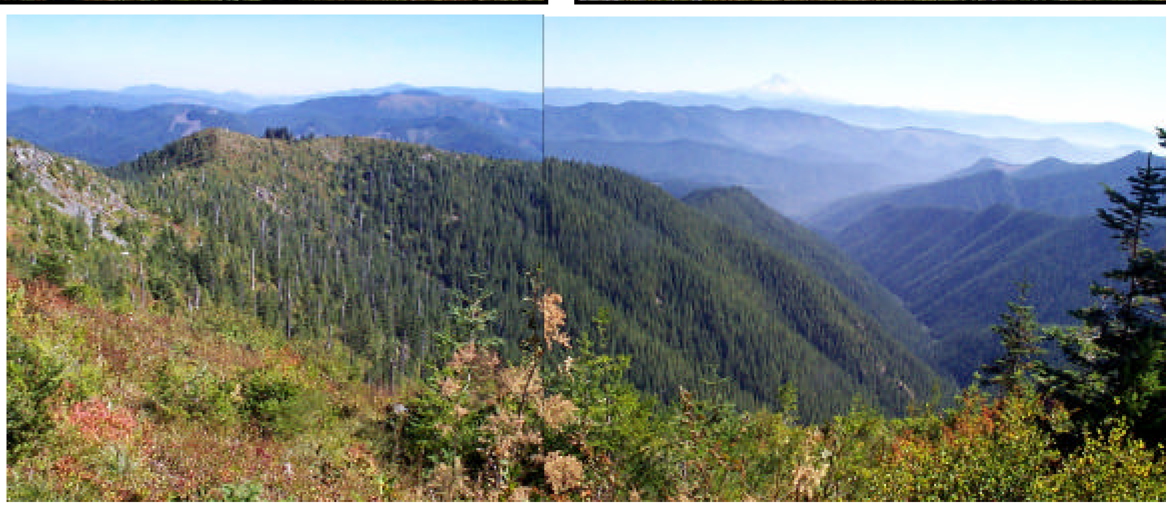
Upper Washougal River Watershed Analysis

September 2000



Mt Adams Ranger District
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Photos on the cover page:

Upper Left: Silver Star Mountain (in background)—at 4,390 feet elevation, the highest point in the watershed. Large unvegetated rock slopes as seen in the foreground and background are characteristic of the high peaks and ridgetops in the watershed.

Upper Right: Small lake at the headwaters of the Washougal River

Lower Panorama: Sparsely vegetated ridgetop, grading into fully forested slopes along the Upper Washougal River (Mt Hood in the background). The upper portion of this slope was one of few areas in the watershed found to have remnant snags.

Washougal Watershed Analysis

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SUMMARY OF KEY FINDINGS

Erosion Processes

- Surface erosion potential across the watershed is low-to-moderate
- Within the watershed, the surface erosion potential is highest in the north, where slopes are steeper
- Mass wasting is not a frequent erosional process in this watershed

Hydrology

- 34% of the watershed is in hydrologically immature vegetation
- 54% of the watershed is in elevations that commonly experience rain-on-snow
- Road densities average 2.0 miles per square mile, and range from 0.2 to 3.4 miles per square mile
- Road systems have increased the natural drainage density by nearly 20% across the watershed
- Over the past several decades, peak and low streamflows are presumed to have been altered in some parts of the watershed due to a combination of wildfire, timber harvest, land use changes and high road densities.

Vegetation

- 12% of the watershed is in non-forest (talus slopes, rock outcrops, water bodies, wetlands, shrub-meadows)
- Nearly 1/5 of the National Forest land (18%) is rock (non-forest)
- 34% of the watershed is in early seral forest
- <1% of the watershed is in late successional forest
- Soils were severely damaged by early century fires, and—particularly in the upper watershed—subsequent erosion has reduced the quality and quantity of soils
- Currently, stand conditions on National Forest lands are in poor condition due to low soil fertility (in part a result of past fires) and the fact that non-local planting stocks were used in reforestation efforts of the 1930's-1960's)
- Fire is a big factor in this watershed because of the populations living in the lower watershed (increases likelihood of ignition), and the effect of the east winds on drying vegetation and on carrying fire (increases likelihood of spread)

Stream Channels

- Channels have been severely disturbed over the past century by wildfire, splash damming, and development
- Currently, 29% of riparian areas in the watershed are in early seral forest vegetation
- Less than 1% of riparian areas are in late seral forest vegetation
- On average, there is a road crossing for every 1.4 miles of stream length in the watershed

Water Quality

- The Washougal River annually exceeds state water quality standards for maximum water temperature
- Water temperatures have been recorded as high as 78ºF at the Fish Hatchery (in 1992)
- The state water quality standard for temperature has been exceeded for as many as 81 days in a single summer in the Washougal River (1992)

Species and Habitats--Wildlife

- Snags are lacking throughout the watershed due to repeated fires and subsequent snag felling by the CCC
- The watershed has a relatively large proportion of special habitats including talus slopes, rock outcrops, mines
- Three spotted owl activity centers are located in the watershed, but none of them are on National Forest lands
- Existing and projected future habitat capability levels for Management Indicator Species such as the pileated woodpecker are well within the historic range of variability

Species and Habitats--Fisheries

- The watershed contains listed steelhead in addition to fall and spring chinook, coho, and sea run cutthroat
- Anadromous fish distribution extends onto the Gifford Pinchot National Forest in the three subwatersheds including : Headwaters Washougal, Upper Washougal, Headwaters West Fork
- There has been a relatively sharp loss in anadromous fish stocks over the last 15 years.
- Loss of habitat contributes to decline in spawning rearing and holding habitat resulting from large-scale fire, logging, damming, road building and land development in the Washougal watershed analysis area.

Human Uses

- Recreation, mining, and forest product gathering are popular in the watershed
- There are 2,180 acres of land designated as Matrix on the National Forest portion of the watershed
- No harvest is recommended from the Matrix for this decade, due to the small size of trees and poor forest stand conditions
- No Matrix stands are scheduled for thinning this decade due to access difficulties and lack of merchantability of the trees

INTRODUCTION

This report documents the watershed analysis conducted on the Upper Washougal River watershed. The analysis addresses all federal and non-federal lands draining to the Washougal River above its confluence with Canyon Creek. Format and methodology for this watershed analysis follows the six-step process outlined in *Ecosystem Analysis at the Watershed Scale: Federal Guide for Watershed Analysis Version 2.2* (USDA 1995).

Watershed analysis is an integral part of the Aquatic Conservation Strategy outlined in the Northwest Forest Plan (USDA and others 1994). This analysis was conducted in response to requirements in the plan for watershed analysis to be conducted on all federal lands in the region. Intent of the analysis is to describe and quantify conditions and key ecosystem processes operating at the watershed scale, and to identify past and foreseeable human interactions with the watershed. Information provided in this analysis will be used by the District as the basis for future project planning.

Completion of the Upper Washougal River Watershed Analysis finalizes the first round of watershed analyses scheduled for the Mt Adams Ranger District. Watershed analysis has been conducted on the District since 1995, and currently all lands managed by the District are included in one of the seven first round watershed analyses to have been completed. Subsequent updates and revisions of these analyses are likely to occur over time as conditions change, as need arises and as funding allows.

The document is organized around the six-steps of the Watershed Analysis process, and throughout the report, tracks seven core topical areas:

1) Erosion Processes
2) Hydrology
3) Vegetation
4) Stream Channels
5) Water Quality
6) Species and Habitats
7) Human Uses

Chapter 1 briefly characterizes the watershed to provide an overview of key distinguishing features about the watershed. Chapter 2 identifies the issues and key questions that guided the individual resource area analyses. Chapter 3 includes the bulk of the analysis, describing the current and reference conditions, and some analysis of findings. Chapter 4 provides a list of recommendations that were identified during or as a result of the analysis process. Following the list of references are the Synthesis tables, which summarize the quantitative findings of the analysis.

CHAPTER 1. CHARACTERIZATION

Setting

- The watershed lies in the western Cascade Mountains, just east of the city of Vancouver, Washington (Figure 1.1)
- The upper watershed boundary is defined by Silver Star Mountain, Lookout Mountain, and Three Corner Rock
- From it headwaters on these peaks, the watershed generally drains to the south and west toward the Columbia River
- The Forest Service manages just 7,337 acres of the watershed (12% of the analysis watershed) located along the upper margins of the watershed (Figure 1.2)

Climate

- The watershed has a temperate marine climate characterized by cool, wet winters and relatively dry summers
- Average air temperatures in the lower elevations of the watershed range from 40°F in the winter months to near 80°F in the summer
- Mean annual precipitation ranges from 60 inches at the base of the watershed to over 120 inches at the upper elevations

Landforms and Geology

- The Washougal River watershed was shaped by volcanic activity occurring from about 30 to 1 million years ago
- Glacial activity has not been prominent in the watershed but there is some evidence that glaciers formed in the upper reaches of the watershed
- The northern portion of the watershed is characterized by steep dissected drainages with shallow soils
- Talus slopes and rock outcrops are more common than vegetation in much of this area.
- Topography becomes more gentle toward the southern portion of the watershed, and soils there are deeper.
- A few large, deep-seated landslides are present in the watershed and there is evidence of past debris flows in the upper portions of the watershed

Hydrology

- The analysis watershed includes the upper portions of the Washougal River watershed, from the confluence of Canyon Creek to the headwaters of the Washougal River
- The Washougal River flows into the Columbia River below Bonneville Dam, near Vancouver, Washington
- Elevations in the watershed range from near 400 feet at the confluence of the Washougal River and Canyon Creek to over 4400 feet at Silver Star Mountain
- Approximately 70% of the precipitation occurs between the months of October and March, with much of that falling as snow in the upper elevations of the watershed
- Peak streamflows occur during the fall through spring period, and are driven by heavy rains, often combined with snowmelt from the lower and middle elevations

Water Quality

- The Washougal watershed is identified as a Tier I Key Watershed in the Northwest Forest Plan due to the presence of anadromous fish.

- Other beneficial uses driving the need for high water quality in this watershed include resident fish populations, the national fish hatchery, and recreational uses of the river.
- Primary water quality parameters of concern on National Forest portions of the watershed include water temperature, turbidity or sediment, and fecal coliform. Little data has been collected to date for these parameters on Forest lands in the watershed.

Stream Channels

- The watershed includes the upper mainstem of the Washougal River, the West Fork of the Washougal River, and a number of tributaries.
- There are approximately 100 miles of fishbearing stream and an additional 300 miles of non-fishbearing perennial and intermittent stream in the watershed.

Vegetation

- Vegetative conditions in the watershed are resultant of a combination of timber harvest and severe, catastrophic fires in the early part of the century.
- The Yacolt burn of 1902 and the Dole fire of 1929 were probably the most important fires in the watershed, but others occurred in 1918, 1923, and 1927.
- Currently, the watershed is characterized by large areas of immature even-aged coniferous forest that originated after these fires
- Originally a highly productive watershed for forest vegetation, the repeated burns left conditions unsuitable for reforestation in some parts of the watershed. A delayed grass-forb stage still covers much of the upper portions of the watershed in lieu of coniferous forest.
- Riparian vegetation tends to be dominated by hardwood species like red alder, big leaf maple, and brush species at higher elevations. In the upper reaches open stand conditions are common making up to 81% of the riparian area. Here the conifers have been slow to reoccupy the riparian zones since the fires.
- Meadows of Silver Star Mountain support highly diverse plant communities, including several uncommon plants and one rare endemic, cold-water corydalis. From Silver Star to Bluff Mountain is a ridgeline rich in views, flowers, berries and beargrass. It has “Special Interest” (SD) status in the Forest Plan.
- Five rare plants have been located in this watershed.

Species and Habitats—Wildlife

- Habitat for wildlife in the watershed favors species that require early and mid-seral forest conditions.
- Special habitats including grassy meadows, rock outcrops, and talus slopes are present in the upper watershed
- Nearly 90% of the watershed is managed by the State of Washington or is in private ownership, so long term wildlife habitat function is dependent upon Habitat Conservation Plan (HCP) areas
- Northern spotted owl Critical Habitat Unit (CHU) WA-41 is about 0.5 miles northeast of the watershed.

Species and Habitats—Fisheries

- The Washougal watershed contains anadromous fish listed as threatened species, proposed threatened species or candidates species including the following: fall chinook, summer and winter steelhead, and coho and sea run cutthroat trout.
- Bull trout have never been recorded in the Washougal watershed however intensive, species specific surveys have not been conducted to confirm presence/absence of this threatened fish.
- Two State fish hatcheries in the Washougal watershed contribute significantly to anadromous fish production and are believed to have a negative impact on natural fish production.
- Little or no stream data exists on streams within the Forest Service administrative lands.

Human Uses

- Current human uses include forestry, agriculture, mining, rural development, recreation
- Mining is more dominant in the northern portions of the watershed
- The southern end of the watershed has received increasing development over the more recent past
- Approximately 28% of the Forest Service lands in the watershed are designated as Matrix in the Forest Plan
- The balance of Forest Service lands are in a non-timber harvest, recreation-emphasis land allocation

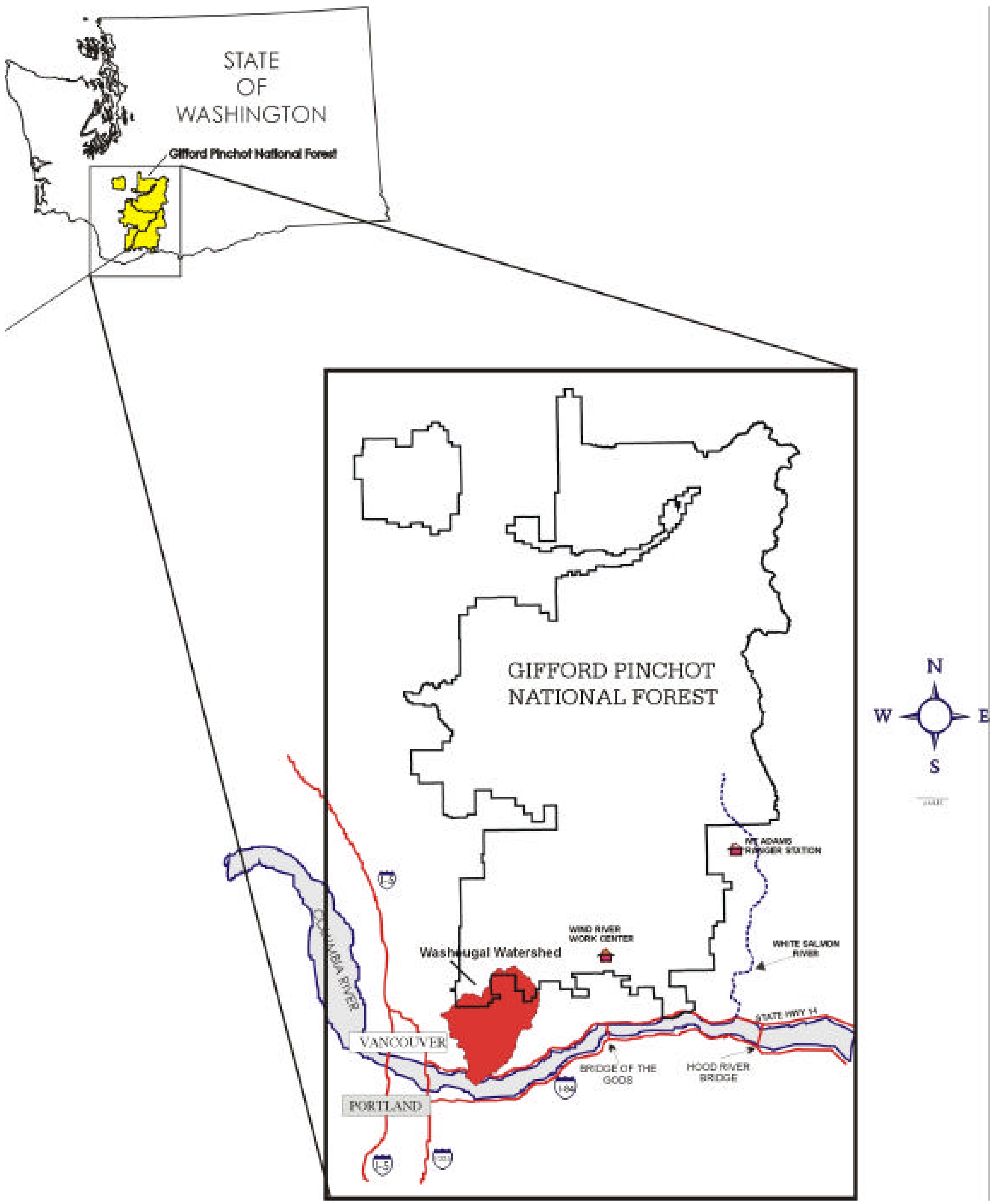


Figure 1.1. Location of the Washougal River watershed.

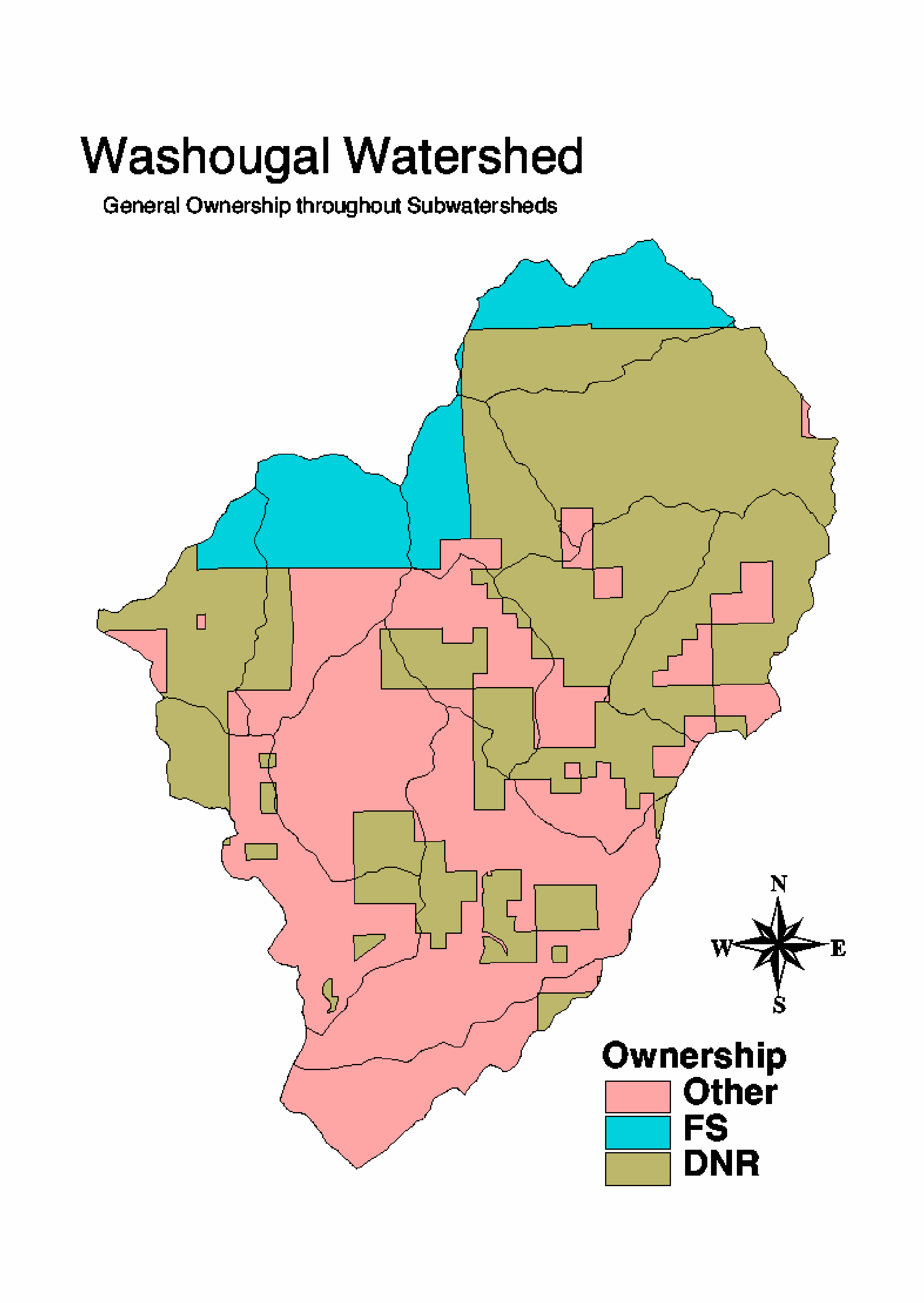


Figure 1.2. Land ownership in the Upper Washougal watershed (subwatershed lines in background).
FS = Forest Service; DNR = Washington State Department of Natural Resources.

CHAPTER 2. ISSUES AND KEY QUESTIONS

Erosion Processes

Issue: Surface Erosion

Surface erosion from hillslopes and roads in the Washougal Watershed could be a contributor to sediment movement in the streams. The large, intense fires of the early part of the century removed much of the vegetation and duff material on the ground which resulted in the susceptibility for soil movement down the steep ground especially in the northern portion of the watershed. These areas have yet to recover. It has also be found that sediment from roads especially in the first few years after construction have been a major source of material moving through the stream systems.

Key Questions:

1) What is the history, present state and future potential of failures from erosional processes.
2) Is there evidence of, or potential for, mass wasting in the watershed?
3) What areas are sensitive to forest practices?
4) What erosional or mass wasting processes are active?
5) Is sediment delivered to streams?

Issue: Soil Productivity

In the northern portion of the watershed the fire regime of the early part of the century has seriously disrupted the nutrient levels in what soils are present. This and the shallow soils left offers very poor growing conditions.

Key Questions

1) What is the extent of soil productivity loss in this watershed?
2) What measures can be applied in future activities to maintain soil productivity?
3) What rehabilitative measures can be undertaken to correct existing soil damage?

Hydrology

Issue: Peak Streamflows

Peak and low streamflows can be affected by changes in forest canopy cover, roads, and other land uses that compact the ground surface, remove or alter vegetation, or re-route natural water drainage patterns. The Washougal watershed has been affected by wildfire, timber harvest, road construction, and rural development over the past century. The combination of these disturbances may have altered the magnitude, timing, or frequency of both peak and low streamflows in the Washougal River and its tributaries.

Key Questions:

1) What factors affect peak and low flows in the watershed?
2) Where and to what degree do these factors occur?
3) How have these factors changed over time?
4) What is the current risk of increased peak flows?
5) How might management activities affect peak or low flows?

Vegetation

Issue: Disturbance

Either through human or natural ignitions, fire has been one of the major sources of disturbance in the watershed. The occurrence intervals for natural large fires range between 200 and 400 years. Since the last large fire in the area in 1929, fire occurrence has been relatively low. Until the 1970's public access into the upper portions of the drainage had been closely regulated as a fire precaution measure. Today the drainage is accessible year around via hiking trails and roads.

Key Questions:

1) What is the natural role of fire within the watershed and how has that changed since the last large fire?
2) What is the current risk of a large fire occurring within the watershed and where is the highest risk?
3) Where can we benefit from managed fires, either prescribed or natural ignitions?
4) What social and political concerns, including the protection of property and life, will affect fire protection, fire use and fuel treatment programs?
5) Are there feasible measures to deal with these concerns while achieving overall resource concerns in the watershed?

Issue: Vegetation Structure and Composition

Historical vegetative structure and composition reflected fire disturbance on a large scale and numerous disturbance agents (fire, wind, disease, and insects) on a small scale. The patch size of distinguishable stands was large, covering hundreds to thousands of acres. Within the past 90 years, wild fires have created large young even-aged timber stands. These stands consist of a single tree layer and originated primarily from artificial regeneration (tree planting) along with some natural regeneration.

Key Questions

1) What are the present stand structures and compositions?
2) How does this compare with the past conditions?
3) How are the vegetative structural stages distributed across the watershed?
4) Is a minimum of 15 percent of the watershed in a late-successional seral stage?
5) What are the implications for future conditions?

Issue: Soil Productivity

The soils within the Washougal River watershed have been impacted by the repeated wildfires over the past century. In some areas the soil is so poor it is questionable whether the site can support healthy functioning conifer stands.

Key Questions

1) What is the extent of soil productivity loss due to past fires?
2) What rehabilitative measures could be undertaken to correct existing soil deficiencies?

Issue: Plants of Concern

The watershed contains special habitats and plant species of concern. However, few extensive plant and habitat surveys have been executed on this watershed.

Key Questions

1) What special habitats occur in the watershed?
2) What survey and manage species occur within the watershed?
3) What Washington State or Forest Service listed sensitive species occur?
4) What federal listed threatened or endangered plant species occur?
5) How are habitats and plant populations of concern expected to change over time?

Issue: Noxious Weeds, Non-Native Plant Species

Noxious weeds and non-native plant species occur in the watershed and have the potential to spread.

Key Questions

1) What introduced species are present and where?
2) What has been and what is the potential effect of non-native populations on native flora and fauna and water quality?

Stream Channels

Issue: Channel Type/Channel Condition

Fish habitat and water quality are strongly correlated with stream channel conditions. Channel conditions can be affected—both directly and indirectly—by a range of land use activities. Channels in the Washougal watershed have been impacted to some degree by wildfire, timber harvest, roading, splash damming, stream cleanout, mining, farming and agriculture, and rural development.

Key Questions:

1) What types of channels are present in the watershed and where do they occur?
2) What factors influence channel conditions?
3) How have these factors changed over time?
4) What is the current condition of stream channels in the watershed?
5) What portions of the channel network are at greatest risk of effects from management activities?

Water Quality

Issue: Water Quality

Water quality in streams within the watershed is important for fisheries as well as for other uses of the water. State water quality standards require water quality to be maintained or improved to the extent that identified beneficial uses of the water continue to be supported. Natural or human caused disturbances can affect water quality in streams by changing canopy closures, ground cover, or ground surface conditions. Land use activities and past catastrophic wildfires have contributed to a number of changes to riparian areas, stream channels, and uplands in this watershed, which may have affected water quality in streams draining the watershed.

Key Questions:

1) What beneficial uses are present in the watershed?
2) What are the primary water quality parameters of concern for those beneficial uses?
3) What is the condition of factors that may affect the primary water quality parameters of concern?
4) How have those conditions changed over time?
5) What portions of the watershed are at greatest risk of water quality concerns?

Species and Habitats

Issue: Wildlife

Numerous wildlife species exist in the watershed because of the habitat types present. Categorizing these species helps resource managers protect limited habitat components and maintain viable populations into the future.

Key Questions:

1) What species are believed present in the watershed?
2) Based on potential habitat, what species could be present?
3) What is the status of TES and MIS species in the watershed?

Issue: Threatened and Endangered Fish

The watershed contains suitable or potentially suitable habitat for threatened, endangered, and sensitive species.

Key Questions:

1) What is the current distribution of listed fish stocks in the Washougal watershed?
2) What is the historical distribution of listed stocks in the Washougal watershed?
3) Where are contributing factors for decline of threatened and endangered fish?
4) What is the habitat quality for TES fish species?

Issue: Fish Habitat and Population

Habitat conditions have been altered by human disturbances such as riparian harvest, road construction, damming, commercial and residential development. These disturbances influence have a direct impact water quality and quantity and an indirect imp act on as well as fish health, reproductive success.

Key Questions:

4) What are the historical and current conditions for fish habitat in the watershed?
5) How have management activities affected fish habitat?
6) How can future management activities improve the existing habitat?
7) What is the current and historical distribution of fish in the watershed?

Human Uses

Issue: Timber Harvest Level from National Forest lands

Scheduled timber harvest is permitted from matrix lands on the National Forest. However, timber harvest can only be considered in the realm of meeting all other ecosystem needs.

Key Questions

1) What are the current vegetative seral stages within the Matrix?
2) What is the long-term probable sale quantity (PSQ) and what is the short term yield given current conditions?
3) What are the current resource limitations to meeting PSQ?

CHAPTER 3. CURRENT AND REFERENCE CONDITIONS

Erosion Processes

Current Conditions

In the Washougal Watershed, geology and landform are important factors influencing the transport and production of sediment. The geology is mostly volcanic in origin with older pyroclastic and basalt flows intruded by granodiorites in the northwest portion of the watershed. Most of the soils are derived from volcanic ash deposits and colluvial deposits from weathered bedrock.

The intrusive rock in the northwest portion of the watershed has produced an area on mineral interest, especially copper, gold, silver, lead and zinc. Most exploratory work in the area has not proved quantities in sufficient amount to mine profitably but there is a recreational use of mining in existence. There are a number of existing mining claims in the area and the potential of future development depends on price of precious metals on the open market.

Mass Wasting

Mass wasting is a natural process that will occur in certain areas regardless of management activities. Past active landslides continue to present potential for movement under certain conditions, which could be natural as well as related to management activities. Most of the mapped landslides occur on other than National Forest lands and the extent of past active mass wasting or future potential of movement has not been determined.

Figure 3.1.1 shows areas mapped as unstable and potentially unstable based on available data. Table 3.1.1 gives a summary of unstable and potentially unstable ground by subwatershed. The information was taken from Forest Geologic Resource and Conditions mapping done on the National Forest and Department of Natural Resources mapping done on the whole watershed.

Surface Erosion

The surface erosion potential in the watershed overall is low-to-moderate. Areas of moderate potential are in the steep, northern portions of the watershed that have not fully recovered from the major fires that went through the area in the early part of the century. Erosion from roads has been a large factor for sediment movement due to the openness of the cuts and fills. Usually the first few years are when most of this type of erosion takes place. As most of the roads in the watershed are in the lower, flatter areas this is probably not as large a concern as in other watersheds.

Table 3.1.1. Unstable and potentially unstable areas in the Washougal watershed.

Subwatershed Number	Subwatershed Name	Subwatershed Size (acres)	Landslides (acres)	Percent Area in Landslides	Debris Flows (acres)	Percent Area in Debris Flows	Potentially Unstable Soils (acres)	Percent Area in Potentially Unstable Soils	Total Mass Wasting Area (acres)	Percent Area in Mass Wasting
A	Headwaters Washougal	4534	0	0	0	0	72	1.6%	72	1.6%
B	Bluebird/Silver Creek	3393	0	0	27	0.8%	578	17.0%	605	17.8%
C	Upper Washougal	7735	0	0	0	0	4	<0.1%	4	<0.1%
D	Stebbins Creek	5342	25	0.5%	0	0	0	0	25	0.5%
E	Middle Washougal	7030	57	0.8%	0	0	0	0	57	0.8%
F	Dougan Creek	3550	0	0	0	0	0	0	0	0
G	Lower Washougal	9445	535	5.7%	0	0	0	0	535	5.7%
H	Canyon Creek	3149	10	0.3%	0	0	0	0	10	0.3%
I	Headwaters West Fork	5235	0	0	0	0	979	18.7%	979	18.7%
J	Hagen Creek	3526	0	0	0	0	71	2.0%	71	2.0%
K	Texas/Wildboy Creek	5087	0	0	0	0	0	0	0	0
L	Lower West Fork	5216	0	0	0	0	0	0	0	0
	Watershed Totals	63242	627	1.0%	27	<0.1%	1704	2.7%	2358	3.7%

Reference Conditions

Mass Wasting

Most large deep-seated landslides occur naturally but can either increase or decrease their rate of movement depending on what kind of management activities occur in the area. Most are located in older weathered pyroclastic volcanic terrain. Triggering mechanisms for these large landslides vary from heavy rainfall to earthquakes. The main difference between the reference conditions and the current conditions would be the rate of movement caused by additional management activities such as timber harvest and home construction.

Surface Erosion

The natural conditions for surface erosion to occur were mainly after large, intense fires that would burn through areas leaving bare slopes on steep ground. Tephra deposits from volcanic eruptions have also been very susceptible to erosion until vegetation became reestablished. The change between reference and current conditions is mainly in the construction of roads and suppression of fires. Roading has probably increased the amount of sediment being transported to streams and the suppression of fires has probably decreased the amount of sediment being moved off the slopes.

