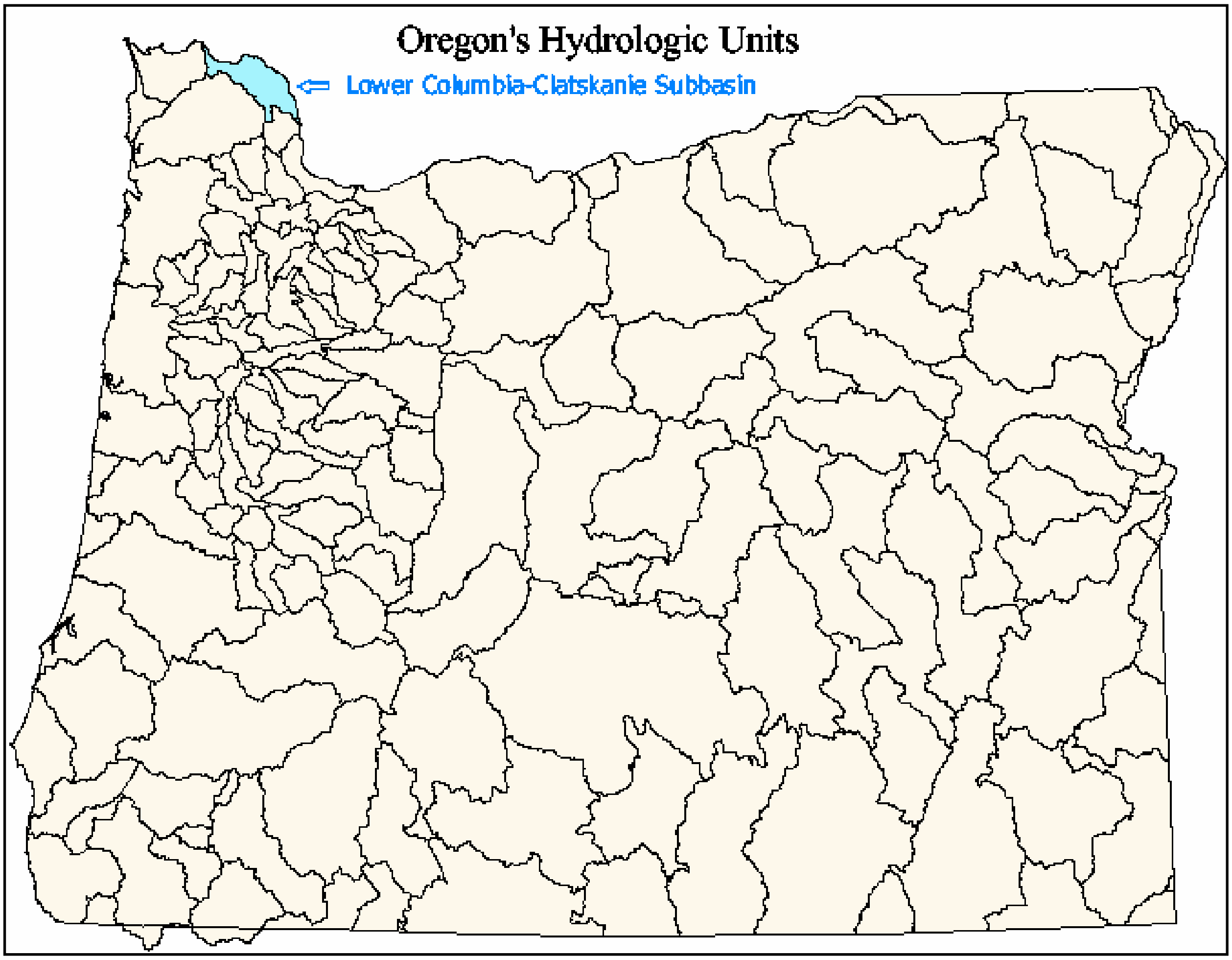


Figure 1.1: Map of Oregon showing the Lower Columbia-Clatskanie Subbasin in relation to other hydrologic units.

I. Introduction to the Watershed Assessment

Purpose

A watershed assessment is a series of environmental evaluations on an area geographically bounded by the extent of the watershed. The definition of a watershed is an area of land in which all the precipitation and groundwater drain down slope to a common point within a stream channel. "Each watershed is drained by a hierarchical network of channels whose size increases downstream from small rills through gullies to small and large river channels as the amount of water and sediment they must carry increases (Dunne, 1978)." Topographical features called ridgelines separate watersheds forming boundaries conveniently mapped for management purposes. Within these boundaries the natural processes and human influences can be summed and analyzed to develop a characterization of watershed conditions. Watersheds are variable in size and within any one watershed a nested set of subwatersheds can also be defined. The practicality of delineating subwatershed boundaries is seen in management and habitat restoration where a large watershed is often partitioned into smaller units to provide a framework for summarizing and analyzing data.

A watershed assessment is the process of evaluating how well a watershed works, with a focus on evaluating the status or health of the aquatic resources. The process includes steps for identifying key issues within the watershed; examining the history of the watershed; describing its features; assessing human influences; and evaluating various resources within the watershed. The goals of the assessment are to identify features and processes important to fish habitat and water quality, determine how natural processes and human activities are influencing those resources, and evaluate the cumulative effects of land management practices over time.

Portland State University prepared this assessment for the Lower Columbia River Watershed Council. The primary goal of the watershed council is to evaluate the conditions within the watershed and develop habitat protection plans and enhancement and restoration projects. The information provided here will be used as a guide for the prioritization and design of restoration projects.

This watershed assessment follows the procedures and guidelines outlined in the Oregon Watershed Assessment Manual. The assessment manual provides a guide on how to compile and evaluate information about watersheds. The manual is organized into ten components: historic conditions; channel habitat types; hydrology and water use; riparian/wetlands; sediment sources; channel modification; water quality; fish and fish habitat; watershed condition evaluation; and monitoring plan. Components one through eight are summarized in the watershed condition evaluation with protection and restoration plans addressed in the monitoring plan component.

