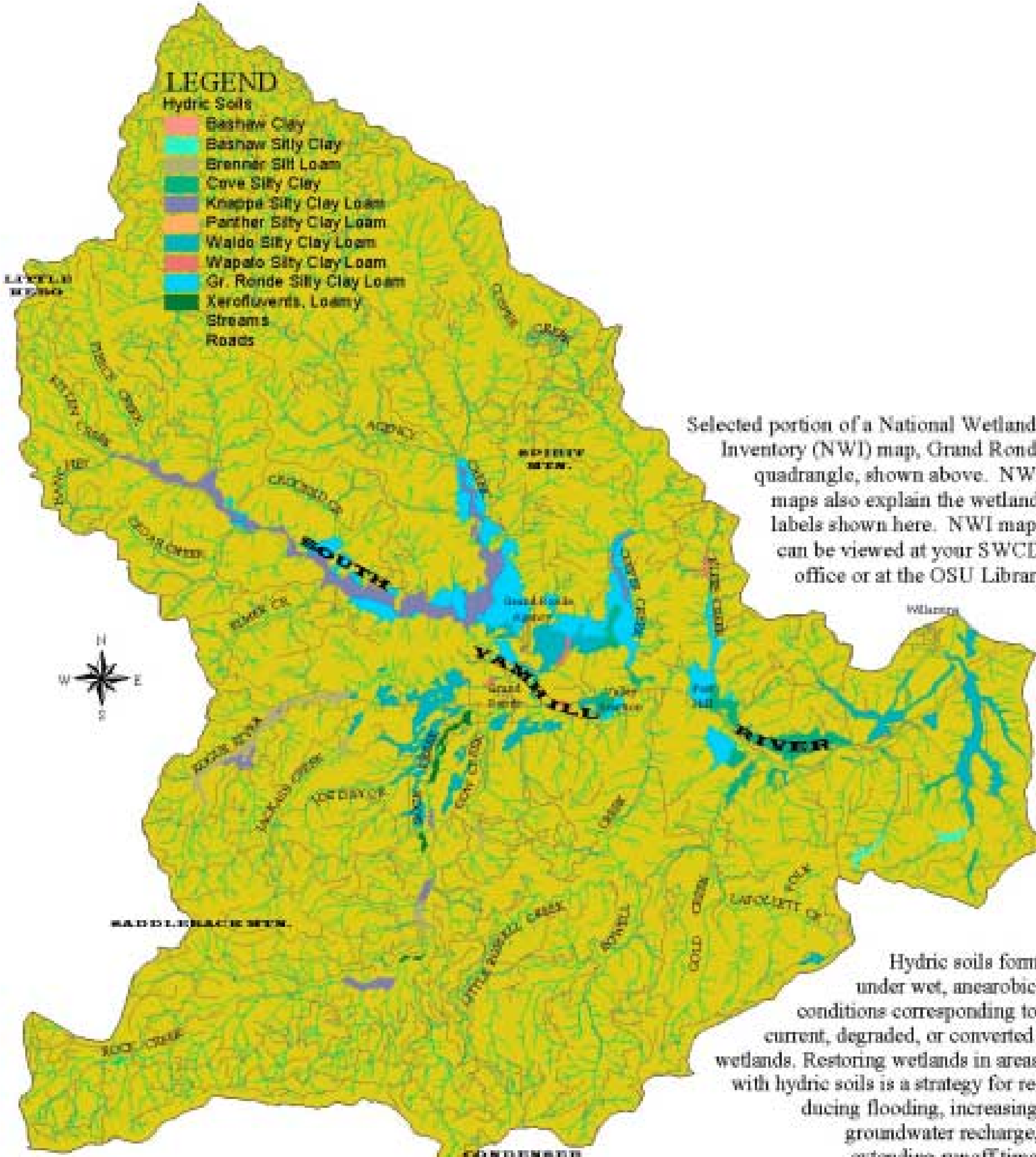
Not all wetlands provide these benefits to the same extent. Each has a unique setting and provides different functions as conditions vary.

Several agencies are involved in the regulation and protection of wetlands including:
- Oregon Division of State Lands (DSL) under federal Clean Water Act and the Harbors Act.
- State Department of Forestry under the Forest Practices Act
- U.S. Natural Resources Conservation Service (NRCS) under the Farm Bill
- U.S. Army Corps of Engineers under the federal Clean Water Act and the Harbors Act.

In seeking to understand wetland conditions in the Upper South Yamhill River watershed, information on both current and "prior converted" wetlands is needed. Prior converted—labeled PC on many photos and maps—means that these wetlands were converted to non-wetland uses such as pasture or cultivation prior to the current understanding of the importance of wetlands. Until passage of the 1985 Farm Bill, the federal government subsidized, encouraged, and facilitated draining of wetlands for cultivation. Since then, there was a change in policy ending subsidies. Wetland loss continues through many ongoing development pressures.

The location of prior-converted wetlands are identified by several sources including:
- Soil Conservation Service soil surveys of Yamhill (1974) and Polk (1982) counties (scale 1:20,000) *Note: The Soil Conservation Service is now the Natural Resources Conservation Service.*
- Farm Service Bureau black and white aerial photos (1994 summer fly-over, scale 1:660).

Map 6. Upper South Yamhill Hydric Soils and Wetlands



Selected portion of a National Wetlands Inventory (NWI) map, Grand Ronde quadrangle, shown above. NWI maps also explain the wetland labels shown here. NWI maps can be viewed at your SWCD office or at the OSU Library.

Hydric soils form under wet, anearobic conditions corresponding to current, degraded, or converted wetlands. Restoring wetlands in areas with hydric soils is a strategy for reducing flooding, increasing groundwater recharge, extending runoff time, and regaining other hydrologic functions.

Wetland Distribution and Trends

Small ponds and wetlands can be found in many areas of the watershed, especially adjacent to smaller tributary streams. Many area wetlands are associated with seeps where the boundary between Nestucca Formation rocks and the underlying Yamhill Formation reaches the surface. Nestucca geology is composed of more permeable sediments that collect water and transfer it laterally above the less permeable Yamhill Formation.

Hydric soils—outlined on soil maps and elsewhere—are a reliable indicator of current and historic wetlands. Hydric soils have formed under predominantly wet conditions. The locations of hydric soils in the Upper South Yamhill River watershed are shown in Map 6. For more information on the location of these soils, contact the Polk Soil and Water Conservation District at (503) 623-5534 or the Yamhill Soil and Water Conservation District at (503) 472-6403.

The area of hydric soils in the Upper South Yamhill River watershed is larger than the area currently designated as wetlands. There is an inherent conflict because most wetlands occur in flatter portions of the landscape that are also desirable for development and agriculture. The majority of land under cultivation in the watershed (greater than 50% and maybe up to 80%) is tiled to drain water from fields in order to improve access for large machinery early in the growing season.

As part of a National Wetlands Inventory (NWI), the U.S. Fish and Wildlife Service (USFWS) mapped areas for remaining wetlands using color infrared aerial photographs at a scale of 1:58,000. Most wetlands on these maps are not field-verified. The minimum acreage mapped is two acres; smaller wetlands do not appear, though many remain. Wetlands that are cultivated but not classified as prior converted are not included in NWI maps but may still be regulated. Some NWI maps, especially in more populated areas, are available in digital form through the USFWS or NWI websites. Unfortunately, the quads for the Upper South Yamhill River watershed have not been digitized yet so they have not been included in this document. The printed versions of NWI maps can be viewed at your local soil and water conservation district or at the Oregon State University Valley Library.

NWI maps show wetland classifications. Each wetland marked on a NWI map has a code indicating whether it is *palustrine* (nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens), *riverine* (associated with flowing water) or *lacustrine* (lakes). Wetlands can be classified further according to their hydrology, vegetation, and substrate. NWI maps also include information about human alterations to wetlands. The Oregon Division of State Lands uses the Cowardin system of wetland classification as do the NWI maps. This makes it easy to compare conditions across the state.

More specific descriptions are used when developing Local Wetlands Inventories (LWI) which are usually completed as a partnership between the Oregon Division of State Lands and a local community. Further information is available from a series of DSL flyers called *Just the Facts....* They include suggestions for identifying, assessing, and inventorying wetlands. Contact DSL at 775 Summer St. NE, Suite 100, Salem, OR 97301-1279, (503) 378-3805 or check their website.

Conclusion

Historically, riparian vegetation and wetlands were much more extensive in the Upper South Yamhill River watershed than they are today. Over the past century and a half, riparian forest and wetland acreages have been significantly reduced through development, ditching, draining, and tiling. Wet prairie is now almost non-existent in the watershed. It once played a significant role for providing habitat for aquatic wildlife, provided off-channel storage of floodwaters, and groundwater recharge during low-flow summer months.

Restoration and enhancement projects may help restore some of these functions in the watershed. Although converted wetlands in developed areas will likely not be reclaimed in the foreseeable future, it is important to determine where the best opportunities exist to enhance, restore, and even create wetlands. This may help mitigate (compensate) for the net loss in wetland function in the area. Improving and restoring riparian zones can be as simple as planting native trees and shrubs. State and federal assistance may be available for landowners that want to enhance, restore, or create wetlands and riparian buffers on their land.

For more information, contact the Wetlands Program, Oregon Division of State Lands, 775 Summer Street NE, Salem, OR 97310 or call the Yamhill Basin Council at (503) 472-6403.

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CHAPTER 5

Channel Habitat Types

Introduction

Channel Habitat Type (CHT) is a classification system for the physical characteristics of streams. The Oregon Watershed Assessment Manual (OWAM), drawing on several stream classification systems already in use, describes 15 types of channel habitat.[3] The Yamhill basin does not have coastal estuaries or desert environments; not all the CHT designations apply here. CHT classifications appear on Map 7 and are based on conditions indicated by USGS 1:24,000 topographical quadrant maps. The maps were particularly important for estimating gradient, confinement, and size of floodplains. See Table 13 for descriptions.

Stream channels in the area do not always fit clearly into one CHT category. This is due to the imperfect nature of classification systems—standard descriptions for a world that is infinitely complex and because of the altered physical condition of the area's streambeds.

Incision or Downcutting

The Upper South Yamhill River and many of its tributaries are *incised* or downcut meaning they have steep banks which limit the stream's ability to move in the floodplain. A natural bottomland stream floods regularly creating new channels and depositing sediments. In their natural state, these streams could be labeled *Floodplains* (CHT classifications FP2 or 3).

Many of the bottomland areas in the watershed, however, more closely fit the description of a *Low gradient, Moderately confined* stream. These channels do not meet the OWAM manual description of "variable confinement by low terraces or hill slopes." Instead, their confinement is due to downcutting of the stream banks. For this assessment they are labeled LC for *Low gradient, confined* streams. The important thing is to find some general indication of conditions on the ground and use that to guide land use strategies.

Table 14 provides descriptions of CHT gradient, channel confinement, stream size, and responsiveness. Stream gradient is the steepness of the channel. The gradient is generally highest in the headwaters and lowest in the valley. There are exceptions to this rule. Sometimes headwater valleys are gently sloping and areas downstream have steeper gradients. "Channel Confinement" describes the narrowness of the stream banks; it determines whether the stream is able to flow onto its floodplain. Unconfined streams meander freely, flood during high flows, and occasionally create new channels. Confined streams become entrenched within steep walls that prevent lateral movement.

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[3] OWAM's CHT system synthesizes six other systems that focus variously on mountain and forest streams, Washington and Alaska streams, stream habitat, map-based surveying, physical geology, and geomorphology.

Table 13. Channel Habitat Type Descriptions (Oregon Watershed Assessment Manual, 1999)

CHT	Description	Fish Utilization
Low Gradient Medium Floodplain **(FP2)**	Main-stem streams in broad valley bottoms with well-established floodplains. Channels are often sinuous, with extensive gravel bars, multiple channels, and terraces. These channels are generally associated with extensive and complex riparian areas that may include sloughs, side-channels, wetlands, beaver ponds, and groundwater-fed tributaries.	Anadromous: Potential steelhead rearing. Resident: Potential overwintering.
Low Gradient Small Floodplain (**FP3**)	Located in valley bottoms and flat lowlands. Usually adjacent to toe of foot slopes or hill slopes within the valley bottom. May contain wetlands. Beavers can dramatically alter channel characteristics. Sediment from upstream temporarily stored in these channels and on the adjacent floodplain.	Anadromous: Potential steelhead rearing. Resident: Potential overwintering.
Low Gradient Confined Channel (**LC**)	Incised channels. Lateral migration is controlled by frequent bedrock outcrops, high terraces, or hill slopes along stream banks. Channels are often stable. High flows are often contained by the upper banks and move all but the most stable log jams downstream. Stream banks are susceptible to landslides in areas where steep slopes abut the channel.	Anadromous: Potential steelhead spawning and rearing. Resident: Potential spawning, rearing, and overwintering
Moderate Gradient Confined Channel (**MC**)	Flow through narrow valleys or are incised into valley floors. Hill slopes may lie directly adjacent to the channel. Bedrock steps, short falls, cascades, and boulder runs may be present. Moderate gradients, well-contained flows, and large-particle substrate indicate high stream energy. Landslides along channel side slopes may be a major sediment contributor.	Anadromous: Potential steelhead spawning and rearing. Resident: Potential spawning, rearing, and overwintering.
Moderate Gradient Headwater Channel (**MH**)	Common in plateaus in Columbia River basalts, young volcanic surfaces, or broad drainage divides. May be sites of headwater beaver ponds. Similar to LC channels, but exclusive to headwaters. Potentially above the anadromous fish zone.	Anadromous: Potential steelhead spawning and rearing. Resident: Potential spawning, rearing, and overwintering.
Moderately Steep, Narrow Valley Channel (**MV**)	Moderately steep gradient, confined by adjacent moderate to steep hill slopes. High flows are generally contained within the channel banks. A narrow floodplain, one channel width or narrower.	Anadromous: Potential steelhead spawning and rearing. Resident: Potential spawning, rearing, and overwintering.
Steep Narrow Valley Channel (**SV**)	Constricted valley bottom bounded by steep mountain or hill slopes. Vertical steps or boulders and wood with scour pools, cascades, and falls are common. Channels are found in the headwaters or side slopes to larger streams. May be shallowly or deeply incised into the hill slope. Channel gradient may be variable due to falls and cascades.	Anadromous: Lower gradient segments may provide rearing. Resident: Limited spawning and rearing.
Very steep headwater **(VH)**	Very similar to SV; VH reaches are steeper.	See SV.

Map 7. Channel Habitat Types (CHT) and Channel Modifications in the Upper South Yamhill Watershed

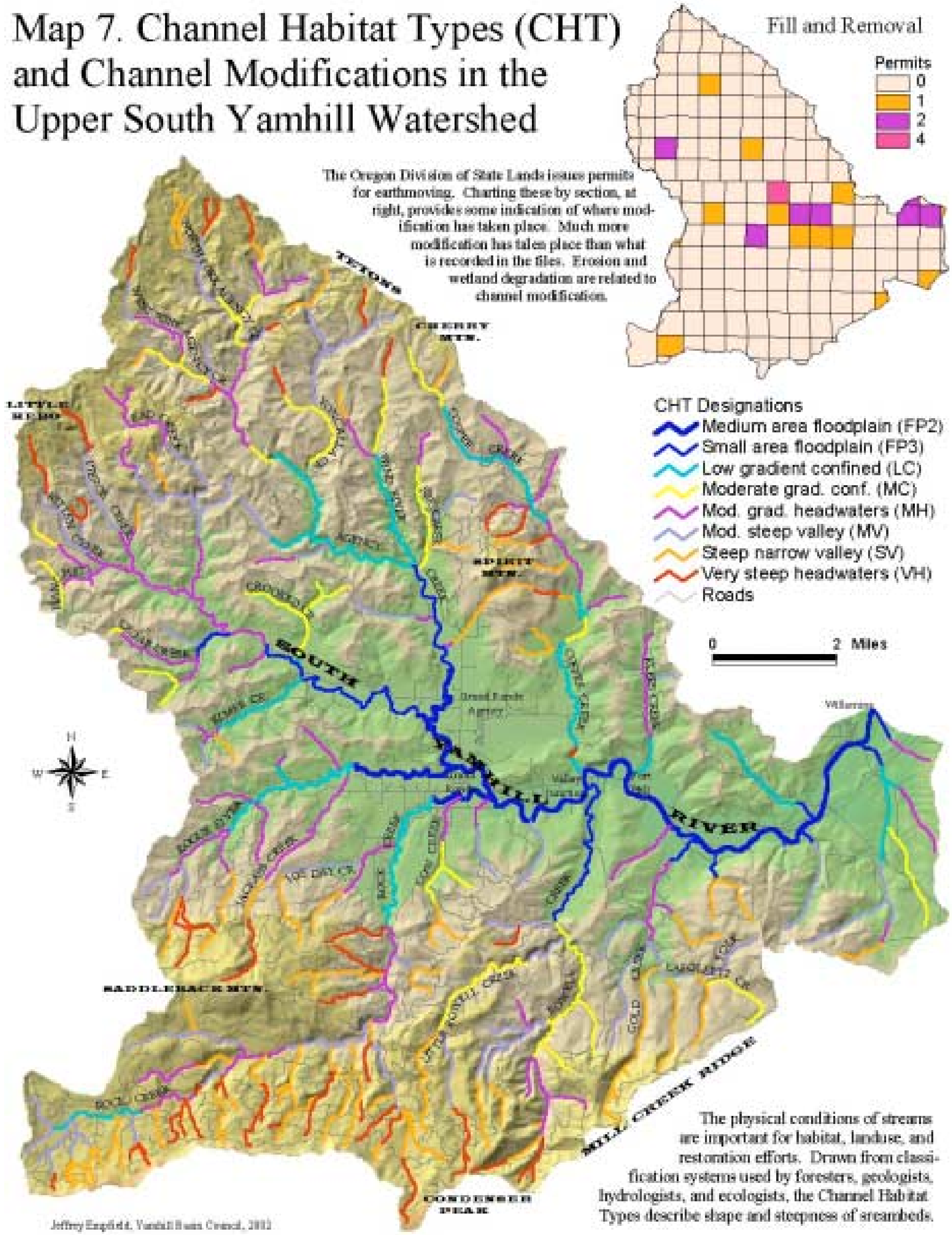

Table 14. Channel Habitat Type Parameters

Channel Habitat Type	Gradient	Channel Confinement	Stream Size	Responsiveness to Change
Low gradient medium floodplain **(FP 2)**	<1%	Unconfined	Large	High
Low gradient small floodplain **(FP3)**	<1%	Unconfined	Small to medium	High
Low gradient confined **(LC)**	<2%	Confined	Variable	Low to Moderate
Moderate gradient confined **(MC)**	2-4%	Confined	Variable	Medium
Moderate gradient headwaters **(MH)**	1-6%	Confined	Small	Medium
Moderately steep narrow valley **(MV)**	4-8%	Confined	Small to medium	Medium
Steep narrow valley **(SV)**	8-16%	Confined	Small	Low
Very steep headwater **(VH)**	>16%	Very Confined	Small	Low

(Oregon Watershed Assessment Manual, 1999)

Channels respond to change differently based on their position in the watershed. Table 15 may help in formulating plans for restoration. The headwaters of Agency, Rock, and Rowell Creeks, for example, are steep with low responsiveness to change in channel pattern, location, width, depth, sediment storage, and bed roughness. Still, these reaches may often be responsive to riparian enhancement. Read the descriptions below for the strengths and weaknesses of channel segments.

Low gradient streams that are generally more responsive to change are also located in more level, developed parts of the watershed. Refer to Map 4 for current land use patterns. Depending on land use, these areas may benefit from projects that encourage meandering or moderate flooding. At the very least, these areas would benefit from improved stream bank vegetation.

Some possible reasons for stream incision or downcutting:

- A large proportion of area floodplains no longer experience natural flood patterns during heavy precipitation; this is due to a number of factors, including the straightening and damming of streams, wetland drainage, historic forest fires, and some forest management practices. A consequence is that a larger volume of water is concentrated in the stream during shorter periods of time, causing higher velocities. These higher velocities carry more energy and they tend to erode banks and scour the channel.
- Settlers have removed large woody debris from area rivers since the 19th century. As late as the early 1980s, land managers cleared wood from streams because it was mistakenly thought this would increase the quality of fish habitat. Now it is known that logjams decrease velocity, increase storage capacity, and create habitat.
- Stream bank modifications such as hardening of the bank with rip-rap (rocks that hold the soil in place) or concrete prevents the stream from gradually changing its course. Meander patterns find the stream's natural curvature to best dissipate energy and decrease erosion.

Table 15. Channel Habitat Type Restoration Potential

CHT	Riparian Enhancement Opportunities
Low gradient medium floodplain **(FP2)**	Due to the unstable nature of these channels, the success of many enhancement efforts is questionable. Opportunities for enhancement occur where lateral movement is slow. Lateral channel migration is common and efforts to restrict this natural pattern will often result in undesirable alteration of channel conditions downstream. Side-channels may be candidates for efforts that improve shade and bank stability.
Low gradient small floodplain **(FP3)**	The limited power of these streams [i.e. low stream flows] offers a better chance for success of channel enhancement activities than the larger floodplain channels. While the lateral movement [i.e. meandering] of the channel will limit the success of many efforts, localized activities to provide bank stability or habitat development can be successful.
Low gradient confined **(LC)**	In basins where water temperature problems exist, the confined nature of these channels lends itself to establishment of riparian vegetation. In non-forested land these channels may be deeply incised and prone to bank erosion from livestock. As such, these channels may benefit from livestock access control measures.
Low gradient moderately confined **(LM)**. *Note: although no sections have this designation in the Upper South Yamhill, this characterization may apply to LC stretches.*	Like floodplain channels, these channels can be among the most responsive of channel types. Unlike floodplain channels, however, the presence of confining landform features often improves the accuracy of predicting response and helps limit the destruction of enhancement efforts common to floodplain channels. Because of this, LM channels are often good candidates for enhancement efforts. In forested basins, habitat diversity can often be enhanced by the addition of wood or boulders. Pool frequency and depth may increase, and side-channel development may result from these efforts. Channels of this type in non-forested basins are often responsive to bank stabilization efforts such as riparian planting and fencing. Beavers are often present in the smaller streams of this channel type.
Moderate gradient confined **(MC)**	Same as LC and MV.
Moderate gradient headwaters **(MH)**	These channels are moderately responsive. In basins where water temperature problems exist, the stable banks generally found in these channels lend themselves to the establishment of riparian vegetation. In non-forested land, these channels may be deeply incised and prone to bank erosion from livestock. As such, these channels may benefit from livestock access and control measures.
Moderately steep narrow valley **(MV)**	Same as LC and MC.
Steep narrow valley **(SV)**	These channels are not highly responsive and in-channel enhancements may not yield intended results. Although channels are subject to relatively high energy, they are often stable. Where stable banks exist, there are opportunities for riparian enhancement. These channels may provide large woody debris in the basin.
Very steep headwater **(VH)**	Same as SV.

