# Ecola Creek Watershed Assessment: A Living Document

**By**

**Shelley Parker**

**&**

**The Ecola Creek Watershed Council**

Jerome Arnold

Jim Closson

Tevis Dooley Jr.

Mike Jackson, PhD.

Ed Johnson

Scott Marlega

and

Jan Siebert-Wahrmund

May, 2001

Special Thanks to the following people and groups for contributing to the project:

We would like to thank the Oregon Watershed Enhancement Board for financing the project and granting the extensions needed to complete the project; Oregon Department of Fish and Wildlife fish biologist Chris Knutsen, who helped write the assessment grant; Jim Closson, Watershed Coordinator for Clatsop County who helped write the assessment grant, along with assist the assessment and the development of GIS maps; Willamette Industries for their resources, participation and contribution to the assessment; the City of Cannon Beach for contributing innumerable resources including an office space, access to office supplies and technical support of employees; the Columbia River Estuary Study Taskforce for the GIS resources, technical support and publishing skills of Matt VanEss; the various offices and divisions of the Oregon Department of Fish and Wildlife for technical support; and Todd Cullison, Watershed Coordinator for Clatsop County for assistance in publishing the assessment. Other groups which contributed to the project include:

Cannon Beach Historical Society
Clatsop County Historical Society
Clatsop County Soil and Water Conservation
Oregon Department of Forestry
Oregon Department of Environmental Quality
Oregon Department of Water Resources
Oregon Division of State Lands

We would also like to thank the following reviewers who gave their valuable insight and time:

Jerome Arnold
Rainmar Bartl
Tevis Dooley Jr.
Dan Elek
Cruz Flores
Mike Jackson, PhD.
Ed Johnson
Michele Long
Scott Marlega
Steve McNulty
Mark Morgans
Joe Sheahan
Leslie Stewart
Bob Teagle

## TABLE OF CONTENTS

# CHAPTER 1 INTRODUCTION

## 1.1 The Ecola Creek Watershed Council

Ecola Creek Watershed Council Mission Statement:

> *The Ecola Creek Watershed Council is a group of interested citizens, agencies, and property owners that serves the purpose of gathering and dissemination relevant information pertaining to the condition of the watershed. The council will provide a public forum for discussion and conduct the planning and implementation of meaningful activities related to watershed conservation.*

The Ecola Creek Watershed Council (ECWC) was formed in 1997 and Clastop County commissioners officially designated the council on August 5, 1997. The council is comprised of interested private citizens, landowners, and representatives from natural resource agencies, private timber industry, special districts, and the City of Cannon Beach. All ECWC meetings are open to the public. The organizational structure consists of a steering committee that brings issues before the entire watershed council. All decisions are made by consensus at general meetings of the council. The ECWC has no regulatory authority.

## 1.2 Purpose and Scope

The purpose of the watershed assessment is to collect the most current available information about the Ecola Creek watershed and to characterize its condition. It is a process for evaluating how well a watershed is working and includes examining historical impacts, describing features and evaluating various resources within the watershed. More specifically, a watershed assessment makes it possible to determine which features and processes in the watershed are working well and which are not. It does not give us site-specific prescriptions for remedying problems, but it should enable the development of an action plan and monitoring strategy for conserving and improving fish habitat and water quality.

The watershed assessment is a working document and will be subject to continual updates and additions as time goes by and more information is gathered and analyzed. It was conducted following the guidelines contained in the Oregon Watershed Assessment Manual

(OWAM) developed for the Governor's Watershed Enhancement Board (GWEB) by the Watershed Professionals Network (WPN, January 1999). The OWAM was designed to be used by local citizen groups such as watershed councils and soil and water conservation groups, along with the assistance from technical experts. A Project Manager was employed to complete the assessment utilizing volunteer assistance from the Ecola Creek Watershed Council and community when possible. During the course of this assessment, a revised draft manual was released and new methodologies were incorporated where possible (WPN, June 1999).

Water quality and fisheries are important aquatic resources that are evaluated as a fundamental expression of healthy watersheds in the OWAM. Water quality is a result of natural watershed processes and human activities at a particular site on a stream or river. Different criteria are used to measure water quality depending upon the uses of water for a particular stream. Water quality criteria provide a warning system when activities in a watershed are limiting the uses of water.

The most widespread group of fish in the state are salmonids. Salmonids are a class of fish that include salmon, trout and char are best recognized as indicators of watershed health. This is because salmonids have particular habitat and water quality requirements, with some species more specific than others. While the assessment focuses on the health of salmonid populations and does not evaluate the status of other species within the watershed, good habitat and water quality conditions for salmonids usually conveys good conditions for other species.

In order to focus their efforts in the assessment process the ECWC developed several goals and objectives to be met; they are summarized below.

Goal 1. Provide the basis for prioritizing where to protect and enhance water quality, protect and maintain diversity of fish and wildlife habitat and native vegetation throughout the watershed.

Objective 1. Gather and summarize all existing data and reports concerning the Ecola Creek watershed on the following topics:

- The condition of fish and wildlife habitat in the streams, riparian areas, uplands, and the estuary.
- The status of fish populations.
- The water quality and water quantity of Ecola Creek.
- The effect of timber management and roads on water quality and fish resources.
- The effect of urbanization on the watershed.

Objective 2. Identify data gaps in the current existing information and prioritize actions to fill them.

Objective 3. Identify factors limiting fish resources and water quality in the Ecola Creek watershed.

- Design an action plan to address critical issues.
- Determine the most current, scientifically approved and effective, as well as economically and socially acceptable methods for treating the limiting factors.

Goal 2. Increase public involvement and education.

Objective 1. Facilitate partnerships between local citizens, public agencies and private companies.

Objective 2. Present assessment findings and the Ecola Creek Watershed Council action plan to the public.

**1.3 Geographical Information System**

Geographical Information Systems (GIS) is a computer system designed for storage, manipulation, and presentation of geographical information such as topography, elevation, streams, roads, etc. The assessment initially used GIS to create a base map to facilitate a manual assessment. Later, GIS became available for mapping and the hard copy maps were digitized by the Columbia River Estuary Study Taskforce (CREST). GIS data is increasingly used to evaluate watershed conditions and guide appropriate restoration activities, but the data are only as accurate as their scale and source data (referred to as metadata). GIS data must be field examined to assure an accurate representation of on-the-ground conditions in a watershed. GIS data layers that were used in the development of this assessment are described below. Layers will be updated or modified as more information id collected.

Streams (1:12,000): Stream coverage was obtained from the Clatsop County GIS coordinator. Streams were digitized at 1:12,000 from 1994 aerial photography for Clatsop County. A visual check of the stream coverage demonstrated that they match the United States Geological Survey (USGS) quadrangles in all but a few locations.

Channel Habitat Types (1:24,000): Channel Habitat Types (CHTs) were mapped on USGS 7.5-minute topographic maps by the ECWC based upon gradient, side slope constraint, and order. The information was digitized by CREST and attributed to the 1:12,000 Clatsop County stream layer.

Zoning: There is no metadata associated with this layer. This coverage was provided by CREST and is believed to be the most up-to-date zoning coverage for Clatsop County. The coverage is currently being updated.

Watershed Boundaries (1:12,000): Watershed boundary coverage was obtained from the Clatsop County GIS streams data and adjustments were made by CREST to reflect the Ecola Creek watershed. Subwatershed boundaries were delineated by the Ecola Creek Watershed Council based on USGS 7.5-minute topographic drainage patterns and digitized by CREST attributed to the 1:12,000 watershed boundary layer based on the Clatsop County streams data.

Roads (1:12,000): Data on roads was obtained from the Clatsop County GIS data. A comparison with USGS 7.5-minute topographic maps and field visits demonstrated that the data set appears to represents the roads in the watershed accurately. In addition, the roads layer was updated by Willamette Industries to identify the decommissioned roads on their property.

Potential Large Woody Debris Recruitment (1:24,000): This layer was digitized from a 1:24,000 Willamette Industries map attributed onto the 1:12,000 Clatsop County stream layer by CREST. The Large Woody Debris (LWD) recruitment information was part of the riparian function component of the Ecola Creek Watershed Analysis conducted by Western Watershed Analysts for Cavenham Forest Industries Division of Hanson Natural Resources

Company in 1995. Willamette Industries bought Hanson Natural Resource Company's land in 1996.

Salmonid Distribution (1:100,000): Salmonid distribution coverages were obtained from the Oregon Department of Fish and Wildlife (ODFW), but were not used with the assessment due to their incompatibility with the stream layer, inaccuracies and limited scope in the watershed. ODFW mapped current salmonid distribution by attributing 1:100,000 stream coverage based on survey data and best professional judgement of local fish biologists. The data on Ecola only convey distribution on the mainstem, West and North Fork of Ecola Creek. For this reason, Oregon Department of Forestry Presence/Absence maps based upon USGS 7.5 Minute topographic maps were digitized by CREST and used to convey fish distribution. StreamNet is also working on digitizing ODF's Fish Presence/Absence data. The Oregon Department of Fish and Wildlife (ODFW) is also working on a new 1:24,000 stream layer for it's databases. The ODFW GIS data is available on the ODFW website at http://www.dfs.state.or.us.

ODFW Habitat Surveys (1:100,000): Two data layers from field surveys of stream channel conditions by ODFW were attributed to 1:100,000 scale stream layers. A reach level data layer gives an overview of current habitat conditions based upon habitat unit data from the field surveys. Reach level data can be used as a reference point for later comparative work or for the analysis of overall stream conditions. A Habitat data layer includes all of the habitat unit data from the field surveys and is a representation of the condition of the stream at the time of the survey.

National Wetlands Inventory (1:24,000): The primary source for wetland information used in this assessment was the Cannon Beach Local Wetland Inventory (CBLWI) which is not currently mapped digitally (Fishman Environmental Services, 1993). In addition, maps of the National Wetlands Inventory (NWI) created by the United States Fish and Wildlife Service and field observations were used and are the only wetland information conveyed digitally for this assessment at this time. It is important to note that NWI maps are based on aerial photo interpretation and not on ground-based inventories of wetlands. On-the-ground inventories of wetlands often find extensive wetlands that are not included on the NWI maps.

## 1.4 Geographic Setting

The Ecola Creek watershed is a fifth field watershed located in the southwest corner of Clatsop County (821.88 square miles) on the northern coast of Oregon, 80 miles west of Portland. [1] Ecola Creek drains a watershed of approximately 22 square miles directly into the Pacific Ocean, passing through the town of Cannon Beach. The entire basin lies within six miles of the Pacific Ocean and the maximum elevation is 3,075 feet along the ridge of mountains in the southwestern border of the watershed. Onion Peak is just southeast of this ridge standing at an elevation of 3,065 feet. Elevations along the eastern boundary of the watershed vary widely, but generally lie within 1500 to 2000 foot range (WWA, 1995).

The assessment focuses on the mainstem of Ecola Creek and its two forks: the North Fork Ecola Creek and the West Fork Ecola Creek. The watershed was divided into three subwatersheds for ease in evaluating several of the assessment components. The three subwatersheds are the Lower Ecola subwatershed, the West Fork subwatershed and the North Fork subwatershed (Figure 1.1). The subwatershed delineations were inspired by the natural drainages of the mainstem Ecola Creek, West Fork Ecola Creek and North Fork Ecola Creek respectively.

Tributaries to Ecola Creek that were included in the assessment are presented in Figure 1.2. The name Swigart Creek is the unofficial name used throughout the assessment for the unnamed tributary whose confluence with the mainstem of Ecola Creek is just east of the Elm Street bridge on the north bank. Most tributaries are unnamed in the watershed and designating names for the creeks could be the focus of a future ECWC project. In addition, Trib 2 is incorrectly mapped. The tributary flows north by northwest and semi-parallel to Ecola Creek to combine with Trib 1. The combined waters of Tribs 1 and 2 empty into the mainstem of Ecola Creek approximately 3/4 of a mile downstream from where Trib 2 is shown to flow into Ecola Creek on the map. Channel meandering of this nature is common in low gradient, unconstrained areas.

[1] Fifth field watershed refers to the USGS delineated watersheds throughout the United States describing both the hierarchy of watersheds and their relative size (WPN 1999).

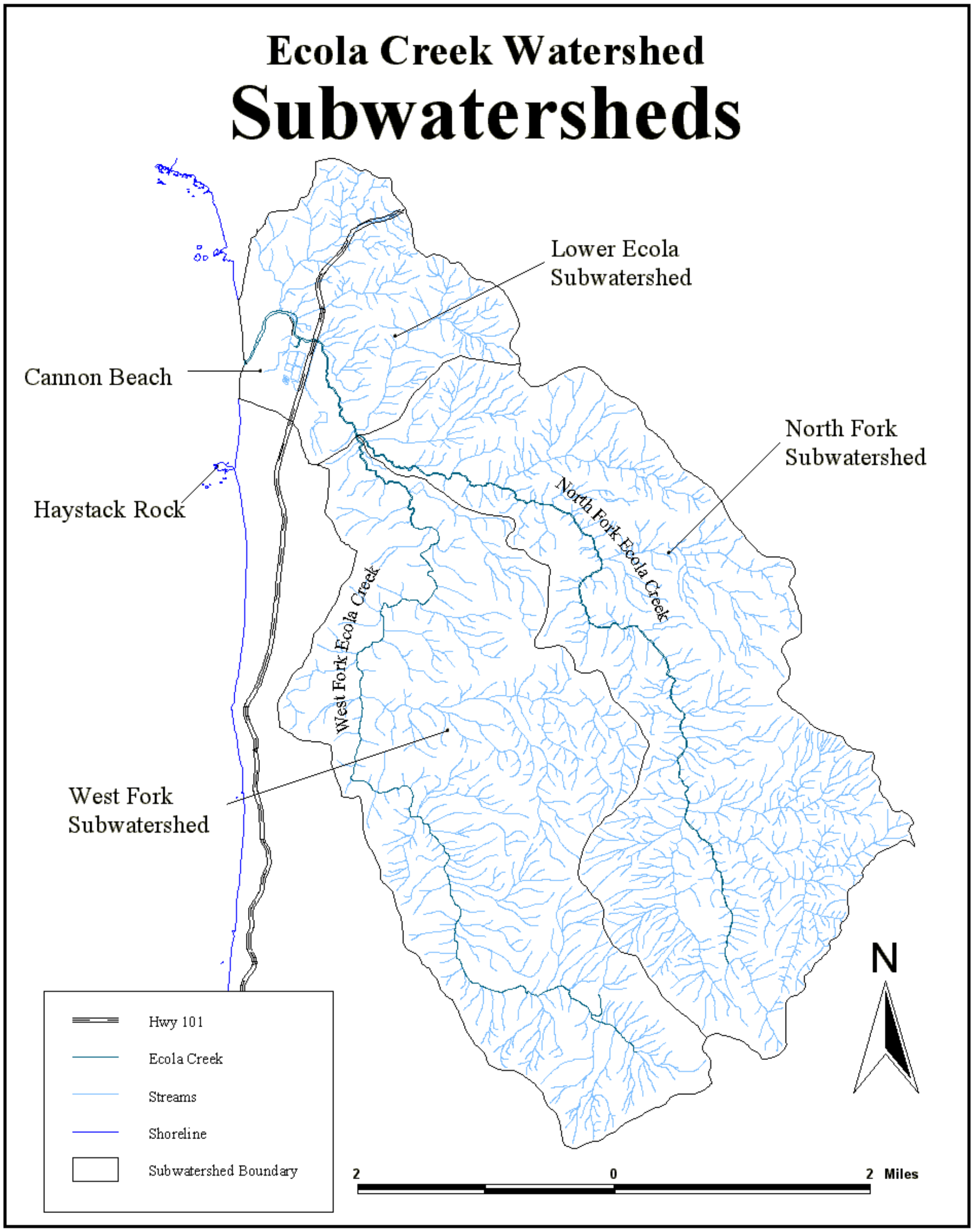



Figure 1.1 The three subwatersheds in the Ecola Creek basin: Lower Ecola, West Fork and North Fork subwatersheds. Also illustrated are major landmarks in the region.

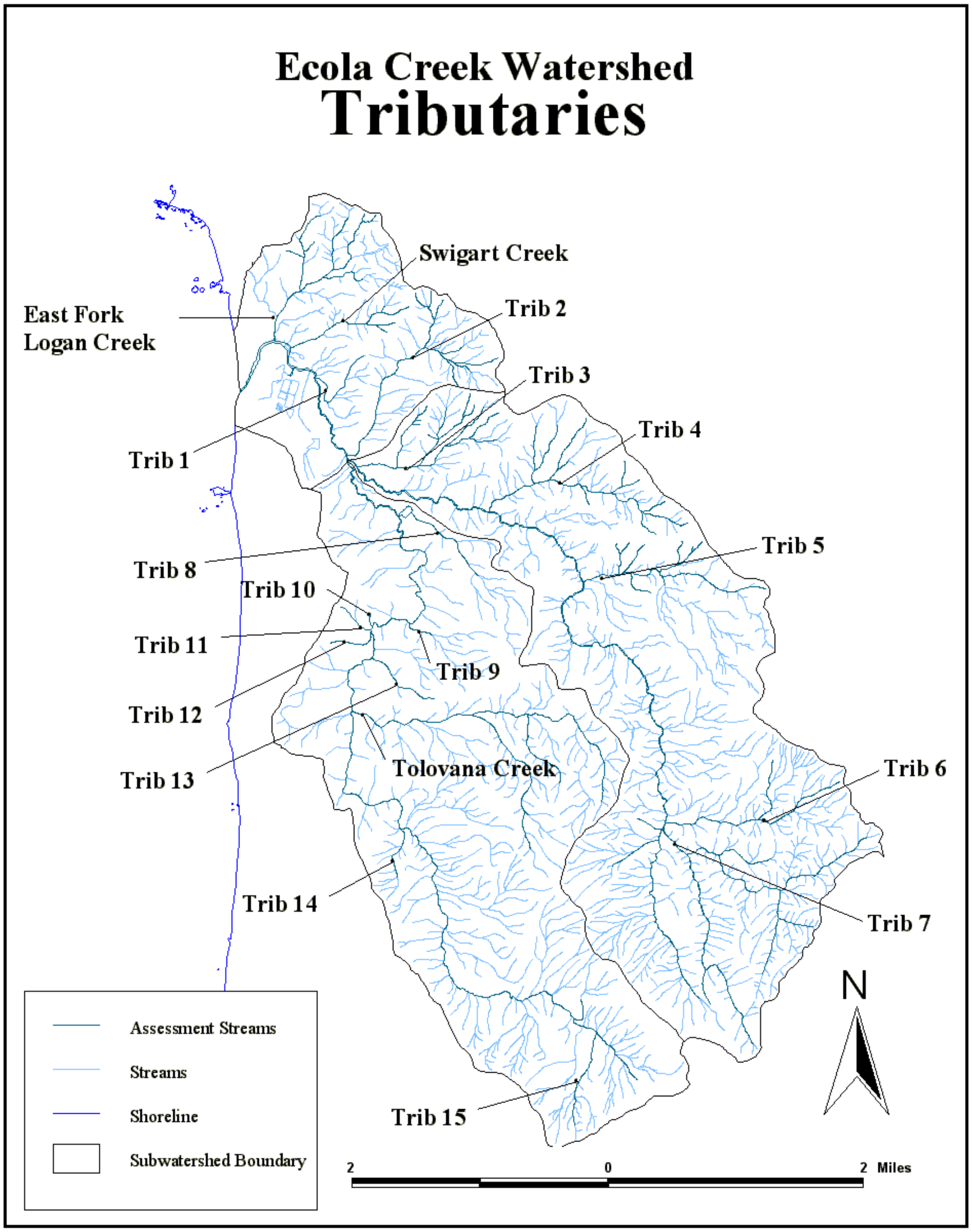



Figure 1.2 Tributaries included in the Ecola Creek watershed assessment.

## 1.5 Ecoregion

The State of Oregon is divided into ecoregions based on such characteristics as climate, geology, physiography, vegetation, soils, land use, wildlife and hydrology. These characteristics work over time to form consistent ecosystem patterns over geographic areas. Each ecosystem has characteristic disturbance regimes that shape the form and function of watersheds in the region. Ecoregions within the Ecola Creek watershed are the Coastal Lowlands, the Coastal Uplands and the Volcanics ecoregions (OWAM, January 1999). More information is available concerning ecoregions (Omernik and Gallant, 1986 and Pater et al. 1998 in OWAM).

The Coastal Lowlands are low gradient depositional areas of the coastal fringe from Gold Beach in the south to Seaside in the north. Stream gradients are low and often meander and can be greatly influenced by the tide. Soils range from deep silty clay loams to sand and the geology is alluvial deposits on low terraces or spits of wind-blown sand. Erosion rates are low due to the low gradient.

The Volcanics ecoregion comprises most of the upland area of the Ecola Creek watershed that drains to the lowlands. It extends from Cannon Beach in the north to Florence in the south and occurs in discrete blocks from the ocean up to 60 miles inland. Streams are moderate gradient with steep gradients occurring in headwater streams. Soils are gravelly silt loam in lower gradient areas to very gravelly loam in steep areas.

Geology is volcanic and includes basalt flows, dikes and sills and concreted basalt materials. Erosion rates are high due to abundant precipitation, high uplift rates, steep slopes, fractured rock, and frequent landslides. Landslides are usually shallow often triggering debris slides and occur in steep headwater channels. Debris slides are capable of traveling long distances.

The Coastal Upland ecoregion extends along the Oregon coast from Astoria to Brookings and is characterized by watersheds with high stream density and low gradient, large and medium size streams (and some small streams). Headwaters are small streams often with steep gradients and bordered by steep slopes. Geology is weak sandstone and soils are mostly deep silt loam. Erosion rates are high due to abundant precipitation, high uplift rates, steep slopes, weak rock, and frequent landslides. Landslides are deep-seated earth flows in lower gradient areas or shallow landslides in steep headwater channels.

Runoff for all three ecoregions is high and non-uniform in the late fall to early spring during rain storms, especially when snow is on the ground. Peak streamflows occur in the winter months and because snowpack development is minimal (only during unusual storm events), the peak flow generating process for the watershed is rainfall. Peak flows from rain events average 150 to 200 cubic feet per second (cfs) per square mile in lowland areas and average 200 to 300 cfs per square mile in volcanic areas. Ecola Creek peak flows average 400 cfs per square mile due to its high elevations and close proximity to the ocean according to Oregon Department of Forestry 50-year peak flow estimates and the OWAM (WPN, January1999).

In the Volcanics and Coastal Uplands ecoregions, riparian areas are typically characterized by a hardwood zone immediately adjacent to the stream and a conifer zone located outside of the hardwood zone. Conifer regeneration in the riparian area is common, especially if an organic substrate exists for hemlock and spruce seed regeneration. Competition from non-conifers can be intense, especially where salmonberry, huckleberry and alder become established. The lowland riparian areas typically have Sitka spruce and willows and beaver activity is common.

Common trees and shrubs found in all three ecoregions include Sitka spruce (*Picea sitchensis*), western hemlock (*Tsuga heterophylla*), western red cedar (*Thuja plicata*), grand fir (*Abies grandis*), Douglas-fir (*Pseudotsuga menziesii*), red alder (*Alnus rubra*), vine maple (*Acer circinatum*), salmonberry (*Rubus ursinus*), huckleberry (*Vaccinium sp*.), salal (*Gaultheria shallon*) and Oregon grape (*Berberis nervousa*; Franklin and Dyrness, 1973).

## 1.6 Topography and Climate

The Ecola Creek watershed is a north to northwest facing drainage with headwaters that drain steep and mountainous narrow valleys, often breaking abruptly to more gentle slopes below (Figure 1.3). The West Fork and North Fork of Ecola Creek converge approximately 1.4 stream miles above Highway 101 in a large valley bottom and floodplain and drain to the sea.

The climate of the Ecola Creek watershed is mild with wet winters and cool, dry summers. The daily average high temperature in summer is 67° F and the daily average low in winter is 37° F. Annual precipitation varies from an average of 80 inches in the lowlands to well over

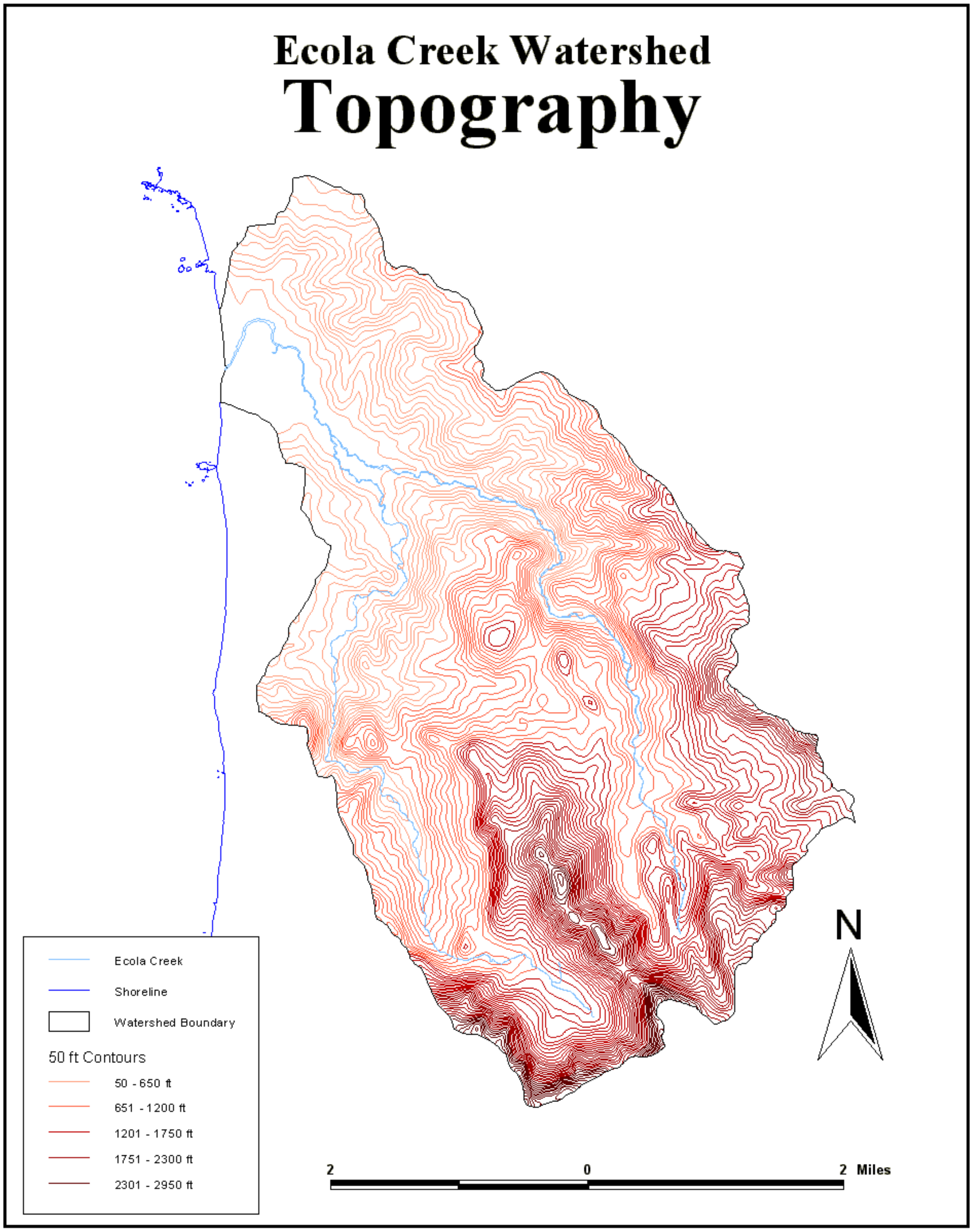



Figure 1.3 50 foot contours illustrating the steep terrain in the Ecola Creek watershed.

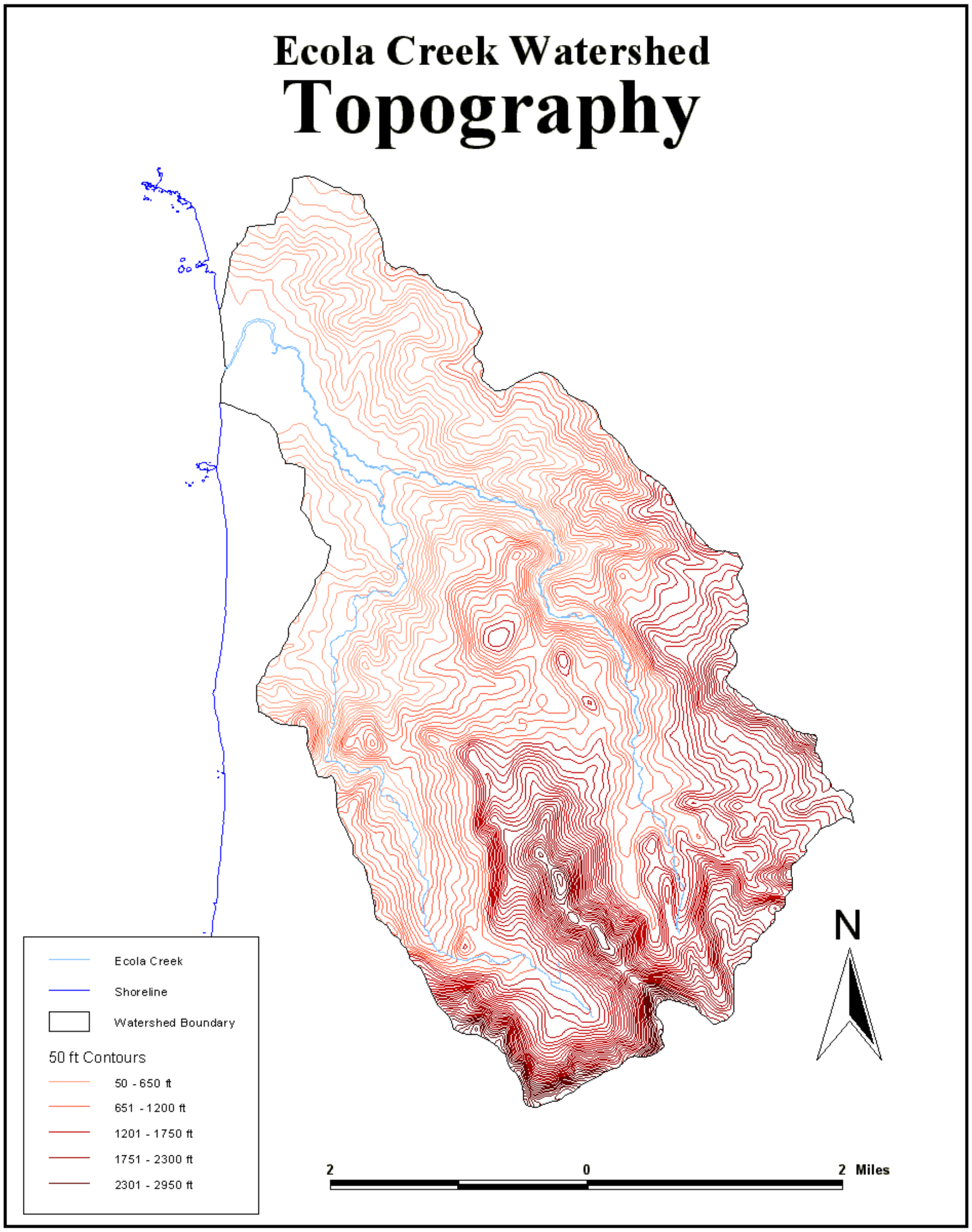



Figure 1.3 50 foot contours illustrating the steep terrain in the Ecola Creek watershed.