Watershed Issues

Through out the Pacific Northwest there have been substantial declines in salmonid runs. This fact has prompted the National Marine Fisheries Service (NMFS) and US Fish and Wildlife Service (USFWS) to list several species of salmonids as threatened or endangered within the Columbia River system. In the NMFS final rule for "Designated Critical Habitat for 19 Evolutionarily Significant Units (ESU) of Salmon and Steelhead in Washington, Oregon, Idaho, and California" the Lower Columbia-Clatskanie Subbasin is listed under nine different ESU's as critical habitat (NMFS, FEB 16, 2000). This population trend is not new; it has its roots in the colonization and subsequent industrialization of the northwest. Because the depletion is the cumulative effect of multiple human activities over a wide geographic area, identification of a single cause is not possible. Causes for the declining populations include a variety of factors from hydroelectric developments and habitat loss to unsuccessful management strategies and competition from hatchery fish. The initial phase of the watershed assessment involved an identification of issues of concern and potential causes for locally depleted salmonid runs. These issues are based on regulatory listings and land use categories and provided an outline of potential watershed issues during the initial phases of the assessment. The issues identified include:

- Declining wild salmon and steelhead populations;
- Water quality parameters for E. Coli and dissolved oxygen do not meet the state standards in the Clatskanie River;
- Loss of streamside vegetation and functions and increased amount of sediment entering streams from forestry activities;
- High summer water temperatures in streams;
- Stream straightening and channelization;

- Undersized or failing culverts creating migration barriers and potential for slopefailures;
- Degraded instream salmonid habitat due to flow alteration, lack of woody debris, and channel scouring.

The watershed assessment addresses each of these issues through its various components by compiling and analyzing existing data. The sections of the assessment include: historical conditions, channel habitat types, hydrology and water use, riparian/wetlands, sediment sources, channel modifications, water quality, fish and fish habitat, and lastly the watershed condition evaluation. The sections of the assessment will be discussed in the order given with the historical conditions included in the introduction to the assessment.

The Subbasin in Oregon

The area of land included in the Department of the Interior's definition of the Lower Columbia-Clatskanie subbasin (Figures 1.1 & 1.2) spans the Columbia River including streams in Washington and Oregon. The boundary of the subbasin has been defined by the Department of the Interior (DOI), U.S. Geological Survey (USGS) publication, "Hydrologic Unit Maps", Water Supply Paper 2294 (1987), and the DOI, USGS, 1:500,000 Scale Hydrologic Unit Map: State of Oregon (1974). This watershed assessment addresses the portion of the subbasin within Oregon, and does not include analysis of the Columbia River or islands within the river. Rather the focus of this assessment is the tributaries of the Columbia River within the Oregon side of the subbasin (hereafter referred to collectively as the subbasin).

Located in the northwest corner of Oregon, the subbasin spans two counties and contains five cities with the largest, St. Helens, being partially contained within its boundaries (Figure 1.2). Bounded by the Columbia River to the north, the Coast Range and Willamette Valley to the south, the subbasin contains a broad range of climatic and geographic characteristics. Elevations range from sea level along the tidally influenced Columbia River to 3007 feet on the slopes of Nicolai Mountain. The subbasin drains 298 square miles and contains three fifth field watersheds Plympton Creek, Clatskanie River, and Beaver Creek. These fifth field watersheds are based on the Regional Ecosystem Office's 1996 designations. Of these three, the Clatskanie River is the only true watershed, within which all of the streamflow is channeled through a common outlet.

The presence of the Columbia River as a natural border to the subbasin necessitates the division of the subbasin into numerous and in some cases small watersheds. In order to analyze the natural processes and human influences in a watershed the boundaries need to accurately represent the true ridgelines separating watersheds. The Beaver Creek and Plympton Creek fifth field watersheds have been divided into smaller watersheds which are both sixth and seventh field (Figure 1.3). The designation of the field of a watershed is dependent on size. The watersheds have been partitioned based on topographical features (ridgelines) and hydrologic connectivity. These watersheds have a wide range in size, the smallest ones are seventh field watersheds. A detailed description of the subwatersheds and rationale for their boundaries will be presented in the section on hydrology and water use. The size of these subwatersheds ranges from less than half a square mile to nearly 95 square miles. The largest of the watersheds are the Clatskanie River (slightly smaller than the fifth field watershed of the same name), Beaver Creek, Tide Creek, Goble Creek, Green Creek, Plympton Creek, and Hunt Creek. The floodplains north of the town of Clatskanie are historic floodplains of the Columbia River that

Data sources: USGS hydrologic unit units; USGS hydrography digital line graph data sets;
Oregon State Service Center for GIS county, city, and highway data sets.