(Oregon Watershed Assessment Manual, 1999)

Conclusion

Channel Habitat Types help one understand local streams by labeling them according to gradient, confinement, size, and substrate. This classification should be useful in combination with other characterizations in the assessment to estimate a given stream's sensitivity to restoration efforts. Use the tables describing channel types and how they respond to help form restoration strategies.

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CHAPTER 6

Channel Modifications

Introduction

This chapter illustrates some of the known modifications to streams in the Upper South Yamhill River watershed. The Oregon Watershed Assessment Manual (OWAM) describes channel modifications as any of the following: impounding, dredging or filling water bodies and wetlands, splash damming, hydraulic mining, stream cleaning, and rip-rapping or hardening of the streambanks. Other modifications include road crossings (bridges and culverts) and streams adjacent or parallel to roads that have cut off the streams' ability to interact with their floodplain and riparian areas.

Stream channels are normally dynamic systems that respond to physical conditions including climate. Human manipulation at times magnifies or counters the evolutionary changes that streams naturally undergo. This section examines how humans have impacted stream channel structure and consequently the aquatic habitats of the Upper South Yamhill River watershed. This chapter includes information from residents, fill and removal permits, aerial photos, and Federal Emergency Management Agency (FEMA) floodplain data.

Flood Plain

The Federal Emergency Management Agency (FEMA) 100-year-floodplain is shown on Map 8. The map identifies which areas of the region are prone to flooding. The larger rivers and streams in the area historically meandered and routinely flooded their banks, changed directions, and carved side channels. There is physical evidence of this natural process in ghost channels, oxbow lakes, and wetlands. Activity in the flood plain constitutes Channel Modification.

When possible, it is advantageous for landowners with streamside properties to leave floodplain areas undeveloped. Such an approach will reduce flood damage and increase wetland areas for wildlife and open space as well as for groundwater infiltration. Streams can provide additional off-channel water storage during high flows.

Historic Channel Modifications

Throughout history humans have modified streams both intentionally for irrigation, transportation, and drinking water and accidentally through their land use practices and modification of the landscape. In the Yamhill basin, for instance, residents dug a new channel for Mill Creek in 1900 using muscle and animal power. Over the past century the growth in earthmoving technology has resulted in a much larger scale of modification.

In terms of area affected, logging and the roads associated with logging have had the greatest impact on stream modification in the Upper South Yamhill River watershed. In the hilly, forested parts of the watershed, logging road construction has followed the path of least resistance, often paralleling streams. To protect investment in road infrastructure humans have learned to use channel hardening (rip-rap) to keep streams from undercutting roads.

Unfortunately, this has harmful effects on the health of streams by preventing natural channel movement. By restraining the flow to one channel the stream's ability to meander is taken away. This prevents streams from evolving in ways that dissipate energy, sustain habitat, and recharge wetlands. When constrained, streams maintain high velocities, erode their banks, pick up sediment, and become incised.

Road crossings have similar effects. Since many roads are close to streams and people desire relatively straight roadways, roads cross streams repeatedly. Bridges and culverts at stream crossings are often located in the streambed and require permanent footings and backfill. Private residences and side roads require additional bridges or culverts to provide access. This further limits the movement of the stream. Roads placed next to streams also prevent the formation of side channels while they reduce or eliminate many needed functions associated with riparian areas. These functions include shade, a source of large woody debris, area for flooding, and habitat complexity.

Historical aerial photographs reveal different conditions near streams in the past. Photos from the mid-20th century show streams in roughly the same location as they are now. The interesting difference is that the land adjacent to streams contained wet oxbows, what are today known to be valuable wetlands. Many of these large wetland areas no longer exist. On aerial photos taken in 1994 some contours of the historic oxbows are still visible. Other interventions such as logging, straightening of streams, and removing wood from streambeds have contributed to the high level of modification in streams. Even straight property lines have an impact by orienting land use and development to imaginary boundaries rather than natural ones such as ridgelines.

DSL Fill and Removal Permits

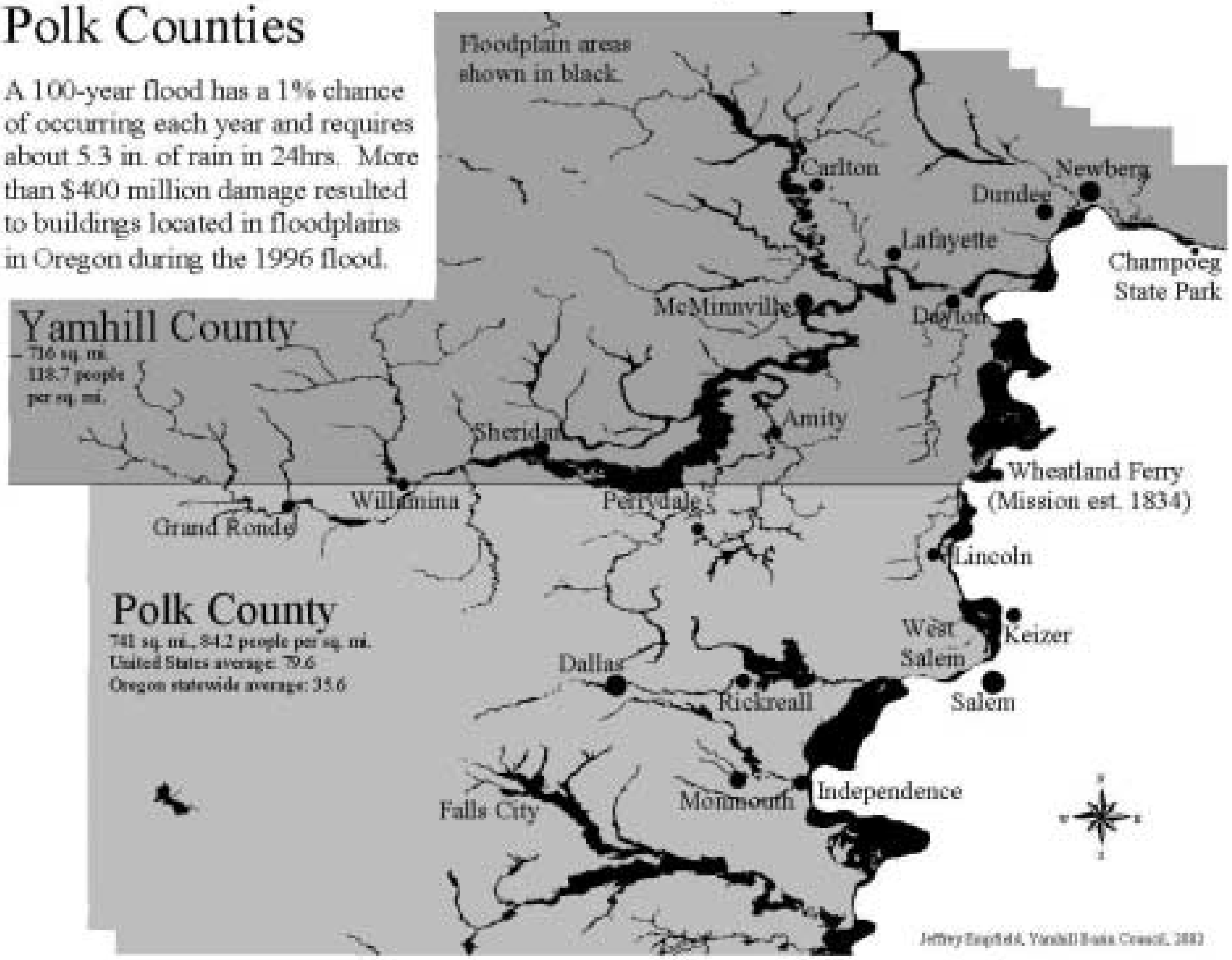
It is difficult to thoroughly assess the extent and location of historic channel modifications in the watershed. Fill and removal permits (on file at the Division of State Lands) give some sense of the physical modifications in the area. Permits were not required until the late 1970s, so little is recorded prior to then. While many fill and removal permits apply to off-stream projects such as road work or reservoir construction, others focus on in-stream channel modification. Much off-stream work has direct or indirect effects on streams—by increasing siltation, for example.

In this watershed, the most common modification on file has been the installation of rip-rap in streams throughout the watershed. There is also a great deal of activity surrounding bridge replacement, bridge removal, upgrading culverts, replacing culverts, extending culverts, highway widening, and filling in wetlands for "ingress and egress" from residences. Other modifications are for activities such as installation of pipelines, electrical lines, or sewer lines.

There is an encouraging trend toward increased ecological awareness indicated by permits. As early as the 1970s, permits alluded to erosion control. Through the 1980s, ecological efforts expanded and by the 1990s they played a role in most designs for modification, included efforts to minimize impacts to wetlands.

Map 8. One Hundred-Year Floodplain of Yamhill and Polk Counties

A 100-year flood has a 1% chance of occurring each year and requires about 5.3 in. of rain in 24hrs. More than $400 million damage resulted to buildings located in floodplains in Oregon during the 1996 flood.



Agency Creek falls at approximately RM5. April 24, 2002

Growing awareness of natural resources is reflected in public works policy as well. Road and bridge work now typically includes a Wetlands Mitigation Monitoring Program. These policies call for environmentally sensitive practices such as creation of gradual stream banks to avoid scour, increasing runoff storage capacity in wetlands, improving wildlife habitat, and restoring areas to preexisting wetland conditions. Bridge replacements also include efforts to avoid impacting wetlands as well as mitigation for any wetland areas that are unavoidably lost.

Mitigation means to mollify, to make less severe, or to temper one's impact. In Oregon, if someone damages or destroys wetlands they may be able to legally mitigate their impact by creating new wetlands or by enhancing other degraded wetlands in the area. Mitigation involves re-grading and planting native wetland species in the impact zone (1:1) as well as building new wetlands at the standard ratio of 1.5:1 wetland acres lost. Replacing 50% more wetland area than one destroys recognizes that artificial wetlands do not adequately replicate the functions of natural wetlands. Mitigation may also take the form of enhancing existing wetlands at a 3:1 ratio in terms of area impacted. In cropped wetlands, the standard is reduced to 2:1.

Monitoring for success requires 80% survival of new plants after three years. The overall design may also include constructed wetlands intended to improve water quality of runoff from roads and parking lots. Pavement runoff contains sediment and pollutants such as power steering fluid, antifreeze, oil, gasoline, tire rubber, and heavy metals from brake pads. Wetland delineation determines the extent and location of pre-existing wetlands and includes an analysis of soils, vegetation, and hydrology.

Conclusion

In terms of percentage of the watershed, forestry has had the greatest impact on stream modification. See Map 4. Roads often restrict streams within steep banks, eliminating side channels and preventing routine flooding. Instead, surface flows are altered, resulting in less frequent but more concentrated floods. The larger creeks of the Upper South Yamhill River watershed flow through developed land or are being farmed on their floodplain; increasingly, area streams receive additional infrastructure incompatible with seasonal flooding.

There are immediate opportunities for enhancing vegetation to provide more diversity. Where possible, owners with land that floods could leave that land undeveloped and use it in flood-compatible ways. Such an approach will reduce flood damage and increase wetland areas for wildlife and open space as well as for groundwater infiltration. Streams can provide additional off-channel water storage and fish habitat if given the opportunity to be connected to that habitat through oxbows, side channels, and wetlands.

Table 16. Recent Fill and Removal Activity in the Upper South Yamhill River Watershed

- 1992 Improved junction between Hwy 18 and Hwy 22, widen roads, replace bridge. Wetland impacts were to be mitigated by plantings and excavation, cofferdams, anti-turbidity efforts, etc.
- 1992 Two areas of vegetative bank protection with rock; working with SCS to help develop the project in a way that is compatible with stream and fishery concerns.
- 1993 Bridge replacement with precautions for sedimentation, erosion, etc. Culvert for fish passage.
- 1994 Highway 18 widening, box culvert extension, and embankment effecting approximately .29 acres of wetland/riparian area. Mitigation of approximately .75 acres with monitoring for three years to insure at least 80% survival of plantings.
- 1994 CTGR to develop destination resort/gaming center on 70 acres of tribal land. 80,000 sq. ft. Facility with subsequent hotel, RV park, and other resort-type development on farmland with some small recognized wetlands. Sediment and Erosion control plan included in technical specifications requiring contractor to control erosion during construction. Storm water system used "best management" to minimize non-point source loading: sediment/oil separating catch basins, and approximately 700 feet of vegetated swales to convey runoff to retention pond. Rehabilitation of .73 acres of wetland to mitigate impacts on .66 acres of "jurisdictional wetlands."
- Spirit Mountain Casino filled in wetlands to build a parking lot. Mitigation implemented south of parking lot and on south bank of South Yamhill River. Impacted wetland contained grasses, forbs, and checker-mallow.
- Two road crossings on small creek near Willamina. Deeply incised channel required 10-15 ft of fill over culverts (48" dia.). Road banks seeded with grass, mulched. Strawbales and silt fencing were used to prevent erosion.
- 1996 Waterline installation through bed of Joe Day Creek. Creek rerouted during construction and then restored to "original state" with native plantings.
- 1996 5,800 cu. yds. fill in wetland area near SYR for development of an RV park at Spirit Mountain Casino. .451 acres jurisdictional wetland impacted. Wetland functions were described as low. "No undisturbed native plant communities." Approximately 3 acres of the site were set aside for preservation of prairie habitat through cooperation with the USFWS and 2 acres were set aside for subsurface sewage disposal where soils allowed. Storm water system incorporated "best management practices" as described above.
- 1997 Replace culvert with bridge on Agency Creek for fish barrier reasons. Other options were installing a larger culvert or an additional overflow culvert that would have helped the fish passage problem as well as installing a bridge.
- 1997 Wetland fill for construction of CTGR health clinic. Approximately .75 acres of wetland impacted (seasonally flooded-to-saturated emergent wetland). Mitigation was to take place on 1 acre in the vicinity. An old oxbow of Agency Cr. was to be reconnected hydrologically and then planted with shrubs, trees, and emergents. An additional .3 acre of wetland was to be created in the oxbow and an additional .7 acres of mitigation would be accomplished by excavating ponds and a shallow wetland area near an existing large forested wetland. Wetlands were to be hydrologically connected.
- Stabilize roadway embankment on Hwy 22. All in stream work (Agency Cr.) was to be done above the bank line minimizing removal of vegetation and then replanted with trees, shrubs, and grasses.
- Emergency authorization for riprap along Agency Creek to protect eroding bank next to Hwy 22.
- 1997 repair roadway shoulder due to slide damage.
- 1997 Four clusters of class 700 riprap installed at edge of Rogue River to encourage riffles and fish resting places. ODOT was to later place plant cuttings elsewhere described as repair to a slide.
- 1999 Emergency authorization for removal and or fill for a washed out culvert/road on Rowell Creek.

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Oregon Division of State Lands fill and removal permit files.

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CHAPTER 7

Sediments

Introduction

Sediments are a concern due to their effects on water quality and wildlife. Major sources of sediment include cultivated fields, construction sites, landslides, dirt and gravel roads, pavement, and insufficiently vegetated stream banks. Bank erosion potential is greatest in the lower elevation main channels where soils contain mostly fine materials that erode easily. This is also where stream entrenchment encourages lateral scour of stream banks.

Water draining from roads can move considerable amounts of sediment from drainage ditches and road surfaces. Road ditches sometimes fill in with sediment from *ravel*, sliding and erosion of the road cut slope. Ditches are designed to move water away from the roads; when the ditch has no vegetation, flowing water picks up sediment and carries it into streams. It is important to remember ditches are essentially an extension of streams because they drain directly to them. The amount of sediment potentially contained in runoff from any road is difficult to estimate. A road surfaced with high-quality rock can be quickly reduced to a quagmire if water pools during wet weather or if there is heavy traffic. A road with poor-quality surface may not degrade much at all if it is used mainly during dry weather. Paved roads prevent road surface erosion but create other problems including petroleum-based pollution and impervious surfaces that prevent surface water from soaking in.

Hilly areas classified as having a potential for debris flows or high risk of erosion are a major concern. Debris flows are initiated by landslides on steep slopes that quickly transform into semi-fluid masses of soil, rock, and other debris. Typically they scour materials for a portion of their path and move rapidly down steep slopes and confined channels. Landslides can become large debris flows; the debris flow inset on Map 8 does not indicate maximum potential size.

In forested uplands, logging is challenging due to steep slopes. Soils are also shallow and loose in these areas. Constructing roads in the forested uplands requires many stream crossings. Heavy rains produce flows that often result in erosion or even road fill failures.

Decades of Erosion

Over thirty years ago county officials identified stream bank erosion as the largest single soil erosion problem in Yamhill County according to the 1979 *Natural Resource Conservation Plan* of the Yamhill County Soil and Water Conservation District. The major causes of erosion were agricultural cultivation, increased runoff due to agricultural drainage ditching and tiling, timber harvesting and urban development within riparian areas, removal of riparian vegetation, and straightening of streambeds.

Roadside erosion was also identified as one of the main contributors of sediment to streams in 1979. At that time the Yamhill County Road Department identified 35 miles of “severe roadside erosion” in the county. Several factors contributed to the problem, including narrow right-of-ways requiring steep road cuts, inadequate drainage ditches and culverts, siting roads in areas with highly unstable soils, and lack of soil-stabilization seeding and maintenance.

Soil erodibility (also called K factor) is a measure of the susceptibility of soil particles to detach and move as a result of rainfall and runoff. Soil properties affecting soil erodibility include soil texture, percent of sand present greater than 0.1mm, organic matter content, soil structure, soil permeability, clay mineralogy, and the presence of rock fragments. Soil erodibility and steepness can be correlated for relative risk of erosion. Map 8 illustrates erosion potential in the watershed.

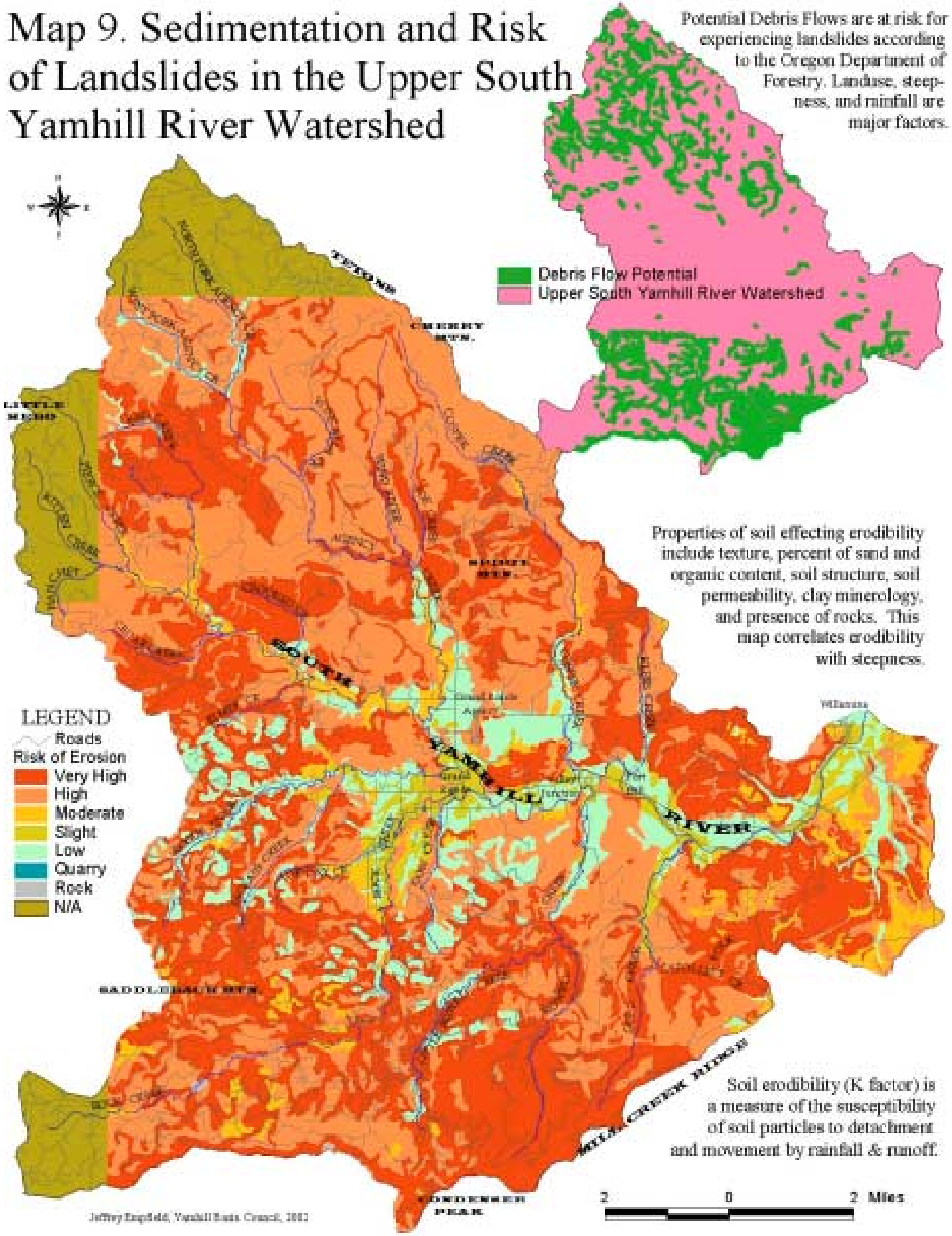
Recognizing that rural roads contribute significant amounts of sediment to waterways, the Yamhill Basin Council helped form a Roadside Water Quality Committee that meets to collaborate on issues related to county roads. Currently, the members include representatives from the Yamhill Basin Council, Polk and Yamhill County Public Works Departments, Yamhill Soil and Water Conservation District, Oregon State University Extension, Oregon Department of Transportation, and local landowners and residents. The committee is working to improve the conditions of ditches through a seeding project that began in 1997. The goal is to improve the ability of ditches to transport water while leaving the soil in place. This is accomplished through reshaping the ditch, preparing a good seed bed by eliminating weeds, and seeding a low growing grass such as creeping red fescue in the ditch.

Yamhill County maintains its ditches by mowing but it does not mow all ditches in agricultural areas, only those where visibility is an issue. Polk County applies herbicides to roadside vegetation. In terms of sedimentation, mowing is preferable to herbicides because vegetated ditches retain sediments instead of letting them pass on to streams. Equally important, chemicals sprayed in or near drainage ditches will likely end up in streams.

