

Yamhill Basin Council

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# Willamina Watershed Assessment

**August 2nd, 1999**

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**Prepared for the Yamhill Basin Council.**

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## Abbreviations and Acronyms

Bureau of Land Management	BLM
Channel Habitat Types	CHTs
Coliform forming units	CFU
Cubic feet per second	cfs
Department of Environmental Quality	DEQ
Department of Geology and Mining Industries	DOGAMI
Dissolved oxygen	DO
Division of State Lands	DSL
Environmental Protection Agency	EPA
Geographical Information Systems	GIS
Governor's Watershed Enhancement Board	GWEB
Micrograms per liter	ug/l
National Wetland Inventory	NWI
Nephelometric turbidity unit	NTU
Oregon Department of Fish and Wildlife	ODFW
Oregon Department of Forestry	ODF
Oregon State University Extension Service	OSUES
Oregon's Watershed Assessment Manual	OWAM
Resource Assistance for Rural Environments	RARE
River Mile	RM
Soil Conservation Service	SCS
State Center for Geographical Information Systems	SCGIS
Total Maximum Daily Load	TMDL
United State Army Corp. of Engineers	USACE
United States Geological Survey	USGS
Water Resources Department	WRD
Water year	WY
Yamhill Basin Council	YBC
Yamhill Soil and Water Conservation District	YSWCD

## **1.0 Introduction**

The Yamhill Basin Council's adopted *Watershed Action Plan for Yamhill River and Chehalem Creek* includes action items for fish and wildlife habitat improvement. The YBC began mapping riparian, or streamside, vegetation along the Yamhill River and its two forks in the fall of 1996. The YBC quickly realized that it needed to look at more than just streams. The YBC began developing an assessment project in 1997 to evaluate conditions of the entire watershed.

The Governor's Watershed Enhancement Board (GWEB), recognizing the need for a common watershed assessment methodology developed an assessment manual for watershed councils. The first draft was released in December 1997. Dave Hanson, YBC Vice-chair, and six interns from Linfield College used this draft manual in January 1998 to complete sections of the Willamina Creek assessment.

The Yamhill Basin Council was awarded funds in 1997 through GWEB to hire a consultant to complete the assessments. After reviewing the draft manual, the council decided that it would be more effective to hire a project manager through the Resource Assistance for Rural Environments (RARE) program at the University of Oregon.

The YBC hired Robert Bower through RARE to manage its watershed assessment project in January 1999. In February 1999, GWEB released the final draft of the Oregon Watershed Assessment Manual. (A final version of the manual will be released in fall 1999.)

The purpose of the assessment project is to determine how watersheds in the Yamhill Basin are working. The YBC in partnership with the Yamhill Soil and Water Conservation District hopes to use this information to determine where to focus protection, restoration and enhancement efforts. A secondary purpose is to involve landowners in these watersheds. While the assessment process may leave us with more questions than answers, we feel that it is an important first step in managing our local watersheds.

This is our first watershed assessment, and because it was started under the first assessment manual and finished with the final draft, some of the sections will differ from the subsequent assessments. Where possible the raw data are included in this report or appendices. A preliminary list of stream segments in need of restoration and/or additional information is included in the Watershed Condition Summary Section. This Condition Section also acts as the Executive Summary for the assessment results. The next step will be to take this information and collaboratively develop a strategy with the landowners, businesses and agencies in the Willamina watershed.

***Melissa Leoni, Watershed Coordinator***  
**Yamhill Basin Council**

## **1.1 Purpose**

The Willamina watershed assessment was prepared for the Yamhill Watershed Council (YBC). It contains technical information about the past and present watershed conditions. The primary purpose of the watershed assessment is to evaluate how natural and human processes influence the watershed's ability to produce clean water and suitable habitat for aquatic life. The watershed assessment will serve as a baseline for developing and prioritizing restoration activities. The information collected in this assessment aims to aide the YBC in developing restoration projects and monitoring plans for the Willamina watershed.

## **1.2 Background**

### **1.2.1 Physical Location**

The Willamina Creek watershed is located in the Yamhill watershed in the Northwestern Willamette Valley. The 52,224-acre watershed is situated on the eastern slope of the Coastal Mountain range and generally flows south toward the Yamhill River. With the exception of a few sections in Tillamook County most of the watershed lies within the western part of Yamhill County. See **Figure 1** for watershed location.

Elevations in the watershed range from 220 ft above sea level near the town of Willamina to Bald Mountain at 3057 ft. Other geographical features of interest include Willamina Falls, Green Top Mountain (2078 ft), Stony Mountain (2415 ft), Darling Mountain (1060 ft) and Pumpkinseed Mountain (1680 ft). Named creeks in the watershed include: Willamina, East, Coast, Indian, Tindle, Coast, Burton, Canada, Gilbert, Baltimore, La Toutena Mary, and Cedar Creek. There are numerous unnamed creeks in the watershed. We have divided the watershed into four sub-basins: Upper Willamina, East Creek, Coast Creek and Lower Willamina. See **Figure 2**.

### **1.2.2 Population**

The Willamina watershed population density is concentrated in and around the township of Willamina in the lower Willamina sub-basin. Using the LandView III Environmental mapping software (USDC, 1995) populations were recorded at 1717 for the township of Willamina. The census information listed Willamina having 458 families and 606 households. Owner occupied housing was 64% with the remaining housing being rental units. The Willamina watershed population was estimated at between 2200-2400 persons. Because a majority of the watershed is zoned for forestry and agriculture, the population in the watershed is relatively sparse when compared to other areas of Yamhill County. Most of the anticipated growth will most likely be centralized in the Lower Willamina sub-basin.

### **1.2.3 Climate and Topography**

The climate in the Willamina watershed is marine-influenced with extended winter rainy seasons; summers tend to consist of long periods of hot and dry weather. Snow and ice does accumulate in the higher elevations of the watershed, which usually melts within a few days after the snowfall. 'Rain on snow'<sup>1</sup> events are relatively infrequent due to the low number of days during the year when snow has accumulated. During the 1964 and 1996 winter storms, snow had accumulated in the Willamina watershed enough to contribute to the record flooding that occurred.

Estimates of rainfall were made using an Average Annual Precipitation Map (Oregon Climate Service, 1990). Rainfall for the Willamina watershed varies according to elevation. Results show that the lower elevations of the watershed, such as near the town of Willamina, have precipitation ranging from 40 to 60 inches per year. Higher elevations in the watershed such as on Bald Mountain have annual precipitation averaging between 100 to 140 inches. The closest local measurements for precipitation were recorded in McMinnville starting in 1910 and can be obtained by contacting the Oregon Climate Service located at Oregon State University.

Temperature data that have been recorded in McMinnville since 1961 was used to approximate Willamina's climate. Records in McMinnville indicate a mean annual daily temperature of 52.4 °F, a mean annual maximum of 63.7 °F and a mean annual minimum temperature of 41 °F. The hottest and lowest temperature recorded in McMinnville during this period were 106 °F and -5 °F, respectively. This approximation would be useful for the lower elevations of the Willamina watershed but less applicable for the higher elevations where the temperatures would be expected to be significantly lower.

The topography of the watershed differs dramatically from the confluence to the headwaters. The lower Willamina sub-basin is generally characterized by broad rolling pastures and low lying hills. Elevation ranges from around 220' to roughly 500'. The three remaining sub-basins are characterized by narrower valley bottom pastures and meadows, steeper slopes and relatively larger hills. Elevations range from around 300' to 3057' at the top of Bald Mountain on the northern edge of the upper Willamina watershed.

### **1.2.4 Geology**

The Willamina watershed geological materials consist mainly of volcanic and sedimentary rocks. These rocks were formed during the Eocene and Oligocene ages of the Tertiary period. The sedimentary rocks generally consist of shale, claystone, sandstone, and siltstone. The volcanic rocks mainly consist of basaltic lava and tufts. The sedimentary rocks tend to be near the surface while the volcanic tends to be the underlying bedrock (SCS, 1974).

The Soil Survey for the Yamhill Area (SCS, 1974) lists three primarily soil associations for the Willamina watershed. The areas located near the stream in the Lower Willamina sub-basin are classified as Wapato Cove association, which is poorly drained silty clay loams and clays. The mid-range elevations of the watershed are generally made up of Peavine association soils, which are well drained, gently sloping to steep, silty clay loams over silty clay: formed over sedimentary rock. The

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<sup>1</sup> 'Rain on Snow' events occur when heavy snow accumulation is followed by intensive spring rains and can cause flooding.

upper elevations and headwater areas of the three upstream sub-basins are recorded to be the Hembre-Astoria-Klickitat soil association. The characteristics of this group include strongly acidic, silt loams over silty clay loam and silty clay, and stony loams over very gravelly clay loam, with 80-120 inches of annual precipitation. For more information on soils see the sediment sources section of this document.

### **1.2.5 Vegetation**

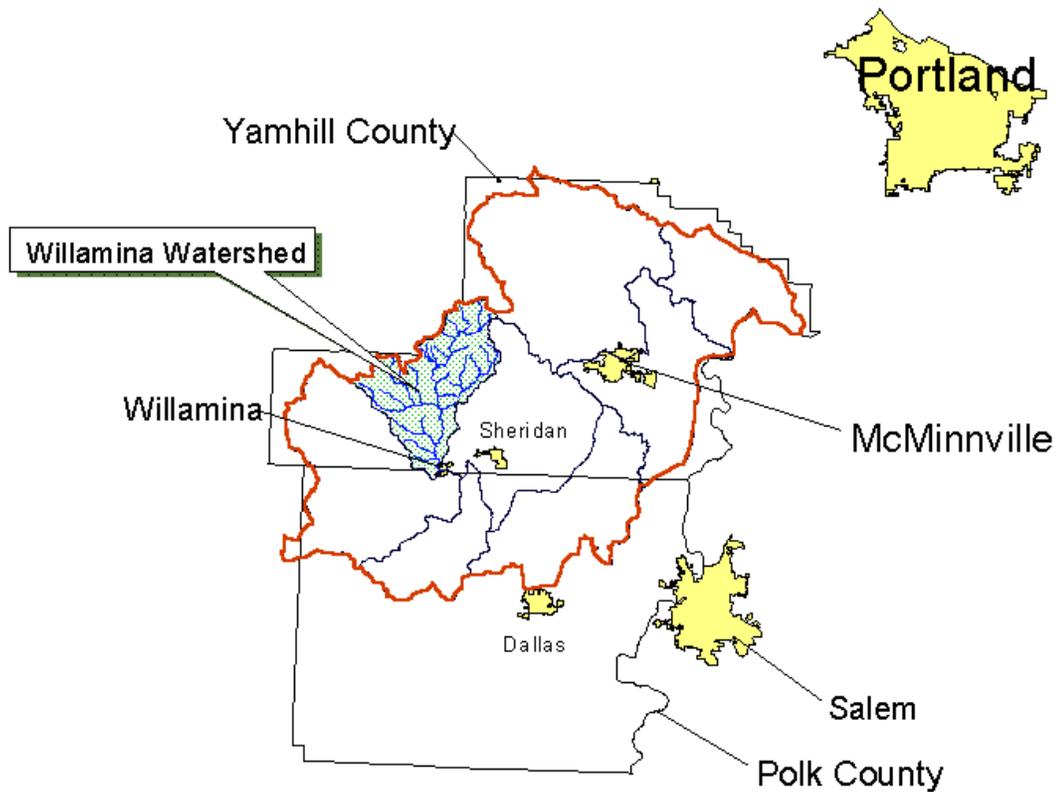
The Willamina watershed is heavily forested (91%), particularly in the Willamina, East and Coast Creek sub-basins. A BLM GIS analysis of the south Yamhill watershed (BLM, 1998) showed 67% of the forested acreage as conifer stands and the remaining 33% as hardwoods. Of the conifers, Douglas-fir is considered to be the dominant species with even-aged stands between 30 and 70 years of age. Western Red Cedar and Western Hemlock are also common; at the higher elevations some Noble fir may be present. Grand fir also occurs in sparse pockets near streams and at the lower elevations of the watershed.

Red alder, bigleaf maple, black cottonwood, Oregon ash and white oak and several types of willows are the major hardwood species found in the watershed. Red alder by far is the most dominant of these hardwood species and is predominantly found along streams, wetlands and in disturbed parts of the watershed. Most of the other species of hardwoods are found mostly in the lower Willamina sub-basin. The majority of understory and riparian vegetation consists of vine maple, salmonberry, salal, and swordfern.

An increasing problem in the Oregon Coast Range and the Willamina watershed is the presence of a fungus known as laminated root rot (*Phellinus weirii*). The root rot attacks Douglas-fir and Grand fir and often causes mortality. Estimates from the BLM analysis indicate that 10-15 % of Willamina's forestlands is infected with this disease (BLM, 1998).

Of the non-forest lands in the lower part of the watershed, the vast majority of vegetation is agricultural production. Grass seed is the most dominant; wheat, flower seeds, filberts, grapes, nursery stock and Christmas trees are also cultivated.

# Figure 1. Willamina watershed

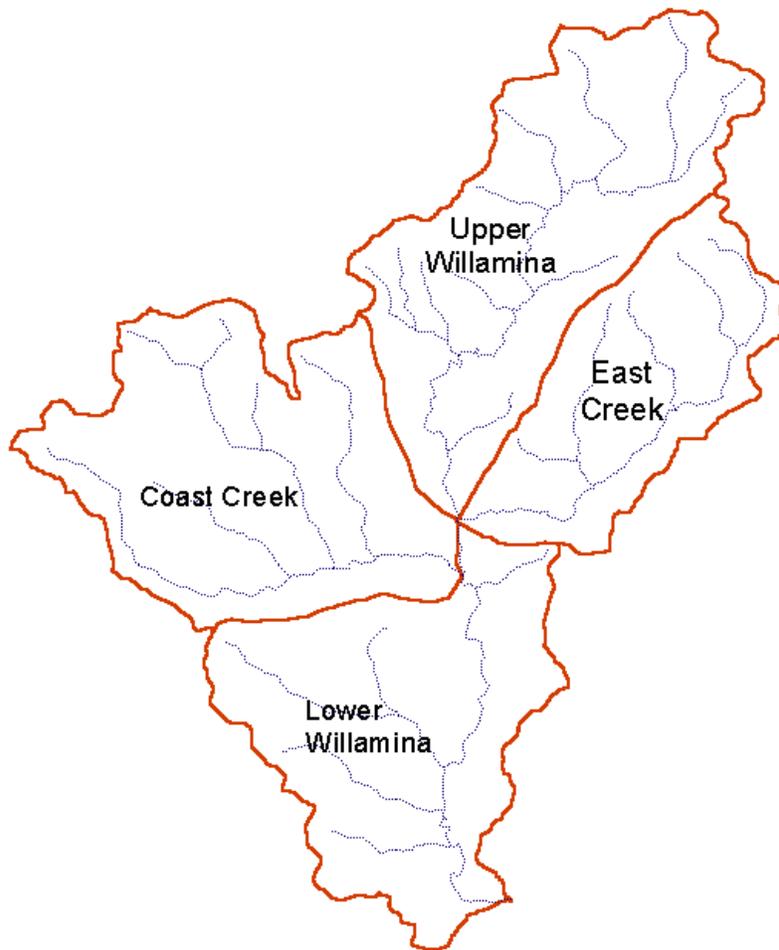


- Yamhill Basin Boundary
- Yamhill Sub-basin Boundaries
- Major Streams
- City Limits
- Willamina Watershed
- County Boundaries

0 20 Miles



# Figure 2. Willamina Subwatersheds



 Major Streams  
 Willamina Watershed

2 0 2 Miles



## **1.2.6 Habitats**

According to the BLM 1998 analysis, forest habitats in the watershed are “highly fragmented, relatively young, and lack complex features such as snags, coarse woody debris, and individual tree defects.” Conditions like these tend to result in an abundance of species that utilize early to mid-seral stage and/or edge forest habitats. Species that utilize such habitats include northern alligator lizard, rufous hummingbird, black-tailed deer and red flowered current. Species that depend on more mature forests are the northern spotted owl, tailed frog, red tree vole and many lichen species. For most of the Willamina watershed, the land management practices of the recent past have strongly influenced the landscape today. There is little recorded mature interior forest habitat and virtually no old growth timber left in the Willamina watershed. Fragmented forest landscapes can limit the dispersion ability of some species (BLM, 1998).

Due to significant changes in elevations, habitats and the species that utilize them, vary relative to elevation. Animal species that are presently found in the upper elevations of the watershed include black tailed deer, Roosevelt elk, black bear, mountain lion, bats, beavers, mink, river otter, raccoon, nutria, quail and grouse. The mid to lower elevations include these animals as well as frogs, toads, salamanders, snakes, raptors, geese, ducks, and many fish species.

## **1.2.7 Noxious Plants**

The Yamhill Soil and Water Conservation District (YSWCD) has developed a list of noxious plant species for the county, which includes the Willamina watershed. (Table 1) The purpose of the list is twofold. It records most of the noxious weeds known to grow in Yamhill County and it categorizes the weeds in to the “A” and “B” class designations. The “A” class weeds are considered the first priority for eradication and monitoring plans coordinated by the YSWCD. The Class “B” weeds are of concern but are considered as less of a priority. For more information on Yamhill’s noxious weeds, contact the YSWCD in McMinnville.

**Table 1. Yamhill County Noxious Weed List**

Yamhill County Noxious Weed List (1999)		
Common Name	Scientific Name	List/Add Date
<b>Class A list:</b>		
Italian Thistle	<i>Carduus pycnocephalus</i>	1/29/90
Gorse	<i>Ulex europaeus</i>	1/29/90
Meadow Knapweed	<i>Centaurea pratensis</i>	8/13/90
Yellow Starthistle	<i>Centaurea solstitialis</i>	2/26/91
Purple Loosestrife	<i>Lythrum slaicaria</i>	2/26/91
Puncturevine	<i>Tribulus terrestris L.</i>	3/3/99
<b>Class B List:</b>		
Mile Thistle	<i>Silybu marianum</i>	11/13/89
Canada Thistle	<i>Cirsium arvense</i>	11/13/89
Tansy Ragwort	<i>Senecio jacobaea</i>	11/13/89
Scotch Broom	<i>Cytisus scoparius</i>	11/13/89
Field Bindweed	<i>Convolvulus arvensis</i>	2/26/91
Large Crabgrass	<i>Digitaria sanguinalis</i>	2/26/91
Blackgrass	<i>Alopecurus myosuroides</i>	2/26/91
Johnsongrass	<i>Sorghum halepense</i>	3/26/91
Velvetleaf	<i>Abutilon theophrasti</i>	3/26/91
Field Dodder	<i>Cuscuta pentagona</i>	3/26/91

The most common exotic plants are the scotch broom (*Cytisus scoparius*), Canada thistle, and Himalayan blackberry (*Rubus discolor*). Areas infested with dense blackberry growth can limit wildlife access to forage areas and reduce recreational use of land. The 1999 noxious weed list places the scotch broom in the “B” class and does not list the blackberry. This does not reflect a lack of concern for those weeds but that eradication efforts would be nearly impossible due to their extensive growth. Efforts are concentrated on weeds that can be significantly reduced.

### 1.2.8 Fire History

Prior to the last 50 years, the fire history in the Willamina watershed has been largely local and anecdotal. Forest fire information was gathered from several primary sources: State of Oregon vegetation maps dating 1901 and 1936, a United States Department of the Interior Technical Notes titled *Preliminary Reconstruction and Analysis of Change in Forest Stand Age Classes of the Oregon Coast Range From 1850 to 1940* (Teensma D.A. et. al., 1991), and *The Great Fires of the Oregon Coast Range: 1770-1933* (Zybach, 1988). In addition to these primary sources, fire history was also gathered by talking to historians, residents and other fire related documents.

Fires in the Willamina watershed have resulted from both natural and human-induced causes. Natural fires were mostly the products of lightning strikes “but the frequency of thunderstorms in the Willamette Valley ranks among the lowest in North America” (Zybach, 1988). Thus the relative frequency of these natural fires is thought to be extremely low.

Human-induced fires were thought to be caused by both regional Indians and settlers. Kalapuyan Indians used fire for a number of practical reasons including agriculture, hunting, communications, warfare, visibility, safety and sanitation (Zybach, 1988; Boyd, 1985). Native uses of fire were thought to be consistent on a year-to-year basis until white explorers first came into the area 1782. With the introduction of smallpox and malaria the Kalapuyan populations dwindled between 1782 - 1849, as did their use of fire in the Willamette Valley. Native uses of fire were replaced with those of the European settlers, which included trail building, amusement, agriculture, camping and hunting, logging slash and incendiary (Zybach, 1988).

There appears to have been three catastrophic fires since 1840 that have significantly affected the Willamina watershed. The first was the Nestucca fire which "...burned over 300,000 acres in the late 1840s. Most of the area burned has regenerated naturally and vigorously, except for an area near Mt. Hebo that was burned periodically by homesteaders to improve pasturage" (Teensma, 1991). A second (unnamed) fire occurred sometime during the 1880-1890s that burned a considerable amount of the watershed. Neither the cause nor extent of this fire is known but its occurrence is documented on vegetation maps of the period. The 1901 vegetation map showed the entire Willamina watershed having been burned. The Tillamook fire of 1933 is thought to have caused several localized burns in the Willamina watershed in the sub-basin of Coast and upper Willamina Creeks. All fire dates and locations were estimated using vegetation maps and general knowledge of the watershed location.

The largest well-documented forest fire in Willamina watershed and Yamhill County history occurred in 1949. On September 29<sup>th</sup> the Telephone Register (now the News Register) reported that "18,000 acres of slashing and second growth timber" was burned. The fire started in Peavine Canyon and spread to East Creek area six miles north of Willamina. This fire impacted sections of the East Creek sub-basin.

Broadcast burns have been used as a forest management tool by both private and governmental foresters to remove logging slash and control competing ground vegetation. Presently their use is extremely limited by concerns regarding air quality and erosion runoff. The current fire policy for both private and public lands in the Willamina watershed is to control and extinguish any fires that occur (personal contact with Boise Cascade, ODFW and BLM, Feb. 1999).

## 1.2.9 Sensitive Species

The following eight species found in the Willamina watershed are either protected by the Federal Endangered Species Act or are of concern because of low population. We have included some information about each in order to introduce their habits and habitat to the reader. All of the species listed here have been confirmed by field verifications (Natural Heritage Program, 1998). There are several species that may live in the Willamina watershed that have not been field verified. Some of these species include the bald eagle, marbled murrelet, clouded salamander and the pileated woodpecker.

### **Nelson's Sidalcea (*Sidalcea nelsoniana*)**

**Status: Listed as Threatened Species (Federal and State)**

**Date last observed: 1990**

The *Sidalcea nelsoniana* is commonly known as Nelson's sidalcea in the mallow family (*Malvaceae*). These plants are identified most easily while they are in flower, often appearing in spirea or weedy

grasses. *Sidalcea nelsoniana* is a perennial herb with a pinkish-lavender to pinkish-purple flower born in clusters at the end of 1 to 2.5 feet stems.

