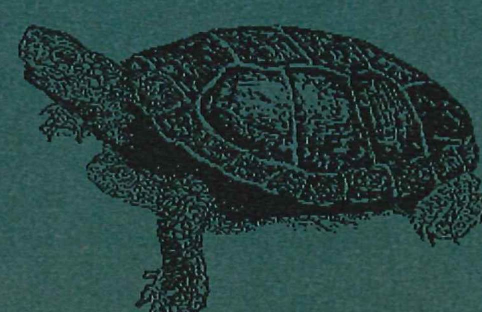
The Tualatin River

Tualatin River Watershed

Partners For Clean Water

Watershed Atlas



Tualatin River Watershed Atlas

Produced by the Tualatin River Watershed Council with funding from the Tualatin Valley Water Quality Endowment Fund of the Oregon Community Foundation

March, 2001

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Acknowledgments:

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Matt Dunnahoe: final map production

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Tualatin River Watershed Atlas

Preface

The Tualatin River Watershed Council (TRWC) received funding from the Tualatin Valley Water Quality Endowment Fund of the Oregon Community Foundation for a series of projects to increase resources available to residents of the Tualatin Watershed. The Tualatin River Watershed Atlas is one of these projects to help improve understanding of the Tualatin and its drainage basin.

This Atlas utilizes information from several sources including the Tualatin River Watershed Council's Technical Supplement to the Action Plan, the Tualatin Watershed Information System CD-ROM, Metro's Regional Land Information System Lite CD-ROM (Metro 2000), the US Environmental Protection Agency (EPA) and others. The TRWC Action Plan offers specific ways to improve, restore, and manage the watershed and takes a watershed-wide approach to integrate existing plans and efforts.

Tualatin River Watershed Council

The Tualatin River Watershed Council was established in 1996 as an advisory, non-regulatory body of residents, governments, and organizations working together to proactively address watershed management issues in the Tualatin Watershed. The mission of the council is "to foster better stewardship of the Tualatin River Watershed resources; deal with issues in advance of resource degradation; and ensure sustainable watershed health, functions, and uses."

The Council strives to provide a framework for coordination and cooperation. Decisions are made by consensus. The 20-member council, represents key interests and stakeholders in the watershed, ensuring a comprehensive view of watershed issues.

For more information, visit our website: www.trwc.org.

The Watershed

Background

Set within a growing and thriving metropolitan area, a productive agricultural landscape, and upland forests, the Tualatin Watershed is in a dynamically changing region of the country. Its lowlands, which predominantly have been agricultural lands, are giving way to increased residential and industrial settlement. Its headwaters in the upland forests are particularly important for water quality and fish and wildlife habitat. As the population and economic base of the region grow, stresses to the watershed are expected to increase. In order to foster a biologically healthy and functional resource, while still supporting the economy of the region, active stewardship of the watershed is essential. A biologically healthy watershed will reduce the likelihood of long-term degradation of the local environment and will maintain public health and the quality of life for which this region is known.

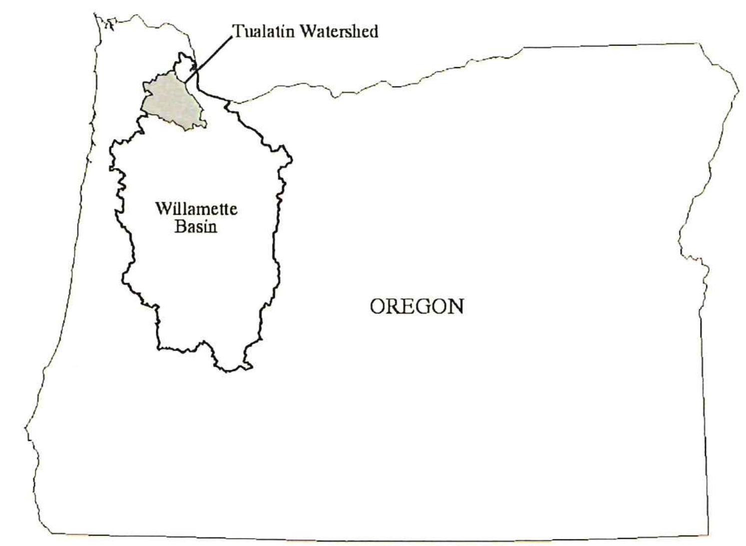


Figure 1. Locator map for the Tualatin River Watershed

A healthy watershed ecosystem: 1) is biologically diverse with abundant and beneficial plant and animal populations; 2) is resilient enough to heal itself after catastrophic events without large investment of outside resources; 3) minimizes the output of undesirable products such as air pollution, water pollution, and solid waste while maximizing the sustainable production of desirable commodities such as food, fiber, and manufactured goods; and 5) fulfills housing, economic, social, aesthetic, spiritual, and recreational values.

DEFINITIONS:

Anadromous Fish: Fish that hatch in fresh water streams or rivers, migrate to the ocean as juveniles where they grow to maturity, and then return to fresh water.

Groundwater: Water that is underground in an area of porous material. Most wells tap ground water.

Non-Point Source Pollution: Pollution occurring from widely-dispersed land areas and is carried in runoff water from a field, forest, or urban area into a stream or lake.

Point Source Pollution: Pollution originating from the discharge of pollutants from a single, readily identifiable source such as an industrial or sewage discharge pipe.

Riparian Area: Vegetated areas located at the banks of rivers, lakes, and wetlands. These are particularly important for water quality and wildlife habitat since they remove sediment and pollution as well as provide a home for wildlife.

Stakeholders: Any individual or group who has an interest in or will in some way be affected by things that occur in the watershed. Farmers, environmental organizations, and businesses are examples of stakeholders.

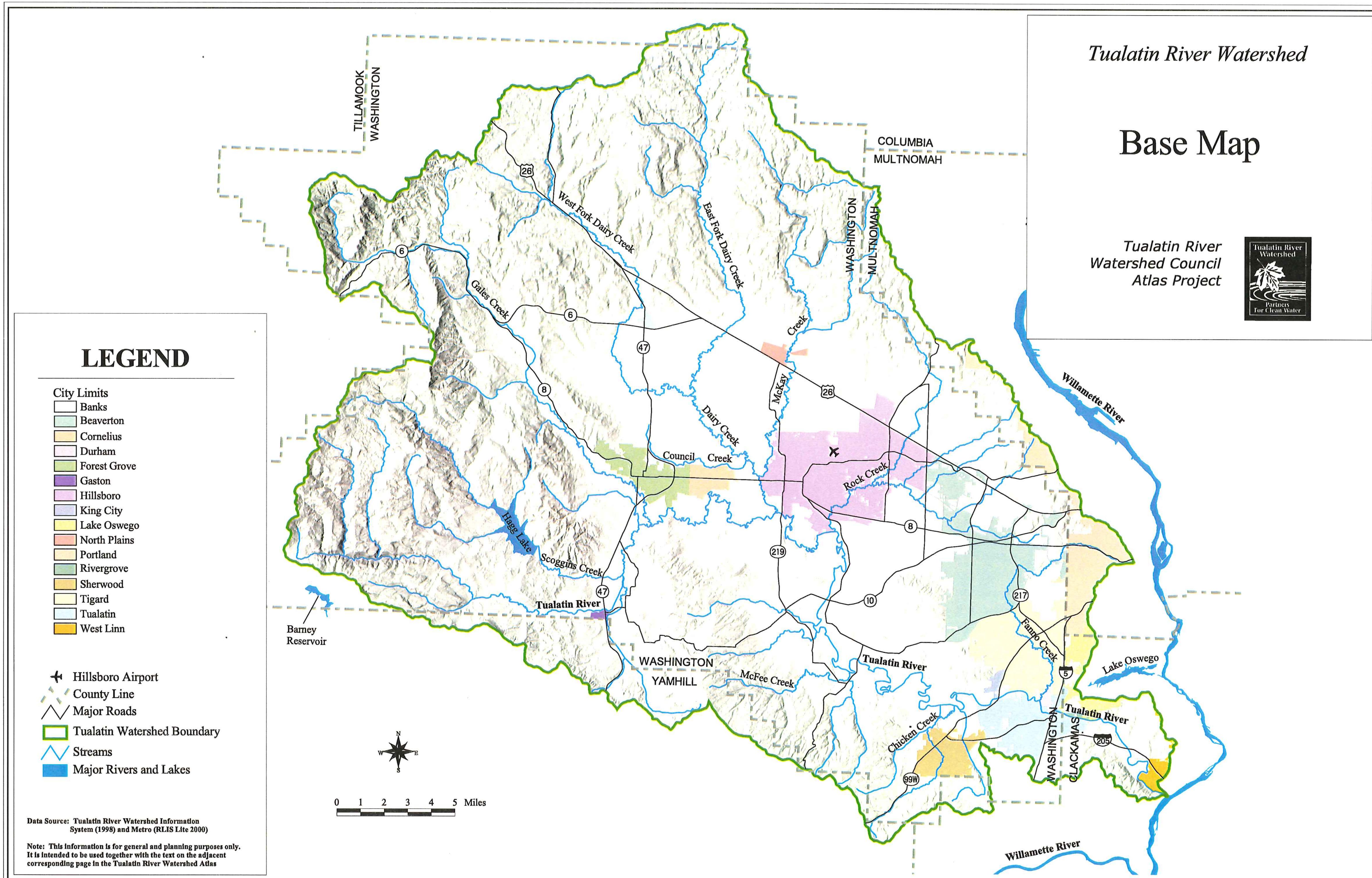
Stewardship: Exercising responsible care over the resources entrusted to us. Requires managing water and other resources in the most responsible way we can.

Tributary: A stream that flows into a larger body of water. For example, Fanno Creek is a tributary of the Tualatin River.

Macroinvertebrates: Aquatic organisms used as indicators of good ecosystem health. They lack a backbone and are large enough to be seen with the naked eye. Crayfish and the mayfly are examples of macroinvertebrates.

Watershed: The area of land that drains into a lake or a river. As rainwater and melting snow run downhill, they carry sediment and other materials into our streams, wetlands, and groundwater.

Wetlands: Areas covered with water at least part of the year. They have certain distinctive types of soils, plants, and drainage. They provide habitat for fish and wildlife, help filter pollutants, and control floods.



Tualatin River Watershed
Base Map
Tualatin River Watershed Council Atlas Project
Tualatin River Watershed
Partners For Clean Water
LEGEND
City Limits
Banks
Beaverton
Cornelius
Durham
Forest Grove
Gaston
Hillsboro
King City
Lake Oswego
North Plains
Portland
Rivergrove
Sherwood
Tigard
Tualatin
West Linn
Hillsboro Airport
County Line
Major Roads
Tualatin Watershed Boundary
Streams
Major Rivers and Lakes
Data Source: Tualatin River Watershed Information System (1998) and Metro (RLIS Lite 2000)
Note: This information is for general and planning purposes only. It is intended to be used together with the text on the adjacent corresponding page in the Tualatin River Watershed Atlas
0 1 2 3 4 5 Miles
N
W
E
S
TILLAMOOK
WASHINGTON
COLUMBIA
MULTNOMAH
WASHINGTON
MULTNOMAH
WASHINGTON
YAMHILL
WASHINGTON
CLACKAMAS
West Fork Dairy Creek
East Fork Dairy Creek
Gales Creek
Dairy Creek
McKay Creek
Council Creek
Rock Creek
Hagg Lake
Scoggins Creek
Tualatin River
Barney Reservoir
McFee Creek
Tualatin River
Chicken Creek
Fanno Creek
Tualatin River
Lake Oswego
Willamette River
Willamette River
26
26
6
6
47
47
8
8
219
10
217
5
205
99W

Getting to Know Your Watershed

Let's Start With the Basics.

What is a Watershed?

A watershed is an area of land that drains into a lake or river. We all live in watersheds. Watersheds are places we call home, where we work, go to school, and where we play.

Why is the Tualatin Watershed Important?

Healthy watersheds are vital for a robust environment, community, and economy. The Tualatin River provides water for drinking, irrigation, and industry. Many people enjoy the Tualatin Watershed's lakes and streams for their beauty, boating, fishing, and swimming. Healthy watersheds also provide food and shelter for wildlife.

Everyone relies on water and other natural resources to exist. What you and others do in the watershed impacts the water running into the river.

Understanding Your Watershed

The Tualatin River Watershed is a dynamic and unique place. It is a complex web of natural resources (soil, water, air, plants, and animals) and has many features that separate it from other watersheds. Some important features are listed below.

Size

One important feature is the size of the watershed. Some watersheds, like the Columbia River, can be very large, stretching across several states and into other countries. These large basins include many smaller river basins or watersheds. These smaller watersheds can be subdivided into even smaller ones. For instance, the Willamette River is a tributary of the Columbia River Basin. Since the Tualatin River flows into the Willamette River, it is a watershed of the Willamette Watershed. The Tualatin watershed itself has six main subwatersheds. These are Dairy-McKay, Gales, Upper Tualatin-Scoggins, Middle Tualatin, Rock, and Lower Tualatin. The Tualatin River Watershed is 712 square miles and approximately 42 miles long and 29 miles wide.

Watershed Boundaries

The geographic boundaries of the watershed are formed by ridges or high areas from which water drains toward the Tualatin River or its tributaries. The headwaters of the Tualatin and many of its tributaries originate in the Coast Range and from the Tualatin Mountains, a spur of the Coast Range. These hills wall in the valley on the north and east. The Chehalem and Parrett Mountains form the southern rim of the watershed.

Terrain

The topography (terrain) is another important feature. How flat, like in the floodplains, or how steep the land is impacts how fast water drains. The faster the drainage, the more potential for flooding and increased soil erosion. The Tualatin Watershed is composed of a mixture of landscape types including uplands, wetlands, riparian areas, streams, and lakes.

Soil Type

Soil type is also important. For example, sandy soils allow the ground to soak up water faster. This reduces surface runoff, but can affect groundwater. Clay soils, on the other hand, are tighter and do not allow as much water infiltration. This can lead to more runoff and soil erosion.

Vegetation

The area nearest the water greatly affects water quality. This is why buffer strips, wildlife habitat, wetlands, and riparian areas are important aspects of your watershed. Both buffer strips and wetlands utilize nutrients and tie up sediment to help improve water quality. Wetlands also act as natural sponges to absorb peak flows of water and reduce flooding. Many fish and wildlife species rely on wetlands for rearing their young and for food and shelter.

Animals

One meaningful way to evaluate the health of an ecosystem is to directly observe the animals that live there. The animals can reflect the effects of various stressors, such as an increase in pollutants in the river. Animal studies can therefore show problems that otherwise would be missed or underestimated.

Natural Resource Uses

Natural resources are used in many different ways in the Tualatin. The river is used for drinking water, farms rely on it for irrigation and livestock watering, and homeowners use it to water lawns and to wash cars. At places like Hagg Lake people enjoy water for recreational uses like fishing, swimming, and boating. The quality and quantity of water are very important to the watershed's stakeholders.

Water Quality and Pollutants

In the past, most water quality problems were traced to the most obvious cause, point-source pollution. Since point source pollution is any pollution source that comes from a specific location such as a pipe discharging pollutants directly into the river, this means the problem can usually be traced back up the pipe to the source. Much progress has been made in preventing further water quality problems from point sources.

Non-point source pollution problems are more difficult to control because the sources are often hard to identify and difficult to measure. This type of pollution results from a variety of activities. Non-point source pollution can be the water that runs off crop, forest, and urban landscapes. Non-point sources include failing septic systems, runoff from parking lots, construction sites, and irrigation and drainage systems. Even automobile exhaust getting in the atmosphere and falling back to earth in the rain can result in non-point source pollution.

Stakeholder Uses

To fully understand the Tualatin Watershed, it is important to look at how it is used by the people who live, work, and play here. Since stakeholder uses vary through time, it is important to include social, economic, and employment trends.

Examples of watershed stakeholders:

Landowners
Local businesses
Developers
Recreational users
Government agencies
Farmers
Woodland owners
Teachers
Conservation groups
Environmentalists
Church groups
Schools
And many others!