Ditches in Yamhill County are re-graded on a 10-year rotation. Budget constraints prevent a more ideal seven to eight year schedule. Some areas receive yearly maintenance while others are maintained every twenty years. Ideally, re-ditching would be restricted to the driest months of the year to prevent sediment from the exposed surface from entering waterways. However, due to the workload, road ditching is scheduled year round. Most road grading occurs during the winter months when the road substrate has enough moisture to be reshaped.

If you would like further information on roadside seeding or other road-related issues contact the Yamhill Soil and Water Conservation District, 2200 SW 2nd St., McMinnville, (503) 472-6403 and ask for the “Roadside Vegetation Management” brochure.

Map 9. Sedimentation and Risk of Landslides in the Upper South Yamhill River Watershed



Storm Water Runoff

Storm water runoff is drained both by pipe and natural open channels from paved and industrial areas. Some drainage systems are inadequate or improperly located. Frequent flooding and ponding is often due to under-capacity storm drains and debris-blocked ditches. Upgrading, rerouting, and detention are possible alternatives.

Upgrading usually involves installation of larger capacity pipes. Generally, engineers design public storm water drains for five or ten-year "frequency events." Rerouting means laying new lines to carry water to a different drainage. Another strategy is designing for storm water detention. Runoff detention is a straightforward approach: simply delay runoff in upstream locations using something like a constructed wetland. By slowing runoff flooding problems downstream are reduced. Water can be released slowly at a rate the system can handle. Detention can also occur in ponds, underground, or on rooftops.

Currently, there are no requirements by the U.S. Environmental Protection Agency (EPA) on storm water quality for towns the size of Willamina or Grand Ronde. Such requirements will likely be imposed eventually. Communities may implement low or no cost options for improved storm water quality such as:

- Keeping natural channels open where possible in preference to installation of storm drains;
- Adopting appropriate erosion control measures for construction activities;
- Adopting standards for the construction of water quality and detention facilities for major new industrial and commercial projects.

Impervious Surfaces

Storm water runoff increases substantially where there is development and associated impervious surfaces including streets, parking lots, sidewalks, loading areas, and rooftops. Together these surfaces increase the volume of runoff by preventing water from soaking into the ground. Impervious surfaces also tend to concentrate runoff in streams more quickly. This, in turn, decreases the time of concentration for a given rainfall to enter the stream and generally increases peak flows downstream. Transforming agricultural lands to urban lands can increase the rates of storm runoff by a factor of two to four. Consequently, impervious area is very significant in the analysis of storm drainage systems.

Mapped Impervious Area (MIA) is a rating system for different degrees of impermeability. For in-town residential areas, the estimated MIA ranges from 40% to 65%, depending on housing density and percentage pavement. For commercial areas it is 90%, and for industrial areas it is about 80% due to the lack of vegetation. Open areas or "green spaces" have an MIA of zero.

Impervious surfaces in the Upper South Yamhill River watershed are concentrated in the commercial areas along Highway 18 and on other private compounds. Large buildings, parking lots, roads, and paved driveways contribute to the problem.

Runoff Contaminants

Inevitably, impervious surfaces and rural road ditches collect oil and gas, steering fluid, exhaust particulates, rubber from tires, and anti-freeze that cars leave behind. Nitrogen from agricultural lands and the many pollutants originating from industry and consumer household products also collect in surface runoff. To keep these contaminants out of the streams it is easier to control them at the source than to remove them downstream through some treatment process. Simply curtailing purchases of chemicals (including petroleum products) is the first step. Strategies are also needed for buffering fresh water sources. There are several forms of remediation for reducing the impact of contaminants in water.

Contaminants are most effectively removed by passing runoff through an area where plant uptake of the nutrients is significant and where heavy metals and toxins can either settle out or be consumed in a safe way before entering the stream. These areas can be natural or man-made grassy swales, settling or detention ponds, or constructed wetlands. In each instance, the objective is to maximize the amount of surface contact and time of contact with the remediation plants.

For reducing soil sediments, in all cases, it is more effective to substantially reduce erosion at the source. This is one of the biggest challenges for landowners. The costs of erosion go beyond the loss of fertility of the land. All reservoirs have a limited life span before sediments fill them.

In addition to cultivated fields, construction sites are sediment contributors because soil is generally left bare until the finishing touches are applied. Irrigation installers and landscapers are then hired to create lawns. Sediment catch techniques such as straw bales, silt fences, woven matting, detention ponds, and temporary swales can be used to filter runoff from building sites. Another possibility is gravel exit routes to help remove mud from vehicle tires. This helps keep soil off the pavement and out of streams.

In general, natural draws and streams should be retained. A well-vegetated, slow-moving creek system can provide channel storage of runoff waters and can often assimilate contaminants prior to discharging water into the river. Wetlands are highly valuable in this respect.

Conclusion

Potential sources of sediment include dirt and gravel roads and ditches, impervious surfaces, slope failure, and erosion of disturbed soil. All ditches drain to a water body, usually a stream. Some area ditches are being managed to decrease their sediment contribution through roadside seeding. It is recommended that drainage ditches be mowed rather than sprayed. For more information contact the Yamhill County Soil and Water Conservation District (SWCD):

Yamhill SWCD: (503) 472-6403
2200 SW 2nd Street
McMinnville, OR 97128

The volume of storm water runoff is increased substantially through development, especially by increasing impervious surfaces. Impervious areas include all pavement such as streets, parking lots, sidewalks, loading areas, and rooftops. Runoff contaminants are most effectively removed by passing runoff water through a constructed wetland. There, plant uptake of nutrients may be significant. Heavy metals and toxins can either settle out or be consumed more safely before storm water reenters a stream.

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CHAPTER 8

Hydrology and Water Use

Introduction

This chapter deals with the hydrology of the watershed in terms of flood history, flow records, groundwater aquifers, and ways that human use of land and water affect stream flows. The hydrologic cycle is the circulation of water through plants and animals into the atmosphere, as precipitation, surface water (streams, lakes, and oceans), and finally as groundwater before again entering plants, animals, and the atmosphere. It has distinct stages including precipitation, surface run-off, percolation, ground water, transpiration/respiration (plants and animals expire water vapor), and evaporation. Human activities and technologies influence each stage.

Peak Flow Events

Hydrographs for the South Yamhill River show a quickly fluctuating or "flashy" pattern of runoff. See Figure 1. Flow increases rapidly after precipitation and peak flows dissipate quickly once rainfall ends. This is typical of areas with relatively impermeable geology such as the Upper South Yamhill River watershed. Infiltration of ground water does not occur easily so storm water runoff rapidly follows surface and subsurface routes to streams and rivers.

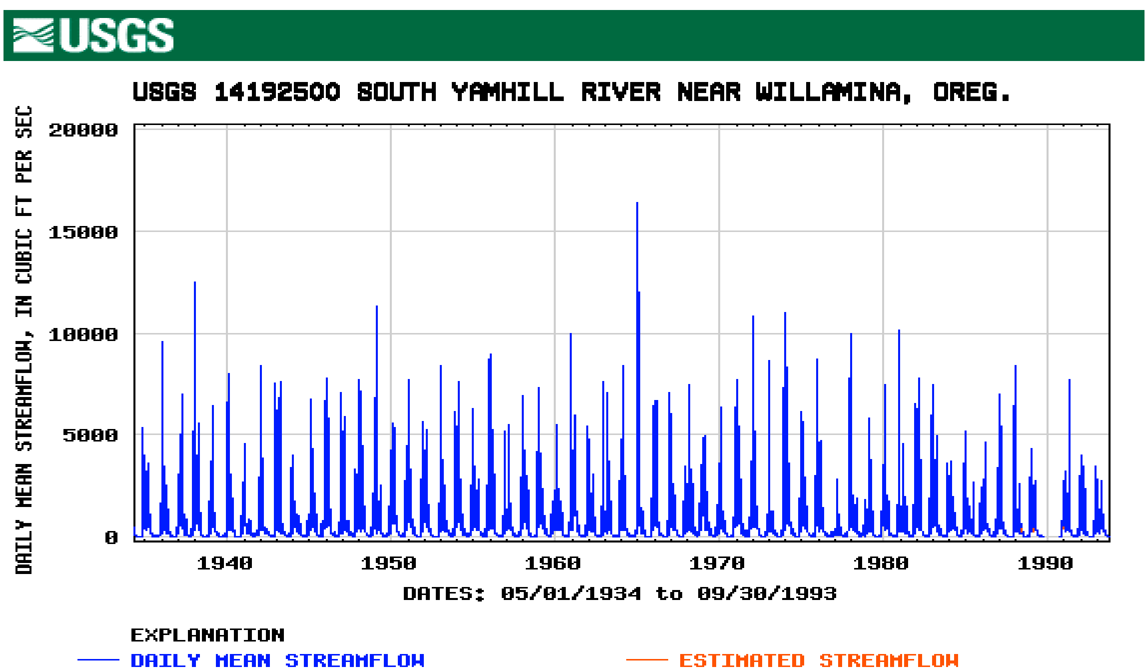


Figure 1. Flow data from the South Yamhill River gaging station near Willamina (gage # 14192500). At this point the South Yamhill drains an area of 133 sq. miles and is located 235.55 feet above sea level (USGS Oregon website). Both the OWRD and USGS Oregon websites provide a variety of data including current and historic hydrographs, peak flows, and information on water quality.

The earliest recorded floods in the region occurred in 1843, 1844, 1852, 1861, and 1890. The 1861 flood (likely a "100-year frequency event") is considered by some to be the largest known flood in the area. It is difficult to determine because there were no measurements of volume being taken at the time. The largest floods in the past century occurred in December 1955, December 1964, January 1965, January 1972, November 1973, January 1974, and January 1996.

Precipitation is not the only factor influencing flows. Withdrawals for irrigation and drinking water, stream and wetland modifications, changes in land use and water-related technology, and the removal of vegetation are also important. These factors not only affect the amount of water present in streams but also the rate of release into streams during a storm. For example, if a braided stream (multiple intertwined channels) is modified or restricted to one channel, it will act more like a flume than a slow moving reservoir for storm water. The flow will respond more rapidly and will move rain water downstream leaving less water upstream to gradually soak in.

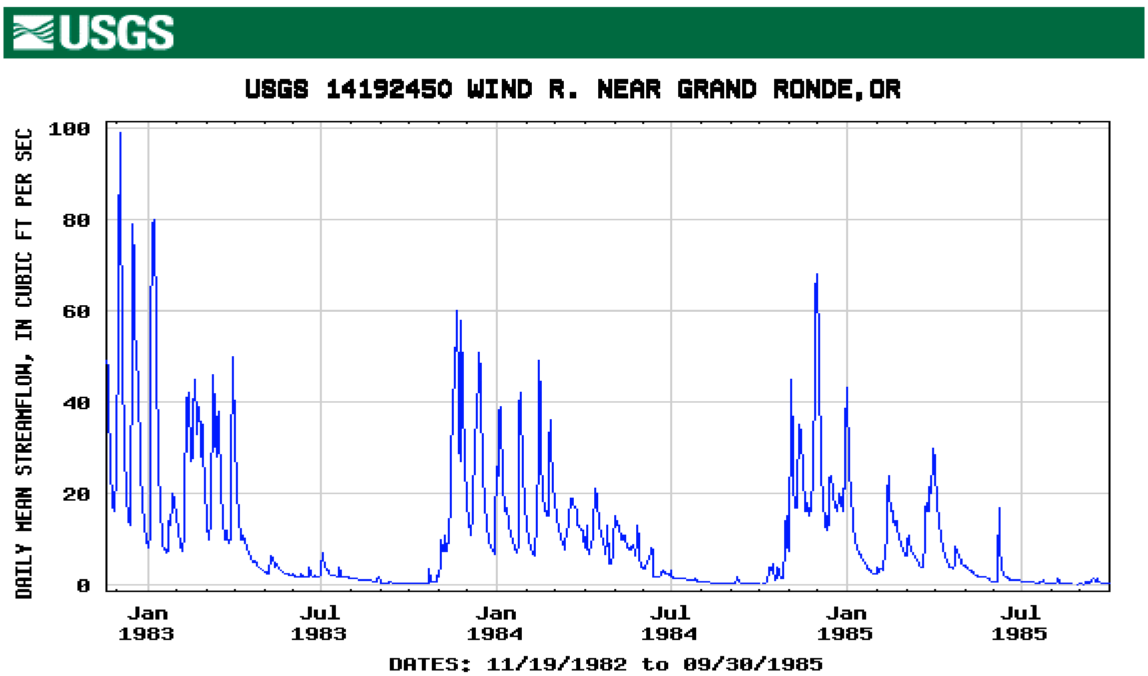


Figure 2. Data from Wind River gaging station near Grand Ronde (gage # 14192450). (USGS Oregon website)

When left in their natural state, streams drain slowly and provide a variety of benefits:

- Greater sinuosity (meandering) resulting in more stream-riparian contact, larger riparian areas, and slower flow velocities.
- Raised channels that reach the flood plain exchange water with wetlands and help to transfer water to riparian areas more efficiently.
- Deeper flood plain soils for water storage and plant growth.
- Evolving channels that change in location and create backwaters and other aquatic habitat.
- More pools and deeper pools for fish and humans.
- Natural disturbance of riparian areas that promote habitat complexity.
- Less fluctuation between low flows and peak flows resulting in less property damage.
- More frequent, minor, localized flooding and less frequent, major flooding downstream.

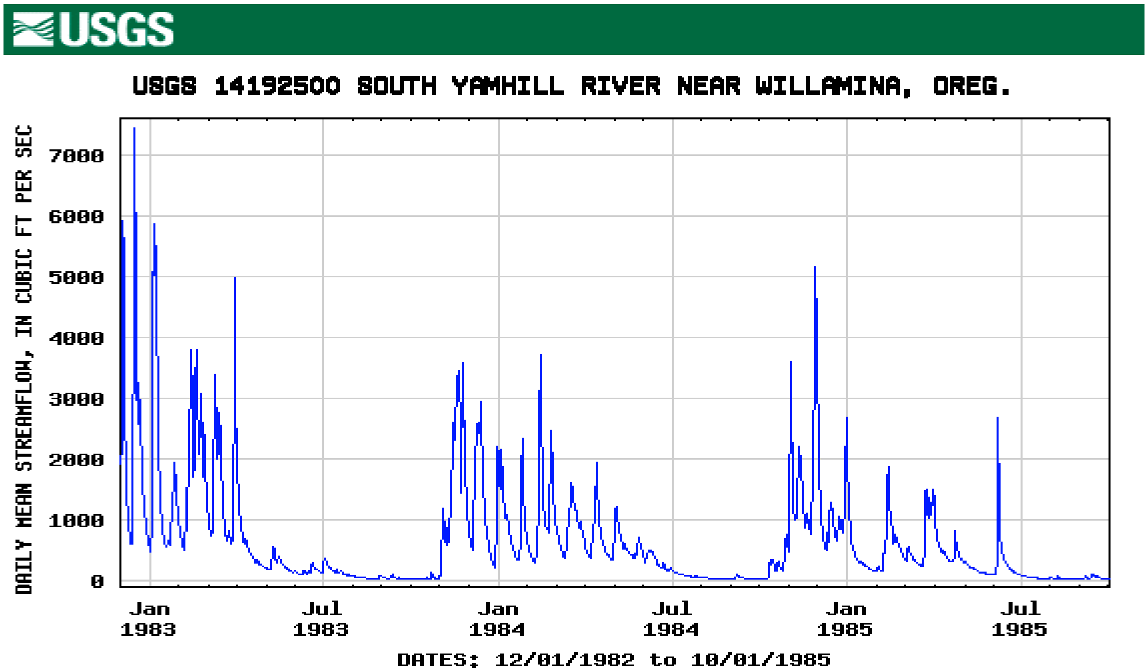


Figure 3. A subset of data for the South Yamhill River (gave # 14192500) corresponding to dates in Figure 2, above. (USGS Oregon website) Despite differences in volume between streams there are close similarities in flow patterns.

Predicting Flood Frequency and Risk

By looking at historic stream flow records one can estimate likely flood levels and frequency. Figures 2 and 3 above indicate that between seven and ten peak flows occur in this area each water year. On both large and small streams, peak flows increase by a factor of 10 or more from ambient winter stream flows. Knowing the probability of a given flood level occurring requires decades of record keeping.

Map 9 shows the approximate 100-year flood plain for Polk and Yamhill Counties as outlined by the Federal Emergency Management Agency (FEMA). FEMA subsidizes property owners' purchases of flood insurance. A structure's risk is based on the elevation of its lowest floor. Flow records are essential for predicting future flood levels. Some flow records in Oregon date back about 100 years but most areas have been measured for a much shorter period. Models have been developed to examine the relationship between precipitation and various land uses to predict flood recurrence levels without actual flow data. Even in areas where flow records exist, predicting floods is difficult.

Table 17. Precipitation Rate and Annual Probability for Various Levels of Flooding

Flood Frequency	Rate of 24 hr. Precipitation	Annual Probability
2 year	2.4 in	.50 (50%)
5 year	3.1 in	.20 (20%)
10 year	3.6 in	.10 (10%)
25 year	4.2 in	.04 (4%)
50 year	4.7 in	.02 (2%)
100 year	5.3 in	.01 (1%)

The state climatologic service examines weather trends for Oregon. The region has a 20-year wet and 20-year dry cycle. The significance of this for flood information is that data collected from a stream for the past 30-year period may contain 20 years of relatively dry conditions so flood predictions will be different from data collected during a 20-year wet period.

Groundwater

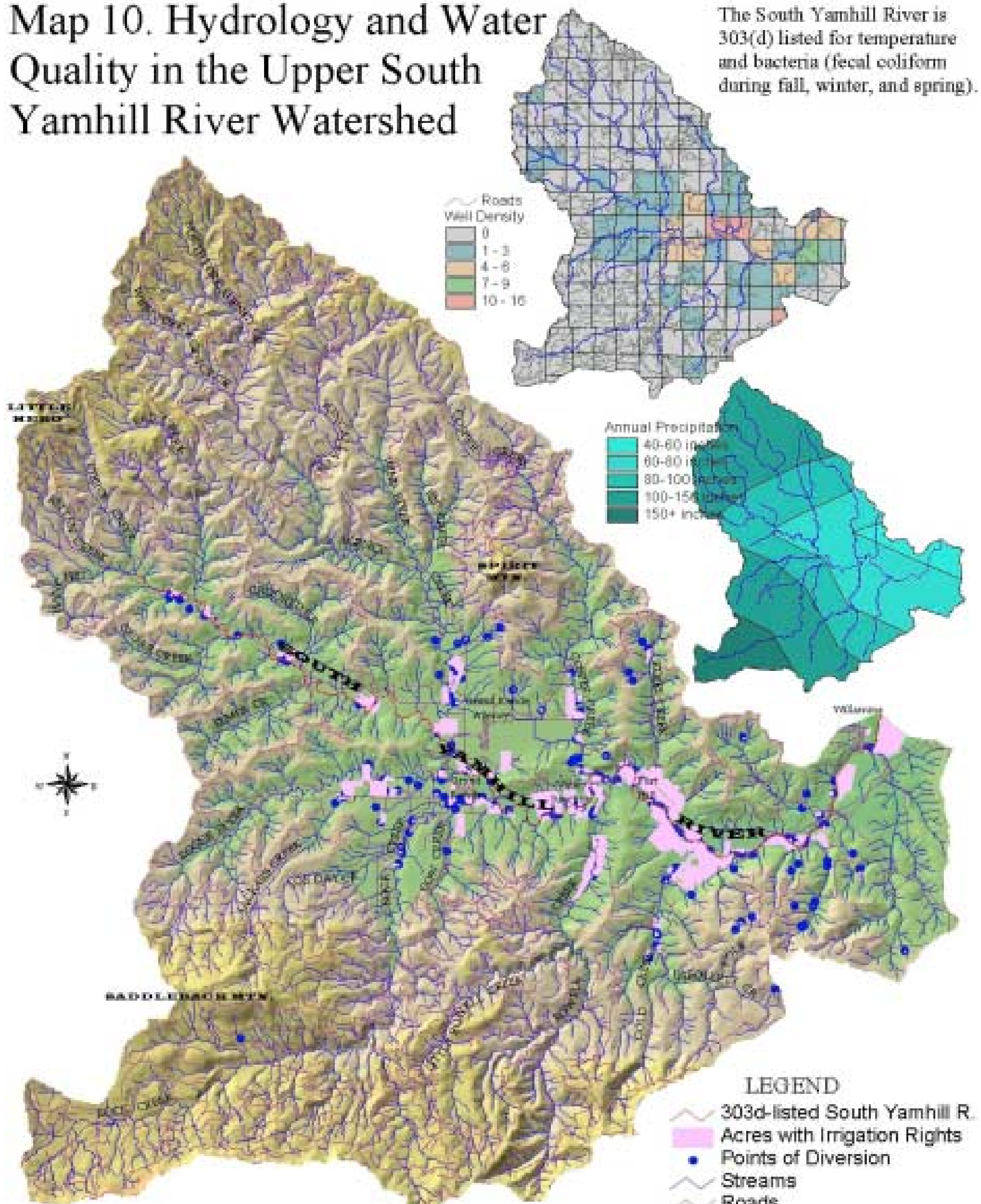
Hydrographs indicate most precipitation in the Grand Ronde area follows surface or shallow subsurface pathways to streams. This means there is rapid runoff and relatively little percolation to natural storage aquifers. Due to this limited storage capacity, stream flows are tied more closely to seasonal precipitation patterns. Shallow groundwater springs occur throughout the watershed but, also due to low permeability of aquifers, they generally have low yields. Water quality in streams, wells, and springs is generally good. One exception to this is that many drilled wells yield saline groundwater. Additional development of water will be restrained by water rights held downstream, the low permeability of the area's geology, and problems relating to saline water pockets.

The complex geology of the area has created springs and seeps at a number of locations where subsurface flows lead to the surface. Numerous domestic wells exist in the area but are used by individual residences and do not contribute to the supply of the local water association. See the Well Density inset on Map 10.

Tribal needs for water are met through the Grand Ronde Community Water Association. The Tribe is "concerned about the vulnerability of this water supply and whether it will be adequate to sustain Tribal economic development and…domestic needs," according to a recent report by the USGS. The Tribe also anticipates needing irrigation water at future development sites but does not currently hold significant water rights.

Because of this and the region's rapid growth in general, water needs continue to increase. In addition, much of the area is not served by central water and sewage systems, so many homes depend on individual wells and septic systems. To obtain ample water supplies, wells commonly must be drilled to depths of several hundred feet. Even at these depths some wells produce poor quality water.