Nelson's sidalcea inhabits gravelly, wet soils from elevations ranging from 300 to 4000 feet. Once an undisturbed wet prairie species, they are now found primarily where remnant patches of native grassland species still occur, often where prairie merges with deciduous woodland. They will tolerate non-shaded areas, standing water, and encroachment by other woody species. This type of habitat exists in the Willamina watershed along streams, in meadows and along roadsides. Populations of Nelson's sidalcea in Yamhill County appear to be on the rise due to restoration efforts (personal communications, Nature Heritage, 1999).

Prior to European colonization of the Willamette Valley, natural fires and fires set by Native Americans maintained suitable *Sidalcea nelsoniana* habitat. Projects such as stream straightening, construction of splash dams, and rip-rapping have resulted in an increase in instream flow, and reduced the amount of water that is diverted naturally into adjacent meadow habitat. Populations are also threatened by development of water projects, farms, rural housing, etc., which results in the loss of habitat for the plant.

**Weak Bluegrass (*Poa Marcida*)**

**Status: Species of Concern**

**Date Last Observed: 05/21/1987**

The *Poa marcida* is commonly known as weak bluegrass. They can be distinguished by their short ligules, nearly closed sheaths, and two flowered spikelets. They can be seen flowering in June and July, inhabiting moist areas in deep, coastal coniferous forest, primarily on mountain slopes and flats at elevations from 1000 to 6600 feet. Population estimates for the Willamina watershed are not known at this time.

**Loose-flowered Bluegrass (*Poa laxiflora*)**

**Status: Species of Concern**

**Date Last Observed: 08/04/1980**

The *Poa laxiflora* is commonly known as loose-flowered bluegrass. Information on this species is difficult to obtain. They are perennial plants with strong creeping rhizomes, and seeds, inhabiting rocky open slopes or moist wooded areas at elevations of 300 to 6300 feet. They are most likely to be found in the northernmost portions of the Willamina watershed. Population estimates for the Willamina watershed are not known at this time.

**Meadow Checker (*Sidalcea campestris*)**

**Status: Candidate for listing as Threatened or Endangered (State of Oregon)**

**Date Last Observed: 06/26/1984**

The *Sidalcea campestris*, commonly known as meadow checker-mallow can be distinguished by its pale flowers, deeply dissected leaves, and long racemes. They can be distinguished from *Sidalcea hirtipes* by ecological and geographical range, less spicate inflorescence and more deeply dissected leaves. They are seen flowering from April through July. They inhabit elevations of 360 to 2000 feet, usually in areas not regularly plowed such as fields, roadsides, and along fencerows. Population estimates for the Willamina watershed are not known at this time.

**Northern Spotted Owl (*Strix occidentalis caurina*)**

**Status:** Threatened (State and Federal)

**Date Last Observed:** 1990

The *Strix occidentalis caurina* is commonly known as the northern spotted owl. The controversy around this species has been highly publicized. There is considerable controversy surrounding the proposals to set aside sufficient habitat to insure the owl's long term survival, because its nesting habitat generally has commercial value. There are between 1,200 to 1,400 breeding pairs in Oregon, but the species has largely been eliminated from large parts of former range, especially the coastal forests. These animals are closely associated with old-growth coniferous forests or mature forests with old-growth characteristics. The USFWS has designated 7560 acres in the Willamina watershed as critical spotted owl habitat (BLM, 1998). They eat small mammals such as squirrels, woodrats, and lagomorphs. They are currently listed as a federally threatened species. Populations in the Willamina Watershed are not known at this time.

### **Northern Red-Legged Frog (*Rana aurora aurora*)**

**Status:** Species of Concern

**Date Last Observed:** 09/29/1992

The commonly known Red-Legged frogs are suffering in areas where the bullfrog (*Rana catesbeiana*) has been introduced. In the central Willamette Valley they frequently use temporal waters, usually ponds or overflows that are dry by late May or early June. This animal's diet generally consists of beetles, terpillars, isopods, and various other small invertebrates. They usually breed in water that is present year round. The eggs can be found attached to stiff submerged stems. Populations in the Willamina watershed are not known at this time.

### **Mountain Quail (*Oreortyx pictus*)**

**Status:** Species of Concern (State)

**Date Last Observed:** 1992

The *Oreortyx pictus*, commonly called the mountain quail, is managed by the state as a game species. For these birds, nesting occurs mainly from April to Mid-July, with geographic variability (earliest at low elevations). Family groups of the birds stay together through fall and winter. Although these animals are found in forested and brushy areas, it is most common to see them in regenerating clear cuts and areas at the edge of forest clearings. They migrate to lower elevations in winter. In spring and summer they feed on herbaceous vegetation, especially leaf buds, flowers of legumes and some insects. Populations in the Willamina watershed are not known at this time.

### **Winter Steelhead (*Oncorhynchus mykiss*)**

**Status:** Threatened

Information regarding Willamina's winter Steelhead can be found in the Fish Section of this document.

### **Species information resources:**

The Natural Heritage Program  
821 SE 14<sup>th</sup> Avenue  
Portland, Oregon  
Phone: (503) 731-3070  
Terry Campos

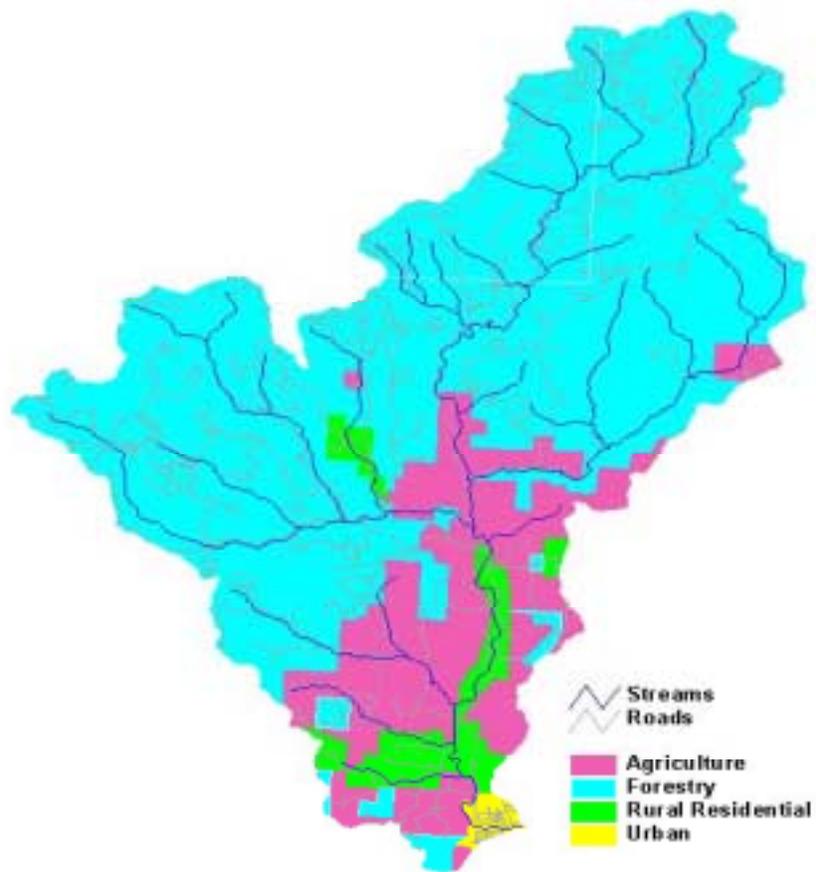
US Fish and Wildlife Service  
Division of Endangered Species

Webpage: [www.fws.gov/r9endspp/r/fr93490.html](http://www.fws.gov/r9endspp/r/fr93490.html)

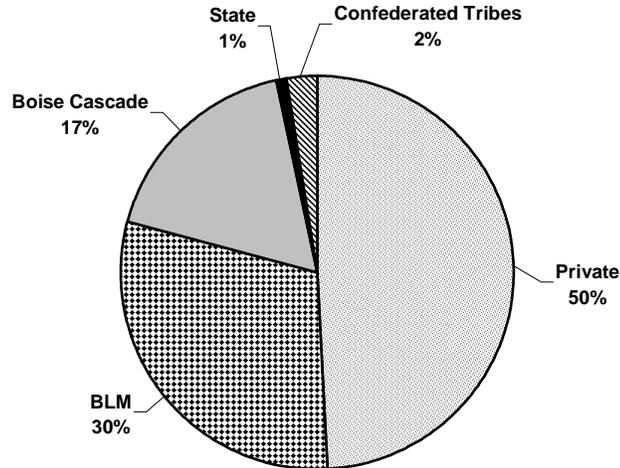
### **1.3.0 Land Use Summary**

An estimate of land ownership was conducted using a Land Ownership map provided by Boise Cascade (Figure 3). Results indicate that 70% of the land in the Willamina watershed is privately owned (Figure 4). Of the 52,224 acres in the watershed the largest block of ownership is the non-industrial private owners with 25,652 acres. Private timber interests in the watershed include Boise Cascade with more than 9,000 acres and Weyerhaeuser with nearly 1,300 acres. Lands under public ownership include the Bureau of Land Management with 15,689 acres and the Oregon Department of Forestry with 480 acres.

**Figure 3. Land use**



**Figure 4. Willamina Watershed Land Ownership**



Forestry is the dominant land use in the Willamina watershed especially in Upper Willamina, East and Coast Creek sub-basins. Agricultural crops, including both irrigated and non-irrigated or “dry” farming, dominate the Lower Willamina sub-basin. There are some small-scale animal operations in the drainage including beef cattle, horses, pigs, and other livestock.

### **1.3.1 Mining**

The only known types of mining that have been conducted in the Willamina watershed are gravel for road construction and clay for brick production. In 1900, a clay deposit was discovered in the hills just south of the town of Willamina. A local miner, Oran Edwards, established a mine there and the clay from the mine was hauled to Newberg to make bricks for building construction. In 1907 the Pacific Face Brick Company moved to Willamina and was renamed the Willamina Clay Products Company. The plant closed in 1974 and was demolished in March of 1976.

Records from the Department of Geology and Mining Industries (DOGAMI, 1999) show only two other mines located in the watershed. The Willamina Lumber Company rock quarry (DOGAMI Id. # 36-0021) which was closed in 1980, and the Mendenhall Pit (DOGAMI Id. # 36-0004), owned by Rick Mendenhall Logging and is currently permitted for use as a rock quarry. The original application date was 1974.

Persons must apply for a permit from DOGAMI if they disturb 5000 cubic yards or one acre of ground in a 12-month. The permitting process did not come into existence until 1974 and records of mines and quarries before that date are largely anecdotal.

### **1.3.2 Agriculture**

“Since the organization of Yamhill County in 1842, agriculture has been the dominant industry” (Gross, circa 1960). Due to the topographical nature of the Willamina watershed, agricultural production was mainly limited to the lower Willamina sub-basin with the exception of small fields and pastures scattered in the upper parts of the watershed. Specific accounts of Willamina’s agricultural past are limited, and the following information pertains to all of Yamhill County.

During the initial years following the settlement of the watershed, agriculture consisted mostly of cattle grazing and subsistence farming. During the first 20 years the “the valleys were settled rapidly, the range cattle were pushed back into the hills, and the growing of wheat on the level lands became the dominant industry” (Gross, circa 1960). A census by the United States in 1880 reported wheat, oats and hay accounted for 99 percent of the agricultural production in Yamhill County.

During 1880s, clover was discovered to grow successfully in Yamhill County and became dominant paying crop. “By 1900, this crop occupied 1,216 acres, wild grasses 250 acres, tame grasses 8,007 acres, while 3,033 acres of grain were cut green for hay” (Grouse, 1960s). With in increase in clover production the livestock industry flourished. Hops also became a significant part of the local agricultural economy with a 1900 census reporting 1,801 acres in production.

During the ten years between 1900 and 1910 the dairy industry got its start and gradually expanded in the area. Corresponding with this trade production in clover, grasses and hay increased accordingly. By 1909 clover production had increased by nearly 500 % and acres of grain cut green for hay had increased 600%. Fruits and nuts were also getting their start in Yamhill County and made up a sizable of the agricultural market by 1909. Production of hogs, sheep, goats, and poultry becoming a significant portion of the regions agricultural economy.

A 1919 census report found that of the total agricultural income that year, 35% came from cereals, 21% from fruits and nuts, 17% from livestock, 12% from hay and forage, and the balance from miscellaneous crops. Since 1919 wheat production has decreased while dairy and prune production has increased. By 1925 it was reported that there were 2,864 farms in Yamhill County with an average size of 83.56 acres per farm. The twenty-five year period between 1925 –1959 witnessed a drop in the fruit tree production of apples and pears with filberts becoming a larger share of the fruit and nut market.

Commercial production of berries came into play following World War I. Loganberries, strawberries, raspberries, blackberries and gooseberries were the initial berry crops introduced with strawberries by far the dominant crop. Walnuts and the Franquette nuts also became an import part of this industry.

During the 1930s the federal government started to encourage the planting of cover crops during the winter to hold soil. Yamhill County's small seed industry thus got its start and these crops helped improve the quality of the soil for cereal grain production. Grass seed crops became important between 1935 and 1939, and the acreage for these crops for lawn grasses has increased up to the present day.

Ewing Young, reported to be Yamhill County's first farmer, "contributed very highly to the increase of cattle production" (Grouse, circa 1960). Young drove the first sizable herd (600 head) into Yamhill County in the early 1800's. Ed Carey of Lafayette was reported to have brought the first St. Maws milking cow into Yamhill County. This cow was the foundation animal for that strain of Jerseys here in Yamhill County and the entire state of Oregon.

A comprehensive agricultural study of the Willamette basin (PNRBC, 1969) reported distributions of crop data collected for Willamina Creek during the early 1960's. It was reported that there were 205 farms in the creek watershed, 3,190 acres of cropland, 480 acres of rangeland and 2,000 acres of forestland that was grazed. Of the 3,190 acres of cropland, 2,640 acres were dryland and the remaining 550 acres irrigated.

Currently the dominant crops grown in the Willamina watershed are mostly grass seed, wheat, flower seeds, filberts, grapes, hay and nursery stock. There also are some Christmas trees plantations in the area. Locations and exact production amounts for crops are difficult to obtain due to variations on a year by year and farm by farm basis. For more information on specific crop information, contact the Farm Service and/or Oregon State University County extension, both located in McMinnville.

### **References and Resources for Introduction section**

(U.S. Department of Commerce (USDC). 1995. *Landview III Environmental Mapping Software – Census Data*. Oregon State Archives, Salem, OR.

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(Gross, T. Yamhill OSU County Extension Agent. Circa 1960. *County Extension Agent's notes on Yamhill County Agricultural History*. OSU Extension Services, McMinnville, OR.

## 2.0 Watershed Characterization and Assessment

### 2.1 Willamina Historical Information

#### Methodology

Using the protocol described in the OWAM, the author and several volunteers compiled historical information for the Willamina watershed. Information was gathered from numerous sources including the Yamhill Historical Society, the McMinnville Public Library, Oregon State Library archives in Salem, local historians, local residents, and a resident historical survey conducted by mail. A complete list of references is included in the back of this section.

#### Historical Information

The following timeline provides a chronological list of important events that helped shape the present condition of the Willamina watershed. Brief narratives of the major events follow the timeline.

#### Willamina Timeline:

##### Pre-European

- Kalapuya Indians use fire as a tool to improve pasture, visibility, game habitat, increase yield of seeds, clear land for planting and reduce danger from snakes and insects.
- 1782 Willamette Valley Indians are exposed to smallpox, native populations decline. Valley vegetation burning decreases accordingly.
- 1812 Beginning of direct white contact with the Indians of the Willamette Valley (Boyd, 1985).
- 1831 Malaria outbreak begins in Indian population.
- 1840+ Wetland areas are tiled and drained for agricultural and residential uses.
- 1841 Kalapuya population estimated at 600. Malaria outbreak leads to significant decreases in Indian populations and subsequently burning. Forest begins to “reclaim” prairie valley habitat.
- 1848 Nestucca fire burns large part of Willamina watershed forests.
- 1849 Kalapuya tribe population recorded at 60 members.
- 1856 Kalapuya, Umpqua and Takelma Indians moved to the Grand Ronde Reservation near Willamina. Congress ratifies treaty with Confederated Bands of Grand Ronde.
- 1861 Large flood on South Yamhill River and tributaries. Magnitude estimate to be similar to 1964 flood.<sup>2</sup>
- 1879 Town of Willamina founded, population 70.
- 1880 Manufactures Census reports splash damming “Talbot and Caves sawmill received its logs on Willamina River”.<sup>3</sup>
- 1901 Willamina’s Jack and Timberlake sawmill uses splash damming on East Creek (RM 8.8 Willamina Creek). Original Willamina Bridge lost to fire<sup>4</sup>.

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<sup>2</sup> Flood information from Yamhill River Flood Plain Information, Yamhill Soil and Water Conservation District Jan. 1976

<sup>3</sup> Splash damming information from Yamhill River Navigability Study, Division of State Lands, 1981.

<sup>4</sup> Willamina Historical Research and Survey, *Melanie Jennings*.

- 1901 Reservation subjected to allotment, most lands were ceded back to the United States government.
- 1907 Railroad to Willamina completed, brick plant constructed.
- 1910 First reservoir built on Willamina Creek, used to turn waterwheel.
- 1911 Willamina Township water supply established on Lady Creek, small dam built five miles south of town.
- 1912 1,140,000 feet of logs sent down to Willamina sawmills from as far up RM 13.5 “Log floatation on the lower 8.8 miles of Willamina Creek during a period of thirty five years...made it a navigable stream”.<sup>2</sup>
- 1933 Tillamook Forest fire burns 240,000 acres, causes smaller localized fires in Willamina watershed.
- 1934 Indians of the Grand Ronde Community are chartered; tribal trust lands amount to 440 acres.
- 1940 Intake and pump station built on Willamina Creek for second water supply.
- 1949 Large Yamhill County fire burns parts of Willamina drainage.<sup>5</sup>
- 1950 Willamina Flood plain west of Willamina Township drained and diked.
- 1951 Tribal charter terminated by Congress and remaining 440 acres of reservation acreage and buildings sold.
- 1952 Greatest of recorded floods in Willamina watershed.
- 1980s Stocking of Willamina drainage with fish ceased.
- 1988 Congress creates new Grand Ronde Reservation of 12,035 acres.
- 1993 Water supply master plan upgraded to allow for increased pumping.
- 1994 Local citizen’s group fights plans for Buck Hollow reservoir. Plan rejected.
- 1995 Large flood in Willamina watershed (100+ year event).
- 1999 Forest land management agreement signed between U.S Forest Service and the Confederated Tribes of the Grand Ronde.<sup>6</sup>

## Historical Narrative

The Kalapuyan Indians were the original residents of the Willamina watershed. The tribe’s people were known to be hunters, gathers and exceptional fishermen. Valley vegetation burning was conducted by a majority of the tribes in the Willamette Valley including the Kalapuya tribes. Burning was conducted for a variety of practical reasons including improved pastures for game habitat, visibility, increased yield of seeds, clear land for planting, and to reduce the threat of snakes and insects (Boyd, 1985).

It is thought that the indigenous people’s valley burning kept the Willamette Valley as an oak savanna ecosystem. However due to a series of settler induced disease outbreaks between 1812 – 1849, the Kalapuyan population decreased dramatically as did the vegetation burnings. In accordance with this decrease the savanna climax community was systematically replaced by conifer forests and exotic weed species.

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<sup>5</sup> From Article in Telephone Register, Sept. 29, 1949

<sup>6</sup> Agreement concerning conducting studies, forest inventories, and developing a management plan for Forest Service lands within the South Yamhill basin north of the reservation. (Kathleen Feehan, Environmental Specialist, Confederated Tribes of the Grande Ronde.)

Settlers first moved to and homesteaded in the Willamina watershed during 1840's and established a sawmill and a gristmill in the area. The town of Willamina was founded in 1879 with an initial population of 70 people. Beginning in the 1840's until the present day, wetlands and low lying areas in the watershed were tilled and drained for urbanization and agriculture. In 1848, the Nestucca fire burned large sections of the northwest Oregon coast range including significant parts of the Willamina watershed. Pockets of mature and old growth trees are suspected to have survived the burn, but most of the forests were decimated. Settlers were also known to use fire to clear land for agriculture and grazing. Fires would often get out control and burn large parts of the Willamina watershed; records of specific smaller fires are difficult to find.

A large flood estimated to be similar in size to the 1964 flood occurred in 1861 in the South Yamhill, Willamina area. Throughout the rest of the 19<sup>th</sup> century settlers continued to move to the area and build farms, churches, schools, mills and homesteads in the watershed. Splash damming (late 1800's into the early 1900's) was commonly used throughout the Willamina watershed as a tool for moving logged trees to downstream sawmills. Splash dams are created by first building a dam in a stream that increases the depth of the creek upstream. After a sufficient amount of water and downed trees are collected behind the dam, it is quickly removed to send the water, logs and debris quickly downstream. Splash damming an easy way to move lumber to the mill, it also tends to scrub and channelize the stream.

1855 saw the formation of the Grande Ronde Reservation now located in the eastern part of Yamhill County. Indian tribal members from the numerous tribes in the Willamette Valley including Kalapuya, Umpqua, and Takelma were moved there. During the early 1900s lands were ceded back to the United States government. In 1956, Congress turned over the remaining tribal assets to a trustee who sold or disposed of the remaining acreage and buildings. In 1988 congress created a new Grand Ronde Reservation of 12,035 acres. In 1999 the Confederated Tribes of the Grande Ronde signed a land management agreement with the BLM for federal lands upstream from present day reservation lands.

During the early 1900's settlers continued to move to the area, and the town of Willamina continued to grow. In 1901 the original bridge over Willamina Creek burned down as well as the local gristmill. Natural disasters seemed to be a common occurrence in the early part of the century with the 1933 Tillamook burn claiming 240,000 acres and parts of the Willamina watershed, and the 1937 flood causing major damage in the watershed. In 1940 the intake and pump station was built on Willamina Creek to provide water to the growing town. A large fire was recorded in 1949 by the Telephone Register to have burned large parts of the East Creek area in the Willamina watershed.

The state of Oregon began stocking winter Steelhead and coho salmon in the Willamina watershed in the early 1960's. Coho salmon are not native to the watershed but were widely sought after in ocean sport and commercial fisheries. Winter Steelhead are native to Willamina watershed but the stock used, Big Creek stock, spawns earlier than the native Steelhead and was used to supplement natural production. Stocking of hatchery fish continued up until the 1980's when concern over success of the stocking programs and their impacts upon native fish led to the termination of both programs. Today there are no stocking programs being pursued in the watershed.