100 inches in the uplands. Coastal northwest Oregon has some of the highest annual rainfall in the state, with most occurring between October to April and averaging only six inches from July through September. Rainfall can be heavy and severe. Snowfall accumulation is infrequent except in the highest elevations during unusual storms which bring very cold, moist air to the region.

High winds often accompany winter rainstorms on the Oregon Coast and are generally from the southwest with gusts in excess of 100 miles per hour having been recorded nearly every year. Extreme windstorms capable of toppling large swaths of trees occur about every 35 to 100 years (WPN 1999).

Streamflow for Ecola Creek relates directly to the watershed precipitation pattern, which is typical of many coastal streams; high flows occur during October through April and low flows occur from July through September. Because of the steep stream gradient, Ecola Creek rises quickly following periods of heavy rain.

## 1.7 Human Impacts and Features in the Watershed

Zoning in the Ecola Creek watershed is presented in Figure 1.4. Forestry is the major land use in the watershed and is represented by zone F-80. Commercial forestlands include 12,255 acres owned by Willamette Industries, 957 acres owned by the Oregon Department of Forestry and 25 acres owned by Longview Fiber (Willamette Industries-Watershed Statistics). The town of Cannon Beach is the only developed area in the Ecola Creek watershed. Urban areas within the watershed comprise the north end of Cannon Beach, including the main business district, and cover an area of approximately 297 acres (ECWC-grid method).

### 1.7.1. Industrial Forestry

Since its commencement in the early 1900's, industrial forestry has had an impact on virtually every feature in the watershed. With industrial forests extending over 95 percent of the watershed, past logging practices and their network of supporting roads is thought to have contributed disproportionately to turbidity and the accretion of silt in the lower reaches of the creek. In addition, logging practices in the past cleared vast areas of forest of virtually all merchantable timber without regard to wildlife habitats, riparian areas and streams. The most significant change in macro vegetation in the watershed has been the conversion of a landscape dominated by late-seral (mature, old growth) conifer forests to younger (grass-herb,

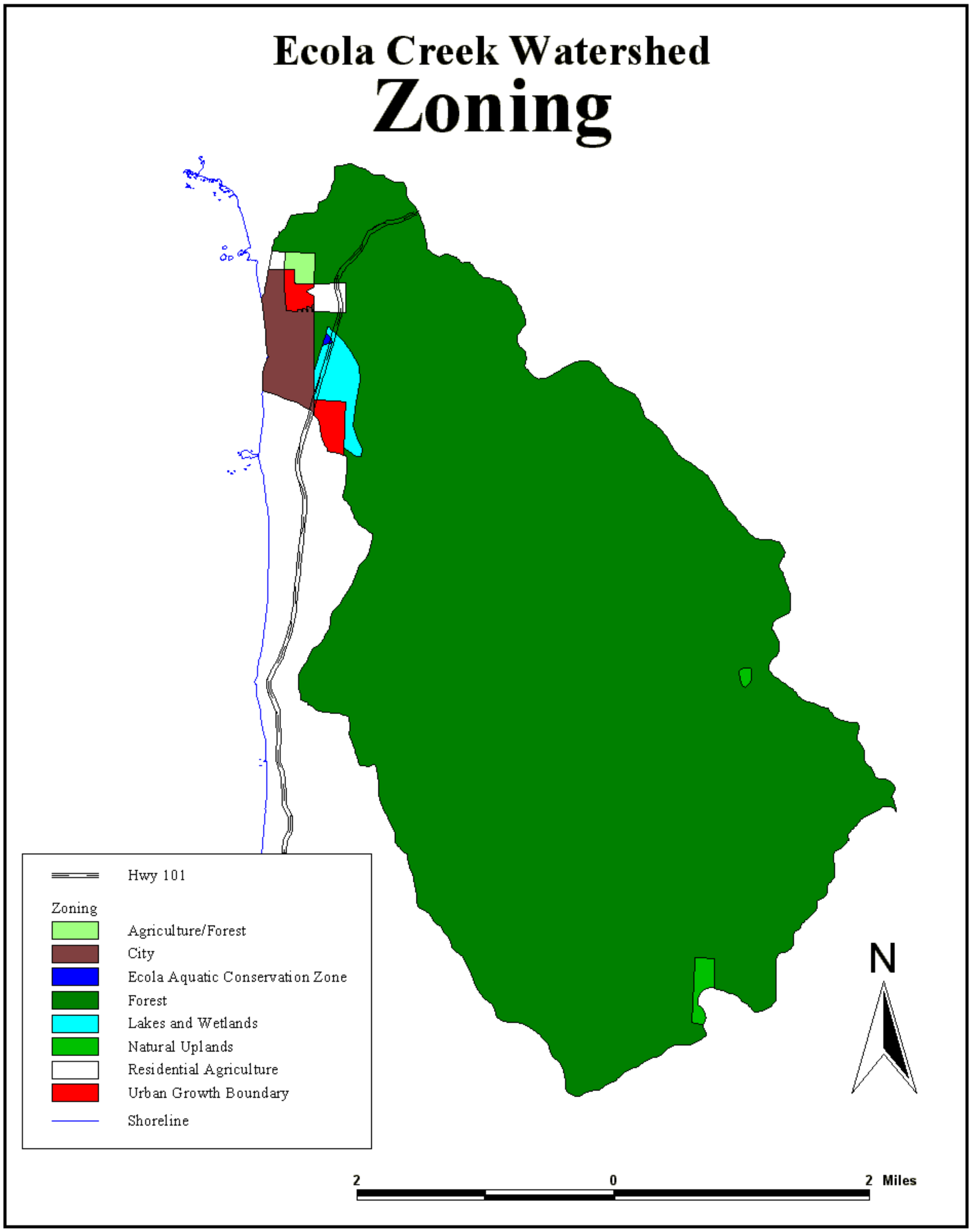



Figure 1. 4 Zoning in the Ecola Creek watershed.

shrub, and small conifer) forests as a result of clear-cut timber harvesting. Harvested areas regenerated naturally or methods of seed trees and seed blocks were used until 1963 when Crown Zellerbach purchased the watershed. Forest regeneration practices employed by Crown Zellerbach were aerial seeding and hand planting, the latter method utilized by Willamette today.

Gradual realization of the effects of logging practices resulted in the adoption of harvesting regulations, road building standards and methods that greatly reduce habitat degradation. Improperly placed roads are now being reconstructed or decommissioned and allowed to revert to the natural landscape. Culverts of inadequate capacity or that are impediments to fish passage are being replaced. Stream temperatures dangerous to fish are now more controllable because streamside logging buffers provide needed shade for the stream where cutting was once allowed. In time, the riparian buffers will also be a source of large woody debris for the streams, contributing to the formation of deep pools and providing fish with holding areas and places of refuge from predators.

### 1.7.2. Recreation

From western man's earliest arrival he has intimately relied upon the watershed. In early times subsistence hunting was the dominant need, but with the easing of lifestyles, angling, hiking, hunting and gathering satisfied recreational desires. In recent years the extensive network of industrial forest roads provided easy public access to the watershed which the landowners allowed almost without constraint until the public's abuse of the privilege. The abuses resulted, with exceptions, in forest road closure to motorized vehicles in 1989.

### 1.7.3. Urbanization

Although approximately 2 percent of the Ecola Creek watershed is devoted to urban use, the impact these areas have on the watershed can be significant. Water pollution from urban areas and habitat loss are the primary urban impacts.

The two principal sources of urban area pollution to Ecola Creek are street runoff via the storm sewers and surrounding lands and effluent from the sewage treatment facility. Storm sewers deliver sediments and runoff from streets coated with residues of automobile by-products, landscaping fertilizers, pesticides and herbicides, and the detritus of city existence. Such contaminants have detrimental effects upon salmonids and aquatic insects in addition to degrading water quality.

A large portion of downtown Cannon Beach was constructed on filled tidal wetlands within the floodplain of Ecola Creek resulting in the loss of habitat valuable for winter and summer salmonid rearing and for water retention during high stream flows and ocean tides. Visible remnants of the early landscape are the Little Pompey Wetlands east of the downtown area and the spruce forest wetland north of the sewage lagoons and recycling center. These wetland habitats are examples of the former tidelands upon which downtown Cannon Beach was built.

Prior to 1970, the downtown of Cannon Beach was known to flood several times a year, although severe floods were infrequent but well documented. Extreme flood events were record in 1939, several in 1940, 1953,1961, 1964 and 1967. Two of the historical extreme flood events in Cannon Beach are worth mentioning. In 1964 a tsunami hit the West Coast caused by an Alaskan earthquake. The tsunami washed out the bridge crossing Ecola Creek, moved powerlines, a house and a trailer and flooded the town (O'Donnell, 1996). Later in 1967, high velocity west winds combined with very high tides to flood the downtown area under 2.5 feet of water in 1967 (U.S., 1974). In response to the damages resulting from this particular flood, a low levee was built in 1970 that extends from the Elm Street Bridge to Second Street. Since then no serious flooding in the downtown area has occurred.

### 1.7.4 Water Use

Cannon Beach's municipal water is supplied by three springs during most of the year. Located approximately 1.5 miles up the West Fork of Ecola Creek, the springs' production of up to 800 to 1,000 gallons per minute (gpm) is usually adequate for all but a few weeks in the peak summer tourist season. If there is a deficiency, it is made up with water withdrawn from the West Fork. The water withdrawn from the creek is cleaned through a sand filtration plant built in 1994 and located on the West Fork just downstream of the springs.

Water not consumed or lost to evapotranspiration after it is withdrawn is returned to the stream approximately one mile downstream of its point of withdrawal via the effluent of the sewage wastewater facility. The result is a one mile reach of stream vulnerable to the amount of water used by the city. This reach is an important salmonid spawning and rearing area.

Both the mainstem and West Fork of Ecola Creek have also been designated Streamflow Restoration Priority Areas by the Oregon Plan in an effort to restore native fish runs. The effect water withdrawals have on the creek is difficult to determine, however. Currently, there are no stream gauges in the watershed to measure natural stream flows. The City of Cannon Beach is in the process of planning the installation of stream gauges on both forks of Ecola Creek. In addition, the amount of water withdrawn from the watershed at any one time is difficult to monitor given the design of the water distribution system for the City of Cannon Beach. Natural stream flow and water use need to be adequately assessed to address water quality concerns in the watershed.

### 1.8 History

The history of the watershed in the form of a timeline and narrative has been compiled by the watershed council and is included in the Appendices of this document (Appendix A). The focus of a historical component to the watershed assessment is to emphasize issues that relate to landscape conditions, aquatic/riparian habitat, fish populations and water quality. Historical information can provide clues to the status of the watershed around the time of European settlement and how conditions have changed over time. It is hoped that providing a reference of conditions for the watershed will be helpful when restoration activities are undertaken.

# CHAPTER 2 CHANNEL HABITAT TYPES

## 2.1 Introduction

Stream channels were broken into Channel Habitat Types (CHTs) based upon the Oregon Watershed Assessment Manual's (OWAM) protocol. CHT designations were based upon stream geomorphic structure including stream size, channel gradient and channel confinement. Stream reaches with similar geomorphic structure have similar responses to channel modifications and restoration. The CHT component was designed to identify areas in the watershed most sensitive to land uses and most responsive to restoration efforts, both of which affect fish habitat. Portions of the watershed highly sensitive and moderately sensitive to channel alterations were identified based upon CHT designation.

Table 2.1 lists the geomorphic characteristics associated with each CHT and Table 2.2 rates CHT sensitivity to channel alterations. Please refer to the OWAM for a more detailed description of CHT characteristics. Channel type classifications apply to broad areas and a more thorough field verification of conditions will be necessary before restoration plans are undertaken.

The OWAM's critical questions for the CHT component were:

1. What is the distribution of CHTs throughout the watershed?
2. What is the location of CHTs that are likely to provide specific aquatic habitat features, as well as those areas which may be the most sensitive to changes in watershed condition?

## 2.2 CHTs in the Ecola Creek watershed

A total of 21 streams were assigned CHTs in the Ecola Creek watershed: four in the Lower Ecola subwatershed, ten in the West Fork subwatershed and seven in the North Fork subwatershed. Figure 2.1 illustrates the distribution of CHTs throughout the watershed and Figure 2.2 groups the CHTs in the Ecola Creek watershed according to their sensitivity to channel alterations. The 21 streams were grouped by subwatershed and Table 2.3 presents the percentage of total river miles for each subwatershed's CHTs.

Sensitive reaches tend to lack terrain controls which define confined channels. These areas are commonly referred to as response reaches and display visible changes in channel

Table 2.1. Channel habitat type descriptions and their associated stream geomorphic characteristics taken out of the OWAM (WPN 1999).

| CHT Code | Gradien | CHT Name | Channel Confinement | Stream Size |
|---|---|---|---|---|
| EL | <1% | Large Estuary | Unconfined to moderately confined | Large |
| FP1 | <1% | Low Gradient, Large Floodplain | Unconfined | Large |
| FP2 | <2% | Low Gradient Medium Floodplain | Unconfined | Medium to large |
| FP3 | <2% | Low Gradient Small Floodplain | Unconfined | Small to medium |
| LM | <2% | Low Gradient Moderately Confined | Moderately confined | Variable |
| LC | <2% | Low Gradient Confined | Confined | Variable |
| MM | 2-4% | Moderate Gradient, Moderately Confined | Moderately confined | Variable |
| MC | 2-4% | Moderate Gradient Confined Channel | Confined | Variable |
| MH | 1-6% | Moderate Gradient Headwater | Confined | Small |
| MV | 3-10% | Moderately Steep Narrow Valley | Confined | Small to medium |
| BC | 1->20% | Bedrock Canyon | Confined | Variable |
| SV | 8-16% | Steep Narrow Valley | Confined | Small (headwater tributaries) |
| VH | >16% | Very Steep Headwater | Confined | Small (headwater tributaries) |

Table 2.2. Channel Habitat Type Sensitivity as presented in the OWAM (WPN 1999).

| Low Sensitivity | Moderate Sensitivity | High Sensitivity |
|---|---|---|
| BC, VH, SV | MV, MH, MC, LC | FP1, FP2, FP3, MM, LM |
| | EL | |

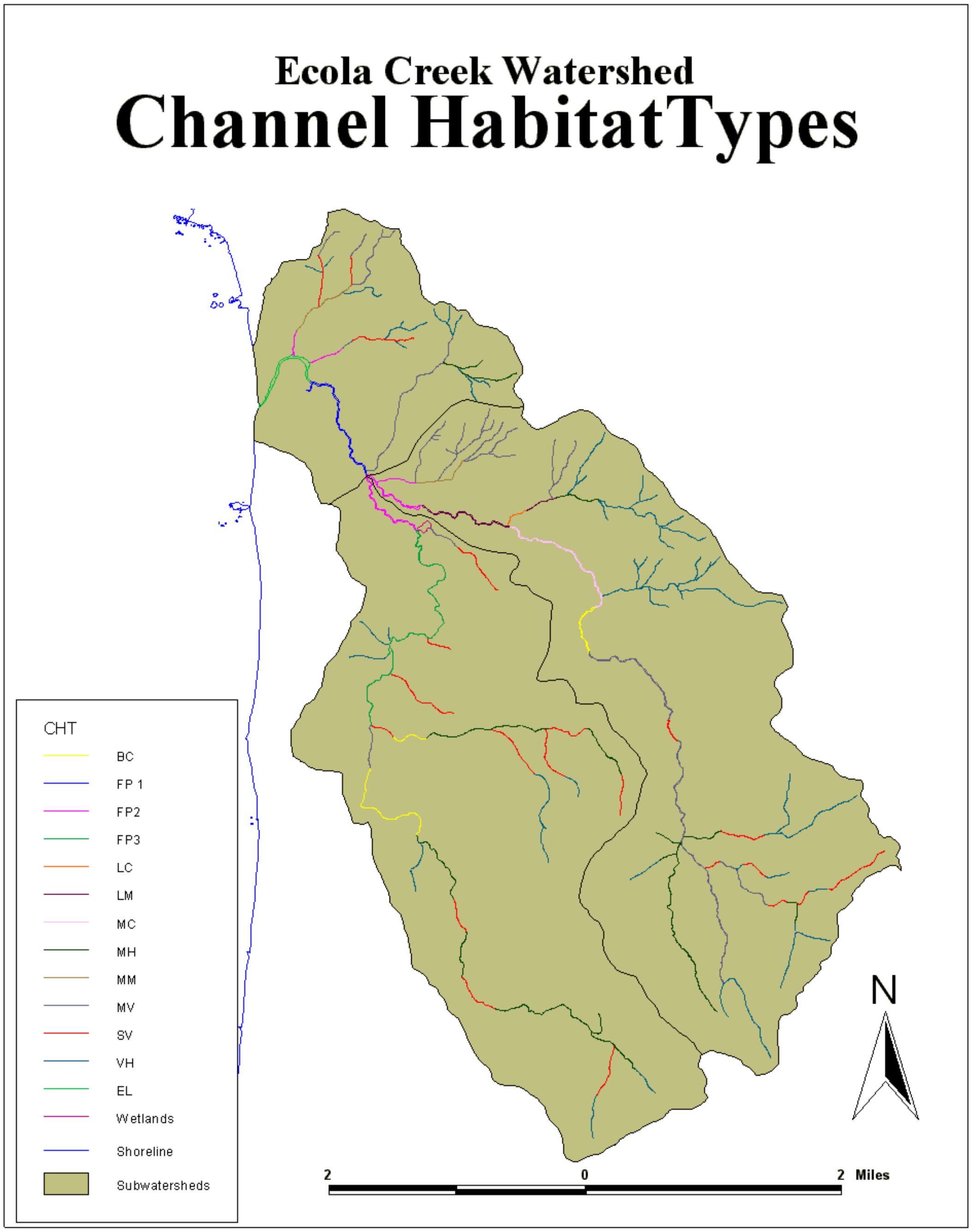



Figure 2.1 Distribution of Channel Habitat Types in the Ecola Creek watershed.

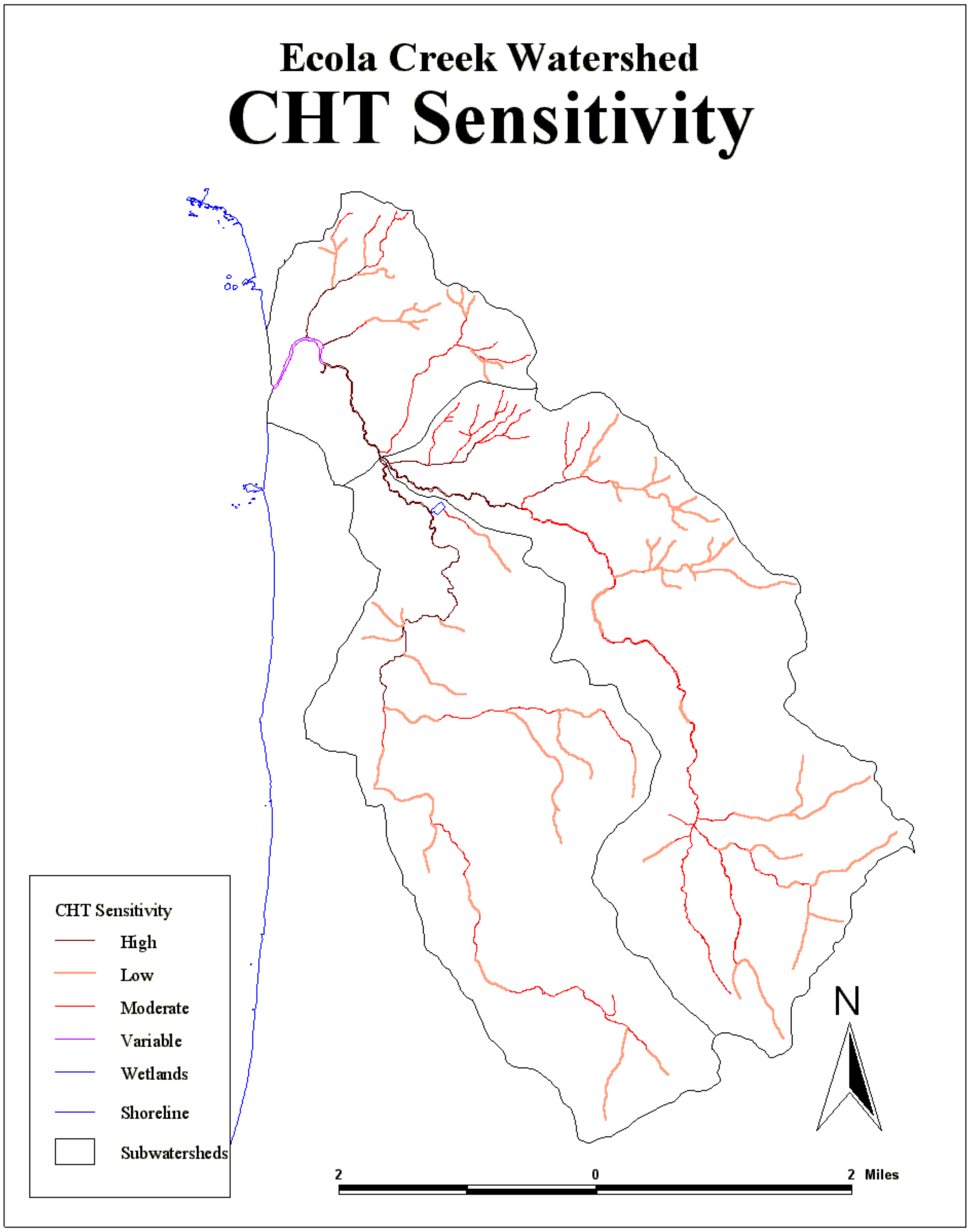



Figure 2.2 Channel Habitat Types in the Ecola Creek watershed grouped according to their sensitivity to changes in the factors that impact channel development. The more sensitive areas are most likely to exhibit physical changes from land management acitivities, as well as restoration efforts.

characteristics when flow, sediment supply, or in-stream structures (such as large woody debris) are altered. Highly sensitive reaches in the Ecola Creek watershed make up approximately 14% of the CHTs designated. Highly sensitive streams generally have low gradients and extensive to limited floodplains. As would be expected, map 2.2 illustrates that most of the highly sensitive reaches are located in the Lower Ecola subwatershed and the lower reaches of the West and North Fork subwatershed. Most of the highly sensitive reaches are the FP1 and FP2 areas located on the mainstems. In addition, highly sensitive areas are located in the lower reaches of several tributaries in the same region of the watershed.

Moderately sensitive reaches make up approximately 38% of the watershed and in general are streams with moderate gradients and confining channels. Adjustments of channel features in these areas are usually localized and of a modest magnitude. Moderately sensitive reaches in the Ecola Creek watershed are generally located upstream of the highly sensitive reaches and extend all the way into the headwaters of all three subwatersheds.

Table 2.3. Percentage of Channel Habitat Types in the Lower Ecola subwatershed grouped according to sensitivity to watershed disturbance.

| | | Percent Channel Habitat Type | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | High Sensitivity | | | | | | Moderate Sensitivity | | | | Low Sensitivity | | |
| Subwatershed | Miles | % EL | % FP1 | % FP2 | % FP3 | % LM | % MM | % LC | % MC | % MH | % MV | % BC | % SV | % VH |
| Lower Ecola | 8 | 6.0 | 12 | - | 4.0 | - | 5 | - | - | 9.0 | 28 | - | 12 | 23 |
| West Fork | 17 | - | - | 13 | 1.3 | - | - | - | - | 23 | 3.9 | 7.4 | 32 | 20 |
| North Fork | 24 | - | 2.2 | - | 0.4 | 4.4 | 1.8 | 0.8 | 6.3 | 8.9 | 28 | 1.8 | 6.5 | 39 |
| Total | 49 | 1.0 | 3.1 | 5.3 | 0.7 | 2.2 | 1.7 | 0.4 | 3.1 | 14 | 20 | 3.5 | 16 | 30 |

# CHAPTER 3 HYDROLOGY

## 3.1 Introduction

Hydrology is the science of the behavior of water from the atmosphere into the soil. Hydrological characteristics important in the watershed assessment are peak stream flows and minimum stream flows. Peak flows occur as a result of large storm events and are the most significant channel altering events; the structural characteristic of the channel is a function of these events. Minimum flows occur during summer low flow months and are important for the affect they have on aquatic life and for the ability of the watershed to produce water for out-of-channel uses such as domestic and municipal use.

The hydrology section of the Oregon Watershed Assessment Manual (OWAM) evaluates the potential impact from land use on the hydrology of a watershed. Alterations to the natural hydrologic cycle potentially cause increased peak flows and/or reduced low flows resulting in changes to water quality and aquatic ecosystems. Land uses that bring about vegetation changes, soil compaction, and an increase in impervious surfaces can have large impacts on the hydrology of a watershed. Examples of human activities that can impact watershed hydrology are timber harvesting, conversion of forestland to agriculture, grazing, urbanization and construction of road networks.

Critical questions for the hydrology component are:

1. What land uses are present in the watershed?
2. What is the flood history in the watershed?
3. Have land uses in the basin had a significant effect on peak flows?
4. Is there a probability that present land uses in the basin have a significant effect on peak flows?

## 3.2 General Watershed and Peak Flow Characterization

Table 3.1 illustrates general watershed characteristics for the three subwatersheds in the Ecola basin. Average elevations for both the West Fork and North Fork subwatersheds are well above 1,000 feet, indicating portions of each watershed are within potential rain-on-snow elevations. However, rain events are the primary peak flow generating process for the ecoregions in the Coast Range. Peak flow refers to the maximum instantaneous rate of stream flow during a storm or other period of time. In addition, the Ecola Creek basin generally develops very little snow pack and the snow pack that does develop is only on the highest peaks and is of a short duration. Therefore, it is assumed that the peak flow generating process for all three subwatersheds is rain.

Table 3.1. General watershed features and precipitation for the Ecola Creek watershed. Average annual precipitation are estimated from the City of Cannon Beach and ODWR. Area is based upon ODWR WARS tables. Mean elevation for the three subwatersheds and maximum elevation for the Lower Ecola subwatershed are based upon GIS calculations. Maximum and minimum elevations for the North and West Fork subwatersheds are based on USGS 7.5-minute topographic maps.

| Subwatershed Name | Area ($mi^2$) | Average Elevation (ft) | Minimum Elevation (ft) | Maximum Elevation(ft) | Mean Annual Precipitation (inches) |
|---|---|---|---|---|---|
| Lower Ecola | 3.97 | 431.1 | 0 | 850.0 | 84 |
| West Fork | 8.55 | 1,395 | 50 | 3,076 | 127.73 |
| North Fork | 9.36 | 1,466 | 50 | 3,065 | 127.62 |
| Total Watershed | 21.88 | 1,353 | 0 | 3,076 | |

**3.3 Hydrologic Characterization**

Historically, Ecola Creek had two stream gauges located on the North and West Fork, just upstream of their confluence, from the period of 1974-1986. Data from the gauges are not reliable for peak flow characterization due to their location within an unconstrained floodplain. Daily mean flow records for each gauging station were obtained from the Oregon Department of Water Resources (ODWR) and used to characterize stream flows in the West Fork and North Fork subwatersheds. It should be noted that the City of Cannon Beach is planning to install two stream flow gauges in the watershed, one on the mainstem of Ecola Creek and the other on the West Fork of Ecola Creek.

The West Fork subwatershed is the municipal watershed for the City of Cannon Beach and the historic stream gauge was located approximately .5 miles downstream from the city's point of diversion. The West Fork drains approximately 8.55 square miles of land and the North Fork subwatershed drains approximately 9.36 square miles of land. Stream flow patterns for both subwatersheds are typical of Oregon coastal watersheds with the majority of high flows and storm events occurring between the months of October and May (Figure 3.1 and Figure 3.2). The dramatic sharp peaks in Figures 3.1 and 3.2 are indicative of watersheds with steep slopes as is the case with Ecola Creek. The graphs illustrate how quickly both subwatersheds move water during storm events. The summer months consist of base flow conditions with very few storm events. Average annual maximum daily mean flows for the West Fork subwatershed range between 117 cubic feet per second (cfs) and 1730 cfs, with the largest event occurring in December of 1975. Average annual maximum daily mean flows for the North Fork subwatershed range between 165 cfs and 1420 cfs with the largest event occurring in December of 1977. It should be noted that stream gauge data on the West Fork had multiple periods of data gaps. A comparison between Figures 3.1 and 3.2 indicate that the missing data is most likely masking high flows throughout the year for the West Fork subwatershed.