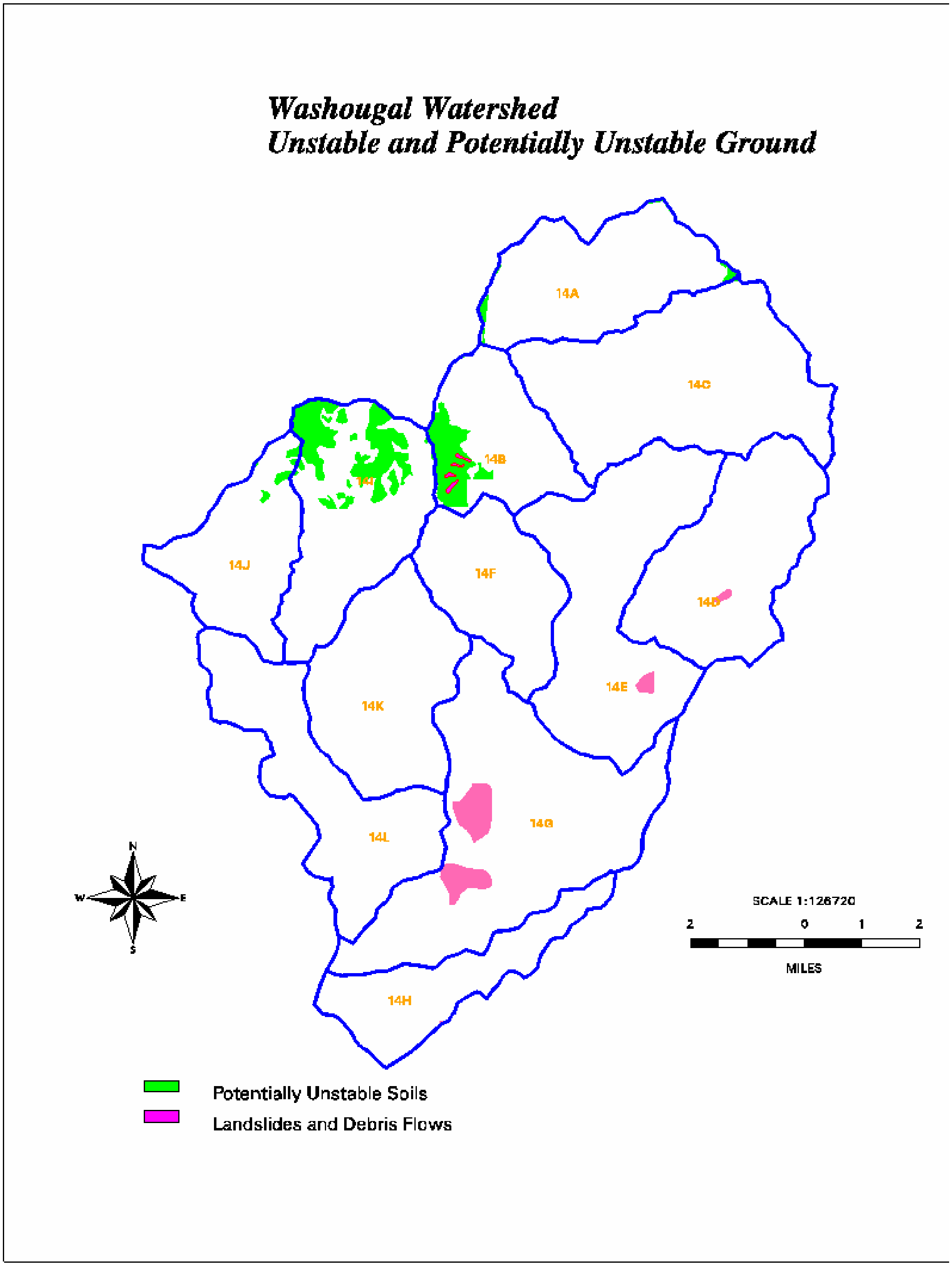


Figure 3.1.1. Mapped landslides and debris flows, and soils identified as potentially unstable.

Hydrology

Reference Conditions

Hydrography

The Washougal River watershed (NFS 1708000114) lies on the western slopes of the southern Cascades in Washington State. The entire Washougal River watershed drains an area of some 200 square miles, including a very small share of Forest Service lands at the upper edge of the watershed. This assessment focuses primarily on the upper and eastern portion of the watershed, which includes all lands that drain to the Washougal River above its confluence with Canyon Creek. At approximately 63,242 acres (99 square miles) in size, the analysis watershed represents approximately half of the entire Washougal River (5^{th} field) watershed. Within the analysis watershed are twelve (6^{th} field) subwatersheds (Figure 3.2.1, Table 3.2.1). Subwatersheds range in size from the Canyon Creek subwatershed (14H) at 3,149 acres to the Lower Washougal subwatershed (14G), which is approximately 9,445 acres.

Table 3.2.1. Subwatershed names, numbers and size in the Upper Washougal River analysis watershed.

Subwatershed Name	Subwatershed Number	Area (Acres)
Headwaters Washougal River	14A	4,534
Bluebird/Silver Creek	14B	3,393
Upper Washougal River	14C	7,736
Stebbins Creek	14D	5,342
Middle Washougal River	14E	7,030
Dougan Creek	14F	3,550
Lower Washougal River	14G	9,445
Canyon Creek	14H	3,149
Headwaters West Fork Washougal	14I	5,235
Hagen Creek	14J	3,526
Texas/Wildboy Creek	14K	5,087
Lower West Fork Washougal	14L	5,216
(Entire Analysis Watershed)	(14)	63,242

The analysis watershed is 10 to 12 miles wide at its widest, and stretches approximately 15 miles in length from its northern tip to the southernmost point. The drainage network has two major forks, the mainstem of the Washougal to the east, and the West Fork Washougal to the west. National Forest ownership lies at the very upper end of each of these two forks.

The watershed has a dendritic drainage pattern, with the mainstem of the Upper Washougal River flowing generally from north to south before bending west near the southern end of the analysis watershed.
To the west, the watershed is bordered by the lower (North Fork) Washougal River watershed; to the north by the Lewis River watershed, to the east by the Rock Creek watershed and to the south by a number of smaller direct tributaries to the Columbia River.

The mainstem of the upper Washougal River is approximately 20 miles long from its headwaters on Lookout Mountain to its outlet near the Clark and Skamania county boundary. The West Fork of the Washougal River is the largest tributary in the watershed, draining approximately one third of the analysis watershed. Upper portions of the watershed are characterized by steep slopes and incised drainages. Toward the lower end of the watershed, topography becomes more gentle, and rolling.

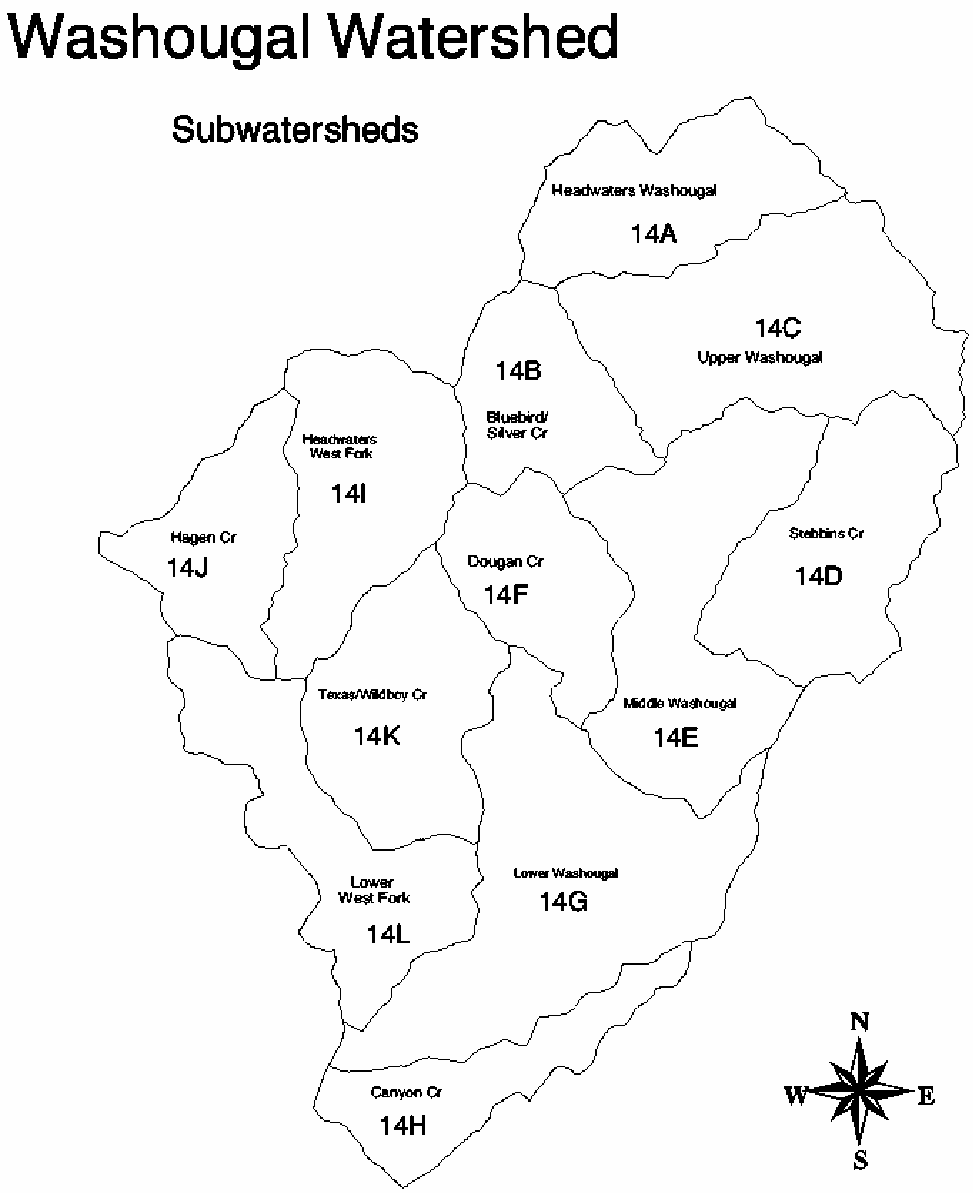


Figure 3.2.1. Subwatersheds in the Upper Washougal River watershed.

Climate

Climate in the Washougal is typified by cool wet winters and warm dry summers. Because the watershed lies in the western Cascades portion of the Columbia River gorge, climatic patterns are strongly controlled by marine-influenced air masses that move in off the Pacific Ocean. Summers are warm with infrequent precipitation, and from November through March, approximately 70% of the watershed's moisture is delivered in a combination of rainfall and snow.

Elevations range from less than 400 feet at the outlet to over 4,200 feet on Lookout Mountain at the northeast corner of the watershed. . As such, there is a relatively strong moisture gradient from west to east and from south to north as elevation increases. Average annual precipitation ranges from 60 inches in the lower portions of the watershed to over 120 inches at the higher elevations to the north.

Nearly one half of the annual precipitation measured at the Skamania Fish Hatchery (elevation 440 feet) occurs in the three month period of November through January, and over 80% occurs between the months of October and April. Average monthly precipitation ranges from 13 inches in December to just over one inch in July. Air temperatures at the Hatchery range from an average of 44°F in December to 80°F in August (Figure 3.2.1).

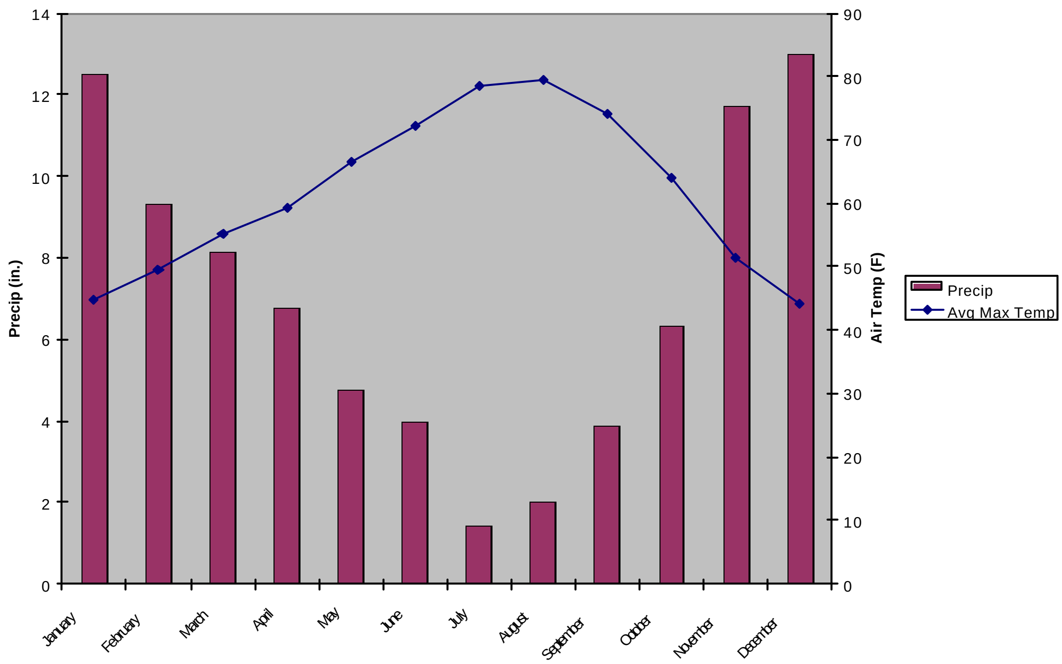


Figure 3.2.1. Average monthly precipitation and average maximum air temperatures, Skamania Fish Hatchery (located at approximately 440 feet elevation in the Washougal watershed), 1965-1994.

Because the gorge creates a gap through the Cascade Mountains which provides a conduit for air flow from the east side of the Mountains to the west, high winds are common throughout the gorge. Although wind patterns can be highly variable, and generally come from the west during the summer months, cold winds from the east side of the mountains draining west through the gorge during winter storms can create extremely icy conditions. This cold air flow from the east can tend to depress the snow level in the gorge to elevations below what would be experienced in nearby areas that are not influenced by the gorge. Such conditions have led to a number of occasions (prior to the dam construction on the Columbia River) when the Columbia River has completely frozen over (Allen, 1984). Lying just north of the gorge, weather conditions in the Washougal are influenced by the winds associated with the gorge.

Elevation is an important factor affecting the hydrology of the watershed because of its influence on air temperature, and the form that precipitation occurs. Lower elevations that experience precipitation almost exclusively as rainfall show runoff response very closely tied to precipitation intensity. The very lower end of the analysis watershed falls into this rain dominated elevation zone. Elevations just above this rain dominated zone commonly experience a mix of rainfall sequences and periods of snowfall and snowmelt are referred to as the “rain-on-snow” zone. In these elevations, snowpacks commonly develop and then completely or partially melt out several times during the course of the year. During rainfall, these areas can act as sources of enhanced runoff from snowmelt that occurs in conjunction with the rain. At higher elevations, runoff is delayed as snowpacks accumulate. These colder, deeper packs at high elevations have increased capacity to absorb and retain rainfall, further delaying runoff from these areas. But as freezing levels climb with the approach of warm frontal systems, the high elevation snow dominated areas begin to contribute a larger share of the total runoff. Summer discharge can also be affected by elevation in that snowpacks that persist late into the summer months can provide late season discharge. Because the maximum elevation in the Washougal is just over 4,000 feet, this watershed has very limited snowmelt contributions into the summer months, and in normal years would have no snow at all during the late summer months when annual low flows typically occur.

Figure 3.2.2 identifies the proportion of the Upper Washougal watershed in different precipitation zones. These zones simply reflect the most common form of runoff-producing climatic process occurring in that portion of the watershed. The “rain-on-snow” elevation zone comprises approximately 54% of the watershed, and an additional 38% of the watershed lies in the rain dominated elevations. The highest elevations in the watershed near Lookout and Bluff Mountains are in the snow dominated zone, which represents approximately 8% of the watershed.

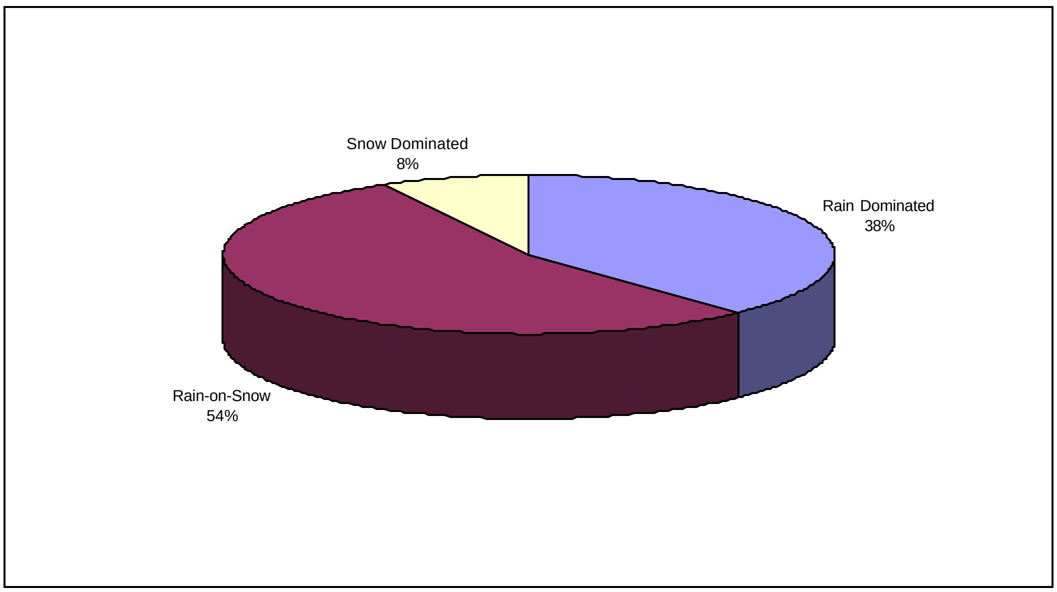


Figure 3.2.2. Proportion of the Upper Washougal River watershed in three precipitation zones.

Data for this figure was developed by the Washington State Department of Natural Resources, and is based largely on elevations. Although the mapping shows 54% of the analysis watershed in rain-on-snow elevations, it is likely that some of the land in the rain dominated portions of the watershed actually experiences rain-on-snow at a relatively high frequency compared to similar elevations in other watersheds. This is because of the effect the gorge has on lowering winter air temperatures during east wind conditions (as described above). Figure 3.2.3 shows the elevation band where rain-on-snow is thought to most commonly occur in the Washougal watershed.

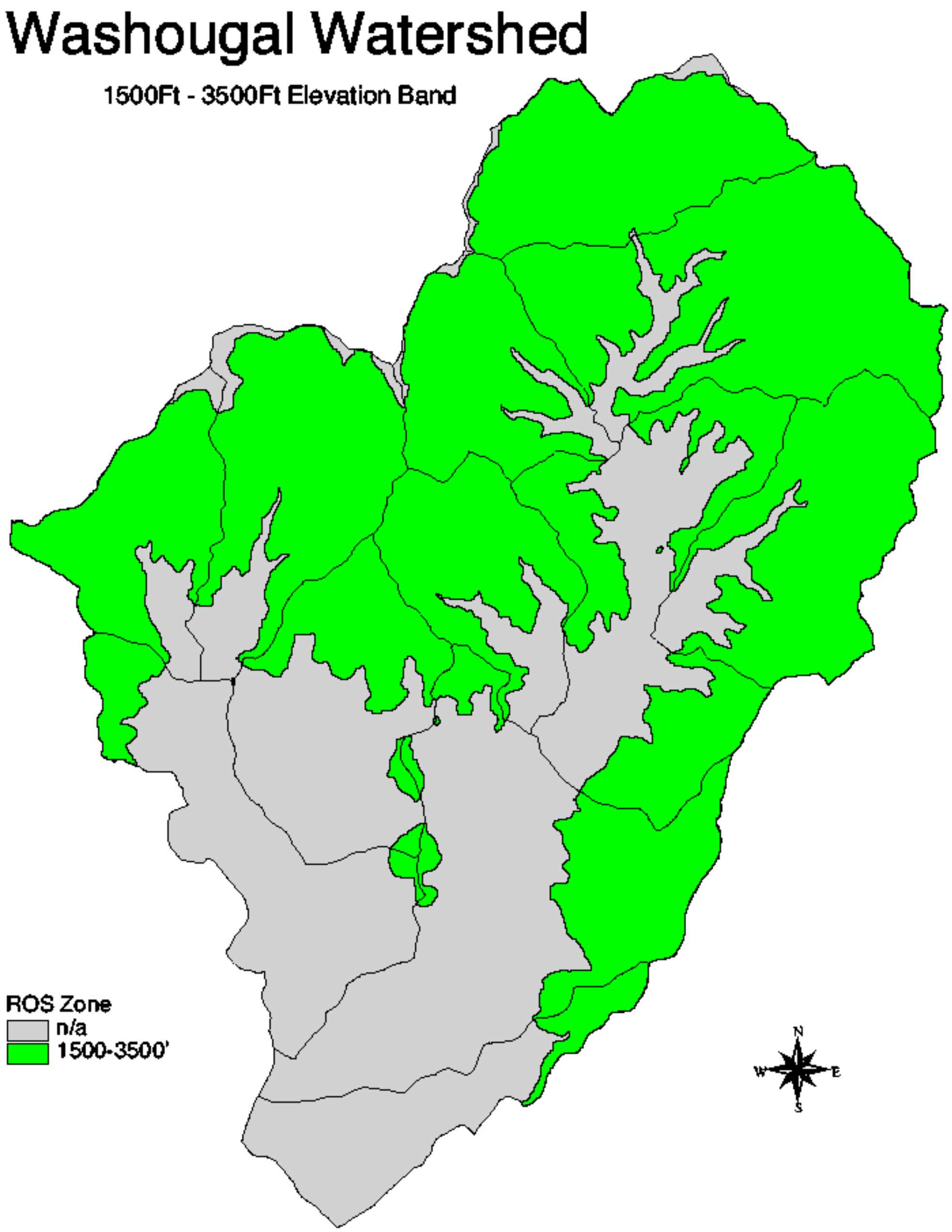


Figure 3.2.3. Elevations in the Upper Washougal watershed with a high probability of experiencing rain-on-snow.

Peak Streamflows

Peak streamflows in streams draining the Washougal watershed occur during the fall through winter months when snow cover is common over upper elevations of the watershed. The largest events generally occur between November and February in response to heavy rainfall or rain-on-snow conditions. High flows occurring during these times commonly result from warm, wet frontal systems coming from the Pacific Ocean. These systems bring rainfall, warm temperatures, and high winds, and are capable of melting a large volume of snow.

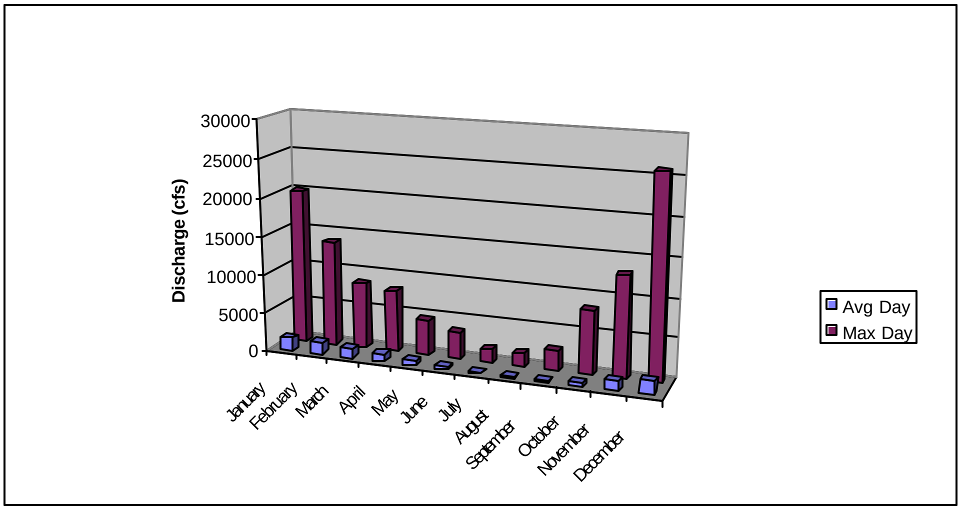


Figure 3.2.4. Average and maximum daily discharge (by month) on the Washougal River.

Figure 3.2.4 shows the average and maximum daily discharge (by month) on the Washougal River. The data for this chart was collected at a USGS gauging station located just downstream of the mouth of the analysis watershed. The lack of a spring peak in the annual hydrograph for either the maximum or average discharge is indicative of the relatively low elevations and west side location of this watershed. Spring snowmelt here is a relatively small component of the annual water production due to the higher percentage of precipitation that occurs as rain.

Disturbance Processes

Peak and low streamflows in the watershed are a function of climatic processes combined with physical conditions at the watershed and subwatershed scale that control the routing of water from the atmosphere to the ground, and from hillslopes into stream channels. Primary disturbance processes affecting hydrology of the watershed during the reference period included storm systems and periods of drought, which controlled water inputs; and wildfire, which would have affected the physical structure of the forest canopy, and thus affected the timing, and form of the water leaving the system. Climatic events are clearly the primary drivers for runoff processes in the watershed, and fire, by affecting vegetative cover in the watershed would have been the largest and most frequent factor modifying how water was processed in the watershed. Because the Washougal watershed lies at the lower and middle elevations of the western Cascades, loss of forest cover by wildfire would have affected both low flow and winter discharge conditions in the watershed.

Forest cover is a key factor affecting the hydrology of systems where rain-on-snow occurs because as forest cover is removed, accumulations of snow increase in the open areas. Rates of snowmelt are higher in the open areas as well because during rain-on-snow conditions, the transfer of heat from the air to the snowpack is increased due to the increased wind speed and air turbulence over the snowpack. As incrementally more of the watershed is put into an open condition (i.e. by wildfire), the increased water available for runoff from each of the open areas can combine to increase the size of resulting streamflows.

In the Washougal watershed, areas of greatest concern for altered snow accumulation and melt during rain-on-snow lie in the elevations between 1,500 and 3,500 feet. This elevation band is commonly referred to as the rain-on-snow (ROS) zone. Although rain-on-snow is not limited to these elevations, this is the area where it most commonly occurs. As the proportion of any subwatershed affected by fire was increased, the potential for higher peak streamflows was greater due to the increased runoff that occurred from burned over areas during rain-on-snow driven floods. Fire frequency assessments in the region have found that return intervals for stand replacing fires in the area including the upper Washougal watershed would range from 10's to several 100's of years for fires covering anywhere from a few acres to thousands of acres in extreme cases (USFS, 1993). Under these conditions, entire subwatersheds would have at times been completely burned. At the same time, other subwatersheds would have been largely or entirely skipped over by fire for decades or even hundreds of years.

In an 1899 survey of southwest Washington, Plummer found that approximately 16% of the Wind River (an adjacent watershed) was in "burned areas", and approximately 84% was "timbered" (Plummer, 1900). Plummer's surveys of other nearby watersheds found "burned areas" comprising 7% of the Little White Salmon River watershed at that time, and 26% of the White Salmon River watershed. Although these conditions represent only a snapshot in time, they provide some context for the magnitude and range of areas burned in the past by wildfire, and the relative proportion of these large watersheds in early seral condition at the turn of the century. Essentially the entire Washougal watershed was burned during the Yacolt and Dole burns that occurred earlier this century.

The significance of the fire analyses to hydrologic response is that at any given time under reference conditions, there were likely large areas of the landscape that were in a burned condition, and which were experiencing increased peak streamflows. Nearby subwatersheds that were covered in mature forest were at the same time experiencing average or below average sized peak flows. Partially burned subwatersheds functioned somewhere between the burned and fully mature watersheds. The result of this would have been higher variability in the timing and magnitude of streamflows from subwatersheds in the analysis watershed during reference conditions.

Although changes in peak streamflows could be relatively large following extensive fires, the effect of the increased peak flow levels on stream channels may have been somewhat less than would be expected today under similar vegetative conditions. This is because streams historically had higher levels of in-channel woody debris and more large standing trees along streambanks than under current conditions. Fire may in fact have provided a mechanism for introducing additional woody debris to the stream when riparian areas were burned. In general, channels under reference conditions had a higher degree of roughness, in-channel structure, and bank integrity than under current conditions, and so would have been more resilient and better able to handle changes in flow regimes.

Current Conditions

Peak Flows

The U.S. Geological Survey monitored streamflow levels on the Washougal River from 1945 through 1981 at a site approximately four miles downstream from the outlet of the analysis watershed. Because there is a relatively small contributing drainage area below the analysis watershed and above the gauge site, discharge measured at that gauge is in large part generated by discharge from the analysis watershed. The largest flood known to have occurred on the Washougal was probably the February, 1996 event, but unfortunately the stream gauge had been abandoned by that time, so the flood discharge was not measured. For perspective, the February 1996 event on the East Fork of the Lewis River (just north of the Washougal watershed) was estimated at 28,600 cubic feet per second (cfs), nearly 50% greater than the next largest flood measured there in 67 years of stream gauging. For the East Fork of the Lewis River, this flood was estimated to have a recurrence interval of 500 years or more by the U.S. Geological Survey.

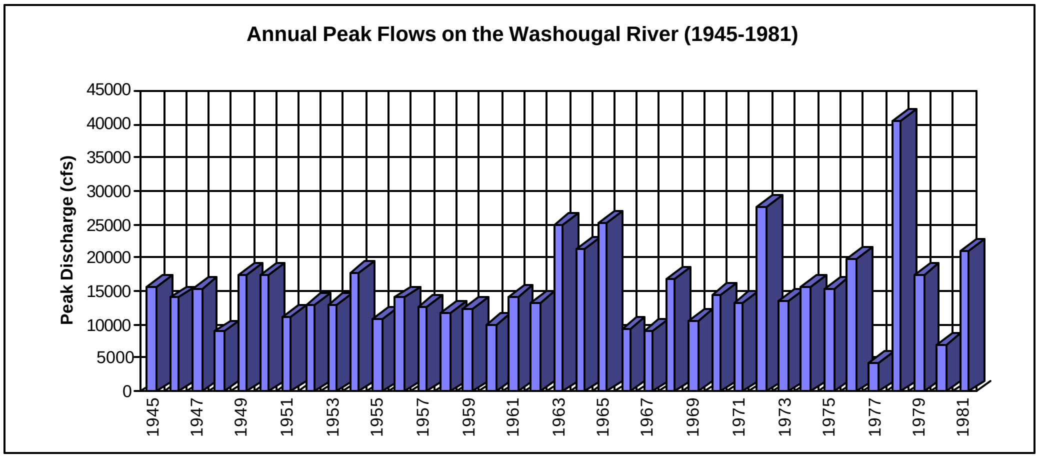


Figure 3.2.5. Annual maximum peak flows on the Washougal River (1945-1981).

The largest previous flood measured on the Washougal occurred in response to a rain-on-snow event, in December of 1977 (water year 1978) (Figure 3.2.5). At 40,400 cfs, this event was nearly 50% larger than the previous flood of record on the Washougal. Major floods also occurred on the Washougal in January, 1972, December, 1964, January 1964, and November, 1962. Approximately 90% of the largest flows on record for the Washougal occurred during the November through February period. This is significant, because it is during these months that there is presumably snow cover over some portions of the watershed, and soils are fully charged with moisture from early winter and fall rains. The '96 flood was typical of the kinds of conditions that cause the largest flooding in systems like the Washougal. A heavy snowfall was followed by deep freezing and a subsequent warm, wet frontal system that remained in the area over a period of days. The resulting snowmelt combined with runoff from heavy rains caused major flooding throughout the region during that event.

Disturbance Processes

Seral class of vegetation and extent of roading in the watershed are two primary factors that can affect the timing and magnitude of peak and low streamflows by altering the routing of water from the atmosphere to stream channels. Since fire has been largely eliminated from the system through prevention and suppression efforts, vegetation conditions are now primarily affected by timber harvest on both public and private lands.

Vegetation

Vegetation in the watershed plays a strong role in determining the timing and magnitude of water available for runoff during periods of rainfall and snowmelt. Generally, as the proportion of a watershed in early seral vegetation is increased, the potential for the timing or magnitude of peak flows to be altered is increased. Forest cover is a key factor affecting the hydrology of systems where rain-on-snow occurs because as forest cover is removed, snow accumulation can increase in the open areas. Rates of snowmelt are higher in the open areas as well because during rain-on-snow, the transfer of heat from the air to the snowpack is increased due to the increased windspeed and air turbulence over the snowpack. As incrementally more of the watershed is put into an open or early seral condition (i.e. by wildfire or timber harvest), the increased water available for runoff from these hydrologically unrecovered areas can combine to increase the size of resulting streamflows.

Currently approximately 88% of the watershed is in some form of forest vegetation. Approximately 34% of the land area is in early seral vegetation, clearcuts, or meadows, and there is essentially no late successional forest remaining in the watershed (Figure 3.2.6). Early seral vegetation is defined here as a combination of the grass/forb, shrub/seedling, and open sapling/pole vegetation classes.

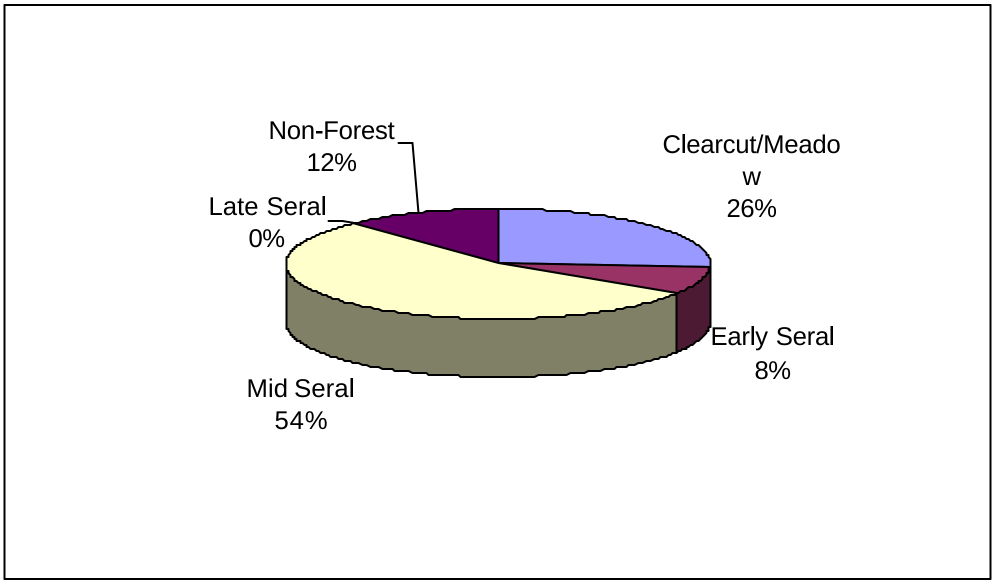


Figure 3.2.6. Vegetation seral classes in the upper Washougal River watershed.

The early seral forest and recent clearcuts provide greater levels of water available for runoff during rain-on-snow conditions, because they have less capacity to intercept snow in the forest canopy, and have limited capacity to modify winds and turbulent heat exchange with the snow surface in those areas. The increased snow accumulations and increased rate of melt can contribute to changes in both the timing and magnitude of peak streamflows.