## References and Resources for Historical Conditions

- Bureau of Land Management (BLM). 1901, 1936. *State of Oregon Vegetation Map*. Salem, OR.
- Ternsma, P. D. A. Oct. 1991. *Preliminary Reconstruction and Analysis of Change in Forest Stand Age classes of the Oregon Coast Range from 1850 to 1940*. US Department of the Interior, # OR-9.
- Hanson, D. 1998. *Oak Savanna*. Wampka – The Journal of the Che-ahm-ill Watershed Society, Winter- Spring, Cheahmill Watershed Society.
- Moser, S.A, Farnell J. E. 1981. *Yamhill River Navigability Study*. Division of State Lands, Salem OR.
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- Zybach, B. 1988. *The Great Fires of the Oregon Coast Range: 1770-1933*. College of Forestry, Oregon State University, Corvallis, OR.
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- United State Army Corps of Engineers. January 1976. *Flood Plain Information – Yamhill River-North Yamhill River-South Yamhill River*. Portland District Office
- Yamhill County Planning Department. 1974 *Yamhill County Comprehensive Plan*. Yamhill County courthouse. McMinnville, OR.
- Jennings, M. 1998. *Willamina Historical Background and Survey*. Internship Report. Linfield College, McMinnville OR.
- Buty, S., Sullivan, A. 1999. *The Natural History of Willamina*. Internship Report. Linfield College, McMinnville, OR.
- White, John. 1999. *Personal Communications with Historian*. January 20<sup>th</sup> – February 23<sup>rd</sup> 1999. Yamhill County Historical Society. Lafayette, OR.

## 2.2 Channel Habitat Types

### Methodology

The OWAM has drawn on several stream classification systems to create a basic group of channel habitat types (CHTs). These classifications enable a better understanding of how land use can alter the stream channel form, and help identify how the different habitat types will respond to restoration efforts. This channel classification system provides a framework and mechanism for evaluating watershed-wide stream conditions influences of management activities and potential restoration opportunities.

Willamina's CHTs were classified by Linfield College students Lora Ziegler and Carol Schrage. The October 1997 draft of the Oregon Watershed Assessment Manual was used for this process. Data

from ODFW stream surveys and habitat studies were used where they were available, but the coverage was limited mostly to the major streams of the watershed.

The process for identifying each stream segment as a specific habitat type involves several steps. The first step is to gather the materials required, including aerial photographs, topographical maps, and stream surveys from ODFW. The next step in the process is to break up the streams of the watershed into segments, depending on channel gradient classes. The third step involves assessing the topography of the channels and determining their confinement. Using these characteristics, CHTs are then assigned to corresponding channel sections. For more information about the exact protocol please refer to the 1997 OWAM.

**Covered:**

- Channel gradient designations using “blue line”<sup>7</sup> streams of USGS topographical maps.
- Flood plain width designation using USGS topographical maps and field verification.
- Channel habitat types using maps, aerial photographs and field verification.

**Not Covered:**

- CHTs were only determined for USGS “blue line” streams. There remain many smaller streams where CHTs should be determined.
- Temperature and shading were not used for determination of CHTs (from 1997 OWAM draft).

**Channel Habitat Types**

Knowing the CHTs and their locations provides understanding of the Willamina watershed, and important information for many of the other sections in this assessment including Fisheries and Riparian Conditions.

Willamina watershed consists of nine different channel habitat types (Figure 5). Descriptions for each habitat type are recorded in Table 2. Distribution and lengths in each sub-basin are summarized in Table 3.

**Table 2 Willamina Watershed Channel Habitat Types**

Channel Habitat Type	Description	Fish Utilization
Low-Gradient Floodplain, Channel Large-medium (FP2)	Mainstem streams in broad unconstrained valley bottoms, bounded by low terraces or gentle landforms	Anadromous: Important coho, steelhead spawning, rearing & migration corridor. Resident: Important spawning, rearing & overwintering.
Low-Gradient Floodplain, Channel Small (FP1)	Low gradient unconstrained floodplain channels often occupy the floodplains of larger streams or rivers.	Anadromous: Important coho, steelhead spawning, rearing & migration corridor. Resident: Important spawning & rearing.
Low-Gradient Constrained Channel (LC)	Low to moderate gradient hillslopes with limited floodplain, relatively straight valle, partial or complete barriers may occur at bedrock knickpoints.	Anadromous: Potential coho, steelhead spawning & rearing. Resident: Potential spawning, rearing and overwintering.

<sup>7</sup> “Blue Line” streams are those that are recorded on the USGS 7.5-minute quad maps of the Willamina area.

Moderate Gradient, Moderately Constrained Channels ( <b>MM</b> )	Alternating hillslope and/or high terraces limit channel migration. Bedrock steps with cascades may present forming partial or complete barriers.	Anadromous: Limited Coho spawning & rearing. Potential steelhead spawning & rearing. Resident: Potential spawning, rearing and overwintering.
Moderate Gradient Constrained Channels ( <b>MC</b> )	Narrow open to moderate v-shaped valley, hillslope constrained or hillslope-terrace constrained.	Anadromous: Potential steelhead spawning & rearing. Resident: Potential spawning, rearing & overwintering.
Moderately Steep, Narrow Valley Channel ( <b>MV</b> )	Narrow valley, hillslope constrained but can develop narrow floodplain.	Anadromous: Potential steelhead spawning & rearing. Resident: Potential spawning & rearing.
Bedrock Canyon Channel ( <b>BC</b> )	Very Narrow v-shaped, bedrock constrained, Migration barriers, can occur anywhere within drainage system.	Anadromous: Lower gradient segments may provide rearing. Resident: Limited resident spawning and rearing.
Steep Narrow Valley Channel ( <b>SV</b> )	Narrow v-shaped, hillslope constrained.	Anadromous: Lower gradient segments may provide rearing. Resident: Limited resident spawning and rearing.
Very Steep Headwater Channel ( <b>VH</b> )	Narrow v-shaped, hillslope constrained.	Very limited resident Rearing.
Moderate Gradient Headwater Channels ( <b>MH</b> )	Open V-shape, hillslope constrained. Common to plateaus in Columbia River basalts, young volcanic surfaces, or broad drainage divides; common sites of headwater beaver ponds.	Anadromous: Potential steelhead spawning and rearing. Resident: Important resident spawning and rearing.

A majority (55%) of the CHTs in the Lower Willamina sub-basin are classified as flood plains (FP2 & FP3). This contrasts with the other three sub-basins, which have a majority of their CHT designated as either steep valleys (SV) or very steep headwaters (VH).

**Table 3. Distribution and Lengths of Willamina CHTs\***

<b>Channel Habitat Typing (CHT)</b>							
Subwatershed	CHT	Miles Surveyed	Total Surveyed (%)	Subwatershed	CHT	Miles Surveyed	Total Surveyed (%)
Upper Willamina	BC	26	16	East Creek	FP2	1.2	11
	FP3	1.2	7		LC	3.1	30
	LC	30	18		MC	0.5	5
	MM	0.4	2		MM	0.3	3
	MV	28	17		MV	1.0	9
	SV	5.3	32		SV	4.0	39
	VH	1.3	8		VH	0.4	4
<b>Subtotal:</b>		<b>16.5</b>	<b>100</b>	<b>Subtotal:</b>		<b>10.4</b>	<b>100</b>
Lower Willamina	FP2	9.6	55	Coast Creek	LC	3.1	20
	FP3	1.1	6		MC	1.2	8
	LC	0.9	5		MH	0.6	3
	MC	0.4	2		MV	1.5	9
	MH	2.2	13		SV	8.4	53
	MV	1.2	7		VH	1.1	7
	SV	1.8	10		<b>Subtotal:</b>		<b>15.8</b>
	VH	0.2	1				
<b>Subtotal:</b>		<b>17.4</b>	<b>100</b>				

\*CHT abbreviations are explained in table 2.

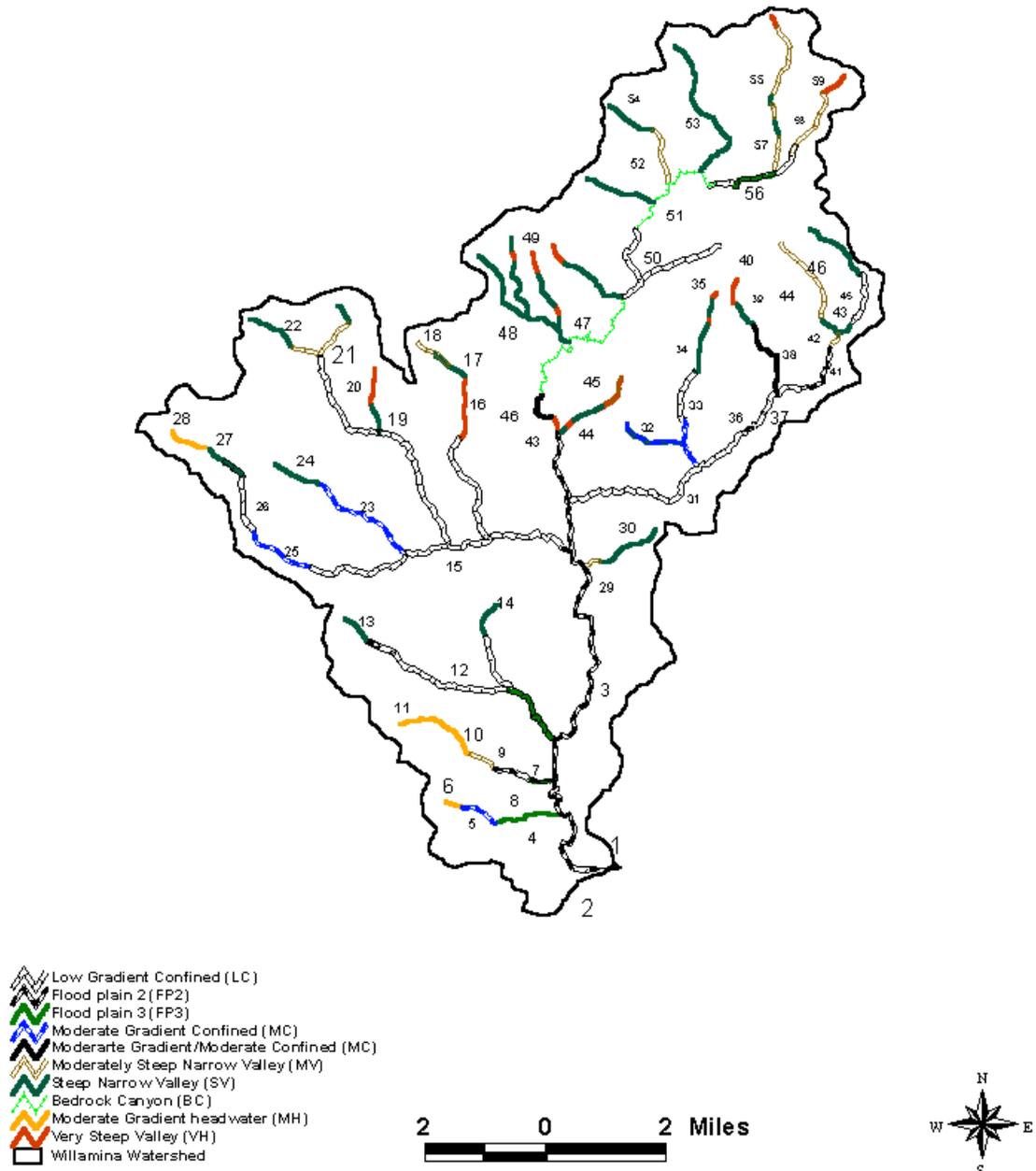
## **References and Resources**

U.S. Geological Survey topographic maps (Niagara Creek, Springer Mountain, Stony Mountain, Sheridan, Grand Ronde, OR, 1:24,000, 7.5-minute quadrangle, **1970** photorevised 1975 and 1969, photorevised 1986).

USDA Farm Service Agency. 1994. *1:660 ft. Aerial photographs*. McMinnville, OR.

Hanson, Dave. 1998. *Local resident knowledge and field verification*.

# Figure 5. Channel Habitat Types & Matrix Numbers



## 2.3 Fisheries

### Introduction and Methodology

The main objective of the Fisheries section is to identify fish species in the watershed, where they occur, and what is known about their populations. The focus of this section is primarily on anadromous salmonid species such as winter Steelhead and coho (silver). Other fish species such as sculpin and cutthroat trout<sup>8</sup> are important parts of the aquatic ecosystem but are not considered as high a priority at this time due to their relatively abundant populations. An understanding of the current and historical fish populations can aid us in determining where and when to focus our conservation and restoration efforts.

This section was completed by the author using the 1998 OWAM and by utilizing work done by Yamhill resident Dave Hanson, and Kira Besh of Linfield College as well as several agencies reports (see references) from the BLM and ODFW. Dave Hanson and Kira Besh used the 1997 draft of the OWAM to assess fish conditions and populations. Information that was not available at the time of their assessment is included in this section.

#### Covered:

- ❑ Stocking history
- ❑ Life history and patterns, important habitat areas
- ❑ Known migration barriers
- ❑ Some field verification

#### Not Covered:

- ❑ Species interactions
- ❑ Distribution maps – (data not available)

### Fish Background

The Willamina watershed has an extensive list of fish species present in its waters (Table 4). This list includes both native and exotic as well as warm and cold water (salmonid) species. In the spring of 1999, winter Steelhead (*Oncorhynchus mykiss*) were listed as threatened species by the National Marine Fisheries Service (NMFS) under the Federal Endangered Species Act. This listing has the potential to affect many of the present day land uses and water-related practices in the Willamina watershed. Land uses and management practices that affect water temperature, flow, turbidity, sedimentation and many other factors will be assessed in order to direct improvement efforts for the sustainable recovery of salmonids and other threatened aquatic life forms.

With regards to the status of coho salmon in the Willamina watershed: “The few coho (Silver) salmon (*Oncorhynchus kisutch*) present in the Willamina watershed are not included under any listings because they are non-native and are of hatchery origin. Lower Willamette coho were listed but that did not include any coho in the upper Willamette basin” (Gary Galovich, ODFW 1999).

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<sup>8</sup> Note: Cutthroat trout are considered a high priority and in fact drive many of our (ODFW) management and regulatory decisions in the watershed because of their wide distribution. They are also frequently used as the best indicator of stream/watershed health (Gary Galovich, 1999).

<b>Table 4. Willamina Native Fish Species</b>
<b>Anadromous:</b>
Steelhead Trout ( <i>Oncorhynchus mykiss</i> )
Coho Salmon ( <i>Oncorhynchus kisutch</i> )
Pacific Lamprey ( <i>Entosphenus tridentatus</i> )
Western brook Lamprey ( <i>Lametra richardsoni</i> )
<b>Resident:</b>
Cutthroat Trout ( <i>Oncorhynchus clarki</i> )
Longnose Dace ( <i>Rhinichthys cataractae</i> )
Rainbow Trout ( <i>Oncorhynchus mykiss</i> )
Prickly Sculpin ( <i>Cottus asper</i> )
Reticulate Sculpin ( <i>Cottus perplexus</i> )
Riffle Sculpin ( <i>Cottus gulosus</i> )
Torrent Sculpin ( <i>Cottus rhotheus</i> )
Redside Shiner ( <i>Richardsonius balteatus</i> )
Sucker (Catostomus sp.)

Coho salmon, Steelhead and cutthroat trout as well as other fish species use a significant portion of Willamina's streams and tributaries as habitat. Figure 6 maps both the stream sections designated as salmonid habitat (from DSL Map, 1999) and surveyed areas designated by ODFW as suspected spawning areas for winter Steelhead (ODFW, 1992). There is no designated habitat for Coho salmon in the Willamina watershed (ODFW, 1992). Many of Willamina watershed's smaller tributaries and streams have never been surveyed for fish habitat. Therefore undesignated areas of Figure 6 should not be discounted as potential habitat or spawning areas.

## **Fish History**

While the ODFW considers Willamina Creek to be one of the more productive winter Steelhead streams in the Coast Range Sub-basin of the Upper Willamette Valley, it probably never supported large numbers of winter Steelhead prior to stocking efforts (ODFW, 1995). There are reports of Steelhead in the sub-basin prior to ODFW stocking programs but many of these were at that time considered to be strays from other rivers systems. Hatchery stocking of Steelhead in the Willamina watershed began in 1964 and ended in 1989 (Appendix I). More than 500,000 winter Steelhead fry, fingerlings, yearling smolts and adults were released into to the Willamina watershed over that time period (ODFW, 1992).

All of the hatchery winter Steelhead released into the Willamina watershed came from the Big Creek hatchery. Majority of the Steelhead were released into Willamina Creek from 1964-1983. In 1983 the Oregon Department of Fish & Wildlife S.T.E.P program<sup>9</sup>, which encouraged participation by

<sup>9</sup> STEP - Salmon Trout Enhancement Program - A volunteer/information/education component of ODFW's fish management program. STEP program is still in existence today (Gary Galovich, ODFW, 1999).

local residents and private landowners, began to release winter Steelhead fry stock into the smaller streams and tributaries of the watershed. STEP discontinued stocking efforts in 1989.

Willamina Creek is considered to have the best return for winter Steelhead in the coast range sub-basin of the upper Willamette (Figure 7). Estimates made from ODFW tag returns show nearly 800 fish harvested between 1977 and 1989 (ODFW, 1992).

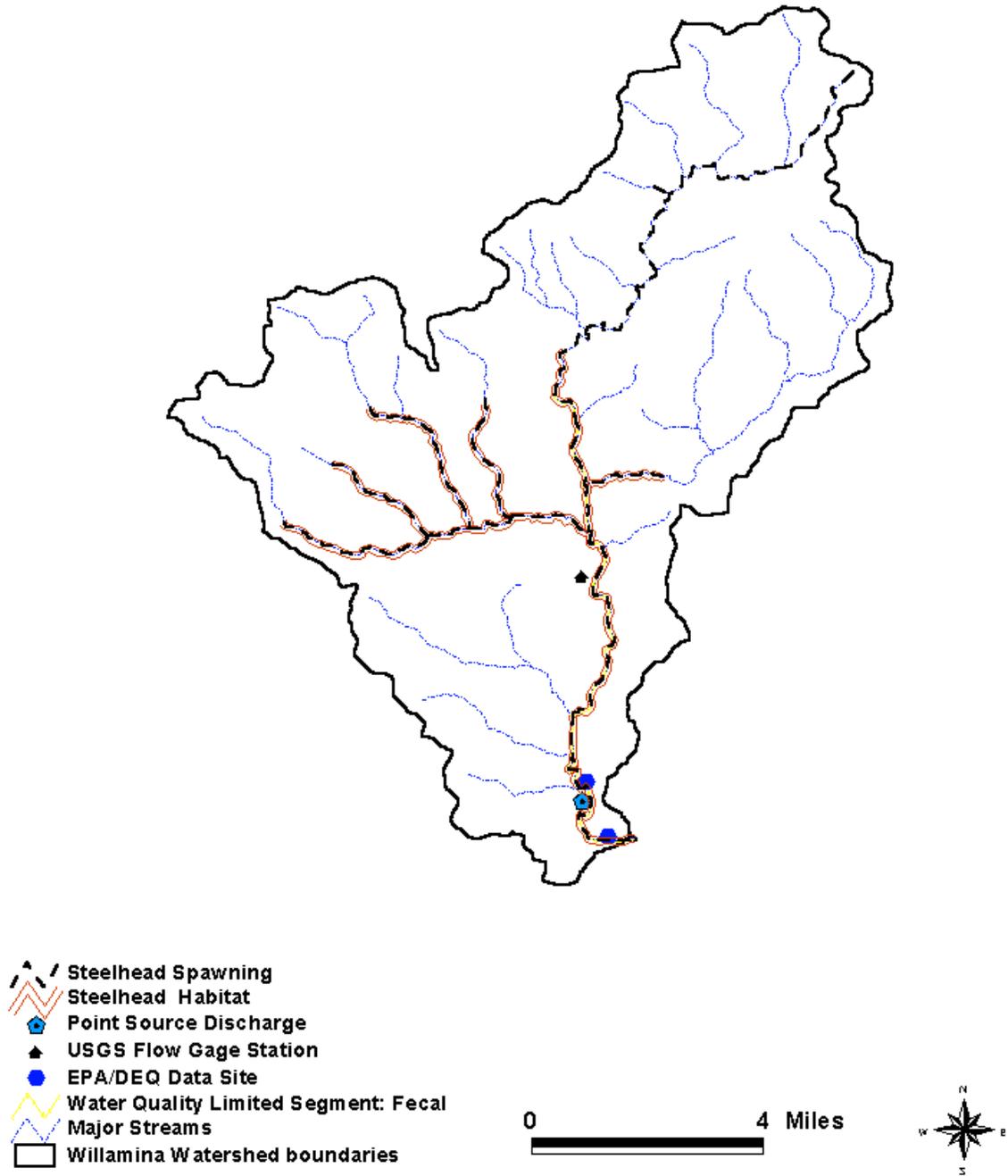
**Figure 7. Willamina Steelhead Return**



Coho salmon are not native to the Willamette basin above Willamette Falls. They were first introduced above the falls in the 1920s and large releases of hatchery Coho occurred from the 1950s through the 1970s. Coho were stocked in the sub-basin in the 1960s and 1970s as part of an effort to establish a self-sustaining run of Coho to the upper Willamette basin. These stocking effort were terminated when returns did not meet expectations (ODFW, 1992). Records show that more than 110,000 Coho (Silver) salmon were released into the Willamina watershed between the years 1953 and 1958 by the Oregon Fish Commission (OFC, 1960).

Exotic warm-water game fish including largemouth bass, channel catfish crappies and bullhead catfish have been stocked in the South Yamhill watershed beginning in 1934 until as late as 1978. Other species of exotic fish have been captured and transplanted to the watershed for recreation fishing. (ODFW, 1992).

**Figure 6. Steelhead Habitat/ Water Quality**



## **Life Histories**

Knowing where sensitive fish are at a particular time of the year is valuable information for planning restoration and monitoring efforts. Winter Steelhead are generally located in the upper reaches of the Willamina watershed. Spawning begins around late January and ends in late April with a majority occurring in mid-late spring. Winter Steelhead juveniles rear in fresh water from 1 to 2 years and then migrate to the ocean in the spring. Most Steelhead spend approximately 2 years in the ocean. Their ocean distribution is poorly known but it appears that they migrate further offshore than other salmon. The spawning adults return inland during the winter and may spawn more than one once (OSUES, 1998).

As mentioned previously, Coho (Silver) salmon have been released in the Willamina watershed. Suspected spawning areas of these fish would coincide with hatchery release locations. Coho juveniles rear throughout a watershed and tend to live in pools in the summer. One-year-old juveniles migrate to the ocean during the spring and tend to rear just off the Oregon coast for approximately 2 years. Adults return to fresh water in the fall and spawn in the late fall and winter. The spawning generally takes place in concentrations on gravel bars in the upper parts of watersheds (OSUES, 1998).

Cutthroat trout are native to the coast range sub-basin. The stocks in the Willamina watershed are considered not to be anadromous. They display two life history patterns: resident where they stay in the system and fluvial where they migrate between stream basins. Cutthroats are the only native trout in the Willamina watershed. Other trout including rainbow and brook may exist as a result of releases and are not native to the Willamina watershed. Cutthroats tend to spawn in the winter and early spring using small pockets of gravel. They have been reported to spawn more than once and their spawning ages vary. They prefer to spawn in the uppermost tributaries and streams of watersheds (OSUES, 1998).