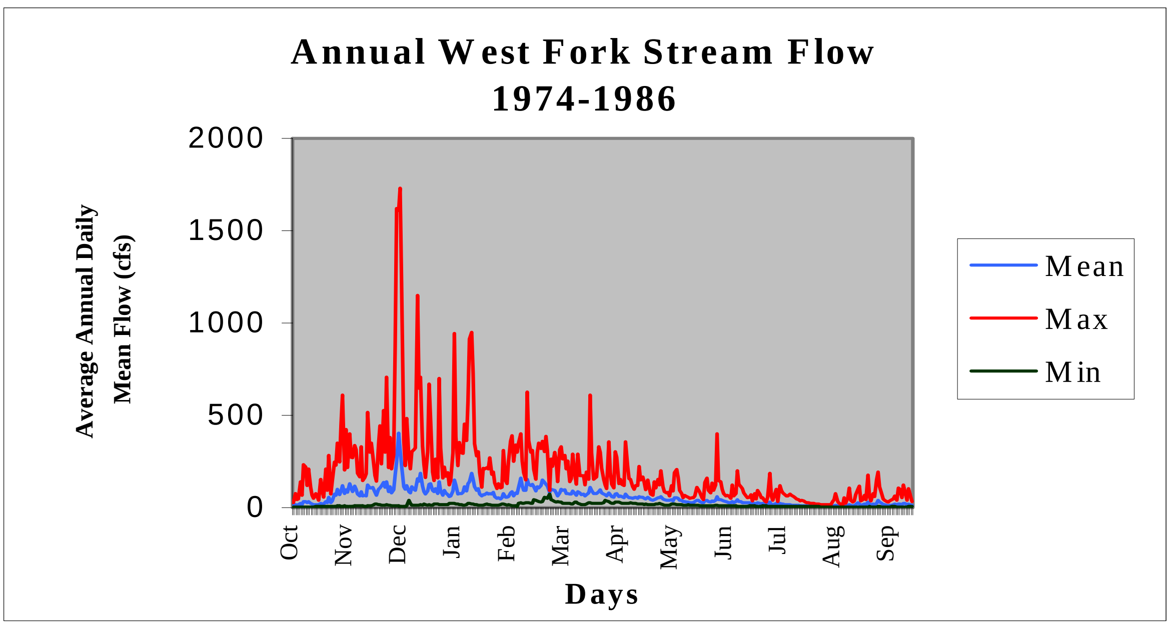



Figure 3.1. Average Annual Daily Mean Stream discharge for the West Fork stream gauge based upon daily mean records for the period of 1974-1986.

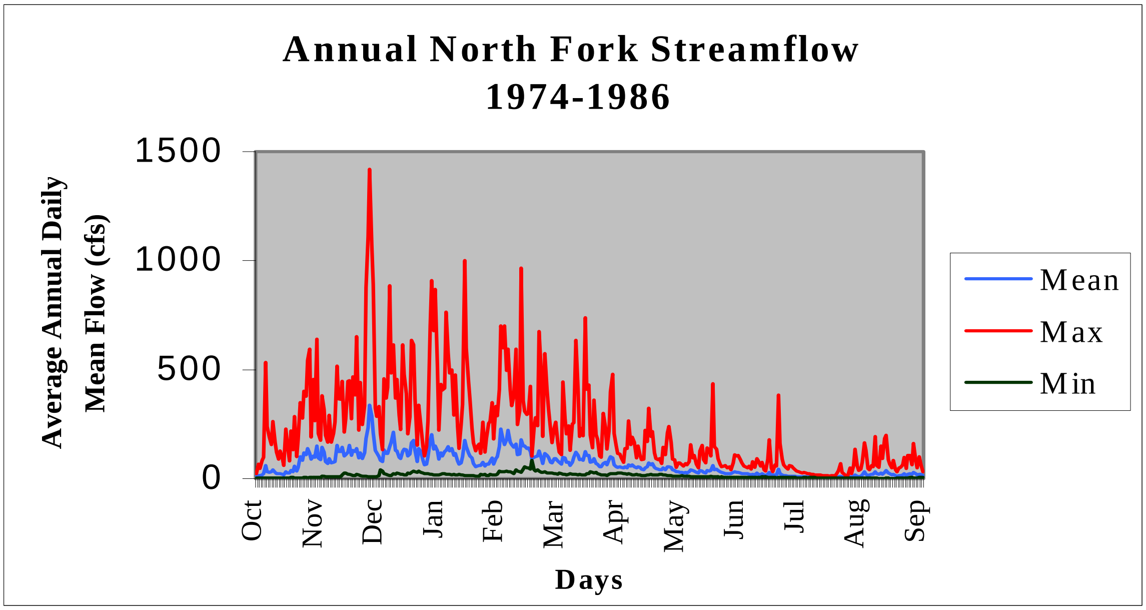



Figure 3.2. Average Annual Daily Mean Stream discharge for the North Fork stream gauge based upon daily mean records for the period of 1974-1986.

### 3.4 Potential Land Use Impacts on Peak Flows and Low Flows

Land use can have pronounced impacts on the hydrology of a watershed. Land uses that decrease the rate of infiltration and or the ability of the soil surface to store water are typically the most influential in affecting the watershed's hydrology by increasing peak flows. Increased peak flows can alter stream channels and impact floodplains as well as affect ground water storage that is important during low flow summer months. Low flows can affect vegetation and aquatic organisms that depend upon a constant supply of cool, oxygenated water.

The hydrology assessment techniques in the OWAM assess land uses that may potentially increase peak flows or reduce low flows and they prioritize the subwatersheds most likely to need restoration. Hydrology is a complex subject and this screening process deals only with the most significant hydrologic process affected by land use: runoff. Land uses that can potentially affect the hydrology in the Ecola Creek watershed are: forestry and urban development. Grazing occurs in the watershed, but the area is small and positioned low in the watershed making peak flow affects unlikely. Table 3.2 lists the percentage of each land use for each subwatershed.

Table 3.2 Percentage of land use in each subwatershed in the Ecola Creek basin. Forestry acreage is based upon figures in the Ecola Creek Watershed Analysis by Western Watershed Analysts, 1995. Range-Land and Urban acreage are based upon grid method calculations.

| Subwatershed Name | Area (acres) | Forestry | | Range-Land (grazing) | | Urban | |
|---|---|---|---|---|---|---|---|
| | | acres | % | acres | % | acres | % |
| Lower Ecola | 2,539 | 2,240 | 88.2 | 2 | .1 | 297 | 11.7 |
| West Fork | 5,470 | 5,470 | 100 | 0 | 0 | 0 | 0 |
| North Fork | 5,991 | 5,991 | 100 | 0 | 0 | 0 | 0 |
| Total Watershed | 14,000 | 13,701 | 97.86 | 2 | .01 | 297 | 2.12 |

### 3.4.1. Forestry

Approximately 95% of the Ecola Creek watershed is commercial forestland. Large-scale vegetation changes in the way of timber harvesting can directly influence the flow-regime for a watershed by reducing interception and evapotranspiration, both of which play important roles in the infiltration rate and allow more water to be absorbed into the soil (WPN, 1999). Open areas in high elevations accumulate more snowpack, causing a potential increase in water yield. In addition, forestry related effects on peak flows may be a function of the peak flow generating process, with the greatest likelihood of an increase in peak flows occurring during rain-on-snow events (WPN 1999).

The screen for potential forestry impacts on peak flows in the OWAM focuses on timber harvesting and the peak flow generating process in the watershed. It is determined by the OWAM's hydrology assessment that forest harvest practices do not likely influencing peak flows in the watershed by increasing the effects of rain-on-snow events because the Ecola Creek watershed is dominated by rain events.

### 3.4.2. Forest Roads

Road networks associated with forestry can alter the rate of infiltration on the road surface and the natural drainage pattern. The surface for most older forest roads is compacted soil that is impermeable to precipitation. Modern forest road networks are constructed of crushed rock. Older forest road networks primarily increase streamflow by replacing subsurface flow with surface runoff (Bowling and Lettenmaier 1997 in WPN 1999). Roads can also intercept and divert overland flow and shallow subsurface flow, potentially rerouting the runoff from one sub-basin to a different sub-basin.

The forest road assessment focuses on the density of roads within each subwatershed. The assessment does not consider the condition of the roads themselves including their drainage pattern, proximity to streams, etc., any of which may accelerate the delivery of water or sediment to the stream. It should be noted that roads can potentially increase peak flows regardless of the peak flow generating process (WPN 1999).

The OWAM assigns an eight percent threshold of concern for road density in each subwatershed. When the percent roaded area exceeds 8 percent, road issues may cause hydrologic impacts and further investigation is warranted. Subwatersheds with a 4 to 8 percent roaded area are considered to have a moderate potential for hydrologic impact and those with less than 4 percent have a low potential for hydrologic impact. Road mileage and subwatershed acreage data were determined using GIS and Willamette Industries sources. Roaded area was calculated using a standard road width of 25 ft (from ditch to ditch), although road widths in the watershed are generally less.

The Lower Ecola subwatershed was the only sub-basin to demonstrate moderate potential for increasing peak flow as a result of forest road construction (Table 3.3). The remaining subwatersheds exhibited low potential for peak flow enhancement due to forest road construction. But, because road mileage data is based upon GIS sources, data should be verified by an alternative source at a later date.

### 3.4.3. Urban and Rural Residential Roads

Urbanization has the greatest potential of all the land uses for impacting the hydrology of a watershed. In urban areas, a significant portion of the land surface becomes impervious and the result is a decrease in infiltration rates and recharge rates, corresponding increases in peak flows and volume of runoff and a decrease in watershed response times. In addition, low

Table 3.3 Percent forest road area in each subwatershed for the Ecola Creek basin. Subwatershed road mileage was determined by GIS and obtained from CREST. Total road mileage was determined by two GIS sources: Willamette Industries, Inc. and CREST (as indicated below).

| Subwatershed | Area ($mi^2$) | Area Forested ($mi^2$) | Total Linear Distance of Forest Roads (miles) | Roaded Area ($mi^2$) | Percent Roaded Area | Relative Potential for Impact |
|---|---|---|---|---|---|---|
| Lower Ecola | 3.97 | 3.5 | 35.34 | 0.17 | 4.79 | MODERATE |
| West Fork | 8.55 | 8.55 | 59.9 | .28 | 3.29 | LOW |
| North Fork | 9.36 | 9.36 | 58.57 | .28 | 2.94 | LOW |
| Total Watershed | 21.88 | 21.41 | 130*/153.81** | .61*/.72** | 2.85*/3.36** | LOW |

*Willamette Industries
**CREST

flows are affected by reduced groundwater recharge resulting from impervious surfaces and pervasive nonpoint source pollution often accompanying stormwater runoff.

The urban and rural residential roads assessment estimated the extent of imperviousness for the Lower Ecola subwatershed to screen for potential hydrologic impacts as a result of urbanization. Only the Lower Ecola subwatershed was assessed because the other two subwatershed lack of urban and residential areas. Urban road density was estimated to represent the extent of impervious services for the sub-basin as assumed by Method 2 in the OWAM. Total linear distance of roads in urban areas was determined by hand using a map wheel and base map. The results conclude that the Lower Ecola subwatershed exhibited potential hydrologic impact due to impervious surfaces in urban areas, with an urban road density of 28 $mi/mi^2$.

### 3.5 Conclusions

In general, current land use practices in the Ecola Creek Watershed do not demonstrate a high potential for increasing peak flows as a result of timber harvest practices, construction of forest roads or the establishment of urban and rural residential areas. The exception being urban and rural residential areas in the Lower Ecola subwatershed. Further investigation is warranted for this subwatershed to verify the assessment's findings for high potential hydrological impacts.

It is possible that there are other impacts to the watershed's hydrology resulting from land use practices. Large scale vegetation removal associated with forest practices can reduce evapotranspiration, increase infiltration and subsurface flow, and increase overland flow (WPN, 1999). In addition to the impacts of impervious surfaces on hydrology, urban area management in the Lower Ecola subwatershed has diked Ecola Creek and filled wetlands for flood protection. By disconnecting Ecola Creek from its floodplain, downcutting of the channel can occur resulting in increasing flow velocities and changing peak flows.

# CHAPTER 4 WATER USE

## 4.1 Introduction

The water use component in the Oregon Watershed Assessment Manual (OWAM) focuses on low-flow issues in the watershed. Low flows can adversely affect aquatic life and ground water recharge. Water that is withdrawn from the stream has the potential to affect aquatic habitats by reducing stream flows. Water can be taken from surface or groundwater sources to serve several beneficial uses, such as municipal, domestic and irrigation uses. Subsequently, water for domestic and municipal uses may be returned to the stream by way of a sewage treatment facility. Not all the water is returned, since a certain percentage is lost through evapotranspiration, consumed or not returned at all if discharge is located downstream of the point of uptake. If sewage discharge is located significantly downstream of the point of withdrawal, the area in between is considered to be dewatered. Dewater refers to the permanent removal of water from the stream channel, thus decreasing the natural stream flow (Bischoff, et al 2000).

Water rights and water use were examined for each of the water availability basins (WAB) in the watershed. WABs are watersheds defined by the Oregon Department of Water Resources (ODWR) for the assessment of streamflow conditions. Methods for identifying low-flow concerns in each subwatershed included: summarizing water rights and their beneficial uses, identifying subwatersheds with negative water availability values, identifying subwatersheds with consumptive uses exceeding 10% of the natural streamflow, and identifying Streamflow Restoration subwatersheds.

Critical questions for the Water Use component in the OWAM were:

1. For what beneficial uses is water primarily used in your watershed?
2. Is water derived from a groundwater or surface-water source?
3. What type of storage has been constructed in the basin?
4. Are there any withdrawals of water for use in another basin? Is any water being imported for use in the basin?
5. Do water uses in the basin have an effect on peak flows?
6. Do water uses in the basin have an effect on low flows?

## 4.2 Water Rights

Under Oregon law, all water is publicly owned and, with few exceptions, water withdrawal requires a permit. Anyone withdrawing water from surface and some ground water sources must have a water right from the ODWR. Water rights in the State of Oregon are based upon the prior appropriation doctrine or "first in time, first in right" subject to the availability of water in streams and the ability to use the water without waste. The earliest water right (known as senior water right) has the right to divert water prior to any water right established at a later date (known as junior water right). Associated with each water right is an instantaneous flow amount (maximum rate at which water may be withdrawn at any point in time which is usually measured in cubic feet per second), an annual volume restriction (water duty) and a designated beneficial use. Beneficial uses in the Ecola Creek watershed include aesthetic quality, fishing, domestic water supply, resident fish and aquatic life, salmonid fish rearing, salmonid fish spawning and water contact recreation (ODWR website).

There are three primary types of surface water rights: in-stream rights, out-of-stream rights and storage rights. In-stream rights designate a given quantity of water to remain in the stream for a specific beneficial use, most often for aquatic resources, wildlife, or aesthetics. Out-of-stream rights, or consumptive uses, entail withdrawing water directly from the channel with subsequent application for a specific beneficial use. Storage rights apply to on-stream or off-stream reservoirs. Surface water rights in the Ecola Creek watershed are presented in Table 4.1 and Figure 4.1 illustrates the location of municipal water rights, water rights other than municipal, and storage sites.

### 4.2.1 Out-of-stream rights

There are a total of 9 out-of-stream, non-cancelled, surface-water rights in the Ecola Creek watershed on record at the ODWR: 1.5 cfs in the Lower Ecola subwatershed, 3.11 cfs in the West Fork subwatershed and .01 cfs in the North Fork subwatershed. The most substantial rights in the basin are the three municipal water rights located on the West Fork of Ecola Cr, totaling 3.1 cfs. Two water rights totaling 1.6 cfs are for the three unnamed springs that feed the West Fork and used by the City of Cannon Beach year round. Additionally the city has a conditional use permit to extract water from the West Fork when supplementation is needed in the low flow summer months. The water right on the West Fork is 1.5 cfs. It should be noted

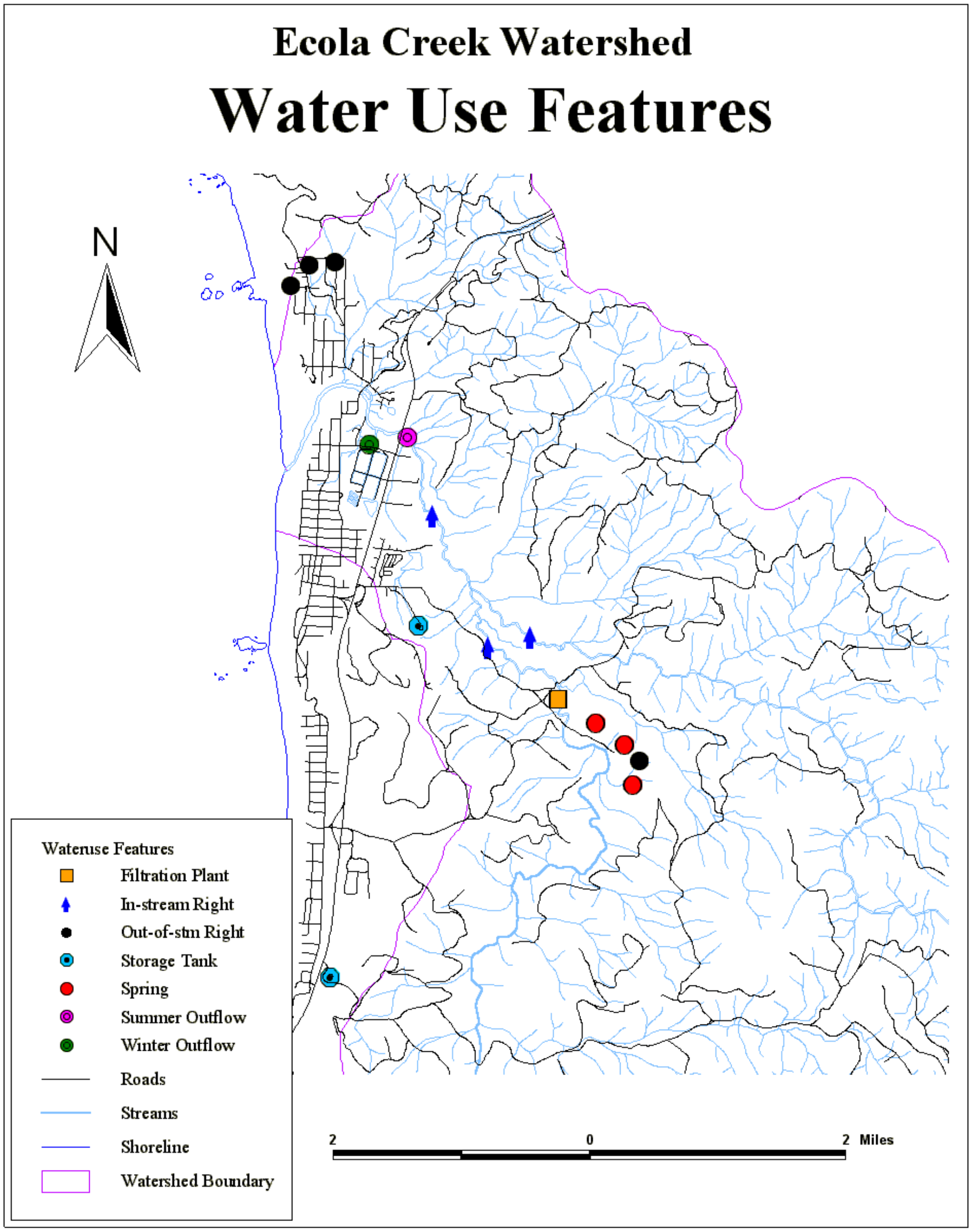



Figure 4.1 Water Use features in the Ecola Creek watershed. Out-of-stream rights are those with known locations other than the municipal water rights. Municipal water rights are depicted as the springs and filtration plant.

that a large domestic right totaling 1.0 cfs is located in the Lower Ecola subwatershed on the mainstem of Ecola Creek according to the ODWR database. The right was originally owned by Elk Creek Light and Water, but the company has since been sold and the name of the current owner is not required to be updated with the ODWR. This right may be part of the municipal rights owned by the City of Cannon Beach. The City bought the Cannon Beach Water Company (formerly known as Elk Creek Light and Water) when they took over the water distribution system in the early 70's. Further pursuit with different divisions of the ODWR could locate the owner since the right needs to be updated to remain operational.

There are no withdrawals of water for use in other basins in the Ecola Creek watershed, nor is any water being imported for use in the basin.

4.2.2 In-stream water rights

In addition to nine out-of-stream rights, there are three in-stream rights in the watershed. In-stream rights were established in 1973 on the mainstem of Ecola Creek for the protection

Table 4.1 Out-of-stream and in-stream water rights in the Ecola Creek watershed. Data was obtained from the Oregon Department of Water Resources website.

| # | Subwatershed | Type of Use | Priority Date | Flow Rate (cfs) | Source | Permit # |
|---|---|---|---|---|---|---|
| 1 | Lower Ecola | Domestic | 10/10/16 | 1.0 | Elk CR/ Pacific | S3135 |
| 2 | Lower Ecola | Domestic | 5/5/32 | .07 | Crookham/ Logan | S10596 |
| 3 | Lower Ecola | Domestic | 3/16/33 | .45 | Unnamed str/ Logan | S10832 |
| 4 | Lower Ecola | In-stream | 5/9/73 | Table 4.2 | Mainstem Ecola Cr | MF11 |
| 5 | Lower Ecola | Domestic Non-commercial | 3/6/91 | .01 | Crookham/ Logan | S51247 |
| 6 | West Fork | Municipal | 5/25/33 | .6 | Unnamed spr/ West Fork Ecola | S10936 |
| 7 | West Fork | Municipal | 8/20/36 | 1.0 | Unnamed spr 3 / West Fork Ecola Cr | S12321 |
| 8 | West Fork | Municipal | 4/15/77 | 1.5 | West Fork Ecola | S41717 Conditional Use |
| 9 | West Fork | In-stream | 10/11/91 | Table 4.2 | West Fork Ecola Cr | IS71935 |
| 10 | West Fork | Domestic Non-commercial | 10/3/94 | .01 | Spring/Elk | S52732 |
| 11 | North Fork | Domestic | 8/3/34 | .01 | Unnamed spr/ North Fork Ecola Cr | S11352 |
| 12 | North Fork | In-stream | 10/11/91 | Table 4.2 | North Fork Ecola Cr | IS71942 |

The localities for water rights ten and eleven are undetermined by this assessment. Their locations need further investigation.

Table 4.2 Monthly values for in-stream water rights (in cubic feet per second) on the mainstem, West Fork and North Fork of Ecola Creek. In-stream values change according to the life-history needs of aquatic organisms.

| Subwatershed | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mainstem Ecola | 15.0/ 60.0 | 60.0 | 70.0 | 70.0 | 70.0 | 70.0 | 60.0 | 30.0 | 15.0 | 5.0 | 5.0 | 5.0 |
| West Fork Ecola | 14.3 | 33.0 | 33.0 | 33.0 | 33.0 | 33.0 | 33.0 | 20.0 | 10.0 | 5.0 | 5.0 | 5.0 |
| North Fork Ecola | 18.4 | 36.0 | 36.0 | 36.0 | 36.0 | 36.0 | 36.0 | 20.0 | 10.0 | 5.0 | 5.0 | 5.0 |

of aquatic life. Later, in 1991, in-stream rights were established on the West Fork and North Fork of Ecola Creek for the protection of anadromous and resident fish rearing. In-stream rights in all subwatersheds vary seasonally depending upon the needs of the aquatic resources they protect and remain junior to most water rights in the watershed.

4.2.2 Storage

There are two main storage reservoirs for the City of Cannon Beach and plans for a third are underway. The Main Storage Tank was constructed in 1974 and has a storage volume of 1 Million Gallons (MG). It is located on Elk Creek Road near the city owned RV Park. The tank is supplied directly from the unnamed springs and the slow sand filter plant. The Tolovana reservoir was constructed in 1986 and provides an additional 1.6 MG of storage. The reservoir is connected to the distribution system by a single 12-inch pipe that serves as both supply and feed to the tank. The combined volume of the two reservoirs is 2.6 Million Gallons (MG) (EES, Inc., 2001). The third reservoir will serve the north end of Cannon Beach and will provide an additional 30,000 gallons of storage. Figure 4.1 illustrates the locations of the Main Storage Tank and the Tolovana tank.

## 4.3 Water Availability

Water Availability Reports at the 50% and 80% exceedence level for each subwatershed were obtained from the ODWR website (Table 4.2.1 and 4.2.2). Water Availability Reports indicate the monthly net water values for streams. Net water available is the theoretical amount of water in the stream after consumptive uses (out-of-stream rights), storage, and in-stream water rights are subtracted from the estimated natural stream flow for each month.

Exceedence level is the amount of estimated water present in the stream for a designated percentage of the time (50 and 80 percent). The exceedence level is determined from a 30-year base period that takes into account wet and dry cycles. The June 1999 version of the OWAM requires that 50 percent exceedence values be used, but 80 percent values are also included, as they are the values required by the January 1999 version and are the values ODWR uses to allocate additional water rights. The net water values were reported in Tables 4.2.1 and 4.2.2

Potential low flow conditions exist in the Lower Ecola and West Fork Ecola subwatersheds according to the 50 percent exceedence level table, and in all three subwatershed according to the 80 percent exceedence level table. Negative values indicate over allocation in the subwatershed; streamflow is insufficient to meet the demand for all in-

Table 4.2.1 Monthly Net Water Available by Water Availability Basin (WAB) at the **50%** Exceedence Level. Data obtained from the Oregon Department of Water Resources website and reported in cubic feet per second.

| Water Availability Basins | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mainstem Ecola Cr | 112.00 | 130.00 | 82.60 | 24.90 | 21.60 | 21.40 | 15.60 | 9.97 | 12.40 | **-26.70** | 82.60 | 142.00 |
| West Fork Ecola Cr | 39.80 | 49.20 | 32.20 | 4.70 | 2.20 | 7.10 | 4.70 | 2.00 | 2.50 | **-2.20** | 33.10 | 59.40 |
| North Fork Ecola Cr | 54.4 | 61.00 | 37.30 | 4.8 | 6.90 | 6.30 | 3.85 | 1.34 | 3.37 | .30 | 30.00 | 61.90 |

Negative values (in bold) indicate months where streamflow is insufficient to meet all demands for in-stream and out-of-stream uses.

Table 4.2.2 Monthly Net Water Available by Water Availability Basin (WAB) at the **80%** Exceedence Level. Data obtained from the Oregon Department of Water Resources website and reported in cubic feet per second.

| Water Availability Basins | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ecola Cr. Mainstem | 23.90 | 49.60 | 20.40 | **-.43** | 7.38 | 8.38 | 7.87 | 2.57 | 6.27 | **-45.10** | 15.20 | 41.60 |
| West Fk Ecola Cr | 6.70 | 16.70 | 4.10 | **-7.20** | **-3.50** | 1.00 | .72 | **-2.15** | **-.17** | **-7.69** | .50 | 21.10 |
| North Fk Ecola Cr | 9.00 | 22.50 | 9.20 | **-6.60** | **-1.20** | 1.10 | 1.10 | **-1.11** | .30 | **-11.30** | .70 | 12.40 |

Negative values (in bold) indicate months where streamflow is insufficient to meet all demands for in-stream and out-of-stream uses.

stream and out-of-stream uses. Conservation measures are recommended to help mitigate low-flow problems, however, the extent of the low flow problem needs to be determined if restoration efforts are to be made.

### 4.4 Consumptive Water Use and Streamflow-Restoration Priority Areas

The monthly percentage of natural stream flow withdrawn for consumptive use for each subwatershed was determined from the Water Availability Reports (Tables 4.3.1 and 4.3.2). Months with values greater than 10% (in bold) indicate high consumption. Streamflow Restoration Priority Areas (SRPA) were also identified in the tables. The identification of SRPAs was an outcome of the Oregon Plan and were determined through collaboration between ODFW and ODWR. Criteria for SRPA designation are based upon a combination of biological factors and water use (WPN, 1999).

The Lower Ecola subwatershed and the West Fork subwatershed are designated SRPAs and both consumptive use tables indicate high potential for dewatering problems in the subwatersheds, although values differ between the two exceedence levels. Because the West Fork subwatershed has more consumptive uses than the Lower Ecola subwatershed, it presents the greatest flow-restoration potential of the two if conservation measures are undertaken.

Table 4.3.1. The percentage of monthly consumptive use by Water Availability Basin (WAB) determined from the **50%** Exceedence Level Water Availability report. Data obtained from the Oregon Department of Water Resources website.

| Water Availability Basins | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mainstem Ecola Cr** | 1.85 | 1.69 | 2.20 | 3.88 | 6.24 | 8.62 | **14.29** | **18.64** | **16.49** | 9.32 | 2.35 | 1.60 |
| West Fork Ecola Cr** | 4.08 | 3.63 | 4.54 | 7.60 | **12.25** | **15.35** | **24.22** | **30.70** | **29.25** | **20.40** | 4.48 | 3.25 |
| North Fork Ecola Cr | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

*(Values over ten (in bold) indicate months where streamflow is insufficient to meet all demands for in-stream and out-of-stream uses.
**Indicate state designated Flow Restoration Priority basins.

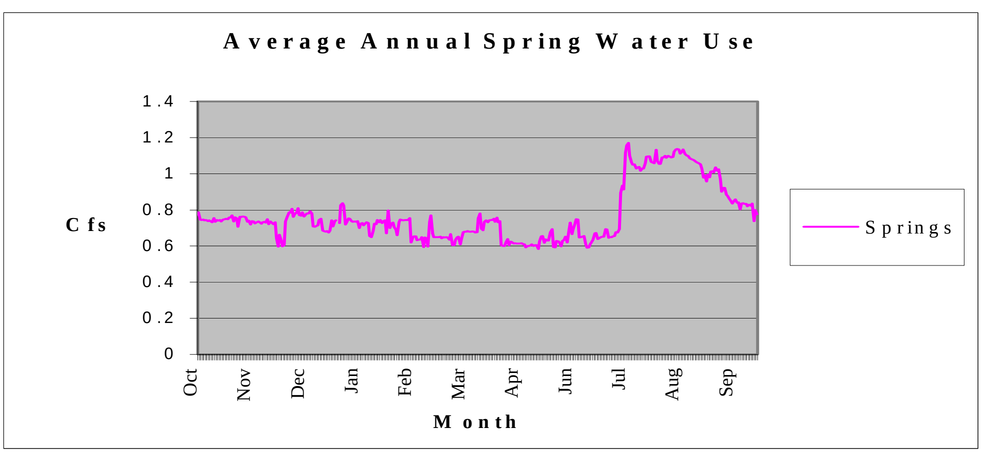
Table 4.3.2. Percentage of monthly consumptive use by Water Availability Basin (WAB) determined from the **80%** Exceedence Level Water Availability report. Data obtained from the Oregon Department of Water Resources website.