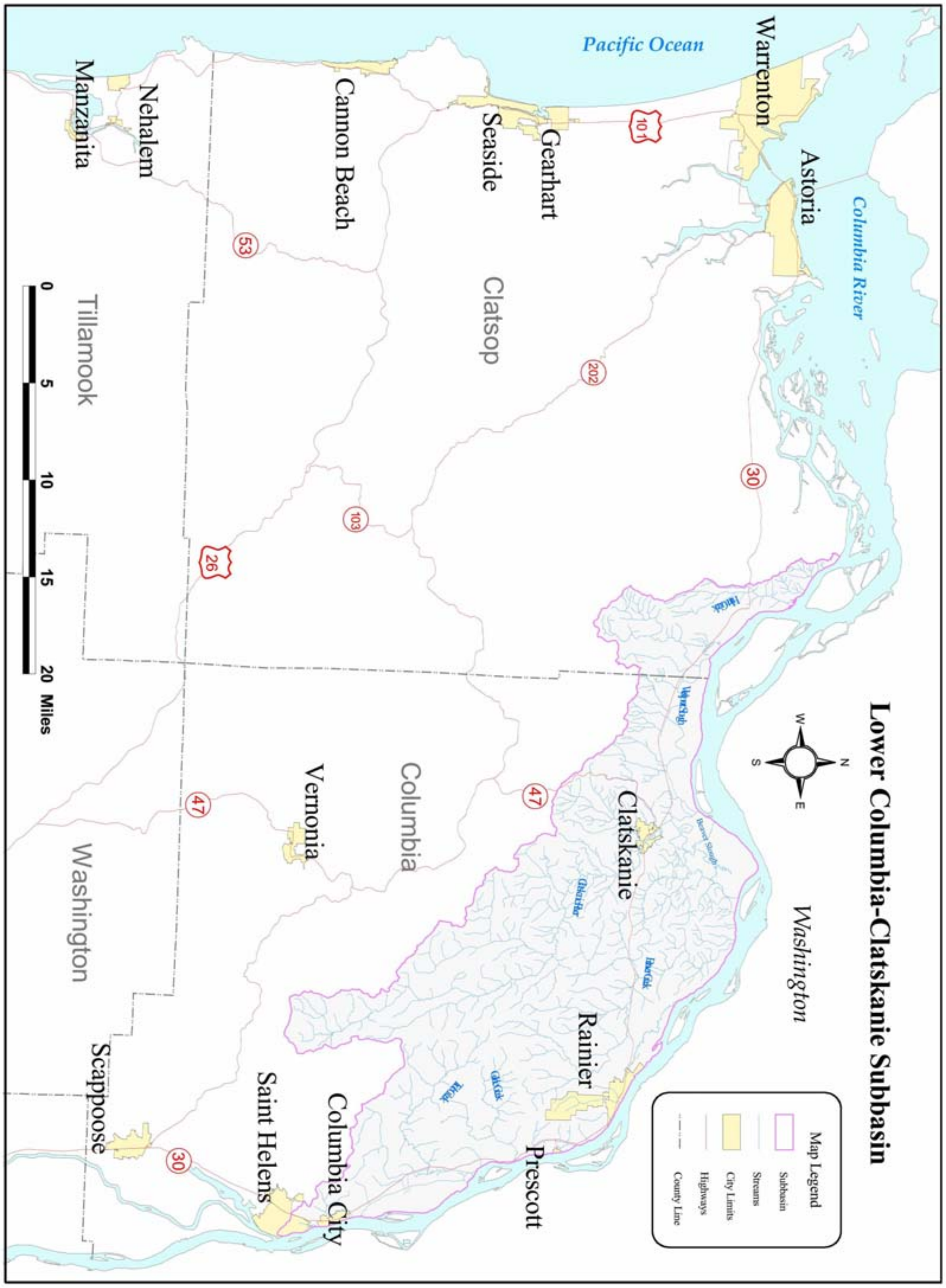


Figure 1.2: The location of the Lower Columbia-Clatskanie Subbasin in Oregon.

Lower Columbia-Clatskanie Watershed Assessment *Page I-5* *Introduction to the Watershed Assessment*

are now cutoff from the river by dikes and levees but still serve as a connection between watersheds.

Land Use and Ownership

Land use within the subbasin is classified into nine categories: forestry, pasture, crops, rural residential, urban, industrial, water, parks and recreation, and mining (Figure 1.4 & Table 1.1). Forestry includes private and public forestlands. Pasture is defined as grasslands that are either grazed or harvested for hay. The crop category includes typical crops such as corn and peas, plus blueberries and cottonwoods. Significant portions of the agricultural zone in the subbasin have been converted into cottonwood plantations that have a rotation of eight years for pulp trees. These plantations have land use characteristics of both crops and forestry, however the ground is tilled following each harvest and the rotation is significantly shorter than a stand of timber. Timber harvest rotation ranges from a minimum of forty years on private lands to eighty years on federal lands. Industrial land uses include timber mills and ports. Urban land use is comprised of incorporated cities, which will be identified later in this section. The parks and recreation land use is equivalent to areas zoned by the state as parks and recreation. The mining land use is equivalent to areas zoned by the state as natural resource or mining. Lakes, ponds, and sloughs have been delineated and included as the water land use.