Warm water game fish including largemouth and smallmouth bass, white crappie, bluegill, pumpkinseed, yellow perch, and brown bullhead can be found in the lower reaches of the Yamhill river watershed. Non-native bullfrogs are also found. They generally live and spawn in the lower reaches of the watershed. Spawning times and locations vary with each species. Their populations are considered to be relatively stable (ODFW, 1992).

## **Current Fish Habitat Conditions**

Using the 1996 draft of the OWAM, Kira Besh and Dave Hanson conducted an assessment of the current fish habitat conditions in the Willamina watershed. Using ODFW stream surveys and class maps of Willamina, Coast and East Creeks and by working with ODFW biologist Gary Galovich they were able to quantify the current conditions. They reported a “moderate degree of confidence concerning data from ODFW stream class maps and stream surveys. Gaps exist in data especially for smaller tributaries” (Besh, 1998). Some field verification of both fish barriers and conditions were conducted during the spring of 1998. Dave Hanson is a resident landowner in the watershed and provided information gathered from personal experience for the process.

Before current habitat conditions are discussed it should be noted that stream survey data and maps are only a snapshot in time of a dynamic aquatic system. The winters of 1998-1999 brought heavy

rainfall to the Willamina watershed that may have altered the conditions surveyed and reported here. Caution should be used in the use of this data and all fish barriers should be confirmed with field verification before restoration or monitoring efforts are implemented.

The assessment process weighs the conditions of several parameters and gives an overall rating for each surveyed segment of Willamina streams. The habitat parameters are number of pool areas, pool frequency, gravel availability, and gravel quality. Using ODFW criteria<sup>10</sup>, habitat parameters were rated as good, fair and poor for each segment of stream surveyed. An overall rating for each segment was determined using the following criteria.

GOOD	All parameters rated as Good or Fair.
INDET	One or two parameters rated Poor.
POOR	Three or more parameters rated Poor.
ND	No data.

Data was not available for many of the named and unnamed tributaries of the Willamina watershed. Older surveys from the 1950s and 60s of some of the smaller creeks are available but were not reviewed due to time constraints. Note that ODFW data was used from both the 1995 and 1990 stream surveys. Habitat surveys from Willamina Creek begin at river mile 10. Incompatibilities between the locations of OWAM Channel habitat types and actual ODFW stream survey reaches caused the assessors to utilize the ODFW stream reaches for segment identification.

Generally the surveyed sections of the Willamina watershed were assessed to be in good condition. However the last 1.5 miles of Willamina Creek has poor ratings for both pool frequency and gravel quality. Some improvement was recorded in Willamina Creeks' first stream reach between the 1991 and 1995 stream surveys for gravel availability. Willamina's fish habitat condition summary is presented in Table 5.

## **Fish Barriers**

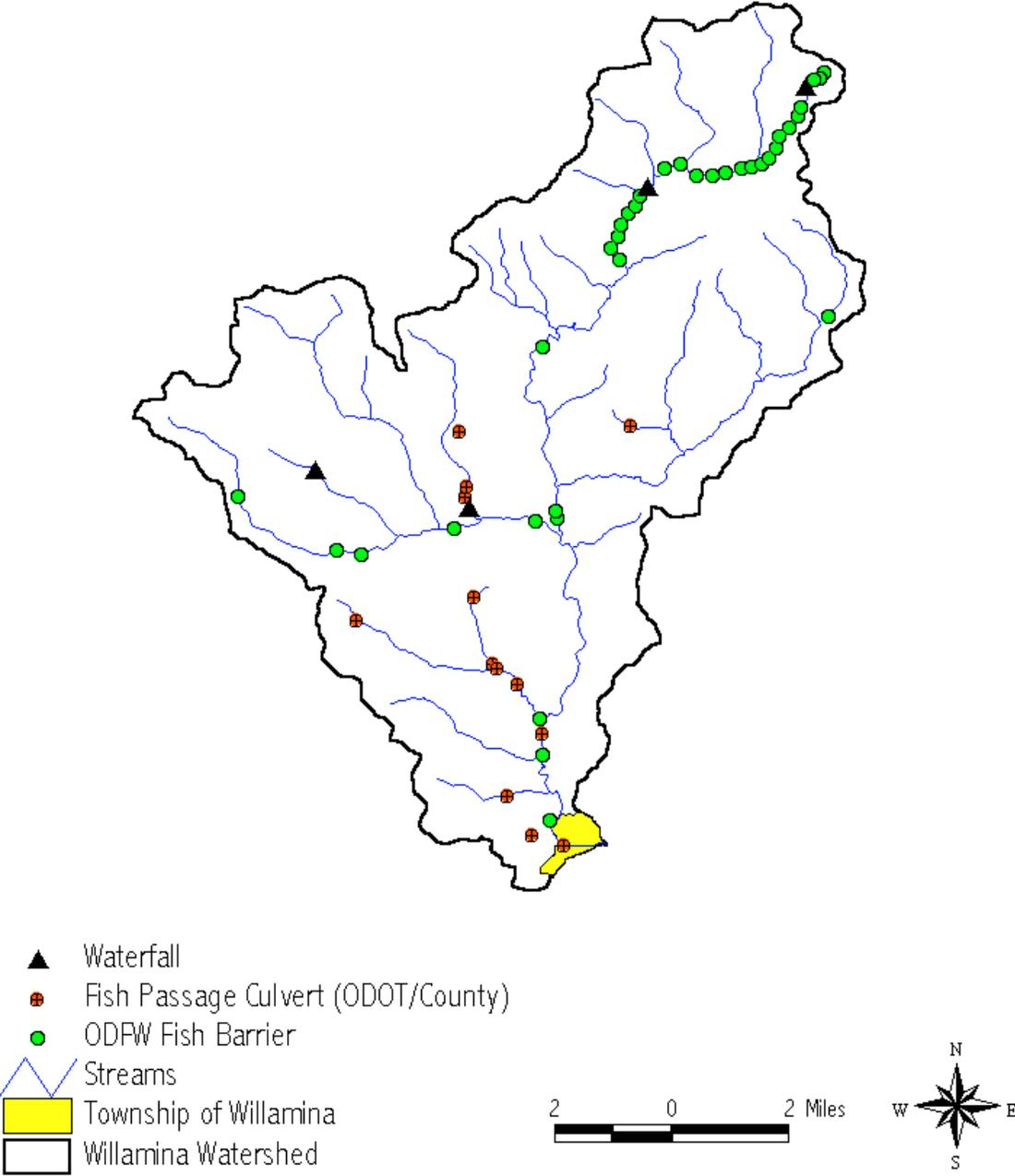
Fish barriers are generally considered to be either natural or human created obstacles that impede the passage of fish. Barriers include such things as culverts, dams, waterfalls, logjams and beaver ponds. For anadromous fish species, barriers can pose a problem for both migration and spawning as well as for resident and fluvial fish species. As habitat, population or water quality conditions change, perhaps even seasonally, fish need to move to watershed locations that have more favorable habitat conditions.<sup>11</sup> Fish barrier locations were collected from ODFW stream surveys and from a fish passage culvert database constructed by ODFW and recorded in Figure 8 (Mirati, 1999). Human-created and natural barriers are depicted on the map. Descriptions and exact locations of barriers are available in Appendices II-A, B.

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<sup>10</sup> For more information on ODFW criteria for rating stream habitat please contact ODFW in your area.

<sup>11</sup> Gary Galovich, ODFW fish biologist, 1999

# Figure 8. Willamina Fish Barriers



## References and Resources for Fish Section:

- Besh, K.V. 1998. *Fisheries Evaluation of the Willamina Watershed*. Linfield College Internship: Fall/Spring Semester 1998. Yamhill Watershed Council, McMinnville, OR.
- Mirati A. (Fish passage coordinator). 1999. *Fish Passage Culvert Database from ODOT and County Roads*. Oregon Dept. of Fish and Wildlife, Portland, OR.
- Oregon Department of Fish and Wildlife. (ODFW) 1952. *Mainstem of Yamhill and Tributaries Inventory*. District office, Adair Village, OR.
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- Oregon Division of State Lands. (DSL) 1999. *Essential Salmon Habitat – Maps*.
- Oregon Fish Commission (OFC). June 1960. *Fish Commission Survey*. ODFW, Adair Village, OR.
- Oregon State University Extension Service. (OSUES). 1998. *A Snapshot of Salmon in Oregon*. Publications, OSU, Corvallis OR. 97331.

## 2.4 Riparian Conditions

### Introduction

Riparian areas are by definition regions adjacent to streams, rivers and wetlands with characteristic plant and animal species that are unique to this habitat. Riparian areas generally have higher levels of moisture in the soil than do adjacent upland areas. These elevated moisture levels generally support a more abundant and diverse ecosystem and there are a wide variety of hydraulic, geomorphic and biotic processes that determine the riparian area or zone.

Riparian vegetation influences fish habitat and water quality in many different ways. It provides shading which helps to decrease the daily fluctuations in water temperature and provides fish cover from predation. It stabilizes stream banks, which decreases erosion and prevents downcutting. It provides habitat for insects and macro-invertebrates, which are a food source for fish. It also provides detritus or organic litter to the stream, which provides vital nutrients to the entire ecosystem. Riparian areas are also an important source of large wood recruitment to the system that is vital for fish habitat. The large wood provides cover for fish and also diverts channels and obstructs flow, which thereby increases channel and habitat complexity.

## Methodology

The Riparian Conditions for the Willamina watershed were determined using the OWAM.<sup>12</sup> The manual uses a six-step method to determine the quality and quantity of the riparian vegetation. The first step is the preparation by which all of the materials necessary are collected, which include base maps, ecoregion designations (see channel habitat typing for details), aerial photographs (provided by the USDA Farm Service Agency), land use maps, conversations with ODFW personnel, and the use of some field verification.

The second step divides the watershed into riparian condition units, which include differences in vegetation, shading, canopy cover, stream size, sub-basin, the ability to contribute large woody debris, and channel habitat types. Frequently the grading of the riparian sections comes down to a judgement call based on the composite of information compiled. Sections that are scored as moderate to low must be field verified before restoration work is initiated.

The next two steps check the preliminary results by field verification and then by mapping the recruitment of large wood for fish habitat. Some field verification of the streams was done, but a majority of the riparian conditions in the watershed were not surveyed. Step five constructs a map of the three types of riparian situations found in the watershed

Riparian Conditions or situations are grouped using the terms poor, fair, and good. The assessment team found it more prudent to redefine them as a grading system and called them low, medium and high (Table 6).

**Table 6. Riparian Condition Classifications for Willamina Watershed**

<b>Current Riparian Classification</b>	<b>Definitions</b>
<b><i>High</i></b>	Wide Riparian zones, mature trees in riparian zone, fairly continuous or only somewhat interrupted. Land use has potential to allow regeneration of riparian areas (agriculture, pasture, forest, some urban and suburban).
<b><i>Medium</i></b>	Narrow riparian zone, interrupted riparian continuity, and some trees in riparian even if limited by streamside roads or road/utility crossings. Land use has some potential to allow regeneration of riparian areas (agriculture, pasture, forest, some suburban and urban).
<b><i>Low</i></b>	Riparian vegetation absent, bank hardened, streamside roads, road/utility crossings or current land uses producing highly fragmented, interrupted riparian corridor and/or reaches where no trees are present in riparian zone. Land use is less likely to allow regeneration of riparian areas (industrial, some suburban, some urban, interstate highways, some irrigated agriculture).

<sup>12</sup> Riparian Conditions data collected and compiled by Linfield Interns, Carol Zeigler and Laura Schrage.

### **Covered:**

- ❑ Topographical and land use maps
- ❑ Conversations with ODFW personnel and ODFW stream surveys
- ❑ Aerial photographs
- ❑ Some field verification

### **Not Covered:**

- ❑ Information from Private Landowners
- ❑ Field verification of results.
- ❑ Federal information (BLM)

### ***Figure 9. Missing***

### **Additional Questions and Concerns:**

The riparian conditions reported here are based on the methods described in the October, 1997 draft of the OWAM. To better understand the methods used to obtain the above-recorded data, it is suggested that the reader reference the manual.

### **Riparian Conditions Results (by sub-basin)**

#### **Lower Willamina**

The Lower Willamina sub-basin has by far the most impacted riparian areas in the watershed (Figure 9). Rural residential and urban land use create a low to moderate potential for large woody debris contributions coupled with a low-grade riparian corridor along the lower section of Willamina Creek and parts of Tindle Creek. The Lower Willamina averages a buffer strip of greater than 30 feet along its banks (See Appendix III-A). The continuity of the lower Willamina is typified by some interruptions in the riparian zone, road and utility crossings, clearings, and patchy streamside vegetation. Figure 10 shows the percentage of land use adjacent to the streams surveyed.

#### **Upper Willamina**

The upper Willamina sub-basin has some sections of low and medium grade riparian coverage in some of the headwater areas where land management activities have occurred. However, a large portion of the drainage has high-grade riparian conditions, with good conditions for large woody debris contributions. The width of the buffer for the sub-basin averages over 30 feet and the riparian vegetation is mostly continuous along the streams.

The majority of land uses in the upper Willamina sub-basin is for forestry (91%), agriculture and rural residential. Additional information regarding temperature, mature and second growth timber stands and information gleaned from ODFW surveys is included in Appendices III-A, B, C, and D.

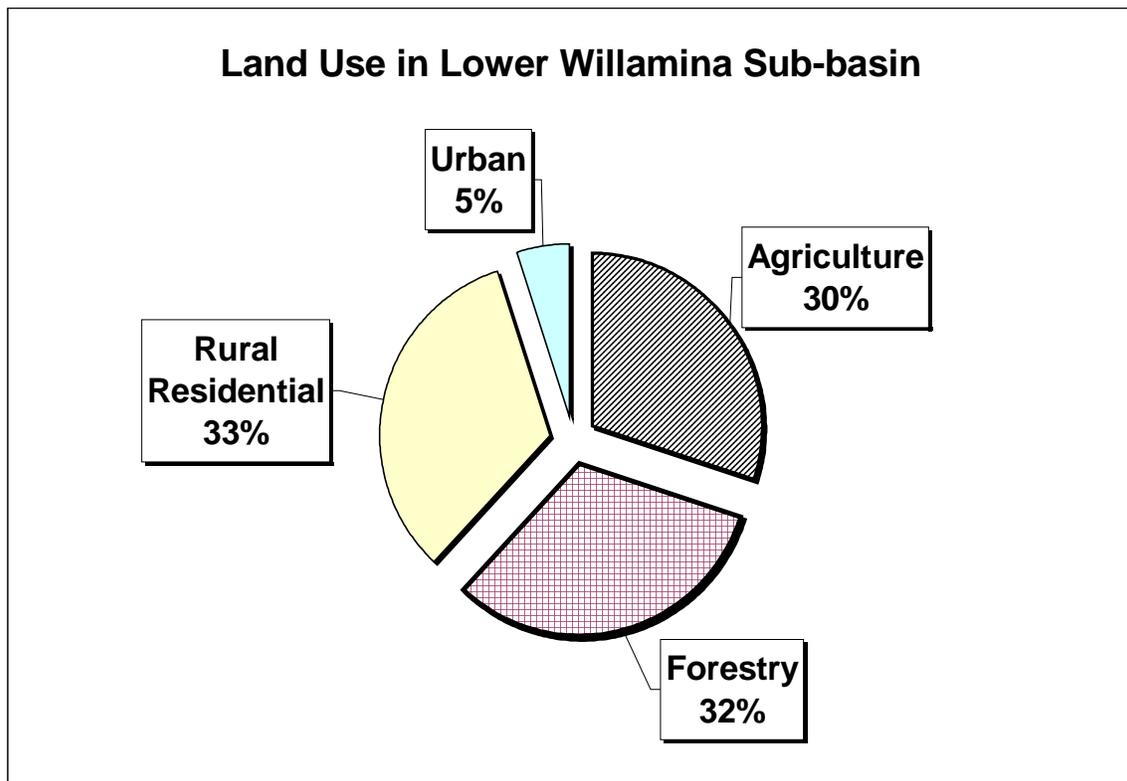
#### **Coast Creek**

The Coast Creek sub-basin has one small section of low grade riparian at the confluence of Coast and Willamina Creek (Figure 9). The lower sections of Canada, Burton and Upper Coast Creek

have been designated with a moderate grade riparian condition. A majority of the sub-basin has a high grade of riparian condition with 95 % of the riparian land use forestry and 5% rural residential.

The average buffer width is much like the two previous sub-basins, which are typified by relatively wide riparian buffers over 30 feet. There is generally a vegetation buffer between the stream and the upland land uses on most of Coast Creek sub-basin. See Appendices III-A, B, C, and D for additional information.

**Figure 10. Percentages of Land Use in Lower Willamina Sub-basin**



Additional information regarding the riparian surveys is included in Appendices III-A, B, C, and D.

### **East Creek**

The East Creek sub-basin has one section of low-grade riparian conditions and a small section of moderately graded riparian conditions on La Toutena Mary Creek (Figure 9). Conversations with Dave Hanson (local resident) have identified the low-grade section of East Creek as being an area of grasses and wetlands. While this type of area would be identified as having a low riparian condition (according to protocol) and not readily providing shade and large woody debris, wetlands and grasslands are naturally occurring conditions and are a part of a healthy stream system. Additional field verification is required for a better understanding of this specific location.

The land use along the riparian corridor of East Creek is mainly forestry (87%), while the remaining lengths (13%) are mostly used for agriculture. East Creek has the highest average width class of the

sub-basin in Willamina, and the highest majority of forested riparian zones. East Creek also has a high continuity average which means that most of the riparian zone vegetation is continuous. See Appendices III-A, B, C, and D for additional information.

### **References and Resources for Riparian Conditions**

Galovich, Gary. ODFW Fish Biologist. 1998-9. *Personal Communications*. NW Regional Office, 7118 NE Vandenberg Ave Corvallis, OR. 97330-9446

Hanson, Dave. Yamhill Basin Council. *Willamina Riparian Assessment Team*.

Oregon Department of Fish and Wildlife. (ODFW) 1990. *Aquatic Inventories Project*. District Office, Adair Village, OR.

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Zeigler, Carol Linfield College Student. *Willamina Fish Assessment Team*.

## **2.5 Wetland Conditions**

The wetlands section of the Willamina watershed assessment was conducted and written by Patricia Farrell, member of the Yamhill Watershed Council, resident of Yamhill County and a professional wetlands consultant.

### **Introduction**

Wetlands are defined as areas that are saturated or inundated for long enough during the year that they support particular types of vegetation and soil. These areas are often referred to as swamps, marshes, or bogs and they provide important biological functions in watersheds, such as absorbing floodwaters, filtering pollutants, recharging groundwater, and supporting a variety of wildlife.

Wetlands also include less easily recognized features such as wet meadows, swales, seasonal seeps, and sometimes ditches. In Oregon, and the west in general, wetlands may be completely dry in the summer. Wetlands are typically associated with streams and rivers, however they may also be isolated features in the landscape, often resulting from topographic depressions, heavy impermeable soils, compaction and/or perched water table.

Wetlands in the state of Oregon are regulated by the Oregon Division of State Lands (DSL) and the U.S. Army Corps of Engineers (USACE). In order to be considered jurisdictional wetlands they must meet three criteria established by the Corps. These are hydric soil, wetland hydrology, and wetland vegetation.

## **Methodology**

### **Wetlands Cartography**

Off-site mapping was conducted to determine the approximate location of wetland boundaries. Source information included the USGS topographic quadrangles for the Willamina watershed, the Soil Survey of Yamhill Area, Oregon (SCS, 1974), the National Wetlands Inventory (NWI) maps, 1986 black and white aerial photographs at a scale of 1" = 660' from the Natural Resource Conservation Service (NRCS), and local knowledge.

The U.S. Fish and Wildlife Service, as part of the National Wetlands Inventory (NWI) program, has mapped wetlands in the study area (Figure 11). The NWI maps are generated primarily on the basis of interpretation of relatively small-scale color infrared aerial photographs (e.g., scale of 1:58,000) with limited 'ground truthing' conducted to confirm the interpretations.

Wetlands mapped on the NWI maps were transferred to a watershed base, along with their Cowardin classification code. Prior converted and farmed wetlands were transferred from annotated NRCS aerial photographs. Other features such as springs, ponds, streams and waterfalls were transferred from the USGS maps to the base map. Following the preliminary mapping, portions of the watershed were visited to verify approximate locations of some of these features.

The following information is related to the NWI Cowardin classification codes used in the wetland mapping, process for Willamina watershed.

#### **Wetland Classification**

*The classification of wetlands as defined by plants, soils and the frequency of flooding is described in "Classification of wetlands and deepwater habitats of the United States" (Cowardin, et. al. 1979).*

#### **Palustrine System**

*All nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens and all such wetlands that occur in tidal areas where salinity is less than 0.5%. This includes areas traditionally called swamps, marshes, fens, as well as shallow, permanent or intermittent water bodies called ponds.*

#### **Open water (POW)**

*A wetland class consisting of areas of water less than 6.6 feet deep.*

#### **Emergent Wetland (PEM)**

*These wetlands have rooted herbaceous vegetation, which stand erect above the water or ground surface.*

#### **Scrub-shrub Wetland (PSS)**

*Wetlands dominated by shrubs and tree saplings that are less than 20 feet high.*

#### **Forested Wetland (PFO)**

*Wetlands dominated by trees that are greater than 20 feet high.*

#### **Prior Converted Cropland (PC)**

*Wetlands that have been used to produce a commodity crop, have been hydrologically altered (i.e. drained),*

*and have surface inundation for less than 15 days.*

The *National Food Security Act Manual* (NFSAM-USDA Natural Resources Conservation Service, 1994) is used by the COE for delineation of agricultural wetlands, including “prior converted croplands” and “farmed wetlands”. The difference between the two manuals is the hydrology criteria. The NFSAM distinguishes between prior converted cropland and farmed wetland based on duration of inundation during the growing season (i.e. less or greater than 15 days). The 87 Manual hydrology criteria do not make this distinction.

Prior converted cropland is defined by the NRCS in the *Food Security Act Manual*, August 1988, as “...wetlands that were drained, dredged, filled, leveled, or otherwise manipulated, including the removal of woody vegetation, before December 23, 1985, for the purpose of, or to have the effect of, making the production of an agricultural commodity possible, and an agricultural commodity was planted or produced at least once prior to December 23, 1985” (USDA, National Food Security Act Manual, 1994).

In addition to the hydrological manipulation and commodity crop production, the area must not be inundated for more than 15 consecutive days during the growing season, and must not have been abandoned for more than five consecutive years; in order to be considered prior converted cropland. Abandonment is defined as the cessation of cropping, forage production, or management.

Prior converted croplands are not subject to regulation by the COE under Section 404 of the Clean Water Act. DSL only recognizes/accepts a prior converted cropland determination on Exclusive Farm Use zoned land if the proposed activity is a farm use (e.g. barn, feedlot etc...). If any changes to farm use are proposed, such as conversion to residential or commercial land use, the prior converted cropland will be designated as wetland/PC and regulated as wetland.