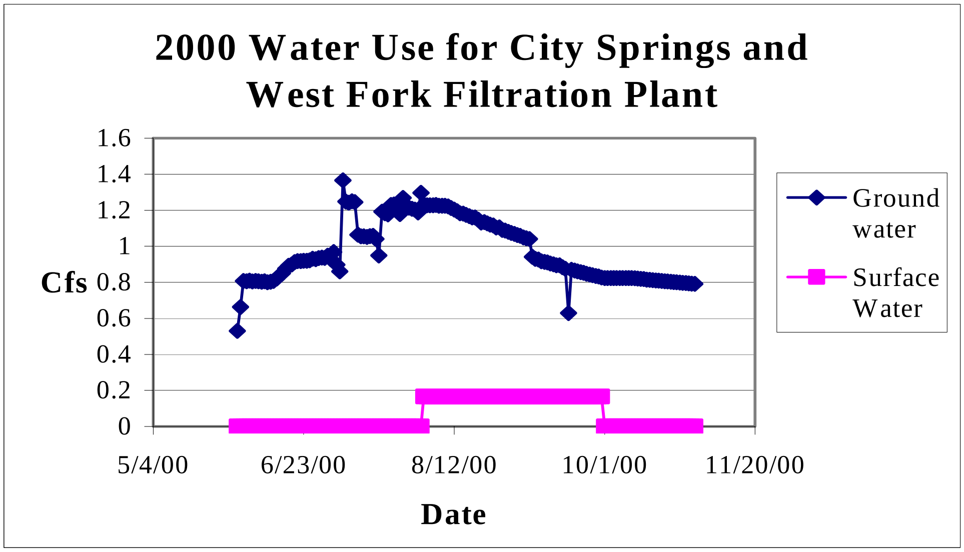
| Water Availability Basins | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mainstem Ecola Cr** | 3.53 | 2.79 | 3.66 | 5.44 | 8.41 | **12.80** | **21.04** | **31.18** | **23.33** | **18.69** | 4.36 | 2.98 |
| West Fork Ecola Cr** | 7.24 | 5.87 | 7.71 | **10.73** | **15.82** | **21.99** | **35.15** | **52.10** | **39.09** | **31.93** | 8.47 | 5.42 |
| North Fork Ecola Cr | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

*(Values over ten (in bold) indicate months where streamflow is insufficient to meet all demands for in-stream and out-of-stream uses.
**Indicate state designated Flow Restoration Priority basins.

### 4.5 City Water Use

Daily city water use values from 1995-2000 were obtained from the Public Works Director for the City of Cannon Beach. Both demand and supply data were provided, but only supply data was used for the assessment because it was found to most closely measure the amount of water withdrawn from the springs and creek. While the water rights for the springs and the creek are instantaneous rights, due to the design of the water system it is not possible to measure the amount of water being withdrawn at any given moment. Instead, daily supply readings were used to get an idea of how much water is being withdrawn and how much of the water rights the City is using.






**4.6 Conclusions**

The greatest amount of water withdrawn from the basin is from the West Fork Ecola Creek for municipal use. The municipal rights total 3.1cfs with two of the rights for springs that feed the West Fork and the third on the West Fork itself. The City of Cannon Beach uses the West Fork subwatershed as its primary source of water. Further inquiry should be made concerning the amount of water the city is consuming. It appears the city comes close to using their 1.6 cfs total water right on the springs, but they only use a very small portion of their conditional use permit right of 1.5 cfs on the West Fork.

The most important step will be establishing stream gauges in the basin to gain a better understanding of the natural streamflow and the potential dewatering hazards posed by water use in the watershed. Data from the ODWR Water Availability Reports assumes natural streamflow based upon statistical manipulation of the ten years of data in the basin, taking into account the natural wet and dry weather cycles. Plans are currently underway at the city for the ODWR to install two stream gauges in the subwatershed. The stream gauge information will aide in understanding the dewatering issues in the watershed and will help determine whether conservation measures are required.

# CHAPTER 5 FISHERIES

## 5.1 Introduction

Salmonids are typically considered the most sensitive fish species occurring within a stream network and are often used as indicators for the health of the ecosystem. The Oregon Watershed Assessment Manual (OWAM) focuses on watershed processes that affect salmonids and their associated habitats with the goal of evaluating watershed management practices and their effect on watershed health. Understanding the condition of salmonid populations, fish distribution and utilization in the watershed is an integral component for habitat improvements.

Available information on fish species, life histories, populations, stocking histories and migration barriers are compiled and evaluated in this chapter. Information on in-stream habitat is included in the Aquatic and Riparian Habitat chapter for organizational purposes.

Critical Questions for the fisheries component in the OWAM are:

1. What fish species are documented in the watershed? Are any of these currently state or federally listed as endangered or candidate species? Are there any fish species that historically occurred in the watershed and are no longer present?
2. What is the distribution, relative abundance, and population status of salmonid[2] species in the watershed?
3. Which salmonid species are native to the watershed and which have been introduced?
4. Are there potential interactions between native and introduced species?
5. Where are potential barriers to fish migration?

## 5.2 Historic and Current Fish Presence

The Ecola Creek watershed supports several species of anadromous and resident fish. Resident fish remain in fresh water all their lives, while anadromous fish return to fresh water streams as adults from the ocean to spawn. Species known to occur in the Ecola Creek watershed are listed in Table 5.1. This is not a complete list of fish species for Ecola Creek. Other marine and freshwater species reside in Ecola Creek, but a more complete list is beyond the scope of this assessment.

[2] Fish of the family *Salmonidae*, including salmon, trout, char, whitefish, ciscoes, and grayling. Generally, the term refers to salmon, trout, and char.

Anadromous salmon in Ecola Creek include coho, fall chinook and chum. Anadromous trout include winter steelhead and sea-run cutthroat trout. Pacific lamprey are also considered anadromous fish, as they, too, have an ocean going phase in their life cycle. Resident fish include resident cutthroat trout, rainbow trout, river lamprey and sculpin.

Table 5.1 Species known to occur in the Ecola Creek watershed.

| Common Name | Latin name | Source |
|---|---|---|
| Coho | *Oncorhynchus kisutch* | ODFW1979, 1997 |
| Steelhead | *Oncorhynchus mykiss* | ODFW 1979, 1997 |
| Chinook | *Oncorhynchus tshawytscha* | ODFW 1997 |
| Cutthroat Trout | *Oncorhynchus clarki clarki* | ODFW 1979, 1997 |
| Chum | *Oncorhynchus keta* | ODFW 1979 |
| Pacific Lamprey | *Lamptera tridentata.* | Natural Heritage website, |
| River Lamprey | *Lamptera ayresi* | Natural Heritage website |
| Sculpins | *Cottus spp.* | ODFW district biologist |

With the exception of fall chinook, all other fish species present today are thought to be native to Ecola Creek. There are conflicting opinions regarding the chinook populations in the Ecola Creek watershed. In the past, and still today, some ODFW fish biologist's consider the chinook run to consist mostly of strays from a hatchery introduction on the Necanicum beginning in the early 1980's (ODFW 1997 and Sheahan pers.comm.1999). However, numerous accounts by local fisherman contradict the idea that chinook were introduced to Ecola Creek. Many claim that chinook are native to the stream and were present prior to the 1980's (Webb, pers. comm. 1999 and Shields, pers. comm. 1999). An alternative view is that chinook are native to Ecola Creek, but production is limited because of the lack of estuarine rearing habitat (Long, pers. comm.1999 and Sheahan, pers. comm. 1999).

In addition, the chum run in Ecola Creek is thought to be "a small and inconsistent" run according to a 1979 ODFW Draft Fish Management Plan for Ecola Creek.

## 5.3 Fish Distribution and migration barriers

Fish distribution is presented in Figure 5.1 and is derived from the Oregon Department of Forestry (ODF) Fish Presence/Absence survey maps. The fish distribution map illustrates streams surveyed for fish and the portions of the stream where fish were observed or not observed. In addition, the map also illustrates portions of the streams that have not been surveyed. These areas on the map are either assumed to have fish or fish presence is considered to be unknown according to the best professional judgement of ODFW fish biologists. It should be noted that ODF presence/absence surveys demonstrate where fish are observed but species determination is not part of the survey protocol.

Figure 5.1 indicates that anadromous fish distribution is limited in the North Fork subwatershed due to a series of falls that impede passage along the North Fork approximately one mile upstream from its confluence with the West Fork. Resident cutthroat trout have been observed above the falls and this is indicated by the presence of fish above the falls in Figure 5.1.

There are no known natural migration barriers in the Lower Ecola subwatershed, but three culvert barriers and one potential culvert barrier in the subwatershed do limit fish passage. Of the three known culvert barriers, one is located on the East Fork of Logan Creek where the creek crosses US Highway 101; the other two are located on Swigart Creek, one located at the point where the stream crosses Highway 101 and the other just downstream from where a gravel driveway crosses the creek.

There is one confirmed natural barrier to fish passage in the West Fork subwatershed on Tolovana Creek, approximately a half a mile up from its confluence with the West Fork. In addition to this barrier, two historical ODFW habitat surveys (1967 and 1992) indicate another possible barrier on the West Fork approximately .5 miles upstream of its confluence with Tolovana Cr. The 1994 habitat survey on the West Fork did not record the barrier and assessment field visits have failed to locate it as well. The discrepancy between the surveys may be due to an active historic slide on the Tolovana-Hug Point Cross-over road which may periodically create migration barriers on the West Fork of Ecola Creek when it slumps into the creek (Teagle, pers.comm.2001).

### 5.4 Species of Concern and Listing Status

The National Marine Fisheries Service (NMFS) is the designated agency responsible for most marine and anadromous fish under the federal Endangered Species Act (ESA). In this context NMFS decides whether a species should be listed and administers development of

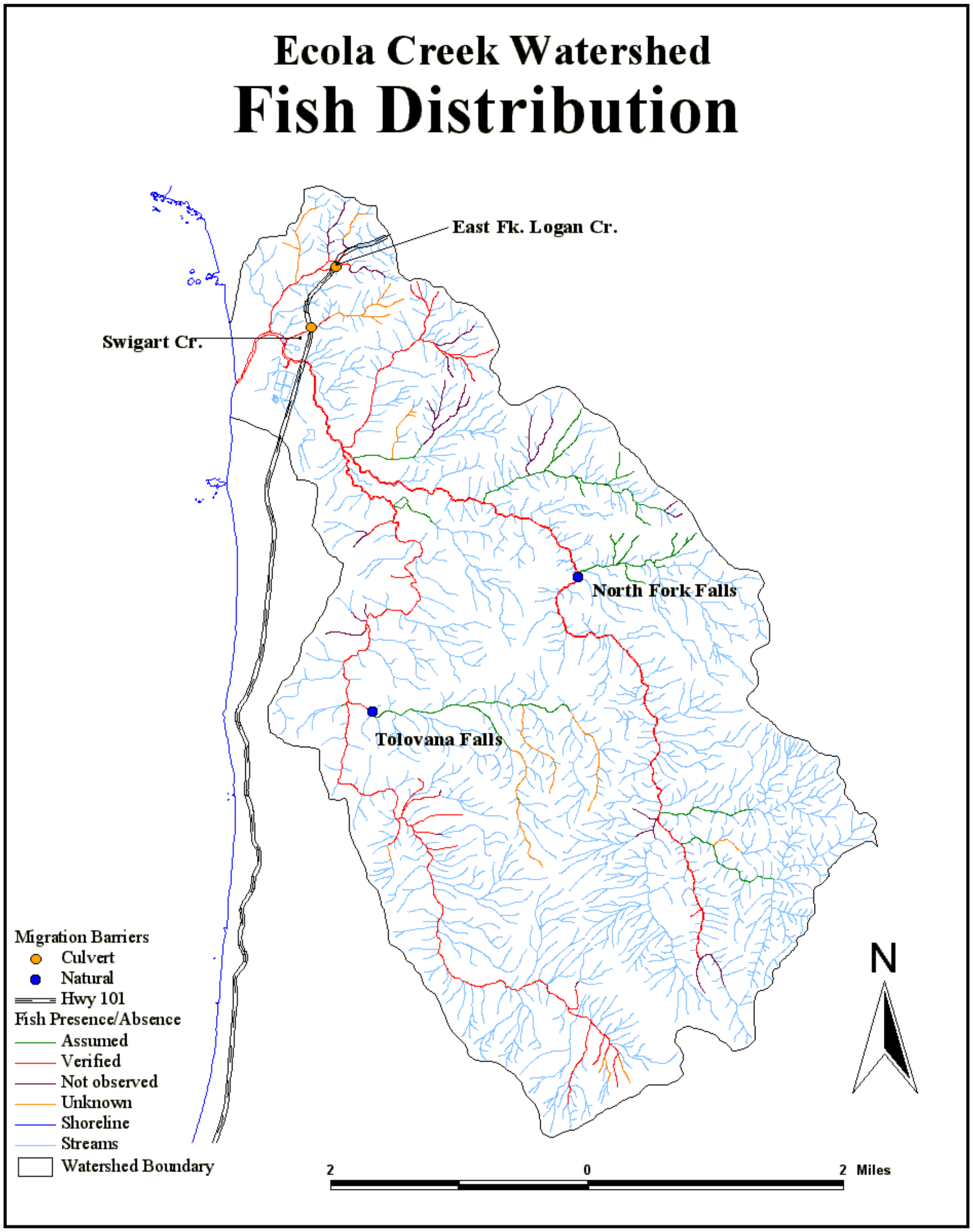



Figure 5.1 Fish distribution in the Ecola Creek watershed based upon ODF Fish Presence/ Absence surveys. The map identifies areas within streams where fish were found, where they were absent, where they were assumed to be and where it is unknown. In addition, ODFW verified fish migration barriers are illustrated.

recovery plans for listed species. As of Nov 1999, however, Coastal cutthroat trout were put under the jurisdiction of the United States Fish and Wildlife Service (NMFS website).

The ESA is designed to protect threatened and endangered species and the habitats they depend on. Along with this federal protection, state and private mandates and public efforts have applied additional safeguards for the species and their habitats. The Oregon Department of Forestry is developing an assessment and management plan to detail forest management practices within areas occupied by threatened species. The Forest Practices Act regulates private timber practices and is designed to help protect important habitat areas. In addition, watershed councils provide efforts at the grassroots level to gather data and help protect valuable habitat areas.

During the course of researching ESA listing proposals, NMFS has identified distinct populations of Pacific salmon, steelhead and sea-run cutthroat trout, which the agency refers to as ESUs. An ESU is an Evolutionarily Significant Unit, which refers to a genetically or ecologically distinct group of Pacific salmon, steelhead or sea-run cutthroat trout. Fish species in the Ecola Creek watershed, their ESU and their ESA status for coastal streams in Clatsop County are reported on Table 5.2. The National Marine Fisheries Service (NMFS) listed Coho as threatened in 1998. Steelhead are considered candidates for listing and cutthroat trout, Pacific lamprey and river lamprey are all Species of Concern (SoC) under the ESA. A brief discussion of each species listed is below. Chinook and Chum listings were determined to be unwarranted for the ESUs in our area.

5.4.1 Coho Salmon

Coho were listed as a threatened species on August, 10 1998. Critical Habitat was designated on February 16, 2000 and Protective Regulations were designated on July 10, 2000. The Ecola Creek watershed is part of the Oregon Coast ESU and is listed as critical coho habitat. This ESU includes all naturally spawned populations of coho salmon in Oregon coastal streams south of the Columbia River and north of Cape Blanco. Major river basins containing spawning and rearing habitat for this ESU comprise approximately 10,606 square miles in Oregon. The following Oregon counties lie partially or wholly within these basins: Benton, Clatsop, Columbia, Coos, Curry, Douglas, Jackson, Josephine, Lane, Lincoln, Polk, Tillamook, Washington, and Yamhill.

5.4.2 Winter Steelhead

The Ecola Creek watershed lies within the Oregon Coast ESU for steelhead. On March 19, 1998, NMFS determined that listing was not warranted for this ESU. However, the ESU is designated as a candidate for listing due to concerns over specific risk factors. The ESU includes steelhead from Oregon coastal rivers between the Columbia River and Cape Blanco. Major river basins containing spawning and rearing habitat for this ESU comprise approximately 10,604 square miles in Oregon. The following Oregon counties lie partially

Table 5.2 ESA and ODFW Status for fish in the Ecola Creek watershed. ESA status obtained from the National Marine Fisheries website. ODFW status obtained from the ODFW and Natural Heritage Database websites.

| Species | ESU | ESA Status | ODFW Status |
|---|---|---|---|
| Coho | Oregon Coast | Threatened | Not listed |
| Steelhead | Oregon Coast | Candidate | Not listed |
| Chinook | Oregon Coast | Not warranted | Not listed |
| Chum | Pacific Coast | Not warranted | Not listed |
| Cutthroat Trout | Oregon Coast | Species of Concern | Not listed |
| Pacific Lamprey | | Species of Concern | Vulnerable |
| River Lamprey | | Species of Concern | Not listed |

National Marine Fisheries web site: *www.nwr.noaa.gov/1salmon/salmesa/index.htm*
ODFW website-*www.dfw.state.or.us/ODFWhtml/InforCntrFish/PDFs/comptefishlist.pdf*
Natural Heritage database-*www.heritage.tnc.org/nhp/us/or/fish.htm*

or wholly within these basins: Benton, Clatsop, Columbia, Coos, Curry, Douglas, Jackson, Josephine, Lane, Lincoln, Polk, Tillamook, Washington, and Yamhill.

5.4.3 Coastal Cutthroat Trout

On April 5, 1999, NMFS determined that listing was not warranted for the Oregon Coast ESU for Coastal cutthroat trout. However, the ESU is designated as a candidate for listing due to concerns over specific risk factors. The ESU includes populations of Coastal cutthroat trout in Oregon coastal streams south of the Columbia River and north of Cape Blanco (including the Umpqua River Basin, where cutthroat trout were listed as an endangered species in 1996).

Major river basins containing spawning and rearing habitat for this ESU comprise approximately 10,606 square miles. The following Oregon counties lie partially or wholly within these basins: Benton, Clatsop, Columbia, Coos, Curry, Douglas, Jackson, Josephine, Lane, Lincoln, Polk, Tillamook, Washington, and Yamhill.

## 5.5 Life History

### 5.5.1 Coho Salmon

Coho smolts typically migrate to the sea in the spring of their second year. In saltwater, coho salmon are bluish-black with silver sides and black spots on the back and upper part of the caudal fin. The side of their mouth is gray or black with white gums. In saltwater they spend 16-20 months rearing in the ocean and then return to freshwater as three-year-old adults. A returning adult may measure up to 40 inches in length and usually weigh between 6 to 12 pounds, but may weigh up to 31 pounds. After the first summer at sea, a small number of the males reach sexual maturity and return that fall as two-year-old “jacks”. Jack returns are used to predict adult abundance for the following year, and serve as a key component for setting ocean coho fishing regulations.

Coho salmon tend to spawn in riffles or gravel bars with low stream velocities, shallow water and small gravel. In the Ecola Creek watershed spawning occurs in the mainstem, lower gradient areas of the North and West Fork and lower gradient areas of accessible tributaries, such as Logan Creek. Spawning occurs generally from November to February, with eggs hatching the following spring (ODFW 1997 and www.streamnet.org).

Coho are especially vulnerable to siltation during their freshwater lifestage, as siltation can ruin spawning beds and smother eggs. When in fresh water, adequate stream cover is important to fry survival, as are high dissolved oxygen levels. Juveniles require quiet water, such as off-channel alcoves and beaver ponds for winter survival and pools with adequate cover for summer rearing. Preference for pools often leads to stranding as water recedes in the summer months. Large wood is important for creation of pools, cover within pools and winter sanctuaries. Coho utilize most accessible areas in a watershed to locate preferred seasonal habitats. Fry feed on aquatic insects, zooplankton and small fish and are prey for larger coho and cutthroat trout. Once reaching the estuaries, coho salmon fall prey to a number of other species. Other factors that may effect coho are human changes, such as shoreline development, residential drainage and the filling of marine and estuarine wetlands. The time spent in this habitat is critical to the development of the species and their ability to survive in the offshore environment.

### 5.5.2 Winter Steelhead Trout

Steelhead have a wide variety of life history patterns which vary among populations. Most steelhead remain in streams for two years after emergence, but may stay in rivers from 1 to 4 years before migrating to the ocean in March through May. Unlike salmon, steelhead migrate individually rather than in schools. Steelhead spend 1 to 5 years at sea before returning to natal streams or rivers. Winter steelhead measure up to 45 inches in length and usually weigh less than 10 pounds, but may weigh as much as 40 pounds. In the sea, winter steelhead are bluish from above and silvery from below with small black spots on the back and most fins.

Winter steelhead tend to spawn in higher gradient areas of the mainstem and forks of Ecola Creek. The North Fork of Ecola Creek appears to have the best steelhead habitat (ODFW 1997). Steelhead generally spawn in riffles and gravel bars with small to medium size gravel. Spawning occurs from January to May. Eggs need good water flow (to supply oxygen) to survive. Fry emerge in late spring with the majority by mid-June. Juveniles prefer high gradient riffles and plunge pool type habitats. In freshwater and estuarine habitats, steelhead feed on small crustaceans, insects and small fishes. Steelhead do not always die after spawning, but will again migrate to the ocean.

The quality of rearing habitat is particularly important for juvenile steelhead due to their extended rearing time. Because young steelhead spend a significant portion of their lives in rivers and streams, they are particularly susceptible to human induced changes to water quality and habitat threats (ODFW 1997 and www.streamnet.org).

### 5.5.3 Coastal Cutthroat trout

Sea-run cutthroat are found in anadromous reaches (below migration barriers) while resident cutthroat are found in all areas of the Ecola Creek watershed, including above barriers and in very small tributaries. Cutthroat trout and steelhead are unlike most other salmonids, because they may spawn more than once. Adult sea-run cutthroat commonly enter streams during the fall and feed on the eggs from other salmons' spawn. Spawning occurs from December through May and fry emerge in spring/summer. Spawning adults can range from ages two to ten, with first time spawners usually being three or four years old. After spawning, the 'spent' or spawned sea-run adults, now called 'kelts', often return to salt water in late March or early April while resident forms stay in freshwater. Sea-run cutthroat trout usually spend less than a year in salt water before returning to spawn.

Young sea-run cutthroat can spend one to nine years in fresh water before they migrate to the estuaries and ocean in the spring, but most commonly they migrate after three years from emergence. Juveniles and adults are carnivorous, feeding mostly on insects, crustaceans, and other fish throughout their lives.

Large woody debris and in-stream structures play an important role in providing valuable habitat for coastal cutthroat trout. In freshwater, adult cutthroat typically reside in large pools while the young reside in riffles, most commonly in upper tributaries of small rivers. Coastal cutthroat trout utilize a wide variety of habitat types during their complex life cycle. They spawn in small tributary streams, and utilize slow flowing backwater areas, low velocity pools, and side channels for rearing of young. Good forest canopy cover, in-stream woody debris, and abundant supplies of insects are crucial for the young cutthroat's survival.

During the estuarine or ocean phase of life, the cutthroat trout utilizes tidal sloughs, marshes, and swamps as holding areas and feeding grounds. These tidal areas are also very important for the survival of the prey fishes that the cutthroat depends on for food. Healthy estuaries with abundant supplies of small schooling fishes and young crustaceans are necessary for the cutthroat's survival (ODFW 1997 and www.streamnet.org).

## 5.6 Population Status

### 5.6.1 Coho Salmon

Coho populations have experienced declines in numerous streams throughout their range in Oregon, Washington, and California. There is a general geographic trend in the health of West Coast stocks, with the southern and easternmost stocks in the worst condition. During this century, naturally reproducing populations of coho salmon are believed to have been extirpated in nearly all Columbia River tributaries. The National Marine Fisheries Service reviewed new information and public comments on the proposed ESUs, and concluded that all three warrant listing under the Endangered Species Act (ESA). Available information supports the agency's finding that the Oregon Coast, Southern Oregon/Northern California Coasts, and Central California Coast ESUs meet the definition of a threatened species, i.e., they are likely to become endangered in the foreseeable future throughout all or a significant portion of their ranges.

Correspondence with ODFW Corvallis Research Lab personnel indicate that population estimates for the Ecola Creek watershed are not possible due to the nature of the surveys in the basin. The surveys are grouped with those of the Necanicum watershed and are designed to give population estimates for a larger geographic region than that of the Ecola Creek watershed. Two ODFW reports were located in the course of the assessment that estimate coho populations in Ecola Creek. The information is included but may not reflect accurate estimates as the basis for their determination is unknown. A 1997 ODFW Information Report on Ecola Creek estimated the coho population in the basin to be between 100-200 fish (ODFW 1997). A prior ODFW report in 1979 determined the production capacity for coho in Ecola Creek to be 275 fish (ODFW, 1979).

Figure 5.2 demonstrates the location of spawning surveys in the Ecola Creek watershed. As the map indicates, there is one annual standard coho survey in the Ecola Creek watershed beginning where Elk Creek Rd crosses the West Fork of Ecola Creek. Table 5.3 below shows Area Under the Curve (AUC) estimates for the standard coho survey on the West Fork. AUCs estimate the total number of coho present on the survey over the course of the spawning season based upon AUC techniques. The adult AUCs only pertain to the stretch of stream in the survey and do not indicate population estimates for the basin. In addition,

Table 5.3 Standard Coho Survey on the West Fork of Ecola Creek illustrating Area Under the Curve (AUC) estimates for the associated survey. The AUC is an estimate of the total number of coho present on the survey over the course of the spawning season based on Area-Under-the-Curve techniques.

| Year | Reach ID | Segment | Coho Adult AUC | MILES | AUC/Mile |
|---|---|---|---|---|---|
| 2000 | 26182.00 | 2 | 15 | 0.50 | 30.00 |
| 1999 | 26182.00 | 2 | 5 | 0.50 | 10.00 |
| 1998 | 26182.00 | 2 | 0 | 0.50 | 0.00 |
| 1997 | 26182.00 | 2 | 1 | 0.50 | 2.00 |
| 1996 | 26182.00 | 2 | 14 | 0.50 | 28.00 |
| 1995 | 26182.00 | 2 | 2 | 0.50 | 4.00 |
| 1994 | 26182.00 | 2 | 6 | 0.50 | 12.00 |
| 1993 | 26182.00 | 2 | 1 | 0.50 | 2.00 |
| 1992 | 26182.00 | 2 | 1 | 0.50 | 2.00 |
| 1991 | 26182.00 | 2 | 25 | 0.50 | 50.00 |
| 1990 | 26182.00 | 2 | 8 | 0.50 | 16.00 |
| 1989 | 26182.00 | 2 | 15 | 0.50 | 30.00 |

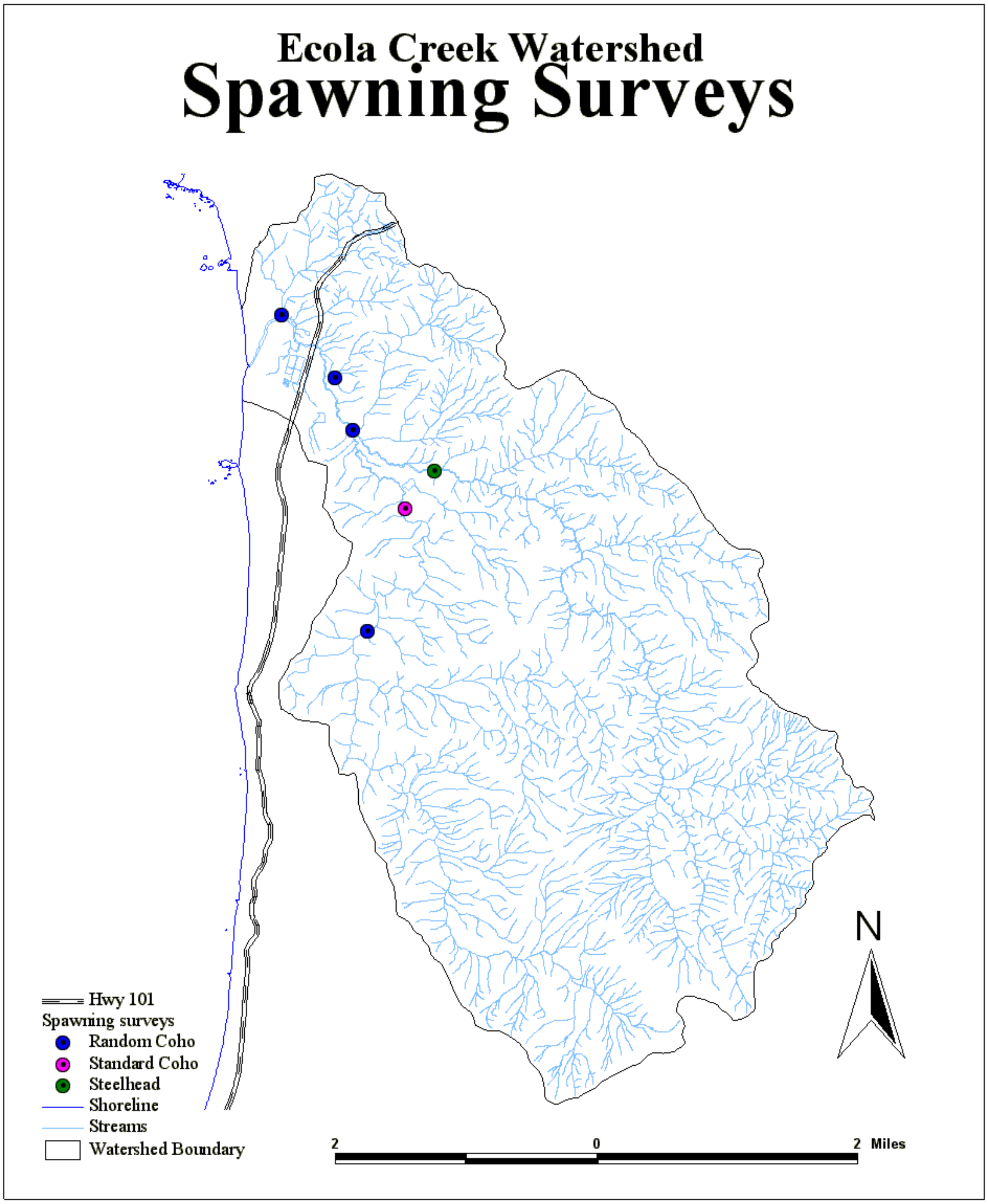



Figure 5.2 The location of ODFW random and standard coho spawning surveys and the steelhead spawning survey in the Ecola Creek watershed.