Because of the lack of specific stand condition data for much of the watershed, the Aggregate Recovery Percent has not been calculated for this analysis. Instead, a simple percent of hydrologically immature forest cover is used to index the hydrologic maturity of the subwatersheds (Table 3.2.2). For these purposes, all early seral stands and clearcuts/meadows will be defined as hydrologically immature, and the mid and late seral stands will be defined as hydrologically mature. Although this is a relatively coarse analysis method, it is used because of the lack of data specifics available, and the fact that most of the watershed is outside of the National Forest.

Table 3.2.2. Hydrologic maturity and percent rain-on-snow (ROS).

Subwatershed Name	Number	% Hydrologically Immature Vegetation	%ROS
Headwaters Washougal River	14A	29%	79%
Bluebird/Silver Creek	14B	22%	65%
Upper Washougal River	14C	19%	91%
Stebbins Creek	14D	20%	62%
Middle Washougal River	14E	25%	56%
Dougan Creek	14F	25%	68%
Lower Washougal River	14G	47%	31%
Canyon Creek	14H	55%	15%
Headwaters West Fork Washougal	14I	53%	66%
Hagen Creek	14J	37%	73%
Texas/Wildboy Creek	14K	46%	37%
Lower West Fork Washougal	14L	36%	10%
(Entire Analysis Watershed)	(14)	34%	54%

The Lower Washougal, Canyon Creek, Headwaters West Fork, and Texas/Wildboy subwatersheds have particularly high proportions of their drainage area in hydrologically immature vegetation, ranging from 46% (Texas/Wildboy) to 55% (Canyon Creek). These figures suggest that streamflows in those subwatersheds are presently influenced quite strongly by a combination of residual effects of the early century fires, and subsequent timber harvest and development that has occurred in the watershed. The levels of early seral vegetation in these subwatersheds are some of the highest seen in any of the watersheds draining the southern portion of the Gifford Pinchot National Forest. However, because Forest Service personnel did not field check and update the vegetation data for lands south of the National Forest boundary (for this assessment), confidence in the accuracy of this data is only moderate at best.

Elevations of the subwatershed are also important in assessing the risk of increased peak flows. Those subwatersheds with a relatively high percent of their area in rain-on-snow elevations, and with a relatively high percentage of hydrologically immature vegetation would be at greater risk of having peak flows increased as a result of past timber harvest. Table 3.2.2 shows the percent of each subwatershed in the high probability rain-on-snow elevations (%ROS), which are generally considered to be from around 1,000 to 3,500 feet in this watershed. Much of the Upper Washougal watershed falls into this elevation band where rain-on-snow is common.

Based on the elevations and amount of hydrologically immature vegetation, the Headwaters West Fork subwatershed would have the greatest concern for increased peak flows during rain-on-snow. Similarly, the Lower Washougal River, Canyon Creek, and Texas/Wildboy subwatersheds have higher potentials for increased flows as a result of the vegetative conditions and elevations there.

Roads

Roads are another important feature on the landscape that can affect the hydrologic functioning of a watershed. By impeding water infiltration, intercepting subsurface water and converting it to surface flow in roadside ditches, roads can accelerate the rate at which water moves from hillslopes into streams. As the number of roads or road density is increased in a watershed, the potential for this localized effect on hillslope hydrology to affect watershed hydrology by changing the rate or timing of streamflows is increased. Table 3.2.3 displays the current road mileage and road densities for each subwatershed.

In addition to the effect forest cover removal can have on peak streamflows, alteration of water routing in a watershed by roading or other forms of soil compaction can also affect the timing and magnitude of peak flows. By compacting the soil, water percolation is reduced, and overland water flow is increased. Cross-slope roads also intercept subsurface water flow at cutslopes, and convert it to surface flow through roadside ditches. Water flowing across the surface in this way moves much faster than subsurface flow. Roadside drainage ditches that drain to either perennial, intermittent, or ephemeral channels in effect increase the drainage density of a watershed, and increase the rate at which water is moved from the hillslopes into surface stream channels. This allows water to concentrate in channels much faster, and can result in higher peak flows.

Table 3.2.3. Road miles and density by subwatershed.

Subwatershed Name	Number	Road Miles	Road Density
Headwaters Washougal River	14A	8.49	1.2
Bluebird/Silver Creek	14B	1.15	0.2
Upper Washougal River	14C	12.25	1.0
Stebbins Creek	14D	14.73	1.8
Middle Washougal River	14E	23.48	2.1
Dougan Creek	14F	8.61	1.6
Lower Washougal River	14G	50.26	3.4
Canyon Creek	14H	12.08	2.5
Headwaters West Fork Washougal	14I	12.83	1.6
Hagen Creek	14J	6.11	1.1
Texas/Wildboy Creek	14K	20.75	2.6
Lower West Fork Washougal	14L	23.88	2.9
(Entire Analysis Watershed)	(14)	194.62	2.0

In general, road densities in excess of 3.0 miles per square mile of watershed area are considered "high" on the Gifford Pinchot National Forest. In this watershed, road densities range from 0.2 to 3.4 miles per square mile, and average 2.0 miles per square mile across the watershed. The greatest road densities in this watershed are found in the lower portions of the watershed, particularly in the Lower Washougal subwatershed (3.4 miles/square mile), and the Lower West Fork Washougal subwatershed (2.9 miles/square mile). Higher road densities can be particularly important in subwatersheds that lie largely in the rain-on-snow elevations, and in areas that have had substantial timber harvest, because these areas would tend to have increased runoff resulting from changes in the snow accumulation and melt processes. Road networks in these areas can complement the increased runoff by allowing the runoff to reach streams more quickly through roadside ditches.

During runoff periods, as additional miles of road begin to capture and route water directly to streams through roadside ditches, the effective surface drainage network in a watershed can be substantially increased. Table 3.2.4 displays the natural drainage network density for each subwatershed, and the percent that the natural drainage density may be increased during runoff periods as a result of the current level of roading in the watershed. The values presented in this table were determined by assuming that during runoff events, approximately 57% of the roads in the watershed function as extensions of stream channels by routing water directly from hillslopes to streams (following Wemple, 1993). Because there are a number of variables that affect how much of the road system actually functions as channel extensions, these numbers are presented only to provide a relative comparison of the potential effects of roads between subwatersheds.

Table 3.2.4. Natural drainage density and percent drainage density is increased by roads.

Subwatershed Name	**Number**	**Stream Miles**	**Natural Drainage Density (mi/mi^2)**	**Current Drainage Density (mi/mi^2)**	**Increase in Drainage Density (%)**
Headwaters Washougal River	14A	48.3	6.8	7.5	10%
Bluebird/Silver Creek	14B	45.7	8.6	8.7	1%
Upper Washougal River	14C	98.7	8.2	8.7	7%
Stebbins Creek	14D	62.9	7.5	8.5	13%
Middle Washougal River	14E	70.4	6.4	7.6	19%
Dougan Creek	14F	38.9	7.0	7.9	13%
Lower Washougal River	14G	55.6	3.8	5.7	52%
Canyon Creek	14H	19.7	4.0	5.4	35%
Headwaters West Fork Washougal	14I	44.3	5.4	6.3	16%
Hagen Creek	14J	29.1	5.3	5.9	12%
Texas/Wildboy Creek	14K	39.7	5.0	6.5	30%
Lower West Fork Washougal	14L	34.8	4.3	5.9	39%
(Entire Analysis Watershed)	(14)	588.1	6.0	7.1	19%

Drainage density in some subwatersheds has been dramatically changed due to road systems. In the Lower Washougal subwatershed, natural drainage densities have been more than doubled. The large increase in drainage density in the Lower Washougal is due in part to the naturally low drainage density there combined with a relatively high road density. The Lower West Fork, Canyon Creek, and Texas/Wildboy Creeks, all lower elevation subwatersheds, similarly show a relatively large increase in drainage density due to roads.

The degree to which any particular road intercepts subsurface flows and re-routes this water to streams via roadside ditches is dependent upon a number of variables including the soil type and depth, subsurface geology, hydrology, slope, and position of the road on the hillslope. Roads located along ridgetops are probably less important to changes in hydrologic flow paths because these roads have no cutslope and no drainage area above them. Roads in mid-slope positions have relatively larger drainage areas above them, and may have long distances below them through which water would normally have flowed via subsurface pathways. When they are intercepting subsurface water, these roads may have the greatest effect on changing the timing of water delivery from hillslopes into stream channels. Roads in lower hillslope positions are probably the most likely to intercept subsurface flows, because these landscape positions are where subsurface water builds up and often intersects the ground surface during precipitation or snowmelt periods. Roads in the analysis watershed are found in all landscape positions, however, the roads in this watershed that lie on National Forest lands are generally in ridgetop locations.

Synthesis

The primary trend in factors affecting peak and low flows in this watershed has been the shift from a fire dominated system to one where timber harvest, road construction, farming and residential development have become the dominant disturbance processes. Currently, the Lower West Fork Washougal, Texas/Wildboy Creek, and the Lower Washougal, and Canyon Creek are the areas where hydrologic functions may be most impacted by the combination of hydrologically immature forest and road networks.

In the future, timber harvest and road construction are the most important human-caused factors likely to affect peak and low flows on the National Forest lands in the watershed. Hydrologic recovery in this part of the watershed will occur as forest vegetation matures and develops, and as roads and compacted areas are decommissioned or rehabilitated. Actual recovery or lack of recovery in this portion of the watershed will depend on the relative proportion of the watershed that is harvested, the natural rate of recovery of forest vegetation in the watershed, the miles of road constructed, and miles of road decommissioned.

Because of the condition of the existing forest and the relatively poor growing conditions on much of the National Forest lands in the watershed, very little if any timber harvest is likely to occur there in the near future. As a result, there will probably be no new road construction in this area either. It is also unlikely however, that roads will be decommissioned in this part of the watershed. This is because there are very few National Forest roads in the watershed to begin with, and those that exist pose relatively low risk to aquatic systems due to their ridgetop locations.

While National Forest portions of the watershed experience relatively low levels of human induced disturbance over the next decade or more, the lower Washougal watershed will in all likelihood see continued disturbance from a mix of activities including forestry operations, land development, and changes in land use. It is significant to note that while timber harvest by itself is a temporary set back for hydrologic recovery, forestland conversion to other non-forest uses, can have much more persistent effects to hydrologic performance of the land. Continued development pressures in this watershed make it likely that additional forestland will be shifted from forest cover to residential, agricultural, or commercial uses over the next few decades, so from a watershed perspective, this system will continue to experience considerable disturbance—as it has over the past century.

Data Gaps

Recent streamflow data is lacking for the watershed since the time the USGS gauge was decommissioned.

Vegetation

Reference Conditions

Forest and Non-Forest Zones

The watershed is dominated by forested ecotypes. The dominant forest zones or plant series are western hemlock and Pacific silver fir. Western hemlock makes up the majority of the area with Pacific silver fir occurring along the ridgelines at the highest elevations. The watershed contains a variety of vegetation conditions that are influenced by weather, elevation, and topography. There is a strong influence from both moist maritime weather and drier, continental weather. Cool, moist weather occurs from November through May and warm, dry weather occurs from June through October. Elevations within the watershed range from 100 feet at the Columbia to 4,222 feet at Lookout Mountain.

Non-forest zones within the watershed consist of talus slopes, rock outcrops, wetlands, water bodies, and higher-elevation, mesic shrub-meadows. Overall, non-forest zones comprise 12% of the Washougal River watershed, a total of 7,497 acres. However, there are likely to be numerous small sites of these habitats that were not mapped, making the total acreage greater. The upper reaches of the watershed, that portion of the watershed on National Forest, is 18% rock, but has fewer wet areas and water bodies. Because of their relative scarcity, non-forest features are often considered unique or special habitats. These areas are the source for much of the species richness, or biodiversity, that is found within the watershed.

Fire played a major role in maintaining certain habitats such as the mesic shrub-meadows along the ridges. Fires burned hot through this area over a short period of time. Some areas burned and re-burned, consuming all of the organic matter that had accumulated, reducing the soil to ash and cinders, thereby hampering reforestation for decades. Tree establishment and growth remains slow to this day.

Another class of non-forest land within the watershed is the rural and residential lands located in the lower portion of the drainage along the Washougal River. The vegetation in these areas is not considered in this analysis except for the possible occurrence of noxious weeds there.

Disturbance—Fire

Fire Groups

A report was prepared addressing the role of fire on the Mt. Hood and the Gifford Pinchot National Forests titled *Fire Ecology of the Mid-Columbia* by Louisa Evers and others in 1994. Several fire groups are identified in this report. The fire groups are based on ecological plant series that have similar fire histories. There is basically one fire group that is represented in this watershed. This is fire group 8, warm moist western hemlock and pacific silver fir. There are areas of fire group 0, which are called miscellaneous special habitats.

Miscellaneous Special Habitats (Group 0)
This fire group includes forested rock, dry meadows, wet meadows, volcanic deposits, alder glades and deciduous riparian communities. These areas have little fuel present, or very discontinuous fuels. Such areas generally don’t carry fire except under extreme conditions.

Warm Moist Western Hemlock and Pacific Silver Fire (Group 8)
This fire group includes most of the western hemlock and pacific silver fir plant associations found in the mid-Columbia. It includes a wide range of topographic positions, moisture regimes, and temperature regimes. This fire group generally lacks fine fuels through most of the stand history. Sites with devil’s club and skunk cabbage may have very heavy fuel buildups, but the presence of water keeps these fuels too moist to burn readily and facilitates

relatively rapid decay. "Classic" old growth stand conditions (closed canopy overstory of large diameter trees over a lush understory) are common in undisturbed areas, indicating infrequent disturbance.

Fuel loading can build rapidly once the overstory begins to die from insect and disease attack and the canopy breaks up. When this begins to happen, conditions become drier in these canopy gaps and can provide a suitable fuel bed for fire starts. At this time, fuel loading is light throughout the watershed.

Deep duff and large logs are typical of this group. However this watershed does not support either. This is due to the large fires around the turn of the century. In this watershed, this fire group is in an infancy stage, with shallow duff and little to no large logs. In most years, the associations in this group are well watered and slow to dry.

Historical Fires (Pre-1900)

Little information exists concerning historical fires in this watershed. Fires were probably scarce until settlement started to occur along the Columbia River.

Large fires did occur in the early 1900's after settlement had begun in earnest. Most of these fires occurred after the area had been logged and the slash was left on site. The most famous of the large fires in this watershed occurred in 1902. This was the Yacolt fire. This fire started in logging slash during a period of prolonged drought. The fire was fanned by east winds. These winds are common in the fall months. Several reburns occurred in the area of the Yacolt burn up to 20 years later.

Lightning does occur in the area of the watershed however most of the fire ignitions have been human caused. If the watershed did not have a large human population center on the lower slopes, fire as a major disturbance source, would play a minor role. With the amount of human interaction with the watershed, the role fire could play as a major disturbance factor rises.

Role of Fire

Prolonged drought (drought lasting at least 3 years) dries the forest floor enough to allow fires to start and spread. Smoldering combustion and creeping fires are most common until dry east winds fan the flames into a much higher intensity fire. Fire frequencies in similar stand types in northern Idaho averaged 50 –200+ years between fires. Ecology plot data taken in this area indicate a similar fire frequency in western hemlock associations and 170-400 years in Pacific silver fir associations. Average return intervals in sites with devil's club and skink cabbage may easily exceed 300 years. A very rough assumption could be made stating that fires in the 1-10 acre size occur about 90% of the time in the 50-200 year interval and fires that are greater than 100 acres occur 10% of the time and fall into the 170-300 year interval. Once again we must emphasize that conditions to support natural ignitions would result from prolonged drought and strong east winds. In addition the fuel loadings on the ground would have to have a chance to build up more than what they currently are. This is not to say that the watershed could not support a large fire today, however the probabilities are low that this would occur from a natural fire start. Harvest activities or other human influence could alter the fuel loadings and increase areas to a higher level of risk.

Forest Seral Distribution

Successional Stages

Pre-European settlement is the point of reference for the historical vegetative conditions of the Washougal River watershed. Prior to European settlement, Indian use of the area was mainly for hunting and gathering with encampments along the Columbia River. There is no information to suggest that Indians influenced forest successional stages in the Washougal drainage through burning like on other parts of the Forest. Since European settlement, the greatest influences to the vegetation classes have been from wildfire and timber harvesting. Table 3.3.1 displays the percentage of area by successional stage and how conditions have likely changed from 1850 to the present.

Table 3.3.1. Historical forest successional conditions

Period	Non-Forest	Early-Successional	Mid-Successional	Late-Successional
Range of Natural	4%	10%-22%	16%-40%	33%-70%
Circa 1850	4%	10%-15%	16%-20%	60%-70%
Current Conditions	12%	34%	54%	0%

Definitions: Non-forest – rock, meadows, rural, and domestic.
Early-successional – Seedlings, saplings, poles, meadows
Mid-successional – small trees and large trees with a single canopy
Late-successional – large trees with multiple stories

The range of natural conditions is adapted from *A First Approximation of Ecosystem Health* (USDA-FS 1993), which is also a known as the Regional Ecosystem Assessment Project or REAP. The REAP characterized various ecosystem components in pre-settlement times. The scale of analysis was the sub basin level. The Washougal watershed lies within the Hood-Wind Sub Basin, which also includes Hood River, Wind River, White Salmon River, and the Little White Salmon River watersheds. The range of Natural values presented in Table 3.3.1 are representative of the western hemlock zone.

Since the watershed had a long fire frequency interval, most of the stands prior to European settlement were in the late-successional stage. The 1850 figures above are estimates of the vegetative condition of the watershed. Evidence of the past late-successional forest exists in the remnants of stumps and down logs that predate the fires of the 1900's. The ridge area west of Lookout Mountain likely always contained some younger successional stages. This area has a history of Indian use as a huckleberry area as well as travel corridor. This would put the area at a higher level of risk from human caused fires. European settlers moved to the area along the Washougal River establishing homesteads in 1850. Timber harvesting in the lower river area provided income and a source of raw materials for construction.

The Current Conditions in Table 3.3.1 represent the data that resides within the Gifford Pinchot National Forest and State of Washington Department of Natural Resources current GIS database. The current vegetation is a result of the wildfires that occurred in the watershed between 1902 and 1929 and the subsequent reforestation efforts spanning several decades to get the area stocked.

Composition and Structure

The composition and structure of the reference forest likely contained lesser amounts of early and mid-successional forest and greater amounts of late-successional forest. The early-successional stands were a product of smaller disturbance events like windthrow, disease pockets, and light to medium intensity fires. The ridge tops also contained more early-successional forest as evidenced by the historic use of the ridges for huckleberry gathering. The late-successional forest was composed of Douglas-fir and hemlock below about 3,000 feet elevation and Pacific silver fir and noble fir above 3,000 feet. The late-successional stands certainly comprised the largest patch sizes within the drainage.

Soil Productivity

Soil productivity is a result of soil structure and nutrient availability. The processes of compaction, erosion, mass wasting, and volatilization of organic matter have the potential to affect significant change in a short time period to soil structure and nutrient availability and hence soil productivity. The processes of soil weathering, nutrient deposition, leaching, and biological interactions also affect these soil attributes, but these processes occur much more slowly and are less affected by management actions.

Forest soils in the Washougal watershed rate as site class III, IV, and V for Douglas-fir productivity (155 to 80 cubic feet per acre per year of timber). Historically, fire was the main factor in affecting rapid changes in soil productivity. Fire volatilizes soil organic matter and briefly making certain nutrients available. Exposed mineral soil is subject to erosion and mass wasting under the altered hydrologic regime.

Current Conditions

Disturbance

Fire

Fire Suppression (Forest Service lands only)
All fires have been aggressively suppressed since the early 1930's. The current Forest Plan direction provides for the use of appropriate suppression response to any wildfire on lands that fall within forest service jurisdiction in the watershed. Appropriate suppression responses could be either control, confine, or contain. On Forest Service lands, each management allocation in the Forest Plan has a suggested suppression response based on values at risk.

Fire History (post 1900)
This has been discussed in early segments of this report. Records were not located for fire starts in the watershed after the large fires at the turn of the century. It is assumed that several small fires have occurred during this time period.

Timber Harvest

The first timber harvesting was done by settlers in the lower part of the Washougal watershed to provide timber for building materials and a source of wood fuel for the steam ships on the Columbia River. Most of the lower drainage was logged prior to the devastating fires of the 1900's. This was not the case in the upper portion of the watershed, on what is now Forest Service land, where much timber was lost to fire. After the last fire that occurred in 1929, the CCC cut snags in the burned area to reduce the hazard of fire reoccurrence.
On some State and private lands in the lower portions, second growth harvesting has been underway for the past decade. No harvesting has been done on National Forest lands.

Landscape Terracing

In the 1950's and possibly into the 1960's, the upper slopes of the watershed were terraced in an effort to get trees to survive and grow. The terracing was done with crawler tractors and consisted of constructing parallel trenches on the hill slopes. The objective was to increase reforestation success by 1) removing the surface rock, 2) exposing underlying soil and 3) capturing runoff. This technique was not very successful and probably resulted in increased site disturbance. Exposing the subsoil and then planting trees in it did not increase tree growth in most instances because the subsoil is low in nutrients and organic matter.

Forest Damage Agents

The primary damage agents affecting the stands in the Washougal watershed include root diseases, bark beetles, and weather.

Root Disease
Laminated root rot is found throughout the forested ecosystem and causes mortality to Douglas-fir and true firs. Western hemlock is moderately resistant; western white pine and western red cedar are highly resistant; and hardwood species are immune to the disease. Laminated root rot causes mortality in small areas from a few trees to up to 2-3 acres in size. Trees weakened by the disease are often killed by bark beetles. The disease continues to spread by root contact gradually until it encounters areas with immune species or no susceptible root systems.

Armillaria is found in all forested ecosystems to some extent. Conifers affected by this disease depend upon a particular strain for each tree species. One strain affects mostly Douglas-fir and true fir. The disease normally becomes established on trees of low vigor, then spreads by root contacts. The primary strategy to be employed to reduce the effects of *Armillaria* includes maintaining tree vigor and stand diversity.

Bark Beetles
Various species of bark beetles affect different tree species in stands weakened by overstocking or root disease, particularly during a prolonged drought period. The two primary species present are the Douglas-fir beetle and the fir engraver. The resultant mortality frequently result in small gaps with high levels of snags and downed logs. Controlling tree density to increase stand health and vigor can minimize bark beetle impact.

Weather
Landform, elevation, and aspect all have an influence on how weather affects sites within the Washougal watershed. The landform consists of dissected drainages that are separated by ridges that receive considerable wind from both the east and west. Winds are influenced by the atmospheric pressure gradients as weather systems move through the Columbia River Gorge. On sites exposed to the wind, "flagging" of trees indicate prominent easterly winds (west to east). The influence of elevation determines the level where snow accumulates during the winter months. Areas above 3,500 feet in elevation have greater accumulations of snow. At these elevations, true firs like noble and Pacific silver fir are more likely to be suitable conifer species for survival and growth. Aspect within the watershed has a direct effect on site productivity. Since many of the slopes within the watershed have a southern aspect, trees are subject to higher temperatures and drier soil conditions, which slow tree growth and may indicate a different plant association (e.g., lower elevation species such as Doug fir above 3500 feet). Under extreme conditions, tree growth can be severely limited.

Forest Seral Distribution

Successional Stages

All forest successional stages occur in the Washougal watershed. Per a combination of the Forest Vegetation and the DNR GIS database, the acres of forest in each stage by sub-watershed are shown in the following table.

Table 3.3.2. Acres of current forest successional conditions by sub-watershed.

Subwatershed	**Early Successional** ***-grass/forb -meadows***	**Early Successional** ***-seedling -sapling -poles***	**Mid Successional** ***-small trees -large tree single-story***	**Late Successional** ***-large tree multi-story***	**Non-forest** ***-rock -wet -water -rural -domestic***
14A	449	863	2969	53	202
14B	171	577	2027	83	525
14C	1092	363	6230	0	51
14D	800	260	3851	0	432
14E	1482	252	4898	0	399
14F	839	64	1462	0	1185
14G	4175	222	3965	0	1083
14H	1651	74	839	*	586
14I	1117	1642	1005	0	1456
14J	705	609	2127	0	83
14K	2168	167	1555	0	1197
14L	1805	76	3043	0	292
Total Acres	**16454**	**5169**	**33971**	**0**	**7491**
Area percent	26%	08%	54%	0%	12%

*Several stands, amounting to roughly 400 acres, may qualify as late-successional. They are discussed below under "unique habitats."
Note: seedlings/saplings are 0-4.9" dbh; poles are 5-8.9" dbh; small trees are 9-20.9" dbh; and large trees are +21" dbh.

Early successional areas in the upper part of the watershed originated after the forest fires of the last 90 years. Some of these areas are very slow to complete the regeneration sequence from the grass/forb stage to established seedlings and on to the sapling/pole stage. The reason for this is the soil damage sites received during the fires, which reduced soil organic matter and site productivity. Despite reforestation efforts over the past several decades, some sites persist in the early succession stages of grass and shrubs. In the lower portion of the watershed, the early seral areas are likely a result of recent timber harvest on both State and private lands. The mid-succession areas are stands (primarily small trees and large trees with single canopy layer) that also regenerated since the original 1902 wildfire, most likely in areas that were not severely re-burned. The late-successional areas are remnant pieces of the forest that began before the catastrophic wildfires and survived the fires intact. These areas occur in drainage bottoms that did not burn with great intensity.

Composition and Structure

Structure and composition of forested stands within the watershed are closely correlated with the seral stage and ecological zones in which they occur. Remnant late-successional old-growth stands which occur in the watershed are the most diverse in both structure and species composition. The early and mid-successional stands are fairly homogeneous in species composition, tree size, and age.

Within the western hemlock ecological zone, species composition in the early and mid-successional stands is mostly Douglas-fir with young western hemlock in the understory. The lower drainage contains naturally regenerated stands that came in after the 1902 Yacolt burn. The upper drainage stands originated in most part from artificial regeneration by tree planting during the 30's, 40's, 50's, and 60's. The seed source of the planting stock came from different locations. Some of the seed was local but much came from such locations as the Willamette Valley, Oregon, and Roy and Renton, Washington. Records are not available as to where the different seed sources were planted throughout the watershed. It is apparent where these off-site seed sources are likely located because the stands show signs of stress. Poor crown and branch development is the most obvious symptom and is characterized by poor form, excessive wind and ice breakage, poor foliage color, poor needle retention, and susceptibility to winter desiccation. Many stands are just not developing as expected for their given age. The suspected factors are low soil fertility and/or off-site seed sources. The result are stands that do not contribute their full potential to the hydrological and habitat functions of the ecosystem. Hydrological functions relate to rain and snow intercept and groundwater recharge. Habitat functions relate to vegetative cover, snags, and coarse wood.

Less than 1% of the area contains late-successional stands. These remnant stands contain a diversity of tree species, multiple layers of trees, snags, and coarse wood. These are stand patches that survived the burns.

Within the Pacific silver fir ecological zone (above 3500 feet), environmental conditions favor the growth of true fir (Pacific silver fir, noble fir, subalpine fir). Past Douglas fir planting in this zone has shown poor success. More recent efforts used noble fir with much more success in survival and growth. Stands in this zone vary from 20 to 90 years old. The stands less than 50 years old originated primarily from artificial regeneration. Older stands originated from natural regeneration following the 1902 fire and did not re-burn in later years. There are little to no late-successional stands within this zone.

Riparian zones are dominated by the early-successional species of red alder at the lower elevations. At higher elevations, early riparian vegetation has been slower to form, but consists of Sitka alder, grasses, forbs and upland shrubs. Historically, the late-successional riparian vegetation consisted of Douglas-fir, western hemlock, and red cedar at the lower elevations and noble fir and Pacific silver fir at the higher elevations. Alder still partially flank the water's edge (where disturbance is common) in the late-successional areas.

Patches created by the burns since 1902 cover thousands of acres. Variations in existing stand sizes are the result of different fires that occurred over the years and tree planting being done at different times. Late-successional patches are small and located in the more protected drainage bottoms. Riparian patches tend to be linear and follow the stream courses. The lower part of the watershed on State and private land contains patches of early-successional forest created by recent clear-cut harvesting and rural development.

Unique Habitats

Old-Growth Forest

The watershed contains very little old-growth forest, defined here as stands older than 250 years. There is a total of 136 acres of late successional forest, which is split between sub-watersheds 14A and 14B (both on Forest Service land). Old growth forest is comprised of a large tree, multiple-story subset of late-successional stands (see Current Vegetation Map). Such stands are unique in the Southwest Washington Province, and are especially scarce in this watershed due to the lasting impact of multiple fires. Old-growth forests are important habitat for a wide variety of fauna and flora, some of which are Threatened, Endangered, or Sensitive. Survey and Manage species are, by definition, dependent on late-successional forests, and some require forests older than those that meet the definition of late-successional.

Riparian Areas

Riparian areas contain elements of both aquatic and terrestrial ecosystems, which mutually influence each other. Riparian areas are habitat for fish and wildlife sustenance, breeding, and movement. Survey and Manage lichens, bryophytes and fungi are often associated with riparian vegetation in a late-successional stage. The rare, endemic cold-water corydalis is a riparian plant. This said, very little late-successional riparian habitat occurs in the watershed (1% of 14A, and 3% of 14B), which is equivalent to a mean of 0.33% watershed-wide. For comparison, the REAP report estimates the range of natural conditions for late-successional riparian habitat to go as low as 23%.

Shrub Meadows

Along Forest Road 41, and along the ridgeline from Silver Star to Lookout Mountain, are some huckleberry areas. Native Americans have picked this area for at least 100 years. There is evidence of pre-historic use of the area as well, and it is likely that the people came for the huckleberries.

Current open stand conditions and slow tree growth will allow adequate sunlight on these bushes to maintain a heavy huckleberry crop for the next 5-10 years. This huckleberry area is different from others on the forest in that it is relatively drier and more exposed, and berries ripen earlier than other popular areas. Limiting factor for ideal huckleberry growth and ripening may be shade and water, making the need to maximize sunlight somewhat less of a concern. Further evaluations will need to occur to determine when and how much thinning might be appropriate for this site if the objective is to enhance huckleberries.

Talus and Rock Outcrops

Rock outcrops and talus slopes are prominent in this steep watershed. The larch mountain salamander (a State sensitive species) is known to inhabit talus slopes adjacent to mature forest; the species has been found in the Columbia Falls Natural Area Preserve (see below). This habitat type is abundant in higher elevations in the watershed.

Caves

There is one known cave 17 miles upriver from the mouth of the Washougal. The moist, cool, and dark conditions provide rare, isolated habitat.

Ponds and Wetlands

Ponds provide wildlife and plant habitat and recreation. With this combination, ponds can be an attractant to unwanted and unintentional biological introductions. Examples of introduced species to watch for are bullfrogs, water milfoil, and purple loosestrife. No surveys have been conducted on these ponds.

High-Quality Forested Ecosystems

Washington Department of Natural Resources lists terrestrial and wetland ecosystems that are high quality. A stand of western hemlock/Oregon oxalis (*Tsuga heterophylla*/*Oxalis oregana*) located in the Canyon Creek sub-watershed (Section 36, T02N, R05E), is listed. It is approximately 300 acres and 110 years old. High-quality ecosystems are to be preserved as exemplary of this plant association type.

Silver Star Mountain

Silver Star Mountain is a Special Area with outstanding botanical, geological, roadless, and scenic properties. Cliffs, talus slopes, and open meadows are notable there. The meadows support a highly diverse plant community, partially because of the slowly-cooled volcanic intrusive rocks uncommon in the region, and the watershed. Overall, Silver Star has a high plant species diversity, whose plant composition includes species more common at higher elevations in the Cascades such as red mountain heather, *Phyllodoce empetriformis*, and western hedysarum, *Hedysarum occidentale*. Other species, such as Douglas'silene, *Silene douglassii* var. *monantha*, are endemic to the Columbia Gorge. Rare plants found here are cold-water corydalis, *Corydalis aquae-gelidae* and cut-leaf bugbane, *Cimicifuga laciniata*, a "watch" species. Of cultural resource importance is Gray's loveage, *Ligusticum grayii*. In 1990, the east-west oriented ridge system from Bluff Mountain to Silver Star Mountain was recommended for designation as a Botanical Special Interest Area by the Gifford Pinchot National Forest. It would overlay the ridge and therefore extend north (along Star Creek) and west into the East Lewis River watershed to the National Forest boundary. It would be approximately 1,500 acres.

Columbia Falls Natural Area Preserve

In the Canyon Creek sub-watershed is the Washington Department of Natural Resources' 510-acre Columbia Falls Natural Area Preserve. Within the preserve are varied habitats: basalt cliffs, talus slopes, a waterfall, and forest stands that are approximately 125 years. Two rare plant species, *Sullivantia oregana* and *Erigeron howellii*, are located in this preserve.

Soil Productivity

Wildfire and human activities are probably the two main factors that influence forest soils the most. The Yacolt Fire of 1902 and the subsequent burns have had a tremendous impact on the soils of the Washougal drainage. Human activities such as sheep grazing and road building have also had an impact on soils in the Washougal drainage but probably not as much impact as the successive burns. Soils throughout the drainage are characterized as thin and rocky with little organic matter or litter layer. It is common in the upper slopes of the watershed to see tree stump remnants in rocky areas where no trees are growing today. Many sites within the drainage burned over two or more times between 1902 and 1930. The fires consumed the organic matter and volatized it into the atmosphere as ash and gasses. Winter rains and snow runoff eroded the fine soil particles away.