The criteria for the Prior Converted Cropland determination is summarized as follows:

- The area was manipulated to make the production of an agricultural commodity possible before December 23, 1985,
- The area produced an agricultural commodity at least once prior to December 23, 1985,
- The area does not flood or pond for 15 consecutive days during the growing season or 10% of the growing season, whichever is less,
- The area has not been abandoned for more than 5 consecutive years.

### **Farmed Wetlands (FW)**

*Farmed wetlands are wetlands which have been manipulated and cropped before December 23, 1985, but which continue to exhibit important wetland values. In addition, farmed wetlands include areas which pond water for 15 or more consecutive days during the growing season. Farmed wetlands are subject to federal wetland jurisdiction.*

### **Riverine**

*The riverine system includes all wetlands and deepwater habitats contained within a channel. A channel is “an open conduit either naturally or artificially created which periodically or continuously contains moving water or which forms a connecting link between two bodies of standing water. Springs discharging into a channel are considered part of the riverine system” (Cowardin, 1979).*

## **Waters of the State (WOS)**

*Natural waterways including all tidal and nontidal bays, intermittent streams, constantly flowing streams, lakes, wetlands and other bodies of water in this state, navigable and non-navigable. Natural waterways are defined as waterways created naturally by geological and hydrological processes, waterways that would be natural but for human-caused disturbances (e.g. channelized or culverted streams, impounded waters, partially drained wetlands or ponds created in wetlands).*

## **Wetland Discussion**

All the wetlands within each of the sub-basins are predominantly agricultural types (i.e., farmed wetlands or prior converted). All the sub-basins also had extensive areas of streams, creeks and rivers (i.e. riverine/waters of the state), including many seeps and springs in the headwaters (Figure 11). Some of these drainages were designated as riverine, while others were designated as palustrine forested systems on the NWI maps.

## **Willamina Wetland Acreage and Distribution**

Following the mapping of wetlands onto the base map, approximate acreage was determined with the use of a planimeter. Table 7 summarizes the results for each of the Willamina watershed Sub-basins.

**Table 7. Wetland Areas Within Each of the Willamina Creek Sub-basins**

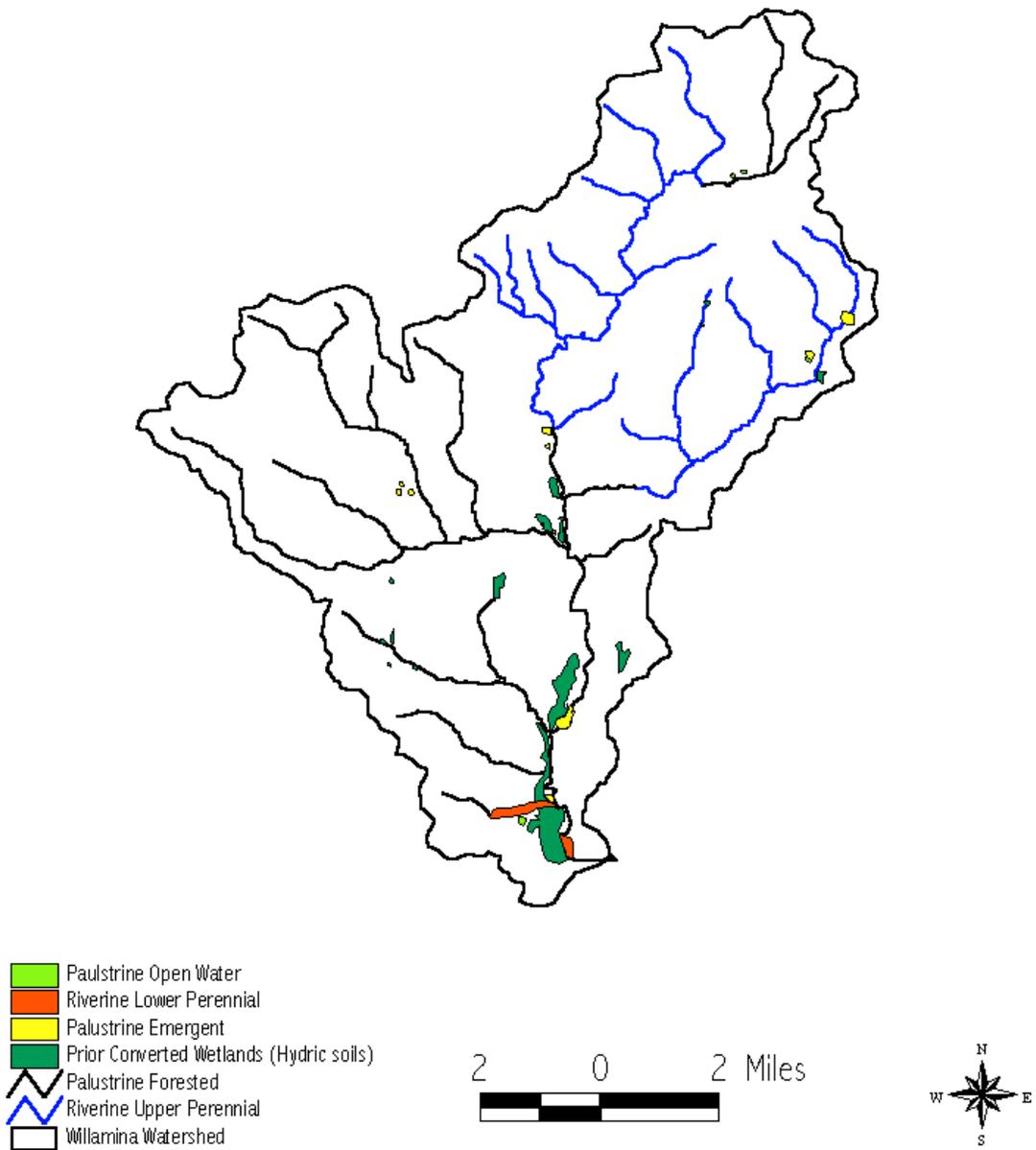
<b>Sub-basins</b>	<b>Wetland Area (acres)</b>
Upper Willamina	83.63
Lower Willamina	294.50
East Creek	61.04
Coast Creek	123.82
<b>Total Wetland Acreage</b>	<b>562.99</b>

## **Confidence Level in Wetlands Assessment**

Wetland locations and boundaries are approximate and will require a degree of field checking. Due to the lack of field verification for this section of the watershed assessment, acreages are likely to be rough estimates. In addition, due to the scale of aerial photographs and lack of aerial coverage for some areas, small wetlands may have been missed in the mapping process, particularly in the upper reaches in forested areas. Mapping errors may also have occurred during the transfer of information from 15-minute USGS and NWI maps to the base map.

Future work includes conducting field review and wetland quality assessment work to refine the wetland boundaries, and to provide a framework for determining restoration opportunities.

# Figure 11. Willamina Wetlands



## References and Resources

- Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. *Classification of wetlands and deepwater habitats of the United States*. U.S. Fish and Wildlife Service, Office of Biological Services, FWS/OBS-79/31. 103 pp.
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- Federal Register. 1982, *Title 33: Navigation and Navigable Waters, Chapter 11, Regulatory Programs of the Corps of Engineers*, Vol. 47, No. 138, p31810, US Government Printing Office, Washington, D.C.
- Reed, Porter B., Jr. 1988 (May). *National List of Plant Species That Occur in Wetlands: Northwest (Region 9)*. Prepared by the U.S. Fish and Wildlife Service, St. Petersburg, FL. NERC-88/18.37.
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- U.S. Geological Survey. *Topographic maps* (Niagara Creek, Springer Mountain, Stony Mountain, Sheridan, and Grand Ronde, OR. 1:24,000, 7.5-minute quadrangle. 1970 photorevised 1975. 1969, photorevised 1986).
- USDA Farm Service Agency. 1978. 1:660 ft. *Aerial photographs*. McMinnville OR Field Office
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## 2.6 Channel Modifications

### Introduction

The purpose of the channel modification section is to investigate and map location in the Willamina watershed where channels have been modified or disturbed. For the purposes of this assessment, channel modification is defined as “any human-caused physical alteration or activity that influences the channel morphology (shape) and changes the stream from its natural state” (Bruener, 1998). Land management activities such as damming, dredging, and rip-rapping to stabilize stream banks alter the physical characteristics of streams. These changes also have the potential to alter the habitat characteristics of aquatic ecosystems. The degree to which the modifications impact these characteristics depends on the type, degree and locations of the channel modifications.

## **Methodology**

The channel modification assessment was conducted by both the author and by Joel Siderius (Linfield intern) using the October 1997 draft of the OWAM assessment manual. The assessment process included gathering all of the known historical and present day information regarding channel modifications in the Willamina drainage. Modification information was then prioritized and field verifications were conducted on those stream segments that could be reached. A majority of the channel modifications noted from aerial photos and stream surveys were not field-verified due to inaccessibility through adjacent private lands or in steep and ravines. A map recording the location of field-verified channel modifications was drafted with the results.

### **Covered:**

- ❑ Federal Emergency Management Agency (FEMA) 100-year flood plain maps.
- ❑ USGS Quadrangle maps, 7.5-minute scale.
- ❑ Yamhill County road maps.
- ❑ Oregon Department of Forestry maps.
- ❑ USDA Farm service aerial photographs.
- ❑ Historical records.
- ❑ Some field verification.

### **Not Covered:**

- ❑ Extensive field verifications.
- ❑ Historical Logging and county road maps.
- ❑ Interviews with long-term Willamina residents.

## **Willamina's Historical Channel Modifications**

The Portland General Electric Company reported a hydroelectric dam located in the town of Willamina in 1939. Specific records noting the dam type, location, and years of service could not be located. There is thought to have been many small-scale diversions, dikes, dredging and instream structures that occurred in the Willamina watershed during the 1800's and early 1900's. Farm management practices where streams were diverted to create tillable land were embraced up into the 1970's. Because of the widespread occurrence and lack of written records, channel modifications are difficult to locate. Most of the information has been either lost or is very difficult to find. One area the author was able to find records was Willamina's splash damming history.

### **Splash Dams**

The earliest record of log drives on Willamina Creek was noted in the 1880 Census of Manufacturers. During the 1880s, it was reported that "(William E.) Talbot and (David M.) Cave's sawmill received logs on the Willamina River."<sup>13</sup> During the spring of 1901 the Sheridan Sun newspaper described the opening of the Jack and Timberlake Sawmill in Willamina "...which obtained its logs with the use of a splash dam on East Creek (RM 8.8, Willamina Creek)" (Moser, et. al. 1981). From the mouth of East Creek the logs were floated down Willamina Creek to the mill.

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<sup>13</sup> Yamhill River Navigability Study, Moser S.A. and Farnell J. E., Division of State Lands March 1981

During 1907 logs were floated down Willamina Creek by the Beaver State Lumber Company a “distance of about seven miles”, and the high waters of 1908 brought “...sawlogs down to Palmer sawmill in Willamina” (Moser, et. al. 1981). In 1912, Joseph and John Brown cut and peeled 1,140,000 feet of fir logs of 10 to 60 inches in diameter and 12 to 32 foot lengths and put them in the creek as far up as River Mile 13.5.

With the increasing construction of railroads in the Willamette Valley extensive railroad tie drives occurred on Willamina Creek during 1912-1914. Grant U. March worked with the operation of the H. H. Parker sawmill located near the mouth of East Creek where the Willamina was used as a log pond. During the spring of 1913, more than 4,000 ties were sent down the creek from this mill to Willamina. Additional ties (1,700) were sent down from the Harry Blackwell farm just below the Parker sawmill during the same month. During the late spring and early summer of 1914, 800 more ties 6”x9”x 8’ long were also put in Willamina Creek by Grant U. March and the Peterson Brothers (Moser, et. al. 1981).

Willamina Creek is thought to have sustained the most splash damming and log runs of the South Yamhill Watershed (Moser, et. al. 1981). From 1879 to 1914, Willamina Creek carried enough logs to “constitute a highway for commerce and give the State a basis to claim its bed from the mouth to East Creek at River Mile 8.8” (Moser, et. al. 1981).

## **Current Channel Modifications**

The present day occurrence of large-scale institutional modifications is not common in Willamina watershed. There is a relative absence of dikes, levees, dams, or channel dredging. This is most likely due to current types of land use and lack of heavy industry along the stream. The most common channel modifications found today are culverts placed at road crossings, and the effects from upslope land management activities such as road construction.

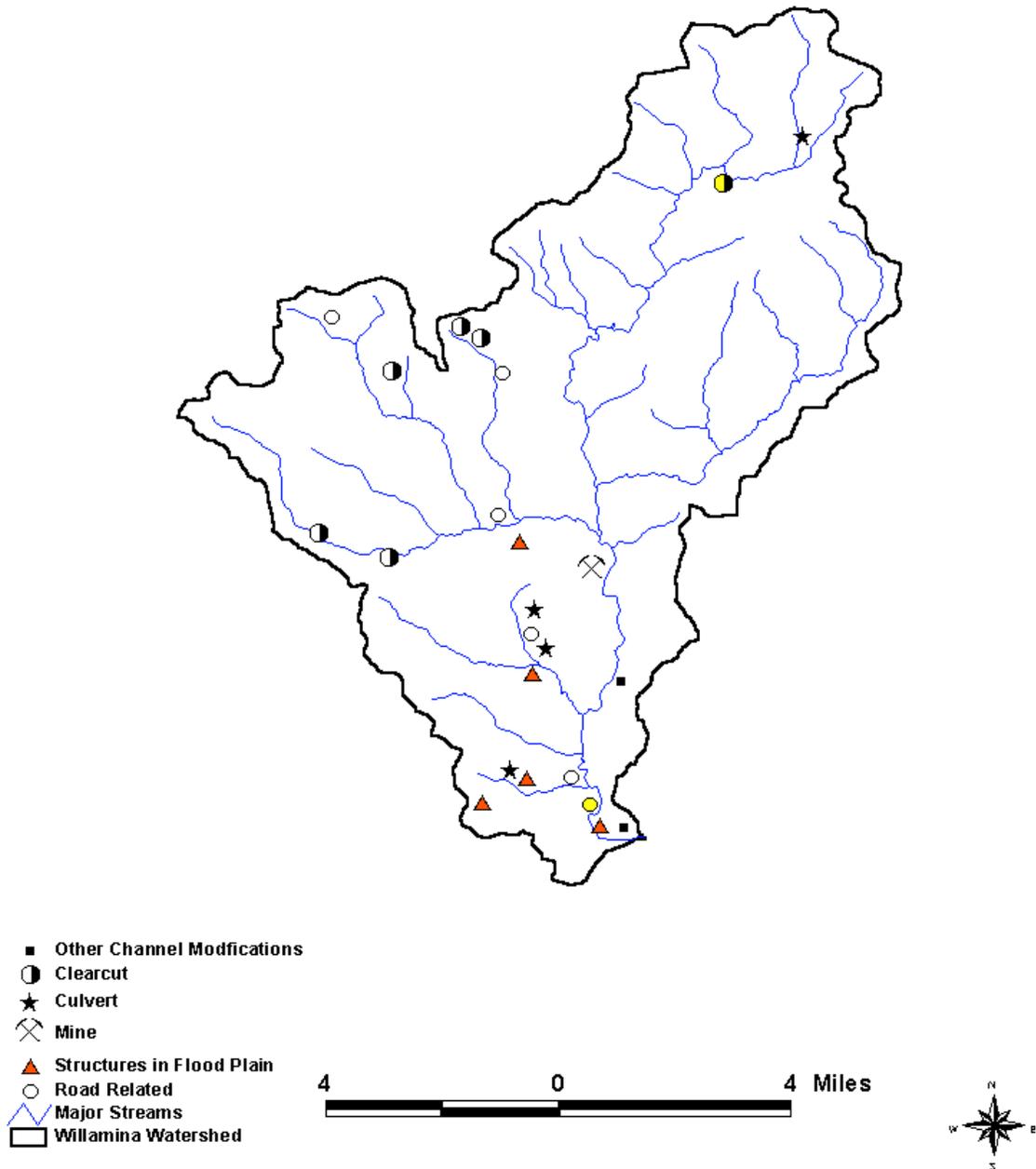
There are innumerable modifications associated with small landowners including rip-rapping, driveway culverts, ditch diversions, and riparian zone vegetation clearing. While these small-scale modifications are important in regards to an overall watershed assessment, they are very difficult to locate and quantify. This is due in part to the lack of public records kept for small-scale modifications.

Generally, the primary and most prohibitive channel modifications are road culverts and bridge pilings. While Joel Siderius estimated that there may be a couple of hundred channel modifications, only the ones that could be physically or verbally verified were included in this report. Figure 12 records the locations of the field verified channel modifications. Table 8 records the types of these modifications, the corresponding map identification number and how they were verified.

**Table 8. Channel Modifications for Willamina Watershed**

Willamina Channel Modifications.		
Map ID #	Type of Modification	Verification
1	Structures encroaching along a Channel	Aerial Photo 1994 H14
2	Un-naturally straight stream section	Topographical Maps
3	Heavily Eroded Area from Structure Construction	Aerial Photo 1994 H14
4	Possible Modification Site (data gap)	Aerial Photo 1994 H14
5	Structures Close to Stream	Aerial Photo 1994 H14
6	Structures and Unimproved Road Close to Channel	Aerial Photo G12
7	Heavily Logged Area with Minimal Riparian Zone	Aerial Photo G11
8	Clear-cut and Eroded Area adjacent to channel	Aerial Photo G11
9	Clear-cut Next to stream	Aerial Photo F12
10	Clear-cut Next to stream	Aerial Photo F12
11	Clear-cut all both sides of Channel	Aerial Photo F11
12	Area of recent road building (data gap)	Aerial Photo F10, topo
13	Inactive Mine	Personal correspondence
14	Two large slabs of concrete in flow of channel	Field Research
15	Cows in Stream, steep and eroding channel banks	Field Research
16	Fences to stream bank, improperly sized culvert (small)	Field Research
17	improperly sized culvert (small)	Field Research
18	Old Bridge pilings not removed from water	Field Research
19	Road bed slumping into active channel	Field Research
20	Culverts	Field Verification
21	Culverts	Field Verification
22	Rip Rap, road bank reinforcing, large scale	Field Verification
23	Road Slide into active channel	Field Research
24	Clear Cut on steep slopes, little riparian buffer.	Field Research
25	Instream Culvert, inhibiting flow.	Field Research
26	Clear-cut	Field Research

# Figure 12. Channel Modifications



## **Additional Questions and Concerns**

Note that much of the watershed was inaccessible for field verification of channel modifications, and aerial maps are limited in their ability depict small-scale modifications. Sources for additional information on modifications are: ODFW stream and habitat surveys (conducted in the 1950s, 60s and 70s), private industrial land owners records, county records of rip rap placements, culvert placements and sizes from ODOT and county records.

## **References:**

Siderius, Joel. 1998. Linfield College Student Intern. *Channel Modifications Team*.

USDA Farm Service Agency. 1994. *1:660 ft. Aerial photographs*. McMinnville OR Field Office.

U.S. Geological Survey topographic maps (Niagara Creek, Springer Mountain, Stony Mountain, Sheridan, Grand Ronde, OR, 1:24,000, 7.5-minute quadrangle, 1970 photorevised 1975 and 1969, photorevised 1986).

## **2.7 Hydrology and Water Use**

### **Methodology - Hydrology**

The natural hydrologic cycle is the driving force behind a watershed ecosystem. The amount of precipitation and the rates of infiltration and evapotranspiration primarily dictate both the quantity and the time of year that water is available in the watershed. Human land use activities can alter the hydrologic cycle and influence the water budget. The primary land use activities that impact hydrology are urbanization, rangeland, forestry, and agriculture. The OWAM protocol dictates that when hydrologic data like flow and precipitation are available for a watershed, that it be included in an overall watershed assessment.

Willamina hydrological data was analyzed using the 1999 draft of the OWAM. The manual uses a series of steps to determine the peak flow characteristics of the watershed. Evaluations are then completed for four separate groups of land uses and activities that potentially affect peak flows. They are forestry, agriculture and rangeland, forest and rural roads and urban and/or rural residential development.

Time constraints and the limited availability of information dictated that some parts of the hydrology/water-use sections were not covered. Below is a list of areas (using the OWAM) that were and were not covered.

### **Covered:**

- Peak flow assessment.
- Low flow assessment.
- Forestry Worksheet – Using BLM forestry data, estimates of crown closure were not available.
- BLM road density data from watershed analysis (BLM, 1998).

### **Not Covered:**

- From OWAM agriculture and rangeland worksheet (H-5). Not enough time to accurately complete, crop information difficult to obtain. Requires extensive fieldwork to assure accuracy.
- From OWAM forest and rural road worksheet (H-6). Urban and residential area worksheet.

Confidence in this assessment would have to be ranked as moderate to low. The analysis of peak and low flow information was conducted with a high degree of confidence. However analyzing the land use impacts requires additional time and information gathering.

## Floods

Streamflow records at the Willamina Creek U.S. Geological Survey gaging station were the principal source of data to document past floods. The Willamina gaging station recorded discharge values beginning June 1<sup>st</sup> 1934, and continued until it was decommissioned on September 30, 1995. Following 1995, the OWRD took over operation of the gage and continues to collect flow data for the gage. However at the time of this assessment the data since 1995 had not been processed. The largest of the floods in the Willamina watershed was estimated to have occurred in 1996. Flows measured during that event on the south Yamhill were the highest levels ever recorded, however no recorded values for Willamina Creek exist due to the gaging stations closure.

The 1974 Army Corp. of Engineers publication Flood Plain Information for the South Yamhill River reported 5 major floods prior to 1996 for which stream flows were recorded (Table 9). The largest of these floods was recorded in 1964 and caused “extensive flooding in the area” (UACE, 1974). The highest recorded flow rate was 7980 cubic feet per second (cfs) on December 22<sup>nd</sup>, 1964. There have been numerous other large floods in Yamhill River Watershed, occurring in 1861, 1931, 1949, 1960, 1962, and 1965.