Adapted from the EPA brochure, " Getting to Know Your Watershed"

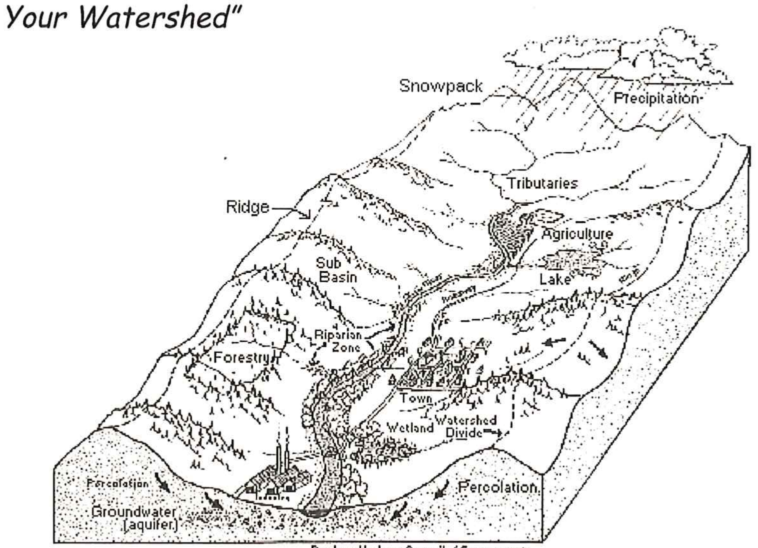
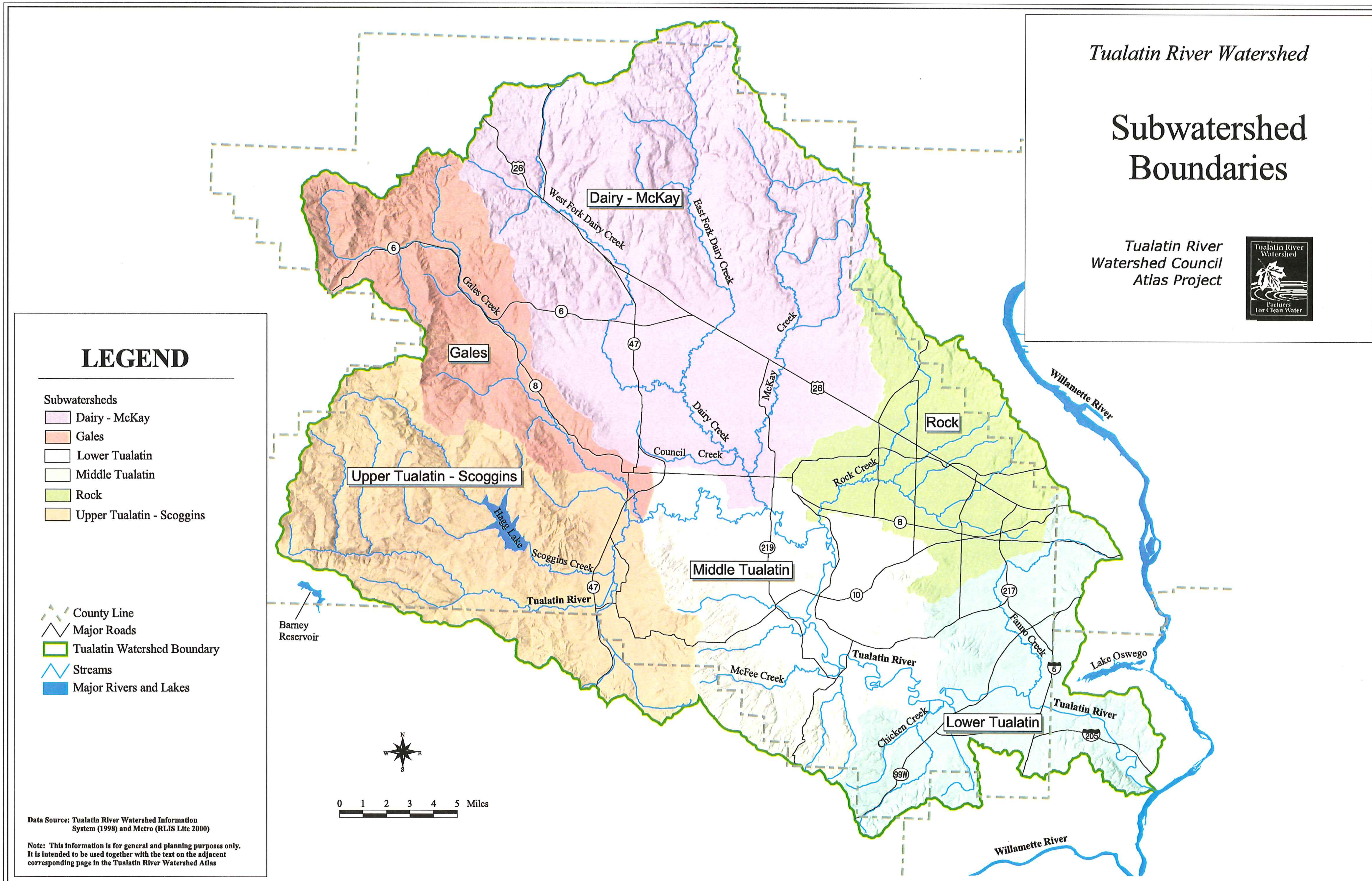


Figure 2. What is a Watershed?


Tualatin River Watershed
Subwatershed Boundaries
Tualatin River Watershed Council Atlas Project
Tualatin River Watershed
Partners for Clean Water
LEGEND
Subwatersheds
Dairy - McKay
Gales
Lower Tualatin
Middle Tualatin
Rock
Upper Tualatin - Scoggins
County Line
Major Roads
Tualatin Watershed Boundary
Streams
Major Rivers and Lakes
Data Source: Tualatin River Watershed Information System (1998) and Metro (RLIS Lite 2000)
Note: This information is for general and planning purposes only. It is intended to be used together with the text on the adjacent corresponding page in the Tualatin River Watershed Atlas
Dairy - McKay
Gales
Upper Tualatin - Scoggins
Middle Tualatin
Rock
Lower Tualatin
West Fork Dairy Creek
East Fork Dairy Creek
McKay Creek
Dairy Creek
Council Creek
Gales Creek
Hagg Lake
Scoggins Creek
Tualatin River
Barney Reservoir
Rock Creek
McFee Creek
Chicken Creek
Fanno Creek
Lake Oswego
Willamette River
Willamette River
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26
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0 1 2 3 4 5 Miles

Watershed History

The land that forms the Tualatin River Watershed was once home to ice-age elephants, camels, and giant beaver. It was re-carved by floods 500 feet deep when an ice dam on the Columbia River broke about 15,000 years ago. Left with rich alluvial soils, swamps, grass-covered prairies, and forests of Douglas fir, Oregon oak, western hemlock, and western red cedar, the watershed was home to diverse wildlife. Mammalian residents included cougar, bear, elk, deer, coyote, beaver, rabbit, muskrat, and fox. Grouse, herons, kingfishers, mallards, geese, swans, quails, owls, and hawks inhabited the watershed while trout, steelhead, and chinook salmon lived in the Tualatin River. These animals were supported by a much larger array of smaller animals and forest understory vegetation including vine maple, hazel, dogwood, salal, and Oregon grape.

The Twality People

The Kalapuya people, emigrating from the Columbia River plateau, made the whole Willamette Valley their home 10,000 years ago. The Tualatin River watershed was the territory of a group of Kalapuya known as the Twality (also called Atfalati), who developed a unique dialect. The Kalapuya numbered approximately 10,000 when European immigrants arrived less than 200 years ago. The Twality burned some lowlands to open meadowlands and concentrate game for hunting.

In 1829, more than half the Kalapuya people died of fever brought by immigrants of European heritage. By 1851, when a treaty was negotiated, only 65 Twality were living in the watershed. Wild game, including beaver, had become scarce. Lowland roots such as camas and wapato, once used by the Twality as a nutritious food source, were nearly gone, consumed by imported swine. No Twality people are alive today.

Settlement by Non-Kalapuyan People

In the 1820s, a few retired fur traders began farming in the Tualatin Watershed which was then about 80 percent forest. Missionaries came next, and they too began farming as the Twality population diminished. News of the fertile land in the watershed brought a larger wave of settlers from the east in the 1850s. By 1855, the last year of the Donation Lands Claim Act, about 350 farms had been claimed in the watershed, occupying land out to river mile 67.

The natural hydrology of the watershed consisted of ever-present marshes and swamps. Hydric soils* covered much of the lowland areas. Spring flooding and building in the floodplain concerned the settlers. Farmers drained much of the lowlands to plant crops and develop pasture for cattle. Settlers built canals, dikes, and dams, as well as drainage ditches.

At first, surplus timber was felled and burned to clear the land. Sawmill owners built dams for power and modified the river and its tributaries to get logs to the mills. In the 1870s, timber was being exported to California, Hawaii, and China from the Durham mill on Fanno Creek. It was later estimated that over 60 percent of the original wetlands were lost as a result of these agricultural and timber practices.

Modernization in the Watershed

The first roads constructed followed old Twality trails, and villages grew around low spots like Scholls, as well as around mills, such as at Dilley. The same year, planning began for riverboat traffic to transport produce to Oregon City, a larger town. The first steamer began runs in 1858. Steamboats often had to stop during months of low flow—July through November in 1869—and they could not negotiate the rapids at the mouth of the Tualatin. In 1871, Chinese laborers were hired to excavate the canal to Lake Oswego (then called Sucker Lake). One of the earliest water rights in Oregon occurred at the outlet of Lake Oswego when Alonzo Durham started a sawmill operation powered by a water wheel in 1850.

> ***Hydric soil:***
> *A soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions in the upper part. This type of soil indicates a wetland was or is present. As you can see from the land cover and hydric soils map on the opposite page, much of the Tualatin Valley is covered with hydric soils*

Steamboat traffic became much less important when the railroads were constructed beginning in 1887. By that time, 14 bridges crossed the Tualatin River. When the Southern Pacific Railroad was completed in 1911, eastern timber companies began investing in the watershed's timberlands and sawmills. They built side rails to forest sites and temporary mills in the forest to avoid bringing logs down to the lowlands.

Several dams were built in the watershed during the late 1800s and the early 1900s. These were used to power flour mills and sawmills and to generate electricity. Two dams were built above Cherry Grove across the mouth of the Tualatin River Canyon. In 1862, the Patton Mill dam was built to power a mill, but was removed at the turn of the century by Oregon's fish commission. The Haines Falls dam was built in 1901 to generate electricity. The Lovengren Dam was then built at the same site to help harvest timber on the south side of the river. It was 200 feet long and created a 70-acre lake. Logs and debris broke the dam in 1913 after a heavy rain in the uplands. Drainage of lowlands continued. Wapato Lake, formerly south of Dilley, was drained by a canal so the lake bed could be used for agriculture. A dike was built to drain Jackson Bottom. The Wapato Lake water right was established in 1928.

In the 1930s, Oregon State University introduced sprinkler irrigation to farms in the watershed. Along with higher productivity, sprinklers brought additional loss of summer flows through greater water evaporation rates. Water quality decreased due to agricultural runoff (Shively, 1993). Rural electrification followed in the 1940s, powering irrigation pumps. Crops changed as a result of irrigation, from predominantly wheat and grains to sweet corn and green beans. The combined effects of logging, drainage, and pumping for irrigation in the 1940s led to heavy winter flows and almost no late summer flows in the river. Irrigation demands rose even more when the nursery industry began to grow in the 1950s. Near the city of Tualatin, water would sometimes flow upstream and the river could easily be straddled by a person in some of the lower river reaches.

The human population in the county continued to grow. As more people demanded irrigation and as summer flows decreased, government leaders began planning Scoggins Dam to store irrigation water.

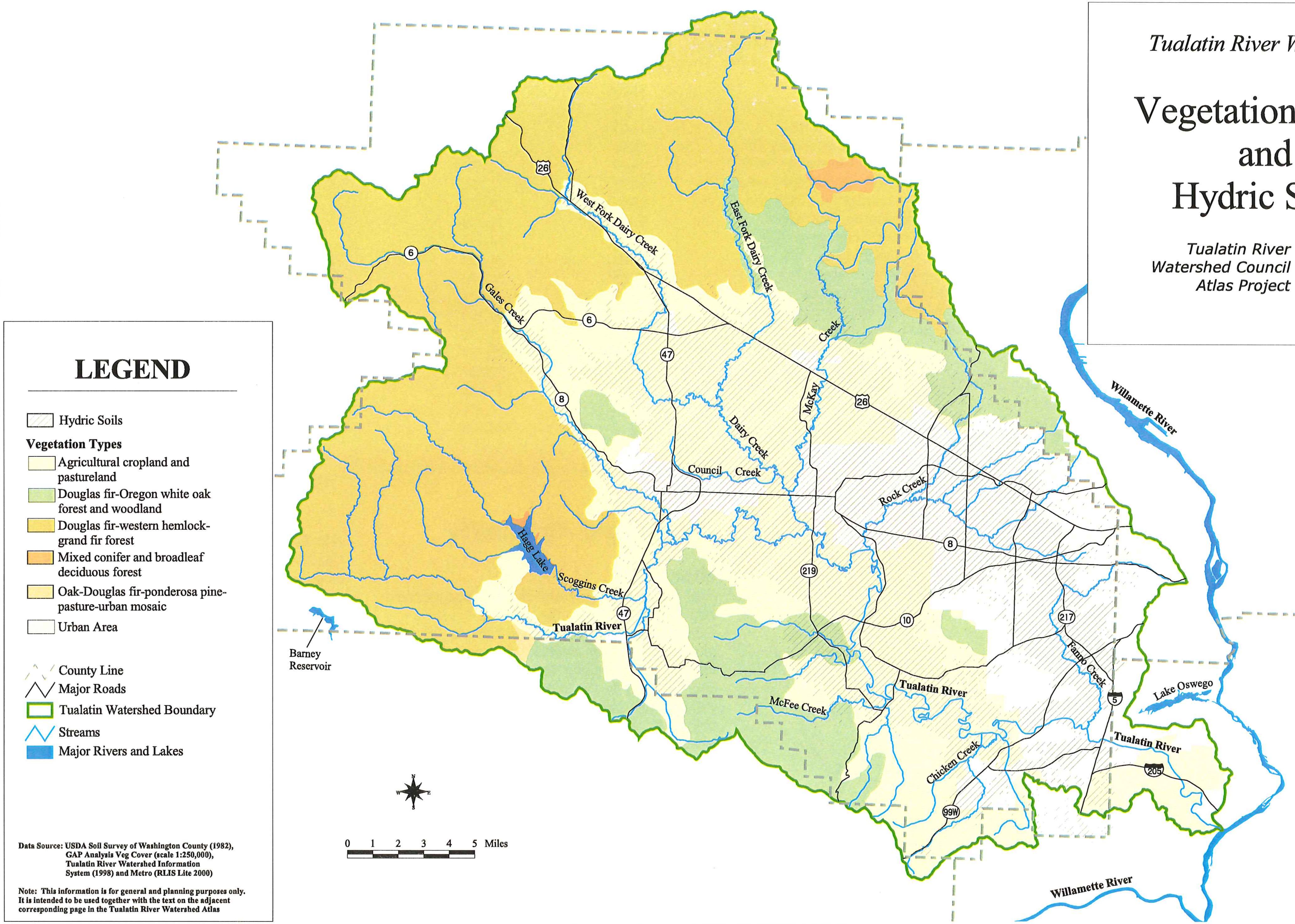
Beginning in 1938, drinking water was imported to the Tualatin Watershed from Portland's Bull Run water supply for the Wolf Creek Water District, and the quantity imported has increased since then. Barney Reservoir was built in the late 1960s to supply water to Hillsboro from the neighboring Trask River watershed, and is now in the process of being enlarged (Washington County Historical Society (WCHS), 1997). By the time Scoggins Dam was built in 1978, about half its storage capacity was dedicated to municipal use to meet the water demands of other towns in the watershed. These included the needs of the fast growing "high tech" industry, which can use up to one million gallons of water per day for each large plant (WCHS, 1997).

Historical information provided by Cass, 1993 except where noted.

Tualatin River Watershed

Vegetation Types and Hydric Soils

Tualatin River Watershed Council Atlas Project



Data Source: USDA Soil Survey of Washington County (1982), GAP Analysis Veg Cover (scale 1:250,000), Tualatin River Watershed Information System (1998) and Metro (RLIS Lite 2000)

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Tualatin Watershed Population

Population

A 1996 estimated human population residing within the Tualatin River Watershed is 451,900, which represents about a 21 percent increase since the 1990 census. A breakdown by county area in the watershed is provided in the table below.

County	Population	Proportion
Washington	376,500	83 %
Multnomah	41,300	9 %
Clackamas	32,300	7 %
Yamhill	1,800	< 1 %
Total	451,900	100 %

Table 1. Population in Tualatin River Watershed [1]
[1] Based on July 1996 estimates (Weinberg, 1997)

Data compiled on the population in Washington County indicate that the median age is about 35 for females and 34 for males. Only 12 % of those moving to the area since the 1990 were 65 or older. Based on estimates made in 1996 by Portland State University Center for Population Research and Census, by the year 2015 the population in Washington County will be 566,500. Similar rates of growth are expected in the other counties that lie within the watershed.

What is an Urban Growth Boundary?

Urban growth boundaries (UGBs) were created as part of the statewide land use planning program in Oregon in the early 1970s. The boundaries mark the separation between rural and urban land. They are intended to encompass an adequate supply of buildable land that can be efficiently provided with urban services (such as roads, sewers, water lines, and street lights) to accommodate the expected growth during a 20-year period. By providing land for urban uses within the boundary, rural lands can be protected from urban sprawl.

The Metropolitan Service District (Metro) manages the regional urban growth boundary for the Portland metropolitan area. Adopted in 1979, the Metro UGB is approximately 365 square miles (about 236,000 acres). It includes 24 cities and the urban portions of Washington, Multnomah, and Clackamas counties. As of February 2000, about 1.3 million people live within the UGB. The objectives are to plan and promote the efficient use of urban land, improve the efficiency of public facilities and services, and preserve prime farm and forest lands outside the boundary.

Metro is required by state law to add land to the boundary if it is needed. Additions to the boundary must be based on a demonstrated need for more urban land. Once a need has been demonstrated, the area selected for the addition must be shown to be superior to other areas. The UGB for the Portland metropolitan area, defined by Metro, extends into eastern and southeastern portions of the watershed.

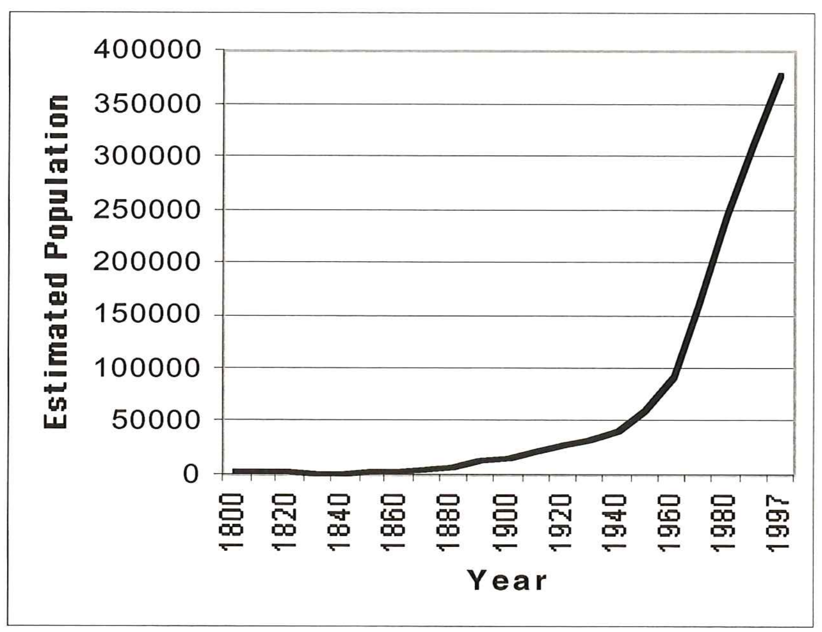


Figure 3. Estimated Population 1800-1997 in Washington County

Year	Estimated Population
1800	1,500
1810	1,500
1820	1,500
1830	500
1840	400
1850	2,652
1860	2,801
1870	4,261
1880	7,028
1890	11,972
1900	14,467
1910	21,522
1920	26,376
1930	30,725
1940	39,194
1950	61,269
1960	92,237
1970	157,920
1980	245,808
1990	311,554
1997	376,500

Table 2. Washington County Population from 1800-1997

Climate and Air Quality

Climate

The Tualatin River Watershed, whose western edge is less than 40 miles from the Pacific Ocean, has a modified marine climate. The prevailing western airflow from the ocean moderates the colder temperatures of the winter and the heat of the summer. Occasional extreme temperatures are associated with outbreaks of dry continental air pushing through the Columbia River Gorge and across the Cascade Mountains.