The better soils in the watershed are on the lower slopes on State and private lands. Forest Service lands in the upper part appear to have soils that are more impacted by fire and erosion. Table 3.3.3 below displays the soil types that occur on National Forest lands within the watershed. For comparison purposes they are shown as Section A), soils considered non-suitable for timber production; Section B), soils with low potential for timber production; and Section C), soils with higher potential for timber production.

<u>Table 3.3.3</u> – Soils on National Forest lands:

Section A – Soils Considered Non-suitable for Timber Production

Soil Mgmt. Unit	14A	14B	14I	14J	Totals
7	36	74	979	71	1,160
7E	22	158			180
Totals					**1,340**

Section B – Soils with Low Potential for Timber Production (Site Class V, often less than 3 feet deep)

Soil Mgmt. Unit	14A	14B	14I	14J	Totals
81	204		224		428
82	1,870	969	631		3,470
8E		345			345
8140				13	13
92R	14				14
Totals					**4,270**

Section C – Soils of Better Productivity (Site IV or better, usually over 3 feet deep)

Soil Mgmt. Unit	14A	14B	14I	14J	Totals
92	418	44	497	314	1,273
9240			1		1
94			28	3	31
95	3	3			6
Totals					**1,311**

According to the inventoried soil mapping units, Forest Service ground consists of about 19% non-timber soil, 62% low timber production soils, and 19% higher timber production soils. This classification does not correlate well with actual stand conditions on the ground. Some of the better growing stands are found on the low potential soils and stands growing very poorly are on better productivity soils. This discrepancy shows that there are likely other factors effecting stand conditions other than soil properties. These other factors include off-site seed sources, weather conditions, topography, and aspect.

Plants of Concern

Weeds

Washougal watershed, like the neighboring Rock watershed, has not been part of concentrated weed survey efforts taking place on the Mt. Adams Ranger. Because fire has stripped the soil of nutrients leaving large areas sparsely vegetated and places where no forest shading exists, the habitat is susceptible to certain aggressive weeds native to arid Eurasia and the Middle East. Weed occurrences have not yet been mapped.
Noxious weeds pose a serious threat to the environment if left unchecked. Federal and state law mandate that action be taken to counter noxious weed infestations.

Non-native species can also be a threat to a healthy ecosystem. One evident non-native plants that falls into this category is Himalayan blackberry (*Rubus discolor*), which is abundant in the lower subwatersheds.

Threatened, Endangered, and Sensitive (TES) Species

Only Sensitive plants, and not Threatened or Endangered plants listed by the U.S. Fish and Wildlife Service, are known or suspected from the Washougal watershed. These species are identified by Washington State Department of Natural Resources and the Pacific Northwest Region of the Forest Service. Three of the plants found in the watershed are listed as “Threatened” by the State: cold-water corydalis (*Corydalis aqua-gelidae*), Oregon sullivantia (*Sullivantia oregana*) and Howell’s daisy (*Erigeron howellii*). The latter two species have their only occurrence in the state within a very restricted range including part of the Washougal watershed. They are endemic to the Columbia Gorge. Road and timber activities and recreation are threats to these populations. More plant inventory should be done to determine if other populations exist.

Plants listed as State Sensitive that have been found in the watershed are: great polemonium (*Polemonium carneum*) and fringed grass-of-Parnassus (*Parnassia fimbriolata* var. *hoodiana*). These plants are vulnerable to decline and could become listed as Threatened or Endangered in the state without active management.

Cold-water corydalis is a riparian species that thrives in cold, shaded streams. It is listed as a Survey and Manage Strategy 1 species and Washington State lists it as Threatened. This corydalis has a very limited distribution, being endemic to a few watersheds in southwestern Washington and northwestern Oregon. Numerous populations occur immediately north of the Washougal watershed. All sites will be protected. A Species Management Guide for this species on the Gifford Pinchot NF was signed by the Forest Supervisor in 1983, and is still in use today. This species has been afforded extra protection since the adaptation of Riparian Reserves as mandated by the Northwest Forest Plan.

Further surveys would likely reveal more rare plant populations. Known habitat requirements for these species and other sensitive species that could occur in the watershed, but have not yet been found, are listed in Table 3.3.4. Except surveys done on Silver Star Mountain, the Forest Service has conducted no methodical botanical searches in the watershed.

Table 3.3.4. Rare plants with habitat in the watershed.

Suspected species	Region 6 Sensitive	State Designation	Habitat
Oregon bolandra *Bolandra oregana*	Y	Sensitive	cliffs and streams near Columbia R.
Fringed grass-of-Parnassus *Parnassia fimbriolata* var. *hoodiana*	Y	Sensitive	meadows
Green-fruited sedge *Carex interrupta*	Y	Watch	sandy, rocky riverbeds, low elev.
Cold water corydalis *Corydalis aquae-gelidae*	Y	Threatened	cold-water streams and riparian
Fringed pinesap *Pleuricospora fimbriolata*	N	Watch	late-successional forest
Great polemonia *Polemonia carneum*	Y	Sensitive	thickets, woodlands, openings
Howell's daisy *Erigeron howellia*	Y	Threatened	meadows
Golden chinquapin *Chrysolepis chrysophylla*	Y	Sensitive	drier forests and ridgetops
Pine broomrape *Orobanche pinorum*	N	Watch	open forest with oceanspray
Few-flowered bog orchid *Platanthera sparsiflora*	Y	Sensitive	wet areas
California swordfern *Polystichum californicum*	Y	Sensitive	woods, rocky openings
Oregon sullivantia *Sullivantia oregana*	Y	Threatened	moist basalt cliffs and talus
Siskiyou false hellebore *Veratrum insolitum*	Y	Sensitive	open thickets to woodlands

Survey and Manage Species

Survey and Manage species are groupings of life forms that receive special listing in the Northwest Forest Plan due to their suspected dependence on late-successional and old-growth forests and a lack of knowledge of their abundance, life histories, and overall uncertainty of their viability. No Survey and Manage botanical species are known to occur in this watershed. This has to do with the fact that no surveys have been undertaken in this watershed. However, as has previously been documented, little to no habitat for Survey and Manage species exists here.

Synthesis of Vegetation Section

Fire

A large fire could occur anywhere within the watershed if the particular weather and fuel conditions combine. This would mean low fuel moistures accompanied with strong east winds. The probability of a human caused fire is moderate-high based on the fact that the watershed has a fairly large population center on the lower slopes. Given the mix of federal, state and private land owners, all with different management practices, it is hard to say which areas may have the highest risk.

Soil Productivity

Essentially every law or regulation that governs Forest Service activities requires conservation of soil productivity. We are directed to manage our lands without significantly impairing the productivity of the soil. Soil damage can also lead to degraded aquatic conditions via erosion and sedimentation.

In Forest Service Region 6 there have been standards and guidelines for soil management for over 20 years (FM 2520, R6 supplement #50). These are intended to describe significance in terms of degree and extent of the various forms of soil damage, which result in impairment of productivity. The Gifford Pinchot Forest Plan directs that no more than a total of 20% of an activity area may be compacted, puddled, displaced, or subjected to a severe burn as a result of the activity (Forest Plan p. IV-61). In addition, the NW Forest Plan further directs modification of site treatment practices and harvest methods to minimize soil disturbance, so that fungi, arthropods, and other soil organisms are not adversely affected (ROD S&G p. C-44).

The existing soil damage as a result of the past wild fires will remain; although some will be corrected through restoration and some will be corrected through the natural processes of re-vegetation, organic matter accumulation, animal activity, and weathering. Restoration activities to restore stability and productivity should focus on establishing native vegetation including trees, shrubs, grasses, and herbs. Other uses of the watershed such as dispersed recreation will have minor effects on soil stability and productivity: although, it may be a large effect on a localized area.

Plants of Concern

Noxious Weeds

The long term goal in this watershed for noxious weeds is to control and eradicate all weed populations according to inventories that begin as soon as possible, and are updated annually.

Vehicles are the primary means by which weeds enter new areas. Seeds, or plant propagules (parts of plant that can reproduce) can travel on wheels, bumpers, or other vehicle part, and be deposited along travel corridors where vegetation is already disturbed. Other avenues for propagule movement include recreationists (boats (for aquatic species), and trails, especially those used by pack animals), stream channels, and air movements. Each project recommended in this analysis will be analyzed for its potential to spread noxious weeds. Weed population locations referenced to potential vehicle or recreation corridors will be part of the project analysis.

Part of the Washougal watershed is included in a roadless area. Current treatment of the area should actively prevent introduction of weed species into the roadless area.

Threatened, Endangered, and Sensitive Species

Unlike Threatened and Endangered species, Sensitive species are not legally protected on private land. The Sensitive plants that occur on Forest Service land in the watershed are protected, however no physical protection of these species is currently warranted because no known threat to them has been identified. None of the sites located in this watershed has been visited enough over the years to know if a threat to them exists. While an appropriate re-visit interval is determined on a sight-by-sight basis, a general rule for plants without an imminent, known threat is to revisit rare plant sites once every five years. Conservation education efforts are a preventative step to be executed at anytime.

Survey and Manage Species

To date no Survey and Manage species have been identified within the Washougal watershed.

Data Gaps

- Incomplete inventory of small wetlands, which influences hydrologic analyses, habitat assumptions, and the amount of suitable acres available for timber harvest.
- Regular updates of forest successional development, primarily in plantations that have advanced from early to mid-successional. This may affect Aggregate Recovery Percentages, spotted owl habitat analysis, and other analyses that rely on information on stand trees classes and successional development.
- Only cursory and partial information is available on species' status and distribution of unique, TES, survey and manage plants and animals, and introduced species.
- Stand examination data is lacking on the stands within the watershed
- Soil conditions in various parts of the watershed to track post-burn recuperation.

Stream Channels

Reference Conditions

Historic riparian and channel conditions can generally be indexed to large scale upland disturbances or to local disturbance in the riparian area. Fire and flooding were probably the dominant factors affecting channel condition and channel change over time in this watershed, aside from the very infrequent but large scale geologic/volcanic events. Large wildfires indirectly affected channel conditions by reducing forest cover and thus influencing peak streamflows (see Hydrology section in this report), but also had a direct effect on conditions in the riparian area when it burned riparian vegetation. Flooding plays an important role in channel condition, but may have greater effect when flood frequency or magnitude is increased (i.e. following large scale vegetative removal) and when mature riparian vegetation has been eliminated or reduced.

While potentially removing much or all of the forest cover from a relatively large area, fires often affect riparian areas to a lesser degree because of the higher moisture regimes and relative vigor of the riparian vegetation. However, during particularly intense burning conditions, these riparian areas can be severely burned along with the uplands. Such was the case with the Yacolt burns that occurred early this century and covered much of the Washougal River watershed, including the riparian areas. Subsequent to large-scale or intense fires, woody debris and sediment inputs to the stream system were increased. Scorched or exposed trees in riparian areas were blown over or fell into the stream, debris flows from burned over hillslopes moved sediment and wood downslope to stream channels, and surface soil erosion increased in areas where duff and ground cover was consumed. Woody debris recruited into stream channels following such fires played an important role in stabilizing the channel during subsequent high streamflow events. Large wood in the system also provided channel roughness, hydraulic variability, helped armor streambanks, and provided locations for intermediate sediment storage throughout the channel network.

The Regional Ecologic Assessment Process (REAP, 1993), identified a range of natural conditions for early and late seral vegetation in the riparian area. The range of natural conditions for early seral vegetation in the riparian ranged from 5-30%. That is, at any given time over history, REAP estimated that 5-30% of riparian areas in watersheds in southwest Washington (Hood-Wind HUC) would have vegetation dominated by early seral conditions. Similarly, 23-92% of the riparian area at any given time would have been dominated by late seral vegetation.

Current Conditions

Disturbance Processes

Over the past 50 years, fire has been replaced by timber harvest and associated activities as the dominant disturbance process affecting riparian conditions in the Washougal River watershed. In addition, continued development of the western end of Skamania County has impacted stream channels in the watershed.

Fire

The series of fires known as the Yacolt and Dole burns were some of the most devastating wildfires known to have occurred in the Pacific Northwest in terms of both the scale and the intensity of the fires. These events left entire subwatersheds denuded of forest vegetation, including riparian areas. The intensity of the fire was so great that soils were permanently damaged in some areas, and even fish were directly affected. A newspaper account from November 1, 1929 notes that all fish life in the headwaters of Hamilton Creek (a stream just south and east of the Washougal watershed) had been killed by the fire, and that "every pool was covered with cooked fish" (Skamania County Pioneer, 1929). The article further points out that part of the reason the riparian area burned so hot was that Hamilton Creek is in a canyon that was "filled with much waste and old dry logs". This probably refers to high levels of large woody debris (and possibly logging slash) in that stream and riparian area prior to the burns.

Because these fires burned such a large area, burned some areas repeatedly, and burned so hot in the riparian areas, much of the large wood that would in some cases be brought into a stream following a fire would have been consumed by this series of fires. Recolonization of these riparian (as well as upslope) areas by conifers has in some cases been set back due to the severity of the fires and their effects on soil productivity. Hardwoods now dominate substantial portions of the riparian area, which may be in part due to the effects of the fires on soil productivity. Moreover, timber harvest occurring prior to the fires and salvage logging following the fires further reduced the amount of available woody debris that may have otherwise entered the streams. Although fire was a common disturbance element in the watershed prior to European settlement, the pre-fire logging, and post fire salvage of snags, green trees, and downed logs further exacerbated the loss of large woody debris in riparian areas and stream channels.

Logging

Logging began as early as the late 1800's or early 1900's in the Washougal River watershed. Early accounts tell of an inclined railroad built by the Hamilton Creek Logging Co. from just above Beacon Rock to the top of Hamilton Mountain (no date provided). This area is several miles south and east of the Washougal River watershed. "This incline was so steep, 65%, that a logger with his cork-shoes could stand on the end of a log, aboard a log loaded car coming down the incline" (Attwell, 1975). This reference continues, "thousands of carloads of logs came down this mountainside until the mountains were logged off in the early 1900's". Although this particular operation used a steam donkey and railroad to bring logs down off the mountainsides, other methods such as splash damming were also used in the area.

Splash damming can severely degrade stream channels by scouring the channel of sediment and wood, and creating a more simplified, less sinuous channel with reduced roughness. When combined with a loss of riparian forest from fire or timber harvest, the effects of splash damming can be very long lasting. Streams rely on roughness elements such as large woody debris to trap and store sediments, create pools and habitat diversity, and to stabilize banks. Because wood was removed from these streams through a combination of splash damming, fire and logging, and riparian areas were similarly depleted of source material for woody debris inputs, these systems have likely had increased rates of sediment transport, decreased area for spawning, decreased hiding cover and pools, and increased rates of channel cutting.

Because very little of the watershed is in federal ownership, there have been no stream surveys to allow quantification of instream conditions. However, several streams to the east and south of the Washougal were surveyed by the Columbia Gorge National Scenic Area. These streams were also affected by the Yacolt burns and early logging activities, and were found to be quite low in large woody debris and pools (USFS, 1996). Although locally developed "reference" conditions have not been established for these elements, the current levels are comparatively low with respect to regionally suggested averages, and are thought to be well below what natural conditions here would be.

Development

Land development has been largely focused in the lower elevations of the watershed. Development around the town of Washougal has since expanded into the lower portion of the analysis watershed for rural residential use, farming and agriculture, mining, and industrial uses. Effects of these activities on stream channels vary depending on the land use, but would include such things as: removal of trees from the riparian area, development of floodplains, confining and straightening of stream channels, and constricting streams at points of road and rail crossings. These types of effects to the stream channels differ from those caused by previously identified disturbance processes, in that these effects would tend to be "permanent" unless they are specifically addressed or are taken out by some other form of disturbance. Stream channel disturbance caused by logging, splash damming, and fire may have long term effects as described above, but natural recovery processes are allowed to restore conditions over the long term there. Natural "recovery" processes occurring in developed areas are often prevented or discouraged if they are not seen as beneficial to the current land use.

Riparian and Stream Channel Responses

Riparian Vegetation

The combination of fire, logging, and splash damming resulted in the conversion of many riparian areas in the watershed to early seral conditions, and the loss of large standing and down conifers in the riparian area and stream channel. Currently, approximately 29% of the riparian areas around streams and wetlands in the watershed are in early seral vegetation (Table 3.4.1). For purposes of this analysis, the silviculturist has defined early seral vegetation to include the following vegetation classes: seedling/sapling, sapling/pole (open and closed), hardwood sapling/pole, and grass/forb.

Table 3.4.1. Percent of the riparian area in early and late seral vegetation.

Subwatershed Name	No.	% Riparian Reserve in Early Seral Vegetation*	% Riparian Reserve in Late Seral Vegetation**
Headwaters Washougal	14A	35%	1%
Bluebird/Silver Cr	14B	18%	3%
Upper Washougal	14C	17%	<1%
Stebbins Cr	14D	18%	<1%
Middle Washougal	14E	21%	<1%
Dougan Cr	14F	28%	<1%
Lower Washougal	14G	43%	<1%
Canyon Cr	14H	43%	<1%
Headwaters West Fork	14I	51%	<1%
Hagen Cr	14J	26%	<1%
Texas/Wildboy Cr	14K	48%	<1%
Lower West Fork	14L	30%	<1%
Entire Watershed	14	29%	<1%

* "Range of Natural" for % Riparian Area in Early Seral is 5-30% (USFS, 1993)
** "Range of Natural" for % Riparian Area in Late Seral is 23-92% (USFS, 1993)

The watershed is at the very upper end of the "range of natural variability" for **early seral vegetation** in the riparian area according to the Regional Ecosystem Assessment Process (REAP) (USFS, 1993). Because of the lack of fire over the past few decades, the amount of riparian area in early seral condition is generally used as an indication of the degree of timber harvest that has occurred in the riparian area over the past 25-35 years. However, because hardwoods are included in the definition used here for early seral vegetation, and because many of the riparian areas burned in the Yacolt burns came back in hardwoods, it is difficult to discern from the data the difference between very young riparian vegetation and well established hardwoods that colonized the riparian areas following the Yacolt. Moreover, because of the relatively poor site conditions in areas of the watershed that were severely burned, some of the vegetation that has come in following the fires may still be considered early seral due to its small size.

In systems where there is a high percent of the riparian area in early seral condition, channel stability may be reduced by a lack of well established root systems of large conifers. In addition, these reaches may be more susceptible to stream heating due to a more open canopy above the stream (see Water Quality section). Some subwatersheds within the Washougal River analysis watershed are well above the "range of natural" conditions for early seral vegetation in the riparian area. In particular the Lower Washougal, Canyon Creek, and Texas/Wildboy subwatersheds, each with over 40% of their riparian areas in early seral vegetation, and West Fork Washougal, which has 51% of its riparian area in early seral vegetation. These are some of the highest values for early seral vegetation in riparian areas found in any of the watersheds draining the southern end of the Gifford Pinchot National Forest.

The proportion of the Riparian Reserve in **late seral vegetation** provides an indication of the amount of the riparian area where there are large, well established root systems, and a high degree of large woody debris recruitment potential. Currently, riparian areas in the watershed have extremely low levels of late seral vegetation. None of the subwatersheds have late seral vegetation levels that even approach the lower end of the range of natural variability as described in the REAP report, and the watershed as a whole has on average less than one percent of its riparian area in late seral vegetation. These extremely low levels of late seral vegetation are due to a combination of the early century fires that impacted the watershed, and subsequent harvest of riparian forest stands.

The lack of late seral forest indicates that the development and recruitment of large trees to stream systems in the analysis area is some time off in the future, and will depend in part on growth rates of riparian forests, but also on how these riparian areas are managed. Riparian areas on National Forest lands will be protected from future harvest by Riparian Reserves that are provided for under the Northwest Forest Plan. Outside the National Forest portion of the watershed, federal riparian protection is not provided, so future management of riparian areas will be based more on Washington State Forest Practice rules. Thinning of riparian forests can be done to accelerate development of larger trees where tree density is limiting development of the late seral conditions. However, access to the riparian areas—particularly in the upper watershed—is difficult due to steep topography and a road system that lies largely on ridgetops.

Prior to the development of late seral conditions in riparian areas across the watershed, the input of wood from existing riparian forests can play an important role in providing roughness, stability, and habitat features in these streams—particularly those smaller streams in the upper portions of the watershed. Although the size of the material available is smaller than what would be provided with late seral forests, this material can still be important to channel processes and fish habitat. Because of its size, woody debris inputs from the present riparian forests may be less persistent in the channel over time.

Channel Connectivity

Stream channels function not only as conduits for transporting water downslope, but also for routing sediment and woody debris downslope, and provide travelways for fish, amphibians, and other aquatic-dependent species in both an upslope and downslope direction. The connectivity of the channel is important to maintaining these travelways for fauna, but also for maintaining channel processes and habitat features in the channels. Road crossings are one form of interruption in the continuity and connectivity of stream channels. Culverts typically restrict the channel cross section through the length of the road crossing, and can influence the downstream passage of sediment and woody debris. They can also provide complete separation of the upstream channel bed from the downstream channel bed when culvert outlets are perched above the downstream channel. Table 3.4.2 presents the number of miles of stream and number of road crossings in the watershed to provide an indication of how channel network connectivity is potentially affected by roads.

Table 3.4.2. Miles of stream, number of road crossings, and average crossing frequency.

Subwatershed Name	Number	Total Miles Of Stream	Total Number Of Road Crossings	Road Crossings Per Mile of Stream	Average Miles of Stream Between Road Crossings
Hdwtrs Washougal	14A	48.315	10	0.2	4.8
Bluebird/Silver Cr	14B	45.704	2	<0.1	22.9
Upper Washougal	14C	98.712	63	0.6	1.6
Stebbins Cr	14D	62.898	48	0.8	1.3
Middle Washougal	14E	70.364	50	0.7	1.4
Dougan Cr	14F	38.875	33	0.8	1.2
Lower Washougal	14G	55.611	75	1.4	0.7
Canyon Cr	14H	19.661	13	0.7	1.5
Hdwtrs West Fork	14I	44.323	29	0.6	1.5
Hagen Cr	14J	29.062	14	0.5	2.1
Texas/Wildboy Cr	14K	39.733	60	1.5	0.7
Lower West Fork	14L	34.817	35	1.0	1.0
Entire Watershed	14	588.075	432	0.7	1.4

The number of road crossings per mile of stream length varies substantially across the watershed, from a low of less than .1 crossings per mile of stream in Bluebird/Silver Creek, to 1.5 crossings per mile in Texas/Wildboy. Viewed a different way, in the Bluebird/Silver Creek subwatershed, there are an average of 22.9 miles of stream for every road crossing, whereas in Texas/Wildboy, there are just 0.7 miles of stream for every crossing. Subwatersheds including Texas/Wildboy and Lower Washougal have a road crossing on average every ¾ mile of stream. This suggests an aquatic system that is highly disturbed, and very possibly disjunct. The high density of road crossings also provides an indication of the relative number of locations where chronic sediment inputs occur, and where the potential for catastrophic inputs of sediments are increased.

Channel Types

Channel gradients are a primary element used in channel typing, and a key factor in assessing channel response to disturbance such as high flows, bank disturbance, and riparian vegetation removal. Higher gradient channels can be primary sediment source areas as well as providing rapid transport of sediment to downstream reaches. Major disturbance processes in these channels typically include avalanches, debris torrents, and other forms of mass wasting. Lower gradient stream reaches are typified by deposition of sediments delivered from upstream or upslope processes. This alluvial material is much less resistant to erosion and bank cutting than the large boulder and bedrock that commonly dominate higher gradient reaches, so changes in channel geometry or shifting of channel locations may be more common in these reaches. Because of the predominance of uncohesive, often finer grained streambed and bank materials, these reaches rely heavily on streambank vegetation and large woody debris for channel stability. In general, the lower gradient channel types are found more commonly in lower watershed positions, while the higher gradient channels are more common in the upper watershed. Channels in the Washougal watershed have not yet been classified in Rosgen channel types.

Synthesis

Little data is available regarding stream channel types or conditions in the watershed. Riparian areas are dominated by early and mid seral forest vegetation, and are sorely lacking late successional forest. The lack of late successional forest in the riparian areas across the watershed means that recruitment of large woody debris will be delayed for many years in the watershed. Recruitment of smaller diameter wood from the mid seral stands will help provide elements of stability and diversity in the channel, but will be more mobile in the system, and less durable over time. The Headwaters of West Fork, Texas/Wildboy Creek, Lower Washougal, and Canyon Creek subwatersheds have exceptionally high levels of early seral forest in the riparian area, so streams in these areas may be particularly low in large woody debris and structure in the channel.

Data Gaps

Stream channel information is lacking throughout the watershed. Stream survey data, along with channel typing would help identify different habitat types present in the watershed, and characterize channel conditions.

Water Quality

Waters Within the Upper Washougal Watershed

Streams within the National Forest are classed by the Northwest Forest Plan (NFP) as either "perennial fish-bearing", "perennial non fish-bearing", or "intermittent". Perennial streams are those that flow water year-round. Intermittent streams are those that only have flow during some part of the year. Some intermittent streams flow only during rainfall or high flow conditions, and others may flow for most of the year, but run dry for a short period of time in the late summer. For purposes of this analysis, stream classes provided in the NFP were applied to all streams in the watershed regardless of land ownership. It is recognized that NFP standards do not apply to any lands or streams outside of Federal ownership. . Table 3.5.1 lists the miles of stream in the watershed, and the acres of lakes, ponds and wetlands.

Table 3.5.1. Miles of stream by class in the Upper Washougal watershed.

Stream Class	**Miles**
Perennial Fish-Bearing Streams*	89.4
Perennial Non Fish-Bearing Streams**	81.6
Intermittent Streams***	327.3
Streams w/Class Undetermined****	89.8

* Includes Washington State Stream Types 1,2, and 3
** Includes Washington State Stream Type 4
*** Includes Washington State Stream Type 5
**** Includes Washington State Stream Type 9

Beneficial Uses and Key Water Quality Parameters

All streams and lakes within the Upper Washougal watershed are rated by the Washington State Department of Ecology (WSDOE) as either Class AA (extraordinary), or Class A (excellent). Stream segments on National Forest lands are rated as Class AA, as are all streams that feed lakes within the watershed. Specific water quality criteria have been established by WSDOE for each of these classes in conformance with the present and potential uses of the water. The purpose for these criteria and the state water quality standards is to ensure that water quality is maintained at levels that continue to support beneficial uses of those waters. The Upper Washougal watershed has a number of important beneficial uses that drive the need for water quality protection. Table 3.5.2 identifies the beneficial uses that occur in the watershed, the subwatersheds they are located in, and the primary water quality parameters of concern. The table is not inclusive of all water quality parameters that may affect the identified beneficial use, but identifies the key parameters of concern from a forest land management perspective.

Table 3.5.2. Beneficial uses and primary water quality parameters of concern in the Upper Washougal watershed.

Beneficial Use	**Subwatershed**	**Primary Parameters of Concern**
Anadromous fish	(all but H)	Temperature, turbidity
Resident fish and other aquatic organisms	(all)	Temperature, turbidity
Domestic water supply	unknown	Fecal coliform, turbidity
Recreation	(all)	Fecal coliform, turbidity

Beneficial Use: Domestic Water Supply

A number of domestic water supplies exist in the analysis watershed. Most of these exist in the lower portions of the watershed and in the West Fork. There are no known domestic water uses occurring on the National Forest portions of the watershed. Potential threats to water systems in the lower watershed include: waste material from livestock, wildlife, septic systems and recreational users of the watershed; chemicals and nutrients from herbicides or fertilizers, and sediment from timber harvest, road and landing construction, and other land use activities.

Beneficial Use: Anadromous and Resident Fisheries
Anadromous fish including steelhead, chinook, coho, and sea-run cutthroat use the Washougal River and tributaries in the lower portions of the analysis watershed. Resident rainbow trout are also found in the upper watershed. Primary water quality threats to fish would be temperature increases (and resultant decreases in dissolved oxygen), and increases in sediment. Loss of streamside shade from timber harvest, grazing, or road construction, and sediment introduction from these same sources are the most likely pathways for affecting the fish through changes in water quality. Continued sediment input from areas of excessive streambank cutting, from existing road systems, and from recreation areas and other developed sites is also a concern

Reference Conditions

Water Temperature

The magnitude and duration of peak streamwater temperatures varies from year to year in response to changes in summer discharge levels, annual variation in air temperature, and changes in the exposure of stream waters to solar radiation by changes in riparian cover and/or widening of the stream channel. The primary factors affecting riparian canopy cover prior to European settlement were fire, insect and disease outbreaks, and debris torrents or large scale flooding that caused loss of riparian shade producing vegetation. As the percent of the riparian area in early seral condition increases, the potential for increased maximum water temperatures is increased. The Regional Ecologic Assessment Project (REAP)(USFS, 1993) found that in the area including the Upper Washougal watershed, early seral vegetation comprised anywhere from 5 to 30% of riparian areas under historical (pre-settlement) conditions. Although there is no direct evidence for what maximum water temperatures were in the Washougal River under reference conditions, the REAP defined the "range of natural" water temperatures for streams in this area to be 7-20 °C.

Turbidity

Historic turbidities were linked closely to large scale disturbances including fire, mass wasting and flooding. Surface soil inputs were negligible under fully forested conditions, but would have increased for a short period following fire, particularly in the case of high intensity burns that damaged soils and consumed the organic component at the soil surface. Following large scale or intense fires, the potential for mass wasting would have increased for a period of time, as stability from tree roots was lost and when subsurface water levels were increased. The most frequent cause for changes in turbidity under historic conditions was likely the occurrence of high streamflow events that caused streambank cutting and mobilization of instream stored sediments.

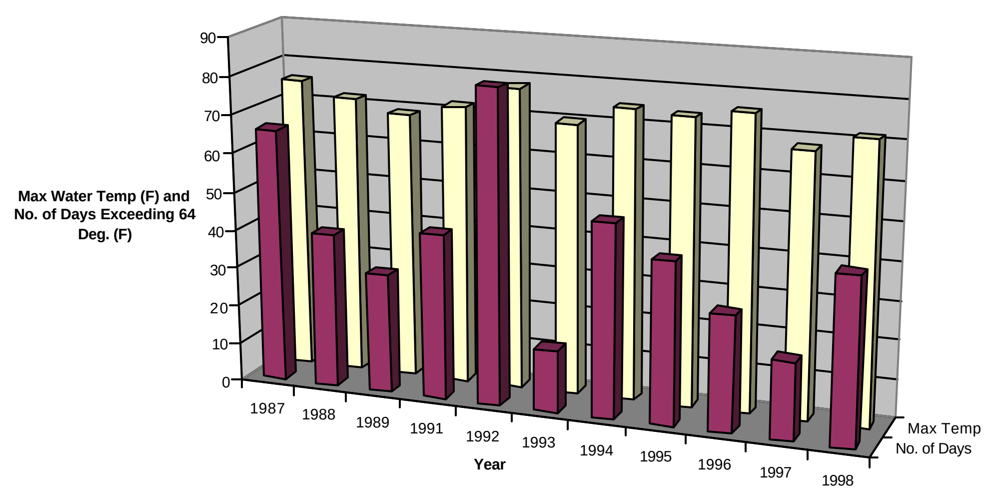
Current Conditions

Limited water quality data are available to characterize water quality conditions in the Washougal. The Washougal Fish Hatchery measures some parameters of water quality including water temperature and suspended sediment, but that data is limited to the hatchery location, and in the case of suspended sediment is limited to infrequent grab samples.

Water Temperature

Water temperatures have been measured since the late 1980's at four locations around the Washougal Fish Hatchery. One of these stations, known as "Pond 13" is representative of water in the Washougal River (C. Mains, personal communication). The other temperature monitoring locations actually sample from mixed sources, including some small tributaries local to the hatchery. Water temperatures in the Washougal River have also been measured by the Department of Ecology as part of their rivers and streams monitoring program. This data is typically collected by grab sampling at specific intervals throughout the year, so would tend to miss much of what is going on with water temperature in the intervening times. Additional water temperature data (also collected by grab sample) were collected by the Pacific Groundwater Group as part of a 1997 water quality report for Skamania County.

Yearly maximum water temperatures from the Pond 13 site are shown in Figure 3.5.1, along with the number of days during each year of monitoring when the water temperatures exceeded the state water quality standard. At the location of the monitoring, the Washougal River is classified as a Class A stream by the state Department of Ecology, and as such has a maximum water temperature standard of 18°C or 64°F



	1987	1988	1989	1991	1992	1993	1994	1995	1996	1997	1998
No. of Days	66	40	31	43	81	16	50	42	30	20	43
Max Temp	76	72	69	72	78	70	75	74	76	68	72

Figure 3.5.1. Annual maximum water temperature at the Washougal Fish Hatchery, and number of days the temperature exceeds Washington State standards.

The state water quality standard for maximum temperature was exceeded in each of the eleven years of monitoring at the fish hatchery. During most years of monitoring, the maximum water temperature exceeded 70°F, and on the warmest year, 1992, water temperatures reached 78°F. Throughout the period of monitoring, the standard was exceeded on average 4 days during the month of June, 16 days in July, 17 days in August, and 4 days in September. During the summer of 1992, virtually the entire month of July (30 days) had maximum temperatures in excess of the state standard. The standard was exceeded on a total of 81 days that summer, and began experiencing high temperatures as early as April. The summer of 1992 was the warmest year on record for a number of streams in the area, due to a combination of low summer flows and relatively high summer air temperatures.