**Table 9. Floods in the South Yamhill Watershed**

Date of Crest*
23-Dec-64
21-Jan-72
16-Jan-74
22-Dec-55
16-Nov-73

\* Data collected on South Yamhill River near Whiteson, Oregon. (Period of Records 1940-1974)

## Stream Flow

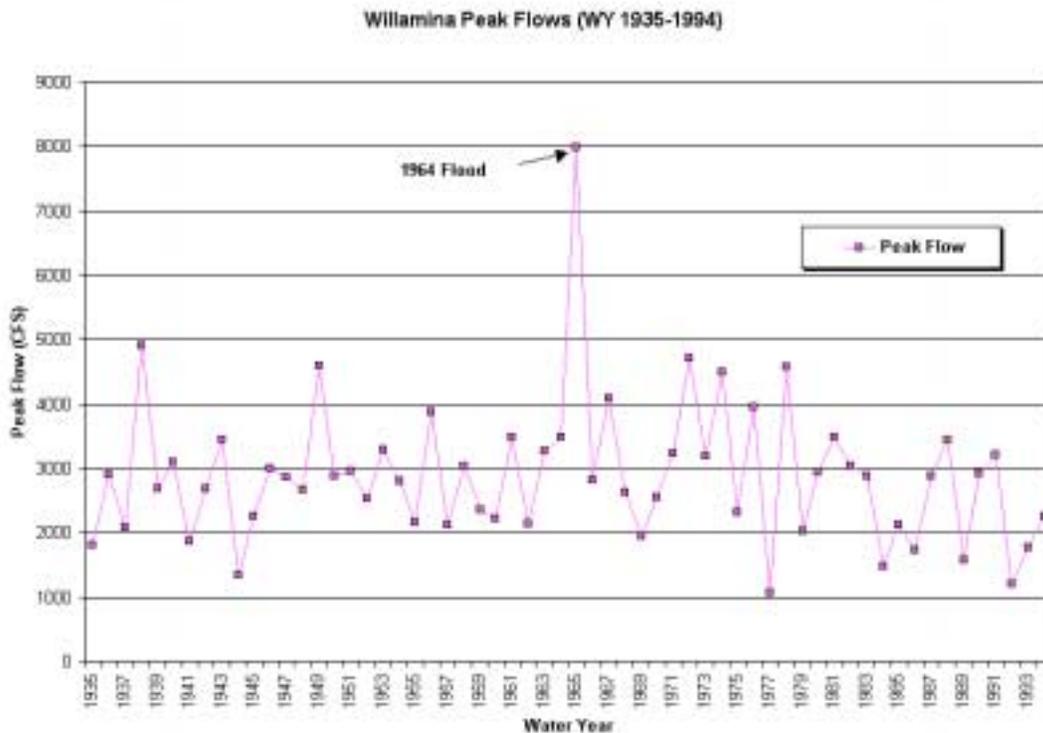
Flow data was collected on Willamina Creek at the gaging station (gage # 14193000<sup>14</sup>) located at RM 6.2, elevation ~350 feet above sea level (WRD, 1999). (See Figure 6) This gage measures flow for an estimated 63 square miles including the three upper sub-basins, (Upper Willamina, Coast and East Creek), there are no known dams or reservoirs in the Willamina watershed with the exception of the log ponds located near the town of Willamina. These log ponds, while still located on water maps of the area, are no longer in use, having been drained years ago.

Gage data was analyzed to determine the years and magnitude of peak flows in the Willamina watershed (Figure 13). Peak flows are defined here as the maximum daily flow (cfs) per water year, for data recorded between 1935-1995. Note that data was not available for the 1996 flood.

<sup>14</sup> Willamina flow data from Water Resources Website: ([http://www.wrd.state.or.us/cgi-bin/choose\\_gage.pl?huc=17090008](http://www.wrd.state.or.us/cgi-bin/choose_gage.pl?huc=17090008))

Peak flows were then analyzed for recurrence intervals using a Log Pearson Type III analysis. The return periods for the 1996 (estimated) and 1964 (WY 1965) flood are estimated to be 100+ year events. The average annual peak flow for the Willamina gaging station was determined to be 2715 cfs. Figure 14 shows the actual and Pearson's predicted flows for the Willamina gage station with the return intervals along the horizontal axis.

**Figure 13. Willamina Peak Annual Peak Flows.**



## Low Flow

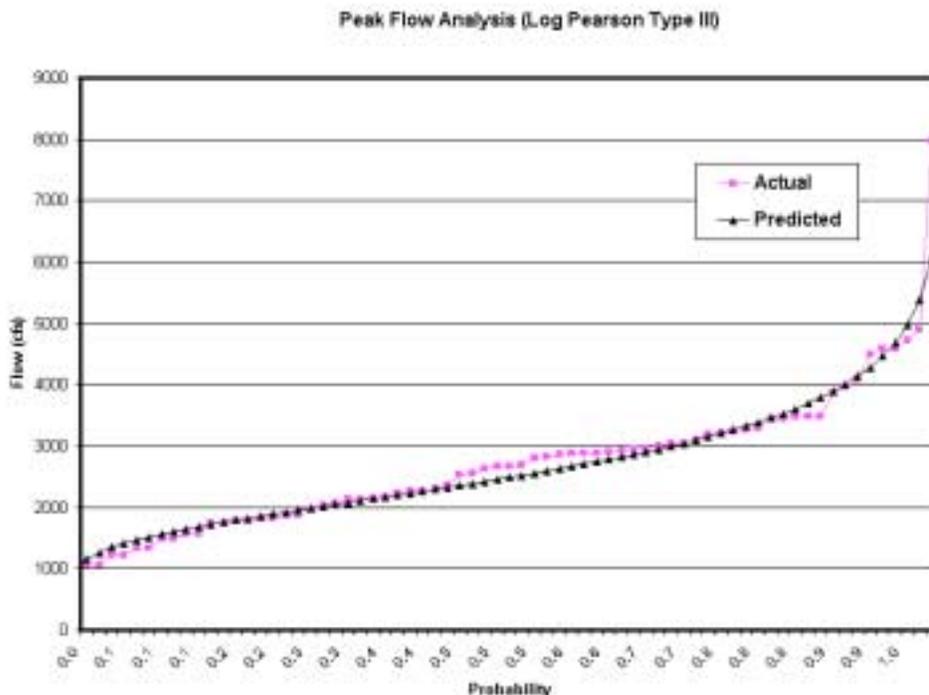
A lack of sufficient stream flow to dilute pollutants and to support aquatic life is a problem throughout the state of Oregon. Low summer flows combined with high demand (primarily irrigation) result in significant water supply problems, for both instream and out-of-stream uses, in the Yamhill drainage (WRD, 1992). Willamina flow data was analyzed to characterize both the time of year when low flows are most likely to occur and the magnitude of Willamina's low flows. Nick Varnum<sup>15</sup> conducted both the analysis of low flows using the Log Pearson Type III analysis and authored the preceding text.

Low flow characteristics of a stream have important implications for water quality parameters. Water quality parameters that can be significantly affected by low flow conditions include temperature and contaminant concentrations. Temperatures tend to increase during low flow conditions and temperature has an effect on all aspects of water quality. For example, the

<sup>15</sup> Nick Varnum, watershed assessment volunteer, is a resident of Yamhill County and a watershed professional with the private firm PNG Environmental in Tigard OR.

concentrations of dissolved gases in water generally decrease with increases in ambient temperature. Therefore, higher aquatic organisms must compete with plants and algae for available oxygen. Streamflow during periods of low flow is almost entirely derived from local groundwater. Contaminants present in groundwater or introduced by point source discharges are subject to much less dilution during low flow conditions.

**Figure 14. Willamina Peak Flow Analysis**



### Low Flow Analysis

Low flow analysis for Willimina Creek was conducted by examining the stream gage record available from the USGS. Streamflow data was collected on Willimina Creek for the period 1934 to 1995. Examination of the record provides a qualitative evaluation for the time of year that low flows are present. A second method for evaluating low flow was to determine the frequency distribution for low flow. This method determines the lowest average 7-day flow for each calendar year. A Pearson Type III distribution was used to determine the 10-year probability of recurrence of the flow. This type of analysis is termed a 7Q10 flow and, among other uses, is used by regulatory agencies for managing water quality receiving waters.

### Low Flow Results

The lowest 7-day average for each year of records (Table 10) shows that low flows range from 9 to 21 feet per second (cfs) with a mean flow of 13 cfs. A Pearson Type III distribution of low flows (Figure 17) shows that predicted 10-year recurrence flow (7Q10) is approximately 17 cfs. Comparing the 7Q10 flow to the daily period of record shows that this flows of 17 cfs, or lower, occur approximately 12 percent of the time. A plot of the daily discharges for Willimina Creek (Figure 15) shows that lowest flows generally occur from late August to early October.

Figure 15. Dates of Low flow for Willamina Gaging Station

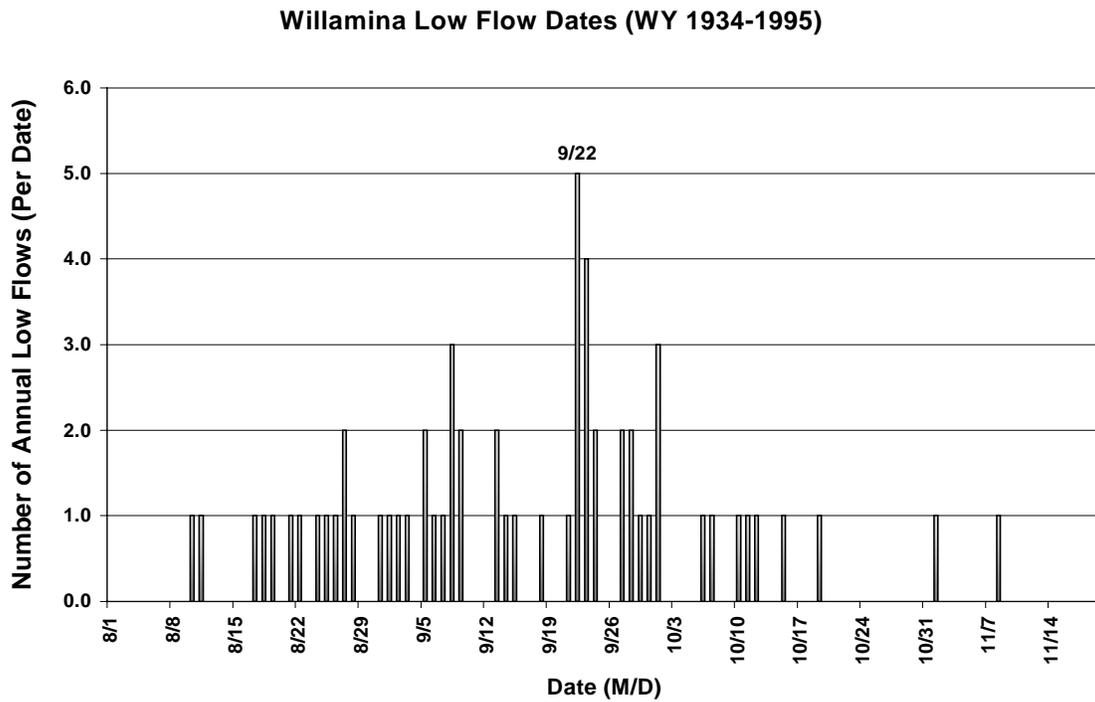
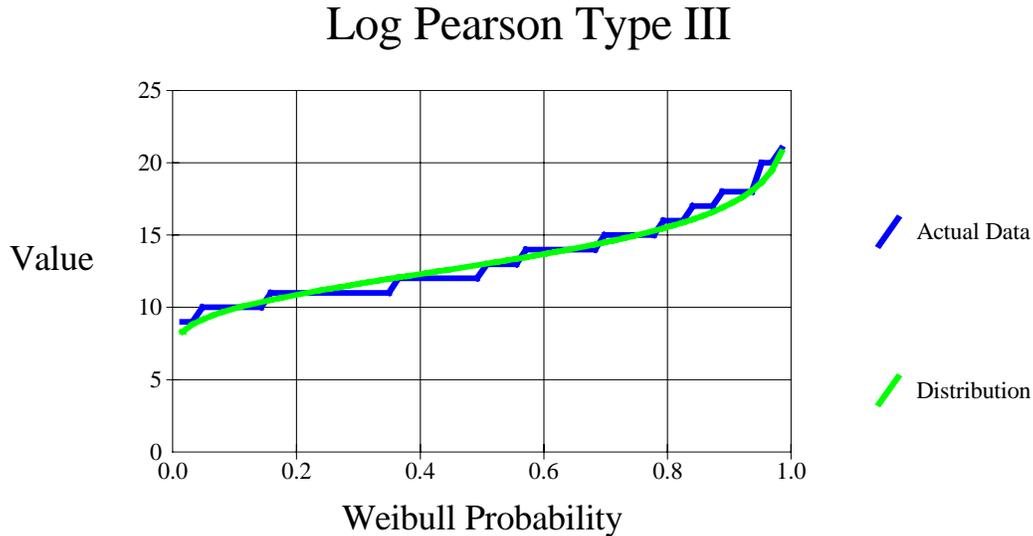


Table 10. Willamina Seven-Day Average Low Flows

Year	7-day Flow						
1934	10	1950	15	1966	12	1982	14
1935	10	1951	11	1967	11	1983	20
1936	13	1953	10	1968	20	1984	18
1937	16	1953	18	1969	11	1985	15
1938	10	1954	21	1970	12	1986	11
1939	9	1955	15	1971	14	1987	10
1940	10	1956	12	1972	11	1988	11
1941	11	1957	14	1973	11	1989	10
1942	12	1958	12	1974	14	1990	16
1943	14	1959	18	1975	12	1991	11
1944	11	1960	14	1976	11	1992	11
1945	14	1961	13	1977	9	1993	15
1946	12	1962	15	1978	17	1994	13
1947	17	1963	18	1979	13	1995	12
1948	15	1964	14	1980	12		
1949	17	1965	11	1981	16		

Figure 16. Willamina Low Flow Analysis, Log Pearson Type III



## Land Use and Hydrology

Land use activities that have a potential to influence the hydrology of the Willamina watershed was analyzed the OWAM. Information was available with regards to forestry practices and urban and rural road conditions for the land use screening. Some information was available for rangeland, agriculture and rural residential development. Further data and field verification is required to complete the land use impacts on peak flows in the Willamina watershed.

Risk from forestry practices in the Willamina watershed on peak flow is unknown. Some of the information that the OWAM required was available for the determination of forestry impacts. This information included historical crown cover as BLM historical stand-age maps and current crown cover in the form of BLM age class distributions (BLM, 1998). The coast range is generally considered to be an area where rain-on-snow events are infrequent in occurrence but have contributed to some of the major flooding including the 1964 and 1996 flood events. More land use analysis is required to understand the impacts caused by forest management practices. Therefore the “unknown” designation was used to encourage further research and field verification.

An assessment of agricultural and rangeland impacts was not possible due to limited time and data constraints. The potential for agricultural impacts is probably highest in the Lower Willamina sub-basin as more than 50% of the land use is designated agricultural. Urban and residential land use impacts were analyzed using known and estimated road densities. A moderate risk was assigned to the Willamina watershed and a high risk was assigned to the area near and in the town of Willamina.

## Water Rights and Use

Under Oregon State law all water is publicly owned. With some exceptions, cities, farmers, factory owners and other users may obtain a permit or water right from the Water Resources Department. Landowners that have water flowing by, through or under their property do not have the right to use that water without a permit from the state (WRD, 1997).

There are a total of 145 current surface water rights permits in the Willamina watershed. The bulk of Willamina's water rights are for irrigation and municipal uses, which can have a significant effect on flows during the summer. The town of Willamina holds municipal rights for water in the watershed. Table 11 summarizes the quantity in cfs and percentage of the total for each type of permit in the Willamina watershed (WRD, 1999).

<b>Type</b>	<b>(cfs)/% of total</b>
<b>Irrigation</b>	<b>13.23/45%</b>
<b>Fish/Wildlife</b>	<b>0.23/0.8%</b>
<b>Municipal</b>	<b>13.22/45%</b>
<b>Domestic</b>	<b>0.76/2.6%</b>
<b>Agriculture</b>	<b>0.04/0.1%</b>
<b>Industrial</b>	<b>1.52/5.2%</b>
<b>Miscellaneous</b>	<b>0.11/1.3%</b>
<b>Total Flow</b>	<b>29.11</b>

Table 12 shows water availability after the water balance has been calculated for all instream and surface water rights. Instream water rights were issued to ODFW for the purpose of supporting aquatic life in Oregon. During the months of June through October when no water is available, the quantity of water rights often exceeds the actual flow. For example, during the month of September, instream and other surface water rights require a total of 52.3 cfs in Willamina Creek while the actual average discharge is only 14 cfs. This can cause a considerable problem if all water permit holders exercise their rights at the same time. Note that some of the water that is withdrawn from the system does return to the stream by runoff and underground flows. This type of flow, while being very difficult to measure, should still be considered in calculating a total water budget for a watershed.

**Table 12. Willamina Basin Water Availability**

<b>Month</b>	<b>Jan</b>	<b>Feb</b>	<b>Mar</b>	<b>Apr</b>	<b>May</b>	<b>Jun</b>	<b>July</b>	<b>Aug</b>	<b>Sep</b>	<b>Oct</b>	<b>Nov</b>	<b>Dec</b>
<b>Water Available?</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>No</b>	<b>No</b>	<b>No</b>	<b>No</b>	<b>No</b>	<b>No</b>	<b>Yes</b>

*Exceedence level = 80*

### **References and Resources:**

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## **2.8 Willamina Water Quality**

### **Introduction**

The purpose of the water quality assessment for the Willamina watershed is to review any water quality data available for Willamina watershed and report any limitations or areas of concern. The physical and chemical condition of the water in a watershed has important influences on both habitats for maintaining aquatic life and for human uses of the water. The water quality assessment section of the OWAM addresses water quality issues that were not included in other parts of the manual: temperature dissolved oxygen, pH, nutrients, bacteria, chemical contaminants and turbidity.

### **Methodology**

The 1999 draft of the OWAM uses a five-step approach for collecting and analyzing water quality data. The first step is the identification of the beneficial uses for the watershed. The next step is to identify the water quality criteria for the Willamina watershed. The next step is to assemble all of the existing data regarding water quality for the watershed. This includes 303(d) listings of water quality limited streams and water quality data that may have been collected for the watershed. The final steps are to evaluate the data for selected parameters and then draw conclusions from that data.

### **Covered:**

- Analysis of water quality data from EPA/DEQ.
- Analysis of water quality publications from USGS reports.
- DEQ, County, EPA, and local resident interviews regarding water quality.

### **Not Covered:**

- Field sampling of water quality parameters.
- Ground water or well water information (difficult to obtain).
- Willamina synthetic, and organic chemical information (not available).
- Stream and river sediment sampling (data not available).

## Willamina’s Beneficial Uses

Oregon’s Department of Environmental Quality (DEQ) is the state agency responsible for protecting Oregon’s public water for a wide range of beneficial uses. DEQ has established the following list of beneficial water uses for Willamina watershed. “Numerical and narrative water quality criteria found in the Willamette basin water quality standards are benchmarks used to determine if water quality “supports” a use such as irrigation, drinking water supplies, or cold water aquatic life (e.g. salmon).”<sup>16</sup> Beneficial uses are determined on a watershed by watershed basis. The Willamina watershed is considered a part of the Willamette basin for which the list was compiled (Table 13). It should be noted that some designations such as hydropower are not necessarily applicable to the actual local uses. The most sensitive of the beneficial uses for the Willamina watershed are for public water supply and salmonid fish.

**Table 13: Willamina Beneficial Uses:**

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

## Water Quality Limitations: Fecal Coliform

DEQ has listed Willamina watershed on the 303(d)<sup>17</sup> list for exceeding the fecal coliform standard. Fecal coliforms are the bacterial organisms that indicate when feces are present in the water and warn us of possible pathogenic health hazards. Table 14 describes the basic information for that listing. Water quality data exists for both Willamina and East Creek but not for the Coast Creek sub-basin and its many tributaries.

**Table 14: Water Quality Concerns**

Location	Parameter	Criteria	Seasons Listed	Basis for Listing	Supporting Data
Willamina Creek, mouth to above East Creek RM 10	Bacteria, fecal	Water Contact Recreation	Fall, Winter, Spring	DEQ Data, (DEQ 1994) observation: “Severe”	4 of 16 samples exceeded max. fecal

Currently the DEQ protocol for listing a water body states that only that water-body sampled and found in exceedence will be recorded on the 303d list. Therefore only Willamina Creek was listed for fecal coliform from the mouth (RM 0) to above East Creek (RM 10). DEQ assumes that above

<sup>16</sup> Dennis Ades, DEQ, personal communication, May 1999.

<sup>17</sup> The 303(d) list is a list of water quality limited streams in the state of Oregon.

RM 10 there are not human sources of fecal contamination (considered the primary source) and thus considers the levels above RM 10 to be the background or natural concentrations<sup>18</sup> (See Figure 17).

Currently the DEQ has decided to change its fecal indicator from the bacterial group of fecal coliforms to a subset of that group known as *Escherichia coli* (*E. coli*). The change is meant to more accurately measure the presence of human fecal contributions to the state's waters. The total maximum daily load (TMDL) process scheduled for the Yamhill watershed in 2007 may require assessments done of tributaries and perhaps even bacterial load limits in the Willamina watershed.<sup>19</sup> Monitoring and restoration plans should adjust efforts accordingly.

Fecal coliform data collected by the Environmental Protection Agency (EPA) and DEQ from the 1970's until 1998. This data was used to determine Willamina's listing on the 303d list for fecal coliforms. Values ranged from 9 colony-forming units (cfu) per 100 ml on 02/10/87 to 45,000-cfu/100 ml on 5/10/72. The Oregon Water Quality standard for fecal coliforms is not to exceed 200-cfu/100 ml as a monthly geometric mean and 400-cfu/100 ml as a weekly mean.

## **Fecal Sources**

In order to assess the potential sources for the fecal pollution problem in Willamina Creek several local resources were surveyed. Conversations with local residents at the Willamina watershed community meeting<sup>20</sup> revealed that while there were relatively low numbers of livestock in the Willamina watershed, there were some streamside grazing and animal pens. The potential therefore exists for fecal pollution from livestock waste runoff into the Willamina system.

A phone conversation with the Yamhill County Santarian, who is responsible for septic system inspections and complaints, estimated that a high percentage of the systems located in NW of Willamina<sup>21</sup> had the potential to fail due to the age of the systems and the prevailing soil types in the area. Additionally, septic systems installed in this area (and Yamhill County) before 1974, are not under county permit and have the potential to fail due to miscalculations of design and drain field placement.

The Yamhill County Santarian also mentioned that the East Street wastewater pump station had failed in the past during high flows causing wastewater to be released into Willamina Creek. This is one of several problems being addressed during the summer of 1999 in Willamina's Phase I upgrades (See Restoration Efforts section for information on Phase I).

## **Temperature**

The DEQ maximum temperature standard for streams is 64<sup>0</sup> F. Growth and reproduction are adversely affected when water temperatures range outside an optimum range to which the native species are adapted. Willamina has an endangered species of cold-water fish spawning in the watershed (winter Steelhead). The Steelhead spawn during the winter months and may spawn more than once during that time. The Coho salmon, also thought to be present in the watershed,

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<sup>18</sup> DEQ Oregon's 1998 Section 303d Decision Matrix, Stream Segment 22J-Will-10.

<sup>19</sup> Dennis Ades, DEQ, personal communication, May 1999.

<sup>20</sup> Willamina Community Meeting held in Willamina on March 30, 1999.

<sup>21</sup> Township 5S, Range 7W, Sections 26,27,34,35. Tenbush Lane area.

generally spawn in the late fall and winter and tend to live in pools during the summer. During those times of spawning, the stream temperature is not to exceed 55 °F in the Willamina watershed. During the rest of the year the 64° F temperature standard applies.