Table 5.4 Random Coho Surveys in the Ecola Creek watershed illustrating Area Under the Curve (AUC) estimates for the associated surveys. The AUC is an estimate of the total number of coho present on the survey over the course of the spawning season based on Area-Under-the-Curve techniques.

| Year | Reach ID | Segment | MILES | Coho Adult AUC | AUC/Mile |
|---|---|---|---|---|---|
| 2000 | Logan Cr. | 1 | 0.52 | 0 | 0.00 |
| 1999 | West Fork | 1 | 0.96 | 6 | 6.25 |
| 1998 | West Fork | 2 | 0.50 | 0 | 0.00 |
| 1997 | Tolovana Cr. | 2 | 0.33 | 0 | 0.00 |
| 1997 | West Fork | 4 | 0.67 | 10 | 14.93 |
| 1996 | West Fork | 4 | 0.67 | 9 | 13.43 |
| 1995 | West Fork | 1 | 0.96 | 3 | 3.13 |

Table 5.4 lists the AUCs for the random surveys in the Ecola Creek watershed for the last five years. The number of random surveys conducted in a basin are based upon the extent of spawning miles available. ODFW records indicate Ecola Creek has only 8.21 miles of available coho spawning habitat, so consequently there are only one or two random coho surveys in any given year.

Population numbers in the Ecola Creek watershed can not be extrapolated from the limited number of fish surveys in the basin, but the surveys do offer an index of abundance over time (Firman, pers. comm 2001; Sheahan, pers. comm. 2001). In order to estimate the entire population of an area as small as the Ecola Creek watershed a census of the entire area would need to be conducted. The spawning miles in the watershed would need to be surveyed once a week during the entire period that coho might spawn (roughly mid-October to end of February) (Firman, pers. comm., 2001).

5.6.2 Winter Steelhead

A 1997 ODFW Information Report on Ecola Creek estimated the winter Steelhead population to be between 150-300 adults (ODFW, 1997). Another ODFW report in 1979 indicated the winter steelhead population to be between 100-300 fish (ODFW 1979).

Steelhead surveys in the watershed are done on a volunteer basis. Two years of summary steelhead spawning survey data from the North Fork are presented in Table 5.5. As with coho, the only way to determine population numbers in a watershed so small is to conduct a census once a week during the steelhead spawning season.

Table 5.5 Summary of North Fork Winter Steelhead Spawning Surveys, Reach 26183.00, segment 2, 1.3 miles

| Year | # Surveys | Total | Marked | Unmarked | Unknown | Dead | Redds |
|---|---|---|---|---|---|---|---|
| 1998 | 10 | 25 | 2 | 5 | 18 | 0 | 55 |
| 1999 | 7 | 21 | 0 | 5 | 16 | | 29 |

5.6.3 Coastal cutthroat trout

Relatively little population data exist for the Coastal cutthroat trout in the Ecola Creek basin and statewide. Currently there are no cutthroat surveys in the watershed. In Oregon, it is believed that the Coastal cutthroat trout is undergoing widespread decline. Several populations in western Oregon are thought to be at moderate risk of extinction, with poor ocean conditions and habitat-related problems thought to be significant contributing factors to their decline. (ODFW 1997 and www.streamnet.org)

## 5.7 Stocking History and Hatchery/Wild Fish Interactions

Ecola Creek has been managed for wild fish for the past two and a half decades. Fish were stocked in the basin prior to the mid-1970s. Adult coho and steelhead were stocked in Ecola Creek in 1974 on both forks according to a 1975 ODFW memo. The same 1975 memo also recommended stocking Ecola Creek with steelhead and coho for following year. A telephone interview with Warren Knispel, the local ODFW fish biologist at the time, indicated that steelhead and coho were stocked in the creek at one time, but when they were stocked and for how long is unknown (Knispel, pers. comm, 1999).

Due to the presence of fin-clipped steelhead in Ecola Creek, it is speculated that considerable straying of hatchery steelhead from releases in the Necanicum and North Fork Nehalem have overwhelmed the early spawning wild steelhead in Ecola Creek (ODFW 1997).

Annual releases of yearling cutthroat trout ended after 1973 (ODFW 1979). It is unknown how long cutthroat were stocked in the Ecola Creek Watershed. It is also speculated that Ecola Creek cutthroat have been influenced considerably by hatchery adult sea-runs from smolt releases in the Necanicum and Nehalem Rivers. These stocking programs were terminated after 1994 (ODFW 1997).

# CHAPTER 6 AQUATIC AND RIPARIAN HABITAT

## 6.1 Introduction

Anadromous trout and salmon utilize different areas of the watershed during different parts of their complex life cycle, often migrating long distances upstream and downstream seeking suitable habitat conditions according to their life stage. In addition, fish distribution varies in a watershed according to physical factors including habitat conditions such as substrate and pool frequency, as well as biological factors such as food availability and distribution. Understanding the spatial and temporal distribution of key aquatic habitat components is a fundamental step in maintaining conditions suitable for salmonid populations.

The Aquatic and Riparian Habitat chapter combines habitat components from three different chapters in the OWAM: the habitat segment of the Fish and Fish Habitat chapter, the Riparian and Wetlands chapter and the Channel Modification chapter. Channel modifications are included because of their affect on fish habitat.

Critical questions for aquatic and riparian habitat are:

1. What is the condition of fish habitat in the watershed according to habitat data on the watershed?
2. What are the current conditions of riparian areas in the watershed?
3. How do the current conditions compare to those potentially or typically present for the ecoregions in the watershed?
4. How can riparian areas be grouped within the watershed to increase our understanding of what areas need protection and what the appropriate restoration/enhancement opportunities might be?
5. Where are the wetlands in the watershed?
6. What are the general characteristics of wetlands within the watershed?
7. What opportunities exist to restore wetlands in the watershed?
8. Where are current and historic channel modifications located?
9. What CHT's have been impacted by channel modifications?
10. What are the types and relative magnitudes of past and current channel modifications?

## 6.2 Aquatic Habitat Assessment

The Aquatic Inventories Program through the Oregon Department of Fish and Wildlife (ODFW) has gathered habitat data on various streams in the Ecola Creek basin. The stream habitat data was gathered using a standard stream survey methodology developed by ODFW (Moore et al. 1997). To assess aquatic habitat conditions the ECWC has compiled the Aquatic Inventory stream data for Ecola Creek. The approach used in the OWAM provides a format for determining how habitat conditions vary throughout the watershed and for comparing watershed conditions with " benchmark" conditions for the State of Oregon.

Stream survey data provide a picture of current stream conditions. Streams are dynamic systems and channel conditions may vary drastically from year to year depending upon environmental conditions such as high-flow flood events, low flow periods, etc. Also, survey methods have evolved and older data may have been collected using slightly different methodologies, as is the case in Ecola Creek. Nevertheless, these data are useful in describing trends in habitat conditions that may be linked to larger watershed processes. Through understanding these habitat distributions in the watershed, problem areas may be identified and addressed.

The locations of the Aquatic Inventory surveys are presented in Figure 6.1. Three separate habitat conditions are compiled from the survey information: pool and substrate conditions, large woody debris conditions and riparian conditions. Individual parameters within each condition category are rated against benchmark conditions for the State of Oregon (Table 6.1). The benchmarks rate conditions as desirable, moderate, or undesirable in relation to the natural regime of these streams. These values depend upon climate, geology, vegetation, and disturbance history. While individual condition parameters are rated, overall condition ratings are omitted. This is because the OWAM lacks overall condition rating protocols concerning data gaps and missing data. There are a significant amount of data gaps in the Ecola Creek survey data. While this makes overall condition summaries difficult, it has been noted where it is possible to indicate strengths and weaknesses in the Ecola Creek watershed from the data.

The Aquatic Inventory surveys available for Ecola Creek are from 1992 and 1994. The 1992 surveys are missing several parameters such as complex pools per km, key pieces of wood and numbers of conifers in riparian areas. Therefore, in reaches where surveys from the two different years overlap, only the data from 1994 is used. Three stream reaches were surveyed in

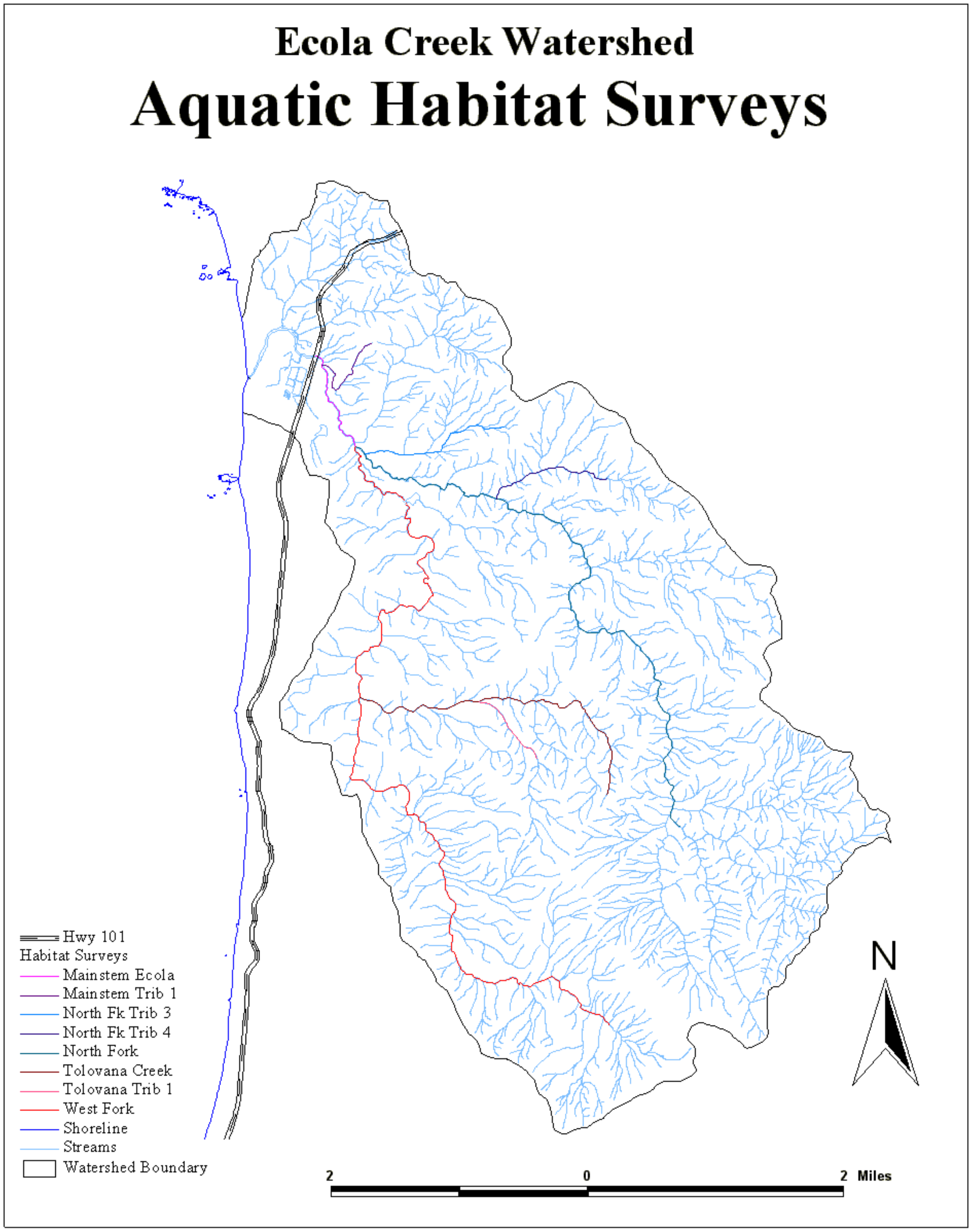



Figure 6.1 The Locations of the Oregon Department of Fish and Wildlife's Aquatic Habitat Inventory Surveys in the Ecola Creek watershed.

the Lower Ecola subwatershed, ten stream reaches in the West Fork subwatershed and nine stream reaches in the North Fork subwatershed. All three of the aquatic surveys in the Lower Ecola subwatershed were conducted in 1992. Only one 1992 surveys is included for the West Fork subwatershed (Reach 1 on the West Fork) and three 1992 surveys are included for the North Fork subwatershed (North Fork Tributaries 2 and 3).

Table 6.1. ODFW Habitat Benchmarks

| | | Undesirable | Desirable |
|---|---|---|---|
| Pools | Pool Area (percent total stream area) | <10 | >35 |
| | Pool Frequency (channel widths between pools) | >20 | 5-8 |
| | Residual Pool Depth: Small streams (>7meters (m) width) | <0.2 | >0.5 |
| | Residual Pool Depth: Med. Streams (☛7m & <15m) | | |
| | Low Gradient (slope <3%) | <0.3 | >0.6 |
| | High Gradient (slope >3%) | <0.5 | >1.0 |
| | Residual Pool Depth: Large Streams (☛15m width) | <0.8 | >1.5 |
| | Complex Pools (w/wood complexity>3km) | <1.0 | >2.5 |
| Substrate | Gravel (percent area) | <15 | ☛35 |
| | Silt-Sand-Organics (percent area) | | |
| | Parent material | >20 | <10 |
| | Channel gradient <1.5% | >25 | <12 |
| Large Woody Debris (minimum size 15cm X 3m) | Pieces/100m Stream Length | <10 | >20 |
| | Volume/100m Stream Length | <20 | >30 |
| | "Key" Pieces (>60cm and 10m long/100m) | <1 | >3 |
| Riparian Conifers (30 meters from both sides) | Number >20-in dbh/1,000ft Stream Length | <150 | >300 |
| | Number >35-in dbh/1,000ft Stream Length | <75 | >200 |
| | (dbh = diameter breast height) | | |
| Shade | Stream width <12 m | <60 | >70 |
| | Stream width >12m | <50 | >60 |

6.2.1 Pool and Substrate Condition Summary

Pools are important channel features for salmonids, providing refuge and feeding areas. Substrates are also an important channel feature since salmonids use gravel beds for spawning. Heavy sedimentation can bury gravel beds resulting in loss of spawning and invertebrate habitat.

In this section, pool and substrate habitats are compared against ODFW benchmarks to evaluate current habitat conditions. Pool and substrate data are presented in Table 6.2. Pool parameters

**Table 6.2 Pool and substrate conditions in the Ecola Creek watershed based upon ODFW benchmark values. Benchmark values provided in Table 6.1.**

| Site | Reach | Stream Length (m) | Gradient | Pool Area | Pool Frequency (Channel widths between pools) | Residual Pool Depth (m) | Complex Pool | Gravel (%area) | Silt-sand-organics (%area) |
|---|---|---|---|---|---|---|---|---|---|
| '92 Mainstem | 1 | 1,409 | .4 | 34.66 | 3.83 | .35 | ND | 73 | 28 |
| '92 Main. Trib. | 1 | 1,159 | .1 | 5.04 | 36.21 | No residual pools | ND | 20 | 80 |
| '92 Main. Trib. | 2 | 1,198 | 4.9 | 13.89 | 13.62 | No residual pools | ND | No riffles | No riffles |
| '94 North Fork | 1 | 4,018 | 9.6 | 43.67 | 4.4 | .75 | 0 | 56.5 | 4.5 |
| '94 North Fork | 2 | 998 | 4.0 | 67.8 | 3.7 | .39 | 0 | 95.0 | 4.0 |
| '94 North Fork | 3 | 661 | 9.4 | 39.44 | 3.6 | No residual pools | 0 | 76.0 | 3.0 |
| '94 Nfk Trib 1 | 1 | 362 | 8.8 | 10.68 | 11.0 | .22 | 0 | 65.0 | 12.5 |
| '94 Nfk Trib 1 | 2 | 478 | 5.5 | 8.35 | 13.8 | No residual pools | 0 | 66.5 | 13.0 |
| '94 Nfk Trib 1 | 3 | 661 | 9.4 | 13.28 | 7.3 | .45 | 1.4 | 61.5 | 16.5 |
| '92 Nfk Trib 2 | 1 | 776 | 1.6 | 53.22 | 12.74 | .30 | ND | 33.0 | 63.0 |
| '92 Nfk Trib 2 | 2 | 1,137 | 9.8 | 1.49 | 111.60 | No residual pools | ND | 0.0 | 100.0 |
| '92 Nfk Trib 3 | 1 | 408 | 9.1 | 8.10 | 10.2 | No residual pools | ND | No riffles | No riffles |
| '92 West Fork | 1 | 5,236 | .8 | 35.47 | 4.32 | .31 | ND | 28.5 | 34 |
| '94 West Fork | 1 | 2,370 | 4.0 | 31.54 | 6.5 | .54 | 0.0 | 65.5 | 1.5 |
| '94 West Fork | 2 | 549 | 1.4 | 41.96 | 5.0 | .45 | 1.0 | 78.0 | 1.0 |
| '94 West Fork | 3 | 5,748 | 5.7 | 33.88 | 6.6 | .73 | 0.0 | 72.5 | 2.5 |
| '94 Tolovana CR | 1 | 351 | 4.0 | 6.41 | 23.7 | No residual pools | 0.0 | 63.0 | 5.5 |
| '94 Tolovana CR | 2 | 2,087 | 8.0 | 21.44 | 4.7 | .58 | .4 | 65.0 | 9.5 |
| '94 Tolovana CR | 3 | 250 | 2.5 | 17.61 | 4.6 | No residual pools | 0.0 | 65.0 | 21.0 |
| '94 Tolovana CR | 4 | 677 | 12.2 | 5.6 | 12.3 | No residual pools | 0.0 | 70.0 | 10.5 |
| '94 Tolovana CR | 5 | 1,638 | 4.0 | 7.53 | 22.5 | No residual pools | 0.0 | 51.0 | 48.5 |
| '94 Tol. CR Trib | 1 | 1,379 | 10.9 | 9.33 | 5.9 | .25 | 1.3 | 63.0 | 15 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| (white) | =Desirable | (light grey) | =Moderate | (dark grey) | =Undesirable | (black) | =No data Available |

rated were pool area, pool frequency, residual pool depth and complex pools. Substrate parameters rated were gravel and silt-sand-organics.

Overall, pool area was generally between moderate and undesirable and pool frequency was generally desirable for the streams surveyed. Ten out of the twelve reaches surveyed were missing residual pools. In the streams with residual pools, the data reflected moderate to desirable conditions. The 1994 surveys revealed predominately undesirable pool complexity for the watershed. Gravel conditions in riffles were predominately desirable, with only three moderate reaches and one undesirable reach. Only gravel conditions on the North Fork Trib 2, Reach 2 rated undesirable. Silt-sand-organic conditions in the watershed varied between a mixture of desirable, moderate and undesirable ratings.

Pool conditions were generally moderate, gravel conditions were desirable and silt-sand-organics rated undesirable for the Mainstem reach. Pool conditions were poor moderate to undesirable the Mainstem Trib. Residual pools were lacking in the Trib, as were riffles in the upper reach. Gravel conditions were moderate and silt-sand-organics were undesirable in the lower reach. Overall pool and substrate conditions rated favorably on the North Fork and West Fork reaches, although pool complexity was poor. The North Fork Trib ratings were generally moderate to poor for all parameters surveyed. Three of the five North Fork Tribs with riffles did have desirable gravel conditions. Tolovana Creek rated undesirable for pool area, pool complexity and silt-sand-organics overall, with mostly desirable pool frequency and gravel conditions. All but one reach out of five lacked residual pools.

### 6.2.2 Large Woody Debris Condition Summary

Large woody debris (LWD) is an important feature that adds complexity to the stream channel. LWD in the stream provides cover, produces and maintains pool habitat, creates surface turbulence, and retains small woody debris. Functionally, LWD dissipates stream energy, retains gravel and sediments, increases stream sinuosity and length, slows the nutrient cycling process, and provides diverse habitats for aquatic organisms. LWD is most abundant in intermediate-sized channels in third to forth-order streams. In fifth order streams and larger, the channel width is generally wider than the length of a typical piece of LWD, and therefore, LWD is not likely to remain stable in the channel. In wide channels LWD is more likely to be found along the edge of the channel. (Bischoff, et. al. 2000)

Table 6.3 presents large woody debris survey data. Three LWD parameters were rated in the Large Woody Debris Condition Summary: pieces of LWD, volume of LWD and key pieces of LWD (>60cm and 10m long/100m). A majority of the reaches rated desirable for pieces of LWD, but there were a significant number of reaches that rated moderate and undesirable. Most surveyed reaches rated undesirable and moderate for volume of LWD; out of the 22 reaches, 11 rated undesirable and 6 rated moderate. Data for key pieces/100m were only available from the 1994 surveys. Desirable conditions were lacking for Key pieces of LWD in all the 1994 surveys. Of 15 surveys that rated key pieces of LWD, 12 rated undesirable and three rated moderate.

**Table 6.3 Large woody debris conditions in the Ecola Creek watershed based upon ODFW habitat benchmark values. Benchmark values for stream habitat conditions provided in Table 6.1**

| Site | Reach | Stream Length (m) | Gradient | LWD Pieces/100m | LWD Volume $M^3$/100m | Key Pieces/100m |
|---|---|---|---|---|---|---|
| '92 Mainstem | 1 | 1,409 | .4 | 14.3 | 22.19 | ND |
| '92 Main.Trib. | 1 | 1,159 | .1 | 4.7 | 11.5 | ND |
| '92 Mainstem Trib. | 2 | 1,198 | 4.9 | 4.3 | 15.6 | ND |
| '94 North Fork | 1 | 4,018 | 9.6 | 16.2 | 25.8 | .7 |
| '94 North Fork | 2 | 998 | 4.0 | 18.1 | 15.2 | .2 |
| '94 North Fork | 3 | 661 | 9.4 | 23.5 | 20.5 | .4 |
| '94 Nfk Trib 1 | 1 | 362 | 8.8 | 64.3 | 48.6 | .3 |
| '94 Nfk Trib 1 | 2 | 478 | 5.5 | 28.1 | 20.2 | .2 |
| '94 Nfk Trib 1 | 3 | 661 | 9.4 | 38.6 | 22.1 | 0 |
| '92 Nfk Trib 2 | 1 | 776 | 1.6 | 2.7 | 10.0 | ND |
| '92 Nfk Trib 2 | 2 | 1,137 | 9.8 | 4.3 | 10.2 | ND |
| '92 Nfk Trib 3 | 1 | 408 | 9.1 | 6.1 | 9.5 | ND |
| '92 West Fork | 1 | 5,236 | .8 | 9.4 | 17.1 | ND |
| '94 West Fork | 1 | 2,370 | 4.0 | 20.8 | 20.6 | .2 |
| '94 West Fork | 2 | 549 | 1.4 | 17.5 | 14.7 | .2 |
| '94 West Fork | 3 | 5,748 | 5.7 | 29.8 | 18.3 | .1 |
| '94 Tolovana Cr | 1 | 351 | 4.0 | 13.7 | 5.1 | .3 |
| '94 Tolovana Cr | 2 | 2,087 | 8.0 | 48.9 | 50.3 | .2 |
| '94 Tolovana Cr | 3 | 250 | 2.5 | 93.5 | 93.7 | 1.2 |
| '94 Tolovana Cr | 4 | 677 | 12.2 | 38.0 | 44.3 | 1.0 |
| '94 Tolovana Cr | 5 | 1,638 | 4.0 | 25.1 | 19.1 | .2 |
| '94 Tolo. Cr Trib. | 1 | 1,379 | 10.9 | 49.4 | 63.4 | 1.3 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | =Desirable | | =Moderate | | =Undesirable | | =No data |

LWD was lacking in the Mainstem reaches as indicated by the moderate and undesirable ratings for both pieces and volume of LWD. The majority of desirable conditions were in the Tolovana reaches, although key pieces rated moderate and undesirable. The West Fork had predominately poor LWD conditions, with pieces of LWD improving somewhat upstream. LWD was predominately lacking on the North Fork for all three parameters rated. The North Fork Trib 1 had a mixture of ratings between the three parameters with pieces rating desirable, volume rating mostly moderate and key pieces rating undesirable. Poor LWD conditions existed for both the North Fork Trib 2 and 3 for pieces and volume (key pieces were not rated).

**Table 6.4 Riparian conifers and shade in the Ecola Creek watershed based upon ODFW habitat benchmark values. Benchmark values provided in Table 6.1.**

| Site | Reach | Stream miles | Gradient | Width | # Conifers >20-in dbh per 1,000 ft | # Conifers >35-in dbh per 1,000 ft | Shade |
|---|---|---|---|---|---|---|---|
| '92 Mainstem | 1 | 1,409 | .4 | 8.9 | ND | ND | 150 |
| '92 Mainstem Trib | 1 | 1,159 | .1 | 2.2 | ND | ND | 146 |
| '92 Mainstem Trib | 2 | 1,198 | 4.9 | 1.5 | ND | ND | 169 |
| '94 North Fork | 1 | 4,018 | 9.6 | 6.1 | 85 | ND | 160 |
| '94 North Fork | 2 | 998 | 4.0 | 5.3 | 0 | ND | 170 |
| '94 North Fork | 3 | 661 | 9.4 | 5.7 | 91 | ND | 157 |
| '94 Nfk Trib 1 | 1 | 362 | 8.8 | 2.3 | 0 | ND | 165 |
| '94 Nfk Trib 1 | 2 | 478 | 5.5 | 2.0 | 61 | ND | 161 |
| '94 Nfk Trib 1 | 3 | 661 | 9.4 | 2.1 | 102 | ND | 161 |
| '92 Nfk Trib 2 | 1 | 776 | 1.6 | 1.6 | ND | ND | 169 |
| '92 Nfk Trib 2 | 2 | 1,137 | 9.8 | 1.0 | ND | ND | 169 |
| '92 Nfk Trib 3 | 1 | 408 | 9.1 | 1.8 | ND | ND | 167 |
| '92 West Fork | 1 | 5,236 | .8 | 6.3 | ND | ND | 161 |
| '94 West Fork | 1 | 2,370 | 4.0 | 4.3 | 30 | ND | 158 |
| '94 West Fork | 2 | 549 | 1.4 | 5.1 | 244 | ND | 171 |
| '94 West Fork | 3 | 5,748 | 5.7 | 4.6 | 30 | ND | 157 |
| '94 Tolovana Cr | 1 | 351 | 4.0 | 3.5 | 0 | 0 | 164 |
| '94 Tolovana Cr | 2 | 2,087 | 8.0 | 2.5 | 61 | 0 | 172 |
| '94 Tolovana Cr | 3 | 250 | 2.5 | 2.2 | 366 | 0 | 175 |
| '94 Tolovana Cr | 4 | 677 | 12.2 | 2.5 | 61 | 0 | 175 |
| '94 Tolovana Cr | 5 | 1,638 | 4.0 | 1.2 | 219 | 24 | 176 |
| '94 Tolo. Cr Trib | 1 | 1,379 | 10.9 | 2.1 | 132 | ND | 171 |

=Desirable =Moderate =Undesirable =No data Available

### 6.2.3 Riparian Habitat Condition Summary

The riparian zone is the area along streams, rivers and other water bodies where there is direct interaction between the aquatic and terrestrial ecosystems (Bischoff, et. al. 2000). Riparian vegetation is an important element of a healthy stream system. It provides bank stability, controls erosion, moderates water temperature, provides food for aquatic organisms, contributes large woody debris, filters surface runoff, provides wildlife habitats, dissipates flow of energy, and stores water during floods. Natural and human induced degradation of riparian zones diminishes their ability to provide these critical ecosystem functions.

Table 6.4 presents the riparian survey data. Three parameters were rated for the Riparian Habitat Condition Summary based upon ODFW stream survey information: shade, conifer #>20-in dbh (dbh= diameter-breast-height) and conifer # >35-in dbh. The data for the 1992 stream surveys are lacking two of the three riparian parameters: conifer # >20-in dbh and conifer # >35-in dbh and most of the 1994 surveys are lacking data on conifers >35-in dbh.

Shade conditions were good in all surveyed reaches. Of the riparian areas surveyed for conifer dbh, conifers >20-in dbh were lacking in all but one survey reach. Only Tolovana Cr. Reach 3 rated desirable for # of conifers >20-in dbh. Conifers >35-in dbh were only surveyed in the Tolovana Creek reaches. Conifers >35-in dbh rated undesirable in all the five reaches and were completely lacking in all but Reach 5.

## 6.3 Riparian Assessment

The Oregon Department of Forestry and Willamette Industries provided aerial maps for the Riparian Assessment. The riparian assessment in the OWAM focuses on large woody debris (LWD) recruitment from the riparian zone and on shade. The riparian zone is the primary natural source of large woody debris. LWD in streams provides a number of important in-stream functions, such as reducing stream energy, storage of sediment, and provision of habitat and cover for fish directly and through changes in channel morphology. Shade is important for minimizing stream temperatures, especially for salmonids and aquatic species during the low flow summer months.

Lack of time and volunteers limited the riparian assessment and it is unfinished. Future ECWC activities should include completing the riparian assessment in conformance with the OWAM. Willamette Industries provided LWD recruitment data obtained from a watershed analysis done for Cavenham Forest Industries Division in 1995 by Western Watershed Analysts (WWA, 1995). The information from the LWD assessment is provided below.

Methods for the LWD assessment relied upon the standard Washington State procedures to evaluate the ability of stream-adjacent stands to provide LWD to stream channels. The Washington procedures rely on a number of assumptions justified by the scientific literature and other data found in sources such as forest inventories and growth and yield information:

- LWD recruitment potential is assumed to be approximately equal for all bank slopes, channel gradients, and valley confinements.
- Older, conifer-dominated, well stocked stands will provide adequate and sustainable supplies of LWD.
- Red alder dominated stands are not able to supply sufficient long-term LWD supplies.
- All trees 12 inch diameter breast height and larger within 66 feet of a stream are candidates for LWD supply.
- The majority (95%) of in-channel LWD is recruited from within 66 feet of the stream.