Map 10. Hydrology and Water Quality in the Upper South Yamhill River Watershed



The Upper South Yamhill sub-basin consists of a series of uplands surrounding the relatively narrow low-lying river valley; this has implications for groundwater. The water table is generally highest beneath upland areas and lowest beneath the valley floor. In other words, the water table elevation somewhat follows the land surface elevation. There are also many local variations in groundwater, some of which reflect seasonal changes.

Wells in Siletz River Volcanics generally yield enough for domestic use. The majority of wells drilled in marine sedimentary rocks are of low yield. Well data for areas with intrusive bedrock indicate low permeability and relatively little groundwater.

Lowland and Basalt Group Aquifers

Much of the Yamhill River Valley has alluvial soils lying over marine sandstone, siltstone, and shale. Alluvial deposits can be water bearing where they are relatively thick, permeable, and in hydraulic contact with adjacent streams, although this is generally rare.

According to Marc Norton of ODWR, yields in marine sediments are generally adequate for single family domestic uses, especially if a large storage tank is used. Yields range from less than one gallon per minute to over 20 gallons per minute. Yields generally decrease over time and the well will need to be deepened or a new well drilled. Wells in marine sediments have a tendency to develop iron bacteria problems that affect the quality and quantity of water. These wells also sometimes yield brackish water, particularly with greater depth.

The most important aquifer in the area is the Columbia River Basalt Group. Groundwater from this aquifer is chemically suitable for most uses including drinking. Some wells drilled into marine sedimentary rocks produce water that is too mineralized for general use without filtration.

Because many wells drilled in uplands penetrate isolated groundwater bodies perched high above the water table, they have a large range in depth, water level, and yield. Some wells have water levels of less than 50ft below land surface, while others nearby or at lower altitudes have much deeper levels. Where the basalt aquifer is heavily pumped, water levels have declined about one foot per year. This decline is not universal throughout the Columbia River Basalt Group.

The basalt consists of a series of individual lava flows that are mostly blocky, jointed lava—each with a unique system of joints. Between some flows are zones of ash, soil, breccia, cinders, or broken rock that are porous enough to permit the movement of water. These are called "interflow zones" and are the main aquifers (water-bearing and water-yielding zones) in the basalt. The basalt group ranges in thickness from only a few feet in some places to 1000ft; individual flows can be up to 100ft thick. Because of this, wells drilled in the Columbia River Basalt Group are highly variable. Yields of wells drilled into the basalt range from about 15 gal/min in the upland areas to as much as 1000gal/min in some lowland areas.

Groundwater recharge is limited. Area aquifers are recharged mostly during winter and spring through precipitation. Many lowland areas are of low permeability; consequently recharge to these units is small. Besides permeability, recharge depends on slope, vegetative cover, attitude of rocks, and precipitation.

Recharge in the area is mostly from direct infiltration of precipitation. Aquifers in the lowlands also may receive some recharge from streams during periods when groundwater levels are lower than adjacent stream levels. However, water levels indicate that adjacent to most streams the water table is actually higher than the stream. Consequently, most streams gain water from the aquifers through springs. In the low-lying residential areas of the valley, quick recharge from streams is unlikely because of the low permeability.

Groundwater levels of the Columbia River Basalt Group are subject to long-term water level declines in some heavily pumped areas where use of groundwater is continually increasing. The recovery of water levels each winter to approximately the same level indicates that these aquifers are supported by recharge from the direct infiltration of precipitation and that, in general, recharge balances discharge.

About 200 water wells exist in the Upper South Yamhill River watershed. Most are located in the valley floor along the South Yamhill River. The alluvial gravel and terrace deposits found there are more consistently productive than the surrounding less permeable upland geologic formations. The water table is very shallow—often less than 10 feet below the land surface—along the valley floor. Despite this, low yields and frequent drawdowns limit the usefulness of wells for larger volumes. The few high-yield wells in the region are likely the result of anomalous geology such as fracture zones or faults.

Drinking Water

The Rock Creek Water District serves nearly 100 homes and recently completed a $1.5 million improvement project. The spring-fed system now includes a diatomaceous earth filter in addition to chlorine treatment. The District has a 200,000 gallon holding tank and new lines, meters, and a pressure reducer. There is a flat rate for customers and the District receives funding through the U.S. Department of Agriculture.

The Grand Ronde Community Water Association was incorporated in 1973 with about 250 members. Membership has grown to nearly 800 members served by over 50 miles of waterlines and six storage tanks with a capacity of 1.3 million gallons. The Association has water rights for over 691 gallons per minute and currently uses between three and four hundred gallons per minute, depending on demand. The source for their water is a group of four springs located about five miles southwest of Grand Ronde. The springs are protected within a private woodland of about 25,000 acres.

Tribal membership is estimated at 3,000 with about 400 members living in the community of Grand Ronde. As the Tribe becomes more established in the community over the coming decades, Tribal members will likely be drawn back to Grand Ronde. A period of economic development on the part of the Tribe began in 1995 with the opening of Spirit Mountain Casino, a multimillion dollar business. Following up on their success, the Tribe has added a hotel and an RV park and plans further development. This points to increasing demands for water.

Table 18. Domestic Water Consumption in the Upper South Yamhill River Watershed

Gallons of Water Sold by the **Grand Ronde Community Water Association** in Recent Years							
	1995	1996	1997	1998	1999	2000	2001
January	4,655,600	5,770,300	6,580,500	6,950,200	8,819,300	8,436,200	6,722,000
February	4,231,960	6,751,100	6,870,500	7,211,200	7,469,000	7,446,200	8,013,000
March	4,023,600	6,325,900	5,983,900	6,230,500	7,276,700	7,620,500	6,825,000
April	4,442,900	5,875,500	6,321,600	7,066,400	7,810,600	8,922,100	7,408,700
May	4,298,200	6,219,800	7,172,100	8,029,300	8,037,400	7,621,400	7,057,000
June	6,045,580	7,924,300	8,290,200	7,784,300	8,946,100	9,201,200	10,882,000
July	6,643,450	10,273,300	7,782,900	9,837,900	11,919,400	12,859,400	9,400,000
August	7,409,180	12,472,100	12,018,100	14,527,800	12,303,100	11,696,100	11,690,000
September	6,305,400	8,738,500	7,929,800	11,970,400	12,466,500	11,244,100	11,664,000
October	4,835,400	6,265,100	6,998,800	8,667,600	9,631,500	7,202,000	7,612,000
November	6,113,200	6,625,400	7,137,300	7,774,100	8,183,800	6,715,000	9,184,000
December	5,225,600	5,431,500	6,345,500	6,418,000	6,865,000	7,111,000	8,080,000
TOTAL	64,230,070	88,672,800	89,431,200	102,467,700	109,728,400	106,075,200	104,537,700
Membership	635	655	661	677	732	766	773
Gallons of Water Sold by the **Rock Creek Water District** in Recent Years							
Service provided to 94 homes. Average volume of ~501,660 gal/mo. in winter and ~911,250 gal/mo. in summer.							

(Grand Ronde Community Water Association, Rock Creek Water District)

Conservation will be part of the solution for meeting increasing demands. Conservation means changing technology and habits to reduce per capita demand for water. For individual consumers, water conservation programs typically take three approaches: education, technical assistance, and regulation. The first two are relatively easy to implement but take longer to impact demand, while the regulatory approach is much more difficult to pass. Increased water rates can be used to reduce peak demand during the summer. Inverted block rates charge higher rates for large users. With growing population densities, regulations that reduce demand are anticipated.

The Growth of Irrigation

As early as the 1960s supplies for irrigation water were becoming scarce. The Yamhill basin had an increasing demand for water and, according to community leaders, stream flow was "not going to be sufficient to provide water to everyone." In 1964, the amount of irrigated land in the region was relatively small but it was increasing quickly. The amount in Yamhill County had increased from 12,475 acres in 1954 representing 15.9% of all farms and averaging 31.8 acres per irrigated farm to 19,218 acres in 1964 representing 18.8% of all farms and averaging 49.8 acres per irrigated farm.

Natural resource conservationists expected area land to yield 15 inches of runoff in an average year, meaning that each acre would produce 15 acre-inches or 1¼ acre-feet of runoff. "Without storage," they concluded, "this water is already passed onward toward the sea in great part when the irrigation season starts."

"The limitation on irrigation appears to be not so much a lack of usable land," wrote the Yamhill County Economic Development Committee in the 1960s, "but limited number of dams, insufficient water, and possibly, the types of farming operations which can make irrigation economically feasible." They knew that there were about 20,000 acres irrigated in 1962 and they felt that twice that amount would be needed by 1970. They also knew that in addition to developing reservoirs, water requirements would need to be adjusted. Current figures for irrigated acres in the county are not available. According to the OSU Yamhill County Extension Office, irrigated acreage is difficult to track because of the variability in use from year to year.

Concern in the Yamhill basin had extended to groundwater as withdrawals for irrigation, domestic, and public supplies increased. Because withdrawals were expected to increase further, information was needed “to aid in the orderly and efficient development of the groundwater resources of the area.”

Stream Flow and Water Rights

Under Oregon law all surface water is publicly owned. Before water is used or consumed, a water right needs to be obtained. This applies to use of water from a creek, stream, or river even if the water is for domestic use. In some cases water rights are needed for ground water as well. Water rights are issued through an application process administered by the OWRD.

Table 19. Selected Stream Flows in the Upper South Yamhill River Watershed

Stream	Date	ft^3/second	Stream	Date	ft^3/second
Trib. of Agency Creek	6-30-95	<.1	Gold Creek	6-07-95	4.7
Yoncalla Creek	4-08-59	16		7-27-95	0.8
Agency Cr. below Yoncalla Cr.	6-07-95	16		7-27-95	0.9
Wind River	4-08-59	15		9-26-95	0.7
Agency Creek below Wind River	6-07-95	18		8-26-96	0.7
Joe Creek	4-08-59	10	Rowell Creek	6-07-95	10
	8-01-95	0.3		7-27-95	3.2
Agency Cr. below Grand Ronde	8-01-95	5.2		8-29-95	3.8
Agency Creek (near mouth)	4-08-59	55		8-26-96	2
	8-27-97	4.2	Cow Creek	4-09-59	4
Ead Creek	4-22-59	7		7-28-95	0.5
	8-02-95	2.1	Jackass Creek	3-20-59	6
Pierce Creek	3-19-59	8		8-23-95	0.5
Kitten Creek	3-19-59	12	Rogue River (west)	8-22-95	1
Hanchet Creek	4-09-59	8	Rogue River (east)	8-22-95	0.2
Cedar Creek	1-03-58	4	Rogue River (mouth)	4-22-59	10
Crooked Creek	1-03-58	3		8-26-96	1.1
South Yamhill River	8-26-96	6.1	Joe Day Creek	3-20-59	8
South Yamhill River (gauge)	8-26-96	18		8-23-95	<.1
	8-27-96	19		8-23-95	0.1
Cosper Creek	4-23-59	6	Trib. of Rock Creek	7-12-95	0.2
	6-07-95	5.7	Trib. of Rock Creek	7-12-95	<.1
	7-28-95	1.2	Rock Creek	4-03-59	55
	8-26-96	0.6		6-07-95	30
Klees Creek	4-22-59	10		8-23-95	6.5
	7-27-95	<.1		8-27-96	5.8
	8-27-96	<.1			

(U.S.G.S. Water-Resources Investigations Report 97-4040 and ODFW notes on file at Adair Village)

Water rights are becoming increasingly important as seasonal water demands are exceeding supplies. Competition between in-stream and out-of-stream uses is intensifying according to the 1992 Willamette Basin Report. At present, issuance of water rights is very limited in the Yamhill basin.

Generally, for water desired for the period May 1 through October 31, new non-storage water right applications are being processed only for domestic use, commercial use for customarily domestic purposes not exceeding 0.01cfs (4.48 gal/min), livestock use, and public in-stream uses. Some streams are limited year round to only domestic use or commercial uses for customarily domestic purposes not exceeding 0.01cfs (4.48 gal/min), livestock, and public in-stream uses. Use may be limited further in the future due to water availability, fish, and water quality concerns.

Water rights for the South Yamhill River are over appropriated from the summer months of June through October. This means that the sum of water rights is greater than the estimated flow in the streams. If all area water rights were exercised simultaneously, the streams would be dry. Of course, water rights are not all exercised at the same time. Some are used every two days while others are used only every three days. Also, some portion of the water removed theoretically flows back into the system. Another factor is the time of day that the water is used—this is not taken into consideration when calculating sum flow and appropriation. Still, the USGS reported in 1997 that "surface water is not a satisfactory alternative" for water users in the area. Figures 1-3 illustrate the wide fluctuations in flow volumes of area streams and rivers.

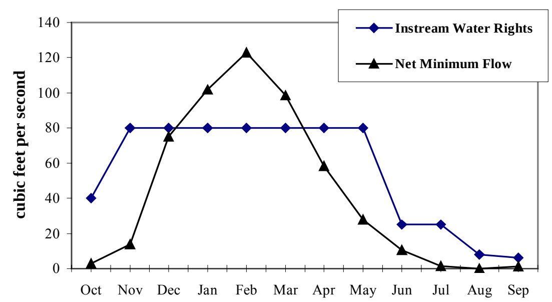
Oregon water law states that water rights not exercised for five consecutive years may be forfeited. Area watermaster Bill Ferber of the OWRD explains:

> "If five years of non-use occurs, it establishes a rebuttable presumption of forfeiture. The forfeiture is not an automatic happening. The water right holder may be able to show the right was not forfeited if one of the situations listed in ORS540.610 took place."

Currently there is no system in place to monitor all water withdrawn by users or stream flows. Therefore, it is difficult to determine the amount of water actually being used. Figure 4 indicates the typical difference in flow volumes and water rights through the water year.

Oregon water law is based on the prior appropriation doctrine—first in time is the first in right. When exercised water rights exceed the available flow, water is distributed among users based upon the priority date of their water right as set by court decree or by the date the application was accepted by OWRD. Junior users can be told to stop using water if a senior user is unable to exercise his/her full right.

Figure 4. Typical Net Flow Versus In-stream Water Rights



An online introduction to Oregon's water law and water rights on the OWRD website states:

> "Watermasters respond to complaints from water users and determine in a time of water shortage who has the right to use water. They may shut down junior users in periods of shortage."
>
> "Watermasters work with all of the water users on a given water system to ensure that the users voluntarily comply with the needs of more senior users. Occasionally, watermasters take more formal actions to obtain the compliance of unlawful water users or those who are engaged in practices which "waste" water. The waste of water means the continued use of more water than is needed to satisfy the specific beneficial use for which the right was granted."

When the quantity of water in a stream is less than the instream water right, the Department will require junior water right holders to stop diverting water. However, under Oregon law, an instream water right cannot affect a use of water with a senior priority date (OWRD 1996).

According to OWRD's Bill Ferber, conflict seldom happens. On paper streams appear over-allocated. In reality users have not yet been denied access to water in the area. How is this possible? Bill has three hypotheses: 1) users are not exercising their full right since rain has been more evenly distributed in recent years or 2) much of the irrigation water eventually percolates through the water table and re-enters the stream or 3) users are not filing complaints. Another possibility is that users are not all taking the water from the stream at the same time of the day. Some may remove water at night or in the evening while others use water during the day.

A lack of sufficient streamflow to dilute pollutants and support aquatic life is an issue throughout the Willamette basin. This is especially true during the summer when flows are naturally low. The absence of snow pack in the coast range also contributes to low flows. Consequently, the primary source of water during the summer is groundwater that enters the streams through seeps and springs. This condition is worsened by out-of-stream demands for irrigation. There are a number of Instream Water Rights (ISWR) on the South Yamhill River and its tributaries meant to guarantee minimal acceptable flows. They appear in Table 20, below.

Table 20. Minimum Flow/Instream Water Rights (ISWR) in the Upper South Yamhill

Stream Minimum flow: 20.0 ISWR : 40.0	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**April**	**May**	**June**	**July**	**Aug**	**Sept**
Agency Cr. at mouth	20.0 40.0	80.0 80.0	80.0 80.0	80.0 80.0	80.0 80.0	80.0 80.0	80.0 80.0	80.0 80.0	25.0 20.0	15.0 10.0	8.0 6.0	6.0 6.0
S. Yamhill, RM 30 to RM 24	12.7 12.7	12.7 12.7	12.7 12.7	12.7 12.7	12.7 12.7	12.7 12.7	12.7 12.7	12.7 12.7	12.7 12.7	12.7 12.7	12.7 12.7	12.7 12.7
S. Yamhill, RM 40 to RM 30	12.0 12.0	12.0 12.0	12.0 12.0	12.0 12.0	12.0 12.0	12.0 12.0	12.0 12.0	12.0 12.0	12.0 12.0	12.0 12.0	12.0 12.0	12.0 12.0
S. Yamhill, RM 41 to RM 40	10.5 10.5	10.5 10.5	10.5 10.5	10.5 10.5	10.5 10.5	10.5 10.5	10.5 10.5	10.5 10.5	10.5 10.5	10.5 10.5	10.5 10.5	10.5 10.5
S. Yamhill, RM 43 to RM 41	10.1 10.1	10.1 10.1	10.1 10.1	10.1 10.1	10.1 10.1	10.1 10.1	10.1 10.1	10.1 10.1	10.1 10.1	10.1 10.1	10.1 10.1	10.1 10.1
S. Yamhill, RM 50 to RM 43	1.1 1.1	1.1 1.1	1.1 1.1	1.1 1.1	1.1 1.1	1.1 1.1	1.1 1.1	1.1 1.1	1.1 1.1	1.1 1.1	1.1 1.1	1.1 1.1

(Bill Ferber, OWRD)

At this time, there are no plans for the state to change the way water rights are allocated or to increase the enforcement of the "use it or lose it" policy. However, the discrepancy between available water and water rights has not been tested by a severe drought (necessitating that more users exercise their irrigation water rights) according to the area watermaster Bill Ferber.

Conclusion

Stream flows and groundwater are influenced by precipitation, loss of wetlands, withdrawals for irrigation and municipal drinking water, stream channel modifications, changes in land use and water-related technology, and the removal of vegetation. Local flooding has changed due to clearing, straightening, hardening, and deepening of major stream channels. Extensive irrigation rights are held for land along the Upper South Yamhill River. Streams in the watershed are over-allocated for water rights. This means that at times seasonal demands exceed the water supply. Conflict has not occurred, but presently most users are not exercising their full water rights.

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CHAPTER 9

Water Quality

Introduction

This chapter provides an overview of water quality as it applies to the Upper South Yamhill River watershed. It addresses issues including temperature, dissolved oxygen, pH, nutrients, bacteria, and chemical contaminants. It also provides information on local domestic water providers and household sources of pollution.

In-stream water quality is desirable for a variety of "beneficial uses" as defined by Oregon water quality standards. Beneficial uses for watersheds in the Willamette Valley appear below.

Table 21. Beneficial Uses for Willamette River Tributaries

• Public Domestic Water Supply	• Resident Fish and Aquatic Life
• Private Domestic Water Supply	• Wildlife and Hunting
• Industrial Water Supply	• Fishing
• Irrigation	• Boating
• Livestock Watering	• Water Contact Recreation
• Anadromous Fish Passage	• Aesthetic Quality
• Salmonid Fish Rearing	• Hydro Power

In the Upper South Yamhill River watershed, cutthroat trout are one of the most important indicators of the overall health of streams. If they are not present in areas where they were found historically, then water quality may be impacted. Salmonids (including trout) need specific conditions for spawning and rearing juvenile fish.

Researchers with the USGS surveyed the water quality in the area in 1995. They collected and tested water samples from 10 streams, 2 springs, and 3 wells (1 shallow, 2 deep) in 1995. They measured for nutrients such as nitrogen and phosphorous, major ions, total dissolved solids, specific conductance, alkalinity, sodium adsorption ratio, dissolved residue, and water hardness. The tests indicate water quality is very consistent throughout the watershed. Even spring water is similar to surface water samples, suggesting relatively shallow sources of spring water. In other words, surface and subsurface flows are closely associated due to the area's geology.

When considering overall water quality of the Yamhill Basin, the many shallow wells in the watershed can also be grouped with streams and springs. Deep well water is different in that it has higher levels of dissolved solids and specific conductance, most likely due to the water's longer subsurface flow paths and increased time spent below ground.

The two deep wells tested (251 ft and 47 ft deep) showed elevated ammonia concentrations "probably due largely to sources such as animal or domestic waste" according to the USGS report. Another possible source of the ammonia is naturally occurring organic matter located underground. Deep wells also had elevated sulfate, boron, and chloride due either to normal mineralization in aquifers or nearby domestic waste. The good news is that although ground water in the populated parts of the watershed is somewhat influenced by animal and domestic waste, this impact is currently slight. Additional data is available from the USGS, specifically the Water-Resources Investigations Report 97-4040.

Other water quality issues found in area wells are the occasional presence of sulfur. The main concerns with sulfur are its distinctive unpleasant odor and associated high salt content of the water. Water is too salty for domestic uses in about five percent of wells drilled in the Upper South Yamhill River watershed. This is a problem throughout the western side of the Willamette Valley and the foothills of the Coast Range. Salty well water occurs most often in valleys or other areas with flat topography and is associated with marine sediments.

Table 22. Drinking Water Quality

Rock Creek Water District monitors water quality for Inorganic Chemicals, Volatile Organic Chemicals (VOC), Synthetic Organic Chemicals (SOC), Lead, and Copper. No samples exceeded Detection Limits in 2000-2001.					
Regulated and Unregulated Detections of Contaminants by the **Grand Ronde Community Water Association** *The Association tests for nearly 100 possible contaminants; only those that exceed Detection Limits are shown here.*					
Contaminant	MCL µg/L*	Detection Limit	Analysis µg/L	MCLC* µg/L	Probable Source
Sulfate	250,000	100	1,100	250,000	Occurs naturally in gr. water
Barium	2,000	2	.2	NA	Erosion of natural deposits
Sodium	NA	100	4,000	NA	Occurs naturally in gr. water
Chromium	100,000	1	4	100	Occurs naturally in gr. water

90th Percentile Results for Lead and Copper				
Date	Round	Lead µg/L	Copper µg/L	Probable Source
Aug. 19, 2000	6	5.0	640	Corrosion of household plumbing
July 10, 1997	5	4.4	330	Corrosion of household plumbing
July 17, 1997	4	2.4	310	Corrosion of household plumbing
Aug. 29, 1995	3	1.0	230	Corrosion of household plumbing
June 30, 1994	2	1.0	680	Corrosion of household plumbing
Dec. 1, 1993	1	4.0	510	Corrosion of household plumbing

*µg/L = Micrograms per liter / parts per billion. Maximum Contaminant Levels (MCL) are the standard *highest* level of contamination allowed but they still incur some risk. Maximum Contaminant Level Goals (MCLG) are determined by our medical knowledge of the level below which there is no known risk to health. They are stricter than the MCLs which are set as close to the MCLGs as feasible using the best treatment technology available.