The watershed's winter climate consists of rainfall from November to April. Dry months are July, August, and September. Seasonal characteristics are well defined, and changes between seasons are gradual. Average annual rainfall decreases from 110 inches along the crest of the Coast Range to 38 inches in the southeastern valley floor. Some 28% of the total annual rainfall is received in fall, 46% in winter, 20% in spring, and only 6% in summer. Extremes in rainfall for individual years have varied from 26 to 65 inches at Forest Grove and from 42 to 83 inches at Timber. Snowfall in the mountainous portion of the watershed can be significant, but is normally quite light on the valley floor. However, Tualatin River flow does not typically receive snow melt after early spring.

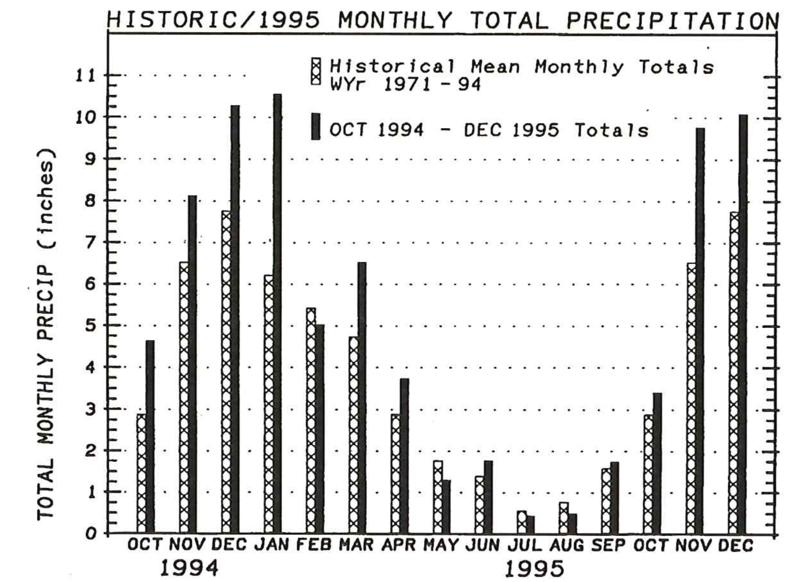


Figure 4. Precipitation Pattern for the Tualatin Valley

Air Quality

The Tualatin River Watershed's air quality is also an important factor in the health of the watershed. Health concerns can be addressed by reducing air particulate, carbon monoxide, and ozone levels. The ability to view some of the region's majestic Cascade peaks, such as Mt. Hood and Mt. Saint Helens, is also important to residents, and requires that good visibility be maintained.

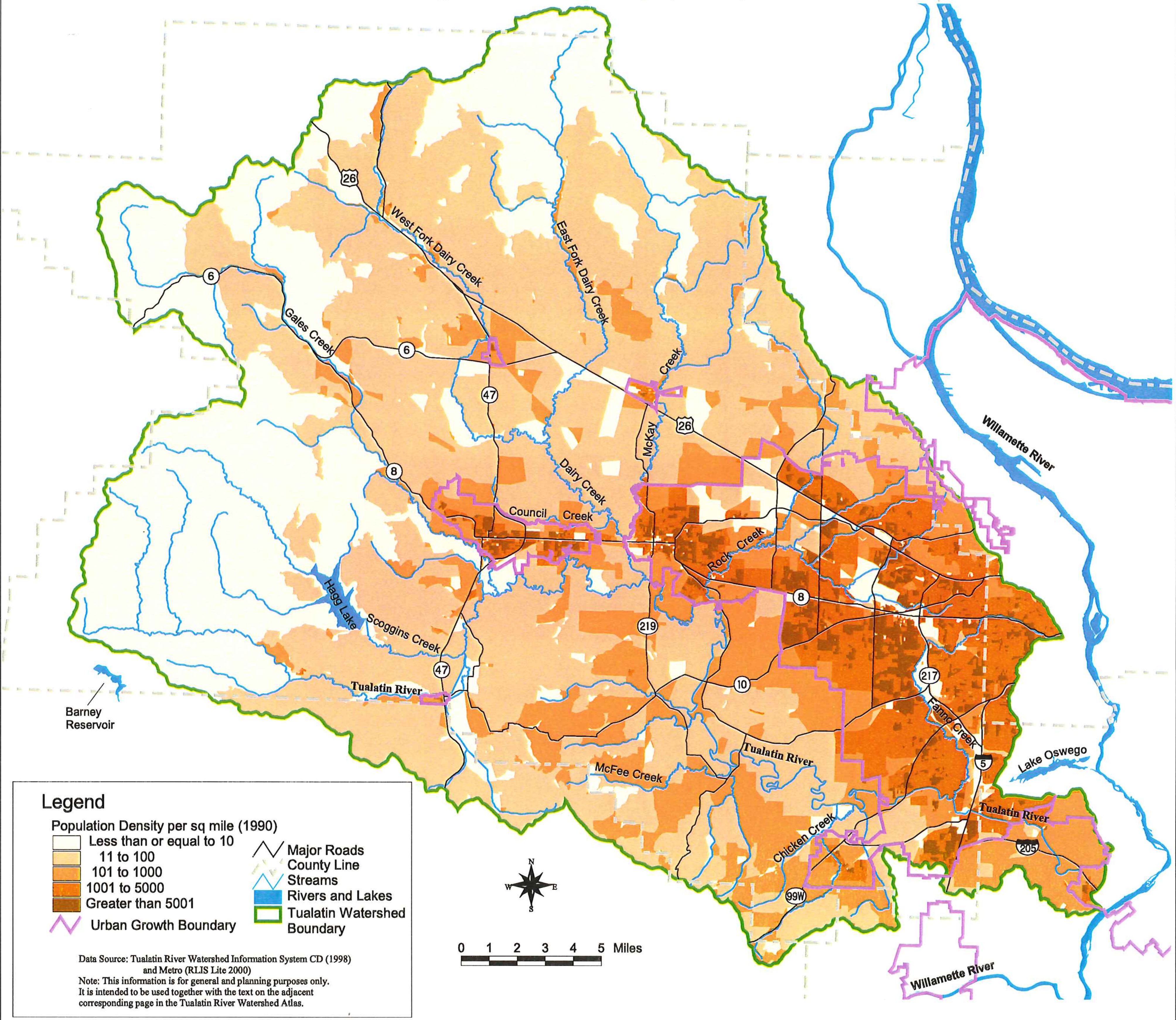
Air quality in the Tualatin River Watershed is monitored and regulated as part of the entire Portland Air Quality Management Area. The air quality within the watershed cannot exceed National Ambient Air Quality Standards as defined by the Environmental Protection Agency.

Tualatin River Watershed

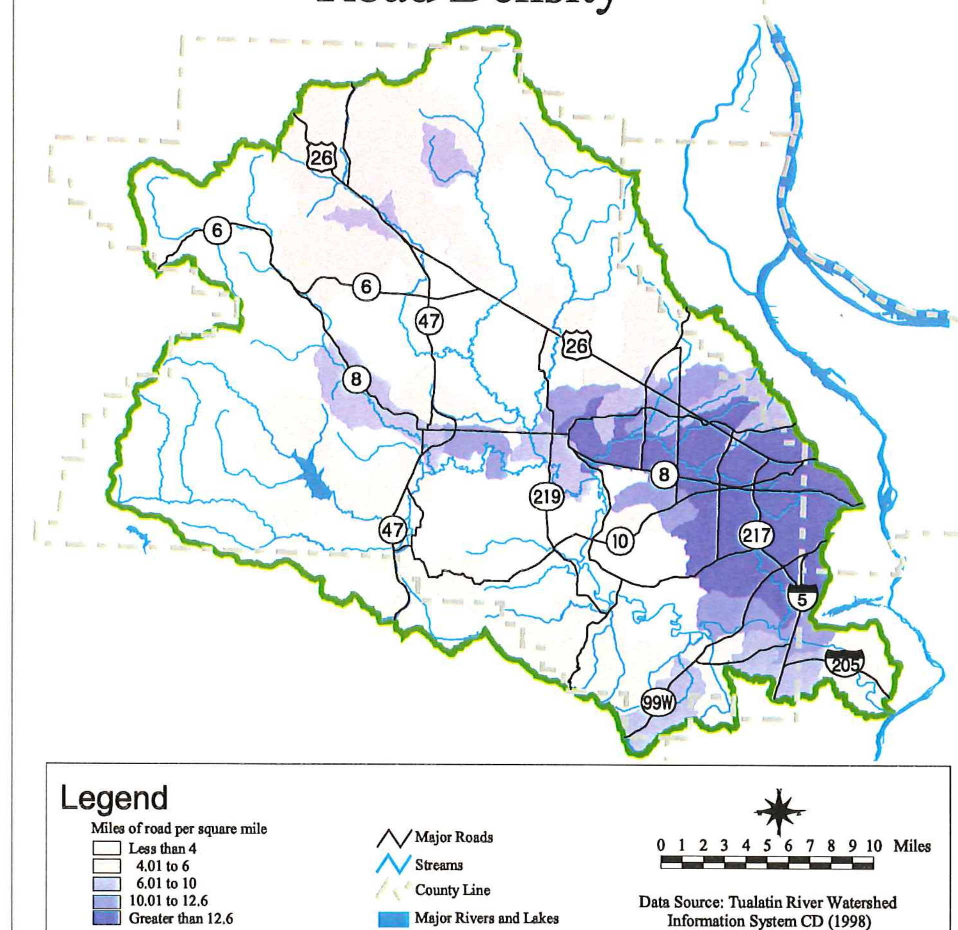
Population Density and Road Density

Tualatin River Watershed Council Atlas Project

Population Density (1990)



Road Density



Watershed Management

Responsible Government Agencies

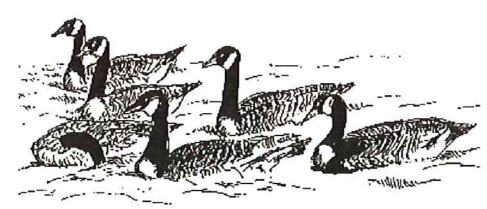
More than 30 state, regional, and local agencies have varying levels of jurisdiction in the Tualatin River Watershed. These agencies include 15 cities, 6 counties, 2 urban regional agencies, 3 land use based agencies, and 11 state agencies. In addition, 12 federal agencies participate at different levels in watershed activities. Many of these jurisdictions overlap in their areas of responsibility as well as in geographic areas, making it difficult for coordinated watershed-wide management. The primary government agencies involved in managing the watershed's resources include:

U.S.D.A. Natural Resources Conservation Service (NRCS)
U.S.D.I. Bureau of Land Management (BLM)
U.S. Fish and Wildlife Service (USF&W)
U.S. Environmental Protection Agency (EPA)
Oregon Department of Forestry (ODF)
Oregon Department of Land Conservation & Development (DLCD)
Oregon Department of Geology & Mineral Industry (DOGAMI)
Oregon Water Resources Department (OWRD)
Oregon Department of Agriculture (ODA)
Oregon Department of Fish and Wildlife (ODFW)
Oregon Department of Environmental Quality (DEQ)
Tualatin Valley Irrigation District (TVID)
Washington and Multnomah Counties
Washington County Soil & Water Conservation District (SWCD)
Unified Sewerage Agency (USA)
Metropolitan Service District (Metro)
16 city governments, a park and recreation district & 4 water districts

State Agencies

The Oregon Department of Fish and Wildlife (ODFW), Oregon Department of Forestry (ODF), and Oregon Water Resources Department (OWRD) maintain branch offices to administer resource management programs in the watershed. In 1971, the Oregon Forest Practices Act was created. This Act, administered by ODF, regulates all forest activities on forest lands. OWRD appoints a watermaster for the Tualatin and Lake Oswego Watersheds to coordinate reservoir resources, regulate water withdrawals, and arbitrate water supply disputes based on water right records. In 1993, the Oregon Department of Agriculture (ODA) was designated as the lead state agency, through Senate Bill 1010, to work with the agricultural industry to address non-point source water pollution. Through a Memorandum of Agreement, ODA has in turn delegated implementation of this task to the Washington County Soil and Water Conservation District (SWCD). Other agencies named by DEQ as "Designated Management Agencies" for the Tualatin River Watershed include ODF, Unified Sewerage Agency (USA), Clackamas and Washington Counties, and the Cities of Portland, Lake Oswego, and West Linn.

DEQ is responsible for monitoring, permitting, and defining environmental rules and ordinances for the region. Planning and road maintenance responsibilities of the Oregon Department of Transportation (ODOT) also affect current and future conditions in the watershed.



The Oregon Department of Land Conservation and Development (DLCD), the agency that may have the most influence over the future of the watershed, has established 15 mandatory goals for planning that are applicable to the Tualatin River Watershed. The goals generally encourage preservation of existing agricultural and forest lands, open spaces, natural resources, and air and water quality, while allowing economic and urban development. These goals are incorporated in city, county, and Metro plans.

Local and Regional Agencies

The cities and counties in the watershed have comprehensive plans which regulate many aspects of development in their jurisdictions, such as stormwater management and land use. The agencies with urban responsibility are the Unified Sewerage Agency (USA) and the Metropolitan Service District (Metro). Local governments (cities and counties) carry out zoning, permitting, and determine permissible land uses. Metro assures that local planning is coordinated throughout the metropolitan area in order to protect air quality, address traffic congestion, and protect farm and forest lands outside the urban growth boundary, as required by state law.

Washington County

Washington County covers a majority of the watershed. The county's Comprehensive Plan for growth and development is divided into two volumes—one for areas within the urban growth boundary and another for areas outside it. Both contain many policies protective of the watershed ecosystem and some that may degrade it (for example, paved parking lots allowed in flood plains hinder water storage and infiltration). The plan includes policies on air quality, water resources, energy resources, biological resources, natural areas, growth (urbanization), noise, natural hazards, transportation, and recreation. The County also has a Community Development Code to guide planning for new housing and other development to meet projected population growth. The Code lists specific standards such as required landscape areas and topsoil conservation.

Unified Sewerage Agency

The Unified Sewerage Agency (USA) is the sanitary sewer and surface water management utility for the homes and businesses in a 120 square mile area of Washington County. USA cleans 56 million gallons of wastewater daily at four treatment facilities before releasing it to the Tualatin River. The cleaned wastewater meets some of the nation's highest treatment standards and is actually improving the water quality of the Tualatin River. USA maintains more than 700 miles of sanitary sewer lines, the public stormwater drainage systems, and is responsible for providing flood control in the Tualatin River and its urban tributaries.

USA is responsible for surface water management planning for about two-thirds of the watershed, while the remainder is managed by the cities of Portland and Lake Oswego. Several watershed plans have been prepared by USA for the urban portions of some Tualatin River subbasins. These plans address surface water management issues and prioritize capital improvements.

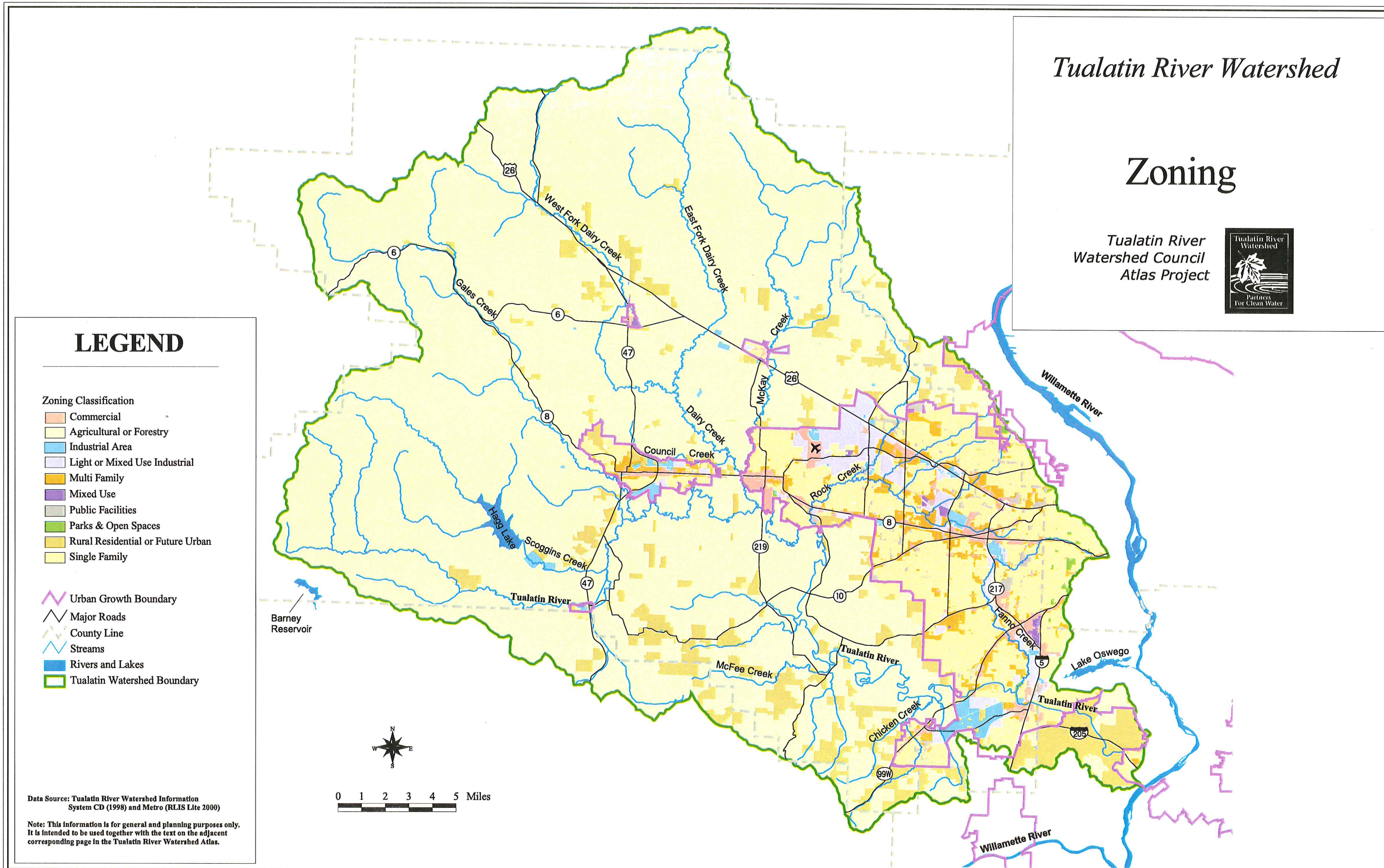
Metropolitan Service District (Metro)

Portions of the watershed within the jurisdiction of Metro are subject to the Regional Urban Growth Goals and Objectives (RUGGOs) that the Metro Council adopted in 1991 (since amended) in accordance with state law. RUGGOs are designed to complement local watershed plans. One objective states that Metro will "manage watersheds to protect, restore and ensure to the maximum extent practicable the integrity of streams, wetlands and floodplains, and their multiple biological, physical and social values." The RUGGOs also address protection of natural areas and wildlife habitat, and agriculture and forest lands, and they require that Metro use performance measures for all goals and objectives.