Currently the Washougal River has not been placed on the State's 303(d) list for "threatened" water bodies. The river was proposed in 1998, but not added because the data used to evaluate for listing only included the grab samples collected by the State, and there were insufficient excursions above the standard in that data to merit listing. If the data collected at Pond 13 is truly representative of conditions in the Washougal River, and if the data from there is collected under an approved quality assurance and quality control plan, it is likely that the Washougal River will be added to the 303(d) list in the future.

Currently, approximately 29% of the Riparian Reserves associated with streams and wetlands in the Upper Washougal watershed are in early seral vegetation (Table 3.5.3). For purposes of this analysis, early seral vegetation has been defined to include the following structure classes from the GPNF vegetation data, and from the State of Washington's vegetation data: seedling/sapling, sapling/pole (open and closed), hardwood sapling/pole, and grass/forb.

Table 3.5.3. Percent of the Riparian Reserves associated with streams and wetlands currently in early seral vegetation classes.

Subwatershed Name	Subwatershed Number	% of Riparian Reserves in Early Seral Vegetation
Headwaters Washougal	14A	35%
Bluebird/Silver Cr	14B	18%
Upper Washougal	14C	17%
Stebbins Cr	14D	18%
Middle Washougal	14E	21%
Dougan Cr	14F	28%
Lower Washougal	14G	43%
Canyon Cr	14H	43%
Headwaters West Fork	14I	51%
Hagen Cr	14J	26%
Texas/Wildboy Cr	14K	48%
Lower West Fork	14L	30%
Entire Watershed	14	29%

Early seral vegetation comprises from 17% of the riparian areas in the Upper Washougal subwatershed to 51% of the riparian areas in the Headwaters of West Fork subwatershed. Five of the twelve subwatersheds within the analysis watershed have early seral vegetation in larger amounts in the riparian area than would be predicted under the “range of natural variability” as described in the Regional Ecosystem Assessment Process (REAP) report (USFS, 1993). Subwatersheds with particularly high levels of early seral vegetation in the riparian area include: Headwaters Washougal, Lower Washougal, Canyon Creek, Headwaters West Fork, and Texas/Wildboy. The relatively high proportion of early seral vegetation is probably due to a combination of the early century fires, the poor growing conditions in areas severely burned by those fires, and to subsequent harvest of riparian forests. Some of the older stands (e.g. hardwood stands colonizing the riparian areas after the fires) that are still considered “early seral” are probably providing substantial shade to the streams, so from a summer water temperature perspective would be functioning relatively well. However, during winter months, those riparian areas that lack conifers may actually experience reduced water temperatures due to the lack of a dense winter canopy cover.

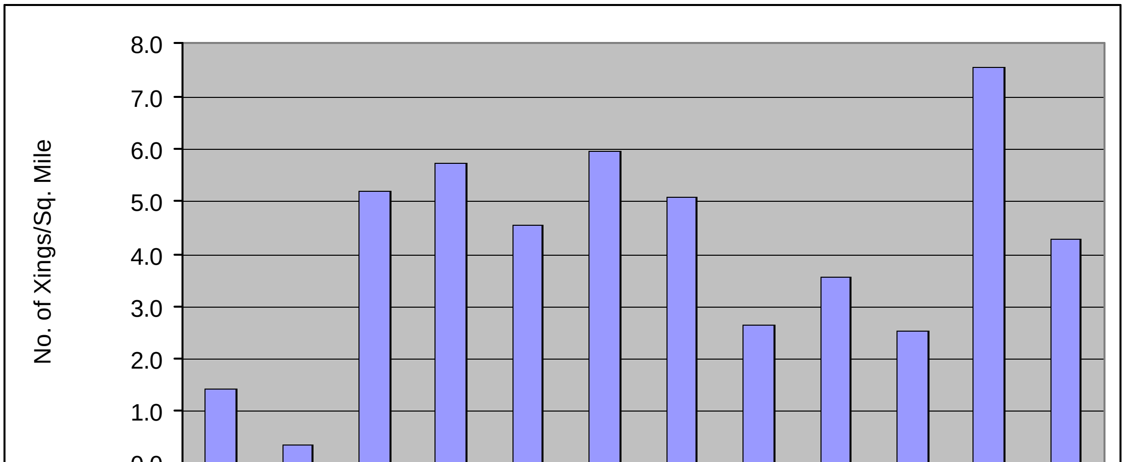
Turbidity

Turbidity or suspended sediment monitoring in the Upper Washougal has been conducted by the Washington Department of Fish and Wildlife at the Washougal Fish Hatchery, by the Department of Ecology as part of their lakes and rivers monitoring program (monitoring was done at a site just below the analysis watershed boundary), and by the Pacific Groundwater Group, at several locations in the watershed. Because each of these efforts has collected a limited number of samples at a limited number of locations, the data is somewhat limited in its value toward detecting spatial or temporal trends, and in determining background levels of turbidity or suspended solids. This is not unlike most other watersheds on the Mt Adams District, where turbidity monitoring has not been consistent enough to provide the needed data for substantial analysis.

Potential sources of turbidity in the watershed include sediment introduction from harvest units, roads, and other developed areas, but also include sediment production occurring through streambank cutting and bank or slope failures. Upslope mass wasting potential is relatively low in this watershed compared with other watersheds on the Forest (see Mass Wasting section of this report), so this is likely a relatively small part of the source for turbidity over the long term.

Chronic, low level inputs of fine sediment in the watershed occur from roads, harvest units, other areas where surface vegetation and soils have been disturbed and surface erosion is actively occurring. Timber harvest units are generally not long term sediment sources, because they revegetate over time either through active reforestation or through natural invasion and colonization of the harvest area. However, roads continue to generate sediment as long as they remain roads, because they continue to be exposed to direct rainfall, and because they promote overland flow during runoff. In addition, road cuts and fill slopes are often poorly vegetated, and contribute sediment both through slow chronic release or by catastrophic failure.

Locations where roads cross streams are one of the primary avenues for sediment from the road prism to be delivered to a stream network. Figure 3.5.4 shows the average number of stream crossings in the watershed, per square mile of land area.



	Headwaters	Bluebird/Silver Cr	Upper Washougal	Stebbins Cr	Middle Wash	Dougan Cr	Lower Washougal	Canyon Cr	Headwaters	Hagen Cr	Texas/Wildboy Cr	Lower West Fork
Series1	1.4	0.4	5.2	5.8	4.6	5.9	5.1	2.6	3.5	2.5	7.5	4.3

Figure 3.5.4. Average number of stream crossings per square mile of land in each subwatershed.

Road crossing densities range from 0.4 in Bluebird/Silver Creek to 7.5 in Texas/Wildboy subwatershed. There are an average of approximately 4.4 road crossings per square mile across the entire Upper Washougal watershed. Compared to other watersheds on the Mt. Adams Ranger District, this is relatively similar to watersheds on the western side, and somewhat higher than those on the east side of the district. Two of the subwatersheds with the lowest stream crossing densities are at the upper elevations of the watershed, and contain substantial areas that are either currently or formerly National Forest lands. These areas tend to have low road densities, and the roads that are there are generally in ridgetop locations.

Synthesis

Currently, no water quality data is available for streams on the National Forest portions of the watershed. However, water temperatures collected lower on the Washougal River indicate that state water quality standards are exceeded in that reach regularly. The causes of the high water temperatures have not been determined, although the predominance of early seral forest vegetation in riparian areas of the watershed suggest that lack of shade is a likely contributor if not the main factor.

The Northwest Forest Plan identifies National Forest portions of the Washougal River watershed as either Matrix or Roaded Recreation. As such, timber harvest and road construction are allowed (within Matrix lands), and recreation will continue to be an area of emphasis in this part of the watershed. Because all streams and other aquatic features on the National Forest are protected by Riparian Reserves, harvest will not occur in those areas unless it is shown to benefit the aquatic systems. On National Forest lands, this should eliminate future reductions in streamside shade that would negatively affect water temperatures. Similarly, sediment introduction from timber harvest on National Forest lands will be reduced by not harvesting along streamsides or in areas that may cause sediment to be delivered to the stream. It is noteworthy that because of the condition of the forest vegetation in the federally managed portion of the watershed and the difficult access, there most likely will not be a great deal of harvest conducted there in the near future anyway.

In addition to the water quality improvements expected from application of Riparian Reserves, water quality should also improve in the National Forest portion of the watershed as a result of the decreased levels of new road construction on the National Forest, and the increased attention to decommissioning unneeded roads. Although there will continue to be some sediment introduction from new (primarily temporary) roads, and from roads that are being decommissioned, the net input of sediment to streams on the Forest is expected to drop over time. As pointed out earlier in this report, the roads on the National Forest portion of the watershed are largely ridgetop roads, and are not thought to be major contributors of sediment to the Washougal River system to begin with.

On state and private lands below the Forest boundary, timber harvest and roading are less restricted, so may continue to affect riparian shade and sediment inputs. Road development and maintenance levels in this portion of the watershed would probably continue at levels similar to what have occurred over the recent past. Continued development of lands for rural and residential uses, particularly in the lower watershed, will require additional water and location of septic or sewer systems, which may put additional pressure on the existing water supply in terms of both demand, and potentially in terms of water quality. Land development will also likely reduce forest cover on streams in the lower watershed as forestland is converted to other uses.

Data Gaps

The watershed lacks data for water temperature and turbidity, two key water quality parameters that would help characterize instream conditions.

Species and Habitats--Wildlife

Introduction

The Upper Washougal watershed is different from other District watersheds in that so much of it is non National Forest System (NFS) lands. Ninety percent of the watershed is under the ownership of Washington State, private citizens, municipality, and or commercial industry. The remaining ten percent of the watershed is NFS land located in the uppermost headwaters. As such, wildlife information is quite limited. The topography of the watershed can be characterized as steep and incised, and with a north to south drainage pattern. The elevation for most of the watershed is below 3,000 feet. The watershed has three northern spotted owl activity centers, is close to Critical Habitat Unit WA-41 (CHU WA-41), and includes Washington Department of Natural Resources, Habitat Conservation Plan, management area (Washington Department of Natural Resources, 1996). Large scale and intensive forest fires in the early 1900s are the primary force responsible for habitat conditions throughout the non-residential portions of the landscape. Industrial lands and human settlement are the more recent and influential forces affecting habitat for wildlife. Several copper mines are present in the headwaters region of the watershed. The land allocation within the Forest Service portion is Matrix as described under the 1994 Northwest Forest Plan. Matrix is designed to provide for timber outputs while maintaining dispersal connectivity (Riparian Reserves) across its landscape for organisms associated with late-successional forest.

Wildlife Habitat

Pileated woodpecker, northern spotted owl, hairy woodpecker and pine marten are likely present, albeit in low numbers, across the landscape. These species are used as indicators of how their community is doing. The late successional forest community is represented by the pileated woodpecker and northern spotted owl; the mid-successional stage by pine marten; the early successional stage by hairy woodpecker. Existing capability levels are 54 pair of pileated woodpecker, 511 pair of hairy woodpecker, 6 pair spotted owl, and 28 male pine marten. It is interesting to note that EXISTING spotted owl rating of six pairs is three more than is known to actually be present in the watershed. Several explanations may apply in this incongruity:

* The MIS model may be over estimating capability.
* There are more owls present in the landscape than have been detected.

In comparison to other watersheds across the district, this one has a notably lower MIS rating.

Structure and Composition

a. Forest

Most of the watershed is within the western hemlock forest zone. A lesser proportion is in the silver fir zone. At the watershed scale, the mid-sere forest condition occupies 54% of the vegetative structural stage (Fig. 3.6.1). This stage represents trees that are 90-100 years old, 9-20.9” DBH, 80-120’ tall, and a moderate to high canopy closure (40-70%). Stand size average is 177

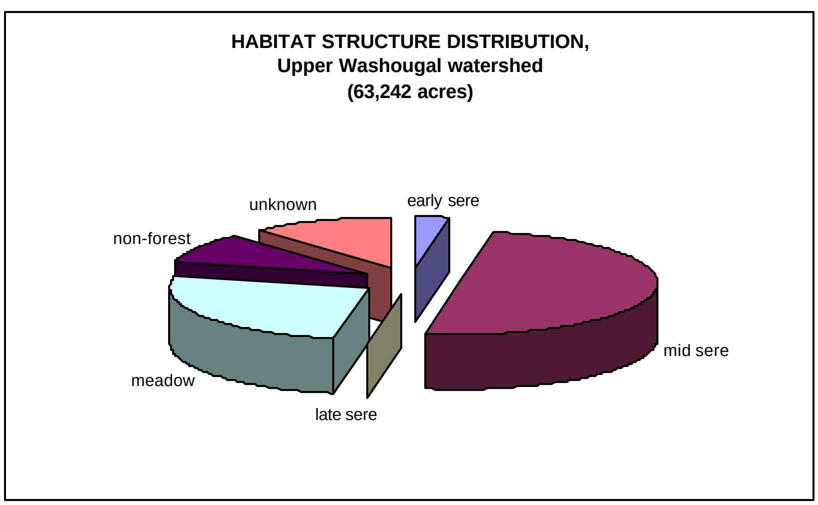


Figure 3.6.1: Habitat structure distribution, Washougal watershed.

acres (SD 582, n=178) with a maximum size of 3,750 acres. This mid-sere forest resulted from the repeat, intensive and extensive stand replacement fires of 1902, 1910 and 1929, commonly known as the Yacolt burn which occurred in September under east wind conditions. The 1902 fire is described as being 15 miles wide and extending 35 miles from Bonneville to Mt. St. Helens (Parsons, 1982). Parsons comments regarding the fires that "The forests that many though would stand eternal were gone. The green that flowed from one mountain top to another was replaced with a smoking, black, bush-burned, mass of twisted, bent and broken trees. Snags two hundred feet high, gray and ugly against the ashen ruins, lay on hill after hill." The "early" structural stage occupies 8% of the watershed and represents conifer plantations in which trees are generally less than 9" DBH. Stand size average is 14 acres (SD 13.6, n=124) with a maximum size of 69 acres. Sites in this category are expected to develop into mid then possibly late sere conifer forest over the next 100-150 years. The most limited structural stage is the "late sere", or "old-growth", which occupies less than 1% of the watershed. Stand size average is 12 acres (SD 9, n=11) with a maximum size of 33 acres. The late sere structure has been converted into earlier sere conditions as a function of stand replacement disturbance, e.g. Yacolt forest fires, and or timber harvesting.

Approximately 260 forested stands are accounted for in the watershed. These stands represent early and mid successional stage forest with an average size of 22 ac. (SD 32). Though the average stand size is small, the proximity of similar structural stage stands, especially the mid sere, and riparian reserves may be sufficient to maintain connectivity across the landscape. Habitat change due to forestry practices is a temporary change in structure with likely potential for redevelopment as wildlife habitat. Habitat change due to human development, e.g. residential, is of a much longer term if not permanent. The central and lower third of the watershed are most impaired while the north and eastern halves are least impaired. The primary impairment to connectivity is due to human developments.

b. Meadow

The "meadow" structural stage occupies 26% (16,454 ac.) of the watershed. Stand size averages 49 acres (SD 193, n=333) with a maximum size of 2,330 acres. It includes conifer plantations with low tree densities as well as grass-shrublands. Plantations are likely more common than actual grass-shrub meadows. The "meadow" structural stage is present throughout the watershed with larger stands in the southern half. The highest elevation "meadow" sites are actual grass-shrub communities such as can be found on Lookout Mountain. The high elevation sites tend towards steeper and exposed topography, have shallow soils with low water holding capacity, have moderate to high evaporation rates, and have brief growing periods. The combination of factors maintains the non-forest environment of the "meadow" structural stage. The mid to lower elevation "meadow" sites are a combination of young conifer plantations and or human development areas. The plantations are expected to develop through the early sere stage and into the mid sere at which time the developmental process would likely be restarted via a timber harvest and planting. Human development areas are not expected to develop into older stages of conifer forest.

c. Unknown

Vegetative structure on 12% (7,355 ac.) of the watershed is of an "unknown" or undefined type.

d. Non-forested

Ten percent (6,010 ac.) of the watershed is "non-forested" to include rock, talus, and aquatic conditions. Stand size averages 87 acres (SD 165, n=69) with a maximum size of 984 acres. The rock outcrops can serve as roosting, nesting, and or foraging habitat for species such as peregrine falcon, golden eagle, and marmot. The talus structure provides habitat for such species as salamanders, pika, and porcupine. Ponds are a unique and limited resource and especially important in their role of habitat for salamanders such as Pacific Northwest Giant and rough-skinned newt. These species reproduce in an aquatic environment but spend much of their lives in upland forest environments. Higher elevation ponds are likely cirques, remnants of glacial activity, and associated with talus.

Snags and Coarse Woody Debris

Snags and coarse woody debris (CWD) provide denning, nesting, roosting, foraging and hiding cover for a host of cavity excavators, secondary cavity users, and other associated species. The abundance and distribution of snags and CWD has been significantly reduced via large scale, multiple burn forest fires and logging operations. An additional force that contributed to the reduction in this resource was the active, large scale felling of snags during the early 1930s. This are the snags that had resulted from forest fires. Snags and CWD are commonly consumed during repeat burns of the same landscape. The pattern of snag and CWD loss is that the first fire weakens and/or kills trees creating snags and CWD then the following fire(s) consume this dead/dry material generating even greater amounts of heat that in turn weakens/kills/burns live trees that might have otherwise survived. The resultant condition is a paucity of older snags and CWD. Occasional 1-20 acre patches of 30-50 snags/acre are present, survivors of the fires and salvage logging. These snag patches likely serve as a wildlife refugia from which surrounding areas with fewer snags can be recolonized and or greater used. Across the landscape, the average snag resource is estimated to approximate 2/acre in the early sere, 6/acre in the mid sere, and 12/acre in the late sere.

Wildlife

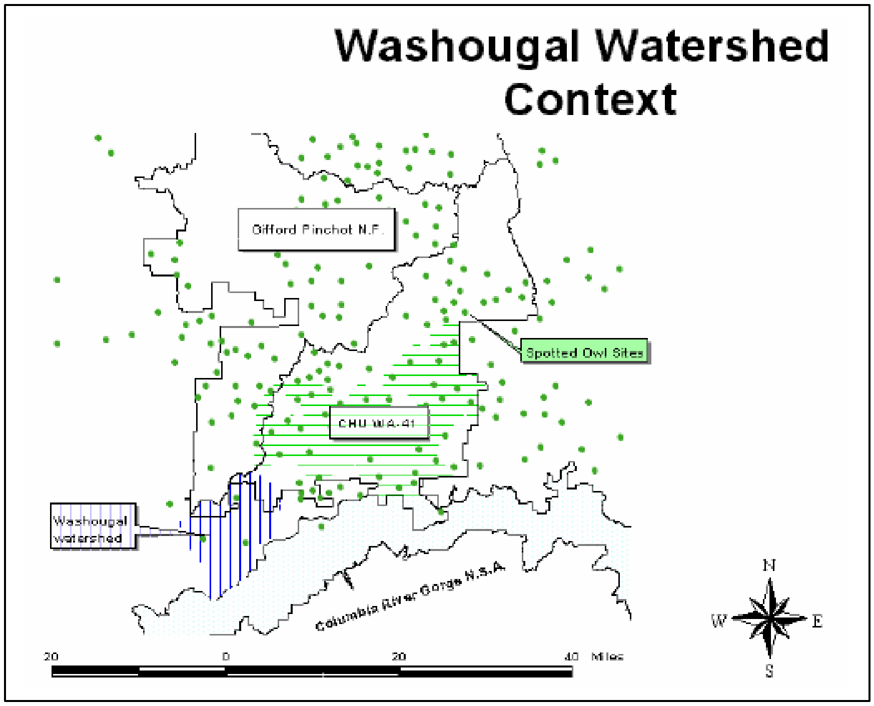
The following wildlife species are found in townships of the Upper Washougal watershed: Larch mountain salamander, Cascade torrent salamander, tailed frog, and red-legged frog. These species are associated with specialized habitat features: talus; high gradient, clear and cool streams; seeps, or rearing pools, backwater areas, and ponds. Anecdotal accounts indicate that some streams got heated during the forest fires that "no life forms were evident". Such events could significantly constrain amphibian population levels and distribution resulting in even a more sparsely populated landscape than would normally exist. Ridge systems such as Lookout Mountain, McKinley Ridge, and Bluff Mountain provide updrafts and thermals for migrating raptors though the number and species of raptors migrating through are unknown. Golden eagle, harrier (*Circus cyaneus*), and purple martin have been observed. The harrier was observed in flight on the northwestern side of Lookout Mountain during September 1999. Anecdotal evidence indicates that mountain goats were present along the upper ridges until the early 1900s. The cause for the change in mountain goat activity seems likely a combination of large scale forest fires and human harassment. Total road density varies from a low of 0.5 miles per square mile in the mid to upper portions of the watershed to a high of 3.5 miles/sq.mile in the lower third. It is likely that there are more roads on the landscape than are accounted for in the density estimate. Road condition and whether it is open or closed to public use is unknown. The potential for wildlife harassment is closely associated with open road density. As such, the lower half of the watershed has the greatest potential for wildlife harassment or viewed another way, the greatest potential for people to experience wildlife.

Bird species composition is strongly correlated with structure (Manuwal and others 1997). The early sere condition is readily colonized by species such as common yellowthroat, MacGilivray's warbler, western bluebird, northern flicker, willow flycatcher, song sparrow, white-crowned sparrow, rufous-sided towhee, and American goldfinch. About 15 years into the life of an early sere conifer plantation, true forest birds such as the chestnut-backed chickadee, golden-crowned kinglet, and winter wren move into the stand. After the stand develops a full canopy, about 20 year, most of the birds found in the earlier stages leave the stand with but a few persisting in small pockets. It is not uncommon to find that a small number, <12, of bird species account for the majority, >70%, of bird activity in developing stands. Winter wren would likely be the most widespread and commonly detected species in a managed forest. Species likely to be detected in all seres would include American robin, Swainson's thrush, dark-eyed junco, rufous-sided towhee, western tanager, Wilson's warbler and winter wren. Species richness in forested areas decreases with gains in elevation. Species less likely to be present at the higher elevations would include American crow, tree swallow, violet-green swallow, house wren, band-tailed pigeon, hermit-Townshend's warbler, common yellowthroat, bushtit, American goldfinch, and song sparrow. About half of the bird species present in the landscape are likely permanent, year-round residents. About a third are neotropical, and about a tenth migrate south of WA state but remain within the United States. Permanent resident species such as chestnut-backed chickadee are more common in later sere forest than in younger. Conversely, species that don't winter in the watershed decrease in abundance with forest age.

TE&S

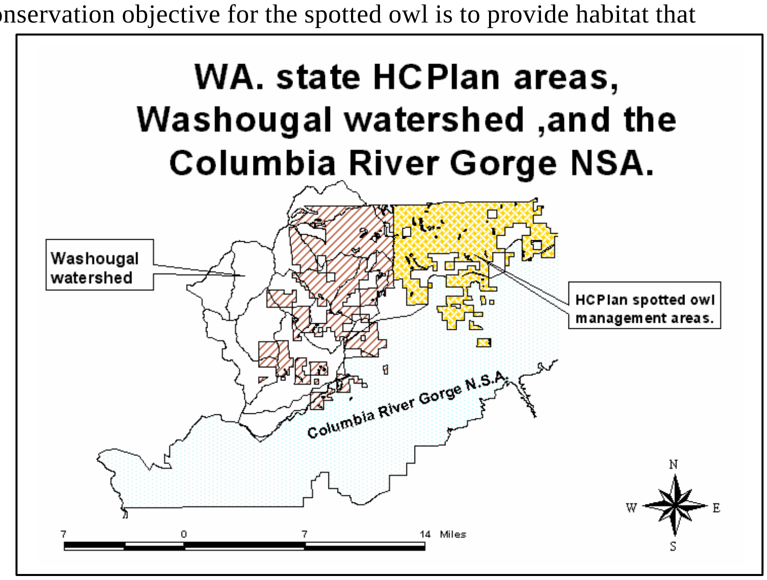
a. Northern Spotted Owl

1) Critical Habitat, WA-41



As the adjacent figure shows, the Upper Washougal (vertical hatching) watershed is situated about 0.5 miles south-west of CHU WA-41 (horizontal hatching). This CHU was designated in part to provide connectivity between Oregon and Washington spotted owl populations. The proximity of the watershed and the CHU is conducive to spotted owl movement. However, vegetation, and topography make that movement more challenging. Late sere forest structure declines markedly at the watershed ridge closest to the CHU. The presence of spotted owls on either side of the watershed ridge is indicative of historic movement. Neither the recency nor the pathway(s) used for such movement is known. That the watershed is closer to Oregon increases the odds of successful conveyance of individual owls across the Columbia River. Residential and municipal developments, which remove late sere forest, in the lower fourth of the watershed however, reduce the odds of spotted owl passage.

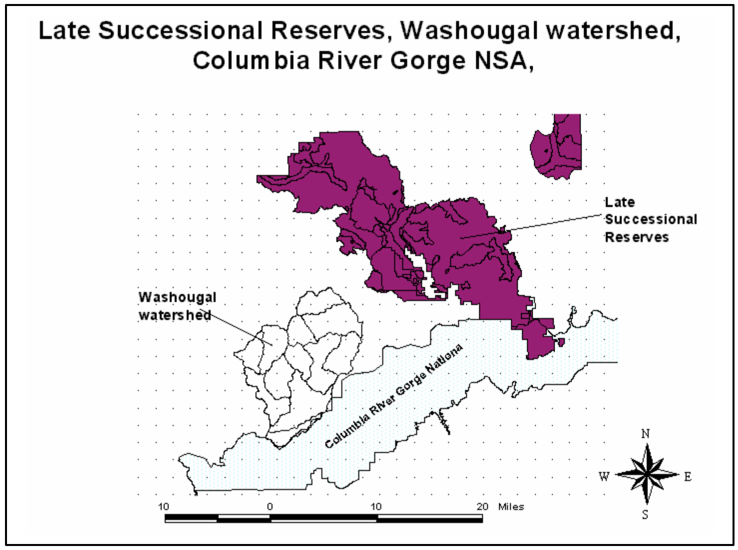
2) Habitat Conservation Plan



Washington Department of Natural Resource's conservation objective for the spotted owl is to provide habitat that makes a significant contribution to demographic support, maintenance of species distribution, and facilitation of dispersal. The demographic support refers to the contribution of individual owls which provides stability and viability for the entire population. The maintenance portion of the objective is regarding the continued presence of owls in as much of its historic range as possible. The dispersal function provides for the movement of juvenile, subadult, and or adult owls amongst sub-populations. The state's conservation strategy assumes that active forest management techniques can be applied to develop and maintain roosting, foraging, and dispersal habitat. A Habitat Conservation Plan (HCP) dispersal area occupies the majority of the state lands within the Upper Washougal watershed. Adjacent to the east side of the watershed is an HCP nesting/roosting/foraging (NRF) area. The state's goal for dispersal and nesting/roosting/foraging areas is to maintain at least 50% of its managed lands within each watershed as dispersal and NRF habitat respectively.

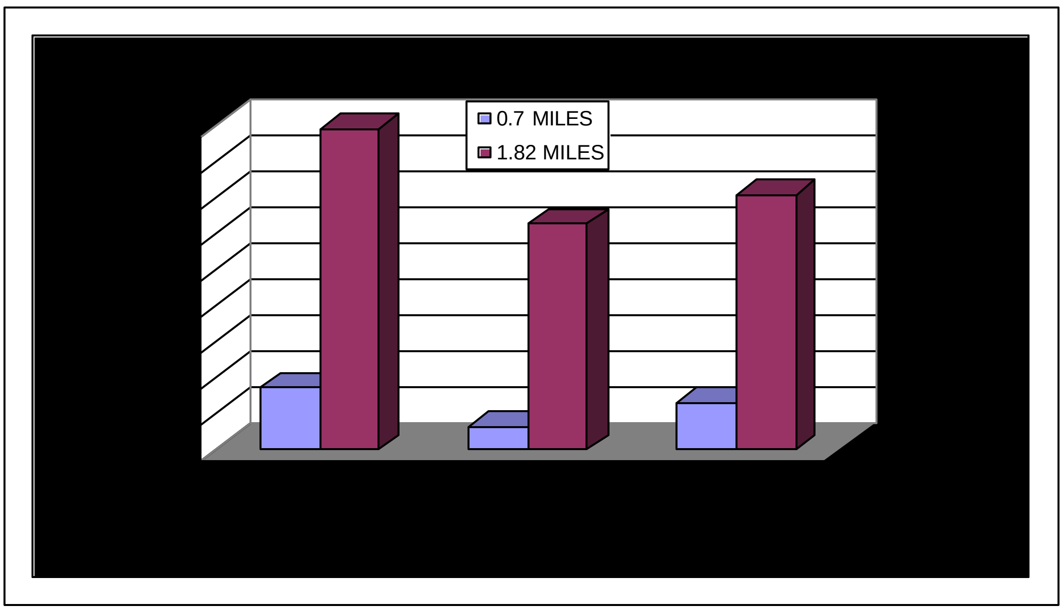
3) Late Successional Reserves

The Upper Washougal watershed is outside of designated and 100-acre undesignated Late Successional Reserves. The nearest LSR is the Wind River LSR about 2.3 miles to the north east, and beyond that is the Peterson LSR. At a similar distance as to the Wind River LSR but to the south, is a similar sized LSR on the Mt. Hood National Forest. LSRs are managed to provide late successional forest function one of which is spotted owl habitat.



4) Owls

The watershed is known to be within the home range of three known spotted owl activity centers: Bluebird Creek, Wildboy Creek, Hard Scramble Creek. The most recent status for the three sites is "Presence" (at least one adult owl in attendance). This status was determined in 1993 for Bluebird Creek and Wildboy Creek, and 1994 for Hard Scramble Creek. These centers are situated off of NFS lands (Figure3.6.2). Habitat (Nesting, Roosting, Foraging) levels, in acres, for each activity center are shown in the adjacent chart.



b. Other Species

Rocky outcrops, steeply incised drainages, and diverse forest vegetation provide suitable habitat for peregrine falcons. Falcons are known to use the Columbia River gorge for nesting and foraging. The Upper Washougal watershed, on the north side of the Columbia gorge, provides foraging habitat for Columbia gorge birds as well as migrating and dispersing individuals. Talus outcrops are particularly common in the upper northwestern part of the watershed. Larch mountain salamanders are reported as being present in this watershed. Salmon return estimates indicate a 75% reduction from past years. This reduction would affect piscivorous species such as osprey, bear, and bald eagle which make use of fish for part of their diet. Mountain ash is rather abundant in the watershed and when coupled with elderberry and huckleberry shrubs, create a substantial fruit crop during the mid summer to early fall. The fruit resource could be used by species such as band-tailed pigeon, cedar waxwing, and coyotes.

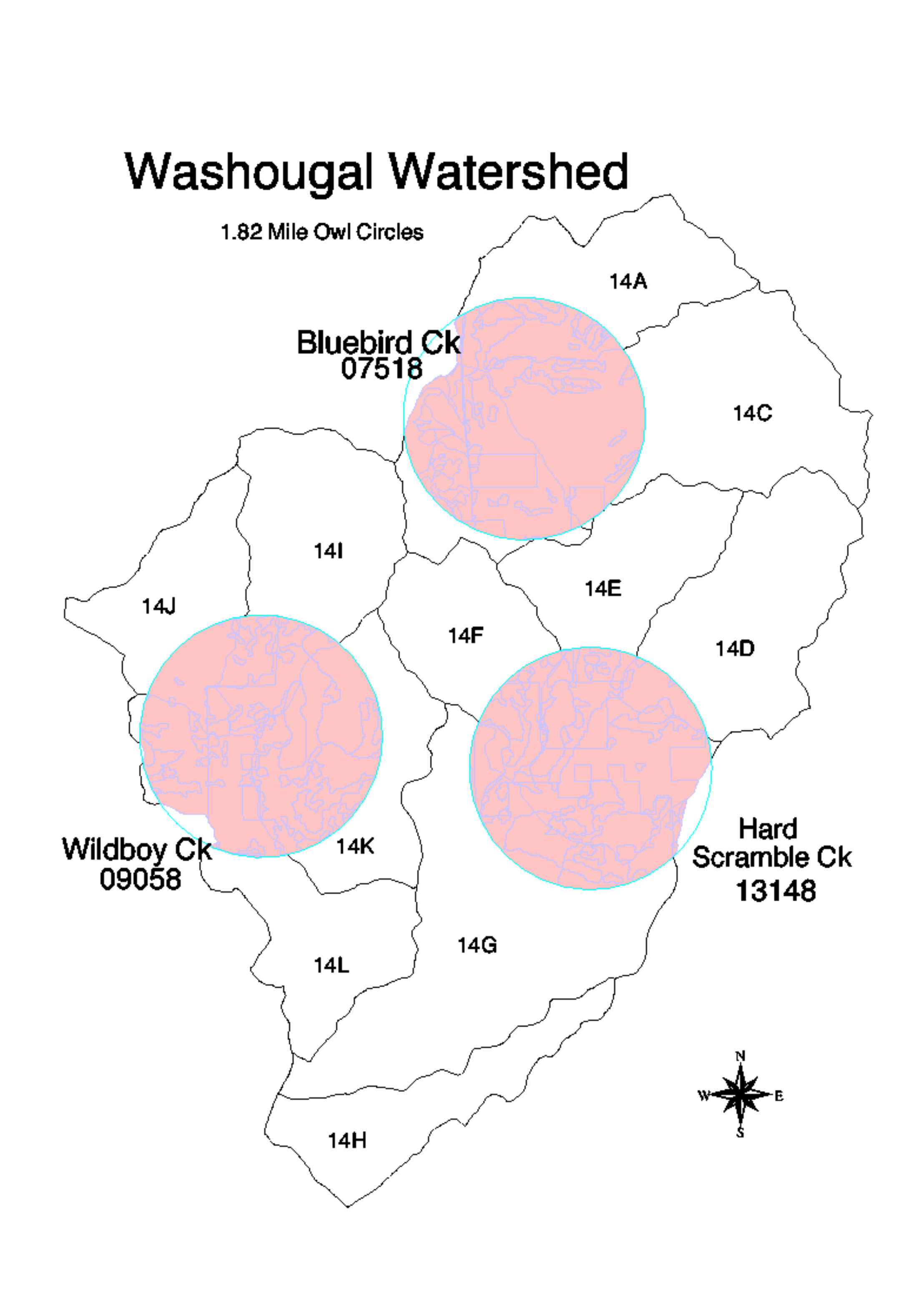
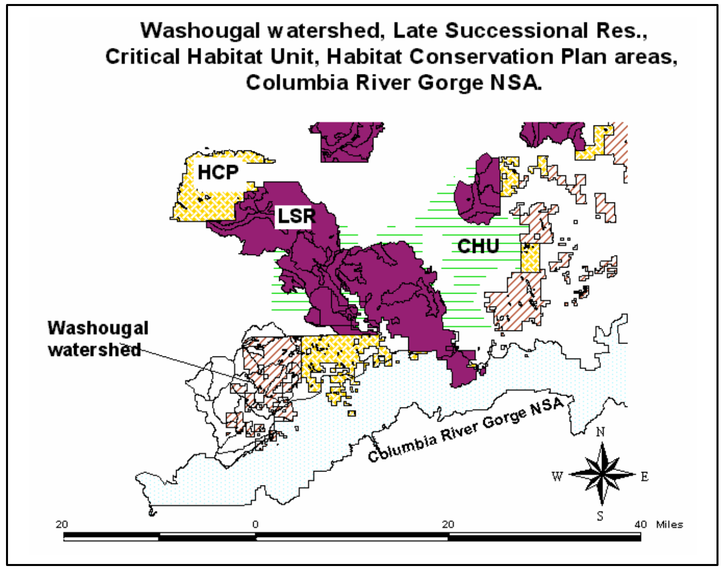


Figure 3.6.2. Spotted Owl activity centers in the Upper Washougal watershed.