(Rock Creek Water District, Grand Ronde Community Water Association)

Oregon is required to set standards of water quality under section 303 of the Federal Clean Water Act. When the standards are not met, the stream becomes listed under section 303(d) rules. The South Yamhill River is currently listed for bacteria as shown in Table 23 below. "Listing" means the water quality is not in compliance with the law and steps need to be taken to bring it into compliance. Forty percent (2 of 5) of sampled summer values exceeded the fecal coliform standard. The sample site was located 0.3 miles downstream of the confluence with Agency Creek. Failure to meet fecal coliform criteria is related to human health and safety and likely has little effect on salmonids. Agency Creek is deficient in biological criteria. Downstream of the Upper South Yamhill River watershed, the South Yamhill River is listed for temperature, flow modification, and bacteria. The Oregon Department of Environmental Quality (DEQ) manages the data that determines 303(d) listing. For more information on safe drinking water call the EPA hotline at 1(800) 426-4791.

Table 23. Water Quality 303(d) Listing for the Upper South Yamhill River Watershed

River Section	Parameter	Criteria	Season	Basis for Listing	Supporting Data
South Yamhill River, Willamina Creek to Headwaters	Bacteria	Water Contact Recreation (fecal coliform 96 Std)	Summer	DEQ Data; d1 in 305(b) Report (DEQ, 1994); NPS Assessment – segment 364: severe, observation (DEQ, 1998)	DEQ Data (Site 402631; RM 53.4): 40% (2 of 5) Summer values exceeded fecal coliform standard (400) with a maximum value of 460 between 1986-1987

(Oregon Department of Environmental Quality website)

Sources of Pollution

National Pollutant Discharge Elimination System (NPDES) permits are required for point sources of pollution that are registered with the EPA. "Major" NPDES permits are for facilities that discharge more than one million gallons in any 24-hour period. There are no major permits in the Upper South Yamhill River watershed. The Grand Ronde Sanitary District holds a minor permit. To put this in context, 33 major NPDES sites and 320 minor sites discharge effluent into the Willamette River or its tributaries.

Stream flow influences the concentrations of both dissolved and suspended contaminants, but the relation between concentration and stream flow is not straightforward. For example, high flows can reduce concentrations by diluting point-source inputs, or, conversely, they can be associated with additional inputs such as non-point-source contaminants in surface runoff. Because flows vary among sites and at individual sites, their variability should be considered whenever concentrations are compared.

The period of greatest concern for pollution or "contaminant loading" of rivers in the area is during the summer months of July through September. This period is important because non-point source contaminants tend to accumulate between infrequent rainfall during the summer and are then washed into rivers with relatively low rates of flow. Low summer flows limit the capacity of the river to dilute incoming contaminants.

Table 24 identifies areas of concern for the Upper South Yamhill watershed. The Department of Environment Quality determined that these areas did not warrant placement on the 303(d) list, but were still worth identifying as problem reaches. According to Mark Charles of DEQ, the EPA is revising its requirements for listing stream segments, to simplify the decision-making process. Mark points out that the stretches listed in Table 24 deserve more attention and will remain areas of concern for state agencies until data indicates otherwise.

Table 24. Upper South Yamhill River Watershed Areas of Concern for 303(d) Standards

Stream Section	Criteria	Cause for Concern (but *not* 303(d) listed).
Agency Creek, Mouth to Falls Rm 3	Biological Criteria (Impaired Conditions)	DEQ Biological Assessment 1994. Streams are considered a Potential Concern with a Discriminant Score of 61 to 75 points. Discriminant score was 64. Rationale for not listing: Did not meet listing criteria.
South Yamhill River, Willamina Creek to Headwaters	Nutrients (Phosphorus)	DEQ Data (Site 402631, MR 53.4): 15% (1 of 7) May through October values exceeded TMDL phosphorus standard (70 µg/l) with a maximum of 110 µg/l between 1986-1998 Rationale for not listing: TMDL established for phosphorus, approved (12/8/92) and being implemented
South Yamhill River, Willamina Creek to Headwaters	Flow Modification	NPS Assessment – segment 364: moderate, observation (DEQ, 1988) Rationale for not listing: No supporting data or information
South Yamhill River, Willamina Creek to Headwaters	Sedimentation	NPS Assessment – segment 364: severe, observation (DEQ, 1988) Rationale for not listing: No supporting data or information
South Yamhill River, Willamina Creek to Headwaters	Temperature	NPS Assessment – segment 364: moderate, observation (DEQ 1998) Rationale for not listing: No supporting data or information.

(Oregon Department of Environmental Quality website)

Types of non-point source contaminants in storm water:

- Nutrients (such as phosphorous and nitrogen) act as fertilizer for aquatic plants like algae. They come from leaking septic tanks, domestic animal wastes, feedlots, fertilizer applied to lawns and cropland, detergents—especially those used outdoors (car washing) and rinsed into street drains, and from decaying plant debris.
- Sediment is considered to be a non-point source contaminant because it causes turbidity and may leave damaging deposits of silt on gravel spawning beds. It also reduces flood storage volumes by filling in streambeds and pools. Sediment is caused by erosion at construction sites, along poorly protected banks of fast moving streams or drainage ditches, from agriculture fields, and from recently or poorly landscaped areas.
- Bacteria, such as *E. coli* come from human and animal waste and serve as an indicator that bacteria or pathogens harmful to humans may be present. *E. coli* and fecal coliform are common in the environment but are not always dangerous; when they are found in high concentrations there is likely a source of raw sewage that requires further investigation or treatment.
- Organic compounds and solvents such as benzene, oil, gasoline, and tri-chloro-ethane (TCE) can be soluble or insoluble in water. Light, floating solvents such as gasoline or oil are often be transported by surface “sheet” flow. Leaking underground fuel tanks can contribute to ground water contamination for years without detection. The plume will generally travel downward until it reaches the water table and then it will move laterally at the top of the water table. Heavier insolubles such as TCE migrate downward through soil horizons rather than being transported by either surface or subsurface water flow. Soluble organics such as anti-freeze are difficult to remove from storm water and are transported downstream. Concerns: changing oil, steam cleaning, degreasing, industrial activities, underground fuel tanks, pesticides, household cleaners, paint, etc.

- Metals, primarily lead, cadmium, copper, and zinc are a concern because of their possible toxic effect on fish, wildlife, and humans. Metals can reenter the food chain through bottom feeding (benthic) species like clams. Significant sources of trace metals are industry, leaded gas, brake shoes, and tires.

Nutrients

Total phosphorus is a measurement of the amount of phosphates in the water column and phosphorus in suspended organic material. Total nitrate is a measurement of the nitrogen present in water. Scientists identify the two as the major limits to plant growth. If there are excessive amounts of phosphorus and nitrates present, plant growth increases and can be a problem in slow-moving water. Algae and other plants remove dissolved oxygen from the water, can interfere with recreation, and with certain algae, produce chemicals that are toxic to animals.

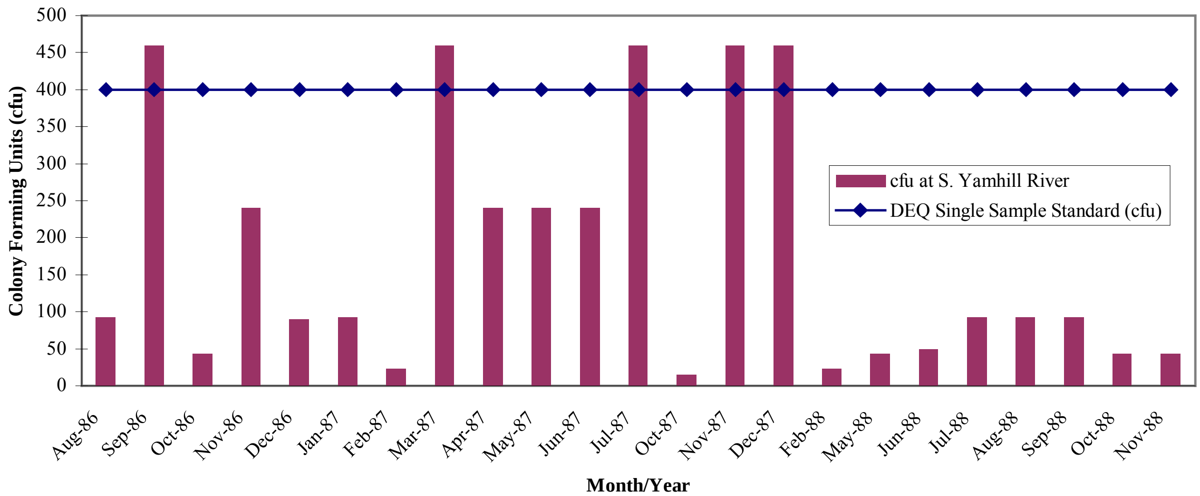
Fecal Coliform and *E. coli*

According to the 1979 *Natural Resource Conservation Plan* of the Yamhill County Soil and Water Conservation District, failing septic systems are a major source of pollution in the area. According to soil surveys, 93% of the soils in Yamhill County severely limit the functioning of septic systems. Septic systems are difficult to place in this region, as there is too much clay for effluent to move through the soil at a sufficient rate, winter standing water eliminates many potential septic sites, and many slopes that are too steep for installing drainage fields.

Fecal coliform are a group of microorganisms that indicate when feces (animal or human) are present in water; they warn of the associated pathogenic health hazards. Their sources include faulty septic systems, runoff from feedlots or other high concentrations of domestic animals, leaking sewer pipes, overflows from sewers or wastewater treatment facilities, and wildlife. Fecal coliform bacteria are expected in all surface streams. DEQ has recently changed the fecal indicator from the bacterial group of fecal coliforms to *E. coli*. The new limit is a 30-day log mean of 126 *E. coli* organisms per 100mL of sample water based on a minimum of five samples with no single sample exceeding 406 per 100mL. This is also the discharge limit of many new National Pollutant Discharge Elimination System (NPDES) permits in the area. The *E. coli* limit replaces the previous limit of 200 fecal coliform per 100ml of sample water.

The change is intended to improve the accuracy of the standard. Other standards will be established for the Yamhill basin (including the Upper South Yamhill River watershed) during the total maximum daily load (TMDL) process scheduled for 2007. This process will assess the "natural" or background concentrations of fecal pollution, temperature and other parameters and establish a threshold by which the watershed will be monitored. The DEQ water quality program website has additional information on this process or you can reach the water quality program office at (503) 229-5279. Fecal counts as high as 10,000 per 100 mL have been recorded in the area after sewer system overflows, with levels greater than 1000 common. The duration of the contamination depends on the magnitude of the spill and the stream flow at the time. Coliform levels can return to normal in as little as 24 hours for small spills at high flows. For larger spills at lower stream flows, it can take a week or longer for the counts to return to ambient or pre-spill levels.

Figure 5. South Yamhil River Fecal Coliform Data from DEQ (1986-88)



Sewage Treatment

All waste treatment or decomposition systems involve bacterial growth—this is a useful tool for consuming nutrients under controlled conditions. In the environment, while bacteria are found naturally, certain types can threaten the health of plants and animals, including humans. This is especially true of bacteria associated with human waste. These bacteria are constantly evolving; some that live in humans may eventually evolve to be pathogenic to humans. A related variable important for sewage treatment is the volume of water in area streams and rivers. Volumes fluctuate widely during the year between huge winter storms and low summer flows.[4] High flows effectively dilute discharges; during low flows, discharges to the river have more of an impact.

A problem with old sewage pipelines is that they leak and allow “I & I”—inflow and infiltration of groundwater during the winter when the water table rises. These same pipes allow some limited “exflow” of raw sewage when the water table drops during summer months.

Grand Ronde Sanitary District was formed in 1980 due to the failure of numerous private septic systems. The District is administered by the Polk County Community Development office and uses a lagoon system. During winter months, they discharge to the South Yamhill River; in the summer, they hold all wastewater in the lagoons for later discharge. Grand Ronde Sanitary District plans to switch to a new system soon; during the summer they will apply discharges to nearby fields as irrigation.

Spirit Mountain Casino wastewater is under federal regulation due to its Tribal association. Despite being exempt from state regulation, managers still work toward achieving the DEQ permit standards. The system used at Spirit Mountain wastewater is called a Sequential Batch Reactor (SBR). It involves continuous flow, a tertiary cloth filter, and ultra-violet disinfection.

[4] Levels in the Yamhill River illustrate the seasonal fluctuation. Flows peaked at over 47,000 cubic feet per second (cfs) during the 1996 flood. In contrast, September flows typically drop to only ~10cfs or less.

The main feature of the system that allows the Tribe to be free of DEQ permitting requirements is an outflow that is located 18 inches underground, not unlike a septic leach field. Most wastewater in the region outflows to surface water bodies, usually rivers or streams. According to Robert Jones, Spirit Mountain wastewater testing results show BODs ("Biochemical Oxygen Demand")[5] at less than 10 ppm and nitrogen levels less than 5 ppm.

An interesting innovation in waste treatment is found nearby at Newberg's sewage treatment plant. Instead of keeping waste in liquid form, Newberg removes solids (sludge), then thickens, dehydrates, and composts the remaining waste. This involves adding carbon in the form of sawdust to the "dewatered" sludge. The carbon balances the concentrated nitrogen and the two fuel a biological process that accelerates breakdown of the sludge. This quickly eliminates the polluting characteristics of waste and creates soil compost as a byproduct. The composting results in a stable, environmentally safe fertilizer available to the public. Called "Newgrow," it exceeds all EPA and DEQ standards and is free of pathogens, although it may have some low levels of heavy metals. According to the promotional literature, Newgrow provides a long-term slow release of nitrogen, phosphorous, and potassium and improves the quality of any soil. For more information call the City of Newberg Wastewater Treatment Plant at (503) 537-1254.

This same basic technique can be used by anybody on a small scale. It is the basis of many composting toilet systems. The essential thing is to add carbon (preferably hardwood sawdust), put a roof over it, and give it some time to decompose. All plant material is high in carbon content and the carbon balances the nitrogen in animal (human) waste to promote efficient decomposition. In a relatively short time the combination results in soil, suitable for planting.

Temperature

High temperatures affect native fish by physically stressing them and even leading to death in many cases. Above their normal range of temperatures, salmon and trout experience increased metabolic rates that makes it difficult for them to eat enough to maintain their body weight. Further exacerbating this condition is that salmonids may lose their appetites and become less competitive in catching food at abnormally high temperatures.

The DEQ maximum seven-day average temperature standard for the Yamhill basin is 64°F (17.8ºC). This means that over any seven-day period, the average maximum daily temperature ideally will not exceed 64°F. During spawning season for winter steelhead, the seven-day average is not to exceed 55°F in order to support salmon spawning, egg incubation, and fry emergence from the egg. These standards are widely debated because temperature cycles vary daily and seasonally and different life stages and different species of fish exhibit different tolerances.

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[5] Sewage is typically 99.94 percent water, with only 0.06 percent of the wastewater dissolved and suspended solid material. The cloudiness of sewage is caused by suspended particles. A measure of the strength of the wastewater is biochemical oxygen demand, or BOD. Biochemical Oxygen Demand (BOD) refers to the amount of oxygen that would be consumed if all organic material in water were oxidized by bacteria and protozoa. The range of possible readings can vary considerably: water from an exceptionally clear lake might show a BOD of less than 2 ml/L of water. Raw sewage may give readings in the hundreds and food processing wastes may be in the thousands.

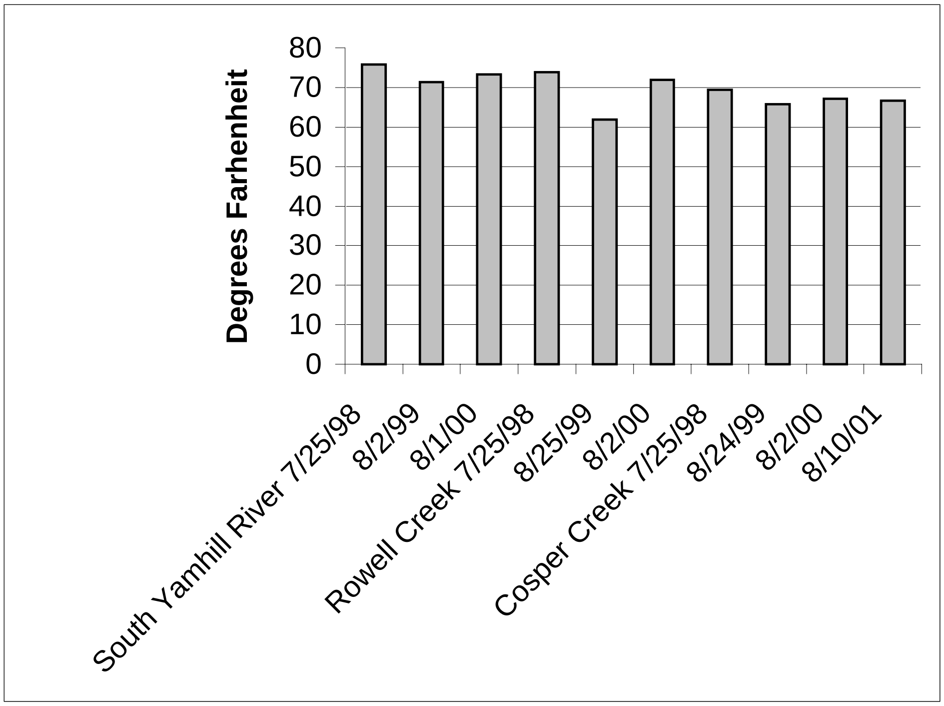

Figure 6. Seven-day Average Maximum Temperature Seasonal Maximums
(Yamhill Basin Council, 2002)

The YBC implemented a monitoring program in 1998 in association with DEQ. The technique is to place special thermometers in area streams that record temperatures every half hour and store the data on a computer chip for later analysis. A number of streams in the Yamhill basin experience their seasonal seven-day maximum around the beginning of August. Figure 6 shows seven-day maximum temperature data for the years 1998—2000 in the Upper South Yamhill River watershed.

The Confederated Tribes of Grand Ronde also implemented a temperature monitoring program in 1998 to gather baseline information about area streams. Unlike the YBC program which covers the entire Yamhill basin, Tribal thermometers are concentrated on Reservation land, in the Grand Ronde community, and in headwater streams on U.S. Forest Service (1999-2001) and Bureau of Land Management lands (2001-Present). In 1998, over half the streams monitored by the Tribe were above the 64° F standard. In 1999, only four out of 23 temperature monitoring sites were above 64° F. In 2000, eight of 25 meters recorded temperatures exceeding the standard. Sunlight and air temperatures influence stream temperatures.

As Rod Thompson of CTGR Natural Resources reports, the 1998 seven-day average ambient temperature during the warmest June-September months was 85.2° F. In 1999 it was 77.1° F and in 2000 it was 75.2° F. Rod explains that by “just looking at the difference in the ambient temperatures it may seem easy to hypothesize why a higher portion of the streams were above the 64° F standard in 1998 than in 1999 or 2000.” Additional years of data collection will contribute further to this analysis.

Table 25 reports CTGR temperature data grouped according to the National Marine Fisheries Service (NMFS) matrix for evaluating stream health. The NMFS matrix characterizes streams as properly functioning where temperatures are at or below 60° F, functioning "at risk" when temperatures are between 60° F and 68° F, and "not properly functioning" where they are at or above 68° F.

Table 25. Stream Temperatures 1998-2000 Grouped by NMFS Matrix Categories

7-Day Maximum Temperatures Reported in Degrees Fahrenheit (Confederated Tribes of the Grand Ronde)

Not Properly Functioning	
S. Yamhill River (Casino)	71.3
Agency Creek (mouth)	68.4
Properly Functioning but At Risk	
Rock Creek	67.3
Rogue River	66.9
North Fork Agency Creek	66.83
Upper Coast Creek	66.4
Upper Agency Creek	64.4
Lower Agency Creek	64.23
N.F. Agency (East U.S.F.S.)	62.95
West Fork Agency Creek	62.9
Burton Creek	62.87
Lower Wind River	62.3
Lower Yoncalla Creek	61.8
Kitten Creek	61.2
Cosper Creek	60.77
Pierce Creek	60.65
Properly Functioning	
Upper Yoncalla Creek	59.83
Ead Creek	58.9
Joe Creek	58.7
N. F. Agency (West U.S.F.S.)	58.55
Yoncalla Tributary	57.5
Upper Wind River	55.95
Yoncalla (U.S.F.S.)	55.8

When DEQ works on the TMDLs ("Total Maximum Daily Loads") for the Yamhill basin they will examine temperature and determine if 64°F is an attainable maximum temperature. Critics say that historically the area's waters exceeded 64°F under natural conditions. There is no historical temperature data to confirm or refute this. There is no dispute that water temperature influences the aquatic ecosystem, including the biological community and the chemical behavior of the system. Most living organisms have adapted to and tolerate only limited temperature ranges. For example, water temperatures exceeding 68ºF (20ºC) are dangerous for salmonid species and temperatures exceeding 77ºF (25ºC) can be lethal.

At this time, DEQ has not monitored any streams above Willamina Creek in the South Yamhill basin; therefore, no streams above Willamina Creek have been listed. In addition, the Confederated Tribes of Grand Ronde (CTGR) have not adopted water quality standards or a water quality standard program. Therefore, EPA retains water quality jurisdiction over Tribal waters.

Dissolved Oxygen

Temperature influences the chemical behavior of many dissolved gases because they decrease in concentration with increasing temperatures. This effect is particularly important for dissolved oxygen (DO) and is one cause of the seasonal variation in the DO concentrations.

Dissolved oxygen is important for supporting cold-water organisms such as salmon and trout. Throughout their lifecycle, these species have different dissolved oxygen demands. The Oregon Water Quality Standards specify the amount of dissolved oxygen to meet the needs of these species. The level of DO that is desired is 8mg/L or higher. In the Yamhill basin, samples range from 8.5mg/L to 13.5mg/L with the majority of the samples in the 9.0mg/L to 10.0mg/L range.

pH

pH is a measure of the hydrogen ion concentration in water and indicates relative acidity or alkalinity. pH values greater than seven indicate alkaline conditions and those less than seven indicate acidic conditions. Water chemistry and water quality are profoundly affected by the relative acidity of the water as hydrogen ions participate in many equilibrium reactions in water. Consequently, the pH can be used to indicate which chemical reactions predominate and can be very important when considering the toxicity of a weak acid or base. In the case of ammonia, for example, the non-toxic, ionized form is dominant when the pH is low (<9.3); but when the pH is high (>9.3) the toxic, neutral form is dominant.