Recent summertime temperature data collected by the BLM in the Willamina watershed indicates that sections of the watershed may be listed for begin water quality limited for temperature. Data recorded in Willamina Creek showed summertime temperatures as high as 72.5°F with seven-day averages<sup>22</sup> of 69.6°F. This seven-day average is of concern since it exceeds the standard by more than 5 degrees. (Leoni, 1999)

Additional data recorded in ODFW stream and habitat surveys is available dating back to the 1950s (Tables 15, 16). This temperature information can prove valuable for comparative studies as well as in DEQ's Total Maximum Daily Load (TMDL) calculations scheduled to be conducted in 2007 for the Willamina watershed. Note that these values are instantaneous measurements and should be used with caution, as present day protocol requires us to collect seven-day rolling average high temperatures for comparison with the standard.

**Table 15. Miscellaneous Temperature Data for Willamina Creek (1953-59)**

River Mile	Location	Date	Time	Temperature <sup>0</sup> F	
				Water	Air
0	Mouth	4/7/1959	1:00 PM	48	62
3.5	Tindle Creek Bridge	"	12:00 PM	46	60
7.2	Just above East Fork	"	10:25 AM	46	58
9		4/16/1959	10:00 AM	44	56
7.2	Just above East Fork	7/30/1953	3:00 PM	58	71
1.5	First bridge above Willamina	8/6/1954	3:30 AM	58	N/A

**Table 16. Miscellaneous Temperature Data for creeks in Coast Sub-basin**

Stream	River Mile	Location	Date	Time	Temperature F <sup>0</sup>	
					Water	Air
Coast Cr.	0	At the mouth	4/15/1959	5:40 PM	49	52
	3.1		"	3:30 AM	49	52
	8.1	At Lonzo Cr.	9/9/1958	10:45 AM	58	76
Gilbert Cr.	0	At the mouth	4/15/1959	5:30 PM	50	56
	2.2		"	4:30 PM	48	54
Canada Cr.	0	At the mouth	9/22/1959	5:15 PM	55	60
	4.5	Below forks	"	4:05 PM	55	60
Burton Cr.	1.2		9/10/1958	10:45 AM	56	60
	2.4	At 26 foot falls	"	11:40 AM	56	58

## Nutrients

Elevated levels of nutrients such as phosphorous and nitrates can cause algae and aquatic plant growth to become a problem and even be lethal in watershed ecosystems. This excessive botanical growth in water body can cause other parameters such as the dissolved oxygen levels to drop significantly creating prohibitive conditions for aquatic animal life. Phosphorous and nitrates can enter the water from a variety of both human and natural sources. Generally elevated levels are

<sup>22</sup> Seven day moving averages of the daily maximum temperature as defined by DEQ.

assumed to be from human sources such as fertilizers used on farms and in urban lawn maintenance.

Willamina Creek has been approved for point source discharge of phosphorous from its mouth to the headwaters. A Total Maximum Daily Load (TMDL) was established for the creek (and the Yamhill watershed) by DEQ on 12/8/92. Phosphorous data collected in Willamina Creek showed 9% (1 of 11) of the samples taken exceeded the TMDL standard of 70 ug/l with a maximum of 200 ug/l between 1986-1988. Data was gathered at RM 0.5 near the town of Willamina. Water quality data used for this assessment can be obtained from DEQ, Salem.

## **Dissolved Oxygen**

Minimum concentrations of dissolved oxygen (DO) are essential to support aquatic life and particularly for salmonid species of the Pacific Northwest. The water quality standards for Oregon contain a number of different criteria for dissolved oxygen. For the purposes of the screening level assessment, the evaluation criterion is set at a minimum of 6.5 mg/l. Data recorded by DEQ and EPA between 1970-88 showed DO values ranging from 8.5 mg/l to 12.7 mg/l all above the screening level assessed minimum value. Specific DO data can be obtained from DEQ, Salem.

## **pH**

The hydrogen ion concentration of water is measured in pH. Acidic pH values are considered those below 7.0 and alkaline (basic) for those greater than 7.0; 7.0 is considered neutral. Water pH is an important indicator of the chemical forms and availability of nutrients, as well as the presence of toxic chemicals in the system. Oregon Water Quality standards generally specify the approved pH range for west side watersheds as 6.5 to 8.5 pH. Data collected by the EPA and DEQ between 1970-88 shows values ranging from 6.9 to 7.8, which fall within the approved range. pH values for Willamina can be obtained at DEQ.

## **Turbidity/ Suspended Solids**

Turbidity is a measurement of the clarity of water. Turbidity is measured by recording the amount of light that passes through a water sample. Generally high values for turbidity (> 50 NTU<sup>23</sup>) indicate excessive amounts of suspended in the system. These solids can affect aquatic life including fish in a variety of ways such as damaging their gills and/or reducing the ability to sight prey. Data recorded by DEQ and EPA between 1970-74 showed turbidity levels ranging from 2.0 to 45.0 JTUs.<sup>24</sup> Additional data collected between 1986 – 1988 showed values ranging from 2.0 to 28.0 NTU (Hach FTU<sup>25</sup>) which fall within the approved range. Specific data can be obtained at DEQ.

## **Other Contaminants**

The use of synthetic chemicals such as pesticides, herbicides and other organic chemicals has increased in recent years in most of areas of the Willamette Valley (Wentz, et. al., 1998). These

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<sup>23</sup> Nephelometric turbidity unit

<sup>24</sup> JTu units are no longer used for measuring turbidity and there exists no feasible calibration method.

<sup>25</sup> Hach FTU units are considered directly equivalent to NTU units.

chemicals can be transported from the land surface to streams through a combination of subsurface drainage, surface runoff, and soil erosion. Infiltration of rain and irrigation water facilitate transport of chemicals to ground water (Wentz et. al., 1998). Synthetic chemicals such as these have the potential to cause damage to Willamina's water quality and aquatic animal species' health and reproduction.

The levels of land applications and instream/groundwater concentrations of synthetic chemicals in the Willamina watershed are not known at this time. Some streams measured in the Willamette basin during a USGS water quality study (Wentz, et. al., 1998) reported elevated levels of some pesticides in the stream sediments. Additionally pesticides such as Atrazine were reported highest "during spring following pesticide application, but relatively high concentrations also occurred during fall runoff" (Wentz et. al., 1998). More information regarding specific synthetic chemical use and instream concentrations is needed for the Willamina watershed.

Elevated levels of heavy metals such as mercury and lead have also been found concentrations in stream sediments receiving stormwater runoff from urbanized areas or areas with mining activities (Wentz et. al., 1998). With other parts of the Willamette Valley showing these elevated levels of heavy metal, more information should be collected regarding specific levels of sediment metals in the Willamina watershed.

## **Point Source Discharge**

DEQ regulates discharges to surface water through permits. Permits designed to protect water quality included water permits, storm water discharge permits, erosion control permits and oil spill contingency plans.

Data collected from DEQ's online Water Quality Facility Information System show two point source discharge permits in the Willamina watershed. Willamina Lumber Company holds two active permits for discharge into Willamina Creek. (Permits # 1215, permit type GEN12Z, application #992912 and # 100, permit type GEN0, application # 994260). The permits are for storm water and for heater cooling water discharge from the mill. For additional information regarding these permits, contact the stormwater-permitting department of the DEQ office in Salem.

## **Data Considerations and Limitations**

It should be noted to the reader that much of the water quality data mentioned in this section is the result of grab sampling a single event, which can only give us an idea of the quality of the water for that particular moment in time. Temperature, pH, dissolved oxygen and many of the other parameters change on an seasonal, daily and evenly hourly basis. Care should be taken to consider the time and date the data was collected in order not to misrepresent or marginalize a particular water's quality parameter. DEQ and the EPA both have adopted specific protocols for the water sampling and should be considered in any analysis or monitoring plans. This assessment reports the ranges of specific water quality parameters in an attempt to demonstrate the prevailing conditions found in the watershed.

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## **2.9 Sediment Sources**

### **Introduction**

Erosion of sediments can be a part of the natural processes in a watershed. Fish and the aquatic habitat have evolved to compensate for natural levels of sediments entering the system. The amount erosion can vary greatly depending on both the season and the weather. The occurrence of events such as landslides, debris flows, wildfires, and bank erosion caused by a stream meandering are all processes that are part of the natural system. All of these processes contribute to a background or natural level of sediments in the aquatic system.

The challenge is to determine what sediment load an aquatic system such as Willamina watershed is adapted to handle and what human-induced sediment loads are exceeding this level. Because both natural and human induced events are so highly variable it makes it difficult to discern between the two when determining prevalent conditions.

### **Methodology**

The OWAM uses several steps to assess the quantity and sources of sediments in a watershed. First, it focuses on collecting an inventory of the visible signs of erosion. This includes locating and mapping landslides, road washouts or areas of extensive gullying. The next step is to identify and map areas of situations for which erosion and movement of sediment into streams is likely to occur

in the near future. This includes housing developments, new storm drain outlets, clearcuts, specific agricultural crop rotations, new road construction, old road failures and undersized culverts. The third step is to summarize the collected information in way that allows us to identify the human-caused problems and prioritize them according to realistic remedies.

This work was completed by both John Randolph<sup>26</sup> and the author during the late winter and early spring of 1999. OWAM-referenced information that was and was not covered during the course of this assessment is listed below.

### **Covered:**

- ❑ ODF Peak Flow Map for OWAM protocol.
- ❑ BLM Landslide Inventory (data collected post 1996 flood on BLM lands).
- ❑ NRCS soil surveys.
- ❑ USGS Topographical maps.
- ❑ ODFW stream surveys, including bank conditions records used in the bank stability section.
- ❑ Conversations with county and state highway engineers to identify any known problem road sections. Information very limited for Willamina watershed.

### **Not Covered:**

- ❑ County, state, and private timber landslide inventories.
- ❑ Private and government locations of upland management practices that have potential to contribute sediments (i.e., clear-cuts).
- ❑ County records of roadwork that identifies problem road sections.
- ❑ Willamina-specific agricultural crop information to understand where potential sediment sources, and forest road hazard inventories from public or private sources.
- ❑ Willamina city stormwater maps, this information will be available next year.
- ❑ Locations of recent burns. Broadcast burns are used infrequently because of air quality concerns in the Oregon Coast Range. No recent wild fires were noted.

Confidence in the results from this section is low to moderate as field verification for a majority of the rural roads and land uses was limited during this assessment.

## **Willamina Sediment Sources**

### **Rural Road Runoff:**

To make an assessment of the amount and location of sediments contributed by road runoff many variables needed to be considered. The quality of surface rock, road maintenance and construction, ditch conditions, cut-slope conditions are some of the data gaps that were identified during assessment process. We examined topographic maps (as described in the OWAM) and recorded the density of roads and road segments in each sub-basin within 200 feet of a stream.

The amount of sediment contributed by road runoff is highly variable and difficult to measure. However it was noted on a field verification trip through the watershed that many of the rural county, state and federal roads in the upper elevations of the watershed were potentially contributing

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<sup>26</sup> Linfield College Intern.

large amounts of fine sediments to the stream system. Preferential flow paths were noted running adjacent to and transecting the numerous gravel roads of the Willamina, East and Coast Creek sub-basins. During peak flow events, the potential for fine sediments and other road materials to migrate to active channels in these flow paths was estimated to be high. Additional measurements and field verification is required to substantiate this observation.

Road densities are often used to estimate the amount of fine sediments contributed to stream systems. A density of greater than 5.0 miles/miles<sup>2</sup> is often used as the threshold of concern for potential fine sediments introduction problems (Novak, 1999). Road densities were estimated using county, BLM, private industrial and state road maps. Estimates were then calibrated for each sub-basin with BLM estimates (BLM, 1998) for total road coverage in Willamina watershed. Note that both East and Coast Creek's road densities are greater than 5.0 miles/square mile. Road densities for Willamina watershed averaged 5.0-miles/square mile for the four sub-basins. Table 17 reports the estimated road densities for each Willamina Sub-basin.

**Table 17 Willamina Watershed Road Densities.**

Sub-watershed	Total area (acres)	Sub watershed (Miles <sup>2</sup> )	Total Road (Miles)	Sub-watershed Road Density (Miles <sup>2</sup> )
East	9602.6	15.0	89.4	6.0
Upper	15083.8	23.6	109.9	4.7
Lower	13186.6	20.6	87.0	4.2
Coast	14351.0	22.4	114.7	5.1
<b>Totals:</b>	52224	81.6	401	<b>Average: 5.0</b>

Roads that are considered be a high risk potential for contributing sediments to stream systems are those with 200 feet of an active channel. Roads that are even a higher risk are those roads within 200 feet that are located on steep slopes (>50% slope). Stream segments in the watershed (>500 feet in length) were identified and total distances recorded.<sup>27</sup> Table 18 records the results of total sub-basin roads. Figure 17 shows locations of some of the high-risk roads in the watershed.

**Table 18 Percentage of High Risk Roads**

Sub-basin	<200' Active Channel	<200' & >50% slope
East	7%	3%
Upper Willamina	11%	6%
Lower Willamina	13%	<1%
Coast	11%	7%
<b>Average</b>	<b>11%</b>	<b>5%</b>

### Off Highway Vehicle Trails and Use

<sup>27</sup> Streams and roads were measured using blue line streams and roads from USGS 7.5 minute and county maps.

Another potential source of fine sediments entering Willamina's waterways would be from off road vehicle (OHV) use. The following information is provided by the BLM-Tillamook. The locations of OHV trails in the Willamina watershed are included in Figure 17.

### **Upper Nestucca OHV Trail Area**

OHV use in the area near the headwaters of the Nestucca River and Willamina Creek has been growing for some time. In May 1990, a Cooperative Management Agreement (CMA) was signed between the Bureau of Land Management and the Applegate Roughriders Motorcycle Club of Dallas, Oregon. This CMA was renewed in 1995. The purpose of the CMA is to provide an area of managed OHV use on BLM lands in the Bald Mountain-Bell Mountain vicinity within the Tillamook Resource Area. Under the CMA, the Club proposes trail locations and the BLM reviews them before they are built. Club members do the work of constructing, signing, and maintaining the trails, on locations and to standards approved by BLM, as volunteers under the auspices of an approved group volunteer agreement prepared from time to time.

The trail system currently consists of a total length of approximately 25 miles, with a number of short, interconnected segments. The trail system is open to motorcycles and small all-terrain vehicles, but closed to four-wheel-drive automotive use. Trails are routed so that vehicles never pass directly through streams or wet areas. Because of this, and due to the fact that the trails are located in the upper reaches of the watershed where surface water is rarely present, impacts to water quality resulting from use of the trails are considered to be negligible.<sup>28</sup>

### **Slope Instability**

Hill slope instability (unrelated to roads) was evaluated by collecting information about recent landslides (BLM Landslide inventory maps, 1997). Landslides, slumps and debris flows that occur near streams can cause chronic turbidity, which inhibits the breathing and impairs the prey sighting ability of fish. When an encroaching landslide constricts a stream, the stream carves away at the base causing further instability and continuous sediment introductions. Slope failures are naturally occurring disturbance events that are part of a healthy aquatic system. Human induced slope increase the frequency slope failures.

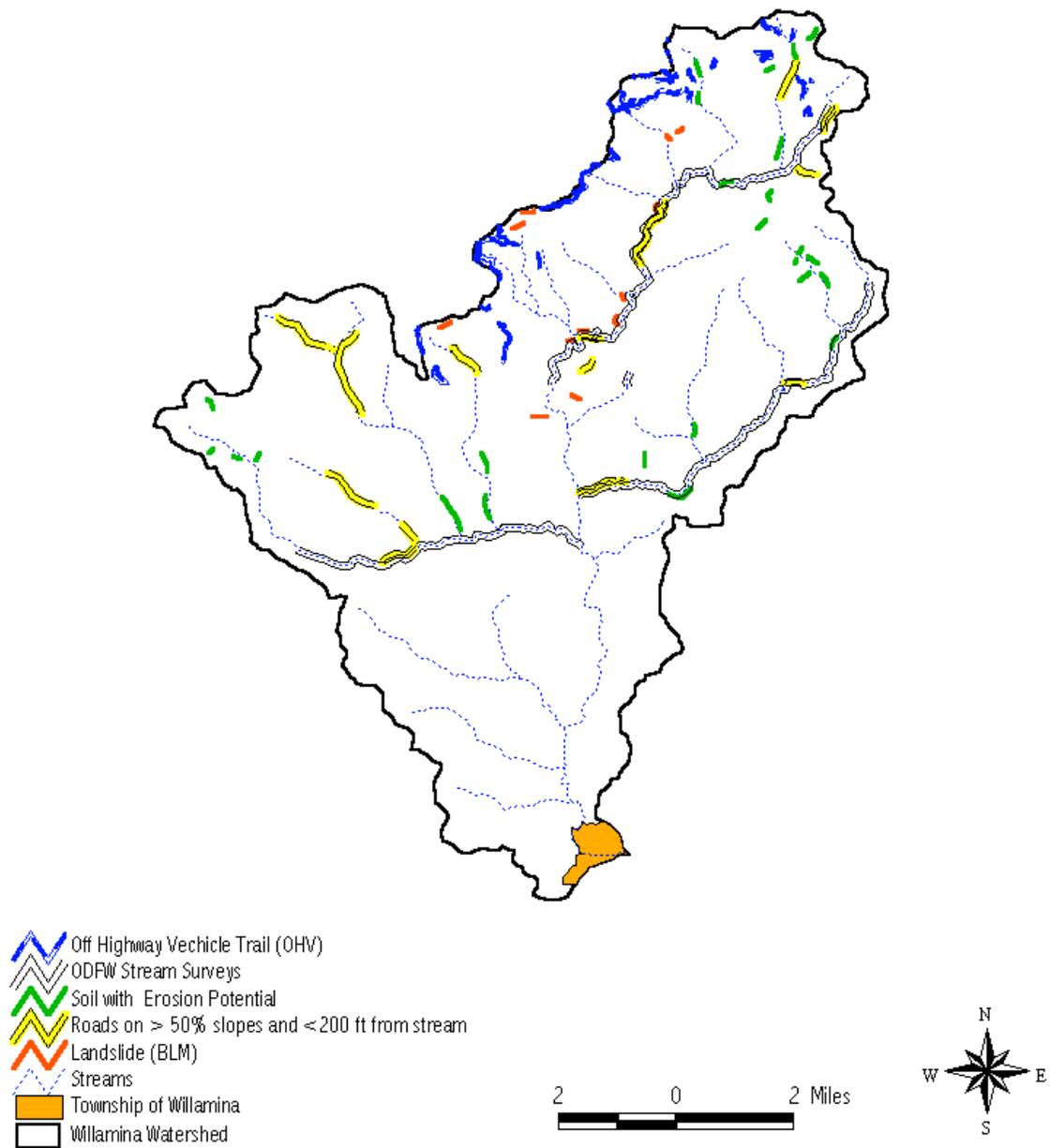
A majority of the landslides recorded by the BLM inventory were located in the Upper Willamina and Coast Creek sub-basins (Figure 17). A watershed analysis conducted by the BLM (1998) reported that 569 acres (1.1%) of the Willamina watershed were rated as "unstable" and an additional 240 (0.5%) as "potentially unstable". These numbers were formulated by using slope, geologic characteristics and sites of historical landslides. (BLM, 1998). According to the NRCS Soil survey (Yamhill County Soil Survey, USDA, 1974) most soil found in the Willamina watershed are rated as having a "low" to "moderate" erosion factor ("**K**").<sup>29</sup>

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<sup>28</sup> Information provided by Warren Tausch, BLM-Tillamook.

<sup>29</sup> K value is used in Universal Soil Loss Equation (USLE) to predict erosion potentials.

# Figure 17. Sediment Sources



## Streambank Erosion

Streambank erosion is likely to be a contributor of sediments to the Willamina system. However it is one of the most difficult to assess in terms of differentiating between natural and human induced causes. Land management activities that increase peak flows have the potential to cause channels to change course and increase stream bank erosion. Additionally land use activities such as instream livestock grazing can reduce streamside vegetation, causing bank instability.

Using the 1996 ODFW stream surveys of stream segments on Willamina, Coast and East Creek, Table 13 was constructed. Variability in the stream bank conditions can be used as an indicator of the potential impacts of upslope land management activities. Figure 18 shows the percentage of each bank stability class on Willamina Creek. Note the variability of the different classes in the different segments of Willamina Creek.

**Figure 18. Willamina Creek Variability in Stream Bank Conditions**

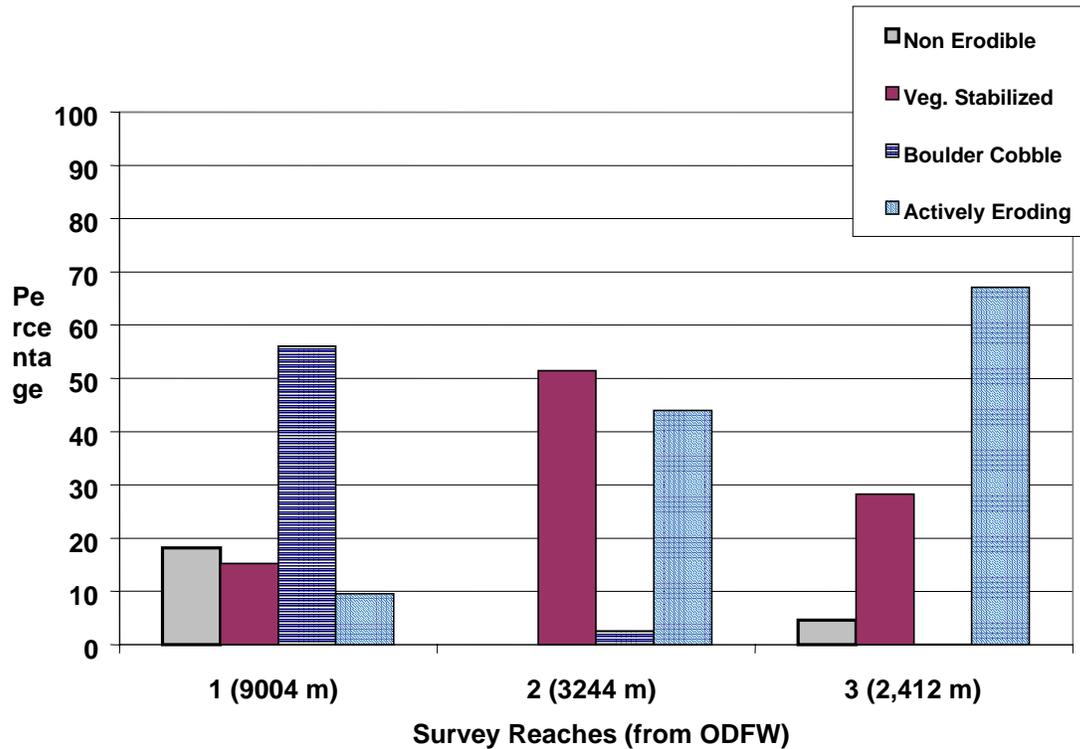


Table 19 shows the percentages of bank classes for each segment of the stream surveyed.