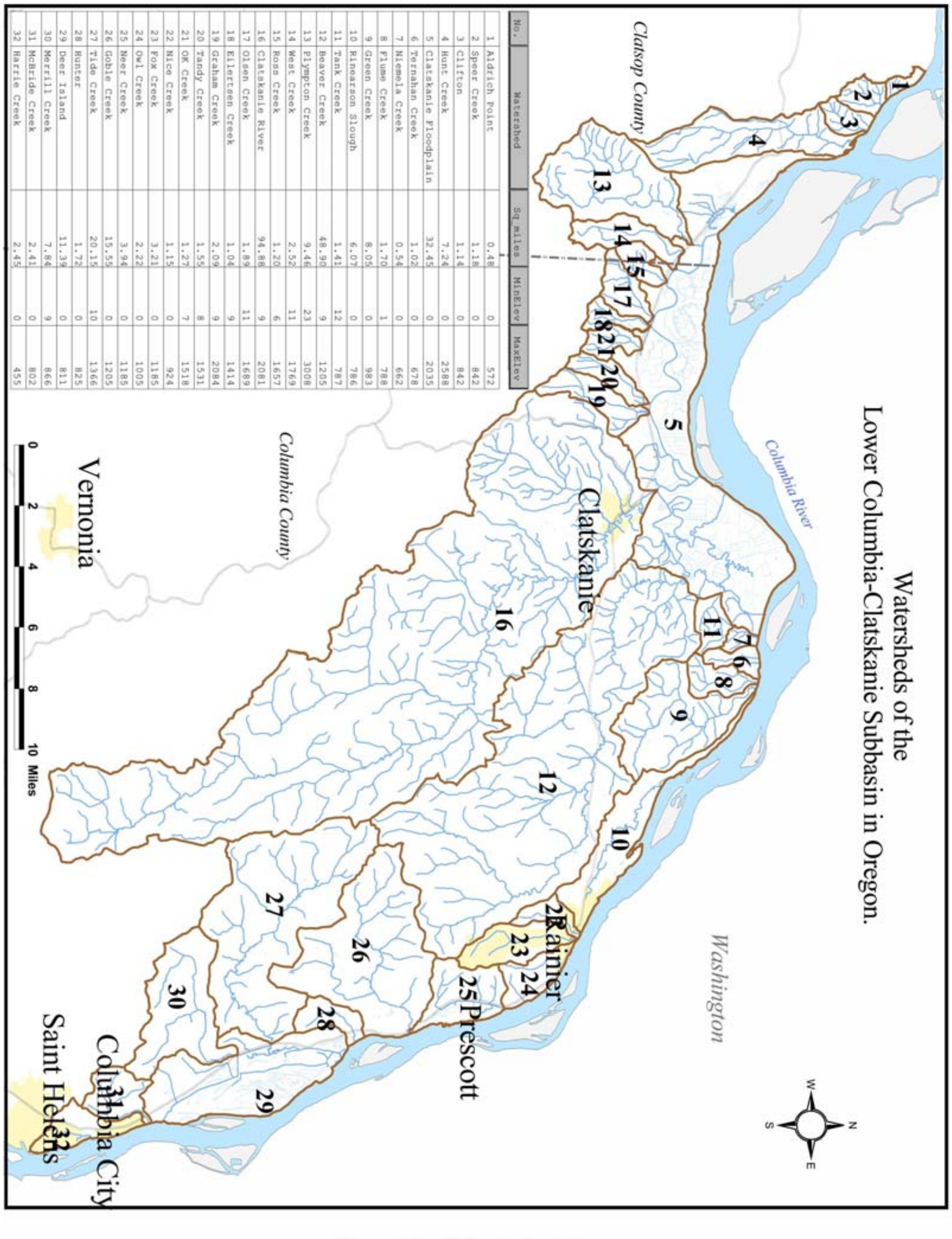
By most accounts the timber industry has played a significant role in shaping the settlement and growth of societies in the Pacific Northwest. The abundance of timber and easy transportation down waterways made for a highly productive industry in its youth. Indeed to this day it is the number one land use in the subbasin comprising 77.4% of the land area. After forestry, the next three land uses in order of magnitude are pasture, crop and rural residential. The eastern half of the subbasin contains a patchwork of land uses that are comprised mostly of forestry, rural residential and pasture. This pattern reflects the gentle topography and proximity to both the Columbia River and Portland that influenced settlement in the eastern portion of the subbasin.

Land Use	Percent of Subbasin
Forestry	77.4
Pasture	8.2
Crops	5.8
Rural Residential	5.1
Urban	1.3
Industrial	1.1
Water	0.6
Park and Recreation	0.4
Mining	0.1

Table 1.1: Land uses throughout the subbasin given as percent of total land area.

Ownership within the subbasin is predominantly private non-industrial (CLAMS, 1994; Table 1.2; Figure 1.5). Comparing the map of ownership to land use it is clear that the majority of timberlands are privately owned. Private non-industrial ownership covers the full range of land uses defined in this section. State and federally owned lands within the subbasin correspond to forestry land use and comprise less than 8% of the subbasin. The miscellaneous category includes city and county parks and forest reserves. The Fox Creek watershed is a drinking water source for the city of Rainier and is included in the miscellaneous category.

Source Data: 10-meter Digital Elevation Models from the Coastal Landscape Analysis and Modeling Study; USGS topographic maps.



No.	Watershed	Sq_miles	MinElev	MaxElev
1	Aldrich Point	0.48	0	572
2	Speer Creek	1.18	0	842
3	Clifton	1.14	0	842
4	Hunt Creek	7.24	0	2588
5	Clatskanie Floodplain	32.45	0	2035
6	Ternahan Creek	1.02	0	678
7	Niemela Creek	0.54	0	662
8	Flume Creek	1.70	1	788
9	Green Creek	8.05	0	983
10	Rinearson Slough	6.07	0	786
11	Tank Creek	1.41	12	787
12	Beaver Creek	48.90	9	1205
13	Plympton Creek	9.46	23	3008
14	West Creek	2.52	11	1769
15	Ross Creek	1.20	6	1657
16	Clatskanie River	94.88	9	2081
17	Olsen Creek	1.89	11	1689
18	Eilertsen Creek	1.04	9	1414
19	Graham Creek	2.09	9	2084
20	Tandy Creek	1.55	8	1531
21	OK Creek	1.27	7	1518
22	Nice Creek	1.15	0	924
23	Fox Creek	3.21	0	1185
24	Owl Creek	2.22	0	1005
25	Neer Creek	3.94	0	1185
26	Goble Creek	15.55	0	1205
27	Tide Creek	20.15	10	1366
28	Hunter	1.72	0	825
29	Deer Island	11.39	0	811
30	Merrill Creek	7.84	9	866
31	McBride Creek	2.41	0	802
32	Harrie Creek	2.45	0	455

Figure 1.3: Watersheds of the Lower Columbia-Clatskanie Subbasin in Oregon.

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Other distinguishing features of the subbasin include the cities of St. Helens, Columbia City, Prescott, Rainier, and Clatskanie. Scattered throughout the eastern half of the subbasin are the small communities of Delena, Alston, Swedetown, Apiary, and Deer Island. The western half of the subbasin is far less populated, aside from the city of Clatskanie there are the following small towns: Clatskanie Heights, Westport and Wauna. Highway 30, which runs from Portland to Astoria, crosses the northern edge of the subbasin. Accessible from highway 30, the Lewis and Clark Bridge connects Rainier with Longview, Washington. Once famous for being the highest cantilever span in the United States, the seventy-year-old, two-lane bridge is being considered for retirement (Nelson, 1999). It is the only bridge spanning the width of the Columbia River between Astoria and Portland.