The Oregon Water Quality Standards specify an acceptable pH range of 6.5 to 8.5 for basins west of the Cascades. Water having a pH value outside of this range is toxic to freshwater organisms. Note that pH values vary during different times of the year based on natural conditions such as photosynthesis and respiration cycles of algae present in the water.

Turbidity and Suspended Solids

Turbidity is a measure how light is refracted as it passes through a water sample. Turbidity is correlated to the presence of suspended sediments in the water column. Sediment can affect salmonids by damaging their gills and reducing their ability to see their prey. In addition, fine sediment may also clog gravels salmonids use for spawning, killing eggs. Turbidity measurements may change drastically depending on the current climatic conditions - for example, heavy rains may increase the sediment load from the land into the stream, increasing turbidity levels.

No turbidity data is available for the Upper South Yamhill River watershed. Data recorded by DEQ from 1986-88 showed turbidity levels in the South Yamhill River near the Whiteson gaging station between 1.0 and 34.0 Hach FTU. DEQ notes that additional turbidity data needs to be collected in the watershed.

Other Contaminants: Organic Compounds, Pesticides, and Metals

The literature concerning pesticides and other water quality contaminants is extensive. Many studies have been conducted in the Willamette basin. Most of the reports focus on the Willamette River with occasional references to the Yamhill basin. There is little specific information for the streams in the Upper South Yamhill River watershed. In general, there are several different pesticides which may be present in the streams and rivers of the Yamhill basin. The most common substances are atrazine, desethylatrazine, simazine, metolachlor, and diuron.

Conclusion

Scattered water quality data exist but information for local waters is not comprehensive. The Upper South Yamhill River is 303(d) listed for bacteria. Agency Creek is considered "at risk" for biological criteria. The Upper South Yamhill is at risk for, nutrients (phosphorous), flow modification, sedimentation, and temperature. The period of greatest concern for pollution or "contaminant loading" of streams in the area is during the summer months from July through September. This period is important because non-point source contaminants tend to accumulate between infrequent rainfall and are then washed into rivers with relatively low rates of flow. Both the Confederated Tribes of Grand Ronde and the Yamhill Basin Council will continue to monitor temperature and other parameters in this area.

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CHAPTER 10
Fish Habitat and Barriers

Introduction

This chapter is important for bringing watershed issues to a focal point. The history, geology, vegetation, soils, hydrology, and water quality of this region combine to affect current fish populations in the Upper South Yamhill watershed. Understanding the current state of native cutthroat trout populations is one method of monitoring local water quality levels, as trout are sensitive to water quality impacts.

The objective of this chapter is to identify historic and current fish populations in the watershed and to evaluate current habitat conditions. The Yamhill basin, as part of the upper Willamette basin, has several native anadromous species: winter steelhead, Pacific lamprey, and spring Chinook salmon. Upper Willamette winter steelhead and upper Willamette spring Chinook salmon are listed as threatened species under the federal Endangered Species Act.

Cutthroat trout are the most plentiful and widespread native salmonid in the Yamhill basin. They play an important role in the aquatic ecosystem. Since they are more widely distributed in the watershed than any other salmonid, the effects of habitat restoration programs might be more effectively measured by examining their effects on trout populations. Cutthroat are the best indicator species for water quality in the Upper South Yamhill River watershed.

Table 26 is a general fish species list for the Yamhill basin. These are native species that are likely to be found in the streams of the watershed given the habitat, water quality, and what ODFW has found in other similarly sized streams. The list includes only native species. Other, non-native fish are also present. For example, coho salmon, catfish, mosquitofish, crappie, large and small mouth bass are all common but are non-native, introduced species in the Yamhill River watershed.

Table 26. Native Aquatic Species in the Yamhill Basin

Common Names of Local Aquatic Species	
• cutthroat trout	• Pacific lamprey
• winter steelhead salmon	• brook lamprey
• sculpin	• northern pike minnow
• dace (speckled, longnose, etc.)	• sucker
• redside shiner	• spring Chinook salmon
• three spine stickleback	• crayfish

Fish History

As early as 1962, the Yamhill County Economic Development Committee found that all fish populations were decreasing in the area except “silver” (coho) salmon. The committee knew that establishment of minimum flows would help fish populations. However they erroneously thought that raising the water temperature by constructing reservoirs would also be beneficial. The committee did call for elimination of industrial pollution. "The establishment of minimum flows and elimination of pollution are the most important things needed to increase the fish population," they wrote. They stated that "treatment of the waters with Rotenone and Toxaphine is about the only successful way to eliminate trash fish" whose populations were increasing.

Pre-settlement, in-stream habitat was different from current conditions. Log jams created diverse habitat, fish passage impediments such as culverts and dams were non-existent, mature timber provided shade resulting in cooler water temperatures and greater dissolved oxygen, and stream meanders provided complex habitat with pools and riffles.

Anecdotal evidence suggests habitat and populations are decreasing in area streams but cutthroat remain in many stretches including headwater streams. Based on stream surveys in the watershed, it is safe to say that the only year-round salmonid presence is native cutthroat trout in most of the larger streams. In headwater streams cutthroat can find the diversity of habitat and water quality needed for all of their life stages. Salmonid activity in some lower reaches of the watershed may be seasonal due to decreased water quality during the summer. Adult cutthroat trout use lower stretches as a migration corridor while juvenile cutthroat use them for rearing and refuge. Juvenile steelhead produced in other South Yamhill tributaries also use lower stretches for seasonal refuge and rearing before outmigration.

There has been some question about the steelhead population in the area. Some state agency people feel that native steelhead have been extirpated from the Yamhill basin. Gary Galovich of ODFW believes this is not the case. He explains his position this way:

> "There are many differing opinions as to the origin of the winter steelhead currently found in the coast range tributaries of the upper Willamette. Some believe that steelhead were never present. Others believe that steelhead were present in relatively small numbers but that the truly "wild" stock has been lost due to habitat change and the introduction of hatchery fish. Still others— myself included— believe that steelhead are native to these streams and are still present in apparently increasing numbers. The current information that we have on these fish (genetic, run timing, etc.) suggests that these are truly native stock and they are being managed as such."

Table 27. Oregon Department of Fish and Wildlife Observations in the Watershed

Creek	**Date**	**Species** CT = Cutthroat, ST = Winter Steelhead
Gold Creek	5-07-59	3" CT
	9-20-83	7 CT 10-14.5cm; 1 ST 10.7cm
Klees Creek	4-09-59	Spot checked 2 mi.; no fish. Locals say creek only trickles in summer.
Cosper Creek	4-23-59	Several CT 4-12"; Reportedly good trout fishing.
	8-24-85	4 CT; 2 ST; 6 coho
	9-20-83	9 CT 7.9-16cm; 5 ST 8.8-13cm
Rowell Creek	1942	Good population of CT
	4-10-59	Locals report trout present and fair year-round flow.
	8-13-64	No fish observed
	9-21-83	5 CT 13.5-22.6cm; 5 ST 7.9-14cm; 14 coho 7.4-10.1cm; 3 perch 6-8cm
Little Rowell Cr.	1942	"Said to possess spawning cutthroat in May."
Rock Creek	4-09-59	1 CT 1"; locals report trout but no salmon. Eight falls.
	9-22-59	No fish observed
	9-21-83	19 ST 7-14.5cm; 1 coho 9.5cm

Table 27 Continued		
Joe Day Creek	3-20-59	No fish observed. "Heavily chocked with debris from recent logging"
Cow Creek	8-17-95	10 CT 5.1-8.9cm; 2 lamprey 6.3, 12.2cm; 4 sculpin
Rogue River	1942	CT present
	4-22-59	4 CT; several 2-6" salmonids; 5 dace; beaver dams, log jams
	9-21-83	4 CT 11.1-14.4cm; 2 coho 8.5, 8.9cm
	6-29-87	13 CT 3.4-17.4cm; 30 coho 5.5-7.4cm
	6-30-87	3 CT 12.1-20.5cm; 8 CY 3.4-11.6; 1 redsided shiner 9.3cm; 1 coho 6.3cm
Jackass Creek	3-20-59	No fish observed. Many beaver ponds.
	6-30-87	7 CT 7.7-18.9cm; 16 CT 3.5-22cm; sculpins; crayfish
	9-13-96	4 CT ~6"
Agency Creek	1942	CT present
	7-30-50	Contains native cutthroat trout
	1956-7	Adult silver (coho) spawned in Agency Creek
	4-08-59	2 small CT, 1 6" CT; dace
	4-06-61	3 CT 6-8"
	7-25-79	5 CT 9.7-17.2cm; 83 ST 4.8-15.2cm; cottids; lampreys
	7-26-79	18 CT/ST? 3.1-7.7cm; 8 CT 9.3-13.5cm; 7 ST 7.5-12.8cm
	1984	CT, ST, and rainbow trout. ~50 steelhead use entire length to spawn.
	8-24-85	7 CT; 2 ST; 53 coho; dace; cottids; crayfish
Joe Creek	4-08-59	1 Ct 1⅛"
Wind River	4-08-59	No fish observed
	9-27-72	5 CT; 5 juvenile ST; 6 juvenile coho; cottids; dace
	7-26-79	10 CT 5.1-16cm; 1 ST 10cm; cottids
Yoncalla Creek	8-14-73	1 CT
	4-20-79	15 CT 7.5-17.1cm
	7-26-79	37 CT4.9-19.2cm; no ST or redds observed; cottids
W. Fork Agency	9-27-72	CT present
	7-26-79	18 CT 4.3-19.5cm; 10 CT 4.2-14.5cm; cottids
	1-20-84	5 CT 10.8-13.5cm; 1 CT 9.3cm; 3 ST 5.7-10.9cm
	10-17-86	10 CT 5.5-10.8cm; 24 CT 4-14.1cm; 15 CT 7.9-12.3; 16 ST 4.9-8.5cm
Elmer Creek	11-17-88	3 CT 6.8-10.2cm; sculpins
Crooked Creek	1-03-58	1 dead coho, stray from South Yamhill River
Cedar Creek	1-03-58	No fish observed
	11-17-88	4 CT 15.6-17.2cm; beaver; sculpin; lamprey
Ead Creek	4-22-59	No fish observed
	1-20-84	No fish despite shocking water thoroughly
W Fork Ead	8-09-77	1 CT 2"
	1-20-84	2 CT 12.3, 17.6cm
Pierce Creek	3-19-59	No fish observed
	9-22-83	32 CT 5.5-20.6cm; 7 ST 6.5-9.8cm; 21 coho 7.3-9.1cm
Kitten Creek	3-19-59	2 Ct 4"
	8-09-77	No fish observed
	9-22-83	16 CT 6.5-15.5cm; 2 ST 8.2, 9.4; 3 coho 7.6-9.1cm
Hanchet Creek	4-09-59	"Salmonids up to 5" are apparent"
	9-21-83	3 CT 10.5-19cm; 12 coho 5.7-8.9cm

(ODFW files at Adair Village Office)

Fish Hatcheries

An ODFW stocking program during the second half of the 20th century aimed to establish new coho runs in the upper Willamette Valley (including the Yamhill basin) and supplement the native coho population of coastal rivers. Coho salmon are not native above Willamette Falls, however. Releases occurred on a variety of South Yamhill River tributaries from the 1950s to the 1980s. Stocking took place in headwater streams for reasons of water quality and habitat. All anadromous fish released in the upper Willamette basin have potentially entered the drainage; spawning likely takes place elsewhere in larger, cooler, cleaner stretches.

Table 28. Yamhill River Basin Stocking History

Species	Anadro-mous or Resident	Native	Stocking Notes
Winter Steelhead (*Oncorhynchus mykiss*)	A-winter/ spring	Y	No hatcheries present in watershed. Not many fish present historically, hatchery releases into the S.Yamhill River 1964-82 from Big Creek stock. STEP fry releases in recent years.
Coho Salmon (*Oncorhynchus kisutch*)	A- late fall/early winter	N	No hatcheries in basin. Stocking from Bonneville, Oxbow, Eagle Creek, Cascade, and Sandy and in 1983, from Cowlitz Hatchery in WA. In 1980s, number of streams stocked decreased to minimize effects on steelhead and cutthroat. Many releases in 60s and 70s to supplement Columbia River run.
Cutthroat trout (*Oncorhynchus clarki clarki*)	R	Y	Never stocked.
Rainbow trout (*Oncorhynchus mykiss*)	R	N	Hatchery rainbow trout released to create fishery. Early as 1920s, 30s, until 1980s. No evidence of natural reproduction.

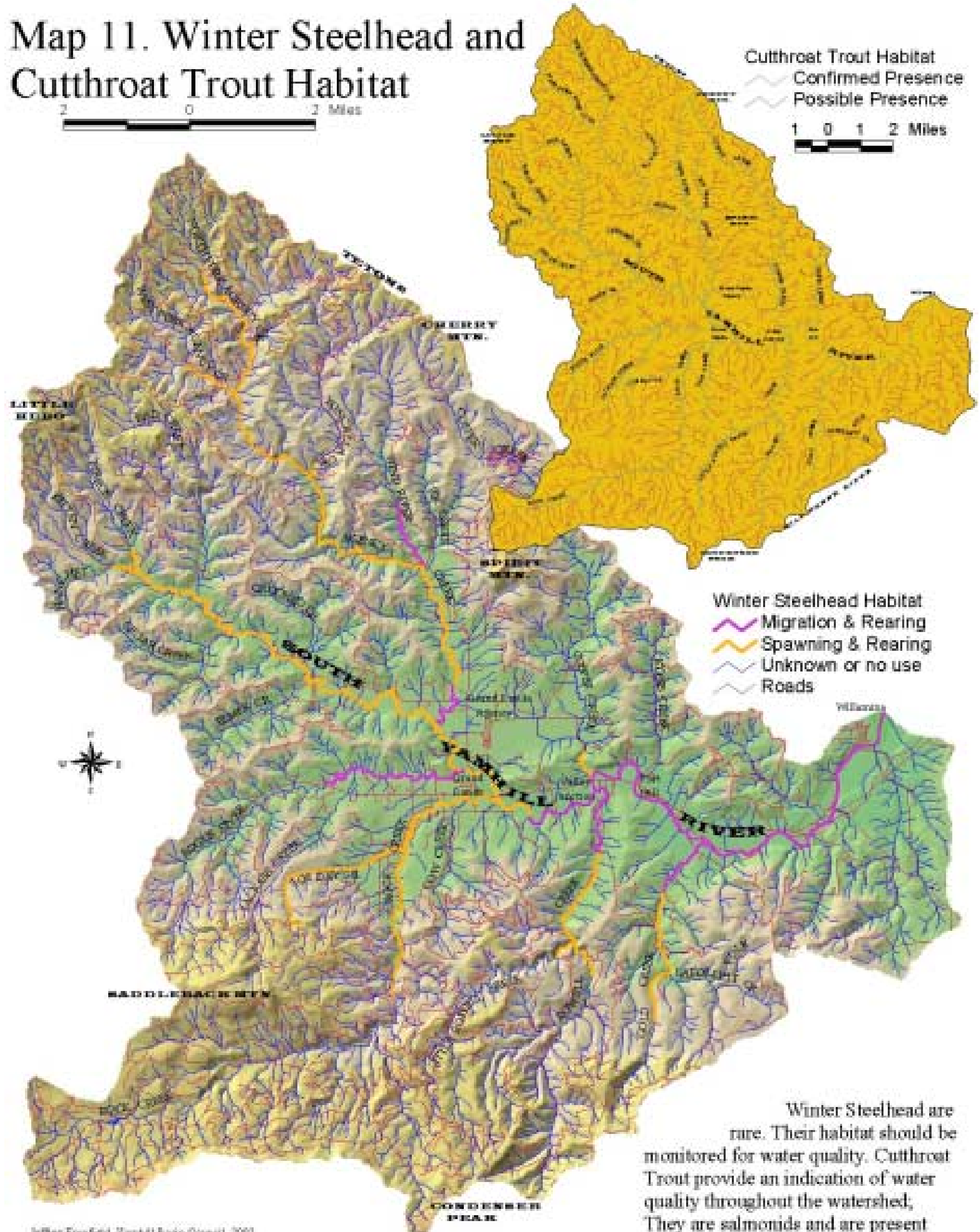
(ODFW *Coast Range Subbasin Fish Management Plan*)

In the 1980s, concerns over the effect of coho on native cutthroat trout and winter steelhead led ODFW to reformulate their hatchery release plan for the region. There are limits to how many fish an area can support. In addition to hatchery fish, non-native fish are displacing native species. ODFW did not want to risk further decreasing populations of native fish by continuing to introduce non-native coho. According to Gary Galovich, ODFW has documented adult coho returning and juvenile coho present in the upper Willamette basin even after hatchery releases were discontinued. This means that introduced coho have been able to sustain themselves through natural reproduction and will possibly remain a factor in the Yamhill basin.

Cutthroat trout are native in the Upper South Yamhill River watershed and have never been stocked here. Although cutthroat are not listed as an endangered or threatened under the Endangered Species Act (ESA), it has been a candidate for listing and is being managed accordingly by ODFW. In general, cutthroat in the Yamhill basin live their entire life in one watershed. Some cutthroat populations are "fluvial," meaning they migrate within their river system, while others like those in Upper South Yamhill streams tend not to migrate.[6] It may be easier to determine the impact of habitat restoration on cutthroat, as they are not subject to as many survival variables as anadramous fish such as steelhead. For steelhead, the journey from stream to ocean and back involves many unknown perils, making the effects of individual watershed restoration projects difficult to discern.

[6] "Anadromous" is used to describe species that live in the ocean and ascend rivers to spawn. "Fluvial" or "potamodrous" fish live in freshwater and migrate into small headwater streams to spawn. "Catadromous" species such as eels live in freshwater but migrate to the ocean to spawn.

Map 11. Winter Steelhead and Cutthroat Trout Habitat



Winter Steelhead are rare. Their habitat should be monitored for water quality. Cutthroat Trout provide an indication of water quality throughout the watershed; They are salmonids and are present in most of the larger drainages.

Table 29. Hatchery Releases of Salmonids in the Upper South Yamhill River Watershed

f = fry, F = fingerling, y = yearling, a = adult

Winter Steelhead

Yr.	Hatch-ery	Number/ Lifestage	Location
1964	NA	109,065 (f)	S Yamhill
1965	Big Cr	17,658 (y)	S Yamhill
1965	NA	7,392 (y)	Agency Cr
1966	Big Cr	10,440 (y)	S Yamhill
1966	Big Cr	8,175 (y)	Agency Cr
1967	Big Cr	10,141 (y)	Agency Cr
1967	Big Cr	202 (a)	S Yamhill
1967	Big Cr	212 (a)	Cosper Cr
1968	Big Cr	5,578 (y)	Agency Cr
1967	Big Cr	446 (a)	Agency Cr
1968	Big Cr	160 (a)	Agency Cr
1969	Big Cr	208 (a)	Agency Cr
1971	Big Cr	200 (a)	Agency Cr
1972	Big Cr	200 (a)	Rowell Cr
1972	Big Cr	330 (a)	Agency Cr
1972	Big Cr	200 (a)	Rock Cr
1973	Big Cr	200 (a)	Rock Cr
1982	Big Cr	44,787 (F)	S Yamhill
1983	Big Cr	3,805 (f)	Cosper Cr
1984	Big Cr	15,000 (f)	Agency Cr
1985	Big Cr	5,000 (f)	Cosper Cr
1985	Big Cr	24,265 (f)	Agency Cr
1986	Big Cr	1,935 (f)	Cosper Cr
1986	Big Cr	74,576 (f)	Rock Cr
1986	Big Cr	32,287 (f)	Joe Day Cr
1986	Big Cr	12,400 (f)	Agency Cr
1986	Big Cr	12,600 (f)	Wind R
1988	Big Cr	29,600	Rock Cr
1989	Big Cr	27,500	Agency Cr
1990	Big Cr	100	Rock Cr

Rainbow Trout* Released in Agency Cr.