Developed partly in response to significant flood damage that occurred in 1996, Metro's Title 3, Stream and Floodplain Protection Plan, addresses conflicts between growth, development, and resource protection. Title 3 also responds to degradation of water quality in urban streams caused by impervious surfaces, loss of riparian vegetation, and construction practices that allow sedimentation and erosion to occur.

Washington County Soil and Water Conservation District

The Washington County SWCD helps primarily rural and agricultural landowners and managers plan and implement conservation systems, working cooperatively with federal agencies and the Oregon State University Extension Service. The SWCD prepared a plan for reducing or eliminating "...all excessive non-point source pollution of the Tualatin River from the rural areas... contributing to the restoration of the Tualatin's waters to a level of quality that will preserve and protect their beneficial uses."


Tualatin River Watershed
Zoning
Tualatin River
Watershed Council
Atlas Project
Tualatin River Watershed
Partners For Clean Water
LEGEND
Zoning Classification
Commercial
Agricultural or Forestry
Industrial Area
Light or Mixed Use Industrial
Multi Family
Mixed Use
Public Facilities
Parks & Open Spaces
Rural Residential or Future Urban
Single Family
Urban Growth Boundary
Major Roads
County Line
Streams
Rivers and Lakes
Tualatin Watershed Boundary
Data Source: Tualatin River Watershed Information System CD (1998) and Metro (RLIS Lite 2000)
Note: This information is for general and planning purposes only. It is intended to be used together with the text on the adjacent corresponding page in the Tualatin River Watershed Atlas.
0 1 2 3 4 5 Miles
N
W
E
S
West Fork Dairy Creek
East Fork Dairy Creek
Gales Creek
McKay Creek
Dairy Creek
Council Creek
Rock Creek
Hagg Lake
Scoggins Creek
Tualatin River
Barney Reservoir
McFee Creek
Chicken Creek
Fanno Creek
Lake Oswego
Willamette River
26
6
47
8
219
10
217
5
205
99W

Hydrology Characterization

Hydrology

The meandering Tualatin River is about 80 miles long and has four large elevation drops; at Ki-a-cuts Falls, Haines Falls, Lee Falls, and Little Lee Falls right before it enters the Tualatin Valley plain at an elevation of 120 feet. The Tualatin enters the Willamette at Willamette river mile 28.5. The Tualatin River drainage basin is approximately 42 miles long and 29 miles wide and covers an area of 712 square miles.

Annually, more than 1.1 million acre-feet of water flow out of the watershed into the Willamette River (including water imported from the Trask and Bull Run rivers). Nearly 85 percent of this flow is discharged during November through March, and less than 3 percent typically is discharged during June through October.

The Tualatin River has five major tributaries:

(1) Gales Creek flows through a mostly forested landscape;
(2) Dairy Creek flows through forested landscape in the uplands, and then through predominantly agricultural lands lower down;
(3) Rock Creek has both agricultural and urban influences;
(4) Fanno Creek is an almost exclusively urban area; and
(5) Scoggins Creek, which receives water releases from Hagg Lake, is mainly forestry and agricultural.

Scoggins Dam, located near the town of Gaston, stores runoff from the Scoggins Creek watershed. The dam forms a reservoir, Henry Hagg Lake, which provides active water storage capacity of about 56,000 acre-feet. The dam and reservoir are owned by the Bureau of Reclamation and operated by Tualatin Valley Irrigation District. The project provides flood control, irrigation water, municipal water supply, water quality benefits, and recreation.

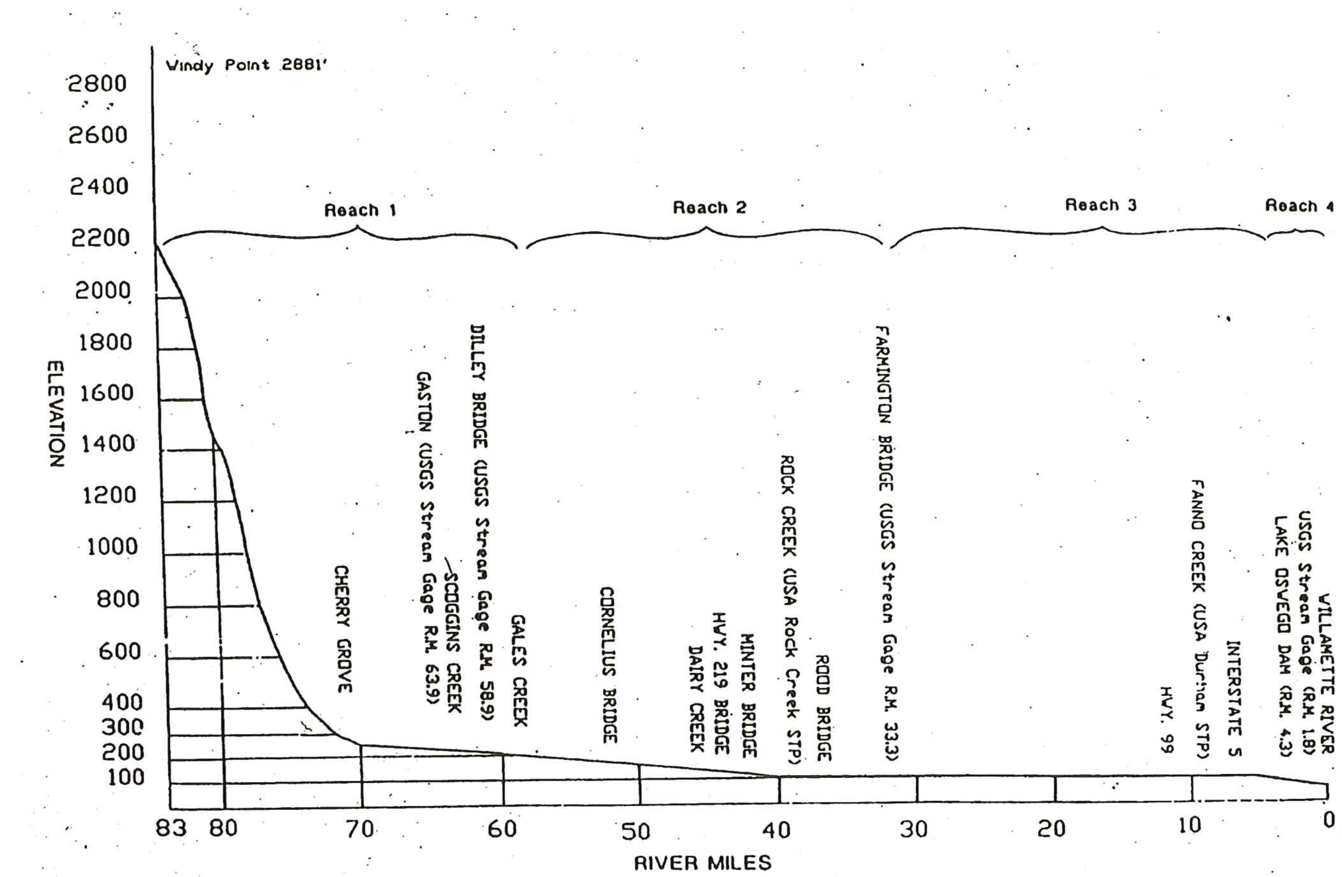


Figure 5. Tualatin River Elevation Profile

Flows within the Tualatin River Watershed exhibit a definite seasonal pattern. The high flows generate extremely high turbidity and suspended solids in the mainstem and many of the tributaries. Significant fall-winter flood events in 1995 and 1996 have increased concern with flood management and control in the watershed. However, water quality impacts from the winter events have not been extensively studied. Increased development within the urbanized portion of the watershed has led to higher peak flows which has led to degradation of streams. There have been no direct studies of the impacts of this stream degradation on stream health.

Low summer flows have historically resulted in high levels of phytoplankton growth and low dissolved oxygen (DO) concentrations. The low DO concerns have led to increased monitoring and management of the Tualatin River during the low-flow months of May through October. Both water quality management practices and flow augmentation have been undertaken to improve water quality during the low-flow period. The goal of flow augmentation is to maintain minimum monthly mean flow of 120 cubic feet per second (cfs) from June to August and 150 cfs for September to November at the Farmington gauge, RM 33.3 (Aroner, 1996). During this summer period, flow in the Tualatin River is increased by as much as one-third of its natural flow through input to the Tualatin River from Scoggins Reservoir (Henry Hagg Lake), Barney Reservoir, and the Rock Creek and Durham wastewater treatment plant (WWTP) effluent.

A shallow aquifer is near the surface of much of the valley floor and lies within alluvial fill. A separate aquifer that is as much as 1200 feet below land surface lies within Columbia River Basalt. The alluvial aquifers are typically filled each winter from precipitation.

Key Areas of Concern

Continued development within the watershed will impact river morphology due to more direct delivery of runoff from impervious surfaces. This contributes to higher flow velocities and subsequent scouring and sediment movement. Increased building and housing developments have the potential for decreasing stream or river riparian buffer zones and loss of trees near these streams. Loss of riparian buffer zones can cause increased temperatures in streams and increased sediment, nutrients, and pollutants reaching the river. Agricultural and forestry activities can also lead to similar degradation due to vegetation removal and unmaintained roads and culverts.

Since the nineteenth century, more than half of the Tualatin Watershed has been converted from original forest and floodplain habitat to urban or agricultural use. The remaining forest is now intensively managed. The valley bottomlands are very fertile as a result of nutrient-rich sediment deposited over centuries of flooding. Though the watershed still receives large amounts of precipitation, water retention has been reduced while water use exceeds the watershed's supply from May into November in an average year. The abundance and diversity of fish and wildlife populations have become threatened by shrinking habitat and human impacts on aquatic and terrestrial communities.

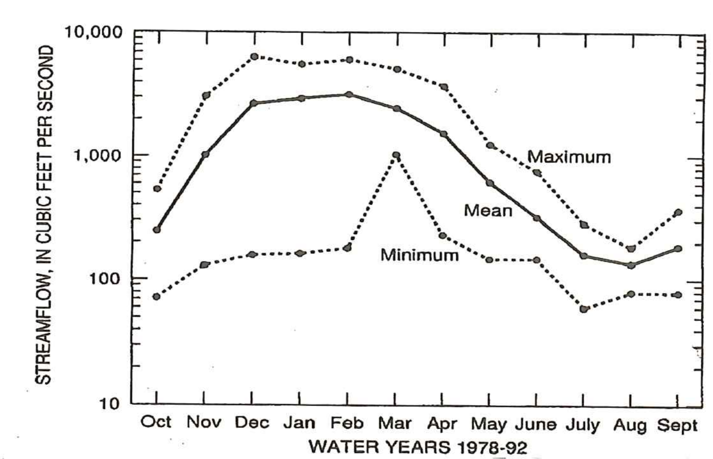
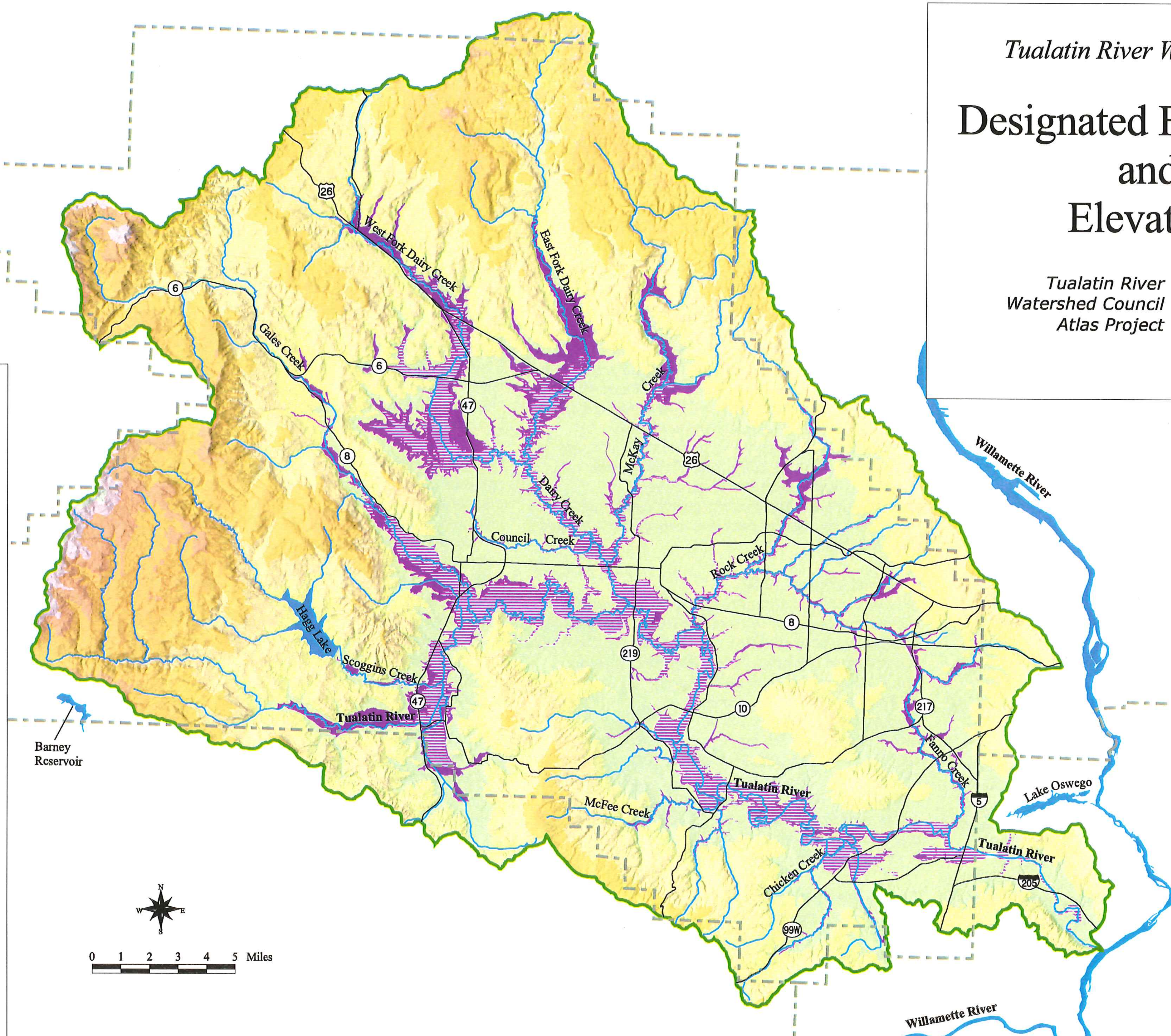


Figure 6. Tualatin River Average Monthly Streamflow 1978-1992

Tualatin River Watershed

Designated Floodplain and Elevation

Tualatin River Watershed Council Atlas Project



LEGEND

Elevation Ranges (feet)

- 3500
- 3000
- 2500
- 2000
- 1500
- 1000
- 500
- 300
- <300

- 1996 High Water Area
- 100 Year Floodplain

- County line
- Major Roads
- Tualatin Watershed Boundary
- Streams
- Major Rivers and Lakes

Data Source: Tualatin River Watershed Information System (1998) and Metro (RLIS Lite 2000)

Note: This information is for general and planning purposes only. It is intended to be used together with the text on the adjacent corresponding page in the Tualatin River Watershed Atlas

Surface Water Quality

Tualatin River water quality has been subject to a great deal of study and increased management since the 1960s. Wastewater came from domestic sewage, canneries, slaughtering, tanneries, food products manufacturers, and others (Cass, 1993). The Clean Water Act (CWA) was established in 1972 to improve the quality of the nation's rivers. Intensive water quality monitoring for the Tualatin River began in 1979.

What is a TMDL?

A simplified answer is that the Total Maximum Daily Load (TMDL) is the amount of a particular pollutant that a particular stream, lake, estuary or other waterbody can 'handle' without violating state water quality standards.

The term "water quality limited" is used in the CWA to define stream reaches that do not meet established water quality standards even after the implementation of standard technology to control the point source pollution. Once a river has been designated as water quality limited, the CWA requires that water quality standards be met by developing standards such as Total Maximum Daily Loads (TMDLs). In 1984 and 1986, the DEQ listed the Tualatin River as water quality limited because of low dissolved oxygen concentrations and nuisance levels of algae caused by elevated phosphorus levels. Beneficial uses of the river, designated as "aesthetics" and "swimming" were listed as impaired by algal blooms.

In 1986, a lawsuit was filed to require enforcement of the Total Maximum Daily Load (TMDL) section of the CWA. Resulting from this lawsuit the Oregon Department of Environmental Quality (DEQ) adopted ammonia nitrogen and phosphorus TMDLs. The establishment of TMDLs in the Tualatin River Watershed prompted several actions. Tertiary (advanced) treatment at Unified Sewerage Agency's two largest wastewater treatment plants, Rock Creek and Durham, was implemented to remove phosphorus. In addition, those plants were re-engineered to encourage bacteria-mediated nitrification within the plant, thereby minimizing discharge of ammonia to the river. These efforts led to significant reductions of phosphorus and ammonia from these point sources on the mainstem Tualatin River.
In addition to point source pollution reduction efforts, the Oregon Department of Agriculture helped control phosphorus releases from many dairy and nursery operations. In June of 1992, it was evident that the point sources would meet their wasteload allocations, defined by the 1987 court action. By June 1993, the Tualatin River was in compliance with the ammonia-nitrogen TMDL, and an extended implementation and compliance schedule had been developed and approved for the total phosphorus TMDL.