Developments within the subbasin are mostly rural. The largest city St. Helens has a population of roughly 9,300 within its city limits (Center for Population Research and Census, 1999). Clatskanie is the second largest at 1,870. Rainier has 1,810, Columbia City 1,665, and Prescott 60. These numbers however do not represent the true extent of the population within the subbasin. As stated earlier there are numerous small towns and developments throughout the watershed with a large concentration in the eastern half. The extent of rural residences can readily be seen on the land use map, which will be introduced in the next section.

Ownership Class	**Percent of Subbasin**
Private Non-Industrial	52.9
Private Industrial	38.0
State	7.3
Misc.	1.4
Bureau of Land Management	0.4

Table 1.2: Ownership within the subbasin in percent of total land area.

Ecoregions and Vegetation

Ecoregions denote areas of general similarity in ecosystems and in the type, quality, and quantity of environmental resources. They are artificial boundaries that serve as a spatial framework for the purposes of research, assessment, management, and monitoring of ecosystems. The ecoregions used in this assessment are level three and four ecoregions (Figure 1.6). Level four is a subdivision of a level three ecoregion. The subbasin crosses two level three ecoregions, the Coast Range and Willamette Valley (Pater, 1998). The Coast Range can be further divided into the Volcanics and Willapa Hills level four ecoregions. The Volcanics Ecoregion is characterized by geology comprised of Tertiary igneous and sedimentary rocks and potential natural vegetation of western hemlock, western red cedar, and Douglas-fir. The Willapa Hills have Miocene sandstone, siltstone, and shale and the potential vegetation is the same as in the Volcanics ecoregion.

Within the Willamette Valley Ecoregion is the Portland/Vancouver Basin, a level four ecoregion. The southeastern corner of the subbasin contains a portion of this ecoregion. Undulating terraces and floodplains with low gradient, meandering streams characterize this region. The general characteristics of the geology include unconsolidated and semi-consolidated, glacial/fluvial deposits in a fault block basin. The potential vegetation includes prairies (maintained by native Americans through burning), Douglas-fir, Oregon ash, alder, and western red cedar.

Data sources: Digital aerial photographs from USGS were used to delineate the land uses

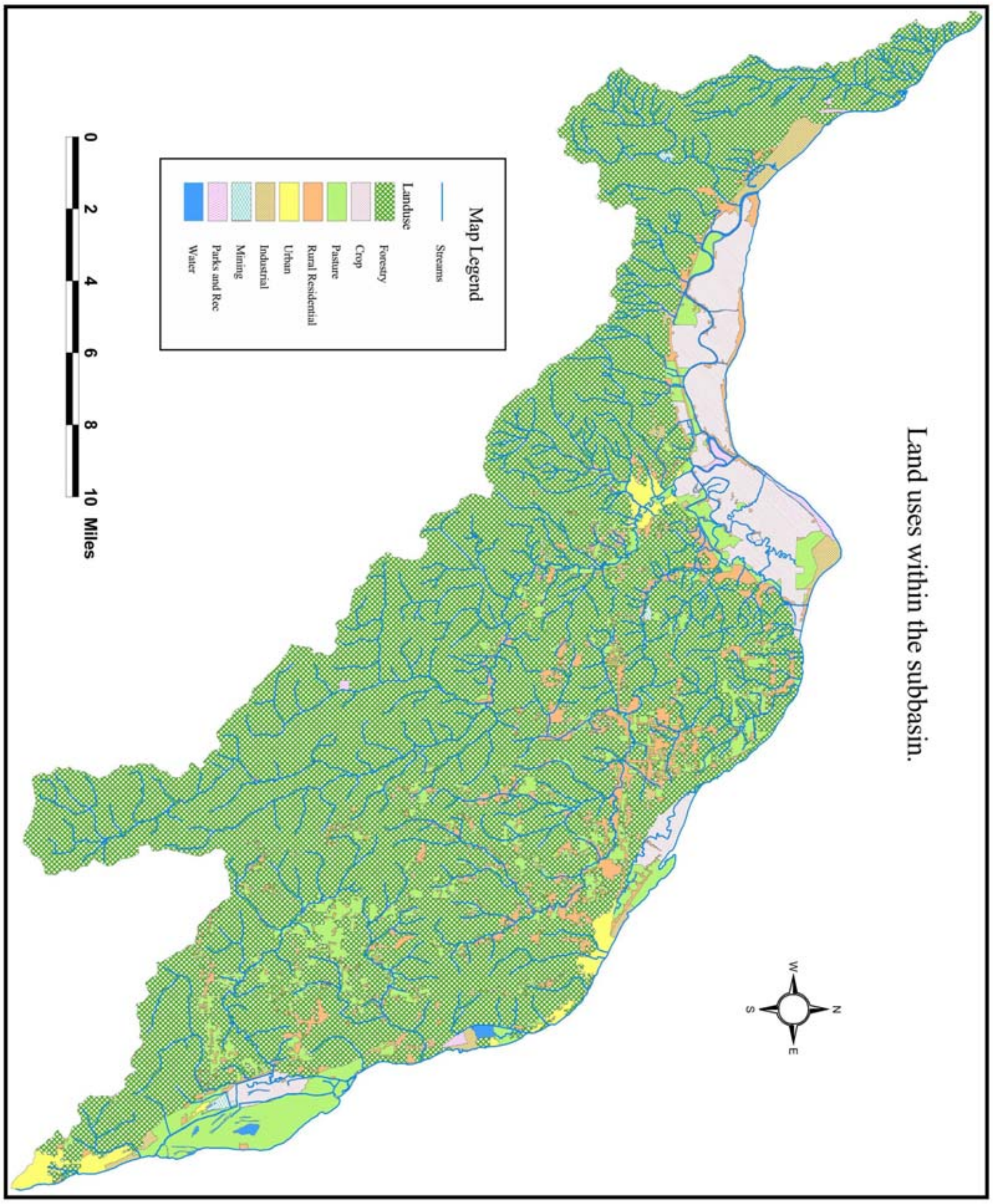

Figure 1.4: Land uses delineated from digital aerial photographs.