Using these procedures, the age, density, and type of stream-adjacent overstory vegetation were determined from 1993 1:12,000 aerial photography and Cavenham's forest inventory for each side of each reach used in the canopy density evaluation. Separate ratings for each side of the stream were combined into a single rating for the reach.

Dominant tree type were defined as:

| | |
|---|---|
| >70 % Coniferous Species | Conifer Dominated |
| >70 % Deciduous Species | Hardwood Dominated |
| All other cases | Mixed |

Size of riparian trees were classified based on age and vegetation class:

| Vegetation Class | Age Class (years) | | |
|---|---|---|---|
| | Young | Mature | Old |
| Conifer | <40 | 40-120 | >120 |
| Mixed | <40 | 40-80 | >80 |
| Deciduous | <40 | 40-80 | >80 |

Stands were considered to be dense if more than 50 percent of the ground is covered by tree canopy.

| Dominant Tree Type | Age/Size | | | | | |
|---|---|---|---|---|---|---|
| | Young | | Mature | | Old | |
| | Sparse | Dense | Sparse | Dense | Sparse | Dense |
| Conifer | P | F | F | G | F | G |
| Mixed | P | P | P | G | F | G |
| Deciduous | P | P | P | F | P | F |
| P= Poor F= Fair G= Good | | | | | | |

Nearly all stream-adjacent stands within the Ecola Creek watershed were dense (density table is not included). However, while most of the stands were presently considered to be of mature size, many of them were young. None of the stands were found to be old. Furthermore, many of the stream-adjacent stands were dominated by red alder, causing many reaches to be classified as poor for LWD recruitment. Results are displayed by color coding stream reaches in Figure 6.1.

The red alder dominated riparian stands common throughout the Ecola Creek watershed were created primarily by clearcutting without buffers by previous landowners, followed by reliance upon natural re-vegetation. Alder-dominated stands often result on cool and wet riparian area sites. Generally, red alder stands set up a particularly poor situation for long-term LWD recruitment: the successional path of riparian alder in coastal environments is towards salmonberry dominated brush fields until interrupted by stand replacing fire (Newton, 1993). However, the Ecola Creek watershed appears to have good conifer regeneration in the understory of alder dominated riparian areas.

The recommendations of Western Watershed Analysis were to remove of alder stands in riparian areas and replace with conifer stands. Stream temperature analysis had indicated that nearly all stream reaches within the watershed were near to or exceeded the Oregon water temperature standard. While the assessment acknowledged that conversion of riparian alder stands to conifers would pose the potential for increased water temperatures, they determined that the net environmental effect of conversions would be positive if carefully designed to maintain creek temperatures within acceptable limits.

However, it is the opinion of the ECWC that cutting alder stands in riparian areas is unnecessary because the Ecola Creek watershed has a large amount of natural conifer regeneration occurring in the understory of alder dominated riparian areas. In addition, the ECWC feels the risks of increasing temperature levels in the creek from removing the alder are

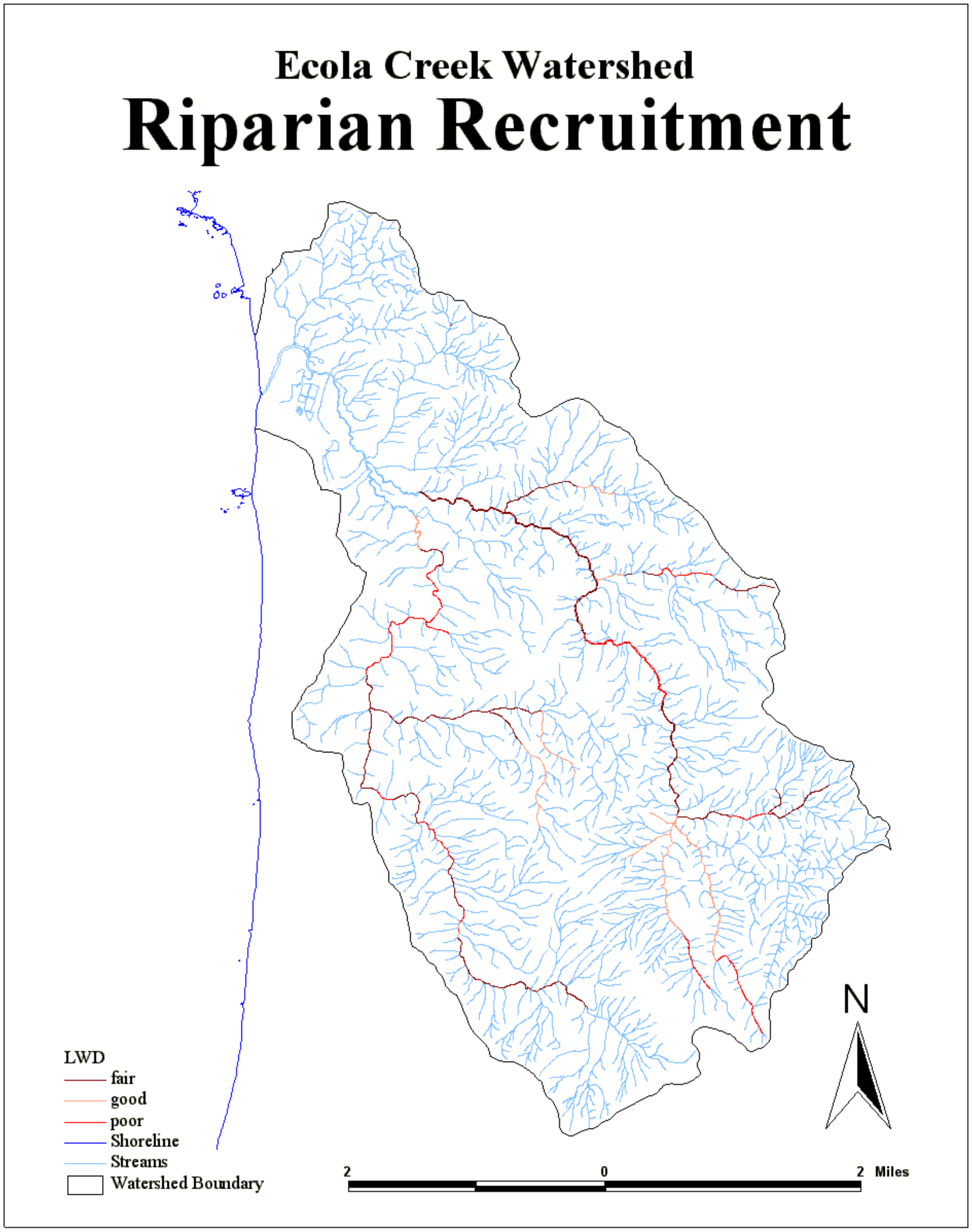



Figure 6.2 Riparian recruitment of large woody debris (LWD) based upon data obtained from Willamette Industries.

too high. Several ECWC activities in recent years have focused on planting conifers in alder dominated riparian areas that lack natural conifer regeneration. This is the preferred method of the ECWC for ensuring future LWD in areas that lack naturally regenerating conifers the watershed.

## 6.4 Wetlands

Wetlands can contribute to critical functions in the watershed. Wetland vegetation improves water quality by trapping sediments and contaminants and can assimilate certain nutrients and some toxins. Wetlands can alleviate downstream flooding by storing, intercepting, or delaying surface runoff and those within the floodplain of a river can hold water that has overtopped riverbanks. In summer, wetlands discharge cool groundwater helping to minimize stream temperatures and extend streamflows into the drier months. They provide habitat and food for a wide variety of aquatic and terrestrial plant and animal species, with many species relying on them for all or a portion of their life cycle. In addition, wetlands can also indirectly support species through the water quality functions mentioned previously (WPN, 1999).

Estuarine and coastal wetlands are important ecosystems that have been in sharp decline since the arrival of European-Americans due to land use practices. Approximately 40 percent of Oregon's original wetlands have been altered or converted to other uses and the functions of many of those remaining have been degraded (OSUES, 1998). Wetlands are protected by federal, state and local regulations and in order to plan for growth it is necessary to know the location of wetlands. Identifying the location of wetlands and wetland attributes will help determine the relationship between wetlands and problems in the watershed. Some of the former wetlands that have been degraded may have opportunities for restoration or enhancement. In addition, the method will help the watershed council determine whether additional data on wetland function is appropriate or necessary.

Three sources for wetland information used in this assessment were the National Wetlands Inventory (NWI) maps created by the U.S. Fish and Wildlife Service, the Cannon Beach Local Wetland Inventory (CBLWI) (Fishman Environmental Services, 1993) and the City of Cannon Beach Surface Water Management Plans for the Downtown and Logan Creek Basins (URS Greiner Woodward Clyde (URS), 1999).

Hard copies of NWI maps and the CBLWI were used for the preliminary wetlands base map and digitized to GIS. NWI maps were created from interpretation of 1:58,000-scale aerial photos that were taken in July of 1982. The CBLWI presents a more detailed inventory of wetlands within the city and urban growth boundary than the NWI maps. It method of analysis was more consistent and detailed than the inventory done by URS. Therefore, mapping information from the CBLWI was used within the city and urban growth boundaries and information from the NWI maps was used outside of the boundaries. It is important to note that NWI maps are based on aerial photo interpretation and not ground-based inventories of wetlands. Content within the URS document, local knowledge and field visits verified, modified and added additional wetlands to the base map and were considered in the discussion that follows.

This is only a first attempt at identifying wetlands and possible restoration sites. It does not indicate wetland function and whether areas are necessarily appropriate or feasible to restore. If the watershed council decides wetland restoration is a goal, a more thorough analysis of wetland function and restoration potential should be conducted by individuals with expertise in wetland restoration.

### 6.4.1 Wetland Extent and Type

The Cowardin classification system is used by the NWI and the CBLWI in classifying wetlands based on vegetation or substrate type, soil type and hydrology. The classification system is a hierarchical approach where the wetland is assigned to a system, subsystem, class, subclass, and water regime. The types and characteristics of wetlands in the Ecola Creek watershed are shown in Tables 6.5 a and b and Table 6.6.

The predominant wetland type in the Ecola Creek watershed is the palustrine wetland which is defined as all non-tidal wetlands dominated by trees, shrubs, and persistent emergents and all wetlands that occur in tidal areas with a salinity below five parts per thousand (Cowardin et al. 1979). Estuarine wetlands are defined as deepwater tidal habitats and adjacent tidal wetlands that are usually semi-closed by land but have open, partially obstructed, or sporadic access to the ocean and in which ocean saltwater is at least occasionally mixed with freshwater (Mitsch and Gosslelink 1993, Cowardin et al. 1979).

Table 6.5a Wetland Attributes for wetlands in the Ecola Creek watershed outside of the Cannon Beach Local Wetland Inventory (CBLWI). Information obtained from NWI maps and field visits.

| Wetland ID | Sub-basin | Connected | Cowardin Class | Cowardin Code | Buffer | Restoration Potential | Field Visit | Source |
|---|---|---|---|---|---|---|---|---|
| 1 | L | Y | Estuarine | E2EMP | D | N | Y | NWI |
| 2 | L | Y | Palustrine | PEMC | FO | Y-fill removal | Y | NWI, TOPO map |
| 3 | L | Y | Palustrine | PFOC | FO | Y-fill removal | Y | NWI, TOPO map |
| 4 | L&W | Y | Palustrine | PFOC | FO | Y-removal of dump materials | Y | NWI, field visit, CHT classification |
| 5 | W&N | Y | Palustrine | PUBFh | FO | Y-removal of road fill | Y | NWI, Field visit, topo maps |
| 6 | W&N | Y | Palustrine | PFOCh | FO | Y-removal of road fill | Y | NWI, Field visit, topo maps |
| 7 | L,W&N | N | Palustrine | PFOC | FO | Y-remove streamflow study culverts | Y | CHT classification, field visit |
| 8 | L&N | Y | Palustrine | PFOC | FO | Y-remove road fill | Y | CHT classification, field visit |
| 9 | W | Y | Palustrine | PFOC | FO | N | N | CHT classification, field visit |

Table 6.5b Wetland Attributes for wetlands contained within the Cannon Beach Local Wetland Inventory (CBLWI) in the Ecola Creek watershed.

| Wetland ID | Sub basin | Size (ac) | Connected | Cowardin Class | Cowardin Code | Buffer | Restoration Potential | Field Visit | Comments |
|---|---|---|---|---|---|---|---|---|---|
| 10A | L | 30 | Y-, area north of 2nd Street | Palustrine | PFOC | FO | | Y | Construction of sewage treatment ponds eliminated center of this large wetland area and redirected flow. |
| 10B | L | 6 | Y-but three culverts with marginally operational tidegates restrict flow | Estuarine and Palustrine | EEM, PEMC, PFOC | D | Y-restore tidal flow | Y | Construction of sewage treatment ponds eliminated center of this large wetland area and redirected flow. Site gradually losing wetland characteristics caused by decrease in tidal flow. |
| 11 | L | <.5 | Y | Palustrine | PFOC | D | Unknown | N | Fill for development of Ecola square and parking area encroached into wetland along north side. |
| 12 | L | <1 | Y | Palustrine | PFOC | D | Unknown-access denied for CBLWI | N | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 16 | L | 8 | Y | Palustrine | PEM, EEM | D | Y-non-native species removed, remove fill where possible. | Y | Wetland disturbed by rocky dike near the Les Shirley Park west of the Old Highway and by grazing horses east of highway. Les Shirley Park interspersed with fill. Small isolated wetlands are scattered in remnant pockets in park north of dike. |
| 19 | L | ~6 | Y | Palustrine | PFOC | D | Y-purchase wetlands for flood retention | Y | West fork Logan Cr ditched and flows through culverts one possibly impedes fish passage. Fill from backyards has encroached on wetlands. Area part of 100-yr floodplain and flood problems occur in residential areas. |
| 20 | L | ~10+ | Y | Palustrine | PFOC | FO | Y- plant riparian vegetation to remedy erosion of old Highway 101 slide. | Y | East fork of Logan Creek cuts into historic Hwy 101 slide containing fill and causing sediment deposition in low gradient areas downstream. |
| 21 | L | <1 | Y | Palustrine | PFOC, PEMC | FO | Y-Gravel and yard debris removed and replaced with native vegetation. | N | Lower half of stream channel ditched and wetlands filled. Heavy impacts to wetland imminent due to future reconstruction of north entrance to Hwy 101. |
| 38 | L | <.5 | N | Palustrine | PFOC | D | U | N | Influenced by historic Hwy 101 fill and fragmented by roads. |
| 42A | L | ~11 | Y | Palustrine | PFOC | D | Y- improve fish passage on City property. | Y | Good habitat for fish, cavity nesters, and amphibians. Portion of site filled with construction debris and roadway associated with residential area in southern region. |
| 42B | L | ~29 | Y | Palustrine | PFOC | D | N | Y | Tertiary treatment facility has altered hydrology. |
| 50 | L | ~2.9 | Y | Palustrine | PFOC | FO | U | N | Margins of wetland impacted by overnight campground and fragmented by Hwy 101. |

D-developed
L- Lower Subwatershed, W-West Fork Subwatershed, N-North Fork Subwatershed

Table 6.6 CBLWI and NWI wetland types located in the Ecola Creek watershed. Wetland codes are from the Cowardin Wetland Classification system.

| Code | System | Class | ubclass or Water Regime |
|---|---|---|---|
| E2EMP | Estuarine (2=intertidal) | EM=emergent | P=Irregularly flooded |
| EEM | Estuarine | EM=emergent | ------ |

| | | | |
|---|---|---|---|
| ESS | Estuarine | SS=Scrub/shrub | ----- |
| PEM | Palustrine | EM=emergent | ----- |
| PEMC | Palustrine | EM=emergent | C=Seasonally flooded |
| PFOC | Palustrine | FO=Forested | C=Seasonally flooded |
| PFOCh | Palustrine | FO=Forested | C=Seasonally flooded<br>h=Diked/impounded |
| PUBFh | Palustrine | UB=Unconsolidated Bottom | F=Semipermanently flooded<br>h=Diked/impounded |

Wetlands in the lower elevations of the watershed have been diked and disconnected from the streams. The Lower Ecola subwatershed is the most heavily impacted and significant portions of its historic wetlands have been isolated and filled due to urbanization, predominately in the city's downtown area.

Table 6.7 Relationship between watershed issues and wetlands.

| Watershed Issue | Relationship to Wetlands | Indicators that Wetland May Perform Function | Possible Additional Data Needs |
|---|---|---|---|
| Insufficient winter salmonid rearing habitat | Wetlands adjacent and connected to the channel can provide this. | Wetland must have direct, passable connection to a stream with anadromous fish. | Assess wetlands in key locations (connected to channel) for opportunities and constraints. |
| Frequent flooding | Wetlands can help to reduce flooding by temporarily retaining water upslope. | Positioned in the middle of the watershed; topographic depression; outlet constrained. | Identify whether important wetlands have been filled or drained. Evaluate possibilities for restoration. |
| Insufficient flows for fish during dry months | Wetlands can be sites of groundwater discharge. | Groundwater seeps that flow year round; wetlands that store surface water year round. | Locate and protect wetlands that may provide this function. |
| Sedimentation in streams | Wetlands can filter sediments from surface-water runoff. | Wetland receives degraded runoff that ultimately enters the channel; wetland densely vegetated. | Identify degraded (e.g., cleared, graded, ditched/ drained) wetlands in key locations that could be replanted to restore water quality functions. |

## 6.5 Channel Modifications

Stream channels are dynamic systems that modify themselves in response to changes in physical watershed features. Human activities can directly alter physical watershed features that, in turn, affect aquatic habitat and the composition of aquatic biota. Table 6.8 lists examples of channel modifications and their probable impacts to the watershed. In-channel structures and activities such as dams, dredging or filling can impede fish migration, alter the physical character of streams and change the composition of aquatic organisms. Identifying channel modification activities can show how human-created channel disturbances affect channel morphology, aquatic habitat, and hydrological functioning.

**Table 6.8 Probable Impacts from Channel Modifications**

| Channel Modification Activity | Probable Impact |
|---|---|
| Dikes, levees, (usually for flood control) | Loss of side-channels and floodplain function, decrease in channel length, and reduction of habitat complexity. |
| Stream-bank protection (rip-rap, pilings, bulkheads) | Decrease in lateral scour pools; likely to incite bank erosion downstream. |
| Built-up areas in floodplains, in/near estuaries, wetlands, and channels | Loss of side-channels, flood attenuation, and food-chain support. |
| Tide gates | Loss of off-channel rearing areas and food-chain support. |
| Roads next to streams | Loss of side-channel rearing areas and food-chain support. |
| Extensive fill associated with road crossings (~250=feet) | Loss of habitat complexity, downstream erosion. |

Table 6.9 lists the channel modification inventory within the Ecola Creek watershed and Table 6.10 lists the channel modification rating system. Figure 6.3 accompanies Table 6.9 and illustrates the channel modifications listed. Although subjective, this rating identifies those activities most likely to affect channel characteristics and aquatic habitat. The type of impact, geographic extent, age and longevity of the modification were all considered when assigning a rating. By far the most substantial channel modification in the Ecola Creek watershed was the diking and filling of the historic floodplain and wetlands in the urban areas of the Lower Ecola subwatershed.

6.5.1 Diking, fill and rip rap in the floodplain

A series of seawalls, rip rap built for flood control and a levee protects the business district of Cannon Beach from tidal inundation and the seasonal flooding that once occurred. The seawalls begin south of Second Street on the oceanfront and extend to Web's Scenic Surf. Immediately north of the seawalls, rip rap and fill extend from Whale Park, to Hemlock Street and from the Cannon Beach Elementary School to the Elm St Bridge. On the north side of Ecola Creek, fill and rip rap begins at Hemlock St and extends east past a couple private homes, serving to prevent overflow from tidal action and high stream flows during storm events. East of the private dwellings is Les Shirley Park which extends east to the Elm Street Bridge The southern edge of Les Shirley Park borders Ecola Creek and remains in natural conditions. A horse path impacts the riparian area here and the park itself contains fill. East of the Elm Street bridge on the north bank, fill associated with a campground and horse riding extend .12 miles.

Until 1950, the south bank of Ecola Creek upstream of the Elm Street bridge was open floodplain for Ecola Creek. The drainage pattern in this area was dramatically altered by the construction of US Highway 101. Construction of the highway significantly altered the natural hydrology of the floodplain and resulted in disconnecting the area west of the highway to the floodplain. Tidal flow and high stream flows continued to bring water to the wetland areas west of the highway and underground flow is thought to occur there also (CBLWI, 1993; URS, 2001) Gradually, between 1950 and 1970, a large portion of the wetlands between the Elm St bridge and Highway 101, on the south bank was disconnected from tidal and stream flow. The eastern-most sewage lagoons and the subsequent extension of the Second Street levee to Highway 101 were constructed in 1958. Three culverts and a tide gate were constructed at Second Street, connecting the wetlands south of Second Street to a side channel of Ecola Creek. The connection significantly reduced the amount of flow to the wetlands south of Second Street. A levee built in 1970 extends east of the Elm Street bridge and south along the eastern border of the Main City Park, eventually connecting with the Second Street levee. This levee successfully cut off the downtown area to most flooding.

The fill associated with the construction of the wetlands tertiary treatment facility and access roads in 1984 and the RV Park in the 1980's continued the same pattern upstream of filling wetlands. While the wetlands in the tertiary treatment facility are still intact, the quality of habitat they provide for salmonids is questionable.

Table 6.9 Channel Modification Inventory

| Site # | Channel Modification Activity Description | Channel Habitat Type | Channel Length (mi) | Degree of Impact | Potential Type of Impact |
|---|---|---|---|---|---|
| 1 | Fill and rip rap from Hemlock Street and private homes on the north side of the Ecola Creek estuary. | Large Estuary | .02 | Low | Restricts channel movement and tidal flow. |

| | | | | | |
|---|---|---|---|---|---|
| 2 | Fill in Les Shirley Park impeding tidal flow extending from western edge of park east to Elm Street Bridge. Horse path degrades riparian area. | Large Estuary | .3 | High | Loss of side-channel salt marsh habitat, channel complexity, floodplain attenuation, riparian habitat and an increase in potential downstream erosion. |
| 3 | Fill, culverts and channelization associated with urban areas on west fork of Logan Creek and its floodplain. | SV | 1/2 in | High | Loss of channel complexity, side channels, flood attenuation, and habitat. Culverts possible velocity barrier to larger fish. |
| 4 | 1968 Highway 101 failure on east fork of Logan Creek where fill next to stream is eroding during high flows. | MM/SV | 7/16 in | High | Sediment source increase in sediment load especially during high flows, suffocating spawning beds and leading fish to less desirable habitat on w fork of Logan Cr. |
| 5 | Culvert on east fork of Logan Creek where creek crosses Hwy 101 | SV | ---- | Low | Barrier to fish migration. |
| 6 | Two impassable culverts on Swigart Creek | SV | 57.7 m + | Mod | Loss of habitat upstream of culverts. |
| 7 | Fill associated with campground and horse stables and compaction from grazing on north side of Ecola Creek, extending east from Elm Street Bridge. | Large Estuary | .12 | High | Loss of side-channel salt marsh habitat, channel complexity, floodplain attenuation, riparian habitat and water quality impacts. |
| 8 | Elm Street Bridge | Large Estuary | | Low | Loss of habitat complexity and downstream erosion associated with bridge crossings. |
| 9 | A series of sea walls on ocean front between Whale Park and area just south of 2nd St. | Large Estuary | .2 | Low | Increase impacts upstream from storm surge events. |
| 10 | Rip rap protecting homes and school between Whale Park Elm St Bridge. | Large Estuary | .15 | Mod | Loss of salt marsh habitat, side channel and rearing habitat, increase impacts upstream from storm surge events. |
| 11 | Low levee built on south side of creek between Elm St Bridge and connecting to Second St. | Large Estuary/ FP1 | .2 | Mod | Loss of side-channel habitat, stream flow and habitat complexity. |
| 12 | Site of winter outflow from sewage lagoons and tide gate | FP1 | ----- | Low | Water quality concerns. |
| 13 | 2nd Street extension built in 1958 (at same time as two eastern most sewage lagoons) and elevated at later. | FP1 | .10 | High | Loss of side-channel habitat, floodplain function and habitat complexity. |
| 14 | Fill associated with downtown area and associated road network in Ecola Creek floodplain. | Large Estuary/ FP1 | .58 | High | Loss of flood attenuation, wetlands habitat. |
| 15 | Sewage lagoons, aeration basin and chlorine contact chamber | FP1 | ----- | High | Loss of wetland/marsh habitat. |

| | | | | | |
|---|---|---|---|---|---|
| 16 | Hwy 101 bridge and roadway built in 1950. | FP1 | .87 | High | Loss of floodplain attenuation and altered drainage pattern. |
| 17 | Site of summer outflow from wetland treatment area. | FP1 | ----- | Low | Water quality concerns. |
| 18 | Wetlands treatment facility and associated access roads that parallel Ecola Creek functioning like a levee. Dredged channel on southern end drains to Ecola and fish passage is blocked to wetlands area south of channel. | FP1 | .40 | High | Loss of side-channel wetland habitat, channel complexity, floodplain attenuation. |
| 19 | Culvert and old logging road on the unnamed trib. 1 in the Lower Ecola subwatershed. | MV | | High | Old logging road is compacted and acts as levee diverting flow around road creating downcutting and erosion of the road. Possible migration barrier at logging road and culvert. |
| 20 | RV Park | FP1 | .10 | Mod | Loss of wetland habitat. |
| 21a | Stream flow diversion site on West Fork Ecola Cr. | FP2 | .12 | Low | Water quality concerns. |
| 21b | Stream flow diversion site on North Fork Ecola Cr. | FP2 | .12 | Low | Water quality concerns. |
| 22a | Powerline Crossings on West Fork Ecola Cr. | FP2 | ----- | Mod | Loss of riparian function and water quality concerns. |
| 22b | Powerline Crossings on North Fork Ecola Cr. | FP2 | ----- | Mod | Loss of riparian function and water quality concerns. |
| 23 | Old Warren Way road fill acting as a levee, creating wetlands. | FP2 | .1 | High | Hinders natural drainage pattern, created current wetland fish habitat in question due to temperature concerns associated with powerline clearing. |
| 24 | Sand Filtration facility constructed in 1994. | FP2 | .04 | Low | Impacts riparian function. |
| 25 | Rip rap protecting water intake to Sand Filtration Plant and temperature probe. | FP2 | .02 | Low | Decrease in lateral scour pools and potential increase in bank erosion downstream |
| 26 | Bridge crossing WFk. on way to springs on Elk Creek road. | FP2 | .12 | Low | Loss of habitat complexity, downstream erosion, |
| 27 | Springs | FP2 | ----- | Low | Water quality concerns |
| 28 | Tolovana Mainline crossing at West Fork. | MV | .02 | Low | Impacts minimal due to channel confinement and recent culvert upgrade to natural bottom culvert. |

| | | | | | |
|---|---|---|---|---|---|
| 29 | Tolovana Mainline crossing at North Fork. | MV | .00 | Low | Impacts minimal due to channel confinement. |

Table 6.10 Channel Modification Rating

| Rating | Description |
|---|---|
| Low | • Channel impacts are not readily apparent.<br>• Impacts likely affect only a small (~<1% of channel or wetland) area.<br>• Channel characteristics such as pattern, width, substrate type, bank erosion, pool features, and large wood distribution are largely unchanged. |
| Moderate | • Impacts are localized but apparent.<br>• Changes to channel characteristics such as pattern, width, substrate type, bank erosion, pool features, and large wood distribution are detectable but not obvious. |
| High | • Impacts are obvious; gross changes in channel characteristics such as pattern, width, substrate, and bank erosion.<br>• A significant length of the channel is affected.<br>• A significant portion of a wetland is affect (drained, filled). |

The Logan Creek basin has also experienced a substantial amount of fill associated with urban areas. A substantial portion of the west fork's floodplain has been filled and the creek itself is routed through a culvert and channelized.

Diking and filling the lower reaches of both the Ecola Creek and Logan Creek floodplains resulted in a substantial loss of flood attenuation, wetlands habitat, complex side channels, and the reduction of habitat complexity. Flooding problems in the Logan Creek basin are a direct result of building in the 100-year floodplain. Urbanization and filling in the floodplain have only exacerbated flood problems in the Logan Creek area. In addition, the habitat loss in both basins directly affects salmonid species which rely on these important areas for winter refuge during high flows and summer rearing.