Year 2001 TMDLs

Since the 1986 TMDLs, water quality concerns have expanded from the mainstem Tualatin River to include the tributaries. In 1998, 274 out of 898 stream miles in the Tualatin Watershed were listed as water quality limited for one or more of the following parameters: bacteria, low dissolved oxygen, temperature, pH, Biological criteria (fish communities), Chlorophyll a, and toxics (iron, arsenic, and manganese). In 2001, four TMDLs were developed addressing dissolved oxygen, temperature, bacteria, and algae/phosphorus. The DEQ plans to use the adaptive management approach to all TMDLs.

Dissolved Oxygen (DO)

Dissolved oxygen gets into water by diffusion from the surrounding air, by aeration (rapid movement), and as a waste product of photosynthesis. Oxygen is necessary to all forms of life, but too much or too little oxygen in the system can be fatal to aerobic life forms. As dissolved oxygen levels in water drop below 5.0 mg/l, aquatic life is put under stress. The lower the concentration, the greater the stress. Oxygen levels that remain below 1-2 mg/l for a few hours can result in large fish kills.

Twenty one tributaries to the Tualatin are listed on the 1988 water quality limited list for dissolved oxygen. According to the DEQ, the two factors that have the most significant effect on the low dissolved oxygen concentrations in the tributaries are temperature and sediment oxygen demand (the decomposition of bottom sediments which consumes dissolved oxygen). Temperature will be addressed through the temperature TMDL. To address sediment oxygen demand, reductions in both point and non-point organic solids discharged to the streams will need to occur.

Temperature

The Tualatin River is home to winter steelhead and resident cutthroat trout. Elevated temperatures can cause increased incidence of disease, an inability to spawn, reduced rates of growth and survival of eggs and juveniles, and increased competition for limited habitat and food, and others. In the mid to upper 70s, temperatures can become lethal to salmonids. The goal of the standard its to prevent or minimize warming caused by human activity when temperatures exceed these values. The Tualatin River and many tributaries exceed the standard in July and August with temperatures ranging up to the lower to mid 70's. Currently, approximately 76% of the stream network exceeds the 64 degree Fahrenheit standard in mid-summer.

Factors that affect stream temperatures include riparian vegetation, stream morphology, warm water discharges, hydrology, climate, and geographic location. Climate and geographic location are outside of human control. In the Tualatin, humans can affect vegetation, channel morphology, and hydrology. With removal of riparian vegetation, the amount of solar radiation reaching the water increases, as it does with widened channels. Impermeable surfaces, such as pavement, reduce summertime base flows and the volume of water. In the Tualatin, modelling by the DEQ indicates that "increases in solar radiation loading due to riparian vegetation disturbance and discharge of warmer water from point sources were primary causes of increased stream temperature." (DEQ, 2001) In order to address warmer temperatures, management plans will increase effective stream shading on most tributaries to a range between 82 and 100%.

Bacteria

The Tualatin River and tributaries are used for swimming, wading, fishing, and boating. Bacterial contamination of these waters can affect the health of people recreating in the water. Bacteria can enter the waterways through several different routes. Untreated sewage can overflow from sewage treatment plants (although this is rare in the Tualatin). Failing septic systems, runoff contaminated with animal wastes (such as livestock, domestic pets), can elevate bacteria levels. The highest levels of bacteria in the Tualatin watershed generally occur during periods of stormwater runoff due to rain events.

Phosphorus/algae

Late summer and early fall algal blooms, resulting from a combination of high nutrient loads (nitrogen, phosphorus) and abundant sunshine are the major controller of dissolved oxygen levels in the main stem Tualatin River. Algal blooms are not desirable because they can lead to depletion of oxygen in the water when they die. Furthermore, algal blooms reduce water clarity, decrease the aesthetic value of streams, produce wide fluctuations in pH, and may produce foul tastes and odors. Growth of suspended algae is stimulated by slow water velocities and high nutrient concentrations.

Other Water Quality Concerns

Biological Criteria

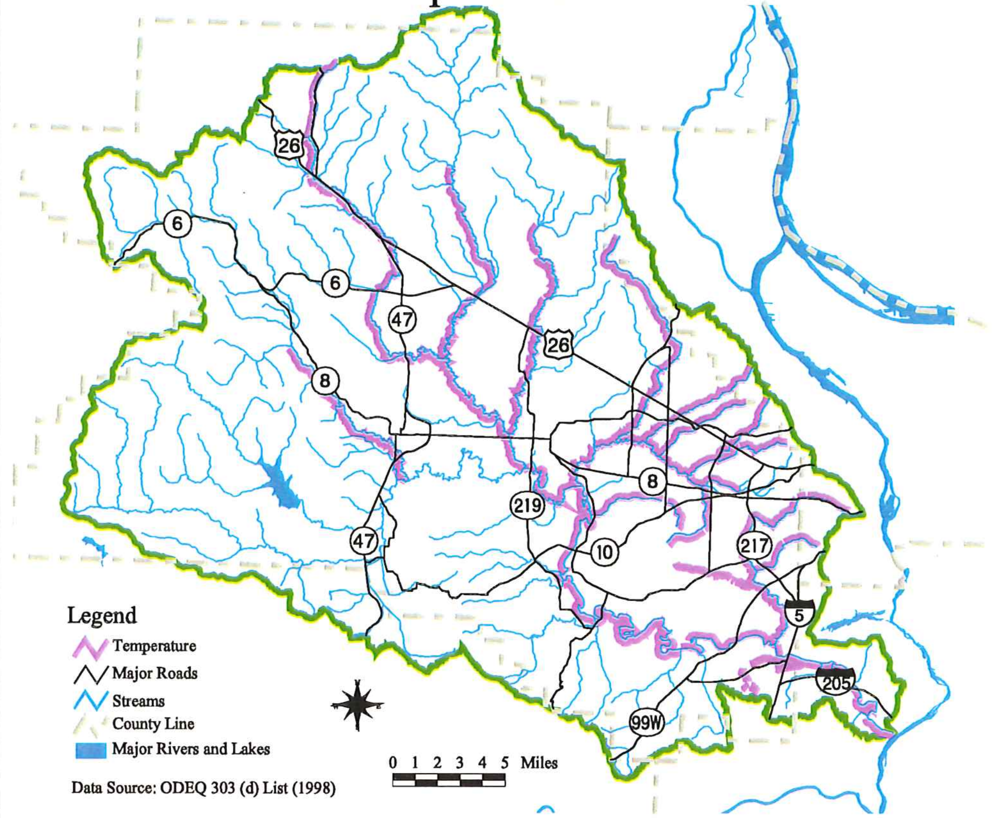
DEQ has determined that physical habitat and water quality affect fish assemblages in the Tualatin and would need to be addressed to show improvements in fish populations. No TMDLs are being developed for biological criteria, habitat, or flow. However, TMDLs are being developed for temperature and dissolved oxygen throughout the basin which should address the pollutants of concern and improve the water quality for the fish assemblages. Other factors such as habitat and flow improvements will also need to be addressed in management plans in order to have substantial improvements in the fish assemblages.

Toxics

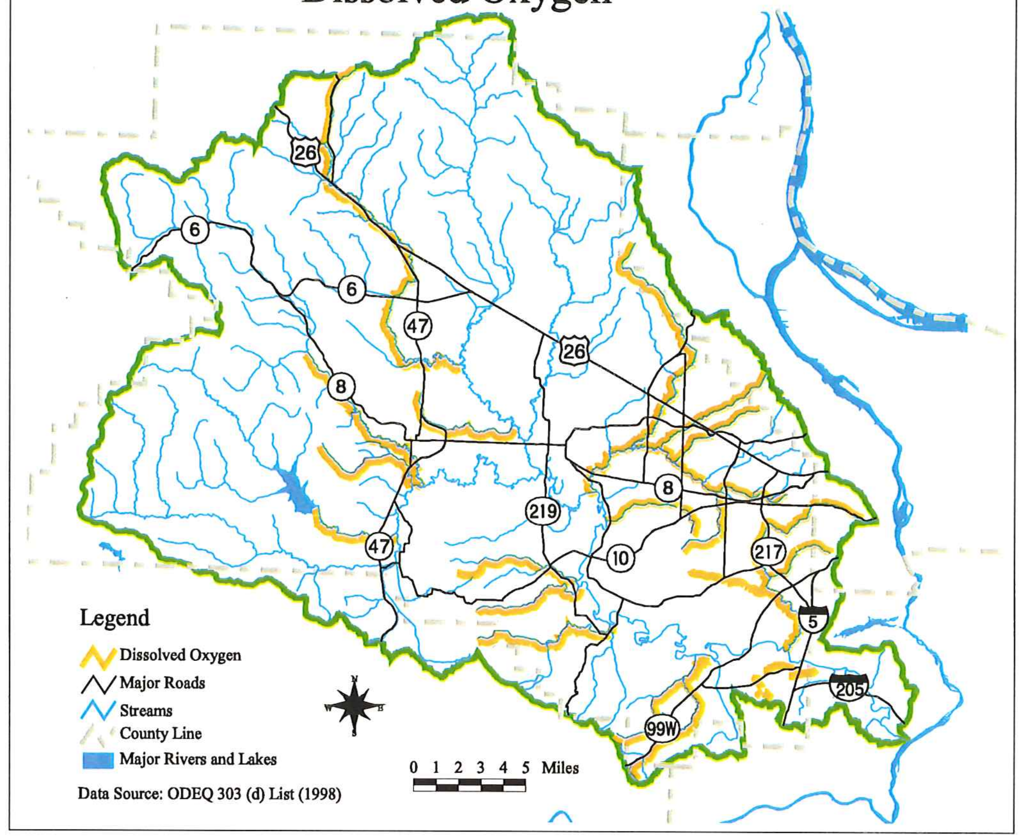
Manganese, iron, and arsenic were found above water quality standards in some water quality samples taken in 1993. After investigating the issue, the DEQ concluded that "Exceedences of water quality criteria for arsenic, iron and manganese are common throughout the Tualatin Subbasin. It appears that arsenic, iron and manganese are mobilized in Tualatin Subbasin groundwater due to their natural presence within local alluvial deposits and the predominance of reducing conditions within associated aquifers. Surface water concentrations of arsenic, manganese, and iron appear to be a reflection of the natural geochemical environment and regional groundwater hydrology." Due to the apparently natural origin of these substances, no TMDL was developed addressing toxics.

Water Quality Limited Streams 1998

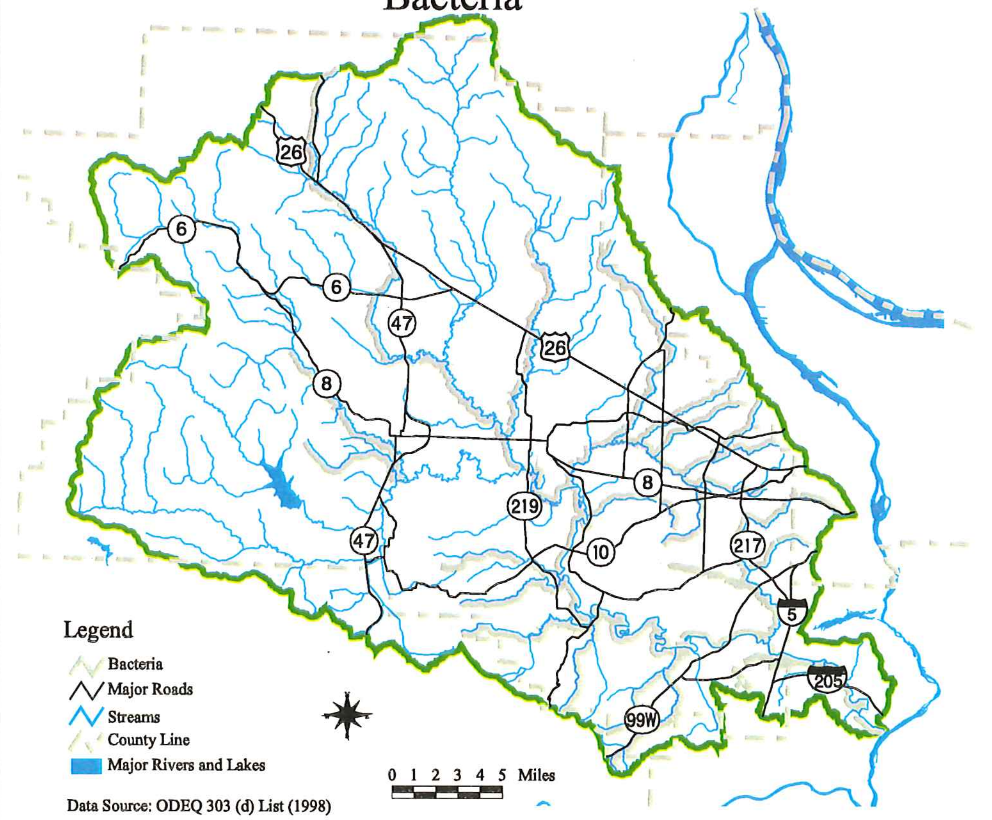
Temperature



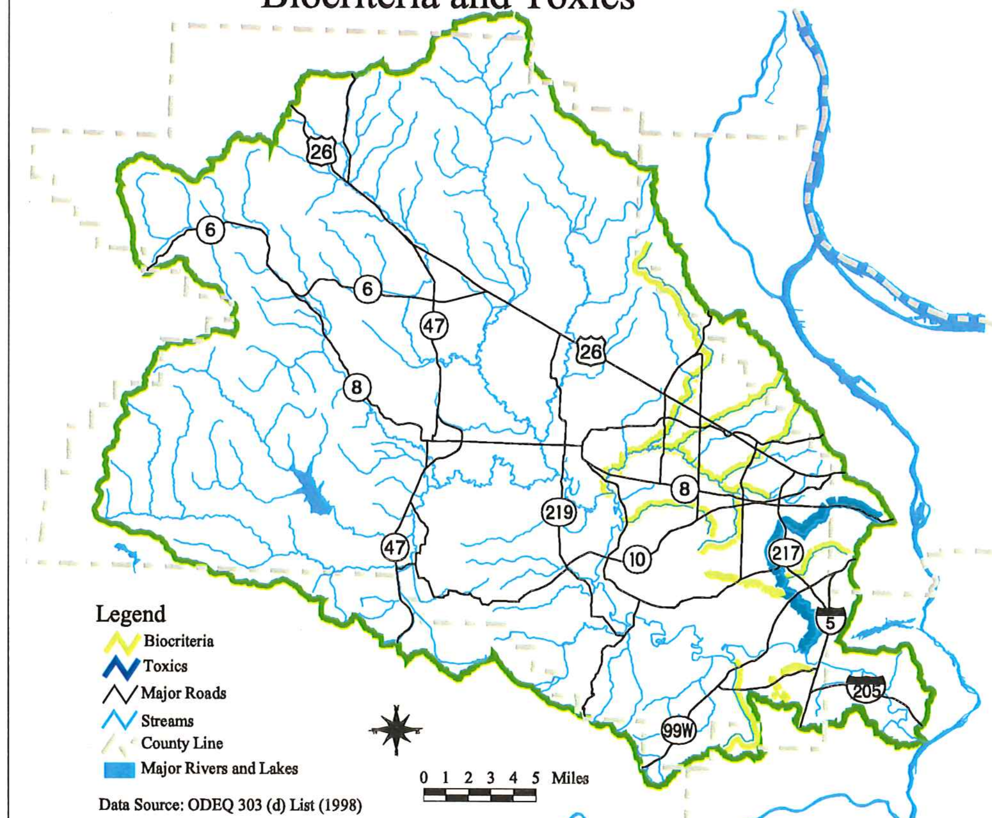
Dissolved Oxygen



Bacteria



Biocriteria and Toxics



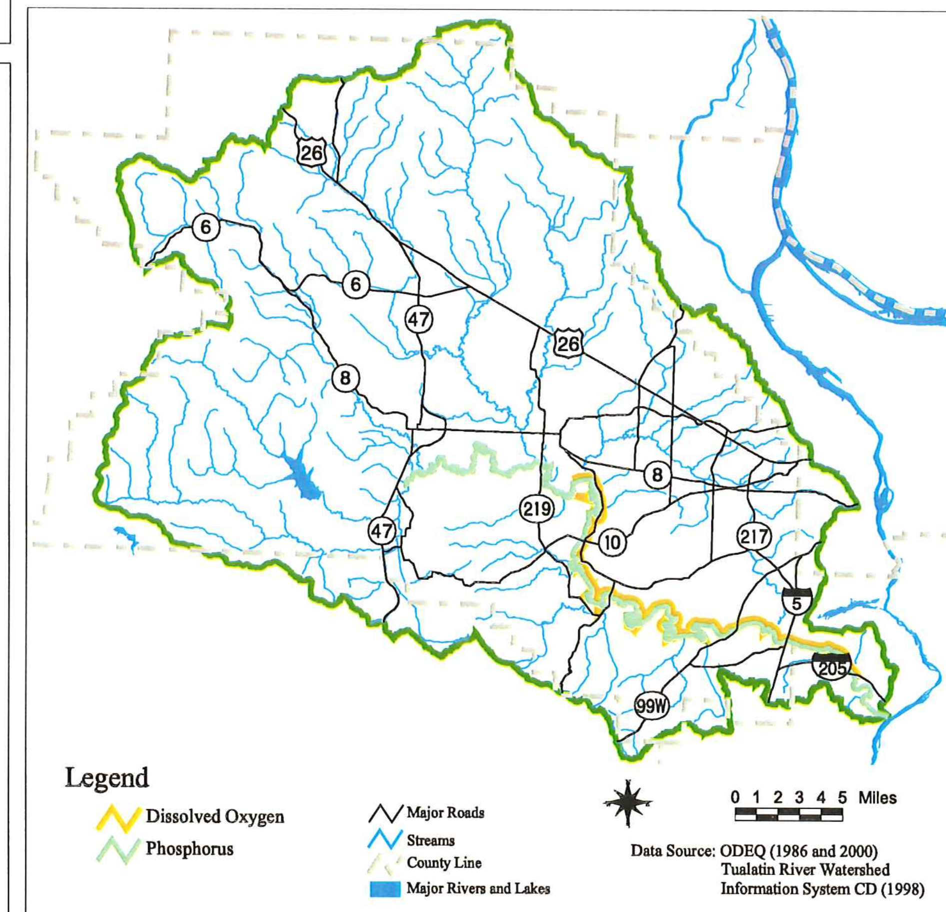
Tualatin River Watershed

Water Quality

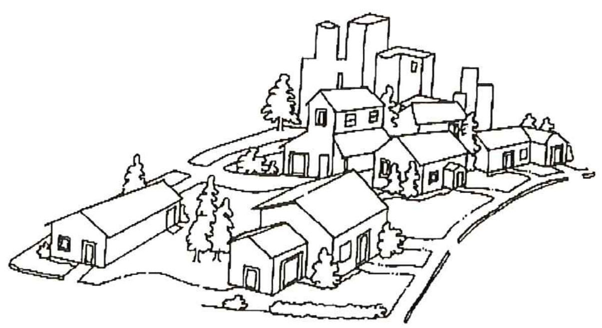
Tualatin River Watershed Council Atlas Project

Tualatin River Watershed Partners for Clean Water

Water Quality Limited Streams 1986



Geography, Geology, and Soils



Geography

The Tualatin River Watershed is a low elevation, low gradient drainage area that covers 712 square miles in the northwest corner of the State of Oregon. The headwaters of the Tualatin and many of its tributaries originate in the Coast Range and from the Tualatin Mountains, a spur of the Coast Range. These hills wall in the valley on the north and east. The Chehalem and Parrett Mountains (1630 and 1240 feet maximum elevation, respectively) form the southern rim of the watershed. The watershed is about 42 miles long when measured in a straight line from headwaters to mouth. After dropping about 2,700 feet over its first 14 miles, the river meanders the rest of its 83 mile length.