Lower Columbia-Clatskanie Watershed Assessment *Page I-13* *Introduction to the Watershed Assessment*

Lush coniferous forests once dominated the landscape of Northwestern Oregon. Early travelers utilized the Columbia River because the dense forests made overland travel slow and difficult. Although there are several endemic species of trees within the region, conifers are by far the dominants. The major species of trees include Douglas fir, western hemlock, and western red cedar. Hardwoods include big leaf maple and red alder. The understory vegetation is typically composed of Oregon grape, vine maple, devil's club, and a variety of ferns with sword and bracken ferns being the most common.

Forests within this region grow rapidly, which is the reason why timber harvesting is the main industry within the subbasin. Dominant tree species could potentially reach heights of 150 to 250 feet tall at maturity. The life span for such a tree is beyond 500 years.

Geology and Soils

The north coast of Oregon was formed mainly from volcanic activity and erosional deposition. During the Paleocene and Eocene epochs, 63 to 36 million years ago, the Coast Range and Willamette Valley were part of a large depositional valley surrounded by the Klamath Mountains to the South, land to the east and a string of volcanic islands to the west (USGS, 1969; Baldwin, 1981). Erosion lead to the accumulation of thousands of feet of sediments in this basin. Volcanism was partly active during this time and was responsible for the initial upheaval of the Coast Range. During the Oligocene, 36 to 25 million years ago, the sedimentary basin of western Oregon began to shrink and the present Coast Range took form. Then during the Miocene Epoch, 25 to 13 million years ago, most of western Oregon continued to uplift and the present Coast Range was born. The coast range experienced two upheavals and at least partial submergence between them, leading to a variety of geologic formations from volcanics to sedimentary rocks.

Perhaps the most interesting event in geologic time was the scouring of the Columbia River by catastrophic floods during the end of the Wisconsin Ice Age. The Cordilleran ice sheet covered the Pacific Northwest extending as far south as Olympia, Washington (Lichatowich, 1999). The Columbia River was the largest watershed on the southern edge of the glacier. Toward the end of the ice age the leading edge of the glacier advanced and retreated several times. This edge created an ice dam that formed Lake Missoula in northern Idaho and western Montana. Lake Missoula covered an area of 3,000 square miles and collected the water from the melting glaciers of western Montana. As the waters built up behind this dam the ice would begin to float releasing a huge flood. The flood raced across eastern Washington and down the Columbia River channel eventually pouring out into the Pacific Ocean. At the present site of Portland, the torrential floods covered the area with over 200 feet of water transforming the Willamette Valley into a lake. These floods "took place at least forty times between 15,000 and 12,800 years ago" (Lichatowich, 1999). Scouring and deposition of sediments occurred throughout the Columbia River channel, including the shoreline of the subbasin.

The surface geology of the subbasin was formed during the Cenozoic Era (Table 1.3; Figure 1.7). Basalt formations are the dominant lithology covering 64% of the subbasin, the remainder being primarily sedimentary rocks and alluvial deposits. Eocene formations are widespread and include both volcanic and sedimentary rocks. Marine sedimentary and tuffaceous rocks from the middle Miocene to upper Eocene cover 19% of the subbasin with scattered patches throughout. Eocene porphyritic basalt can be found in the eastern half of the basin mostly along the floodplains of the Columbia River. Miocene formations occupy about

Data sources: Western Oregon Indsutrial Forest Land Ownership. 1994.
Coastal Landscape Analysis and Modeling Study.