Yr.	Number & Pounds (lbs)	Yr.	Number & Pounds (lbs)
1978	2,800 (980)	1983	2,013 (650)
1979	1,003 (271)	1984	2,000 (656)
1979	1,000 (313)	1985	1,994 (688)
1980	1,999 ((805)	1986	2,001 (607)
1981	1,000 (370)	1987	1,993 (688)
1981	999 (400)	1988	2,003 (658)
1982	2,008 (663)	1989	2,000 (606)

Coho

Yr.	Hatch-ery	Number/ Lifestage	Location	Year	Hatch-ery	Number/ Lifestage	Location
1954	Bonne.	10,000 (y)	S Yamhill	1983	STEP	20,000 (f)	Casper Cr
1954	Sandy	100,000 (F)	S Yamhill	1983	STEP	25,000 (f)	Ead Cr
1955	Sandy	50,000 (F)	S Yamhill	1983	STEP	25,000 (f)	Jackass Cr
1955	Sandy	45,486 (y)	S Yamhill	1983	STEP	8,000 (f)	Kitten Cr
1957	Sandy	79,877 (y)	S Yamhill	1983	STEP	25,000 (f)	Pierce Cr
1957	Sandy	239,556 (F)	S Yamhill	1983	STEP	45,000 (f)	Rowell Cr
1957	Sandy	128,000 (F)	S Yamhill	1983	STEP	50,000 (f)	Gold Cr
1959	Sandy	88,476 (F)	S Yamhill	1984	STEP	25,000 (f)	Hanchet
1961	Bonne.	97,784 (y)	S Yamhill	1984	STEP	25,000 (f)	Kitten Cr
1962	Sandy	63,158 (y)	S Y tribs.	1984	STEP	25,000 (f)	Pierce Cr
1962	Bonne.	402,052 (f)	S Y tribs.	1984	STEP	25,000 (f)	Ead Cr
1963	Sandy	44,979 (y)	S Y tribs.	1984	STEP	25,000 (f)	Rogue R
1963	Bonne.	462,907 (f)	S Y tribs.	1984	STEP	25,000 (f)	Jackass Cr
1964	Sandy	61,814 (y)	S Y tribs.	1984	STEP	25,000 (f)	Rowell Cr
1965	Sandy	69,793 (y)	S Y tribs.	1984	STEP	25,000 (f)	Gold Cr
1964	Cascade	600 (a)	S Y tribs.	1985	STEP	31,208 (f)	Kitten Cr
1965	Klaskan.	1827209 (f)	S Y tribs.	1985	STEP	25,208 (f)	Ead Cr
1965	Oxbow	64,152 (F)	S Y tribs.	1985	STEP	24,450 (f)	Pierce Cr
1966	Sandy	14,329 (y)	S Y tribs.	1985	STEP	49,688 (f)	Rowell Cr
1965	Sandy	220 (a)	S Yamhill	1985	STEP	19,247 (f)	Jackass Cr
1966	Bonne.	799,153 (f)	S Yamhill	1985	STEP	19,247 (f)	Rogue R
1966	Bonne.	150 (a)	S Y trib.	1985	STEP	24,692 (f)	Gold Cr
1967	Trask	104,250 (f)	S Y trib.	1985	STEP	9,000 (f)	Hanchet
1967	Klaskan.	806 (a)	S Y tribs.	1986	STEP	16,093 (f)	Eads Cr
1967	Siletz	100 (a)	S Y trib.	1986	STEP	16,093 (f)	Kitten Cr
1968	Klaskan.	306,000 (f)	S Y trib.	1986	STEP	16,093 (f)	Pierce Cr
1968	Bonne.	140 (a)	S Y trib.	1986	STEP	32,186 (f)	Jackass Cr
1969	Big Cr	300 (a)	S Y tribs.	1986	STEP	32,186 (f)	Rogue R
1969	Alsea	200 (a)	S Y tribs.	1986	STEP	64,373 (f)	Rowell Cr
1970	Big Cr	1226997 (f)	S Y tribs.	1986	STEP	43,197 (f)	Gold Cr
1972	Big Cr	397,240 (f)	S Y trib.	1986	STEP	16,093 (f)	Hanchet
1973	Bonne.	435,226 (y)	S Y trib.	1987	STEP	45,902 (f)	Rowell Cr
1972	Bonne.	208 (a)	S Y trib.	1987	STEP	13,619 (f)	Rogue R
1973	Elk R.	196,100 (F)	S Y tribs.	1987	STEP	12,500 (f)	Pierce Cr
1974	Bonne.	484,769 (y)	S Y tribs.	1987	STEP	40,388 (f)	Kitten Cr
1976	Cascade	124,869 (y)	S Y tribs.	1987	STEP	40,317 (f)	Eads Cr
1982	Sandy	31,388 (f)	Rock Cr	1987	STEP	40,222 (f)	Jackass Cr
1983	Sandy	56,388 (f)	Rogue R	1987	STEP	19,055 (f)	Cosper Cr
1983	STEP	8,000 (f)	Hanchet	1987	STEP	62,122 (f)	Gold Cr
1983	Cascade	98,900 (f)	Rock Cr	1987	Bonne.	41,088 (F)	Rock Cr

*Rainbow Trout from the Roaring River Hatchery

(ODFW *Coast Range Subbasin Fish Management Plan*)

Table 30. Summary of Fish Life History Patterns

Species	Spawning Pattern	Preferred Conditions
Winter Steelhead Trout (*Oncorhynchus mykiss*)	Late January – late April: Juveniles stay 1-2 yrs. Migrate to the ocean in spring where they stay 2-3 years. Return to spawn in winter. May spawn more than once in a season. Ocean distribution not well understood. It appears steelhead move further offshore than other salmonids (OSUES, 1998).	Prefer fast moving water, stream gradient >5%, cool waters, large woody debris important component for their habitat
Coho Salmon (*Oncorhynchus kisutch)*	Juveniles rear throughout watersheds, live in pools in summer. Juveniles migrate to ocean in Spring, rear just off OR coast. Adults return to rivers late fall/early winter. Spawn when 3 years old. Following spawning, they die.	Prefer gravel bars and upper watersheds.
Cutthroat trout (*Oncorhynchus clarki clarki)*	Variable spawning and migration. Potanadromous cutthroat migrate into headwater streams in fall/winter, spawn, return to larger streams. Some do not migrate. Some migrate to estuaries.	Only native trout in basin. Prefer slow moving water, overhanging vegetation.

Table 31. Suspected Spawning Areas in the Upper South Yamhill River Watershed

Species	Stream	River Mile	Species	Stream	River Mile
Winter Steelhead	Gold Cr.	1.0-3.0	winter steelhead	W. Fk. Agency	0.0-0.8
Winter Steelhead	Cosper Cr.	0.0-0.5	winter steelhead	Tributary A*	0.0-0.6
Winter Steelhead	Rowell Cr.	1.0-3.0	Coho	Gold Cr.	0.0-3.0
Winter Steelhead	Rock	0.0-4.0	Coho	Cosper Cr.	0.0-0.5
Winter Steelhead	Joe Day Cr.	0.0-3.0	Coho	Rowell Cr.	0.0-3.0
Winter Steelhead	Agency Cr.*	1.0-11.6	Coho	Rock Cr.	0.0-4.0
Winter Steelhead	Yoncalla Cr.	0.0-0.1	Coho	Ead Cr.	0.0-2.0

*Spawning has been confirmed (StreamNet website)

Fish Habitat

Cosper, Gold, and Rowell Creeks are considered high priority for attaining additional in-stream water rights for improving habitat. Rowell, Rock, Agency, Yoncalla, W. Fk Agency Creeks, and Rogue River are protected from further hydroelectric development by the Northwest Power Planning Council to provide for anadromous habitat and spawning.

Winter steelhead were listed as threatened on March 25, 1999 for the Upper Willamette River (above Willamette Falls). Genetically distinct from Lower Willamette steelhead, winter steelhead enter fresh water in March and April (rather than November or December). Adults use the South Yamhill to migrate to spawning areas in the upper reaches. Parr emerge from the gravel in late spring and rear in the streams for two years before migrating downstream. Juvenile rearing is a very critical stage in salmonid development, and many streams support salmonids only for rearing. Some adults may migrate back down to the Pacific after spawning but little is known about the timing or frequency. Steelhead require cold, clean streams. For the survival of their eggs and young alevin, dissolved oxygen levels need to be at or near saturation. Turbidity can harm eggs and interfere with emergence as well as effect the swimming ability of juveniles. For spawning, gravel must be clean and range from pea to grapefruit size.

Other tributaries of the South Yamhill are documented as supporting migratory species including steelhead, coho, and pacific lamprey that move from the lower Columbia, up the Willamette and the Yamhill River systems. These species may also use the Upper South Yamhill River watershed. "All watersheds in the area contain coastal cutthroat trout (*Oncorhynchus clarki*) and Pacific lamprey (*Lampetra tridentata*)," writes Rod Thompson of the Confederated Tribes of Grand Ronde, adding that these are "important fishing and cultural resources for Tribal members."

Generally, salmonids require cold, clean streams for migration, spawning, and rearing. Dissolved oxygen must be at or near saturation levels for egg and alevin survival. High turbidity impacts egg survival and swimming in juveniles. Critical habitat factors are water, substrate, and riparian vegetation which provide shade, sediment filtration, nutrient and chemical regulation, streambank stability, large pieces of wood, and other organic matter.

Table 32. Fish Distribution in the Upper South Yamhill River Watershed

Stream Name and Length	Species	Primary Use	From (RM)	To (RM)	Miles Used	% of Total
Agency Creek, 12.8mi	Coho salmon	Spawning and rearing	0.0	3.5	3.5	27%
	Winter Steelhead	rearing and migration	0.0	1.0	1.0	7%
		Spawning and rearing	1.0	11.3	10.4	81%
Cedar Creek, 2.3mi	Coho salmon	Spawning and rearing	0.0	0.3	0.3	11%
Cosper Creek, 9.1mi	Winter Steelhead	Spawning and rearing	0.0	0.5	0.5	5%
Ead Creek, 4.6mi	Coho salmon	spawning and rearing	0.0	2.2	2.2	48%
Gold Creek, 5.4mi	Coho salmon	spawning and rearing	0.0	2.7	2.7	49%
	Winter Steelhead	rearing and migration	0.0	1.2	1.2	21%
		spawning and rearing	1.2	3.3	2.1	38%
Joe Day Creek, 2.9mi	Winter Steelhead	spawning and rearing	0.0	2.8	2.8	97%
Kitten Creek, 3.1mi	Coho salmon	spawning and rearing	0.0	1.1	1.1	36%
	Winter Steelhead	spawning and rearing	0.0	0.5	0.5	14%
Little Rowell Creek, 5.2mi	Winter Steelhead	spawning and rearing	0.0	0.2	0.2	4%
Pierce Creek, 3.6mi	Coho salmon	spawning and rearing	0.0	2.1	2.1	59%
	Winter Steelhead	spawning and rearing	0.0	0.4	0.4	12%
Rock Creek, 12.8mi	Coho salmon	spawning and rearing	0.0	4.8	4.8	37%
	Winter Steelhead	spawning and rearing	0.0	5.0	5.0	38%
Rogue River, 7.8mi	Coho salmon	spawning and rearing	0.0	3.1	3.1	39%
	Winter Steelhead	rearing and migration	0.0	2.8	2.8	35%
Rowell Creek, 8.3mi	Coho salmon	spawning and rearing	0.0	3.1	3.1	37%
	Winter Steelhead	rearing and migration	0.0	1.5	1.5	17%
		spawning and rearing	1.5	3.8	2.3	28%
West Fork Agency Creek, 3.5mi	Winter Steelhead	spawning and rearing	0.0	1.0	1.0	28%
Wind River, 3.8mi	Coho salmon	spawning and rearing	0.0	0.1	0.1	2%
	Winter Steelhead	rearing and migration	0.0	1.2	1.2	30%
Yoncalla Creek, 3.9mi	Winter Steelhead	spawning and rearing	0.0	0.1	0.1	3%
South Yamhill River, 61.7mi	Coho salmon	migration	0.0	41.6	41.6	67%
		spawning and rearing	41.6	61.7	20.1	32%
	Winter Steelhead	migration	0.0	41.8	41.8	67%
		rearing and migration	41.8	51.6	9.8	15%
		spawning and rearing	51.6	61.7	10.1	16%

(Streamnet website)

While the health of salmonids is often a major focus of watershed restoration, it is important to evaluate the big picture - riparian habitat for all aquatic and terrestrial life should be addressed in developing restoration projects.

Fish Barriers

Fish barriers are either natural or human-created obstacles that impede the passage of fish and other organisms. Barriers include culverts, dams, waterfalls, logjams, and beaver ponds. They block the movement of anadromous fish as well as fluvial populations such as cutthroat trout. Barriers can impact all aquatic species because changes in habitat, population, or water quality conditions create pressure for fish to relocate.

Culverts that act as fish barriers on state and county roads are reported in an ODFW database. The barriers reported for the Upper South Yamhill River watershed are described in Table 33 below. Numerous studies, including ones conducted in 1996 by the National Research Council, conclude that migration barriers have substantially impacted fish populations. The extent to which culverts impede or block fish migration appears to be substantial. During fish surveys conducted in coastal basins during 1995, nearly all the barriers identified (96%) were culverts associated with road crossings.

Culverts reported in the database are found on fish-bearing streams and were evaluated against established passage criteria for juvenile and adult salmonids. Parameters include:

- Culvert diameter (inches) and length (feet)
- Culvert slope (percent); Generally, non-embedded metal and concrete culverts are considered impassable if the slope exceeds 0.5 to 1.0 per cent. At slopes greater than this, water velocities within the culvert are likely to be excessive and hinder passage
- Presence or absence of a pool
- Pool depth, if present, (in inches)
- Distance of drop (in inches) to the streambed or pool at outlet; Conditions at the culvert outlet are evaluated for drop (distance from culvert invert to stream below) and the presence or absence of a jump pool. If a pool is present, its depth is recorded. The general criteria for pool depth is 1.5- to 2.0-times the height of the jump required to reach the culvert—the fish need a running jump, so to speak. Pools shallower than this depth are considered inadequate. If the height of the jump (pool surface to water level in the culvert) into a culvert exceeds 12 inches during the period of migration, the culvert is judged inadequate and is included in the listing of culverts needing attention. If the jump is greater than 6 inches but less than 12, the culvert is judged to be a passage problem for juveniles only
- Whether the culvert is embedded in the streambed and contains substrate
- Whether water runs beneath the culvert at the upstream end of the culvert; this is a problem for downstream migration of juvenile fish in low water
- Fish size (juvenile, adult, or both) likely to be hindered

The impacts of barriers on migratory species are obvious; movement up and downstream is restricted. Non-migratory populations are also impacted in the following ways:

- Juvenile and resident adult fish must be able to move upstream and downstream to adjust to changing habitat conditions (i.e., temperature fluctuations, high or low flows, competition for available food and cover).
- Resident fish need continuity of stream networks to prevent population fragmentation which decreases gene flow and genetic integrity.
- Catastrophic events can displace entire populations. Barriers can prevent the escape or re-colonization of these habitats.

Tony Snyder of Polk County Public Works reports that since the 1996 floods, they have been working to regrade ditches to match the grade of culverts. They also regularly flush culverts to remove sediment. Yamhill County Public Works Bridge Supervisor Susan Mundy reports that her agency regularly checks and clears blocked culverts. When Yamhill County crews do these activities, they record information relating to fish passage for a local database on all county road culverts.

Table 33. Fish Passage Barriers in the Upper South Yamhill River Watershed

Location: Waterbody, Road, Approximate Road Mile (RM)	Priority	Comments
Unnamed Tributary of Hanchet Creek, Hwy 22, RM 15.1	Medium	Not on straight-line chart. Culverts are too small. Velocity barrier.
Unnamed Tributary of South Yamhill River, Hwy 22, RM 16.7	Low	Not on straight-line chart. Juvenile step barrier. Velocity impedes passage.
Crooked Creek, Hwy 22, RM 19.1	Medium	Velocity barrier at most flows.
Jackass Creek, Hwy 18, RM 19.16	High	3 steps to pool, 1',2',3'. Pools within steps are inadequate. Water velocity in culvert is very high. Probably impassable.
Joe Day Creek, Road 6866, RM 0.2	Medium	Not in Co Rd log. Velocity barrier.
Unnamed Tributary of South Yamhill River, Hwy 22, RM 20.65	Low	Not on straight-line chart. Lower 10' of pipe is steep, inhibiting passage. Juvenile barrier.
Joe Day Creek, Road 6868, RM 0.1	Medium	Not in Co Rd log. Concrete extends 10' downstream @ 10%. Impassable.
Unnamed Tributary of Agency Creek, Road 402, RM 1.29	Medium	At Spirit Mtn Rd. Velocity barrier.
Unnamed Tributary of Rock Creek, Road 6804, RM .79	Medium	.2 miles E of Grand Ronde Av. Velocity inhibits passage. Low water juvenile barrier.
Klees Creek, Road 6705, RM .36	Medium	No access. Water velocity does not appear excessive. Juvenile step barrier. Fort Hill Rd.
Unnamed Tributary of Gold Creek, Road 6704, RM 1.7	Medium	NA
Klees Creek, Road 404, RM 5.35	Medium	Impassable at most flows due to drop.
Unnamed Tributary of South Yamhill River, Hwy 22, RM 24.25	Medium	Not on straight-line chart. Impassable. 0.4 mi E of W junction with Yamhill River Rd.
Unnamed Tributary of South Yamhill River, Road 6718, RM 0.64	Medium	Located @ OK towing. 2 culverts. Barrier.
Cockenham Creek, Hwy 18, RM 0.27	Medium	Not on straight-line chart. At west end of interchange. Upper end @ 3%. Pool inadequate.
Cockenham Creek, Hwy 18, RM 0.27	Medium	Velocity barrier passable when backfilled only.
Unnamed Tributary of South Yamhill River, Road 6614, RM 0.62	Low	Velocity barrier.

(Fish Passage Culvert Database from ODFW)

Habitat Surveys

In the early 1990s, the Oregon Forest Industries Council, the Confederated Tribes of Grand Ronde, and the Oregon Department of Fish and Wildlife undertook several habitat surveys in the Upper South Yamhill River watershed. The surveys were conducted under protocols established in *Methods for Stream Habitat Surveys: Oregon Department of Fish and Wildlife, Aquatic Inventory Project.* The descriptions from these surveys are available as a separate document. Surveyed reaches include portions of the larger streams of the watershed and their tributaries.

Conclusion

Based on first-hand accounts, aquatic populations were larger and more diverse in the past. Historical in-stream habitat was very different than present conditions. Log jams created diverse habitat, fish passage impediments such as culverts and dams were absent, water quality was higher, mature timber provided stream shade resulting in cooler water temperatures and greater dissolved oxygen, and stream meanders provided complex habitat with pools and riffles.

Cutthroat trout are resident to the Upper South Yamhill watershed, and live in the watershed year-round. This makes cutthroat the best local indicator species for salmonids and fish species in general. Endangered winter steelhead are anadramous and use the Upper South Yamhill watershed seasonally.

Coho salmon were stocked in area streams throughout the 1970s and 80s; stocking was discontinued due to concerns about the interactions between hatchery fish and native fish. Introduced coho have sustained themselves through reproduction and remain a factor in the Yamhill basin.

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CHAPTER 11

Restoration and Enhancement

Introduction

Many landowners throughout the Yamhill Basin are beginning to practice restoration on their land, with the goal of re-establishing natural functions of streams and rivers that may have been lost as the landscape has been altered. Restoration activities can be integrated into a landscape where agriculture, timber management, and other human activities are still occurring. The term "enhancement" is defined by the production of improved habitat or watershed conditions that may not have been present previously.

The aim of restoration and enhancement activities is to use knowledge of watershed processes and engineering to improve stream conditions, by addressing areas both adjacent to creeks and in the uplands. In many of these projects, primary goals include improving water quality and fish habitat. In the Upper South Yamhill watershed, restoration and enhancement of streams has been implemented by individual landowners, the Tribe, the Bureau of Land Management, and the forest industry.

A valuable source of information concerning restoration efforts is first-hand accounts by landowners who report on a voluntary basis to the Oregon Plan Watershed Restoration Inventory (OPWRI). If you would like to learn more about this voluntary database, contact Bobbi Riggers at (541) 757-4263 or by e-mail at: Bobbi.Riggers@orst.edu. A great deal of relevant information including recent annual reports is available at www.oregon-plan.org.

Another source of information for existing restoration projects is the StreamNet website. For the Upper South Yamhill River watershed, StreamNet lists two installations undertaken by Willamette Industries to improve roads, bridges, culverts, campgrounds, and erosion control.

The local USDA Service Center is an excellent starting point for local residents interested in restoration. The Yamhill Basin Council, U.S. Department of Agriculture, the Natural Resources Conservation Service (formally the Soil Conservation Service), and the local Soil and Water Conservation District are housed in the Service Center. Advice, design consultation, plantings, and sometimes even partial funding is available. People from one or more of these agencies were involved in many of the projects reported in the database and described below. The USDA Farm Service Agency offers a number of programs that provide technical assistance and funds for landowners who would like to implement conservation measures on their land.

For additional information on USDA program eligibility contact:

USDA Service Center
2200 SW 2nd Street
McMinnville, OR 97128
USDA: (503) 472-1474
Yamhill SWCD: (503) 472-6403

USDA Service Center
580 Main Street, Suite A
Dallas, OR 97338
USDA: (503) 623-9680
Polk SWCD: (503) 623-5534

Passive and Active Restoration

Passive restoration is the quickest method for improving watershed health. Basically, passive restoration involves the cessation of certain land use practices considered harmful to water quality. For example, preventing domestic livestock from entering streams will improve water quality by reducing animal wastes in creeks, and by allowing vegetation to re-establish in formerly grazed riparian areas.

Table 34. Upper South Yamhill River Projects in the Oregon Plan Restoration Inventory

Affiliation	Name/Type	Cost	County	Year	Project Description
Hampton Tree Farms	West Fork Agency Creek	$1,500	Polk	1995	Large wood placement; hardwood conversion, riparian tree planting
ODFW	Cedar Creek Enhancement	$0	Polk	1995	instream large wood placement, rootwad placement
Boise Cascade	Rogue River	$0	Polk	1996	Voluntary Riparian Tree Retention
Boise Cascade	Jackass Creek	$0	Polk	1996	Voluntary Riparian Tree Retention
Agency Creek Management Co.	Agency Cr. Road Risk Assessment	$866	Yamhill	1997	Road survey
Agency Creek Management Co.	Cosper Cr. Road Risk Assessment Survey	$236	Yamhill	1997	Road survey
Small Woodland Owner	Gold Creek	$0	Polk	1998	Instream large wood placement; riparian tree planting, tree retention
Conf. Tribes of Grande Ronde	West Fork Agency	$94,474	Yamhill	1998	Fish passage improvements: 2 culverts upgraded
Willamette Industries	Tributary of Cedar Creek	$265	Yamhill	1998	East Cedar Creek culvert surface drainage improvements
Agency Creek Management Co.	Crooked Cr. Road Risk Assessment	$7,250	Yamhill	1998	Road survey
Hampton Resources	Tributary of Agency Creek	$13,052	Yamhill	1998	Coyote Ridge Enhancement hardwood conversion, tree retention
Willamette Industries	Cedar Creek	$3,000	Yamhill	1998	Voluntary Riparian Tree Retention
Willamette Industries	Tributary of Cedar Creek logging	$4,400	Yamhill	1999	Voluntary Riparian Tree Retention

(OPWRI restoration database)

Off-stream watering can be installed to keep livestock out of the stream. Jim and Linda May of the Lower Yamhill watershed engaged in this type of restoration with their neighbors. When they noticed a herd of cattle was in the creek just upstream of their four-acre pond, they contacted their neighbors to work out a solution. The owners agreed that it would be simple enough to water the cattle off stream and now they keep the cows fenced out of the riparian area.

In another area, the Mays are pursuing active restoration by planting vegetation to stabilize their stream bank on Millican Creek. They were concerned about erosion taking place along the creek flowing through their property so they worked with Dean O'Reilly of the Yamhill Soil and Water Conservation District to plant appropriate riparian plants. Native plants are better adapted to the climate and ecological conditions and consequently require less care to become established. Planting native vegetation is also important because it reduces the potential of introducing noxious weeds.

Active restoration is an attempt to speed up the ecological recovery of a disturbed area by rebuilding natural functions that appear to be missing. For example, in the contemporary landscape of towns, housing developments, shopping areas, and fields there are large stretches of streams that have very little or no large woody debris. Without adequate mature trees nearby, these streams will not receive woody debris in the foreseeable future. Consequently it is increasingly common for landowners and land managers to add tree trunks and root wads to streams that are downcut, eroding their banks, or lack habitat complexity. This is clearly an active restoration approach.