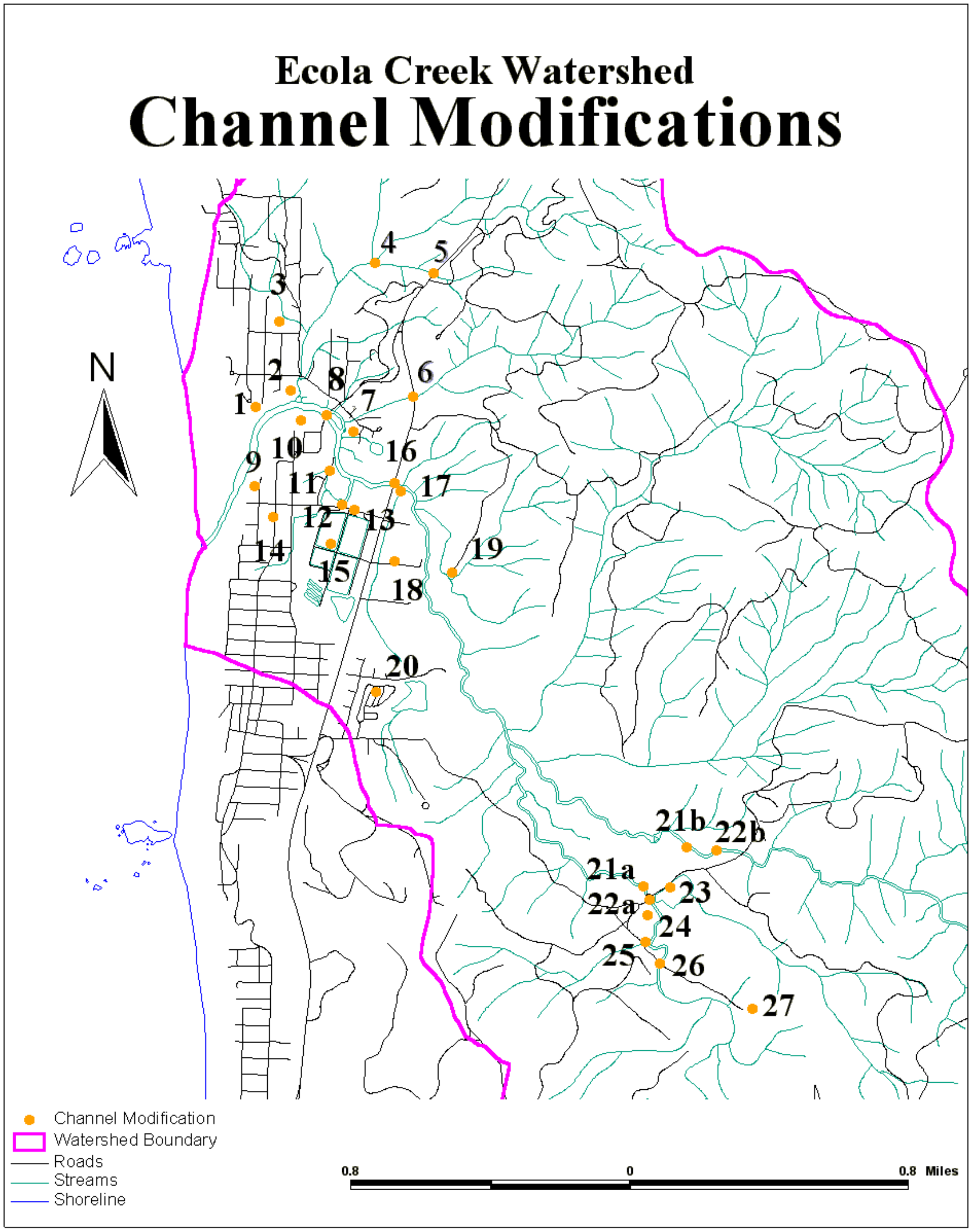



Figure 6.3 Channel modifications in the Ecola Creek watershed. Table 6.7 describes each location, the type of impact and the degree of potential impact. Not shown are the Tolovana Mainline road crossings on the West Fork and North Fork of Ecola Creek.

# CHAPTER 7 SEDIMENT SOURCES

Increased sediment loads in streams can have detrimental effects on fish, their habitat, and their food. Although erosion occurs in undisturbed watersheds, human activities in a watershed can accelerate erosion and increase sediment levels when compared to undisturbed areas. Evidence of the effects of fine sediment on fish is abundant. Increased turbidity decreases salmonid growth rates, increases emigration from affected areas, reduces the ability of fish to find food, and reduces oxygen levels. Sediment that has settled on the stream bottom reduces habitat quality for both fish and the invertebrates on which they feed. Fine sediments also suppress survival and growth rates for juvenile salmon, reduce the quality of spawning habitat, and change the composition of invertebrate species communities (Science Findings 1999).

## 7.1 Introduction

Surface erosion occurs when detachable soils on sufficiently steep slopes are exposed to overland flow and/or the impact of rainfall. Sediments introduced to streams from surface erosion are generally fine-grained. As some erosion occurs naturally within a watershed, fish and other aquatic life have evolved to cope with a certain amount of sediment in streams. The more that sediment levels deviate (either up or down) from the natural pattern in a watershed, the more likely aquatic habitat conditions will be altered.

An assessment of erosion and sedimentation within a watershed requires identifying visible signs of erosion, areas or situations that are at risk for future erosion and identifying the priority areas for remediation. The OWAM assessment concentrates on four categories that were identified as potential sediment sources in the Ecola Creek watershed: road instability, slope instability, rural road runoff and urban road runoff. It was determined, according to OWEB guidelines, that sedimentation from crop, rangeland, burned areas, and other identified sources, were not major contributors as they represented an extremely low percentage of total area within the watershed.

The OWAM’s critical questions for the Sediment Sources component are:

1. What are important current sediment sources in the watershed?
2. What are important future sources of sediment in the watershed?

3. Where are erosion problems the most severe and qualify as high priority for remedying conditions in the watershed?

**7.2 Road Instability**

The stability of a road depends on how well the road was built and the inherent stability of the land it traverses. In general, roads are most stable if built along ridges, especially where slopes are not steep. Less stable locations include steep terrain at the middle of slopes and near streams. Large amounts of subsurface water can cause soils to lose much of their strength, thus most road failures occur during high-intensity rainstorms or snowmelt periods that produce saturated soils (WPN 1999).

The type of road construction practices in the watershed influence the stability of the road. Sidecast roads are constructed by digging into the hillside to form the inside of the road and using the excavated soil to build up the outside of the road. This works well in moderate terrain but can lead to problems on steep slopes. Willamette Industries, Inc. currently uses a system called full-bench road construction. During full-bench construction the excavated material is transported to a stable location rather than using it to form the edge of the road.

The road instability assessment evaluates existing road instability information and potential road instability information and summarizes this information to allow subwatersheds and/or land ownership classes to be compared. Road inventories are the primary source of data used to evaluate the current conditions of roads in watersheds. Willamette Industries has conducted an extensive road inventory on their lands and portions of their road inventory were provided for this assessment. A priority number of one through five was assigned to each culvert, with priority one being the highest concern to repair. The primary protocol for ranking was based on the remaining structure life expectancy. Other factors such as safety, mass wasting potential, flow capacity, chronic sedimentation and fish passage were also considered to establish a priority number.

Priority one and two information were made available for the assessment and the list has been updated to reflect the repairs and decommissions made by Willamette as of May, 2001. Priority one data was analyzed and is presented below in section 7.2.2. Priority two road segments need to be listed and additional road inventory information is required to complete the road-related instability assessment. Future watershed council activities should focus on gathering this information, including information regarding the ODF and City of Cannon

Beach properties, in addition to Willamette's property in the watershed. Information should be consistently updated to reflect Willamette's replacement progress. Field surveys should also be conducted in the watershed and would be helpful in verifying information. This is a time-consuming activity and permission from Willamette Industries, Inc. would have to be obtained.

### 7.2.1 Existing Road Instability Information

Willamette's Road Inventory Summary:

In 1997 Willamette Industries, Inc. developed a forest road inventory in conjunction with the Oregon Department of Forestry (ODF) and the Oregon Forest Industries Council (OFIC). Willamette inventoried approximately 130 miles of roads on company managed forestland in the Ecola Creek watershed. Road features were given a priority class from one to five, one being highest priority for repair and five representing no action needed.

In 1999 the road inventory had been completed and a legacy road improvement/ decommissioning plan was developed. According to this plan, all road segments identified as needing action would be repaired or decommissioned within the next ten years.

Under Willamette's North Coast Resource Area 10-year road plan, all priority one road segments will be repaired or decommissioned by the fall of 2001. The remaining segments requiring action will be repaired or decommissioned by the fall of 2008.

A total of seven miles of roads within the Ecola Creek watershed were decommissioned in 2000. These were legacy roads built prior to the 1972 Oregon Forest Practices Act. The culverts/fills were removed and the natural stream channels were reestablished.

Highway 101/Logan Creek Slide:

On December 13, 1968, half of Hwy 101 slid into the upper Logan Creek basin just downstream of the Logan Creek/Hwy 101 crossing. The other half of Hwy 101 failed in the same area on December 31, 1968 contributing even more slide material to the basin. Approximately 80,000 cubic yards of fill are assumed to have slid from the highway (this is the amount of rock it took to replace the fill that failed).

The waste material was pushed downhill and spread into terrace like features across the Logan Creek valley bottom. Tributaries were diverted into artificial channels and the main channel was pushed as far north as the ridge "toes" allowed. Evidence of vertical, ten foot plus banks and numerous recent slumping indicate erosion is a major problem. Highly turbid waters and sediment load disposition in the area of Logan Creek adjacent to Ecola Park Road have been observed for decades (Arnold, 2001).

Accounts from people in the forties and fifties indicate salmon were once abundant in Logan Creek. Observations of Logan Creek by locals over the years report that the presence of salmon has dropped dramatically. In addition, salmon were not observed during a random coho survey conducted in 2000 by the Oregon Department of Fish and Wildlife. While a regional decline in salmon has been a trend, it is concluded that the decline in salmon numbers in Logan Creek is partially due to sediment and turbid waters caused by erosion of unconsolidated material from the 1968 event (Arnold, 2001).

The effects of the Highway 101 slide do not reflect incompetence but do emphasize the near impossibility of building long lasting roads in areas where the underlying "soft mudstone weathers easily to form deep soils of the consistency and mechanical strength of grease when thoroughly saturated (Alt and Hyndman, 2000)."

Formal surveys of the culvert and slide on the East Fork of Logan Creek should be conducted for the assessment at a later date. A known fish barrier occurs at the point where Highway 101 crosses the East Fork of Logan Creek. Water leaving the outlet of the culvert drops approximately 50 feet before reaching the creek below.

Tolovana Mainline-Hug Point Crossover:

A deep seated land failure is located on the West Fork of Ecola Creek just prior to the point where the Tolovana Mainline-Hug Point Crossover Road passes into the Hug Point basin (T4N R 10W Sec 7&8). The slide extends from the road and may have originated from poor road building practices in the past. It is approximately 10 to 15 acres in size and there is evidence of historic movement present at the base. ECWC members speculate that the slide may be the site of a historic migration barrier to fish passage recorded in an ODFW stream survey in 1967 and an ODFW Aquatic Inventories survey in 1992. The barrier was not recorded in the 1994 Aquatic Inventories survey and field visits by the ECWC have also failed to locate the barrier. The slide also presents a source of woody debris for the creek and an inventory of the area should be made in the future, noting the size of the trees in addition to slide features.

Elk Creek Road Slide:

Years of accumulated yard and construction debris from a dump site on Elk Creek Rd slid off a steep embankment toppling trees and overriding a wetland in 1999. Investigations by ECWC members indicated that the debris flow showed evidence of several previous slides. The yard and construction debris originated on private land, but the toe of the slide was determined to be on Oregon Department of Forestry (ODF) property. A formal survey of the slide should be made for the assessment.

7.2.2 Potential Road Instability Information

The purpose of this section is to identify the location of potential high-risk landslides or road washouts in the watershed in order to prevent road instability. The information for this section was obtained from the road inventory provided by Willamette Industries, Inc. described earlier. The information presented is not a complete inventory of the Ecola Creek watershed.

Stream crossings with undersized culverts were identified. A total of 49 priority one culverts/fills were identified in Willamette Industries' road inventory of the Ecola Creek watershed. During 2000, thirty-two of these were repaired or decommissioned. The remaining priority one culverts/fills are scheduled for repair/decommissioning in 2001. Priorities two through five are scheduled to be repaired by fall 2008.

Culvert size information in the road inventory was evaluated using a method adapted from ODF in which culvert capacity is documented and compared to the capacity needed (Table 7.1). Culvert capacity for each culvert with size data reported was determined from a capacity table in the OWAM. An ODF 50-year recurrence interval peak flow map was used to determine how large a culvert would be needed for stream crossings in the Ecola Creek watershed. Of the culverts with size data, the drainage area for each culvert with a known location was determined from 7.5-minute topographic maps. Ratios between the 50-year peak flow and the current culvert capacity were calculated. The ratios, along with the height of the fill associated with the road crossing were used to assign a hazard rating to each culvert. Hazard ratings were as follows:

Very low: Fill height is 15 feet or less and ratio is less than 1.25.

Low: Fill height is greater than 15 feet and ratio is less than 1.25.

Moderate: Fill height is 15 feet or less and ratio is between 1.25 and 1.75.

High: Fill height is greater than 15 feet and ratio is between 1.25 and 1.75; or fill height is 15 feet or less and ratio is between 1.76 and 3.

Very High: Fill height is greater than 15 feet and ratio is between 1.76 and 2.99; or fill height is 15 feet or less and ratio is greater than 3.

Extreme: Fill height is greater than 15 feet and ratio is greater than 3.

Table 7.1 Culvert capacity and risk of large amounts of sediment entering stream. Culvert size and fill height obtained from Willamette Industries, Inc., the remaining data calculated from protocol in OWAM.

| # | Road ownership | Current Culvert/ Pipe -Arch Size | Current Culvert Capacity (cfs) | ODF Peak-Flow Value (cfs/sq. mile) | Drainage Area (sq. mile) | 50-Year Peak Flow (cfs) | Culvert/ Pipe-Arch Size Needed | Ratio of 50-Yr. Flow to Current Capacity | Fill Height (ft) | Hazard Rating* |
|---|---|---|---|---|---|---|---|---|---|---|
| 12 | Willamette | 48 | 67 | 400 | | | | | 20 | |
| 13 | Willamette | Other | | 400 | | | | | | |
| 14 | Willamette | 12 | <3.5 | 400 | | | | | | |
| 18 | Willamette | 18 | 5.5 | 400 | 0.15 | 60 | 48 | 11 | | Very High |
| 19 | Willamette | Log | | 400 | | | | | | |
| 20 | Willamette | 18 | 5..5 | 400 | 0.06 | 24 | 33 | 4.4 | 3 | Very High |
| 21 | Willamette | 12 | <3.5 | 400 | 1.20 | 480 | 108 | 137 | | Very High |
| 23 | Willamette | Other | | 400 | | | | | | |
| 26 | Willamette | 12 | <3.5 | 400 | 0.13 | 52 | 48 | 15 | 3 | Very High |
| 27 | Willamette | 18 | 5.5 | 400 | 0.06 | 24 | 12 | 4.4 | 4 | Very High |
| 28 | Willamette | 18 | 5.5 | 400 | 0.42 | 168 | 72 | 31 | 5 | Very High |
| 29 | Willamette | 12 | <3.5 | 400 | 0.10 | 40 | 42 | 11 | | Very High |
| 30 | Willamette | 12 | <3.5 | 400 | 0.43 | 172 | 72 | 49 | | Very High |
| 31 | Willamette | 24 | 12 | 400 | 0.46 | 184 | 84 | 15 | 0 | Very High |
| 32 | Willamette | Log | | 400 | | | | | | |
| 33 | Willamette | 24 | 12 | 400 | 0.39 | 156 | 72 | 13 | 0 | Very High |
| 36 | Willamette | Log | | 400 | | | | | | |

The high risk culverts were then combined in Table 7.2 with other risk factors used to identify potential road instability areas. In addition to undersized culverts, the other two risk factors used to identify potential road instability are cracks and slumps in roads and water running down a road or onto an unstable fill. This information was obtained from Willamette's road inventory. Comments regarding slides and fish passage on the road inventories were also noted in Table 7.2.

Once the road instability assessment is completed, the data can be summarized for patterns. Future analysis of road instability data should look to the base map and other sources of information to help answer road instability questions. Road inventory information on the ODF and City properties should be inventoried, as well as geologic information, road age, soils and rainfall patterns are some examples of information sources which could provide clues to road instability problems.

Table 7.2 High Risk Road Segments determined from a portion of Willamette Industries' road inventory of the Ecola Creek watershed made available for the Ecola Creek watershed assessment.

| Number | Subwatershed | Feature Type | Hazard Rating | Road ownership |
|---|---|---|---|---|
| 12 | North Fork | poss. small fish | | Willamette |
| 13 | North Fork | slides | | Willamette |
| 14 | North Fork | slides developing | | Willamette |
| 18a | West Fork | culvert | Very High | Willamette |
| 18b | West Fork | cracks/slump (road separated) | | Willamette |
| 19b | North Fork | culvert collapsed, probable log fill | | Willamette |
| 20a | North Fork | culvert-inlet buried | Very High | Willamette |
| 20b | North Fork | water/fill-stream diverts down road bed | | Willamette |
| 21 | North Fork | culvert | Very High | Willamette |
| 22a | West Fork | culvert | Very High | Willamette |
| 22b | West Fork | water/fill | | Willamette |
| 26a | North Fork | culvert | Very High | Willamette |
| 26b | North Fork | water/fill-road washed out | | Willamette |
| 27a | North Fork | culvert-pipe is washed out | Very High | Willamette |
| 27b | North Fork | water/fill | | Willamette |
| 28a | North Fork | culvert-washout | Very High | Willamette |
| 28b | North Fork | water/fill | | Willamette |
| 29a | North Fork | culvert-inlet buried | Very High | Willamette |
| 29b | North Fork | water/fill-slide 50 ft above culvert diverts ditch | | Willamette |
| 29c | North Fork | slide | | Willamette |
| 30a | North Fork | culvert | Very High | Willamette |
| 30b | North Fork | water/fill-ditch failed above pipe | | Willamette |
| 31a | West Fork | culvert-inlet plugged | Very High | Willamette |
| 31b | West Fork | water/fill-stream washing across road | | Willamette |
| 32 | West Fork | culvert-collapsed pipe, stream cuts down ditch, causing next two failures | | Willamette |
| 33 | West Fork | water/fill | Very High | Willamette |
| 34 | North Fork | water/fill | Very High | Willamette |

## 7.3 Slope Instability

Slope instability is evaluated in the OWAM by collecting information about recent landslide activity and high-risk areas that are likely to be active in the future. Data on recent landslide activity is relatively scarce. The ODF is working on a project that will delineate potential landslide hazard areas for the entire state of Oregon and should be referred to when they are finished. The delineation is primarily based on slope. Some landslide summary information pertaining to the watershed was provided by Willamette Industries, Inc. and is referred to in the following section. Future watershed council activities should focus on completing the slope instability section. When time and resources permit, local knowledge, field visits and aerial photos are the most readily available information sources for this portion of the assessment. However, the use of aerial photos is very limited in locating recent landslides. Landslides among dense trees older than 30 years are seldom detected in aerial photos (WPN, 1999).

### 7.3.1 Slope Instability Summary

Landslides are natural processes that occur in most forested basins of the Pacific Northwest. Different slope processes will generate variable amounts of sediment under differing conditions. To accurately evaluate the landslide or mass wasting hazard potential, analysts and specialists are required to identify the specific trigger mechanisms and differentiate between the types and rates of processes active within a given basin.

The four types of mass wasting are: shallow-rapid landslides, debris torrents, large-persistent deep-seated failures, and small-sporadic deep-seated failures. Shallow-rapid landslides (also known as, debris slides, debris avalanches, or planar failures) commonly occur on steep slopes where soil overlies a more cohesive material (for example, bedrock or glacial till). Soil thickness is typically small compared to slope length or the length of the landslide. Debris in the slide moves quickly downslope and commonly breaks apart to form a debris avalanche. Shallow-rapid landslides typically occur in convergent areas where topography concentrates subsurface drainage (Sidle and others, 1985), and may deliver sediment to streams and damage roads. Altering landscape conditions may increase the susceptibility of an area to shallow-rapid landslides. There is some evidence that removal of trees on steep slopes (greater than about 80%) makes an area vulnerable to shallow landslides and can lead to temporary acceleration of the landslide rate. This window of vulnerability begins when many of the finer roots of the harvested trees become rotten (about 4 years) and ends once the replacement stand has developed a dense root network (about 30 years for wet portions of the state)(WPN, 1999). However, only a small portion (typically a few percent or less) of the landscape actually fails following timber harvest (Ice, 1985).

Mass wasting events may occur on a return interval of one or two years, decades, centuries, or even millennia. While the smaller, more frequent events may cause the fresh scars seen on the landscape, the larger, infrequent events are the real shapers of the landscape.

Both types of landslides are influential in their impact on physical resources. In a natural, unmanaged-forested basin, the dynamic replenishment of material to the channels by mass wasting is essential to the diversity and health of the ecosystem.

The summary mass wasting information from a watershed analysis report on the Ecola Creek watershed prepared by Western Watershed Analysts in 1995 (WWA, 1995) for the former landowner (prior to the 1996 Willamette acquisition) was provided by Willamette Industries, Inc.. All observable failures were identified from multiple sets of stereo aerial photos and locations were confirmed in the field. An interpretation of relative mass failure hazard and maps were developed for the watershed from the historical record of the sites shown to be prone to failure and local topographic, geologic and soils information.

According to the report, debris avalanches in the watershed are generally young in age, although some may represent areas that have continually been susceptible to landsliding for a long period of time. They are both natural and road-caused as a result of past poor road building and maintenance practices. The steeper slopes are particularly susceptible to this type of landslide. Earth flow slumps are determined to be the oldest identified landslides in the area. In general, they are stable and are unlikely to be reactivated by careful road construction techniques. There are only a few slumps in the watershed. Some are located on the banks of the forks of Ecola Creek and were caused by the undercutting of the stream banks. These areas will continue to fail, as the stream continues to undercut and remove the toe areas of these slides. The one type of landslide most attributable to poor road construction are the fill failure areas. When fill failures reach a larger size, they become debris avalanches. In fact, many of the debris avalanches mapped within the area probably originated as fill failures.

Logging hazards were also considered. Many mid-slope failures not related to roads on very steep slopes were identified within the Ecola Creek watershed and the report says that logging related causal mechanisms may have contributed to the occurrence of some of them. However, nearly the entire watershed had been logged prior to the date of aerial photos that were reviewed, as had nearly all of the surrounding area. Therefore it was impossible to determine if past logging practices had accelerated the rate of failure on the slopes (WWA, 1995).

A geology report on the coastal areas of Clatsop and Tillamook counties produced in 1972 (Schlicker, et al., 1972) stated that the Cannon Beach quadrant contains Oligocene to Miocene sedimentary rocks (Toms). In higher regions where the topography is held up by igneous centers, undercutting of the sediments has resulted in the development of landslides covering many square miles. In these areas the sediment s are commonly mantled by a cover of basaltic slide debris and the prospect of future sliding is relatively high.

Tertiary intrusive bodies consist of dikes and sill of igneous rock which penetrate the older sedimentary beds. These intrusive rocks are more resistant to erosion than the sedimentary rocks, and generally form vertical cliffs and constitute many of the higher peaks and ridges of the Coast Range. Slopes are relatively stable in these areas, however care should be taken in defining the position of the lower contact of sills (Schlicker, et al., 1972).

### 7.4 Rural Road Runoff

Rural roads are all roads outside the urban area. They include private logging roads, private roads accessing homes and property, county maintained roads and state highways. Unpaved roads with heavy traffic contribute the most sediment to streams. Most of the unpaved roads in the Ecola Creek watershed are associated with logging. Willamette Industries maintains a “non-motorized vehicle” policy with the public in an attempt to minimize sediment generated by recreational users.

Considerable amounts of sediment can be moved by water, which is channeled down roads and associated ditches. Usually, water flowing through a ditch, picks up sediment and delivers it to streams. The quality of the surface rock, road maintenance, weather conditions and the weight and frequency of traffic on unpaved roads all contribute to the condition and amount of sediment coming from the surface. The break-up of the road is most rapid during wet weather and when heavy truck traffic is frequent. A road surfaced with high-quality rock can be quickly reduced to quagmire if water is allowed to pool during wet weather and there is heavy truck traffic. Poor quality surface rock quickly breaks down fine material and develops potholes. But, it may not degrade much at all if it is used mainly during dry weather (WPN, 1999).

Two assessment approaches are presented in the OWAM to evaluate rural road runoff, but the section was not completed due to lack of time and resources. The first method simply identifies site conditions conducive for high amounts of sediment in road runoff to enter streams. The second assessment is more detailed and requires much more time but yields more useful information about the road system. Watershed council activities in the future should focus on completing one of the two approaches in assessing rural road runoff. Willamette Industries Inc. is the largest landowner within the watershed and provided a current summary on road construction standards and maintenance provided in the following section.

7.4.1 Current road construction standards and maintenance by Willamette Industries Inc..

Recent concern about sediment from road systems entering waters of the state has prompted Willamette Industries, Inc. to adopt new specifications for forest road location, construction, reconstruction, maintenance and erosion control. These specifications are provided below.

<u>Location:</u> Whenever possible existing roads that parallel stream channels are relocated or bypassed and new roads are located near ridge tops to minimize the number of stream crossings. This method of road location helps minimize the possibility of sediment entering waters of the state.

<u>Road Construction, Reconstruction, Drainage Structures:</u> Ditch relief culverts or ditchouts are placed with a maximum spacing of 300-500' and are located to allow any runoff to filter through vegetation on the forest floor prior to entering flowing water. Ditch relief culverts are placed 50' to 100' ahead of all stream-crossing culverts which allows ditch water to filter through vegetation on the forest floor prior to entering flowing water. State law requires that Stream crossing culverts be designed to pass a 50 year flood event, however all crossing culverts installed by the North Coast Resource Area will pass an 100 year event.

<u>Road Construction. Reconstruction, Side-cast:</u> Side-cast material in steeper terrain that has the potential to fail is pulled back and the road is set into the hillside. All waste material in these steeper areas is now hauled to stable waste areas.

<u>Road Surfacing:</u> All weather haul roads are now surfaced with quarried rock and the top lift is usually a finer grade crushed rock that has been processed with a grader and vibratory roller. By processing the rock the road surface is sealed and water cannot saturate the subgrade, this helps prevent the "pumping" of mud unto the road surface.

Roads with natural surfaces have haul restrictions placed on them and active haul is allowed only during periods of dryer weather. All active haul roads are continually monitored and maintained, if a road begins to show signs of failing, active hauling is suspended until the road can be repaired. All non-active haul roads are monitored on an annual basis and during periods of high flows with routine maintenance preformed as needed.

Erosion Control: Where there is potential for erosion a variety of erosion control methods are used. Silt fences and straw bales are used along with settling basins to help slow water and allow suspended sediment to settle out of the water. Additionally, hand seeding or hydro mulching are used to vegetate surfaces and prevent erosion.

## 7.5 Urban Area Runoff

Sedimentation is primarily delivered via the stormwater system in urban areas. The sediment within stormwater can come from a number of sources, including but not limited to, wind-deposited soil, degrading pavement, and erosion from yards and construction sites. The sediment within stormwater also includes a large component of organic matter and pollutants.

A problem with sediment from urban areas is that pollutants are often attached to the sediment particles. Many heavy metals, toxic compounds, nutrients, and bacteria readily attach to sediment particles derived from urban sources. Of major concern are zinc, copper, oil and grease, yard pesticides, and phosphorus. These compounds are known to be harmful at high concentrations to fish and other aquatic life.

A management plan report for three drainage basins in the City of Cannon Beach produced in 1999 made recommendations to construct a sediment trap for the downtown basin to remove runoff pollutants before they are discharged to the Little Pompey wetland (the wetland east of downtown which receives most of the downtown's runoff) before entering Ecola Creek (URS, 1999).

An evaluation of urban area runoff in the City of Cannon Beach was performed by delineating stormwater subwatersheds. Table 7.4 presents the stormwater information. Three urban areas (horses, downtown, and residences) were identified as creating moderate sediment production. All other urban subwatersheds created a low to zero increase in sedimentation runoff. Options to reduce sediment loads to the stream in the moderate sediment producing stormwater subwatersheds are the construction of solid-bottom catch basins such as the one proposed for the Little Pompey wetlands. Another option to reduce sediment runoff in urban areas is to upgrade the street cleaning program in these areas of the City.

| Table 7.4 Urban area runoff | | | | | | |
|---|---|---|---|---|---|---|
| Stormwater Subwatershed | Polygon # | Polygon Area | Area as a Percentage of Total | Sediment Production | Street Cleaning | Sediment Removal |
| Logan Cr. | 101 | 60.72 | 31.89 | L1 | S2 | N3 |
| Les Shirley | 102 | 5.36 | 2.82 | L1 | S2 | N3 |
| Stamm | 103 | 16.62 | 8.73 | L1 | S2 | N3 |
| Horses | 104 | 4.00 | 2.10 | M1 | S2 | N3 |
| School | 105 | 9.44 | 4.96 | L1 | S2 | N3 |
| Downtown | 106 | 30.69 | 16.12 | M1 | S2 | N3 |
| City Park | 107 | 2.81 | 1.48 | L1 | S2 | N3 |
| Residences | 108 | 11.59 | 6.09 | M1 | S2 | N3 |
| Wetlands | 109 | 21.67 | 11.38 | L1 | S2 | N3 |
| RV Park | 110 | 13.43 | 7.05 | L1 | S2 | N3 |
| Elkland | 111 | 9.86 | 5.18 | L1 | S2 | N3 |
| Elk Cr. Rd. | 112 | 4.21 | 2.21 | L1 | S2 | N3 |
| Total | | 190.40 | 100.01 | | | |

Table 7.2 Codes:

1. Sediment production
   - L1- Residential, Low rating
   - M1- Commercial, Moderate
   - H1- Heavy Industrial, High
   - VH1- Developing Urban, Very High

2. Street Cleaning
   - S2 - None or Infrequent, Small
   - M2- Frequent Mechanical, Moderate
   - L2- Vacuum-assisted, Large

3. Sediment Removal
   - N3- None, None
   - M3- Detention ponds/basins, Moderate
   - H3- Treatment Plant Processing, High

### 7.6 Geology

A brief discussion of geology is necessary for the Ecola Creek watershed because the area in which it lies differs significantly from the norm of many coastal areas nearby. The geology of the watershed consists mostly of sedimentary mudstone and basalt lava flows deposited in an offshore ocean environment during Miocene times (Niem and Van Atta, 1973; Niem, 1976; Neel, 1976; in Niem, 1989; WWA 1995). Three younger units of unconsolidated sediments also exist within the watershed deposited on land by the present-day streams and ocean shoreline. These units include: stream alluvium, beach and dune deposits, landslide and colluvium (landslide debris) deposits (Niem 1989; WWA 1995).

The mudstone in the Ecola Creek watershed is informally known as the Cannon Beach member of the Miocene Astoria formation (Niem and Niem, 1985) and is the oldest bedrock in the watershed. The mudstone is intruded by thin basalt dikes and sills throughout the area, as well as interbedded in places with minor thin-thick (1/2 inch to 6 feet) beds of sandstone. The mudstones are medium gray when freshly exposed, but quickly turn reddish orange due to iron oxide production once weathered. The soft mudstone weathers easily to form deep soils of the “consistency and mechanical strength of grease” when thoroughly saturated (Alt and Hyndman, 2000). Landslides and slumps are common in this unit due to its low resistance to sliding and failures (Niem, 1989) but stabilization is easily established with vegetation (WWA 1995).