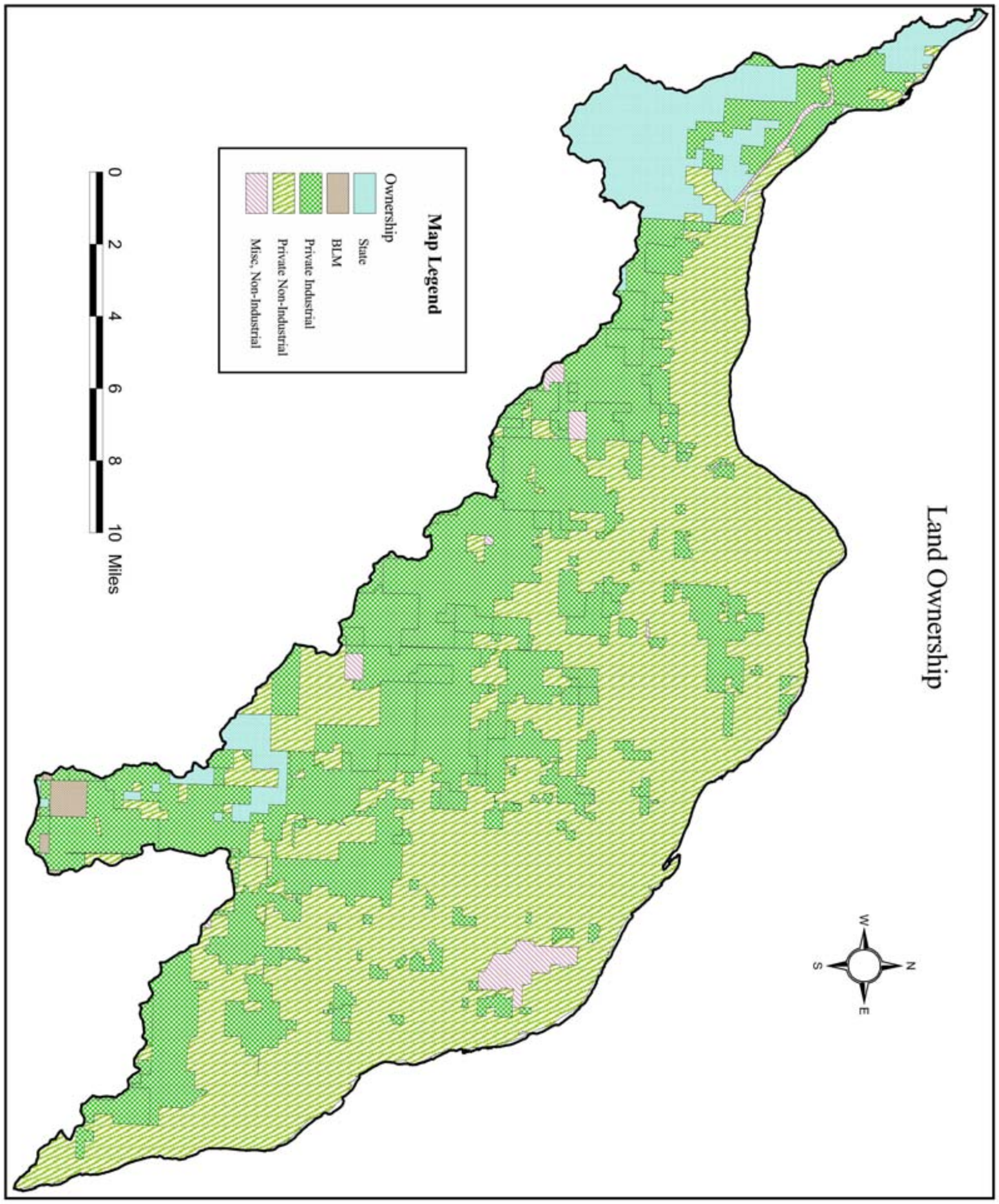

Figure 1.5: Land ownership classes within the subbasin.

seventy percent of the subbasin. The dominant lithology of the subbasin is the Columbia River basalt group, which covers 52% of the land area. The origin of these soils is believed to be basalt flows from northeastern Oregon and southeastern Washington that flowed down an ancestral Columbia River (Baldwin, 1981). Miocene Wanapum basalt covers most the steep terrain along the base of Nicolai Mountain in the northwestern corner. Also found in the subbasin are Miocene lacustrian and fluvial sedimentary rocks in the area of Deer Island. Holocene alluvial deposits spanning from Westport to Port Westward along the Columbia River date back to the time of the Lake Missoula floods.

Epoch	**Age (in millions of years)**	**Lithology**	**Percent of Subbasin**
Miocene	5-25	Columbia River basalt group and related flows	52.5
middle Miocene to upper Eocene	16-52	Marine sedimentary and tuffaceous rocks	19.4
Holocene	< 0.011	Alluvial deposits	7.7
Eocene	39-52	Porphyritic basalt	6.2
middle Miocene	16	Wanapum basalt	5.1
Miocene	5-25	Lacustrian and fluvial sedimentary rocks	4.9
middle and lower Miocene	5-16	Marine sedimentary rocks	2.1
Holocene and Pleistocene	< 3	Landslide and debris-flow deposits	1.5
upper and middle Eocene	45-53	Tuffaceous siltstone and sandstone	.4
		Water	.2

Table 1.3: Geological history of the subbasin with percent of land area covered by each formation.

"Soils in the subbasin have been greatly influenced by such a factors as the cold, wet short growing season at the higher elevation in the Coast Range and the warm, long growing season at the lower elevations along the Columbia River (USDA, 1986)." The soil formation processes are largely due to climatic conditions, topography, and plant associations, as well as the parent (geologic) material. Soils developed from basalt will be dark brown to reddish brown and have textures varying with depth; deeper soils are finer textured. Sedimentary rocks tend to impart a wide range of characteristics to soils dependent on slope and depth of parent material. Sedimentary rocks are often layered, or stratified. Unlike other formations, most sedimentary rocks are laid down in individual, overlapping beds.

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Data source: Pater et al. 1998. Ecoregions of Western Washington and Oregon.