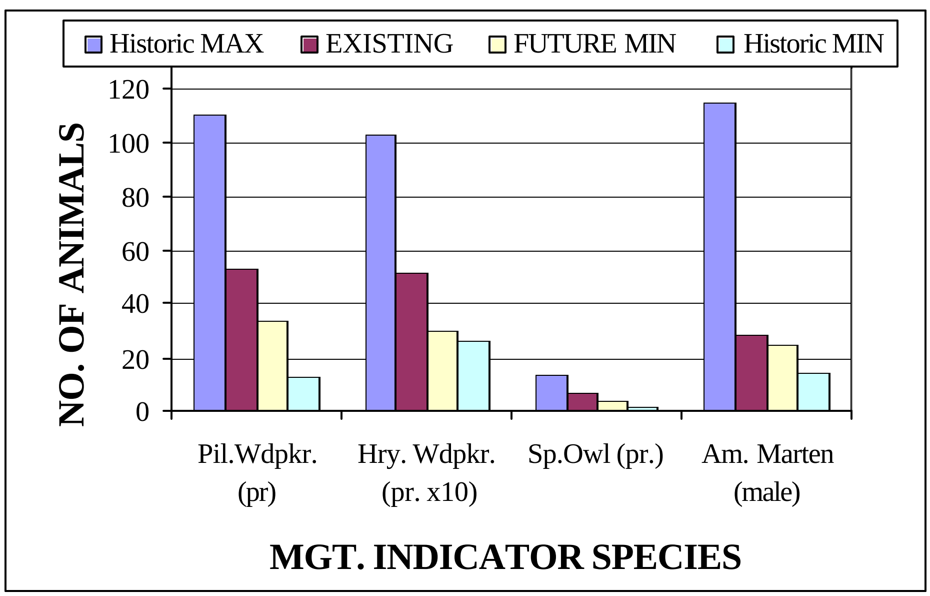
Habitat for the Townsend's big-eared bat is associated with mining structures (shafts and adits) unique to this watershed; although, no surveys are documented. Myotid bat species, e.g. long-eared, long-legged, little brown…, are also very likely present. These myotids are usually forest associated where most of their roosting occurs though exposed rock outcrops, tree stumps, and snags are also used. The availability and distribution of open water may be limiting where myotids live. Myotid bats would likely leave the watershed during the winter, migrating perhaps into the Willamette Valley of Oregon. The Townsend's bats would hibernate within the watershed.



Wildlife Synthesis and Interpretation

Washington Department of Natural Resource lands are the dominant long term habitat area for wildlife and it is here where the watershed's habitat function for wildlife depends. Habitat function is likely maintained by WA state's forestry practices which include Habitat Conservation Plan dispersal habitat requirements along with structure retention, riparian protection, and reforestation. The HCP location and management complements Late Successional Reserves, and Critical Habitat. Successful implementation, with monitoring, of the HCP is essential to the this watershed's habitat function.

The adjacent figure depicts historic maximum/minimum, existing and future minimum levels of the management indicator species and indirectly the communities these species represent. Population levels are based on habitat capability. Historic levels assume that 90% of the watershed is in a late sere forest stage. The MIS projection indicates that habitat capability for the MIS and the communities they represent is below HISTORIC MAX and above HISTORIC and FUTURE MIN.. The FUTURE MIN assumes maximum harvest on non federal lands. It is likely that the watershed contained a significant proportion of late sere forest. At the turn of the century, the Yacolt burn coupled with human development including fuelwood gathering, timbering, agriculture, and residential development significantly altered the structure, composition, and function of the landscape. The resultant condition being one dominated by early sere forest. The historic high level of late sere forest structure is unlikely to reappear over most of the watershed.



It appears that based on the habitat capability for MIS resulting from implementation of the ROD and WA Habitat Conservation Plan, no loss of the wildlife community is expected. Field validation of wildlife-habitat relationships and habitat capability estimates is lacking, effectively making the previous statement of condition a generous approximation. Demographic assessment of the MIS members is essential to accurately reporting on the condition and trend of the wildlife community.

Species and Habitats--Fish

Anadromous Fish

Fall Chinook

Origin
Native fall chinook have been reported in the Washougal (WDF, 1951), but a distinct stock no longer exists. Natural spawning does occur, but these fish are identified as hatchery strays (Devore, 1984).

Brood stock for the Washougal Hatchery is usually obtained from local returning stocks. However, transfers of other stocks into the system are a common practice. In recent years, such stocks as Kalama, Bonneville, Toutle, Washougal, Elochoman, and Grays River have also been imported to fill hatchery needs (WDF, 1990)

Life History
Figure 3.6.1 identifies the life history stages and when they occur through the year.

Life History Stages	M		A		M		J		J		A		S		O		N		D		J		F	
Adult Migration														X	X	X	X							
Adult Holding														X	X	X	X	X						
Spawning														X	X	X	X	X						
Egg/Alevin Incubat'n														X	X	X	X	X	X	X	X			
Emergence																			X	X	X	X	X	
Rearing			X	X	X	X	X	X	X	X														
Juvenile Migration					X	X	X	X	X	X														

Figure 3.6.1. Washougal fall chinook freshwater life history. Skamania County, Washington.

Distribution
Washougal River fall chinook spawning ground index counts are conducted annually between Salmon Falls Bridge at RM 15 and the Wildlife access at RM 12, a distance of approximately 4 miles. Salmon Falls was considered a barrier to salmon migration until a fishway was constructed in the 1950's.

Spawning Areas
Natural production occurs in the mainstem Washougal downstream from the salmon hatchery. Although this includes 20 miles of stream channel, bed rock and boulder areas result in light spawning in the stream with spawning most intensive from RM 12-15. Washougal River fall chinook spawning ground peak index counts are conducted annually between Salmon Falls Bridge and the Wildlife Access, a distance of approximately four miles.

Table 3.6.1. Estimated amount of rearing and spawning habitat by quality of the Washougal watershed fall chinook production area. Skamania County, Washington.

Distance / [a] Area	Excellent	Good	Fair	Poor [b]	Unknown	Total	Confidence
Miles (%)	20	73	07	00		14.3	
Acres (%)	20	73	07	00		103.8	

[a] Production area of considers habitat outside of the Washougal Watershed Analysis area including portions of the Lower Washougal, Little Washougal and Cougar Creek.
[b] Ratings of fair and poor habitat quality may reflect natural physical features such as waterfall barriers, as well as degradation caused by humans.
Source: Presence/Absence database, NPPC, 1991.

Table 3.6.2. Estimated amount of rearing habitat by quality of the Washougal fall chinook production area. Skamania County, Washington.

Distance / [a] Area	Excellent	Good	Fair	Poor [b]	Unknown	Total	Confidence
Miles (%)	00	00	00	100		2.3	
Acres (%)	00	00	00	100			

[a] Production area of considers habitat outside of the Washougal Watershed Analysis area including portions of the Lower Washougal, Little Washougal and Cougar Creek.
[b] Ratings of fair and poor habitat quality may reflect natural physical features such as waterfall barriers, as well as degradation caused by humans.
Source: Presence/Absence database, NPPC, 1991.

Production
In 1951 the WDF estimated the fall chinook escapement to be about 3,000 fish. The number of Washougal fall chinook natural spawners each year during 1967-1971 was estimated to be about 550 fish (WDF, 1973). Hatchery production is currently the dominant component in the Washougal River although some natural production also occurs.

Stock Status
<u>TES Listing</u>
The Columbia River Distinct Population Segment of fall chinook was listed under the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.), as a threatened species. The Washougal watershed is located within the distribution of the Columbia River Distinct Population Segment.
<u>Critical habitat</u>
The Washougal watershed is currently designated as critical habitat for fall chinook. The Washougal watershed is currently considered a "fall chinook" watershed where consultation under section 7 of the Act for fall chinook will be necessary for any projects that may affect this species or its habitat in the Washougal watershed.

Coho

Origin
In the Washougal River coho were not divided into Type-S and Type-N stocks until 1982.

Most existing early coho (Type-S) hatchery programs are considered to be linked o native Toutle River stock coho. Lake stock (Type-N) are informally synonymous with Cowlitz River stock coho. Late stock hatchery programs were developed utilizing Cowlitz River stock, their derivatives, or native late runs. Late coho used in most of the current programs are presumably a blend of all these, although egg transfers from Cowlitz Hatchery occur most frequently (Howell et al, 1985).

By the time fish surveys were conducted on the Washougal River, serious habitat damage had already occurred. Due to the Yacolt Burn, the steep hills were deforested resulting in erosions and flooding. In 1947, the Cottrell Power company removed the last of three small hydroelectric dam which were considered low water barriers to fish migration (located below Washougal watershed analysis area) (WDF, 1990).

In 1958, the Washougal Salmon Hatchery was opened.

Life History
Figure 3.6.2 identifies the life history stages and when they occur through the year.

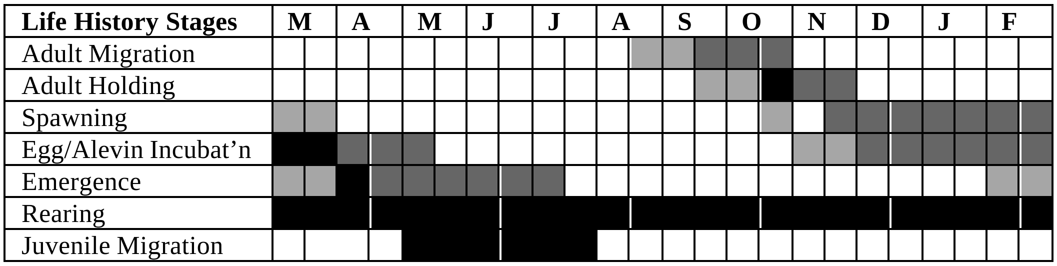


Figure 3.6.2. Washougal. coho freshwater life history. Skamania County, Washington.
Type-S = (light shade) and Type-N = (moderate shade) combined Type-S and Type N = (dark shade)

Distribution
Natural spawning occurs in the most areas accessible to coho. On the Washougal River the heaviest natural spawning occurs in the mainstem between RM 12-15 (WDF, 1990). Natural spawning also occurs in the Little Washougal and the West Fork Washougal.

Spawning Areas
Natural spawning occurs in most areas accessible to coho. Tables 3.6.3 and 3.6.4 describe the amount of spawning and rearing habitat by quality, available in the Washougal River. This data was derived from the Presence/Absence database of the Northwest Power Planning Council, 1991.

Table 3.6.3. Estimated amount of rearing and spawning habitat by quality of the Washougal watershed coho production area. Skamania County, Washington.

Distance / [a] Area	Excellent	Good	Fair	Poor [b]	Unknown	Total	Confidence
Miles (%)	43	53	04	00		23.2	
Acres (%)	54	43	02	00		44.4	

[a] Production area of considers habitat outside of the Washougal Watershed Analysis area including portions of the Lower Washougal, Little Washougal and Cougar Creek.
[b] Ratings of fair and poor habitat quality may reflect natural physical features such as waterfall barriers, as well as degradation caused by humans.
Source: Presence/Absence database, NPPC, 1991.

Table 3.6.4. Estimated amount of rearing habitat by quality of the Washougal coho production area. Skamania County, Washington.

Distance / [a] Area	Excellent	Good	Fair	Poor [b]	Unknown	Total	Confidence
Miles (%)	00	00	28	72		3.2	
Acres (%)	00	00	28	72		23.3	

[a] Production area of considers habitat outside of the Washougal Watershed Analysis area including portions of the Lower Washougal, Little Washougal and Cougar Creek.
[b] Ratings of fair and poor habitat quality may reflect natural physical features such as waterfall barriers, as well as degradation caused by humans.
Source: Presence/Absence database, NPPC, 1991.

Production
In Washington and Oregon adults production of early and late coho from natural spawner is unquantified except for a few instances. Howell et al, (1985) estimated a 10-15 percent of coho production is from natural production. Hatchery production is the dominant component in the Washougal River although some natural production also occurs.

Washougal River tributary sport catch estimates between 1979 - 1986 return years averaged 924 adult coho, and ranged from a low of 172 in 1983 to a high of 2,629 in 1986. These estimated were based in a catch records and limited actual sampling data. However, specific age and brood year analysis for the Washougal River sport catch is unavailable.

The number of Washougal River coho natural spawn escarpment is unavailable. Washougal River Hatchery returns for the 1979-1988 brood years of Type-S coho averaged 5,740 with a low of 551 in 1984 and a peak of 16,999 in 1983. Hatchery returns of Type-N coho for the 1079-1988 brood year averaged 5.296 with a low of 2,743 in 1985 and a high of 10,443 in 1986..

A special fishery of excess coho was once present in the Washougal River near the hatchery. The last full season of the fishery was in 1986 with a partial season of three days in 1987 due to the fact no substantial catch was available. Harvest rates for the 1979-1986 snag fishery averaged 1,193 adults with a low of 325 in 1979 and a high of 3,073 in 1982 bad on catch records and limited sampling.

Stock Status

TES Listing

The Columbia River Distinct Population Segment of coho was listed as threatened under the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.). The Washougal watershed is located within the distribution of the Columbia River Distinct Population Segment.

Critical habitat

The Washougal watershed is currently designated as critical habitat for coho. The Washougal watershed is currently considered a "coho" watershed where consultation under section 7 of the Act for coho will be necessary for any projects that may affect this species or its habitat in the Washougal watershed.

Summer Steelhead - Naturally Produced

Origin

The summer steelhead stock in the Washougal River is indigenous, although interbreeding with introduced Skamania and Cowlitz hatchery stocks has probably occurred. In addition, steelhead which abandoned the Cowlitz system following the eruption of Mount St. Helens in 1980, may have strayed into the Washougal River and spawned with native Washougal stock.

Life History

Figure 3.6.3 identifies the life history stages and when they occur through the year.

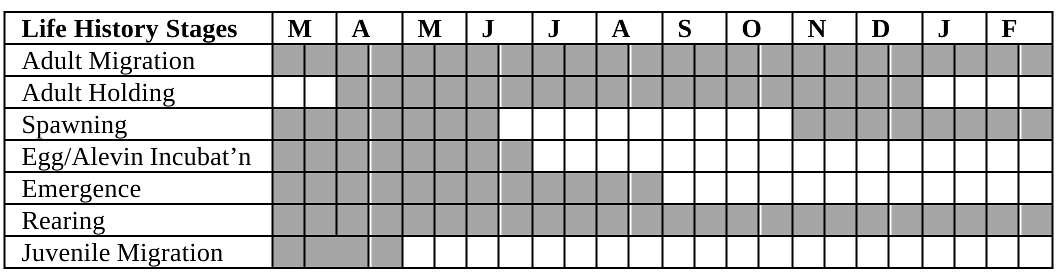


Figure 3.6.3. Washougal fall chinook freshwater life history. Skamania County, Washington.

Distribution

Table 3.6.5 lists spawning and rearing habitat, by quality, for Washougal River steelhead based on estimates from the Northwest Power Planning council.

Table 3.6.5. Estimated amount of rearing and spawning habitat by quality of the Washougal watershed summer steelhead production area. Skamania County, Washington.

Distance / [a] Area	Excellent	Good	Fair	Poor [b]	Unknown	Total	Confidence
Miles (%)	19.3	78.7	1.9	00		36.2	Unknown
Acres (%)	9.4	90	0.6	00		223.4	Unknown

[a] Production area of considers habitat outside of the Washougal Watershed Analysis area including portions of the Lower Washougal, Little Washougal and Cougar Creek.
[b] Ratings of fair and poor habitat quality may reflect natural physical features such as waterfall barriers, as well as degradation caused by humans.
Source: Presence/Absence database, NPPC, 1991.

Summer steelhead are distributed throughout the mainstem Washougal River and its major tributaries including Prospector and Deer Creek within the Gifford Pinchot jurisdictional area. Summer steelhead are also found in the West Fork Washougal inside the forest boundary (Tables 3.6.11 and 3.6.12). Dougan Falls located at RM 21 is considered a low water barrier to steelhead. Above Dougan Falls the stream gradient increases with numerous falls and cascades, which limit the number of fish, that can access the upper section of river.

Spawning Areas
Spawning occurs in the mainstem Washougal River, the West Fork Washougal and in the tributaries of Stebbins and Cougar creeks and the Little Washougal River. The range of spawning habitat is believed to range into the National Forest jurisdictional area but on a very limited scale. These headwater reaches typically have excessive stream gradient, low flows and natural barriers that restrict spawning.

Production
Production Facilities
There are two hatcheries in the watershed, the Washougal Hatchery located on the mainstem Washougal River 16 miles northeast of the town of Washougal and the Skamania hatchery located on the North Fork Washougal River. The Washougal Hatchery is operated by Washington Department of Fisheries and is a major producer of coho and chinook salmon. Skamania Hatchery is operated by Washington Department of Wildlife and produces summer and winter steelhead.
Production Summary
No data is available on wild smolt production. Production has fluctuated widely due to a number of natural events and human activities including; gravel mining on the lower 20 miles of river which stripped the lower river of most of its spawning gravel, pollution from a pulp mill which releases its effluent near the mouth of the river, logging in the upper watershed, and earlier this century forest fires which occurred in the upper watershed. In an effort to increase production, several small dams which blocked or impeded fish passage have been removed or by-passed allowing steelhead access to more of both the mainstem Washougal River and several tributaries.

Stock Status
TES Listing
The Columbia River Distinct Population Segment of steelhead was listed under the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.), as a threatened species on June 10, 1998. The Washougal watershed is located within the distribution of the Columbia River Distinct Population Segment.
Critical habitat
The Washougal watershed is currently designated as critical habitat for steelhead. The Washougal watershed is currently considered a "steelhead" watershed where consultation under section 7 of the Act for steelhead trout will be necessary for any projects that may affect this species or its habitat in the Washougal watershed.

Winter Steelhead - Naturally Produced

Origin
The winter steelhead stock in the Washougal River is indigenous, although some genetic influence has probably been exerted by introduced Chambers Creek, Cowlitz and Elochoman hatchery-stock steelhead. In addition, steelhead which abandoned the Cowlitz system following the eruption of Mount St. Helens in 1980, may have strayed into the Washougal River and spawned with native Washougal stock.

Life History
Figure 3.6.4 identifies the life history stages and when they occur through the year.

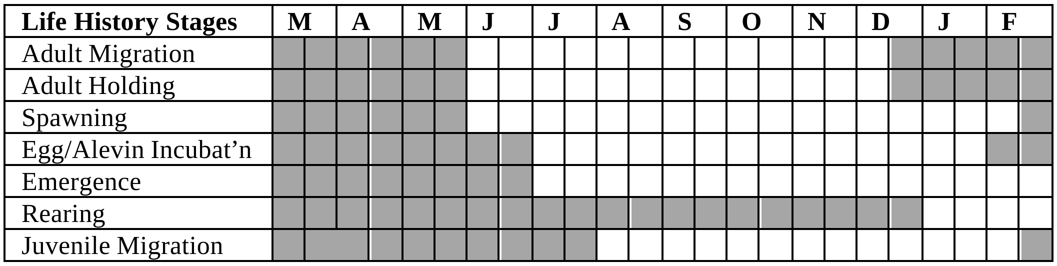


Figure 3.6.4. Washougal winter steelhead freshwater life history. Skamania County, Washington.

Distribution
Table 3.6.6 lists spawning and rearing habitat, by quality, for Washougal River steelhead based on estimates from the Northwest Power Planning council. Winter steelhead are distributed throughout the mainstem Washougal River including the tributaries of the West Fork Washougal, and Stebbins creeks (Figures 3.6.11 and 3.6.12). Dougan Falls located at RM 21 is considered a low water barrier to steelhead. Above Dougan Falls the stream gradient increases with numerous falls and cascades which limit the number of fish that can access the upper section of river.

Table 3.6.6. Estimated amount of rearing and spawning habitat by quality of the Washougal watershed winter steelhead production area. Skamania County, Washington.

Distance / [a] Area	**Excellent**	**Good**	**Fair**	**Poor [b]**	**Unknown**	**Total**	**Confidence**
Miles (%)	26.5	70.8	2.7	0.0		26.4	Unknown
Acres (%)	12.2	87.0	0.7	0.0		172.6	Unknown

[a] Production area of considers habitat outside of the Washougal Watershed Analysis area including portions of the Lower Washougal, Little Washougal and Cougar Creek.
[b] Ratings of fair and poor habitat quality may reflect natural physical features such as waterfall barriers, as well as degradation caused by humans.
Source: Presence/Absence database, NPPC, 1991.

Spawning Areas
Wild winter steelhead spawn in the mainstem Washougal, the West Fork Washougal and the Little Washougal Rivers and tributaries of Stebbins and Cougar creeks.

Production
Production Facilities
There are two hatcheries in the watershed, the Washougal Hatchery is located on the mainstem Washougal River 16 miles northeast of the town of Washougal and the Skamania Hatchery located on the North Fork Washougal River. The Washougal Hatchery is operated by Washington Department of fisheries and is a major producer of coho and chinook salmon. Skamania Hatchery is operated by the Washington Department of Wildlife and produces summer and winter steelhead.

Production Summary
No data is available on wild smolt production although winter steelhead production is considered low. Production constraints would include gravel mining on the lower 20 miles of river, continued urbanization of the watershed which has crated runoff fluctuations resulting in unstable stream flows, pollution from a pulp mill which releases its effluent near the mouth of the river and logging and forest fires which occurred earlier this century in the upper watershed.

Stock Status

<u>TES Listing</u>

The Columbia River Distinct Population Segment of steelhead was listed under the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.), as a threatened species on June 10, 1998. The Washougal watershed is located within the distribution of the Columbia River Distinct Population Segment.

<u>Critical habitat</u>

The Washougal watershed is currently designated as critical habitat for steelhead. The Washougal watershed is currently considered a "steelhead" watershed where consultation under section 7 of the Act for steelhead trout will be necessary for any projects that may affect this species or its habitat in the Washougal watershed.

Summer Steelhead - Hatchery Produced

Origin

The Skamania summer steelhead (*Oncorhynchus mykiss*) broodstock was developed in the late 1950's at the Skamania hatchery. Skamania broodstock were originally developed from native Washougal and Klickitat River steelhead.

Spawning Areas

Spawning occurs at the Skamania Hatchery.

Production

<u>Production Facilities</u>

Skamania hatchery is a major producer of summer and winter steelhead but also rears sea run cutthroat trout. Rearing areas consist of 32 10ft X 80 ft raceways and 3 12 ft X 100 ft adult holding raceways. Incubation is by vertical stacks and hatchery troughs. Water from the Washougal River is used for all rearing except egg incubation where water is supplied from Vogel Creek (virus free water supply) a tributary to the North Fork Washougal River.

Hatchery summer run smolts are released from the Skamania Hatchery located on North Fork Washougal. Skamania Hatchery serves as the primary broodstock collection site and over 100,000 smolts are release to maintain adequate broodstock.

<u>Production Summary</u>

Skamania steelhead are artificially propagated in a hatchery environment. Skamania Hatchery annually produces approximately 800,000 smolt (summer and winter). Current summer production (1992) is approximately 340,000 smolt. Progeny of fish spawned at Skamania hatchery are also reared at Beaver Creek and Vancouver hatcheries. Currently, Skamania Hatchery supplies Ringold springs Rearing Ponds (located on the mid Columbia River above Tri-cities, Washington) with steelhead fry for grow-out release.

Life History Stages	M		A		M		J		J		A		S		O		N		D		J		F	
Adult Migration														■	■	■	■							
Adult Holding														■	■	■	■	■						
Spawning														■	■	■	■	■						
Egg/Alevin Incubat'n														■	■	■	■	■	■	■	■			
Emergence																			■	■	■	■	■	
Rearing			■	■	■	■	■	■	■	■														
Juvenile Migration					■	■	■	■	■	■														

Figure 3.6.5. Washougal cutthroat trout freshwater life history. Skamania County, Washington.

Table 3.6.7. Smolt to adult return for Skamania stock summer Steelhead to Skamania Hatchery on the Washougal River. Skamania County, Washington.

Return Year	**Smolts Planted [a]**	**Hatchery Returns [b]**	**Percent Return [c]**
1970	100,120	4,466	4.5
1971	97,700	4,904	5.0
1972	137,000	4,967	3.6
1973	120,517	2,813	2.3
1974	129,250	4,095	3.2
1975	100,200	4,402	4.4
1976	103,740	4,897	4.7
1977	99,320	6,399	6.4
1978	100,045	6,072	6.1
1979	116,349	3,989	3.4
1980	115,110	5,815	4.9
1981	114,896	8,244	6.9
1982	98,343	5,227	5.1

[a] Smolts reared at Skamania Hatchery and released into the Washougal River.
[b] Hatchery returns include steelhead harvested in the Washougal sport catch.
[c] Percent return does not include fish which may be harvested in the Columbia River treaty and sport fisheries or fish which may spawn in the Washougal River.
Source: Stock Assessment of Columbia River Anadromous Salmonids Vol II.

Cutthroat Trout – Sea Run

Origin

The cutthroat trout (*Oncorhynchus clarki clarki)* stock in the Washougal River is indigenous although there is a hatchery program at the Skamania Hatchery located on the West Fork Washougal. Interbreeding with introduced stocks has probably occurred.

Life History

Figure 3.6.5 identifies the life history stages and when they occur through the year.

Distribution

Table 3.6.8 lists spawning and rearing habitat, by quality, for Washougal River sea run cutthroat trout based on estimates from the Northwest Power Planning council.

Table 3.6.8. Estimated amount of rearing and spawning habitat by quality of the Washougal watershed sea run cutthroat trout production area. Skamania County, Washington.

Distance / [a] Area	Excellent	Good	Fair	Poor [b]	Unknown	Total	Confidence
Miles (%)	19.3	78.7	1.9	00		36.2	
Acres (%)	9.4	90	0.6	00		223.4	

[a] Production area of considers habitat outside of the Washougal Watershed Analysis area including portions of the Lower Washougal, Little Washougal and Cougar Creek.
[b] Ratings of fair and poor habitat quality may reflect natural physical features such as waterfall barriers, as well as degradation caused by humans.
Source: Presence/Absence database, NPPC, 1991.

Table 3.6.9. Estimated amount of rearing and spawning habitat by quality of the Washougal sea run cutthroat trout production area. Skamania County, Washington.

Distance / [a] Area	Excellent	Good	Fair	Poor [b]	Unknown	Total	Confidence
Miles (%)	26.5	70.8	2.7	0.0		26.43	Unknown
Acres (%)	12.2	87.0	0.7	0.0		172.6	Unknown

[a] Production area of considers habitat outside of the Washougal Watershed Analysis area including portions of the Lower Washougal, Little Washougal and Cougar Creek.
[b] Ratings of fair and poor habitat quality may reflect natural physical features such as waterfall barriers, as well as degradation caused by humans.
Source: Presence/Absence database for steelhead trout, NPPC, 1991.

Sea run cutthroat trout are distributed in most of the same places where summer steelhead are found (Rawding, 1999) including the mainstem Washougal River and its major tributaries, West Fork Washougal and its tributaries (i.e. Johnson Creek, Hagen Creek) (Table 3.6.11). Dougan Falls located at RM 21 is considered a low water barrier to anadromous cutthroat trout.

Spawning Areas
Primary natural spawning occurs in the smaller headwater streams and tributaries of mainstem Washougal River, the West Fork Washougal and in Stebbins creeks. Cutthroat spawning densities tends to be much lower densities than other salmonids (Wydoski and Whitney, 1979).

Production
Production Facilities
The Skamania Hatchery has been producing sea run cutthroat since the mid 1980's. There is one cutthroat trout hatchery located in the watershed on the West Fork Washougal.
Production Summary
Hatchery smolt production of hatchery ranges from approximately 10,000 – 25,000 annually. No data is available on wild cutthroat trout production.

Stock Status
TES Listing
The Columbia River Distinct Population Segment of sea run cutthroat trout is proposed for listing under the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.), as a threatened species on June 10, 1998. The Washougal watershed is located within the distribution of the Columbia River Distinct Population Segment.
Critical habitat
The Washougal watershed is currently pending designation as critical habitat for sea run cutthroat. At the time of this publication the Washougal watershed is proposed a "sea run cutthroat" watershed where conferencing under section 7 of the Act for sea run cutthroat will be necessary for any projects that may affect this species or its habitat in the Washougal watershed.

Resident Fish

Cutthroat Trout – (coastal cutthroat trout and west slope cutthroat trout)

Origin
The introduced intermountain or westslope subspecies (*O. Clarki lewisi*) is present in the Washougal and most Cascade Mountain streams. The coastal subspecies of cutthroat trout (*O. Clarki clarki*) ranges from northern California to southeastern Alaska. In Washington this species is widely distributed. Coastal cutthroat trout stock in the Washougal River is indigenous, although interbreeding with introduced westslope stocks has probably occurred.

Distribution
Limited survey data is available in the Washougal watershed. WDFW (2000) reports that resident cutthroat trout are distributed throughout the Washougal watershed above most barriers including the tributaries of the West Fork Washougal, McCloskey, Upper Washougal River and Stebbins and Dougan Cougar creeks (Table 3.6.11, and 3.6.12). Coastal cutthroat trout display a strong interspecific segregation and are found above most barriers where the stream gradient increases and numerous falls and cascades limit fish access.

Spawning Areas
Spawning of resident cutthroat trout occurs in small headwater tributaries. No spawning survey data is available. Suspected spawning areas include the mainstem Washougal River, the West Fork Washougal and in the tributaries of Stebbins and Cougar creeks and the Little Washougal River.

Production
<u>Production Facilities</u>
There are no resident fish hatcheries in the watershed.
<u>Production Summary</u>
No data is available on resident cutthroat trout production.

Bull Trout

Origin
Washington native char exhibit four life histories: anadromous, adfluvial, fluvial and resident. These four life histories strategies are common in various forms of char around the world

Distribution
Limited bull trout specific survey data is available in the Washougal watershed. WDFW's Salmonid Stock Inventory (1996) reports that bull trout have not been observed in the Washougal watershed. Brook trout (*Salvelenus fontinalis*) have been observed in the upper Mcclosky Creek drainage.

Spawning Areas
No reported spawning in the Washougal watershed. Bull trout depend on cold water for successful spawning (43-48oC.). Temperature appears to be a limiting factor in most of the Washougal watershed. Classic bull trout spawning habitat is flat gradient with uniform flow and gravel size substrate. McClosky and Canyon Creeks may have water temperatures conducive to bull trout spawning.

Production
<u>Production Facilities</u>
No hatchery production in Washougal watershed.
<u>Production Summary</u>
No data is available on resident bull trout production in the Washougal. Bull trout production in the lower Columbia (White Salmon, Lewis River, Hood River) is native stock maintained by wild production.

Stock Status

TES Listing

The Columbia River Distinct Population Segment of bull trout was listed under the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.), as a threatened species on June 10, 1998. The Washougal watershed is located within the distribution of the Columbia River Distinct Population Segment.