Nearly half the watershed is a broad alluvial valley where elevations are between 100 and 200 feet. There are only four low notches in the wall of mountains around the Tualatin River Watershed. The Tualatin River drains into the Willamette River through a steep, walled canyon, falling about 50 feet over its last three miles beyond the dam at Lake Oswego. The other notches are found at Wapato Lake, Fields Bridge, which is the mouth of the Tualatin, Oswego Notch and at Tonquin. Through these low spots, prehistoric floods filled the Tualatin River Watershed with approximately 500 feet of water.

During the Wisconsin stage of the last ice age, 12,800 to 15,000 years ago, numerous ice dams across the Upper Columbia River built up, then collapsed, resulting in catastrophic flooding. These floods, referred to as the Missoula or Bretz floods, filled the Willamette Valley. The lake formed in the Willamette Valley by these flood waters is referred to by geologists as Lake Allison. These catastrophic floods punched their way into the Tualatin River Watershed and left a landscape dominated by swamps and prairies. The older alluvial soils in the Tualatin Valley were probably carried during these floods. Newer alluvial soils are found near the Tualatin River, placed by much smaller floods of the river itself.

Floodwaters from the Tualatin River and its tributaries contributed sediment and fallen trees and helped the growth of dense vegetation. The river flow frequently exceeded the channel capacity and spread over the valley floor, forming slow-draining marshlands. Early trapper reports note the wet condition of the valley floor, and one such trapper, Peter Ogden, described the Tualatin Valley as "mostly water connected by swamps." The largest marshy area was near the fork of Dairy Creek. Other marshy areas were found along Wapato Creek and in the embayment of the valley plain.

Geology

The oldest geologic units in the Tualatin Watershed are volcanic and sedimentary rocks formed during the Eocene and Oligocene ages of the Tertiary Period. The volcanic rocks are mainly basaltic lavas and tuffs, and are overlain by the sedimentary rocks, which are mainly shale, claystone, sandstone, and siltstone (Hart and Newcomb, 1965). The watershed has a bowl-like shape, surrounded by mountains and underlain entirely by Columbia River basalt dating from the middle Tertiary period; this is the uppermost bedrock of the watershed. This basalt layer is dense and is composed of an aggregation of lava flows which varies in thickness from zero to more than 1,000 feet. This formation surfaces along many of the boundaries of the watershed, and is buried under nearly 1,500 feet of sediment in the center of the watershed, near Hillsboro. The "bowl" of the basalt is partially filled with unconsolidated sedimentary material which has been described in many ways. The deposits were grouped together by Hart and Newcomb (1965) as undifferentiated Tertiary and Quaternary basin fill. Trimble (1963) broke it into two basic layers: the lower or pre-Quaternary sediments which he termed the Troutdale Formation and the Sandy River Mudstone equivalent, and the upper layer lacustrine deposits dating from the Missoula Floods during the Pleistocene. Madin (1990) described the older, deeper sediments simply as the Sandy River Mudstone equivalent and the upper as catastrophic flood deposits. Recently, Wilson (1996) identified the older sediments as Neogene sediments and the flood deposits as Willamette Silt.

Soils

Soils of the watershed are very fertile in the flood plains of the Tualatin River and its tributary creeks, leading to a lot of agricultural diversity. The soils of the watershed occur in eleven soil associations, as differentiated by the USDA Natural Resources Conservation Service (formerly Soil Conservation Service). Soil on nearly level flood plains and bottomlands is well- to poorly-drained silty clay loam and clay. On the nearly-level to moderately-steep terraces, soil also varies, and is described as silt loam and silty clay loam. Soil in the gently sloping to very steep uplands on well-drained to poorly drained soils are silt loams or silty clay loams. Soil in the Coast Range is well-drained silt loam and cobbly loam.

Water Quantity & Water Rights

Oregon Water Law

Under Oregon law, all water is publicly-owned. With some exceptions, cities, farmers, factory owners, and other users must obtain a permit or water right from the Oregon Water Resources Department (OWRD) to use water from any source whether it is underground or from lakes or streams. Landowners with water flowing past, through, or under their property do not automatically have the right to use that water.

Oregon's water laws are based on the principle of prior appropriation. This means the first person to obtain a water right on a stream is the last to be shut off in times of low streamflows. In water-short times, the water right holder with the oldest date of priority can demand the water specified in their water right regardless of the needs of junior users. If there is a surplus beyond the needs of the senior right holder, the person with the next oldest priority date can take as much as necessary to satisfy needs under their right and so on down the line until there is no surplus. The date of application for a water use permit usually becomes the priority date of the right.

The prior-appropriation doctrine is the basis of water law for most of the states west of the Mississippi River. In Oregon, the appropriation doctrine has been law since 1909.

Tualatin River Water

As of 1992, the Oregon Department of Water Resources had issued rights to divert a total of approximately 1,194 cubic feet per second (cfs) from surface waters in the Tualatin River Watershed. Rights to 722 cfs are held by agricultural users, with 678 cfs specifically for irrigation. Municipalities hold rights to divert 330 cfs and industries hold rights to 37 cfs. Rights to 104 cfs are held for other uses. Full use of these rights could result in diversion of 508,300 acre feet to out-of-stream uses. This would be 46% of the total average annual discharge (OWRD, 1992).

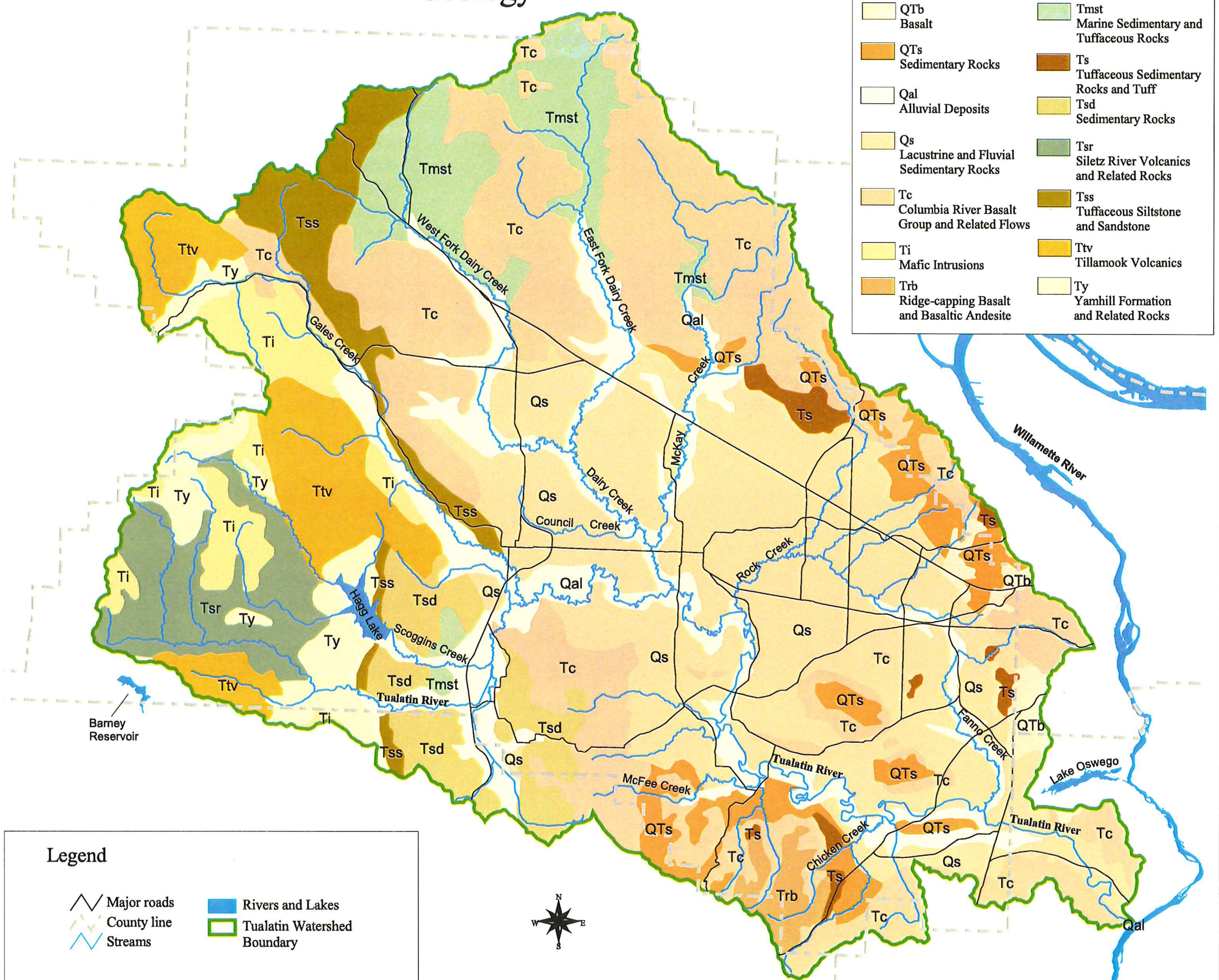
Since 1966, the State of Oregon has set year-round minimum stream flows and instream water rights at various points along the Tualatin River and tributaries. The Tualatin River is managed to meet or exceed existing instream water rights. Flows are generally met on the river due to stored water releases and imported water. Minimum required flows in most of the larger tributaries of the Tualatin are also met, though many smaller streams are not protected by minimum required flows (OWRD, 1992).

Tualatin River Watershed

Geology and General Soils

Tualatin River Watershed Council Atlas Project

Geology



Geologic Units Legend

- QTb Basalt
- QTs Sedimentary Rocks
- Qal Alluvial Deposits
- Qs Lacustrine and Fluvial Sedimentary Rocks
- Tc Columbia River Basalt Group and Related Flows
- Ti Mafic Intrusions
- Trb Ridge-capping Basalt and Basaltic Andesite
- Tmst Marine Sedimentary and Tuffaceous Rocks
- Ts Tuffaceous Sedimentary Rocks and Tuff
- Tsd Sedimentary Rocks
- Tsr Siletz River Volcanics and Related Rocks
- Tss Tuffaceous Siltstone and Sandstone
- Ttv Tillamook Volcanics
- Ty Yamhill Formation and Related Rocks

Legend

- Major roads
- County line
- Streams
- Rivers and Lakes
- Tualatin Watershed Boundary

0 1 2 3 4 5 Miles

Data Source: Tualatin River Watershed Information System CD (1998)
DOGAMI (1991 and 2001) and Metro (RLIS Lite 2000)

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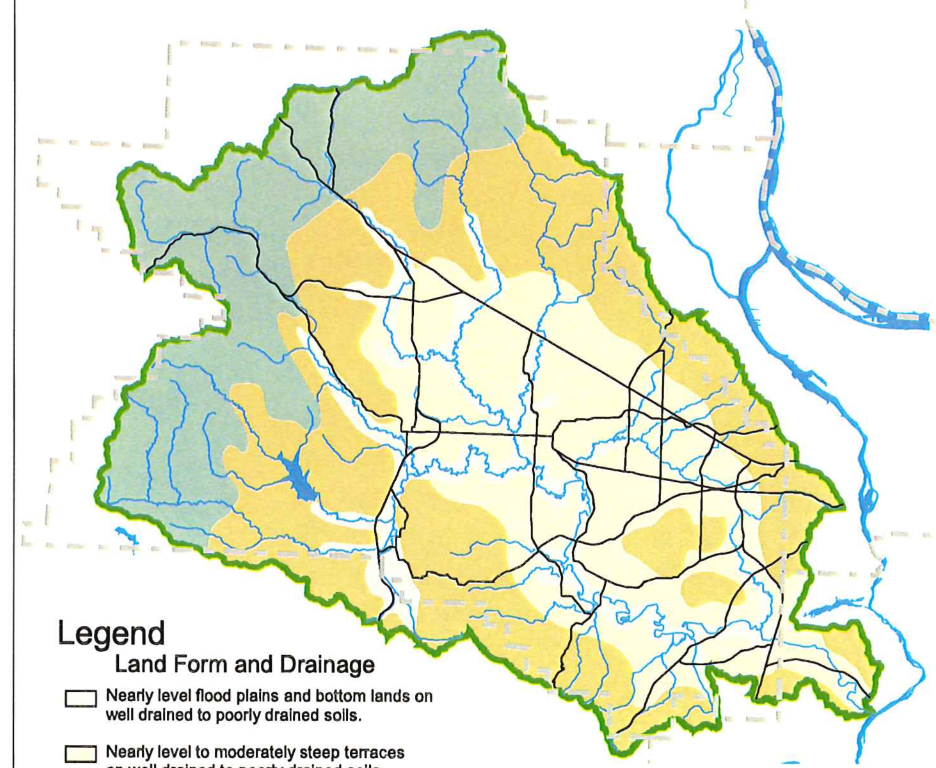
General Soil Classifications



Legend

Land Form and Drainage

- Nearly level flood plains and bottom lands on well drained to poorly drained soils.
- Nearly level to moderately steep terraces on well drained to poorly drained soils.
- Gently sloping to very steep uplands on well drained to somewhat poorly drained soils.
- Gently sloping to very steep mountainous areas of Coast Range on well drained soils.
- Major Roads
- County Line
- Streams
- Major Rivers and Lakes

0 1 2 3 4 5 6 7 8 9 10 Miles

Data Source: USDA, Soil Survey of Washington County (1982)
Tualatin River Watershed Information System CD (1998)

Terrestrial Biota

Ecosystem

The Tualatin Watershed encompasses portions of two ecoregions, the Coastal Range Ecoregion and the Willamette Watershed Ecoregion. Ecoregions divide landscapes into areas of similar land form, vegetation, and soils. The ecoregion concept helps managers assess the quality of the land and water resources relative to appropriate reference conditions. The western and northern sections of the watershed fall within the Coastal Range Ecoregion. The remainder of the watershed is within the Willamette Watershed Ecoregion. Steeper slopes and higher stream densities characterize the Coastal Range portions of the Tualatin Watershed. The Willamette Watershed Ecoregion is flatter with landscape formations dominated by flood plain processes.

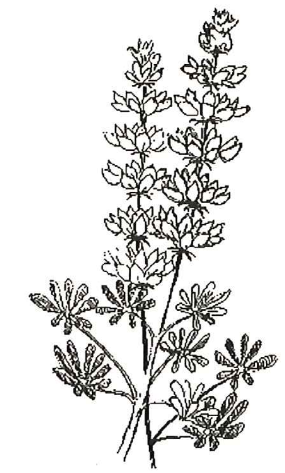
Scientific Resources Inc. (SRI) divided the Tualatin River into four "ecoreaches" in a 1990 report. The ecoreaches were determined based on gradient and other physical, chemical, and biological features of the river. SRI chose descriptive names for the ecoreaches: Riffle (river mile (RM): 0 - 3.4 mi.), Reservoir (RM: 3.4 - 33 mi.), Meander (RM: 33 - 58 mi.), and Mountain (RM: 58 - 83 mi.). Table 3 describes the characteristics of the four Ecoreaches. The first 3.4 mile Riffle Ecoreach of the Tualatin River is dominated by a moderate to high gradient with fast water velocities, bedrock substrate, and a series of pools, riffles, and small falls passable by anadromous fish. The Reservoir Ecoreach has significantly different characteristics from the Riffle Ecoreach. The Reservoir Ecoreach has very slow water velocities which permit occasional stratification and stagnation of pools during summer low flows. In stratified pools, the cooler water on the bottom of the pool is cut off from the atmosphere causing oxygen levels to drop in the deeper water. The distribution of oxygen in stratified pools may force fish to remain near the water surface where warm water temperatures and lack of cover can increase fish mortality. Fish may also move into tributaries. The substrate of the Reservoir Ecoreach is composed of sand, silt, and organic matter. Urban and agricultural encroachment limit riparian cover along the edges of the stream in this Ecoreach. Stream velocities in the Meander Ecoreach are slow but a current remains through periods of low flow. The substrate and riparian characteristics of the Meander Ecoreach are similar to those found in the Reservoir Ecoreach. The Mountain Ecoreach has steep gradients causing faster water velocities with a rock, cobble substrate, and extensive riparian cover.