**Table 19. Bank Erosion Classes from ODFW Stream Surveys**

Stream Survey Erosion Class for Coast, Willamina and East Creeks.					
Creek Name	Stream Segment	Non_Erodible %	Vegetation Stabilized %	Actively Eroding %	Boulder Cobble %
Coast	1 (1,177m)	6.1	88.2	5.7	N/A
	2 (1,656m)	19.4	74.4	6.2	N/A
	3 (499m)	46.5	53.5	0	N/A
	4 (2,691m)	14.9	82	3.1	N/A
	5 (623m)	4.4	88.5	7.25	N/A
	6 (1,780m)	5	79.1	15.9	N/A
	7 (841m)	9.8	77.3	13	N/A
East	1 (2,256 m)	10	72.8	17.2	N/A
	2 (2,272 m)	2.9	70.7	26.4	N/A
	3 (1,641 m)	1.6	79.9	18.5	N/A
	4 (390 m)	3.9	63.65	32.5	N/A
	5 (4,560 m)	1.8	72.7	25.5	N/A
	6 (805 m)	13	44.7	42.3	N/A
Willamina	1 (9,004 m)	18.2	15.2	9.6	56.9
	2 ( 3,244 m)	0	53.4	44	2.6
	3 (2,412 m)	4.6	28.3	67.1	0

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## 2.10 Restoration Efforts

### Current Restoration work in the Willamina Watershed

In order to plan restoration and monitoring efforts for the Willamina watershed, it is important to understand where current and recently completed work is located. Figure 19 depicts some of the locations for road, riparian and instream restoration and protection work in the Willamina watershed.

The BLM is completing restoration work on a five-mile stretch of Willamina Creek located in the Upper Willamina Creek sub-basin (Figure 20.) The treatments include (1) placement of large wood in the streams to benefit resident and anadromous salmonids by creating complex in stream habitats; (2) establishment of multiple species of native trees and shrubs to provide stream shade, bank stability and to combat the encroachment of reed canary grass – an aggressive non-native grass; (3) subsoiling, planting and culvert removal on existing road to restore native vegetation and fish passage.<sup>30</sup> During the summer of 1998, 3.5 miles of the project were completed with the remaining 1.5 miles scheduled to be done by 2001.

The Governor's Watershed Enhancement Board (GWEB) is collecting site locations for both road and instream/riparian restoration projects through out the state of Oregon. Private industries and landowners have been invited to share their restoration projects and plans with GWEB, which is compiling a database, and corresponding map of private and public projects.<sup>31</sup> The location of these restorations are shown in Figure 19.

The township of Willamina has been approved for a Community Development Block grant to refurbish and upgrade their water reclamation facilities. Phase I being completed during the summer of 1999, is improving areas such as city sewer drains, the E street pump station, influent pump station, headworks, and other upgrades. The grant was approved by DEQ in 1998 and work starts on July 1<sup>st</sup> 1999 and should be completed by early fall. Phase II of the project has a projected cost of \$3.4 million dollars and funding sources have yet to be identified. Some of the projected upgrades include a new chlorine tank and out-fall line, new pump station, adding a fourth treatment lagoon.<sup>32</sup>

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<sup>30</sup> For more information contact Kurt Heckerth/Cindy Weston at the BLM Tillamook Field office.

<sup>31</sup> For more information contact Susanne Maleki GWEB, Corvallis (541)-757-4623.

<sup>32</sup> For more information contact the Willamina City Hall at (503)-876-2242.

## **3.0 Summary of Watershed Components**

### **3.1 Historical Information**

#### **Data Gaps**

1. Old maps including those used for logging, farming, county planning, agriculture and flood control were not located during the course of this assessment.
2. Historical landscape photographs were difficult to obtain and were not used during the course of this assessment.
3. Additional interviews with long term residents should be conducted.
4. US Army Corps of Engineers snag removal records.
5. Tax records were not analyzed.
6. General land office survey records were not analyzed.

#### **Summary**

See time line (page # 16-17) for a historical summary.

### **3.2 Channel Habitat Types**

#### **Data Gaps**

1. Due to the scale of the maps used in the Willamina assessment, only “blue line” streams were utilized for the assessment. Streams (intermittent and perennial) that are not recorded on USGS 7.5 maps should be surveyed and included in any further Willamina assessments.
2. Temperature and shading information was not available for this assessment. The 1999 draft of the OWAM does not utilize this information in the protocol for Channel Habitat Types, however it may be considered useful for other sections of the assessment.
3. Stereo Aerial photographs were not available for the Willamina watershed. 2-Dimensional Aerial photographs were available from the Farm Service, McMinnville, OR.
4. Extensive field verification for each segment of CHT including measurements of slope, floodplain width, and other parameters were not collected.
5. A specific comparison between the OWAM CHTs and the ODFW stream surveys needs to be conducted.

#### **Summary**

The lower Willamina sub-basin had a majority (55%) of its CHTs designated as Floodplain 2 (FP2). Some of the upper sections of the western tributaries had some (10%) Steep Narrow Valley (SV) and 13% of the moderate gradient headwaters (MH). A majority of the gradients in the lower Willamina sub-basin was < 2%. Coast, East and Upper Willamina sub-basins generally exhibited similar CHT profile distributions. All three sub-basins had a majority CHT designated as Steep Narrow Valley (SV). All areas demonstrated Channel habitat types typified by moderate to highly confined designations such as Low gradient confined (LC), Bedrock Canyons (BC), Moderately Steep Narrow Valleys (MV). The Upper Willamina appeared to contain the most diverse distribution of habitat types. A majority of the stream gradients in these three sub-basins are in the 4-16% grade range.

### **3.3 Fish Habitat**

#### **Data Gaps**

1. Stream and fish surveys for all un-surveyed (or not recently) stream segments in the Willamina watershed.
2. Information on species interactions.
3. Fish counts for current Willamina salmonid populations.
4. Salmonid distribution maps for Willamina watershed.
5. Information on Pacific Lamprey and other native species with little information.
6. Comparison between older and the more recent stream surveys to determine changing habitat conditions for fish. Answering the question: Are fish habitat conditions improving since the 1950's, degrading, can't tell?
7. Spawning season stream temperature information for spawning locations.
8. Extensive field verifications of fish barriers, and passage culverts.

#### **Summary**

The Willamina watershed has salmonid, warm water and lamprey species present in the watershed. ODFW has designated parts of the watershed as both habitat and spawning areas for some of these salmonid species. Willamina Creek is considered by ODFW to be one of the best winter Steelhead streams in the Coastal Range Sub-basin. Between 1964-1989 more than 500,000 winter Steelhead fry, fingerlings, yearling smolts and adults were released into the Willamina watershed. Harvest numbers for winter Steelheads collected between 1977 and 1989 ranged from 9 to 135 returning fish. Coho salmon are considered non-native to the watershed and were also stocked in the 1960s and 70s. Records show that more than 110,000 Coho salmon were introduced in the watershed between 1953-1958. Cutthroat trout have also been stocked in Willamina with estimates of numbers being difficult to obtain.

An assessment of the current habitat conditions in the Willamina watershed was conducted. The condition assessment results can be used with a moderate degree of confidence because of the data gaps that exist for many of Willamina watershed's smaller tributaries. Overall ratings for surveyed sections of the watershed were good in Willamina, Coast and East Creeks. Two stream segments on Willamina Creek were designated as 'indeterminate'. Analysis of the first segment was from 1990 ODFW stream surveys and was located between RM 10 and 10.81. A poor rating for gravel availability was one of the factors contributing to this overall rating. The second segment was from a 1995 ODFW stream survey and was located between RM 18.05 and 19.64. Poor ratings for both pool frequency and gravel quality were factors in this designation. Fish barrier information for both natural and human causes was collected for the Willamina watershed. The location and priority for restoration of those barriers is recorded in the appendices.

### **3.4 Riparian Conditions Summary**

#### **Data Gaps**

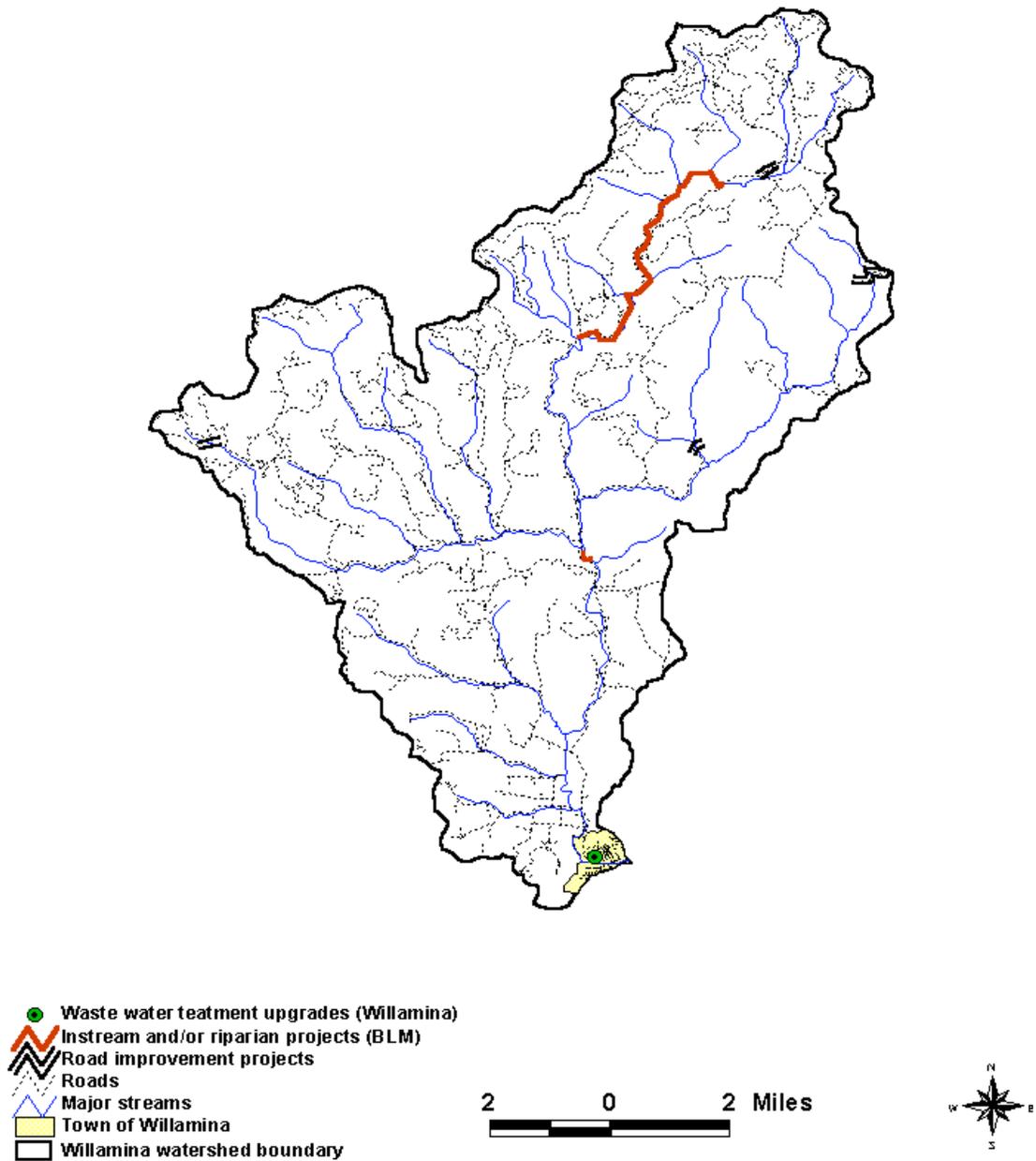
1. Riparian condition information from private landowners.
2. Extensive field verifications for canopy cover, riparian widths, LWD recruitment status, and shade estimations for all segments but in particular those areas designated as having low grade conditions.

3. Riparian information from other agencies needs to be researched and collected including Yamhill County, BLM, and private timber companies.
4. Grazing- How many livestock are grazed in the Willamina watershed? Is rotational grazing utilized in the watershed? Are buffer strips being utilized in grazing management? Is exclusion management utilized?
5. Noxious Weeds – Information regarding the location and populations of Willamina’s exotic plants and noxious weeds.

### **Summary**

Riparian conditions in the Willamina watershed were assessed using the 1997 draft of the OWAM. High, medium and low condition category designations were assigned to segments of the Willamina watershed by sub-basin. The lower Willamina sub-basin had the highest occurrence of stream segments in low and medium condition categories. Interruptions in the riparian zone, a high number of road, utility, streamside clearings and patchy vegetation contribute to these less than desirable conditions. The Upper Willamina sub-basin has some sections of low and medium conditions, but is mostly assessed to be designated in the high condition category. Generally there was a riparian buffer present of over 30 feet and the vegetation was mostly continuous along the stream banks. Coast Creek sub-basin also has some stream segments categorized as being medium grade segments with none of the sub-basin rated as low. East Creek sub-basin had both medium and low condition segments but a majority of the riparian zones were designated in the high category.

# Figure 19. Willamina Restoration



## **3.5 Wetlands**

### **Data Gaps**

1. Extensive field verification of NWI designated wetland locations and conditions.
2. Extensive field verification of wetlands that were located in the field but do not exist on NWI maps.

### **Summary**

The location and quantity (acreage) of wetlands for the Willamina watershed were assessed using NWI maps and aerial photographs. Wetland locations were mapped and total acreage for all wetland types calculated from each sub-basin. The upper Willamina sub-basin had a total of 83.63 acres of designated wetlands. Wetlands in East and Coast Creeks were estimated to at 61.04 and 123.82 acres respectively. The Lower Willamina sub-basin had the greatest total area of wetlands in the watershed with 294.50 acres. Wetlands in the Willamina watershed were predominately agricultural types (i.e. farmed wetlands or prior converted). All of the sub-basins had extensive areas of riparian wetlands designated as either riverine or palustrine forested systems. Due to the lack of field verification for this section, acreage totals are rough estimates.

## **3.6 Channel Modifications**

### **Data Gaps**

1. Extensive field verifications of all known channel modifications.
2. Extensive review of additional historical information regarding channel modifications and diversions.
3. Additional interviews with long term local residents on channel modifications.
4. Review of mining activities and their effects on Willamina channels.

### **Summary**

Channel modifications in the Willamina were assessed per the 1997 draft of the OWAM. Historical modifications to the stream channels of the Willamina watershed included splash damming, small scale diversions, dikes, dredging and instream structures such as dams. Historical splash damming was probably the most significant type of modification, particularly in Willamina Creek. A total of 26 field verified current channel modifications were surveyed in the Willamina watershed. Field verified modifications included rip-rapping, culverts, riparian vegetation clearing, and upslope management practices such as clear-cut logging. There are estimated to be many more current channel modifications in the Willamina watershed that were not field verified during the course of this assessment.

## **3.7 Hydrology and Water Use**

### **Data Gaps**

1. Current stream flow data (since 1995).
2. Water utilization by agriculture and rangeland uses and return flow information.
3. Extensive review of forest management and rural road effects on peak flows.
4. Extensive review of flood prone areas using FEMA reports.
5. Precipitation information for Willamina watershed at the varying elevations.
6. Information on water rights regarding actual use.

7. Agriculture - What are the specific crop rotations in the Willamina watershed? What are their water needs and estimated return flows?
8. Confined Animal operations – Information is needed on confined animal operations in the Willamina watershed. Where, how many, manure treatment management plans, herd sizes.

### **Summary**

Willamina watershed hydrology, land use impacts on peak flows and water use characteristics were assessed using the 1999 draft of the OWAM. Hydrological parameters including peak and low stream flow and historical flooding were analyzed. There were determined to be 5 major floods for which stream flow data was recorded for the Willamina watershed occurring in 1964, 1972, 1974, 1955 and 1973. The 1996 winter flood event was estimated to be the largest known flood for the region but flow data was not available for Willamina watershed. Stream flow data for Willamina watershed (gage # 14193000, 1934-1995) was analyzed for peak and low flow recurrence intervals. The highest recorded peak flow for the Willamina gage was 7980 cfs in December 1964. The average annual peak flow was determined to be 2715 cfs. The lowest seven-day-average flow recorded in at the Willamina gage ranged from 9 to 21 cfs with a predicted 10-year recurrence flow of 17 cfs. Low flows were shown to occur between late August to mid October with the majority of low flows in occurring in the middle of September.

Land use impacts and their effects on peak flows were analyzed per the OWAM protocol. Forestry practices were determined to have an unknown risk for peak flow enhancement due to limited information and field verification. Agricultural and rangeland land use impacts were not possible to assess due to limited time and information. They were designated also as having an unknown risk. Residential land use impacts were assessed as having a moderate risk of peak flow enhancement while urban land uses in and around the town of Willamina were considered to be a high risk.

Water availability and use was also assessed for the Willamina watershed. A total of 145 surface water right permits exist in the watershed with a majority of the 29.19 cfs permitted flow going to irrigation and municipal uses. Water is available for new permits except in the months of June, July, August, September, October, and November when water right claims often exceed actual flow.

## **3.8 Water Quality**

### **Data Gaps**

1. Extensive field sampling of water quality data, in particular for water quality limitation parameters (e.g. fecal coliforms, temperature)
2. Review any new water quality data (since 1988) that has been collected by EPA/DEQ in Willamina watershed.
3. Water quality data for all three upper sub-basins including Upper Willamina, Coast and East Creeks.
4. Ground water or well water quality information.
5. Data on synthetic and organic chemicals. What types of pesticides, herbicides, fertilizers are used and estimates on quantities. Time of day/month/year when they are applied.
6. Stream and river sediment sample data.
7. Additional temperature information for Willamina watershed.
8. Additional information regarding violations and quantities of point discharge permits.
9. Assessment of DEQ/EPA water quality data at RM 2.0.

## **Summary**

Willamina's water quality was assessed per the 1999 draft of the OWAM. Water uses including drinking and industrial water supply, aquatic life, agriculture, recreation, and hydroelectric power were determined to be the beneficial uses in the watershed. Willamina watershed was found to be water quality limited for fecal contamination in Willamina Creek between the mouth and RM 10. Recent temperature monitoring by the BLM has suggested that Willamina watershed may exceed the 64°F temperature standard. Other water quality parameters such as turbidity, chemical toxins, phosphorous, dissolved oxygen, and pH were analyzed using EPA/DEQ data collected on Willamina Creek at RM 0.5. Concentrations of all other water quality parameters were determined to be within EPA and state DEQ guidelines.

## **3.9 Sediment Sources**

### **Data Gaps**

1. Extensive collection of turbidity data for all Willamina streams, in particular for peak flow seasons when turbidity would be highest.
2. Debris flow map from ODF.
3. Landslide inventories from county, state agencies and private companies. Road maintenance records could be reviewed for road locations with reoccurring problems.
4. City stormwater maps.
5. OHV trail use and location information. Assessment of sediment inputs from different types of land use.
6. Agriculture and grazing sediment input data. Types of crops and rotations could be collected to help understand inputs.
7. Extensive field verification of sediment sources.
8. Current fire use – Specific information on fire use for agriculture and logging is required. Locations of recent burns need to be identified.
9. Maps of winter log haul roads.
10. Map of natural surface, gravel and paved roads. Have volunteers drive the roads in areas where the information does not exist.

### **Summary**

Potential sources of sediments in the Willamina watershed were determined per the 1999 draft of the OWAM. Rural road runoff, slope instability and stream bank erosion were assessed using information provided by ODF, BLM, NRCS, USGS, ODFW and some field verification. Road densities for Willamina watershed averaged 5.0-miles/square mile for the four sub-basins. The average percentage of high risk roads for the Willamina sub-basin was determined to be 11% of road <200 feet from the active stream channel and 5% of all roads were <200 and on >50% slopes. The Willamina watershed was evaluated as having 1.1% (569 acres) of its slopes rated as unstable and 0.5% (240 acres) as potentially unstable. Soil surveys of the Willamina watershed rate the soil erosion as being low to moderate. Erosion along stream banks was assessed using ODFW stream surveys 1990, 1995. Bank erosion and stability variety dramatically between streams and segments surveyed. East and Willamina Creeks had the highest percentage of actively eroding stream banks in the watershed.

### 3.10 Sensitive Species Summary

The Sensitive Species section was a part of the background information for the Willamina watershed. It has been included in the summary section because important data gaps were identified during the course of this assessment that should be addressed in any further watershed assessments.

#### Data Gaps

1. Native species - more specific information relating to rare threatened and endangered species. Where are they located, when are they present, where are their areas that they could be encouraged to grow or live.
2. Other agencies have additional species listed as rare, threatened, endangered, sensitive, etc. These listings should be reviewed and understood for their implications in the Willamina watershed.

#### Summary

There are seven plant and animal species that are currently of concern in the Willamina watershed. They are Nelson's sidalcea (*Sidalcea nelsoniana*), weak bluegrass (*Poa marida*), loose-flowered bluegrass (*Poa laxiflora*), meadow checker (*Sidalcea campestris*), northern spotted owl (*Strix occidentalis caurina*), northern red-legged frog (*Rana aurora aurora*), and mountain quail (*Oreortyx pictus*). Information regarding species habitat and watershed locations was presented.

## 4.0 Watershed Condition Summary

### Methodology

The channel habitat types (CHTs) defined during the course of the assessment were used as segment identifiers for the overall summary of conditions. A total of 59 segments were numbered and their locations recorded (Figure 5). CHT segments were then utilized in a decision matrix (Table 20) to ascertain specific locations in the watershed that fall into one of the three following groupings:

**Protect (P)** Areas with relatively high-quality aquatic-riparian habitat fish populations, or water quality conditions.

**Restore (R)** Areas with low-quality aquatic habitat, limitations on fish presence or production, or water quality concerns; the impacts and sources are identified.

**Information (I)** Areas where the aquatic-riparian condition, fish populations, or water quality cannot be accurately determined and/or the links to impacts are not clear.

The assessment component results were used to place each numbered stream segment into one of the three categories. Some components were divided into two sections to accommodate additional information (E.g., the Fish section was divided into both habitat condition and fish barriers). During the course of using this matrix it was observed that specific definitions of the “protect”, “restore” and “information” ratings for each assessment component were required. These definitions are recorded in the footnotes of Table 20. The total number of ratings for each CHT segment were tallied and an overall segment evaluation made. Overall ratings are shown in Figure 20.

CHT segments that were nearly even in all three categories were designated as segments with “Potential Restoration with more Information”. Areas that require protection were not identified during the course of this assessment. While individual component in the matrix designated CHT segments for “Protection”, the summation of these designations was never enough to rate the segment Protect. It is hypothesized that many of the segments currently defined as “requiring information” are in fact areas in need of protective management.

## Appendices

Appendix I	Releases of winter Steelhead to Willamina watershed (1964-1989)
Appendix II-A	Willamina fish barriers and locations descriptions (ODFW)
Appendix II-B	Fish barrier culverts from ODOT/Yamhill County database
Appendix III-A	Riparian condition summary (OWAM Form R-1)
Appendix III-B	Riparian condition summary (OWAM Form R-3)
Appendix III-C	Riparian condition summary (OWAM Form R-2)
Appendix III-D	Riparian condition summary (OWAM Form R-4)

**Figure 20. Watershed condition summary**