Critical habitat

The Washougal watershed is currently designated as critical habitat for bull trout. This determination was based primarily on an absence of data to preclude potential presence of bull trout or suitable habitat. While no reports of bull trout sighting in the watershed have been recorded, the absence of water quality and habitat data, there remains the potential that habitat conditions on Forest Service land may be suitable for bull trout. In an effort to identify watersheds which support or may support bull trout, the U.S. Fish and Wildlife Service initiated an interagency process to gather knowledgeable parties (Washington Department of Fish and Wildlife, U.S. Forest Service, Service) along with all pertinent information available to make determinations for all watersheds on the Gifford Pinchot National Forest. In the absence of rigorous sampling to determine presence/absence of bull trout, the Washougal watershed is currently considered a “bull trout” watershed where consultation under section 7 of the Act for bull trout will be necessary for any projects that may affect this species or its habitat in the Washougal watershed.

Fish Habitat

Table 3.6.10. Summary of key pathway indicators *Where:* PF = Properly Functioning[1], AR = At Risk[1], NPF = Not Properly Functioning[1], U = Unknown, supporting evidence not available to make a determination.

PATHWAYS:	Headwaters Washougal	Bluebird/Silver	Upper. Washougal	Stebbins Creek	Mid. Washougal	Dugan Creel	Lower Washougal	Canyon Creel	Headwater West	Hagen Creek	Texas/ Wildboy	Lower West Fork
INDICATORS	**14A**	**14B**	**14C**	**14D**	**14E**	**14F**	**14G**	**14H**	**14I**	**14J**	**14K**	**14L**
<u>Water Quality:</u>												
Temperatures												
Sediment	U	U	U	U	U	<u>U</u>	AR	U	U	AR	U	U
Chemical. Cond../Nut.												
<u>Habitat Access:</u>												
Physical Barriers	P	U	U	U	U	U	U	U	U	P	NPF	P
<u>Habitat Elements:</u>												
Substrate	U	U	U	U	U	U	NPF	U	U	NPF	U	NPF
Large Woody Debris	AR	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF
Pool Frequency	U	U	U	U	U	U	U	U	U	AR	U	AR
Pool Quality	U	U	U	U	U	U	U	U	U	U	U	U
Off-channel Habitat	U	U	U	U	U	U	U	U	U	U	U	U
Refugia	U	U	U	U	U	U	U	U	U	U	U	U
<u>Channel Cond. & Dynamics:</u>												
Width/Depth Ratio	U	U	U	U	U	U	U	U	U	NPF	U	NPF
Stream bank Condition	U	U	U	U	U	U	U	AR	NPF	NPF	AR	NPF
Floodplain Connectivity	U	U	U	U	U	U	AR	AR	U	U	U	AR
<u>Flow/Hydrol:</u>												
Peak/Base Flows												
Drainage Network Increases												
<u>Watershed Conditions:</u>												
Road Density & Location												
Disturbance History												
Riparian Reserves	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF

[1] These three categories ("properly functioning", "at risk", and "not properly functioning") are defined for each indicator in the "Matrix of Pathways and Indicators" (table 1 on p.10).
[2] For the purposes of this checklist , "restore means to change the function of an "at risk" indicator to "properly functioning", or to change the function of a "not properly functioning" indicator to "at risk" or "properly functioning" (i.e., it does not apply to "properly functioning" indicators).
[3] For the purposes of this checklist, "maintain" means that the function of an indicator does not change (i.e., it applies to all indicators regardless of functional level).
[4] For the purposes of this checklist, "degrade" means to change the function of an indicator for the worse (i.e., it applies to all indicators regardless of functional level). In some cases, a "not properly functioning" indicator may be made worse, and this should be noted.

Distribution of TE&S Fish and Their Habitat

The following two tables identify the distribution of listed fish and their habitats in the Washougal watershed.

Table 3.6.11. Washougal watershed listed fish stocks and habitat for those subwatersheds occurring within the Gifford Pinchot National Forest. Skamania County, Washington. *Where* Y = yes species / suitable habitat is confirmed present; N = No species / suitable habitat is not present; U = Unconfirmed if species / suitable habitat is present.

Subwatershed Number	14A Headwaters Washougal		14B Bluebird/Silver		14C Upper Washougal		14D Stebbins Creek		14I Headwaters West Fork		14J Hagen Creek	
Fish Species	Spp Presnt	Suit Hab. Presnt	Spp Presnt	Suit Hab. Presnt	Spp Presnt	Suit Hab. Prsnt	Spp Presnt	Suit Hab. Prsnt	Spp Presnt	Suit Hab. Prsnt	Spp Presnt	Suit Hab. Prsnt
steelhead trout	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
bull trout	U	U	U	U	U	U	U	U	U	U	U	U
Chum salmon	N	N	N	N	N	N	N	N	N	N	N	N
cutthroat trout	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
coho salmon	N	N	N	N	N	N	N	N	N	N	N	N
Fall Chinook	N	N	N	N	N	N	N	N	N	N	N	N

Sources:

WDFW, Salmon and Steelhead Habitat Limiting Factors WRIA 28 Draft Maps
Sowinski (person. comm, 2000)
Rawding (person. comm., 2000)
Cochran (person. comm., 2000)
Sanders (person. comm., 2000)

Table 3.6.12. Washougal watershed listed fish stock summary for those watersheds occurring outside Gifford Pinchot National Forest jurisdiction. Skamania County, Washington. *Where* Y = yes species / suitable habitat is confirmed present; N = No species / suitable habitat is not present; U = Unconfirmed if species / suitable habitat is present.

Subwatershed Number	14E Middle Washougal		14F Dougan Creek		14G Lower Washougal		14H Canyon Creek		14K Texas/Wildboy		14L Lower West Fork	
Fish Species	Spp Presn t	Suit Hab. Presnt	Spp Presnt	Suit Hab. Presnt	Spp Presnt	Suit Hab. Prsnt	Spp Presnt	Suit Hab. Prsnt	Spp Presnt	Suit Hab. Prsnt	Spp Presnt	Suit Hab. Prsnt
Steelhead trout	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y
bull trout	U	U	U	U	U	U	U	U	U	U	U	
Chum salmon	N	N	N	N	Y	Y	N	N	N	N	N	N
Cutthroat trout	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y
Coho salmon	Y	Y	N	N	Y	Y	N	N	Y	Y	Y	Y
fall chinook	N	N	N	N	Y	Y	N	N	N	N	N	N

Sources:

WDFW, Salmon and Steelhead Habitat Limiting Factors WRIA 28 Draft Maps
Sowinski (person. comm, 2000)
Rawding (person. comm., 2000)
Cochran (person. comm., 2000)
Sanders (person. comm., 2000)

Table 3.6.13 identifies the listing status for salmonids in the Washougal watershed.

Table 3.6.13. Status of listed or proposed stocks of fish found in the Washougal watershed. Skamania County, Washington.

Species Common Name	Species Scientific Name	Listing Status
Lower Columbia steelhead trout	(*Oncorhynchus mykiss*)	Threatened
Columbia River bull trout	(*Salvelinus confluentus*)	Threatened
Lower Columbia River chinook	*(Oncorhynchus tshawytscha)*	Threatened
Columbia River chum salmon	(*Oncorhynchus keta*)	Threatened
SW Washington / Columbia River coastal cutthroat trout	(*Oncorhynchus clarki*)	Proposed Threatened
Lower Columbia River coho salmon	(*Oncorhynchus kisutch*)	Candidate Species

Human Uses

Prehistoric Overview

Approximately 20 km southwest of the Silver Star - Bluff Mountain area are a series of prehistoric sites in the Cascade foothills near Lacamas Lake, in Clark County. Surveys by Fagan et al. (1991) resulted in the identification of five sites, including the Dwyer Creek site , a 40-ha upland camp or short-term residential site (1991:75) containing abundant fire cracked rock, cobble choppers, flaked cobbles and debitage. Subsequent sampling produced projectile point types associated with the period between 5,000 to 2,000 B.P. (Musil 1992). The nearby Morasch site, also on an upland landform, is the most intensively sampled of the Cascade foothills sites in Clark County. Test excavations produced an assemblage of lithic artifact material including flaked cobbles, leaf-shaped points, unifacial tools and debitage (Woodward 1994). The lack of fire-cracked rock suggests a functional difference from activities at the Dwyer Creek Site. Woodward argues for a late Pleistocene or early Holocene age for the Morasch site, but dating remains problematic (1994:7-11).

Although the information on early occupation of the Washougal River drainage is limited, what little is known suggests that the earliest occupations throughout the area were similar in nature to those reported elsewhere in the Pacific Northwest (Beckham at al. 1988).

Archaeology of the Silver Star - Bluff Mountain area

The Silver Star - Bluff Mountain area consists of approximately 13,000 acres of mountainous terrain, including Bluff Mountain and several other peaks more than 1,000 m high, long meadow-covered ridges, and unique alpine-like conditions. Archaeological resources identified in this area include lithic scatters, isolated lithic artifacts, and sites with talus pit features. One site includes a series of trench features possibly related to huckleberry processing. A rockshelter containing cultural material has also been documented. Test excavations have been undertaken at the Silver Star Spring and Miners Bluff sites.

The "Silver Star Indian Pits" , a series of circular talus pit and trough features, are perhaps the best known of the archaeological resources in the area. This complex of rock features is located on the southern flank of Silver Star Mountain, and until recently, appeared on many published maps as a point of interest. The site was examined in 1951 by Louis Caywood, a National Park Service archaeologist (Huntress 1952). In a lengthy newspaper article, Caywood speculated that the "baffling Indian pits" may have been used as a lookout or "might well have been related to the puberty rites of the tribe." Similar features have been identified at four other sites in the area.

Most lithic scatters in the area were initially identified by surface artifacts exposed in roads and trail tread. The majority occur on saddle landforms along ridges connecting mountain peaks. The largest of these sites is the Bluff Trail Lithic Scatter located in a forested saddle between Little Baldy and Bluff Mountain. Subsurface shovel probes excavated at this site in 1992 (Nelson 1992) produced lithic artifact densities averaging approximately 220 artifacts per m3 but included areas with densities up to 1,430 per m3.

Most of the artifact material recovered from lithic scatters in the area consists of small thinning flakes of cryptocrystalline silica (CCS) material varieties such as chert, jasper, and chalcedony. A small amount of obsidian has been recovered from several sites, comprising 6.4 percent of the lithic raw material in the sample recovered from site 45SA308. Two surface artifacts of obsidian, found in the Silver Star Mountain vicinity in 1990, were matched respectively to the Obsidian Cliffs and Inman Creek (Variety A) sources (Hughes 1990a). The Obsidian Cliffs source is located in the central Oregon Cascade Mountains, on the Willamette National Forest. Inman Creek obsidian is found in a secondary deposit of alluvial gravels in the Long Tom River drainage, north of Eugene, Oregon (Skinner 1986:20).

Six to ten shallow, linear depressions, possibly representing huckleberry drying trenches were observed on the east ridge of Bluff Mountain and recorded in 1992 (Nelson 1992). Subsurface probing of the features was not attempted, and the functional interpretation should be considered tentative. This interpretation of site function is somewhat corroborated, however, by a 1952 newspaper article, which alludes to relatively recent (post-1902) use of the Silver Star area for huckleberry collection and processing. In describing the Silver Star Pits site, the author reports how that site "lies just below a good huckleberry area, where a few shallow rectangular depressions that were undoubtedly drying pits can still be seen in the rocky soil" (Huntress 1952:2).

A rockshelter site documented in 1992 by McClure, contained a small surface assemblage of lithic artifacts, including a small, triangular side-notched arrow point. The point style suggests the possibility of late-prehistoric to protohistoric use. No subsurface probing was done, but the protected environment of the rockshelter indicates potential for preservation of faunal and floral artifact material.

In 1993, test excavations were carried out by archaeologist Grady Caulk at the Silver Star Spring site . The report (McClure and Mack 1996) details results of the field investigation and subsequent analyses. Surface collection, shovel probes, and excavations of three 1 m x 1 m test units provide a sample of lithic debitage and formed tools. Among the latter are hammerstones, biface blanks, a preform, a unifacial tool, and projectile points. The presence of both a dart point and an arrow point indicates probable use of the site during the past two thousand years, and possibly earlier. The site appears to have functioned as a seasonal camp where later stages of stone tool manufacture occurred, along with the manufacture of bifacial blanks from locally-available silicified wood. The high frequency (40 percent) of silicified wood among lithic raw materials at this site is particularly noteworthy.

The Miners Bluff site is located in a saddle along the ridge forming the divide between the Lewis and Washougal River drainages, at an elevation of 1090 meters. The site was tested in 1993, and yielded an assemblage of 1,194 pieces of lithic debitage, and seven formed tools and fragments (McClure and Mack 1996). The small number and low diversity of tool types suggests a limited-use camp. Eleven obsidian specimens from the site were submitted for source analysis, and were determined to have originated from the Obsidian Cliffs source in the central Cascade mountains, Quartz Mountain southeast of Bend, and an unknown source.

Ethnographic Overview

The southern Washington Cascades is a diverse landscape, containing a variety of resources used by the native populations. The Silver Star - Bluff Mountain area is situated such that it borders several quite different ecological zones, all of which figured prominently in native usage. These include the Columbia River, the western slopes of the Cascades, and the Pacific Coast. The vicinity of Silver Star Mountain, being on the extreme western end of the Cascade uplands, is unique on the Forest in its proximity to the Portland Basin, the Cascades of the Columbia and the lower Lewis River valley, all of which were areas of relatively high population density in late prehistoric times.

The southern portion of the Washington Cascades is also an area of linguistic and cultural diversity, having been inhabited by three distinct linguistic groups, each with their own resource emphasis. The primary groups utilizing this area during historic and late-prehistoric times included the Sahaptin-speaking Taidnapam, Klickitat, Yakama and related bands; the Salish-speaking Cowlitz; and a number of Upper Chinookan or Kiksht-speaking bands located along the Columbia River. The difficulty of delineating "tribal" boundaries has been pointed out by several authors (Boyd and Hajda 1987:322; Hajda et al. 1995:16), due largely to the political independence of villages, the seasonal shifting of populations in response to resource availability, trading patterns, and village exogamy. Numerous authors have noted the largest cohesive political unit in this area was the village, and intergroup trade, travel and marriage were the rule rather than the exception. The territories used by these groups most likely overlapped and were used in common -- particularly hunting territory. Taking into account the impacts of epidemic disease on population distributions over the past few centuries, the designation of "tribal" boundaries may be a difficult or impossible task.

Settlement Pattern

The settlement pattern of the native population in this area involved residence in semi-permanent villages situated in sheltered locations along either a major river or tributary, and seasonal camping at root digging grounds, fishing stations, and hunting and berrying locales (Ray 1939). An exception may have been the area at the confluence of the Willamette and Columbia Rivers, where resource abundance may have permitted year-round occupation of villages (Saleeby 1983).

The winter villages were composed of groups of extended families, and varied greatly in size. Curtis reported that the Klickitat wintered in the valleys of the Klickitat, White Salmon, Little White Salmon, Wind and Lewis Rivers (1911a:35-36). The Chinook wintered primarily along the Columbia, but again in sheltered locations. The Taidnapam and the Cowlitz wintered along the floodplain of the Cowlitz and Lewis Rivers and their tributaries.

Each year these winter villages were occupied between the late fall and early spring. People remained in these winter villages until the first roots and greens became available, at which time small groups would move to the surrounding hills to harvest them. Seasonal camps were located at sites of needed resources, with the length of stay dependent on the duration and availability of that particular resource.

In the late summer and fall people would move up higher into the Cascade Mountains, following ripening berries. As at other times of the year, some people would continuously be moving back and forth between fishing sites on major rivers and the upland berry-picking and hunting camps. Camps usually consisted of extended families, and these camps were dispersed across the uplands. One type of shelter used was the conical mat house, later replaced by the more typical Plains tipi-like structure. A type reported for the Cowlitz was built of cedar bark slabs or of pole frames covered with mats or boughs (Hajda 1990:509

The 1805-1806 journals of Lewis and Clark (Moulton 1983), Curtis (1911b), and Spier and Sapir (1930) provide names for village locations near the present-day communities of Camas/Washougal and Vancouver/Portland. These were all Chinookan villages. In the vicinity of the present town of Washougal, Curtis (1911b:181) lists the Gahlawashuhwal "tribe" as occupying the village of Washuhwal. Lewis and Clark documented what they referred to as the Sha-ha-la villages of Nechacolee and Neerchokioo, between the mouths of the Sandy and Willamette Rivers. It is likely that Curtis's prefix of "Gahla" and Lewis and Clark's "Sha-ha-la" are renditions of the same form. Numerous groups occupied the area between the mouths of the Lewis and Willamette Rivers, including the various Shoto villages near Vancouver Lake, and the Multnomah and other bands scattered along Sauvie Island.

Subsistence Practices

The subsistence practices of the various groups occupying this area were generally similar, varying mainly by the emphasis placed on individual resources. People depended upon a wide variety of resources for their livelihood, including fish, roots, berries, and game animals. Chinookan peoples located along the Columbia River occupied some of the most strategic locations for procuring salmon, and fish formed the emphasis of their subsistence economy. Klickitat and Yakama peoples still emphasized fish, but roots and berries played perhaps an equal role in their economy. For the Taidnapam and Cowlitz, who did not have access to prime fishing or root gathering sites, a greater emphasis was placed on hunting. For all of these groups, however, the strategy involved the ability to mobilize in order to arrive at a place on the landscape at a time when the desired resource was at an optimal state for harvesting. The ability to remain in a semipermanent village throughout the winter was dependent on the ability to accumulate stored resources for winter use.

In the spring some of the earliest fresh foods available on the east side of the Cascade Mountains were the "celeries," such as bare-stemmed lomatium (Lomatium nudicale) and gray's lomatium (Lomatium grayi), usually available on low-elevation hillsides. West of the Cascades, these included salmonberry shoots (Rubus spectabilis), horsetail shoots (Equisetum sp.), cow parsnip (Heracleum lanatum), and water parsley (Oenanthe sarmentosa). The first salmon runs on the Columbia occurred in the spring, usually in April, and at this time almost all Chinookans and many Sahaptin and Cowlitz groups congregated at fishing sites along the river and its tributaries.

Beginning around May, people moved from their fishing villages up to mid-elevation prairies and hillsides where the root and bulb crops were available for harvest. On the eastern slopes of the Cascade Mountains the primary roots collected were biscuit root (Lomatium cous), bitterroot (Lewisia rediviva), Indian carrot (Perideridia gairdneri) and Canby's desert parsley (Lomatium canbyi). Camas (Camassia quamash) could generally be found on both the east and west slopes of the mountains. On the western slopes of the Cascade Range, wapato (Sagittaria latifolia) was undoubtedly the most important root food. The tuber was collected in quantity, forming a staple and an item of trade for Chinookan peoples in the Portland Basin. The roots of the cattail (Typha latifolia), bracken fern (Pteridium aquilineum), horsetail (Equisetum telmateia), thistle (Cirsium edule) and lupine (Lupinus littoralis) were also collected on the western slopes, principally by the Chinook. This list is by no means exhaustive, since the Yakama alone were attributed with the use of at least twenty-three kinds of roots as food (Curtis 1911a:5). Most were harvested with the use of a digging stick -- a curved hardwood stick with a cross-handle of horn. Some roots were consumed fresh, but the majority were roasted or steamed and then dried and cached for later transport to winter villages. Baking and steaming was usually accomplished in rock-lined underground ovens.

The gathering of vegetable foods continued throughout the summer, at increasing elevations, along with periodic fishing and hunting. In late summer and fall people moved into the mountains to harvest a variety of fruits and nuts, and to continue hunting. Hunting was probably most important for Cowlitz and Taidnapam people occupying inland areas, but even Chinookan peoples hunted to some degree in the uplands. Deer, elk and bear are the species most frequently mentioned, but a wide variety of animals were hunted, both for meat and fur. These include squirrel, grouse, duck, quail, rabbit, beaver, otter, raccoon, and mountain goat. Wolf, fox and cougar were taken for their fur.

Deer could be taken close to village locations in the winter, but elk and bear were primarily taken in the mountains during the berry season (Spier and Sapir 1930:181). Hunting was accomplished primarily with the bow and club, but also through the use of pit fall traps, and by driving animals along their runs to waiting hunters. Deer and elk were taken by groups of hunters with bows who would make a stand on the runway along which the animals regularly passed. Other hunters would then drive the animals towards them. Bear, cougar, wolf, fox and other animals were caught in deadfall traps. Snares were used for smaller animals.

A wide variety of fruits and nuts were harvested in the mountains in late summer and fall. These included gooseberry (Ribes lacustre), golden currant (Ribes aureum), serviceberry (Amelanchier alnifolia), chokecherry (Prunus virginiana), cranberry (Vaccinium oxyococcus), salal berry (Gaultheria shallon), salmonberry (Rubus spectabilis), kinnikinnick (Arctostaphylos uva-ursi), strawberry (Fragaria sp.), raspberry (Rubus luecodermis), blackberry (Rubus ursinus), elderberry (Sambucus glauca), crab apple (Pyrus diversifolia), hazelnuts (Corylus cornuta), acorns (Quercus garryana), black lichen (Bryoria fremontii) and whitebark pine nuts (Pinus albicaulis). Of all the berries which were harvested, however, huckleberries (Vaccinium sp.) were the most important. Several varieties of huckleberries were available in quantities suitable for collection as a stored food, and they could be dried to a raisin-like state.

Techniques used by the Indians in this area for processing huckleberries have been described in several sources (Filloon 1952:5-6; French 1965:379; Briley 1986:159; Hunn 1990:132; Schuster 1975:79; Martin 1979:90; Stabler 1910:10, 21). One method involved spreading the berries out to dry on mats in the sun; another involved spreading the berries on a rack built over a fire pit; and the third involved drying the berries on mats in a trench in front of a smoldering log. Sometimes berries that were log-fire dried were later spread on mats in the sun to complete the drying process. The Salish-speaking Thompson Indians of British Columbia also used several varieties of huckleberries, and Turner et al. (1990:217) describe that these were preserved for winter by soaking the berries, mashing them, and then piling them on a drying rack with fire underneath to keep away flies. They also dried berries on mats in the sun.

Aside from the foods mentioned above, a variety of other plants were collected while in the mountains. These include tules, which were woven into mats; the bark of the western redcedar, which was used to make folded bark baskets; cedar root and beargrass, which were used in the manufacture of coiled baskets; kinnikinnick leaves for smoking; and a variety of plants collected for medicinal purposes.

Other Activities

Another activity which sometimes took place in the mountains was the quest for spirit power. Children, often as young as six years old, were sent off to special places to seek a guardian spirit which would be a source of guidance to them throughout their lives. Ray (1942:235) notes that among the Chinook and the Klickitat, both boys and girls participated in this quest. He lists mountains and bodies of water as destinations during the spirit quest, and both Ray (1942) and Spier and Sapir (1930) report that piling stones or building rock piles was often undertaken as a part of this quest. This served both as an aid in keeping awake and as proof that the young person did indeed stay at the prescribed place.

The guardianship of a spirit or individual protector could be gained only when one was young . . . The protection of a spirit was gained in some solitary place, generally in the mountains. After a period of "training" for a spirit one would appear to the young man in a dream or vision . . .

A child began to "train", that is, prepare for a spirit experience, when still quite young, six to twelve years old. He was sent out at night to some distant lonely place, to a lake, the mountains, the river, a large grove of trees, or some big rock pile. . . . He was bidden to travel about and finish an appointed task at the designated spot. This was always stereotyped; [such as] piling up rocks, . . . The task was always accommodated to the child's strength; at first small rocks, e.g., were piled, larger ones later. This was looked upon as physical preparation for life as well as opening the way to acquiring a spirit (Spier and Sapir 1930:239).

McWhorter (in Hines 1993) questioned two Nez Perce Indians in 1911 and in 1922 as to the origins of the "stone heaps" seen along the Columbia River, and both responded that these might be associated with the quest for spiritual guidance. They described situations very similar to those described by Spier and Sapir, where young boys were sent out to the mountains, and they would pile rocks "so that his people will know that he has been there," and they would wait for "something out there in the night, that . . . will tell him what to do" (Hines 1993:80). Several sites with talus pit features have been recorded in the vicinity of Silver Star Mountain, and these features may be physical evidence of the use of these areas for spirit quest activities.

Implications

Overall the ethnographic pattern indicated for the southern part of the Gifford Pinchot National Forest is one of warm-season use. The collection and processing of various plant foods formed the focus of activities, while hunting and fishing were undertaken on an opportunistic basis. Specific sites located at optimal resource procurement locations may have served more specialized functions, particularly in the case of hunting and fishing areas. Certain areas may have been important in the quest for spirit power.

The Silver Star - Bluff Mountain area was most likely used for hunting and berry collecting, as well as for the collection of other plant species. In recent discussions with representatives of the Yakama Indian Nation, the collection of medicinal plants in this area was specifically mentioned (Johnson Meninick, personal communication 1993). It is also possible that at one time this area figured prominently in the quest for spirit power, since there are numerous talus pit features present, scattered over a broad area. These talus pits may, however, represent the physical remains of other activities, particularly group hunting using blinds (William Yallup and Johnson Meninick, personal communication 1993). Mr. Yallup and Mr. Meninick believed that talus pits located at the very tops of bluffs were likely to have functioned as hunting blinds, where drivers would drive the game up the hills from below. Mr. Yallup and Mr. Meninick also felt that talus pits located in saddles were likely to represent blinds used as training places for young hunters.

A recently completed overview of ethnographic sites on the Gifford Pinchot National Forest (Hajda et al. 1995) contains no reference to use of the Silver Star - Bluff Mountain area. This overview was based on an extensive literature review and interviews with thirty Indian consultants, representing Sahaptin-speaking Yakama and Warm Springs people, Cowlitz and Upper Chinook (Wasco/Wishram). The only reference to use of this general area in Forest Service files is contained in a letter from the District Ranger at Wind River to the Forest Supervisor, dated May 1935, which refers to the spring below Silver Star Mountain. Ranger Shepeard states that "The Indians used it as a summer camp for many years. Arrow Heads and other relics which have been found about the camp ground proves that the Red Man appreciated the camp site long before the coming of the Whites." This reference provides no acknowledgment of recent Indian use of the area nor identity of the Indian groups involved.

Determining the route used to access the area in the past is difficult, since today it is accessible by road or trail from the Camas/Washougal and Vancouver areas, from the valley of the East Fork Lewis River, and from ridgelines connecting to the Wind River Valley. Historic maps indicate that these routes were in use as early as 1888. Determining the cultural affiliation of the Indians who used this area is even more difficult, since it is situated along the periphery of the historic territory of three different sociolinguistic groups. A case could easily be made for use by the Chinookan-speaking Cascade or Multnomah Indians, the Sahaptin-speaking Klickitat or Taidnapam Indians, or the Salish-speaking Cowlitz Indians. The area may well have been used by all three groups at different points in time, and possibly for different purposes. The largest cohesive social unit for all of these groups was the village, and most historians and ethnographers emphasize that the uplands were considered shared territory, open to all friendly neighbors.

Historic Overview

To secure a commercial foothold in the region, British employees of the Hudson's Bay Company established Fort Vancouver, within present-day Vancouver, during the winter of 1824-1825. By the 1840s, Americans had begun to build homes and develop farms around the fort, which served as a fur trade post and supply depot. The U.S. Army established a military post near the fort in 1850. Economic and political factors led to the closure of Fort Vancouver by 1860. During the subsequent decades of the 19th century, settlement expanded throughout Clark County and adjacent Skamania County.

At least two trails provided access to the Silver Star - Bluff Mountain area during the late 19th century, both of which are shown on an 1888 map of Clark County. One of the trails, labeled ``Dole Trail to Fort Simcoe and Texas Gulch" is shown heading east from the Vancouver area to the summit of Silver Star Mountain. Shepeard (1936) describes the route of this trail, noting ``Some time in the late seventies [1870s] a man by the name of Dole built a trail from Vancouver towards Yakima." A second trail, labeled ``Washougal Trail to Texas Gulch", followed the Little Washougal River from the Camas/Washougal area to its headwaters on Silver Star Mountain. Texas Gulch is located along the headwaters of the East Fork Lewis River, 4 to 5 km northeast of the Miners Bluff site. It is located along a trail shown on early Forest Service maps extending east to the Trout Creek and Wind River valleys, where it connected to trails heading ultimately to the Yakima Valley and Columbia River. Both trails may have been Native American travel routes.

The ``Washougal Trail," referred to above, continues to appear on Forest Service maps in 1911 and 1912, but the ``Dole Trail" does not. A 1914 description of the Silver Star Mountain area includes the observation, "Except for the hunter's, trapper's, and miner's trails, which are merely blazed ways through the woods, the area is inaccessible." (Hastings 1915:1). It is possible that the ``Dole Trail" was considered in this category. However, a 1911 map of the Columbia National Forest clearly depicts a trail following the north ridge of Silver Star Mountain.

Mining

Discoveries of copper and gold were made in the late 1890's near the headwaters of the Washougal River and the headwaters of the East Fork of the Lewis River. At the turn of the century, mining districts in the southern Cascades were consolidated in to the Washougal district. Following the initial discoveries, several hundred claims were staked; however, mineralization at most properties was so poor that little in the way of development work took place other than shallow prospect pits and adits. At the more favorable deposits, tunnels up t 3,000 feet in length were driven along the copper veins, and shafts up to 500 feet deep were sunk to test the veins at depth. Properties that underwent extensive exploration and development work for copper and gold in the early 1900's were the Skamania and Last Chance on the West Fork of the Washougal River and the Maybe mine at the headwaters of the Washougal River. Concentrating mills were built at several properties, but because of the lack of ore, milling operations were short lived, or because of the devastating forest fires, most mills burned to the ground, never to be rebuilt. Except for minor production from the Maybee in 1917, and the Last Chance and Skamania in 1916, production from the Washougal district was insignificant.

The Yellow Jacket Mine was initially opened in 1899, and the adit had been excavated to a length of 30 ft by January of 1900. The area burned in the Yacolt fire of 1902, and it is not clear what impact this had on the mine. According to Dodge (1987:4), the Last Chance Mine burned to the ground amidst exploding powder magazines, and the Blue Bird and Yellow Jacket Mines met a similar fate. A 1900 report on the Washougal Consolidated Copper Mining Claims (Brereton 1900) refers to the presence of ``much fine timber on most of the claims, consisting of fir, pine, larch and hemlock". This timber was destroyed in 1902, and the area burned again in the Dole fire of 1929.

There are no records of work at the mine between 1899 and the early 1950's. By 1953 the east adit had been expanded to a length of 120 feet, the first 55 feet of which was timbered. In 1953, 4.5 tons of ore was shipped to Tacoma smelter by Copper Canyon Mines of Camas, Washington. Following this short period of expansion, there was continued small-scale work at the mine from the 1960's through the 1980's.

The Skamania Mine was developed near the turn of the century, by Washougal Consolidated Copper Mining Co. Around 1915, a small concentrating mill was built at the mine and several shipments of concentrates were made to the Tacoma smelter. With the demoralization of the copper market at the close of the war, the mine was abandoned.

In 1966, Northwest Mining Co. of Portland shipped 6 tons of copper ore to the smelter. Since 1966, the mine has been idle. Most underground workings are inaccessible because of flooded shafts and caved adits, and all mining and milling equipment has been removed. Development work at the Skamania Mine consists of a 1040 foot east adit, a 236 foot west adit, and a 458 foot shaft. Four drifts have been excavated along the shaft.

The Maybee Mine was developed by the Washougal Gold and Copper Mining Company between 1900 and 1922. A 25 ton concentrating mill was built at the property, and in 1917 several wagon loads of concentrate were shipped from the mine.

Fire History

The Yacolt burn of 1902 was followed by numerous reburns, the worst of which wiped out regeneration and much of the possible seed source. During the 1930's and 1940's thousands of acres of the burn were planted by CCC crews. Much of the early planting was confined to ridge tops on the theory that intervening gullies and valleys would seed in from above. As a result, some sites were lost to hardwood brush. By the mid-1960s a major effort was underway to reforest this area. Reforestation methods included bulldozer terracing of hundreds of acres of mountain slopes. Due to the loss of the upper organic layer over much of this area, through either burning or subsequent erosion, these reforestation efforts were generally unsuccessful.

Establishment of the National Forest

Public forest lands in the area were set aside as the Rainier Forest Reserve. In 1907 the Forest Reserves were renamed National Forests, and by 1908 the Columbia National Forest was established. Early administration of these lands included horseback patrols of grazing allotments, inspection of mining activity, fire protection duties and trail construction. Local administration was based at the Hemlock Ranger Station, in the Wind River drainage, a considerable distance from the Silver Star - Bluff Mountain area.

Following the establishment of Civilian Conservation Corps (CCC) Camp Sunset on the East Fork Lewis River in 1933, significant developments occurred in the Silver Star - Bluff Mountain area. A company from this camp built the Bluff Mountain Road in 1934 and 1935. The road was built through the Miners Bluff archaeological site, its location corresponding to the present roadbed of Forest Road 4100.502. The year after the road was completed, a CCC tent camp was established near Bluff Mountain for tree-planting crews (Dodge 1987). Other CCC projects undertaken in the area included snag falling and road construction.

Hastings (1915:2) reports use of the Silver Star - Bluff Mountain area as a cattle range began about 1912-1913. A permit system for annual use of the Silver Star Cattle and Horse Allotment was initiated in 1921. Although use of the allotment continued through 1968, ridges east of Silver Star Mountain and north of Bluff Mountain were closed to grazing after 1942. The allotment permittee was A.H. "Henry" Matson, a dairyman with a ranch near Hockinson, a small rural community in Clark County, west of Silver Star Mountain. Each summer, usually in July, the Matsons would drive their herd of dairy cattle over roads and trails to reach the grazing allotment. The day long trip from their ranch was made on horseback. Annual numbers of cattle on the allotment averaged approximately 40 head. The typical season of allotment use was between July 1 and September 30.