Reach	Description	River Mile	Elevation Gradient (ft/mi)	Description
1	Mountain	58-80	80.4	Forested, fast moving mountain streams, rock channels
2	Meander	33-58	28	Transition from timberland to farmland, major floodwater storage, log jams
3	Reservoir	33-3.4	0.2	Flat, reservoir like flow with heavy sedimentation, recreational use
4	Riffle	0-3.4	10.1	Steep gradient, short series of shallow pools and riffles

Table 3. Tualatin River Reach Descriptions

Vegetation

Vegetation within the watershed has changed dramatically since pre-Euro settlement. Agriculture, horticulture, fire suppression, and recent urban development have combined to remove much of the pre-settlement vegetation. Nearly all forests in the watershed are second-growth stands within the Coastal Range Ecoregion. In the Willamette Basin Ecoregion, much of the vegetation has been cleared and the soils have been hydrologically and chemically altered for agricultural or urban development. Over half of the agricultural land is devoted to cropland requiring seasonal tillage. The majority of the agricultural land not requiring seasonal tillage is used for tree crops, pasture, nurseries, or vineyards. Indigenous species in undisturbed or restored areas face competition from exotic species like reed canary grass (*Phalaris arundinacea*) and Himalayan blackberry (*Rubus discolor*), two of the most invasive non-native plant species in the watershed.



Riparian areas are important transitional areas which link water and land ecosystems. Vegetation in riparian areas is dependent on stream processes, such as flooding, and often are composed of plants which require large amounts of water, like willows and cottonwood trees. Riparian areas are important for animals in the watershed. Healthy riparian areas provide shade and protection for aquatic organisms and corridors for terrestrial organisms to travel throughout the watershed. Riparian areas also provide structure and diversity in the form of large woody debris. Vegetated riparian buffer strips of greater than 75 feet exist in many of the reaches within the Mountain Ecoreach. The majority of the Tualatin mainstem has riparian buffers of less than 75 feet wide and many tributaries within the Urban Growth Boundary or in agricultural areas have minimal riparian vegetation. Where present, riparian trees outside the Mountain Ecoreach include Douglas fir (*Pseudotsuga menziesii*) and western red cedar (*Thuja plicata*), and the deciduous willows (*Salix* spp.), Oregon ash (*Fraxinus latifolia*), black cottonwood (*Populus balsamifera*), red alder (*Alnus rubra*), and big leaf maple (*Acer macrophyllum*). Understory is dominated by red-osier dogwood (*Cornus stolonifera*), blackberry, snowberry (*Symphoricarpos albus*), oceanspray (*Holodiscus discolor*), hawthorn (*Crataegus douglasii*), Douglas spiraea (*Spiraea douglasii*), slough sedge (*Carex obnupta*), cocklebur, and reed canary grass.

Terrestrial Wildlife

Terrestrial game and non-game species in the Tualatin Watershed are managed by the Oregon Department of Fish and Wildlife according to structured plans and a wildlife diversity plan, respectively. The majority of large game, including Roosevelt elk, black-tailed deer, and black bear, is found in the Coastal Range Ecoregion. In the Willamette Watershed Ecoregion, where wetlands and agricultural areas provide the majority of habitat, birds are important game species. Concentrated human populations in the valleys produce extensive habitat alteration in the lower sections of the watershed.

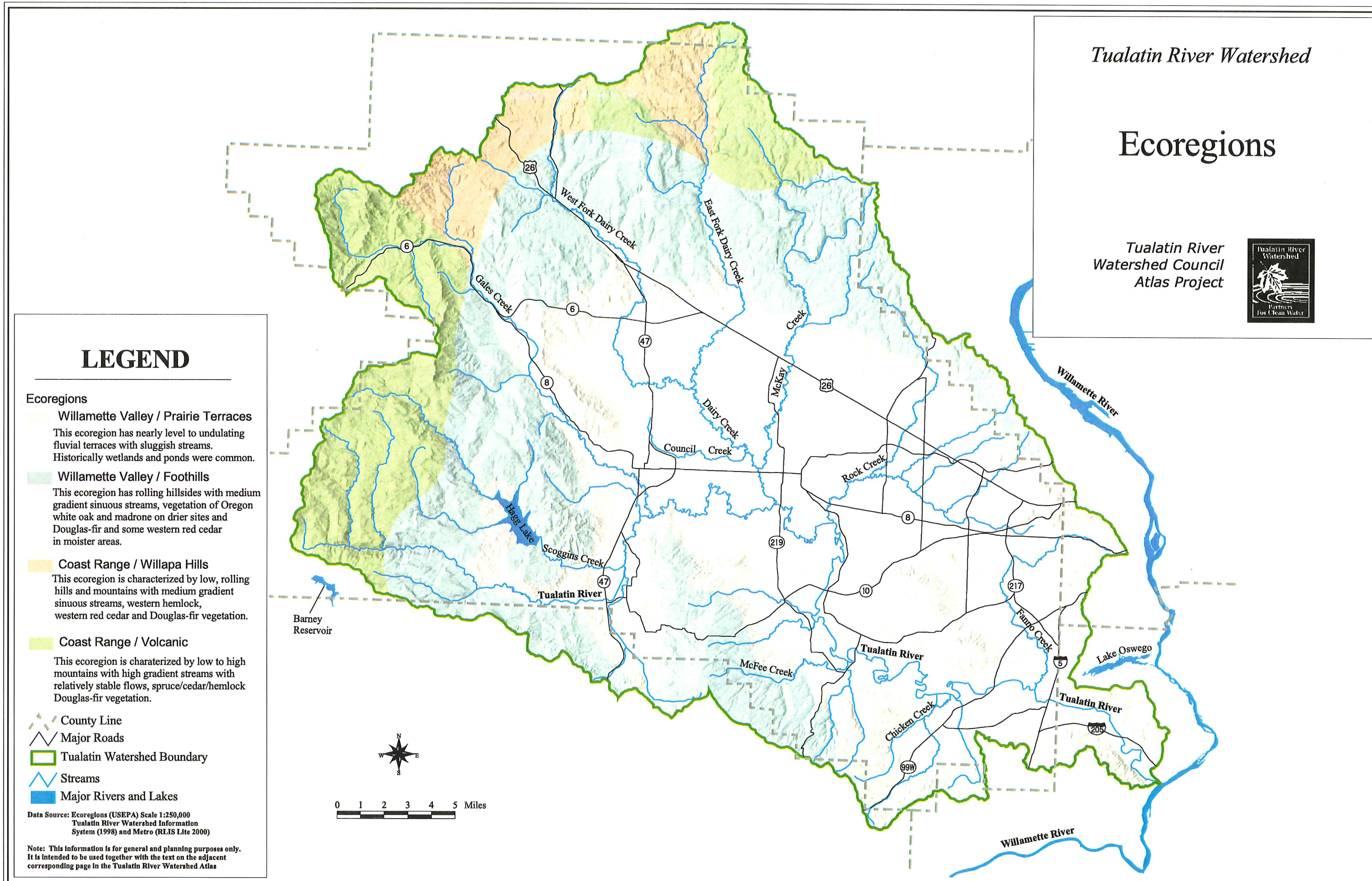
Jackson Bottom Wetland, located south of Hillsboro, and other small ponds and wetlands provide refuge for Canada geese and numerous duck species. It has been estimated that 5,000 Canada geese and 65,000 ducks of various species winter in Washington County. Bird counts at Scoggins Dam conducted by Audubon Society members and Northwest Ecological Research Institute have recorded large increases in starling numbers. Many small mammals, reptiles, and amphibians depend on riparian corridors and wooded areas throughout the watershed, but little specific data exists concerning population assemblages.

The information here is provided in the SRI, 1990 report unless otherwise noted.

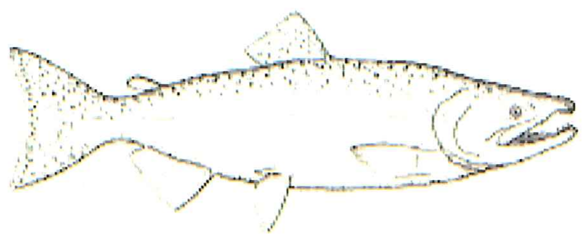
Tualatin River Watershed

Ecoregions

Tualatin River Watershed Council Atlas Project



Aquatic Biota



Aquatic Flora

Aquatic flora in the Tualatin Watershed include duckweed, watercress, and algae. Algae is particularly important to monitor since extensive growths of suspended algae (an algal bloom) leads to depletion of oxygen in the water. Algal blooms decrease the penetration of light which can cause a decline in rooted macro vegetation. Furthermore, algal blooms reduce water clarity, decrease the aesthetic value of streams, produce wide fluctuations in pH, and may produce foul tastes and odors.

Aquatic Fauna

Macroinvertebrates
A healthy aquatic community composed of macroinvertebrates, coldwater salmonids, and other species is important to residents of the Tualatin Watershed. Macroinvertebrates, like mayflies and dragonfly nymphs, are important sources of food for fish. Furthermore, the presence of different kinds of macroinvertebrates can indicate a healthy stream.

Studies of benthic macroinvertebrates have been conducted in the upper reaches of the Tualatin Watershed. These studies have found a high diversity of organisms including several genera of mayflies, caddisflies, and stoneflies. The absence of rocky substrates and moderate-to-high water velocities in the lower reaches of the streams affect the presence of many of these species. Substrate has been found to be the limiting factor in macroinvertebrate populations below the confluence of McKay and Dairy Creeks. The rocky substrates of the upper reaches of the McKay and Dairy Creeks supported a diverse population of organisms relative to the lower reaches where substrate is dominated by sand, silt, and organic matter.

Fisheries
At present, salmonid fisheries in the Tualatin Watershed are depressed as compared with historic diversity and run size. The factors that limit salmonids in the watershed include:

(1) poor habitat (low water velocity, high amounts of silt/organic substrate, and low hydraulic diversity in the river and tributaries)
(2) degraded water quality
(3) low summer flows
(4) high summer water temperatures and
(5) predation by warm water species.

These factors may also cause salmonid usage in some streams to be restricted during the summer and early fall months. In general, salmonids appear to be more abundant in the upper reaches of streams where better physical habitat and water quality exist. The lower reaches are dominated by introduced warm water species, which are typically more tolerant to habitat degradation (ODF&W, 1995).

Species of anadromous salmonids that use the Tualatin Watershed include fall Chinook salmon (Oncorhynchus tshawytscha), coho salmon (O. kisutch), and winter steelhead trout (O. mykiss). Fall Chinook salmon are generally found in the lowest reaches of the Tualatin River, near the confluence with the Willamette River but were found in Scoggins Creek in the 1970s. However, none have been documented in recent years. Cutthroat trout (O. clarkii) occur either as resident or potamodromous (migrating, but strictly in fresh water) populations in the Tualatin Watershed. Other resident salmonid game species include rainbow trout. Warmwater game species include largemouth and smallmouth bass, crappie, bluegill, and catfish. Resident non-game species include dace, squawfish, suckers, sculpins, and three-spine sticklebacks (ODF&W, 1995).

Physical and chemical changes in the streams and the introduction of non-native warmwater species have changed coldwater and salmonid populations in the Tualatin Watershed. Fish habitat constraints identified by the Oregon Department of Fish and Wildlife are:

(1) turbidity and siltation
(2) limited spawning and rearing areas
(3) Balm Grove concrete structure
(4) Lake Oswego Canal, and
(5) predation

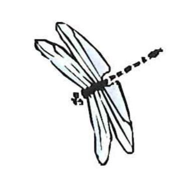
Some parts of the watershed are stocked with cold water game species. ODF&W released rainbow and cutthroat trout in Dairy Creek, Gales Creek, and the Tualatin mainstem but stopped such releases in 1986 to promote natural cutthroat runs. From 1975 to 1995, winter steelhead trout hatchery fish were released into Gales Creek. Hagg Lake and Dorman Pond are still stocked with hatchery trout. Coho salmon, a popular coldwater species, are not believed to have been present in the Tualatin watershed historically; however, construction of a fish ladder at Willamette Falls and stocking by ODF&W since 1962 may have resulted in some natural production today (ODF&W, 1992).

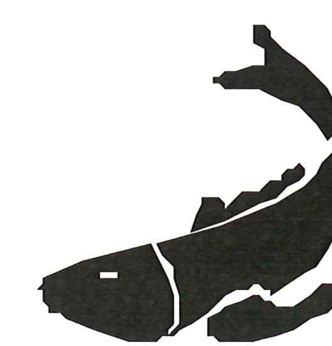
Fifteen tributaries in or near the urban growth boundary in Washington County were surveyed for fish and habitat conditions. ODF&W and the United Sewerage Agency conducted the surveys in 1995. The study used a modification of the index of biotic integrity (IBI) to measure the quality of the fish communities. The IBI ranks streams of defined sizes as excellent, good, fair, poor, and very poor based on the abundance of fish, the diversity of species, feeding structure of fishes, pollution and habitat tolerances of species, and the presence of physical anomalies. The study found only one of the 34 stream reaches sampled ranked good. No reaches achieved excellent scores, 20 ranked poor or very poor, and 13 ranked fair. Some major findings of the report are:

12 of 25 species collected were exotic to Oregon;
Introduced species made up 6% of the total catch;
3% of the fish were intolerant to habitat degradation and pollution;
Intolerant species were generally confined to the upper reaches of forested, free-flowing, relatively undisturbed sites;
Sculpins made up nearly 70% of the total catch
Fish assemblages varied greatly between sites

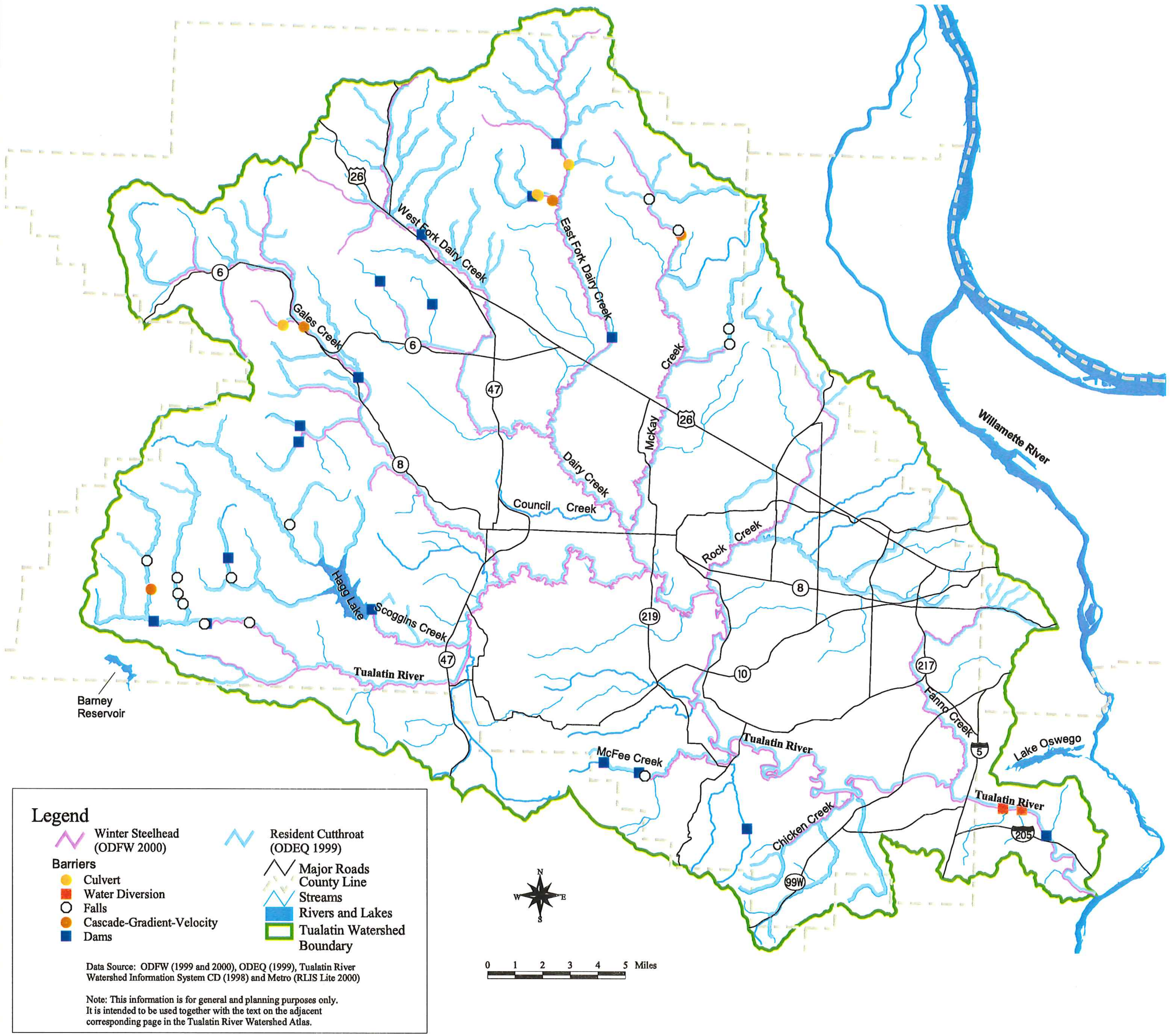
Fish populations outside the urban growth boundary are not as well studied. Upper reaches of the Tualatin River and tributaries within the Mountain Ecoreach support cold water species including resident and migratory cutthroat trout which maintain a popular fishery. IBI scores would likely improve in the upper reaches where the substrate is dominated by boulder and cobble, the landscape is not as developed and water quality is typically better than in the lower reaches.

Unless otherwise noted, information in this section comes from SRI, 1990.