Active solutions are far more difficult, because the eventual outcome of a manipulation is unknown. Natural systems are complex and difficult to predict. The potential for unanticipated negative results is related to the degree of manipulation of a stream. Lower-tech activities such as planting trees and shrubs in a riparian area are less likely to have unintended negative consequences than a re-shaping of a stream bank. It is important to consider natural conditions (and their functions) in any restoration effort. This is particularly true with projects that change land contours, hydrology, or vegetation cover.

Design

For most restoration projects, the costs of heavy machinery, labor, and materials will limit what can be implemented. This can be an advantage when viewed from a long-term evolutionary perspective. Restoring ecosystems slowly, incrementally, with an eye to how the ecosystem responds is preferable to a quick, machinery-intensive makeover. Organic systems appear remarkably well designed but they reach that condition (and sustain it) through endless incremental changes and adaptations. When approaching a landscape problem, one should avoid the assumption that one will be able to permanently solve it all at once.

Many development strategies already reflect this. Area farmer Eugene Villwock of the Salt Creek watershed tells a story of his observances from when the road in front of his house was rebuilt to install a new culvert. As the heavy machinery removed the pavement and roadbed, he noted at least three distinct stages in the development of the road. He describes how the road initially followed the contour of the land as it dipped down to the seasonal stream. In the bottom was a small diameter clay tile placed under the initial road. The next two stages were progressively higher, serving to level the road as it crossed the dip with additional tiles to carry water under the road. Each new road surface was also wider, presumably to accommodate heavier, faster moving traffic. Many small scale projects will be best served by this incremental approach.

Adaptive Management

In recent years, a more holistic approach to land management has emerged in America. It reflects a growing consensus in many professions. From logging and farming to the high tech industry, the use of "adaptive management" is prevalent. As explained in the BLM and Siuslaw National Forest's *Northern Coast Range Adaptive Management Area Guide*, "[a]daptation is the process of responding positively to change."

> "[T]he term adaptive management is used to describe an approach to managing complex systems that builds on common sense and learning from experience. Adaptive management…consists of three basic steps:
>
> - Conscious experimentation in the design of activities
> - Careful monitoring to see how things turn out
> - Regular adjustment of practices based on observation
>
> "Monitoring is perhaps the most critical step in the process: people and funds must be provided to monitor results, analyze what happened, and feed the results back into the design of new projects. Monitoring, based on a sound sampling design, provides regular feedback about how well things are working—or not working—so that practices can be frequently modified in response to new information and changing values."

Local Restoration Examples: On-going Design

The Confederated Tribes of Grand Ronde have worked hard on restoring areas within their reservation lands. In 1997 they replaced a culvert with a bridge on North Fork Agency Creek to help open more than three miles of stream for fish passage. In 1998 they replaced two lower West Fork Agency Creek culverts with bottomless culverts, opening up the stream to the Upper West Fork Agency Creek culvert, which was replaced in 2001.

Also in 2001, culverts on upper West Fork Agency Creek, a tributary of West Fork Agency Creek, Kuri Creek, and lower Wind River were replaced with larger culverts to open up 5.3 more miles of stream for fish passage. A blocked culvert was removed on upper Ead Creek to prevent erosion of the road fill. Although the area above Ead Creek has an impassable waterfall, the replacement will protect downstream spawning and rearing areas from sedimentation.

The CTGR also replaced a culvert on upper Yoncalla Creek with a larger one for the US Forest Service in 2001 because the USFS did not have sufficient funds for the project. A beaver was plugging up the small culvert, flooding the road. Rod Thompson of the CTGR said they "were very concerned that it would blow out and create a large torrent and degrade downstream fish bearing portions of Yoncalla Creek and its water and habitat quality." In 2002, the CTGR replaced the upper Wind River culvert, in a continuation of work on that creek.

Incremental Restoration

In 1999 Doug Rasmussen of the Lower Yamhill watershed decided he wanted to do something with his farm near the South Yamhill River where he has lived all his life. He wanted to restore it for wildlife habitat and water quality protection. Doug contacted Rob Tracey of the NRCS for assistance. After visiting and discussing various alternatives for protecting the site, Doug decided to apply for planning and financial assistance under the Conservation Reserve Enhancement Program (CREP).

For eligible acres—generally riparian corridors and associated wetlands—CREP provides an annual rental payment for land removed from agricultural production. Many farmers find these rental payments more profitable than cropping. CREP also provides financial assistance for establishment of *conservation practices*—suggested land use patterns available in print through the NRCS/SWCD. Some forms of financial assistance require implementation of at least a few of these conservation practices.

Working together, Doug and Rob designed a restoration plan that included native trees and shrubs along a stream, removal of the existing drainage system, shallow excavations for restoring wetland functions, and establishment of a wet prairie plant community. Following completion of the CREP plan and after beginning the on-site restoration, Doug became so enthused by the process that he began making plans for other portions of his farm. He requested information on how to improve an additional 24 acres of upland that had been in continuous crop production for over 50 years.

Doug elected to apply for the Environmental Quality Incentive Program (EQIP) for technical and financial assistance. Doug was successful with his EQIP application and he and Rob subsequently designed a conservation program for the upland. Doug is now in the process of establishing shelterbelts around the crop fields and planting a mix of trees within the fields. These practices serve to increase infiltration of rainwater, provide wildlife habitat, reduce soil erosion, and provide high-value wood products.

Starting Small and Urban Options

Basin resident Ted Gahr is known for his expertise in creating wetlands. This is due to years of experimentation on his own property and through assisting with a number of neighbors' restoration projects. Ted learned how to run a bulldozer years ago when he was a rancher in California. Now he uses them to construct dikes for wetlands and ponds.

His restoration work started almost by accident years ago on his land in Muddy Valley. He had placed some rocks in a stream to make crossing it easier. He later noticed that during heavy rainfall the stream overflowed its banks at that point flooding part of his field. He liked the idea of establishing a wetland there so he expanded the flooded area by digging a little diversion ditch to carry the floodwater further into his field. Ducks soon arrived. He continued to take small steps, based on experimentation and common sense, to gradually increase the functioning and size of his restored wetland. Eventually he removed the drainage tiles and now he has a 15-acre constructed wetland. In all, he has about 30 acres of restored wetland on his land. He is now looking for wetland plants with wildlife or domestic feed value and high yields that could be used as wetland crops.

Although not everyone will want to devote this much time, acreage, and creative energy to restoration, Ted's initial flooding of Prior Converted wetland (drained for agriculture) serves as a model for low input restoration that anyone can follow. Check with the Water Resources Department and the Division of State Lands for permit information before getting started.

One final example comes from homeowner Jacqueline Groth who has been gradually turning her small Dayton lot into an island of native vegetation over a number of years. Finding plants that both enhanced the landscape and were low maintenance were her initial objectives. Finding them proved to be a process of trial and error. Then Jacqueline discovered the Soil and Water

Conservation District's Native Plant Sale. She calls the annual plant sale the least expensive way to acquire her favorite Oregon plants. She also suggests relying on the many sources of information on native plants now available for knowing what to plant and where.

Jacqueline has several suggestions for getting started. The Native Plant Society of Oregon (NPSO) has a local chapter that is an excellent resource for homeowners because it involves networking with other people in the area who can share information. Jacqueline says the SWCD's sale is “far and away the best way to acquire native plants because they are so cheap that you can make mistakes (which you will do) and keep trying, experimenting, and not experience buyer's remorse!” Commercial nurseries are another resource. The Soil and Water Conservation District and Metro (Portland) have regular native landscaping workshops for homeowners.

Economics of Restoration Projects

Many valuable projects can involve smaller acreages with less cost. Something as simple as spending several hours helping to pull shopping carts and old tires out of local streams, like Yamhill Basin Council volunteers did in October, 2001 on Cozine Creek, can have lasting benefits. This, along with many of the previous examples, show that watershed restoration can begin with little more than a good idea and a shovel.

Another important factor is that federal and state agencies provide partial funding through a variety of programs. In the case of the Stonebridge family, assistance from the USDA and ODFW brought the landowner costs down to approximately $5,800. In addition to the $13,000 USDA funds, the ODFW was able to provide $5,000 cost-share for earth moving, planting, and the costs of securing the required water rights.

A related consideration is the added value of ponds and swales with their associated plants and animals, open space, and clean water. Although these values are often difficult to quantify in monetary terms, they can have real economic benefits for farmers, nurserymen, or timber producers. The pay-off comes through local marketing and public relations in a society that is increasingly health-conscious, ecologically aware, and oriented toward outdoor recreation.

A variety of funding programs have been mentioned throughout this assessment. Ken Hale of the Natural Resources Conservation Service (NRCS) characterizes them as different tools for use in the work of land stewardship. Your local USDA Service Center (located both in Dallas and McMinnville) houses the Farm Service Agency, the NRCS, and your SWCD. The people there can help landowners understand the various programs. Currently, many restoration and enhancement projects find support in the Environmental Quality Incentives Program (EQIP) established by the 1996 Farm Bill to provide a single, voluntary, conservation program for farmers and ranchers to address natural resource issues. There are other possibilities such as the Conservation Reserve Enhancement Program (CREP) as well as state Oregon Watershed Enhancement Board (OWEB) grants.

CREP, as described in the Rasmussen example at the beginning of this chapter, is a joint federal and state program that targets significant environmental effects related to agriculture. It is a voluntary program that pays landowners for entering into Conservation Reserve Program (CRP) contracts of 10 to 15 years duration. In Oregon, the CREP program was developed to assist in the restoration of habitats for salmon and trout listed under the Federal Endangered Species Act. Goals of Oregon CREP include reduction of water temperature, reducing sediment and nutrient pollution from agricultural lands, stabilizing streambanks on critical salmon and trout streams, and restoration of stream hydraulic and geomorphic conditions. This program provides a rental payment to landowners willing to manage streamside areas for the benefit of salmon and trout.

OWEB grants are available to anyone addressing altered watershed functions, water quality, and fisheries issues. OWEB funding priorities include 1) removal or improvement of impediments to fish passages, such as dams and culverts; 2) efforts to restore riparian habitat for fish, wildlife and water quality; and 3) projects that involve collaboration between stakeholders and agencies. OWEB also funds projects designed to provide watershed education to the public and monitor the state of water quality in streams and rivers in Oregon. Application forms for OWEB grants can be downloaded from www.oweb.state.or.us/.

Further information on EQIP, CREP, and OWEB funds are available by contacting the USDA Service Centers in Dallas (503) 623-5534 or McMinnville, (503) 472-1474. Ask for a copy of the "Guide for Using Willamette Valley Native Plants Along Your Stream."

Conclusion

Residents and land managers are developing a variety of strategies to improve water quality and habitat in local streams. They are participating in programs aimed at sustainability, getting involved with local groups, or helping out in ways of their own design. Some of these efforts include planting of native species in riparian areas, restoration of wetlands, and working with groups to clean-up local creeks.

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Watershed Summary and Recommendations

The Upper South Yamhill River watershed is very similar to other areas of the Willamette Valley and Coast Range that have been impacted by urban development, forestry, and agriculture. Private ownership of large portions of the watershed has resulted in a wide variety of land-uses and restoration priorities. This document serves as a starting point for identifying ways to improve the water quality and habitat conditions in the watershed. Following is a summary of each chapter's major findings.

Chapter 1: Introduction and Watershed Characteristics

- The Upper South Yamhill River watershed is approximately 90,000 acres in area. For the purposes of local involvement, seven sub-watersheds have been identified: Agency Creek, Cosper Creek, Rogue River, Rock Creek, Rowell Creek, Fort Hill, and the Western Headwaters.
- The majority of the watershed is privately owned and managed for timber production. Historically, fire played a very important role in maintaining oak savanna, prairie, and upland forest ecosystems.
- Timber production has been and continues to be the dominant land use and accounts for over four fifths (80%) of the watershed.

Chapter 2: Historical Conditions

- Kalapuya Natives managed the watershed, in part, with summer burning. Much of the bottomland of the Upper South Yamhill River watershed was savanna and prairie grassland in prehistoric times.
- The native Che-ahm-ill group of Kalapuyan people in this area were part of a distinct upper Willamette Valley culture that had close ties to the people along the Columbia and some contact with coastal and southern Oregon cultures. The local Natives relied heavily on plant foods, secondarily on meat, and little on salmon.
- European settlement brought an end to the intentional burns resulting in many areas becoming more heavily forested, mostly by Oregon white oak and Douglas-fir-dominated woodlands.

Chapter 3: Vegetation

- Vegetation in the watershed varies from forests in the upland areas to a patchwork of residential development and agriculture in bottomland areas.
- Historically, about three quarters (75%) of the watershed was forested. The remaining fourth (25%) was prairie and savanna. Currently, over 80% of the watershed is zoned for forestry.
- There are four main types of native habitat in the watershed— upland forest, riparian forest, prairie (wet and dry), and oak savanna. These habitats evolved with natural and human-caused fire and likely are now reduced and evolving in response to fire suppression.
- Native plants are important because they have evolved with local conditions, such as soils and climate.

Chapter 4: Riparian Areas and Wetlands

- Riparian areas have been intensively managed for timber production and agriculture since settlers arrived in the basin. For many different reasons, forested buffers along stream banks have gradually become narrower.

- The majority of riparian areas have some vegetation, although it is often hardwoods or brush with low potential for adding large woody debris to streams. Some riparian areas have very little vegetation. The benefits of riparian vegetation include cooling shade, balanced water chemistry, and nutrient assimilation from the surrounding soil.
- Non-native plants compete vigorously with native vegetation, especially in stressed or disturbed areas, and pose significant problems for landowners and managers.
- Hydric soils are those that have formed under wet conditions such as in a wetland. They characteristically have high water tables, have ponds, flood frequently, or are saturated for extended periods during the growing season.
- Many of the wetlands in the watershed have been drained or filled to make land available for other uses, resulting in a loss of all but a tiny percentage of the native habitat.
- Wetlands play numerous roles in the health of the watershed. Their benefits include: connecting upland and aquatic ecosystems, lakes, streams, rivers, and riparian areas with one another, capturing sediment from erosion runoff, consumption of nitrogen from agricultural runoff, recharging groundwater by retaining water that then percolates instead of heading downstream, maintaining more steady flows to streams by slowing peak flows, and flood mitigation for the same reason, providing habitat for wildlife, open space, outdoor recreation, education, and aesthetics.

Chapter 5: Channel Habitat Types

- The majority of channels in lowland areas of the watershed were once floodplain-type streams and are now deeply incised channels that meet the criteria for low gradient, confined channels (LC). These pose the greatest challenge to restoration efforts but also provide the greatest value for improving habitat.
- Channels respond to change differently based on their position in the watershed. The headwaters of streams like Rock Creek are steep, with low responsiveness to changes in channel pattern, location, width, depth, sediment storage, and bed roughness. Segments labeled moderate gradient confined (MC), moderate gradient headwaters (MH), and moderate steep narrow valley (MV) are more likely candidates for enhancement projects.

Chapter 6: Channel Modifications

- Channel modification has for years included the following: impounding, dredging or filling water bodies and wetlands, splash damming, stream cleaning, and rip-rapping or hardening of the streambanks. Road crossings (bridges and culverts) and impacts of having roadbeds constructed within 200 feet streams can also be included.
- In terms of area affected, road building has had the greatest affect on stream modification in the Upper South Yamhill River watershed.
- Many fill and removal permits are related to roads. There is a lot of bridge replacement, bridge removal, straightening creeks, road crossings with culverts and earth fill, upgrading culverts, replacing culverts, extending culverts, highway widening, and filling in wetlands for “ingress and egress” from housing developments.
- There is an trend toward more ecological awareness evident in permits. Many recent fill and removal permits reveal efforts specifically aimed at creating wildlife habitat or restoring wetlands.

Chapter 7: Sediments

- Potential sources of sediment include dirt roads and ditches, impervious surfaces, slope failure on steep ground, and erosion of disturbed soil.

- All ditches drain to a water body, usually a stream. Some ditches are being managed to decrease their sediment contribution through roadside seeding. Mowing is considered preferable to spraying.
- The amount of storm water runoff is increased substantially through development, especially by increasing impervious surfaces. Impervious areas include all pavement such as streets, parking lots, sidewalks, and loading areas, as well as rooftops.
- Runoff contaminants are most effectively removed by passing runoff water through a constructed wetland where plant uptake of the nutrients is significant and where heavy metals and toxins can either settle out or be consumed more safely before entering the stream.

Chapter 8: Hydrology and Water Use

- Stream flows and ground water are influenced by precipitation, loss of wetlands, withdrawals for irrigation and domestic use, stream channel modifications, changes in land use and water-related technology, and the removal of vegetation.
- Flooding has changed due to the clearing, straightening, hardening and deepening of the channels.
- On paper, streams and rivers in the watershed are over-allocated for water rights. This means that at times seasonal demands exceed the water supply. Conflict has occurred but presently most users are not exercising their full water rights. Most irrigation rights are held for bottomlands near the South Yamhill River. Many of these areas were historically wetlands but are now drained and tiled.

Chapter 9: Water Quality

- The Upper South Yamhill River is 303(d) listed (polluted) due to bacteria (water contact recreation, fecal coliform—1996 Standard). It is also at risk for nutrients (phosphorous), sedimentation, chlorophyll, temperature, pH, and flow modification.
- The period of greatest concern for pollution or "contaminant loading" of rivers in the area is during the summer months of July through September. This period is important because non-point source contaminants tend to accumulate between infrequent rainfall and are then washed into rivers with relatively low rates of flow.
- The Yamhill Basin Council and The Confederated Tribes of Grand Ronde have stream temperature monitoring programs. The Tribe has measured other parameters in the uplands of the watershed.

Chapter 10: Fish Habitat and Barriers

- Historical in-stream habitat was very different than the present. Log jams created diverse habitat, fish passage impediments such as culverts and dams were non-existent, water quality was higher, mature timber provided stream shade resulting in cooler water temperatures and greater dissolved oxygen, and stream meanders provided complex habitat with pools and riffles.
- Coho salmon were stocked nearby throughout the 1970s and 80s; stocking was discontinued due to concerns about the interactions between hatchery fish and native fish. Introduced coho have been able to sustain themselves through natural reproduction and remain a factor in the Yamhill basin
- Cutthroat have the potential for abundance and are resident fish—meaning they live in the watershed year-round. Native winter steelhead are endangered under Federal law. They use the Willamette, the Yamhill, and the South Yamhill River for part of the year and have the potential for many interactions away from the watershed. Therefore cutthroat trout is the best local indicator species for salmonids and other native fish species.

Chapter 11: Restoration and Enhancement

- Restoration of watersheds may performed through passive or active means. Passive restoration is the cessation of land use activities that are considered detrimental to the health of rivers and streams. An example of passive restoration is the removal of livestock from the stream area, allowing riparian vegetation to recover from grazing. Active restoration calls for the use of direct manipulation of the ecosystem to improve stream health. Examples include riparian plantings and the re-shaping of streambanks.
- Residents and land managers are developing a variety of strategies to improve water quality and habitat in local streams. Some of these efforts include planting of native species in riparian areas, restoration of wetlands, and working with groups to clean-up local creeks.

BLM Land Management Recommendations

The following recommendations are summarized from the BLM's *Deer Creek, Panther Creek, Willamina Creek and South Yamhill Watershed Analysis*. The following points are informative for exhibiting local federal land managers' concerns and their science-based strategies for improving the health and productivity of area forests. "Local federal" may sound like an oxymoron but, in fact, many local people make management decisions for federal lands across the U.S. Note the emphasis on resource conservation in the following guidelines. Timber production, water quality, wildlife habitat, and even recreation appear as goals. (Dana Shuford, et. al. 1998. *Deer Creek, Panther Creek, Willamina Creek and South Yamhill Watershed Analysis, 1998*. Tillamook, Oregon: Tillamook Resource Area, Salem District, Bureau of Land Management.)

Water Resources

- Reduce soil compaction by "obliterating" roads and treating with a "subsoiler" to improve hydrology and stream channels.
- For water quality, consideration should be given to downstream beneficial uses, especially domestic/municipal consumption and cold water fish habitat. Any disturbance of soil or vegetation should be minimized upstream of beneficial uses.
- "Water temperature is a serious problem" in this area. Improve streamside vegetation to achieve adequate stream shading.
- Sedimentation and turbidity should be considered and avoided in relation to water quality and fish habitat. Consider relocating roads that demonstrate chronic problems in this respect.
- Use Best Management Practices when logging to minimize soil erosion and compaction.

Vegetation:

- "Perform density management…to maintain live crown ratios and growth rates" of young conifers. Areas where road closures are planned should be prioritized.
- On Adaptive Management Area lands, prune young trees up to 18ft. to improve wood quality "but do not reduce the crown ratio below 50%."
- "Promptly reforest regeneration harvest areas and manage competing vegetation to assure tree survival and growth."

Riparian Reserves:

- "The purpose of no-cut vegetation buffers is to protect streams and riparian zones from any direct or indirect disturbance from logging activities, and to ensure that stream shading is not reduced. No-cut buffers should be left along all intermittent and perennial stream channels, lakes, ponds, and wetlands during ground disturbing activities such as timber harvest and road construction."

- Buffers of one hundred feet for perennial streams and fifty feet for intermittent streams are “a good starting point from which to evaluate the width needed to adequately protect riparian and aquatic resources.” Increase buffers according to the following points:
    1. The presence of fish (either confirmed or expected) requires wider no-cut buffers. Other beneficial uses such as domestic/municipal water use also merit wider buffers.
    2. “The primary water quality parameter of interest is water temperature. Where water temperatures on-site or downstream are an issue, leave a wide enough no-cut buffer to ensure that stream shading is not reduced, especially on perennial streams.”
    3. Any areas that threaten to erode into a water body (sedimentation) should not be disturbed.

Silvicultural Management of Riparian Areas:

- Create snags by girdling trees. “Inoculate some trees with heart rot-causing fungi” to create “living trees beneficial to primary excavators.” Fall up to two large trees per acre per year “to provide decay stage 1 and 2 logs in areas where they are lacking.”
- When adding coarse woody debris (typically fresh Douglas-fir), do so in a series of “events” over several years. Fell Douglas-firs for this purpose from July to September.
- Create forest openings in dense stands to release understory trees.
- “Enhance the recreational hunting experience for some hunters and improve habitat” by closing roads that are no longer needed for management.

Aquatic:

- “To increase the size and amount of large woody debris,” the best areas for enhancement are those dominated by hardwoods or overstocked conifer stands.
- Where conifers are absent, plant them in streamside areas “in conjunction with the release of hardwoods.” Hardwood “release” should not reduce shading or streambank stability.
- “Increase coarse woody debris and/or large woody debris where it is lacking by felling trees and restricting removal of down logs and snags within Riparian Reserves.”