Seasonal fire closures restricted public access to the Silver Star - Bluff Mountain area into the late 1950s. National Forest road access was improved, and by the 1960s, Portland-Vancouver residents were drawn to the area for its scenic beauty. Increasing numbers of people visit the area to hike, picnic, hunt, ride their horses on mountain trails, and enjoy the displays of wildflowers.

Current Human Uses

National Forest Lands

Mining

Currently mining is very minimal and is primarily exploratory in nature. The most recent activity has occurred at the Skamania mine and Yellow Jacket mine, which were described in the historic information above. The activity consisted of the opening of existing adits and removal of samples for analysis purposes. In the spring of 1999 the access road (Skamania Mines Road) was washed out and there has been no activity since. Currently there are mining claims throughout national forest lands within the Washougal Watershed but no known activities are occurring.

Recreation

Portions of the Silver Star Non-Motorized Area lie within the boundaries of the Washougal Watershed. Within this area hiking is a major activity. Trails located in this area consist of the star trail #174 and the Bluff Mtn. #172. Some of the main attractions are wildflowers, magnificent vistas, camping and hunting.

Timber Harvest--Regeneration Harvest from Matrix Lands

Timber harvest levels have been calculated for the purpose of estimating the timber contributions from Matrix lands on the Mt. Adams Ranger District of the Gifford Pinchot National Forest. The harvest calculation is expressed as the PSQ (Probable Sale Quantity) value. This watershed contains 2,180 acres of Matrix land. Table 3.7.1 below shows potential timber volumes calculated by decade under three different scenarios. Two methods, in addition to the PSQ method, were used. The "optimal" method is an area control model that assumes management of suitable lands under a minimum 110-year rotation. Under ideal conditions and with a normal distribution of stand ages, this method yields the acres that could be harvested while following all LRMP standards and guidelines. The other method, called the "actual" method, takes into consideration what is actually available for regeneration harvest. Note that in the table below that this method results in no regeneration harvest because the Forest Service portion of the watershed currently contains only about 130 acres of mature late-successional timber or less than 1% of the area. The NW Forest Plan standards state that a watershed needs to have at least 15% of the area in late-successional forest stands. Therefore, no regeneration harvest can come from the Matrix for the foreseeable future.

Table 3.7.1. Decadal regeneration harvest estimates from Matrix lands.

	PSQ		**Optimal**		**Actual**	
Watershed	Acres	MBF	Acres	MBF	Acres	MBF
Totals	0	0	198	5,940	0	0

Timber Harvest—Intermediate Harvest (Thinning)

Intermediate harvest is a suitable treatment on Matrix lands and within the LSR where it is desirable and feasible to accelerate the development of stands less than 80 years old to develop late-successional attributes.

Within the Matrix land classification, the PSQ model for determining thinning acres was based on a query of the vegetation data base for stands that were 40-120 years old, had 70% or greater canopy closure, and had trees in the 10-21" dbh size class. Our "optimal" method assumed all Matrix stands would be thinned at least one time per rotation. Since there are a total of 2,180 acres of Matrix lands potentially available for timber management, 198 acres could be available for harvest in a decade. Table 3.7.2 shows the potential thinning aces for the Forest Service lands in the Matrix. Sub-watershed 14A is the only watershed that contains Matrix lands.

Table 3.7.2. Decadal thinning levels from Matrix lands.

Sub-watershed	PSQ Thin Acres	Optimal Thin Acres	Actual
14A	238	198	0

Timber Summary

Regeneration Harvest
Due to the unavailability of mature stands of timber for harvest, no regeneration harvest can be scheduled at this time. It is estimated that it will be 100 years or more before there will be any stands in the Matrix ready for regeneration harvest. It is recommended that this watershed not be used in the calculation of Forest PSQ levels.

Intermediate Harvest.
Currently there are no stands available for intermediate harvest pending further examinations of stands. There are stands within the size limits for intermediate harvest, however, they may be performing other critical ecological functions. The vegetative data base records 2,969 acres of closed canopy trees in the 9" inch to 20" dbh size range within all land allocations of Forest Service ownership. Some of these stands may be suitable and available for a thinning treatment but further analysis is needed. Current limitations to harvest treatment are road access and lack of a merchantable amount of timber.

Timber Stand Improvement

Timber stand improvement activities are silvicultural treatments in young forest stands to increase tree vigor and growth and to minimize insect, disease, and animal problems. Typically these treatments consist of pre-commercial thinning, pruning, and fertilization. There have been few such treatments within the Upper Washougal watershed on Forest Service lands in the past decades. Normally timber stand improvement activities are financed by the benefiting function. For example, thinning to increase tree size and future product value would be paid out of timber management funds. The watershed contains about 2,180 acres of stands in Matrix lands where TSI activities have the potential to improve stand productivity.

Special Forest Products

Special or miscellaneous forest products consist of plants, parts of plants, fruits of plants, and in some cases rocks and minerals from forest lands. The products are used for a variety of purposes that include food, fuel, building materials, landscape materials, and medicinal uses. Humans from early Native American times to the present day have gathered, picked, or collected these products from the forest. Some special forest products are taken for personal use where others are taken for commercial use to be resold or used as a raw material for other products. Through a permit system and monitoring the Forest Service regulates use on National Forest lands. The following is a discussion of the more common special forest product uses within the Washougal watershed.

- **Berries.** Several species of berries including huckleberries, blackberries, wild strawberries, and elderberries are harvested by the public-at-large during the summer and fall. Picking for personal use is not regulated. Commercial picking is regulated, but the Washougal watershed has not been a destination for these Forest users in the past.

- **Bear Grass.** The tops of the bear grass plant are harvested and marketed to the floral industry. Beargrass grows in profusion in the Washougal. Most all of the collection is for commercial use and requires a charge permit. Collection may occur on the National Forest anywhere except within wilderness and research natural areas.

- **Christmas Trees.** Personal use permits for Christmas trees are sold to the public in November and December.

Non-Forest Service Lands

Recreation

Within lands not managed by the Forest Service there is one campground, Dougan Falls which is very popular and recreation use is very high during June through August. Approximately 8 miles of the Three Corner Rock trail is located within the watershed. This trail will take users to Three Corner Rock, which has magnificent views and is also a connector route to the Pacific Crest National Scenic Trail. The Chinook Trail Organization is proposing a trail through the watershed, which would go through both national forest lands, and other lands. The goal of this project is to have a loop trail within the Columbia River Gorge National Scenic Area. Other activities related to recreation include the Dept. of Fisheries Salmon Hatchery and the Dept. of Wildlife Steelhead Hatchery. Both of these hatcheries are managed by the agencies within the State of Washington. Other activities include hunting, fishing, berry picking, etc.

Agriculture

Agriculture within the watershed consists of mostly hobby farms and Christmas tree farms. Forestry and Timber production are still major activities have been decreasing in recent tears.

Urban Sprawl

The Washougal watershed is experiencing the same growth as eastern Clark County is experiencing. Most concentrations of homes occur along State Road 140 and is concentrated at the where the Washougal River and SR140 intersect. At this location is a general store and elementary school. Also located near here are a church, grange, fire station. From this point of concentration homes are located on most private lands with the majority of the western boundary of the watershed.

Timber Harvest

Management of forestlands for timber resources occurs on private, state, and Forest Service lands in the watershed. The private forestlands occur in the lower part of the watershed and are managed under State of Washington Forest Practices regulations. For the most part, these lands are managed on an even aged harvest rotation of about eighty years. State lands are managed on a somewhat longer rotation and provide for a wide range of fish, wildlife, and ecosystem needs.

CHAPTER 4. RECOMMENDATIONS

Recommendations are primarily focused on opportunities on National Forest lands in the watershed, but suggestions are included here for off-Forest lands as well.

1) *Recommendation: **Timber*** **Stand Improvement on early and mid seral stands.**

Description: Timber Stand Improvement work includes the thinning of young stands in the sapling to pole stage. The watershed contains 2,002 acres of these stands where thinning may be an appropriate treatment. The cost of treatment is paid by the benefiting activity. For enhancement of future commodity values, the cost would be paid with appropriated timber funds. For ecosystem enhancement, the cost would be paid by another sources.

Objective: Thinning of young stands is done to enhance future stand characteristics such as tree size, species composition, density, etc. One objective for the Washougal stands is to reduce the occurrence of off-site trees on some of the higher elevation plantations. Eliminating as many of the off-site individuals as possible favors the establishment and dominance of natural Pacific silver fir and noble fir seedlings. Removal of off-site trees from the ecosystem also avoids future problems of these trees disseminating seed and reproducing. The off-site trees are easily identified because they have characteristic poor form, poor growth and vigor, and are growing on the wrong site for a particular species. For example: Douglas-fir planted on a true fir site. Thinning is done by hand with chain saws usually through the use of contracting.

Location: Candidate stands are located wherever sapling and pole stands are found. They occur both inside and outside of Matrix lands.

Timing: Young stand thinning can be done anytime areas are accessible and free of snow. Timing of work also depends upon the availability of funding. These activities are usually deemed non-essential and postponed for economic reasons if funds are scarce.

2) *Recommendation*: **Remove matrix lands from PSQ calculations for regeneration harvest.**

Description: Currently Forest Service Matrix lands within the Washougal watershed do not contain mature stands. Furthermore, there are no late-successional stands anywhere within the watershed. In order to provide the minimum of 15% of a watershed in late-succession habitat, it is necessary to wait until stands sufficiently grow and develop to the large tree size class. Based on existing stand conditions and growing patterns, it will take many more decades before stands develop late-successional attributes. In the meantime, it is recommended that the Matrix lands within the Washougal watershed not be included in the land base used to calculate the regeneration portion of the Forest PSQ (Probable Sale Quantity).

Objective: Provide time for stands to grow and develop late-successional attributes.

Location: All lands within the watershed including Matrix.

Timing: At current stand ages and rates of growth, it will take many decades for stands to develop late-successional attributes.

3) *Recommendation:* **Interplant existing stands**

Description: On many sites in the watershed, the desired future timber stand is not the one currently occupying the site. This is because sites are occupied with off-site tree stocks that are maladapted to the location. In many cases these stands will not grow and develop into the late-successional stands needed to restore the historic ecosystem that existed before the fire disturbance. Interplanting can reintroduce adapted tree species back into areas where they once existed and are currently lacking. This type of project work would be considered restorative and could be funded with either restoration or appropriated funds. This work could also be incorporated with a timber stand improvement activity designed to reduce stocking of the off-site trees.

Objective: Reintroduce locally adapted conifer tree stocks into areas where they are lacking and where natural seed sources do not exist, making the likelihood of natural seeding low. The tree species to be planted are noble fir, Pacific silver fir, and western hemlock.

Location: Any sites that contain off-site plantations that do not have a component of locally adapted tree stocks. The first priority would be seedling/sapling stands above 3,000 feet elevation. The second priority would be stands with an open canopy and without adapted trees on all elevation zones. Third priority would be closed canopy stands that do not contain adapted trees on all elevation zones. Potential planting locations have not been determined. On-the-ground surveys would be necessary to locate the areas.

Timing: Tree planting is usually done in the spring of the year; however, early fall planting is possible if adequate soil moisture is present. It would take one to three years to grow nursery stock for out-planting. Container stock would be the quickest to grow.

4) *Recommendation:* **Reinstall gate on road to Lookout Mt.**

Description: Install a new gate at entrance to the spur road that leads to the top of Lookout Mtn.

Objective: Control access to the radio tower site and reduce public use of this hazardous and poorly maintained road.

Location: Gate should be located at the entrance to the 4100-501 spur to Lookout Mtn.

Timing: As soon as funding is available.

5) *Recommendation:* **Assess use of Upper Washougal and ridgelines as berry-picking destination.**

Description: Due to the potential for overuse of the resource, multiple areas are needed for berry picking, particularly huckleberry picking. Concomitant to planning other vegetation management (e.g., silviculture) projects, consideration for this resource will be given.

Objective: If appropriate, the objective would be to enhance the huckleberry resource.

Location: Lookout Mountain to Silver Star, along roads and ridges.

Timing: The assessment should take place prior to commitment of the area to other resources through vegetation manipulation.

6) *Recommendation:* **Establish Botanical Special Interest Area**

Description: The area from Silver Star to Bluff Mountain was previously proposed to be a Botanical Special Interest area. Follow-up, including a concrete and updated proposal is needed.

Objective: To create a Botanical Special Interest Area.

Location: 1,500 acres from Silver Star to Bluff Mountain.

Timing: 2-3 years.

7) *Recommendation:* **Determine current status (occupied, single, nesting, no contact) of spotted owl activity centers across the watershed.**

Description: As an interagency cooperative project with private landowners, survey habitat within 0.7 miles of historic activity centers to determine site status. Start sampling at the center then work outwards.

Objective: Site status: occupied, single, nesting, no contact

Location: Three activity centers: Bluebird, Wildboy, Hard Scramble

Timing: Spring through late summer for two consecutive years.

8) *Recommendation:* **Estimate dispersal (immigration, emigration) of spotted owls across the watershed and into the Wind River Late Successional Reserve.**

Description: As an interagency cooperative project with private landowners, capture and mark owls (adult & juvenile) at the three activity centers in the watershed as well as the three nearest centers outside the watershed and towards or within the Wind River LSR.

Objective: Mark and recapture individuals to ascertain dispersal source and destination sites. Estimate dispersal pathways.

Location: Six activity centers: 3 within the watershed, and 3 in the Wind River LSR.

Timing: Spring through late summer for five consecutive years.

9) *Recommendation:* **Identify the best candidate stands for future late-successional habitat**

Description: The NWFP directs that at least 15% of a watershed should provide late-successional or old growth habitat for the conservation of flora and fauna that require that habitat. The Washougal watershed currently contains less than 1% of the area in late-successional stands.

Objective: Provide for the future needs of late-successional dependent species by identifying those stands that are closest to meeting or have the best potential to meet late-successional habitat attributes in the future.

Location: The best candidate stands regenerated after disturbances in the early 1900's including the Yacolt fire of 1902. Regeneration was from natural seeding from locally adapted trees. Some of these stands are located in the lower watershed on State and private lands. Few of these stands are located on National Forest land due to subsequent fires and artificial reforestation. There are no rules as to where the late-successional habitat should be located in a watershed that contains mixed ownership. No one landowner is obligated to provide for all of it. The best solution would be a cooperative effort involving all landowners in the watershed.

Timing: Efforts for a solution to this problem can be done at any time. The Forest Service would be the likely agency to lead the effort.

10) *Recommendation:* **Cultural Resources Protection and Monitoring**

Description: The Silver Star/Bluff Mountain area has an extremely high density of archaeological sites. The locations of some of these sites, such as the Silver Star Talus Pits, have been shown on maps since very early times. Since the Silver Star area is readily accessible from the Portland/Vancouver metropolitan area, there is a high risk of site damage. The intensity of illegal motorized use in the area also increases the risk of site damage. Annual monitoring of these sites, along with appropriate signage that provides a strong protection message, would aid in long-term site protection.

Objective: To monitor the status of archaeological sites which are highly visible and which receive the highest degree of public visitation, and to provide a strong message of site protection.

Location: Silver Star Talus Pits, Little Baldy Talus Pits

Timing: Annually (late summer)

11) *Recommendation:* **Maintain the genetic integrity of the wild steelhead population**

Description: Reducing the risk of genetic introgression between hatchery and wild summer run steelhead could possibly be accomplished by one or more of following activities: 1) increase the adult trap efficiency at the Skamania Hatchery (RM 11 of West Fork Washougal) to capture and remove a significant number of hatchery fish. 2) reduce the number of smolts released 3) increase harvest of hatchery fish.

Objective: Increase the ratio of wild to hatchery steelhead in the upper North Fork Washougal index area to greater that three.

Location: Upper North Fork Washougal

Timing: Beginning immediately

12) *Recommendation:* **Conduct a fish inventory**

Description: Conduct fish surveys Suggested methods should follow American Fisheries Society's Interim Protocol for Determining Bull Trout Presence (Peterson et. al. 2000).

Objective: Determine fish species composition and species distribution. Surveys should determine presence/absence of bull trout with a statistical rigor (C.I. 95%)

Location: Prioritize list of stream with suitable habitat for bull trout (water temperatures < 50 ^{0} C.)

Timing: Beginning immediately

13) *Recommendation:* **Restore stream structure, process and function by reintroducing instream large woody debris.**

Description: Conduct surveys of degraded channels and determine where there are opportunities for stream restoration.

Objective: Increase instream large wood component to historic levels (> 80 pieces / rive mile)

Location: Rosgen C channels that have poor channel stability (> 50% lower bank instability)

Timing: Beginning immediately

14) *Recommendation:* **Monitor the natural production of steelhead smolt and adult population.**

Description: Natural production monitoring in the index portion of he Washougal River watershed should be expanded by development of mainstem adult sampling and smolt yield estimation program using modification of the existing weir and traps near the Washougal Salmon Hatchery.

Objective: : Develop an adult escapement estimate and smolt production estimate.

Location: Washougal River near salmon hatchery

Timing: Beginning immediately

15) *Recommendation:* **Monitor the Washougal watershed for key indicators of stream health.**

Description: Conduct level II stream surveys on all fish bearing or potentially fish bearing segments of the Washougal to quantify in stream habitat conditions. Methods should be consistent with USDA Forest Service Pacific Northwest Region Stream Survey Protocol (version 6.0).

Objective: Quantify key physical features of Washougal Watershed (i.e. pool: riffle ratios, channel stability, large wood count…etc).

Location: All fish bearing streams

Timing: Beginning immediately. Surveys conducted during summer low flow.

16) *Recommendation:* **Restore stream structure, process and function by developing riparian area condition**

Description: Accelerate the development of riparian area vegetative conditions by using standard silvicultural techniques (e.g. thinning overstocked stands and releasing suppressed conifers). Development of large living trees is intended to improve channel shade and lower bank stability. Riparian area species should consist of native locally adapted vegetation that represents the historic composition.

Objective: Increase lower bank stability (> 80%), provide stream shade (> 70 %) and provide a long-term source of large woody debris recruitment.

Location: In areas of poor lower bank stability (< 50%) and poor stream shade (< 40 %)

Timing: Beginning immediately

17) *Recommendation:* **Assess East Fork Dugan Falls landslide for restoration potential**

Description: Conduct a field investigation of the 1997 landslide which generated large volumes of sediment to significantly alter instream habitat and Washougal Hatchery operations.

Objective: Determine causal mechanism, develop a restoration plan to stabilize the stream and reduce further sediment input.

Location: East Fork Dugan Creek

Timing: Beginning immediately

18) Additional fish habitat management recommendations for Washougal Watershed are provided in the following table:

PATHWAYS:	Washougal subwatersheds											
	Headwaters Washougal	Bluebird/Silver	Upper. Washougal	Stebbins Creek	Mid. Washougal	Dugan Creek	Lower Washougal	Canyon Creek	Headwater West	Hagen Creek	Texas/ Wildboy	Lower West Fork
INDICATORS	14A	14B	14C	14D	14E	14F	14G	14H	14I	14J	14K	14L
Water Quality:												
Temperatures												
Sediment												
Chemical. Cond../Nut.												
Habitat Access:												
Physical Barriers	M	R	M	M	R	M	M	M	M	M	R	R
Habitat Elements:												
Substrate	U	U	U	U	U	U	U	U	U	U	U	U
Large Woody Debris	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF	NPF
Pool Frequency	U	R	U	U	U	U	U	U	U	U	U	U
Pool Quality	U	R	U	U	U	U	U	U	U	U	U	U
Off-channel Habitat	M	U	M	U	R	U	R	R	M	M	M	U
Refugia	U	U	U	U	U	U	U	U	U	U	U	U
Channel Cond. & Dynamics:												
Width/Depth Ratio	U	U	U	U	U	U	U	U	U	U	U	U
Stream bank Condition	U	U	U	U	U	U	R	U	U	U	U	U
Floodplain Connectivity	U	U	U	U	U	U	R	R	M	U	U	U
Flow/Hydrol:												
Peak/Base Flows												
Drainage Network Increases												
Watershed Conditions:												
Road Density & Location												
Disturbance History												
Riparian Reserves	R	R	R	R	R	R	R	R	R	R	R	R

Where: M = Maintain [3] existing fish habitat, R = Restore [2] existing condition and U = Unknown; existing condition may or may not warrant restoration, supporting evidence not available to make a recommendation.

REFERENCES

Allen, John E., 1984. *The Magnificent Gateway*. Timber Press, Forest Grove, Oregon.

Attwell, 1975. *Tahlkie Books*, Skamania, Washington.

Beckham, Stephen Dow, Rick Minor, Kathryn Toepel, and Jo Reese, 1988. Prehistory and History of the Columbia Gorge National Scenic Area, Oregon and Washington. Submitted to USDA Forest Service, Columbia Gorge National Scenic Area, Contract NO. 53-04HI-84730. Heritage Research Associates Report No. 75. Eugene.

Bonneville Power Administration (BPA) and 6 co-authors. 1992. Stock Summary Reports for Columbia River Anadromous Salmonids. Volume III: Washington Subbasins Below McNary Dam. Report DOE/BP-94402-3. In Connolly (1995).

Bonneville Power Administration (BPA). 1994. Draft Amendments to the 1994 Columbia Basin Fish and Wildlife Program. Portland, OR. In: Connolly (1995).

Boyd, Robert and Yvonne Hajda, 1987. Seasonal Population Movement Along the Lower Columbia River: The Social and Ecological Context. American Ethnologist 14 (2):309-326

Brereton, R. M., 1900. The Washougal Consolidated Copper Mining Claims. Descriptive Report. Manuscript on file at Washington State Department of Natural Resources, Division of Geology and Earth Sciences Library, Olympia, Washington.

Briley, Ann, 1986. The Lonely Pedestrian: Francis Marion Streamer. Ye Galleon Press.

Curtis, Edward S., 1911. The North American Indian. Volumes 7 and 8. The Plimpton Press, Norwood, Massachusetts.

Dawley, E.R. Lederwood, T. Llahm, and J. Jensen. 1982. Migrational characteristics of juvenile salmonids entering the Columbia River estuary in 1981. National Marine Fisheries Service.

Dodge, Nicholas, 1987. Silver Star Mountain. A Short History and Plant List. The Mazamas, Portland, Oregon.

Fagan, John, Jo Reese and David DeLyria, 1991. Archaeological Study of the Camas Meadows Development Project, Clark County, Washington. Report to Vanport Manufacturing, Inc. Archaeological Investigations Northwest, Inc., Report No. 10. Portland, Oregon.

Filloon, Ray, 1952. Huckleberry Pilgrimage. Pacific Discovery 5(3):4-13.

French, David, 1965 Ethnobotany of the Pacific Northwest Indians. Economic Botany 19:378-382.

Hajda, Yvonne, 1988. Southwestern Coast Salish. In Handbook of North American Indians. Volume 7. Edited by W. Suttles, pp. 503-517. Smithsonian Institution, Washington.

Hajda, Yvonne, David Ellis, John Fagan, Douglas Wilson, and Bonnie Mills, 1995. Ethnographic Sites of the Gifford Pinchot National Forest, Washington. Archaeological Investigations Northwest, Inc. Report NO. 59. Submitted to Gifford Pinchot National Forest, Vancouver, Washington.

Hastings, W. G., 1915. Land Classification of the Columbia National Forest, Washington 1914-1915. Report to the Secretary of Agricutlure, May 14, 1915. Report on file, Gifford Pinchot National Forest, Vancouver, Washington.

Hines, Donald, 1991. Magic in the Mountains, the Yakima Shaman: Power and Practice. Great Eagle Publishing, Issaquah.

Howell, P. J. , K. Jones, D. Scarnecchia, L. LaVoy, W. Kendra, and D. Ortmann. 1985. Stock Assessment of Columbia River Anadromous Salmonids, Volumes I and II. Final Report of Oregon Department of Fish and Wildlife, Washington Department of Fisheries, Washington Department of Game and Idaho Department of Fish and Game (Project 83-335, Contract DE – AI79 – 84BP12737) to Bonneville Power Administration, Portland Oregon.

Hughes, Richard E., 1990. Letter Report to Grady Caulk, District Archaeologist, Wind River Ranger District, dated April 23, 1990 detailing results of x-ray fluorescence analysis of obsidian specimens.

Hunn, Eugene, 1988. Nch'I Wana "The Big River" – Mid Columbia Indians and Their Land. University of Washington Press, Seattle.

Huntress, Betty, 1952. Baffling Indian Pits Line Columbia river. The Sunday Oregonian Magazine, February 17, 1952, pp.2-3.

Johnson Meninick, personal communication to Cheryl Mack, 1993

Mains, Catie, personal communication to Bengt Coffin, August, 1999

Manuwal, David A. and Scott Pearson, 1997. Wildlife Use of Managed Forests: A Landscape Perspective. Timber Fish & Wildlife, TFW-WL4-98-002.

Martin, Virginia Beavert, 1979. Summary of Yakima Indian Treaty Relations, and Use of the Gifford Pinchot National Forest. Report on File at Mt. Adams Ranger District.

McClure, Richard and Cheryl Mack, 1995. The Silver Star Spring Archaeological Site (45SA309), Test Excavations and Significance Evaluation. Gifford Pinchot National Forest Heritage Program, Vancouver, Washington.

Moulton, Gary, 1986. The Journals of the Lewis and Clark Expedition, July 28 – November 1, 1805. University of Nebraska Press. Lincoln, Nebraska.

Musil, Robert, 1988. Archaeological Testing at the Dwyer Creek Site (45CL405), Clark County, Washington. Report to Vanport Manufacturing Inc. Heritage Research Associates Report No. 116.

Nehlsen, W., Williams, J. E., and J. A. Lichatowich. 1992. Pacific Salmon at the Crossroads: Stocks at Risk from California, Oregon, Idaho, and Washington. *Fisheries*, 16(2):4-21.

Nelson, Margaret A., 1988. Cultural Resource Survey, Silver Star Trails Project, Skamania County, Washington. Report prepared for Wind Rver Ranger District, Gifford Pinchot National Forest, Contract No. 43-053-2-0873, Northwest Archaeological Associates, Inc., Seattle.

Parsons, M..E., 1982. Across Rushing Waters. Published by POST-RECORD, Camas, WA.

Plummer, F., 1900. *Mount Rainier Forest Reserve, Washington. Twenty-first Annual Report of the United States Geological Survey, Part V.* Document No. 5, 56th Congress, 2nd Session.

Rawding, D. 1999. DRAFT Preliminary Life History Trajectories and Classification of Key Habitat for Wild Summer Steelhead (Oncorhynchus Mykiss) In the Wind River Basin. Washington Department of Fish and Wildlife, Fish Program.

Ray, Verne, 1939. Cultural Relations in the Plateau of North America. Publications of the F. W. Hodge Anniversary Publication Fund 3. The Southwest Museum, Los Angeles.

Ray, Verne, 1942. Cultural Element Distributions: XXII, Plateau. University of California Anthropological Records 8:99-258.

Saleeby, Becky, 1983. Zooarchaeological Indicators of Seasonality: Six Portland Basin Sites. In Contributions to the Archaeology of Oregon, 1981-1982. Edited by D. E. Dumond, pp. 57-65. Association of Oregon Archaeologists. Occasional Papers 2. Portland.

Schuster, Helen, 1975. Yakima Indian Traditionalism: A Study in Continuity and Change. Ph.D. Dissertation, Department of Anthropology, University of Washington, Seattle.

Shepeard, Ross, 1936. Memorandum of February 25, 1936 from District Ranger Ross Shepeard to Richard Bottcher. Document on file at Wind River Ranger District, Carson, Washington.

Skamania County Pioneer, 1929. News article titled *"Fires Take Heavy Toll"*, November 1, 1929.

Spier, Leslie and Edward Sapir, 1930. Wishram Ethnography. University of Washington Publications in Anthropology 3(3):151-300.

Stabler, H. O., 1910. Special Fire Report of 1910, Columbia National Forest. November 5, 1910. Manuscript on File at Mt. Adams Ranger District, Trout Lake, Washington.

Turner, Nancy, Laurence Thompson, M. Terry Thompson, Annie Z. York, 1990. Thompson Ethnobotany. Royal British Columbia Museum, Memoir No. 3. Victoria.

USDA-Forest Service, 1996 *Woodward Creek Stream Survey* (Col. River Gorge National Scenic Area).

USDA-Forest Service, 1993. *A First Approximation of Ecosystem Health*. Regional Ecosystem Assessment Project, Pacific Northwest Region. Portland, Oregon.

Washington Department of Fisheries. 1990 Washougal River Subbasin, salmon and Steelhead Production Plan.

Washington Department of Fish and Wildlife. 1997. Final Environmental Impact Statement for the Wild Salmonid Policy. Washington Department of Fish and Wildlife. Olympia, WA.

Washington Department of Fish and Wildlife. 1998. Fishing in Washington. Washington Department of Fish and Wildlife, Tumwater, WA.

Washington Department of Fish and Wildlife. 1997. Final Environmental Impact Statement for the Wild Salmonid Policy. Washington Department of Fish and Wildlife. Olympia, WA.

William Yallup and Johnson Meninick, pers. comm. to Cheryl Mack, 1993

Woodward, John, 1994. Report on Testing Phase of 45CL428, a Paleoindian Site Near Camas, Washington. Report to V&L Homes. Woodward and Associates Report No. 94-11.

Aquatics Synthesis Table

Subwatershed	Threshold	A	B	C	D	E	F	G	H	I	J	K	L	14	17	9	10
		Hdwtrs	Bluebird	Upper	Stebbins	Middle	Dougan	Lower	Canyon	Hdwtrs	Hagen	Texas	Lower	Entire			
Name		Washou	Silver Cr	Washou	Creek	Washou	Creek	Washou	Creek	West Fk	Creek	Wildboy	West Fk	Wshed	Rock	Wind	LWS
Acres		4534	3393	7736	5342	7030	3550	9445	3149	5235	3526	5087	5216	63242	27277	143502	86462
Hydrology																	
% in ROS		79%	65%	91%	62%	56%	68%	31%	15%	66%	73%	37%	10%	54%	63%	70%	69%
% Hydrologically Mature	<75%	71%	78%	81%	80%	75%	75%	53%	45%	47%	63%	54%	64%	66%	83 (ARP)	86 (ARP)	81 (ARP)
Road Density	>3	1.2	0.2	1.0	1.8	2.1	1.6	3.4	2.5	1.6	1.1	2.6	2.9	2.0	2.9	2.6	2.8
Drainage Density Incr.		10%	1%	7%	13%	19%	13%	52%	35%	16%	12%	30%	39%	19%	22%	29%	
Water Quality																	
Max Temp	>18C	nd	nd	nd	nd	nd	nd	26	nd	nd	nd	nd	nd	nd	21	25	20
% RR in Early Seral	>30%	35%	18%	17%	18%	21%	28%	43%	43%	51%	26%	48%	30%	29%	28%	8%	21%
Strm Xing Density		1.4	0.4	5.2	5.8	4.6	5.9	5.1	2.6	3.5	2.5	7.5	4.3	4.4	7.8	5.8	5.4
Stream Channels																	
% RR in Late Seral	<23%	1%	3%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	16%		20%
Stream Xing Freq		0.2	0.0	0.6	0.8	0.7	0.8	1.3	0.7	0.7	0.5	1.5	1.0	0.7	1		
Fisheries																	
Resident Fish		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			
Anadromous Fish		Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y			
Key Spawning Habitat		N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			
Spawning Hab. Conds	P	F	P	G	F	F	F	F	F	F	F	P	G	F			
Rearing Habitat Conds	P	F	F	F	F	F	F	F	F	F	F	P	F	F			
Adult Holding Conds	P	F	F	F	F	F	F	F	F	F	F	P	F	F			

Nd = no data

Columns at far right show comparison of variables with other nearby watersheds where data is available.

Terrestrial Synthesis Table

Subwatershed	Threshold	A	B	C	D	E	F	G	H	I	J	K	L	14	17	9	10
		Hdwtrs	Bluebird	Upper	Stebbins	Middle	Dougan	Lower	Canyon	Hdwtrs	Hagen	Texas	Lower	Entire			
Name		Washou	Silver Cr	Washou	Creek	Washou	Creek	Washou	Creek	West Fk	Creek	Wildboy	West Fk	Wshed	Rock	Wind	LWS
Acres		4534	3393	7736	5342	7030	3550	9445	3149	5235	3526	5087	5216	63242	27277	143502	86462
Geology/Soils																	
Mass Wasting		0%	1%	0%	0%	1%	0%	6%	0%	0%	0%	0%	0%				
Potentially Unstable Soil		2%	17%	nd	nd	nd	nd	nd	nd	19%	2%	nd	nd				
Vegetation																	
% Non Forest		4%	15%	1%	8%	6%	33%	11%	19%	28%	2%	24%	6%	12%			
% Early Seral		29%	22%	19%	20%	25%	25%	47%	55%	53%	37%	46%	36%	34%			
% Mid Seral		65%	60%	81%	72%	70%	41%	42%	27%	19%	60%	31%	58%	54%			
% Late Seral		0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%			
Wildlife																	
Spotted Owl Activity Ctr		0	0	1	0	1	0	0	0	0	0	1	0		9	31	12
% Area in HCP		34%	47%	86%	67%	67%	47%	25%	5%	0%	0%	19%	9%	37%	55%	5%	5%
% Owl Suitable (Forage)		65%	60%	81%	72%	70%	41%	42%	27%	19%	60%	31%	58%	54%			
Human Uses																	
Acres Matrix (FS only)		2176	0	0	0	0	0	0	0	0	0	0	0	2176			

Nd = no data

Columns at far right show comparison of variables with other nearby watersheds where data is available.