Fish Distribution



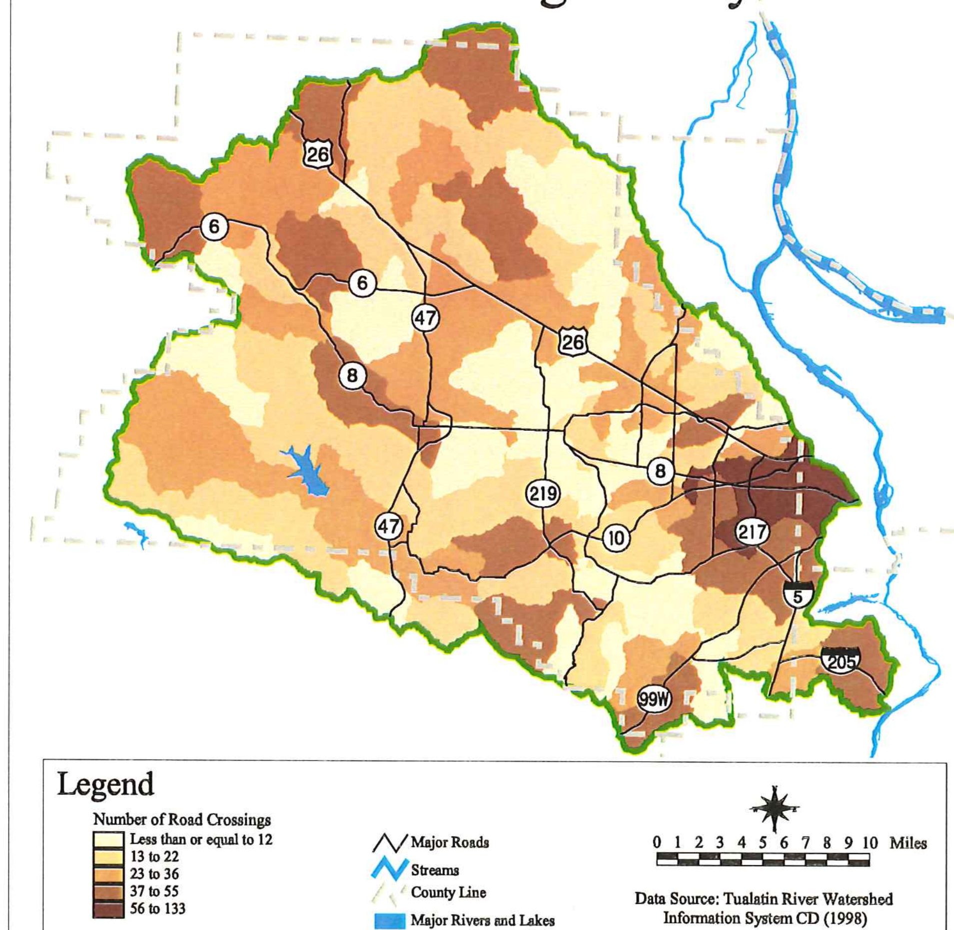
Tualatin River Watershed

Fish Distribution and Road Crossing Density

Tualatin River Watershed Council Atlas Project

Tualatin River Watershed
Partners For Clean Water

Road Crossing Density



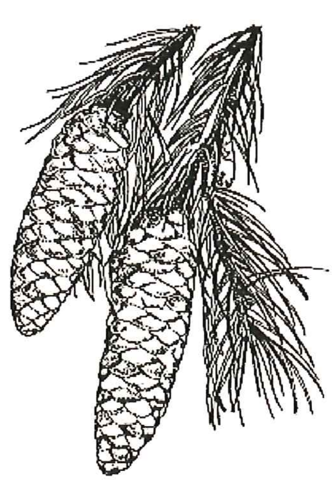
Human Components

Land Use

Home to over 450,000 people, the watershed is approximately 15% urban, 35% farmland, and 50% forested. Major cities located in the watershed include Beaverton, Forest Grove, Hillsboro, Tigard, Tualatin, and portions of Portland. Five percent of land in the watershed is managed by the State of Oregon, and 2% by the Bureau of Land Management. The rest is privately owned or municipal. Thirty three percent of the watershed is impervious surface, with about two thirds of that area directly connected to drainage structures.

Most of the forested land in the watershed lies in the mountains and foothills of the westerly Coast Range, where the Tualatin River headwaters originate. Some forest remains in the northerly Tualatin Mountains and the Chehalem Mountains to the south. Almost none of the forest is old-growth. Additional natural lands include the Tualatin River Wildlife Refuge (800 acres) and other wetlands that lie in the floodplain.

Agriculture in Washington County is dominated—in terms of land area used—by production of grain, hay and silage (61,000 acres) and of grass and legume seeds (20,000 acres). Tree fruits and nuts, vegetable crops, and small fruits and berries also occupy significant acreage in the watershed (19,000 acres total). In terms of gross farm sales, however, specialty products predominate. These include nursery crops and Christmas trees.



Interest in protecting riparian and wetland areas has grown as the remaining natural areas are threatened. Stewardship groups composed of concerned citizens and organizations work to protect and restore these areas. The groups include, but are not limited to: the Tualatin Riverkeepers, the Wetlands Conservancy, Trout Unlimited, the Association of Northwest Steelheaders, TRWC, and numerous Friends, Citizen, and Watch groups.

Why monitor water quality?

Monitoring can be conducted for many purposes, but it is particularly useful to:

- characterize waters and identify changes or trends in water quality over time
- identify specific existing or emerging water quality problems
- gather information to design specific pollution prevention or remediation programs
- determine whether program goals — such as compliance with pollution regulations or implementation of effective pollution control actions — are being met
- respond to emergencies, such as spills and floods.

Transportation

Most urban areas of the watershed lie within the Tri-County Metropolitan Transportation District of Oregon (Tri-Met). Tri-Met currently has 24 bus routes that serve communities in the watershed. All of its buses are equipped to carry bicycles. A light-rail line between Portland and Hillsboro began service in 1998 and also carries bicycles. Limited industrial railroad transportation service also exists.

Metro's environmental considerations specifically promote reduction of air pollution through increased use of transit, telecommuting, zero-emission vehicles, carpools, vanpools, bicycles and walking; reduction of negative impacts on parks, public open space, and wetlands; and reduction of noise and visual impacts of the transportation system on neighborhoods (Metro, 1995).

Socioeconomics

According to the 1990 census, 19% of the watershed's population has a bachelor's or higher degree. In 1994, the per capita personal income in Washington County was $23,504, according to the Oregon Economic and Community Development Department, and had been rising more than $1,000 per year for several years. Prosperity in the area is reflected in the low unemployment rate and by the presence of the northwest's largest enclosed shopping center. Many residents of the watershed commute to work outside of the watershed. The Tualatin River Subbasin Local Agricultural Water Quality Advisory Committee (1996) estimates that 15 jobs are generated by every $1,000,000 in gross farm sales.

In Oregon as a whole, timber harvest has declined since the 1970s. Much of the harvest is immediately transported out of the county.

Wackernagel and Rees (1996) estimate that the amount of land required to produce the goods consumed by an average U.S. citizen is 12.6 acres. This would include food and animal products, housing, transportation, consumer goods, and services such as education, health care, and banking. At this rate, the current population of the watershed, 451,900, is using 5,693,940 acres to meet its needs, an area more than 12 times the size of the watershed. Of course much of this land is also outside of Oregon and the U.S. Even if the estimate is high, clearly residents of the watershed are highly dependent on ecosystems elsewhere. As the population grows (as it is projected to do), we become increasingly dependent on imports from other areas.

Recreation

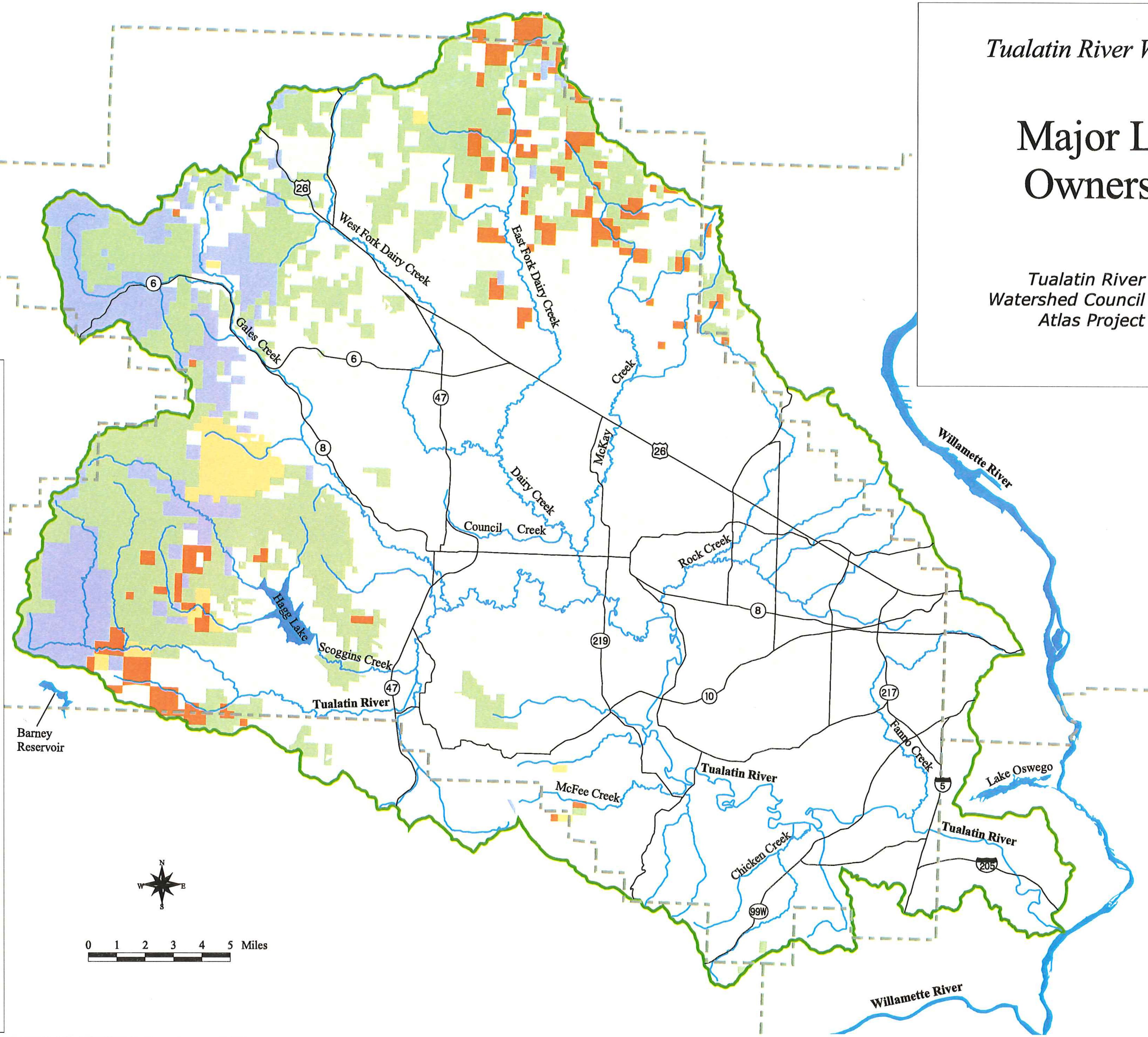
The Tualatin River Watershed provides many recreational opportunities. Within Washington County, about 5,255 acres of public parks, including wetlands natural areas, are available to the public for outdooor recreation. Most of this area lies within the watershed. Some additional park acreage in the watershed lies in neighboring counties.

With 2,600 acres, Henry Hagg Lake is the largest recreational area in the watershed. Also called Scoggins Valley Park, Hagg Lake offers boating and fishing opportunities. The lake is an important part of the managed water system and is a Washington County park. The only State park in the watershed is Banks/Vernonia State Park, with 450 acres. Remaining wetlands natural areas comprise 474 acres in the watershed. The Tualatin Hills Nature Park is the largest one of these areas with 180 acres. The cities of Aloha and Beaverton have 676 acres of parks. Most of these parks and wetlands are managed by Tualatin Hills Parks and Recreation under a 20-year acquisition and management master plan (WCVA, 1996). There are also numerous city-owned parks in the watershed.

Tualatin River Watershed

Major Land Ownership

Tualatin River Watershed Council Atlas Project



LEGEND

Major Land Ownership

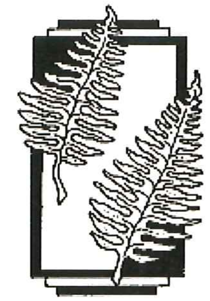
- BLM Lands
- Municipal Lands
- Private Industrial Forestlands
- Private Non-Industrial Lands
- State Lands

- County Line
- Major Roads
- Tualatin Watershed Boundary
- Streams
- Major Rivers and Lakes

Data Source: OSU Forest Sciences Laboratory (1994), Tualatin River Watershed Information System (1998) and Metro (RLIS Lite 2000)

Note: This information is for general and planning purposes only. It is intended to be used together with the text on the adjacent corresponding page in the Tualatin River Watershed Atlas

APPENDIX A



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Appendix B

Abbreviations and Acronyms:

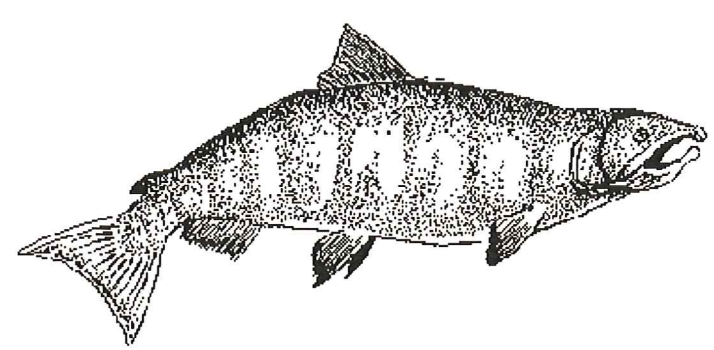
BLM	Bureau of Land Management
BMP	Best Management Practice
BOR	Bureau of Reclamation
cfs	cubic feet second
CWA	Clean Water Act
DEQ	Department of Environmental Quality
DMA	Designated Management Agency
DO	Dissolved Oxygen
EPA	Environmental Protection Agency
GIS	Geographic Information System
GPS	Global Positioning System
IBI	Index of biotic integrity
IWRM	Integrated Water Resource Management
LA	Load Allocation
Metro	Metropolitan Service District
NH3	Ammonia Nitrate
NMFS	National Marine Fisheries Service
NRCS	Natural Resources Conservation Service
ODA	Oregon Department of Agriculture
ODF	Oregon Department of Forestry
ODFW	Oregon Department of Fish and Wildlife
ODSL	Oregon Division of State Lands
OGI	Oregon Graduate Institute
OSU	Oregon State University
ODOT	Oregon Department of Transportation
OWEB	Oregon's Watershed Enhancement Board
OWRD	Oregon Water Resources Department
PSU	Portland State University
QA/QC	Quality assurance and quality control
RUGGO	Regional Urban Growth Goals & Objectives
SWCD	Soil and Water Conservation District
SWRP	Student Watershed Research Project
Title 3	Stream & Floodplain Protection Plan (Metro)
TMDL	Total Maximum Daily Load
Tri-Met	Tri-County Metropolitan Transportation District of Oregon
TVID	Tualatin Valley Irrigation District
UGB	Urban Growth Boundary
USA	Unified Sewerage Agency
USGS	United States Geological Survey
USFWS	United States Fish and Wildlife Service
WLA	Waste Load Allocation
WWTP	Waste water treatment plant

Appendix C

Anadromous and Resident Fishes in the Tualatin Watershed

Anadromous Fishes		Resident Fishes			
Common Name	**Scientific Name**	**Common Name**	**Scientific Name**	**Common Name**	**Scientific Name**
Chinook salmon	*Oncorhynchus tshawytscha*	Yellow bullhead	*Ictalurus natalis* **	Chiselmouth	*Acrocheilus alutaceus*
Coho salmon	*Oncorhynchus kisutch***	Brown bullhead	*Ictalurus nebulosus* **	Peamouth	*Mylocheilus caurinus*
Cutthroat trout	*Oncorhynchus clarki*	Black bullhead	*Ictalurus melas* **	Northern squawfish	*Ptychocheilus oregonensis*
Steelhead trout	*Oncorhynchus mykiss*	Channel catfish	*Ictalurus punctatus* **	Goldfish	*Carassius auratus* **
White sturgeon	*Acipenser transmontanus*	White catfish	*Ictalurus catus* **	Common carp	*Cyprinus carpio* **
Pacific lamprey	*Entosphenus tridentatus*	Yellow perch	*Perca flavescens* **	Longnose dace	*Rhinicthys cataractae*
Western brook lamprey	*Lampetra richardsoni*	Walleye	*Stizostedion vitreum* **	Redside shiner	*Richardsonius balteatus*
		Pumpkinseed	*Lepomis gibbosus* **	Prickly sculpin	*Cottus asper*
		Warmouth	*Lepomis gulosis* **	Reticulate sculpin	*Cottus perplexus*
		Bluegill	*Lepomis macrochirus* **	Torrent sculpin	*Cottus rhotheus*
		Green sunfish	*Lupomis cyanellus* **	Largescale sucker	*Catostomus macrocheiluss*
		Smallmouth bass	*Micropterus dolomieui* **	Mountain sucker	*Catostomus platyrhynchus*
		Largemouth bass	*Micropterus salmoides***	Sand roller	*Percopsis transmontana*
		White crappie	*Pomoxis annularis* **	Starry flounder	*Platichthys stellatus*
		Black crappie	*Pomoxis nigromaculatus* **	Banded killifish	*Fundulus diaphanus* **
		American shad	*Alosa sapidissima* **	Mosquitofish	*Gambusia affinis* **
		Cutthroat trout	*Oncorhynchus clarki*	Speckled dace	*Rhinichthys osculus*
		Rainbow trout	*Oncorhychus mykiss*	Three-spine stickle-back	*Gasteroesteus aculeatus*

** Not indigenous. These species were not found in the Tualatin River Watershed prior to 1800.
(Source: ODFW, 1992)



Appendix D

Tualatin River Watershed Council Information

The purpose of the Council is to coordinate key interests within the Tualatin Basin and facilitate cooperation and understanding among all stakeholders. The Council was formally recognized by the Washington County Commissioners in 1996 to represent the diverse elements of the watershed.

The Council collaborates to pro-actively identify and resolve ecological and management issues, focus resources, agree on goals for watershed protection and enhancement, and foster communication among all watershed interests.

The Council is currently implementing the *Tualatin River Watershed Action Plan* - a long-term vision of ways to improve water quality, enhance fish and wildlife habitat, reduce soil erosion, minimize flooding, and increase recreational opportunities. Maintaining close to a 20-member council, the watershed council represents key interests and stakeholders in the watershed, ensuring a comprehensive view of watershed issues. Council members also regularly communicate with other groups and individuals, forming an even broader network of watershed stakeholders. The stakeholder groups who are part of the council are:

Agricultural Community
Business/Industry
Chambers of Commerce
Citizens
Commercial/Recreational Fisheries
Education Community
Environmental Community
Forestry Community
Local Government
Urban Community

For more information about the Tualatin River Watershed Council visit our website at http://www.trwc.org or call us at (503) 681-0953 or (503) 648-3174.