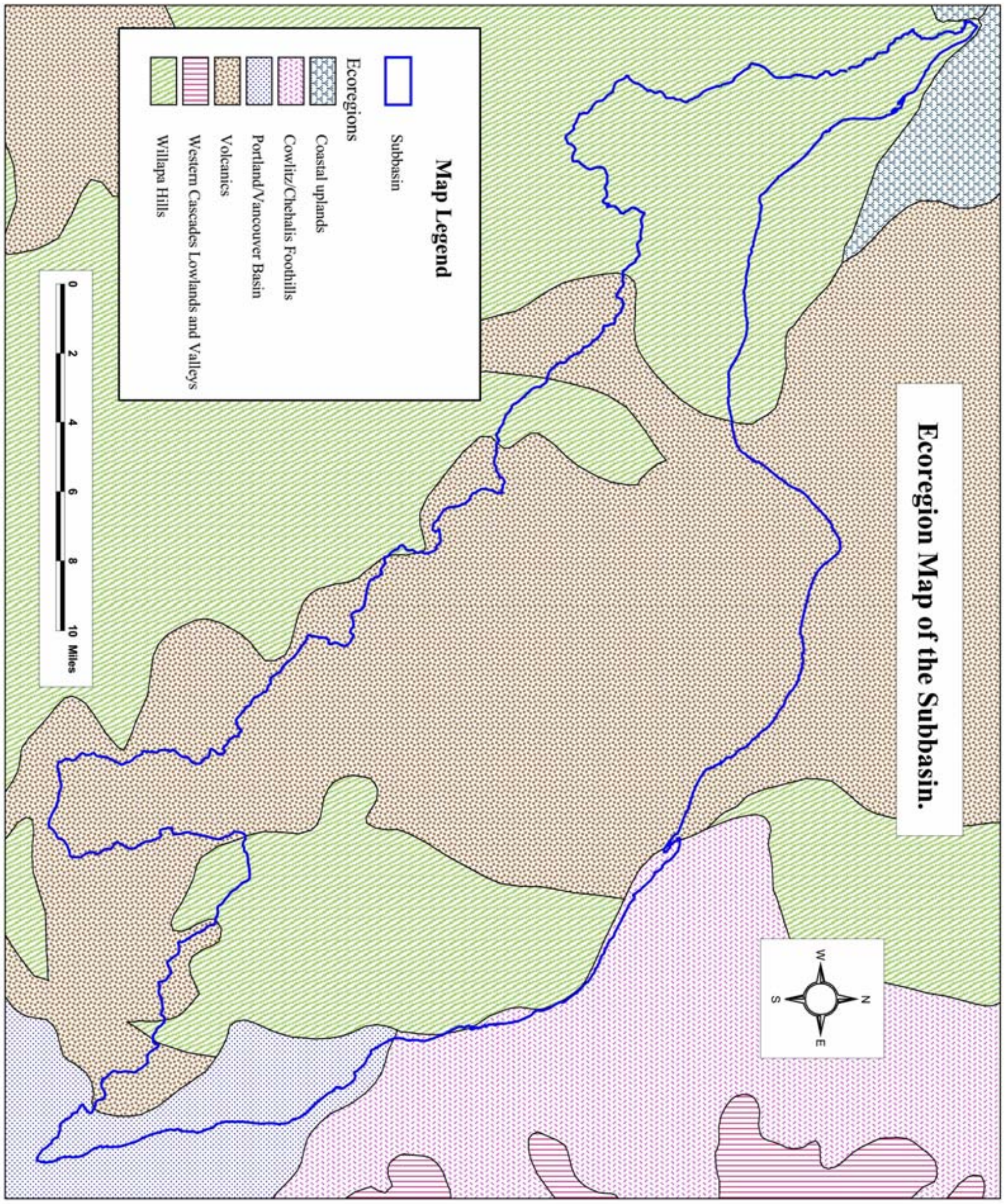

Figure 1.6: Ecoregion of Western Oregon and Washington.

Data source: Walker, G.W., and N.S. MacLoed. 1991. Geologic Map of Oregon. USGS.
Digitized by Harry Casler, NMD Western Mapping Center.

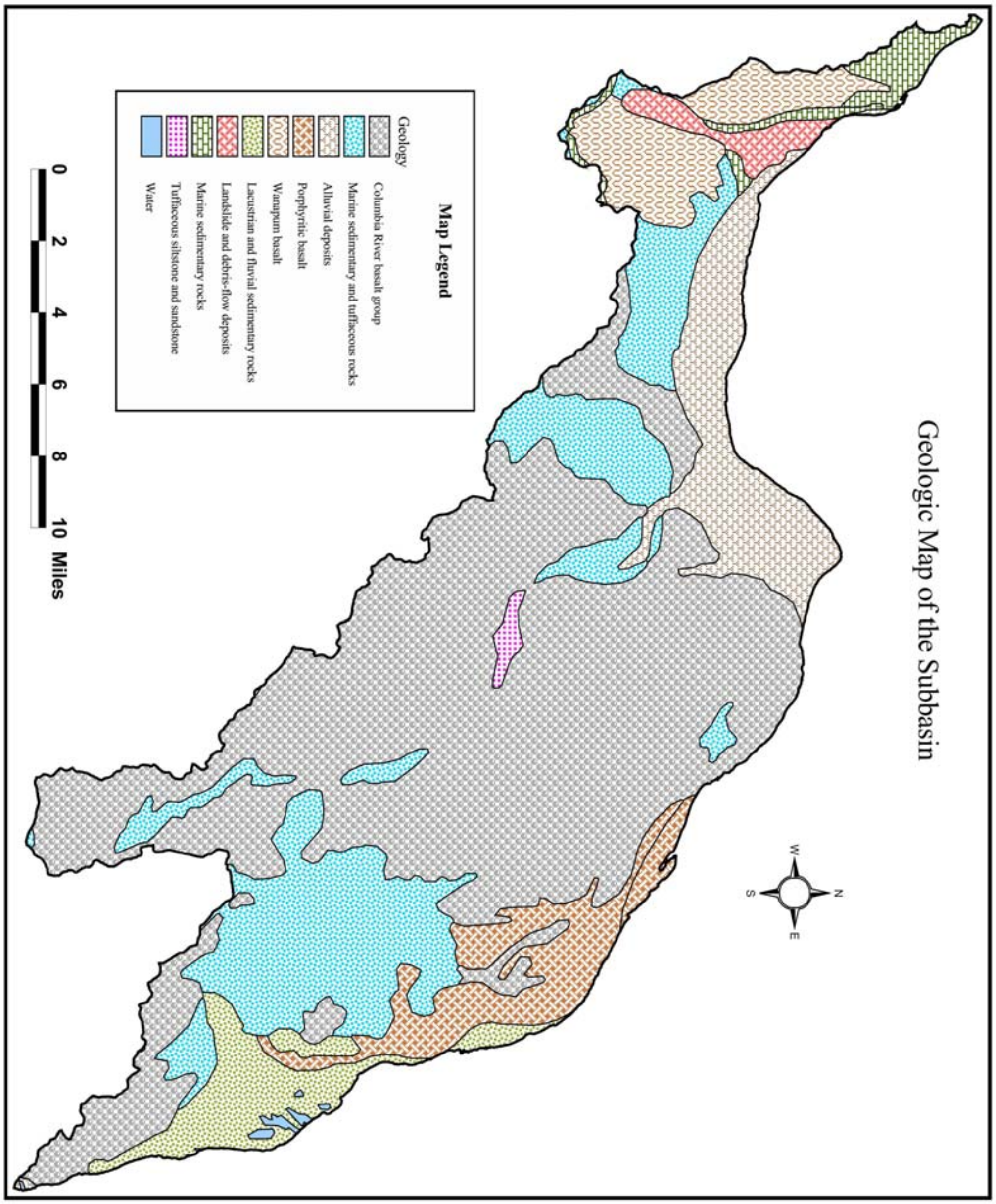

Figure 1.7: Geologic map of the subbasin from USGS map of Oregon.