Basalt is a very hard and sturdy volcanic rock and withstands the battering of surf and wind to form headlands along the coast and the mountainous peaks in the watershed, including Onion Peak. The most common type of basalt in the Ecola Creek watershed is volcanic breccia from the Grande Ronde Basalt of the Columbia River Basalt Group. Volcanic breccia are lava flows that cooled in the ocean. The volcanic breccias in the Ecola watershed formed 15 to 18 million years ago (Niem, 1989) from huge flood-type basalt lava flows erupted from vents in NE Oregon. These flows filled the ancestral Columbia River basin and Gorge and finally reached the ancient shoreline and flowed into the ocean. The volcanic units overlie the Cannon Beach mudstone on the steep mountainous slopes of the watershed. According to Niem (1989) much of the volcanic breccia has been weathered to a depth of tens of feet, forming thick, soft, reddish brown residual soil with large spheroidal boulders of fresh, hard breccia.

Slow movements of the earth's crust over millions of years have uplifted the area and determined the shape and texture of the Ecola Creek Watershed, giving it its high relief, and in turn, its copious rainfall, high productivity, and varied ecology.

**7.7 Soils**

There are many different types of soil types found in the Ecola Creek Watershed. Listed below are the major types and a brief description (SCS, 1988).

Kloochie-Necanicum complex, Necanicum-Ascar, Kloochie silt loam complex**:** These soils are deep and well drained. The upper layer is dark reddish brown silt loam. Below this are reddish brown silt loam and gravelly loam over partially weathered basalt. The risk of water erosion is high if the areas of woodland are harvested and the slash is burned. The steeper areas are susceptible to slumping, and the risk is increased when roads are constructed across the slope. Depth to bedrock limits rooting depth in some areas.

Laderly-Rock outcrop complex, Murtip-Caterl complex, bouldery: These are deep and moderately deep, well drained gravelly silt loam, very gravelly loam, and loam, and are located on mountains. Slopes range from 3 to 90 percent. Elevation is 1,600 feet to 2,800 feet. The main limitations of the soils are slope, the hazard of water erosion, susceptibility to slumping and depth to bedrock.

Templeton-Ecola silt loams, Skipanon gravelly silt loam: These soils are located on mountains of sedimentary bedrock. These soils formed in colluvium. They are deep and very deep, well drained gravelly silt loam, silt loam, and loam. The main limitations are slope, the hazard of water erosion and susceptibility to slumping**.**

**Low lands/stream buffers**

Walluski silt loam, Brenner silt loam, Nehalem silt loam: These soils are deep and very deep, moderately well drained and poorly drained silt loam and silty clay loam. Soils were formed in alluviums. The main limitations are susceptibility to compaction and slow permeability. Grazing during the wet periods in winter and spring compacts the soils.

Coquille-Clatsop complex, Tropopfluvents: Are located on tide influenced flood plains, they are deep soils and are very poorly drained. The limitations of these soils are wetness and the hazard of flooding.

# CHAPTER 8 WATER QUALITY

## 8.1 Introduction

Water quality is judged good or bad relative to how the water is used. For example, water meeting all drinking water standards might not meet the standards for cold water fish such as salmon. The Oregon Watershed Assessment Manual (OWAM) provides a screening level water quality assessment with the purpose of identifying obvious areas of quality impairment. The screening level assessment identifies recognized uses of water, known as ‘beneficial uses’, and compares key attributes of water quality against criteria that apply to the identified beneficial uses.

Attributes are selected water quality measurements indicative of a pollution category; the attributes utilized in the OWAM assessment include temperature, dissolved oxygen (DO), pH, nutrients, bacteria, turbidity, and chemical contaminants. Evaluation criteria established in the OWAM are derived from the Oregon Water Quality Standard, OAR CH 340. Some factors related to water quality, such as sediments and hydrology, are addressed in other sections.

Critical questions for the water quality component in the OWAM are:

1. What are the designated beneficial uses of water for the stream segment?
2. What are the water quality criteria that apply to the stream reaches?
3. Are the stream reaches identified as water quality limited segments on the 303(d) list by the state?
4. Are any stream reaches identified as high-quality waters or Outstanding Resource Waters?
5. Do water quality studies or evaluations indicate existing water quality has been degraded or is limiting the beneficial uses?

## 8.2 Beneficial Uses

The term “beneficial uses” is defined in the Oregon Water Quality Standards and are those water uses that provide essential or desirable conditions for humans and aquatic life. Not just any aquatic life, but conditions which sustain the incredibly complex web of interacting chemical, physical and biological attributes/agents for some very sensitive species… in Ecola Creek… Steelhead and Coho.

Sensitive beneficial uses defined by OWAM are listed in Table 8.1. All of the listed Beneficial Uses are applicable to Ecola Creek. The beneficial uses listed in Table 8.1 are linked to the specific measurable water quality criteria as discussed in the following section.

Among the identified human uses are the stream's high aesthetic quality, its use for fishing, it is the municipal water supply for the City of Cannon Beach, and the lower estuary reaches are used for water contact recreation. Diverse aquatic life including several different species of resident fish and several anadromous salmonid species utilize the stream for spawning and rearing. Ecola Creek is also listed as a Coho salmon "Core Area" in the Oregon Plan for Salmon and watersheds.

Table 8.1 Sensitive Beneficial Water Uses

| Beneficial Use | Applicable to Watershed |
|---|---|
| Aesthetic quality | yes |
| Fishing | yes |
| Domestic water supply | yes |
| Resident fish and Aquatic life | yes |
| Salmonid fish rearing | yes |
| Salmonid fish spawning | yes |
| Water contact recreation | yes |

**8.3 Water Quality Criteria**

Water quality criteria are detailed in the Oregon Water Quality Standards. A brief summary of the Oregon Water Quality Standards provided in OWAM is shown in Tables 8.2 and 8.3. These criteria apply to most streams and rivers in the state. It should be noted that the official Oregon Water Quality Standards should be consulted when a water quality attribute is identified as an issue of concern, because the Evaluation Criteria is a screening… not a decision criteria. Oregon Water Quality Standards are available online at DEQ's website.

"DEQ protects water quality by using both numeric and narrative water quality standards to protect defined beneficial uses such as aquatic life, fisheries, recreation, aesthetics and drinking water supplies. While there may be competing beneficial uses in a river or stream DEQ is required under federal law to protect the most sensitive of these beneficial uses." [3]

Table 8.2 Water Quality Criteria and Evaluation Indicators

| Water Quality Attribute | Evaluation Criteria |
|---|---|
| Temperature | Daily max. 64ºF (7-day moving average) |
| Dissolved oxygen | Minimum of 8.0 mg/l |
| pH | 6.5-8.5 |
| Nutrients | No statewide numeric criteria |
| Total phosphorus | Indicator: 0.05 mg/l max. |
| Total nitrate | Indicator: 0.30 mg/l max. |
| Bacteria | Water contact recreation |
| E. coli | 126/100ml (30 day log mean; 5 samples) |
| E. coli | 406/100ml (single sample maximum) |
| Turbidity | Indicator: 50 NTU max (above background) |
| Contaminants, organic | Indicator: Above detection limits |
| Contaminants, metals | Chronic toxicity for freshwater aquatic life—see Table 8.3 |

Table 8.3 Chronic Toxicity for freshwater aquatic life

| Metal | At 100 mg/l hardness | At 25 mg/l hardness |
|---|---|---|
| Arsenic | 190.0 µg/l | |
| Cadmium | 1.1 µg/l | 0.4 µg/l |
| Chromium (hexa) | 11.0 µg/l | |
| Copper | 12.0 µg/l | 3.6 µg/l |
| Lead | 3.2 µg/l | 0.5 µg/l |
| Mercury | 0.012 µg/l | |
| Zinc | 47.0 µg/l | 32.7 µg/l |

"When a water quality standard is established, the first step is to identify the beneficial uses sensitive to the parameter. Then criteria are established based on the levels needed to protect the sensitive uses. For example, the uses typically most sensitive to dissolved oxygen are fish and aquatic life. Fish and other aquatic organisms need an adequate supply of oxygen in the water to be healthy and productive. In this case, the criteria identify minimal amounts of dissolved oxygen that need to be in the water to protect the fish. In other cases, as with many

3 DEQ FAQ "What is the 303(d) List?"

of the toxic pollutants, the criteria may identify the maximum amount that may be in the water without risk to the aquatic biota or to human health. For other parameters, such as bacteria or some toxic compounds, human health is the most sensitive beneficial use."[4]

## 8.4 Available Water Quality Data

Data has not been collected on a consistent basis on water quality related criteria for the Ecola Creek Watershed. There are however several sets of available data which provide a base to make the preliminary water quality evaluation meeting OWAM's water quality assessment needs.

Water quality data for the Ecola Creek watershed used in this assessment includes:

1. City of Cannon Beach monitored Ecola Creek at three locations related to the discharge of treated waste water (January 1990 to December 1991; two samplings per month; temperature, DO, pH, BOD, suspended solids, nitrate and phosphorous tested).

2. Willamette Industries monitored stream temperature (North Fork, West Fork and Main Stem sampled hourly; 7/8/1999 to 11/15/1999. Three points West Fork, two points North Fork sampled hourly; 6/27/2000 to 9/29/2000). Two sites on the West Fork and one site on the North Fork have had data logging temperature monitors from mid-summer 1994, until October 1998.

3. Contracted Water Quality Analysis in 1994 to 1996 on the North and Lower West forks was done for Cavenham Forest Products Co.

4. City of Cannon Beach monitored the West Fork Ecola Creek for the Pilot Plant Testing Program to Evaluate Feasibility of Slow Sand Filtration at the bridge (12/3/92 to 8/9/1994; temperature, turbidity, pH, and total and fecal coliform sampled most weekdays).

4 (DEQ WQStdsBeneficialUses.htm)

5. City of Cannon Beach water supply sampling 9/4/1996, was tested for organic and inorganic contaminants.

6. Oregon DEQ did mixing zone study related to the waste water discharge permit, 1999. This study is attached as addendum #1 to chapter 8.

7. Ecola Creek Watershed Council (ECWC) monitored stream health (1998-2000).

8. City of Cannon Beach monitored water temperature 1996 trough 2000 on the West Fork, at the slow sand filter intake and midstream with the Main Storage Tank's overflow brook.

Ecola Creek is not on the 303(d) list. The 303(d) is a list of Oregon Water Quality Limited Water Bodies and is compiled in order to fulfill requirements of the federal Clean Water Act. The objective of the Clean Water Act is "to restore and maintain the physical, chemical, and biological integrity of the nation's waters." Discharges including runoff to streams and lakes are not allowed to degrade water quality so that the cumulative effect of all discharges produces a condition outside Water Quality Standard limits, resulting in a 303(d) listing.

**8.5 Water Temperature**

Cool water temperatures are a requirement for salmonid species, amphibians and other aquatic life and a seven day moving average maximum temperature of 64ºF is the standard for all Oregon rivers set by the Oregon Water Quality Standards, as shown in Table 8.2. In addition a maximum seven day moving average temperature of 55ºF also applies to Ecola Creek for times when the waters support spawning, egg incubation and fry emergence.

Temperature data from Willamette Industries monitoring for 1999 and 2000 are available for locations on the West Fork (1.8 miles up-stream from the Highway 101 bridge) and North Fork (1.6 miles up-stream from Highway 101 bridge) for both years and for one location on the Main Stream for 1999. These data are shown graphically in Figures 8.1 to 8.3. The seven day moving average of daily maximum temperature does not exceeded the 64ºF limit for the two years.

**Figure 8.1 Ecola Creek - 7-Day Moving Average Maximum Temperature - 1999**

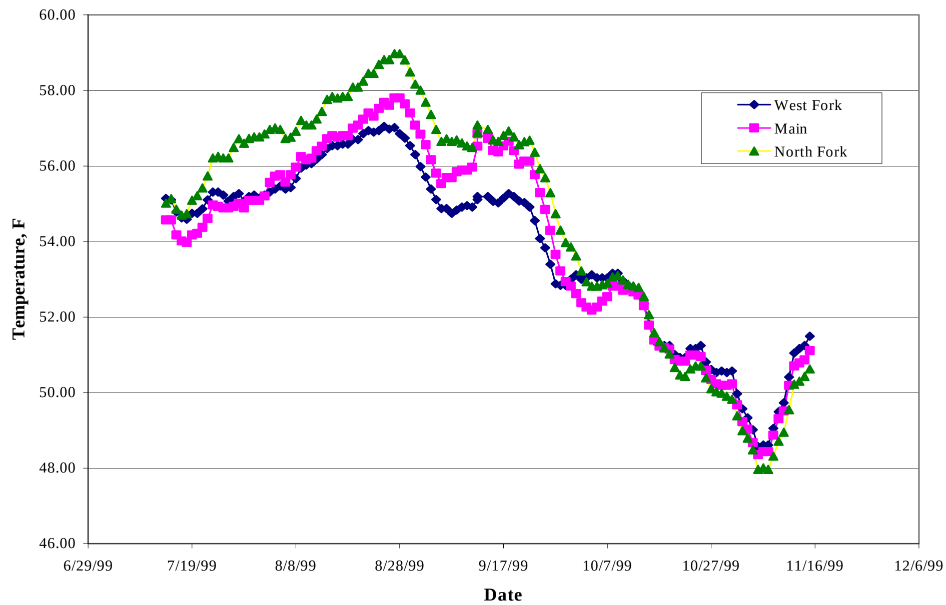
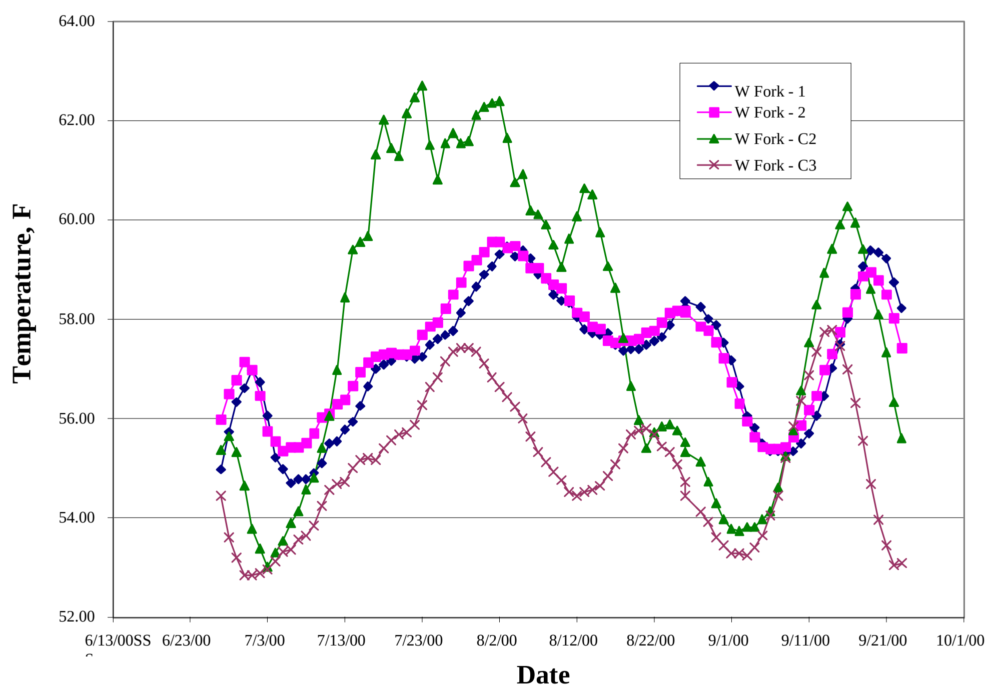



**Figure 8.2 7-Day Moving Average Maximum Temperature West Fork Ecola Cr --2000**



West Fork 1 is located 3.4 miles up-stream from Highway 101 bridge)

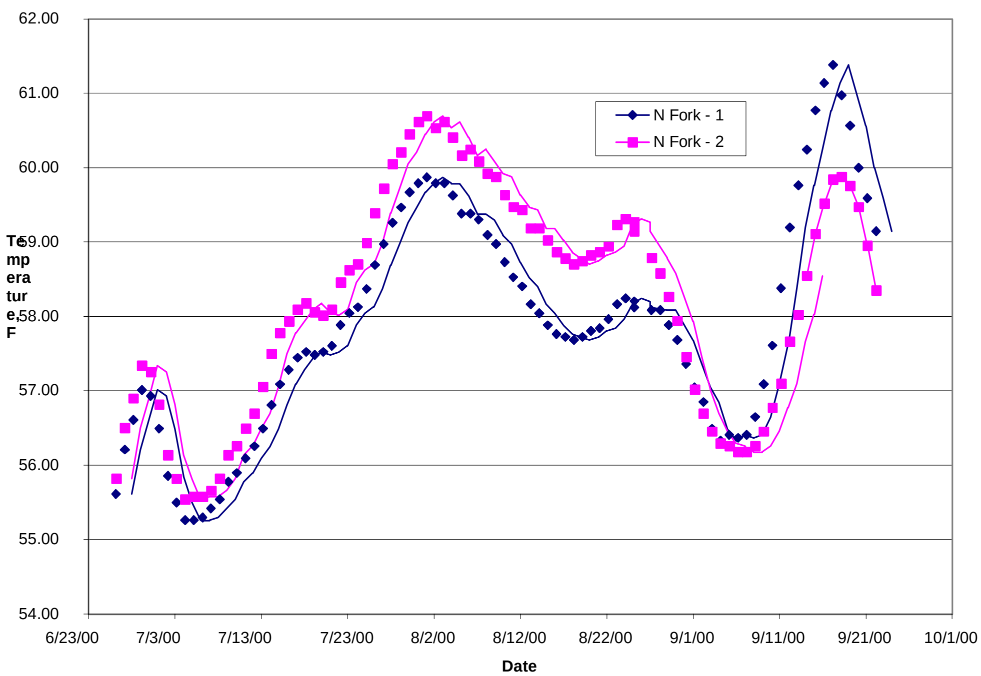
West Fork 2 is located 1.8 miles up-stream from Highway 101 bridge)

West Fork C2 is located 5.2 miles up-stream from Highway 101 bridge)

West Fork C3 is located 5.4miles up-stream from Highway 101 bridge)

Temperature data from the West Fork monitors C2 and C3 do not appear to be consistent. These are new monitors located near the Willamette Industries Rock Crusher Road. Further checking of these monitors will be done in the future.

**Figure 8.3 Ecola Creek - North**
**7-Day Moving Average Maximum Temperature - 2000**




Source: Willamette Industries

North Fort 1 is located 1.8 miles up-stream from Highway 101 bridge)

North Fork 2 is located 1.6 miles up-stream from Highway 101 bridge)

Table 8.4a lists the maximum seven day moving averages of daily maximum temperatures for each year from 1994 through 1998.

| Table 8.4a Annual highest seven day moving average of daily maximum temp. | | | | | |
|---|---|---|---|---|---|
| Lower West Fork | | Lower North Fork | | Mid West Fork | |
| Period Dates | Ave Temp | Period Dates | Ave Temp | Period Dates | Ave Temp |
| Aug.14 -20, 1994 | 58.98 | Aug.15-21, 1994 | 59.63 | Aug.14-20, 1994 | 59.63 |
| Jul.17-23, 1995 | 60.15 | Aug. 6-12, 1995 | 56.61 | Jun.27-Jul.3,1995 | 58.34 |
| Jul.23-29, 1996 | 59.14 | Jul.12-18, 1996 | 60.28 | Jul.10-16, 1996 | 58.34 |
| Aug. 5-11, 1997 | 59.25 | Aug.7-13, 1997 | 63.84 | Aug.5-11, 1997 | 59.09 |
| Aug.10-16, 1998 | 60.78 | Aug.10-16, 1998 | 65.71 | Aug.10-16, 1998 | 60.26 |

Source: Willamette Industries

The temperature criterion of 55ºF maximum is for times and waters supporting spawning, egg incubation and fry emergence from the gravel. For Ecola Creek, perhaps due to low water flows in the early Fall, spawning salmon typically do not enter the stream until November. Coho enter the stream and spawn during the November to March period and Steelhead enter from January to June. Fry emergence could be expected in two to four months. Temperature data available for this period for the years 1994 through 19989 is summarized in table 8.4b.

| Table 8.4b Spawning time, egg incubation and fry emergence from gravel, 55 degree criterion, annual highest seven day moving average of daily maximum temp. | | | | | |
|---|---|---|---|---|---|
| Lower West Fork | | Lower North Fork | | Mid West Fork | |
| Period Dates | Ave Temp | Period Dates | Ave Temp | Period Dates | Ave Temp |
| Oct.1 - 7, 1994 | 54.06 | Oct.1 - 7, 1994 | 54.74 | Oct. 1 - 7, 1994 | 54.94 |
| Oct.1 - 7, 1995 | 54.58 | Oct.1 - 7, 1995 | 54.82 | Oct. 1 - 7, 1995 | 53.74 |
| Oct,1 - 7, 1996 | no data | Oct.1 - 7, 1996 | no data | Oct.4 - 10, 1996 | 53.74 |
| May 25 - 31, 1997 | 55.03 | May 11 - 17, 1997 | 58.33 | May 24 - 31,1997 | 54.65 |
| Apr.27-May 3,1998 | 54.83 | Apr.28-May 4, 1998 | 58.98 | Apr.- May | no data |
| Oct.1 - 7, 1998 | 54.12 | Oct.1 - 7, 1998 | 57.41 | Oct.1 - 7, 1998 | 53.25 |

Source: Willamette Industries

As indicated in table 8.4b, the moving average of daily maximum temperatures exceeds 55 degrees F. several times, especially the North Fork in the Spring. This almost certainly is due to the long, shallow, non-shaded riffle just upstream of where the temperature data logger was located. This non-shaded stretch is the power line crossing which is at a shallow angle with respect to the creek, exposing a long stretch of creek to direct solar gain. A willow planting was recently done to help shade it. This site is a candidate for large woody debris.

In addition, the City of Cannon Beach monitored points on the West Fork just above the city water intake for the slow sand filter and midstream near the confluence with the Main Storage Tank's overflow brook. At publishing time there were several unresolved issues in regard to the city's data. In the near future an addendum to the assessment will include the charts and data summaries.

## 8.6 Water Chemistry

Intermittent testing of Ecola Creek for chemical characteristics has been done by the City through monitoring the discharge of treated waste water. During a period from January 1990 to December 1991, sampling was made at three locations:

- Main stem Ecola Creek at the little city park by the grade school
- Main stem Ecola Creek just east of Highway 101 bridge
- Main stem Ecola Creek just up-stream from the wastewater wetlands

Sampling was done twice each month and testing included:

- Dissolved oxygen (DO)
- pH
- BOD (Biological Oxygen Demand)
- Suspended solids
- Ammonia
- Nitrate
- Nitrite
- Phosphorous

In addition, the City collected data over the period December 1992 to September 1994 from the West Fork of Ecola Creek at the bridge. This was the Pilot Plant Testing Program to Evaluate Feasibility of Slow Sand Filtration. Approximately sixteen samples were taken each month for the following measurements:

- Temperature
- Turbidity
- pH

- Precipitation for the day prior to sampling was recorded
- Bacteria

Intermittent water quality monitoring over the period October 1998 to the present has been done by ECWC members. Temperature, dissolved oxygen, turbidity, conductivity and salinity were measured. Also, a small number of pH tests were performed in October 2000.

8.6.1 Dissolved Oxygen

Oxygen is necessary for all animal life. Aquatic life uses oxygen dissolved in the waters where they live. High levels of dissolved oxygen are critical at various life stages. Water absorbs oxygen from the air and from photosynthesizing aquatic plants. At any given temperature, water can dissolve only a certain amount of oxygen, and is saturated when it reaches that value. Cold water can hold more oxygen in solution than warm water. Saturated water, when warmed, will lose oxygen to the atmosphere. Dissolved oxygen is used or depleted primarily by aquatic animals, decomposing organic material, non-photosynthesizing plants, and oxidizing rock and minerals.

Eggs and early larval-like stages of fish called alevin depend on highly oxygenated water flowing through the gravel which covers the redds. Dissolved oxygen (DO) levels below the point of saturation retard growth of salmonid embryos and hatching is delayed or premature. Salmonid juveniles survive at less than saturated levels but growth and other factors are adversely affected.

The OWAM criteria for dissolved oxygen is set as a minimum of 8.0 mg/l, see Table 8.2. Data from the City of Cannon Beach testing in 1990-1991 period was analyzed and the average, maximum and minimum data for the three sample points are shown in Table 8.5a. Only one measurement was below the OWAM criteria. This low sample was from Ecola Creek east of the Highway 101 bridge on 9/10/91. The cause of this low oxygen level is not certain but may be related to an extremely low rainfall and high temperatures during the month of September 1991.

Dissolved oxygen was also calculated as a percentage of total saturation based on the water temperature at time of sampling for the City data set described above. The measured temperature of each sample was compared to total saturation levels for dissolved oxygen from a standard table of saturation. The measured dissolved oxygen in the sample was then

| Table 8.5a Dissolved Oxygen – 1990 and 1991, mg/l | | | |
|---|---|---|---|
| | Estuary | City Park/101 Bridge | Up-stream Wet Lands |
| Average | 10.4 | 9.9 | 10.7 |
| Maximum | 13.9 | 13.8 | 14.1 |
| Minimum | 8.2 | 5.9* | 8.3 |
| * only measurement below 8.0. Taken 9/10/91 | | | |

expressed as a percentage of full saturation at the specific temperature of the sample. Average, maximum and minimum values from these data are shown in Table 8.5b.

The average percent saturation is in the 90-97 percent range close to maximum saturation of 100 percent. Some data points are above 100 percent. The cause of this has not been determined. It could be due to errors in the temperature and dissolved oxygen testing. Water can become over saturated with oxygen for instance when the temperature rises. Lower temperatures allow higher dissolved oxygen quantities which do not immediately dissipate as the temperature rises. Another cause of over saturation is in the case of pressurization such as occurs at dam discharges, but Ecola Creek is not dammed.

| Table 8.5b Percent Saturation Dissolved Oxygen – 1990 and 1991 | | | |
|---|---|---|---|
| | Estuary | City Park/101 Bridge | Up-stream Wet Lands |
| Average | 94.2 | 90.8 | 96.4 |
| Maximum | 118.6 | 117.9 | 121.7 |
| Minimum | 75.4 | 57.4 | 74.8 |

Table 8.5c summarizes dissolved oxygen data taken in the 1998-2000 Ecola Creek Watershed Council monitoring. The dissolved oxygen levels are above the OWAM 8.0 mg/l criteria with the exception of a sample from the Estuary in the waste water mixing zone, see note below.

Although the Ecola Creek Watershed Council monitoring data exceeds the minimum screening level of 8.0 mg/l, concern is indicated with the sometimes low percentage saturation of DO on the North Fork and Main Stem. More sampling is needed, especially during the Summer and Fall low flow periods. Also, because DO varies throughout the day, the cycling between minimums just before dawn and maximums in the late afternoon needs to be quantified for each season. The effect of long Winter nights and heavily overcast days on dissolved oxygen, even though the water is colder, is a question to be addressed.

| Table 8.5c Dissolved Oxygen -- 1998 through 2000 | | | | |
|---|---|---|---|---|
| | Estuary | Main Stem | W. Fork | N. Fork |
| | mg/l--% of sat. | mg/l--% of sat. | mg/l--% of sat. | mg/l--% of sat. |
| Average | | 9.24/84.4% | 9.51/85.8% | 8.97/82.5% |
| Maximum | 9.04/85.6% | 10.44/91.7% on 10/29/00 | 10.03/88.3% on 10/29/00 | 10.21/89.9% on 10/29/00 |
| Minimum | 9.04/85.6% | 8.31/79.8% on 9/18/99 | 8.78/86.1% on 8/20/99 | 8.23/79.3% on 8/22/99 |
| # less than 8.0 g/ml | See note* | none | none | none |
| *Note: Estuary split, Quality Assurance/Quality Control (QA/QC), DEQ & ECWC sample taken from waste water mixing zone, values were 7.70/66.6% and 7.35/63.5% on 11/22/99, but were not counted in the statistics. | | | | |

8.6.2 pH

The acidity or alkalinity of water is measured in terms of pH which is the logarithmic value of the hydrogen ion concentration of the water. Aquatic organisms typically function best in an intermediate pH range, 6.5 to 8.5. The pH level of streams can be upset by mining operations and other disturbances. Drainage from forest areas, wetlands and peat are usually in the low pH range. Subsurface water that passes through mineral formations can range into the higher pH values depending upon the mineral. pH also varies throughout the day, becoming more acidic with increased dissolved carbon dioxide at night. Likewise, a seasonal variation naturally occurs.

"Water pH is critical to fish habitat because it can affect fish egg production and survival, aquatic insect survival and emergence, and the toxicity of other pollutants such as heavy metals or ammonia."[5]

The OWAM summary of Oregon Water Quality Standards lists a pH range of 6.5-8.5 as acceptable for Oregon streams. Measurements made during the 1990-1991 City sampling (Table 8.6) showed a minimum of 6.0 and a maximum of 7.1 with an average of 6.4. A large portion of the measurements were below the 6.5 lower limit. The cause of the low pH results

5 DEQ Water Quality Monitoring Guidebook

is not known, later tests, noted below give higher values. In the City samplings made in 1993-1994, a minimum of 6.8 and a maximum of 7.1 was found. October 2000 pH testing done by the ECWC found an average of 7.21, maximum of 7.4 and minimum 7.02.

Table 8.6 pH – 1990 and 1991

| | Estuary | City Park/101 Bridge | Up-stream Wet Lands |
|---|---|---|---|
| Average | 6.4 | 6.4 | 6.4 |
| Maximum | 6.8 | 7.1 | 7.1 |
| Minimum | 6.1 | 6.0 | 6.1 |

8.6.3 Nutrients

Chemicals in water that stimulate the growth of algae and aquatic plants are termed nutrients. Phosphorus and nitrogen are the main growth-limiting nutrients in water. Algae and aquatic plants are part of the chain which utilizes the energy from sunlight to form food and grow and which are then consumed by invertebrates which in turn provide food for fish in the stream. Excess algae and aquatic plant growth can be detrimental to water quality. When the growth is dense enough to block sunlight, shaded plants die and decompose consuming dissolved oxygen to levels below those suitable for other aquatic life.

Data from the City of Cannon Beach 1990-1991 sampling are summarized in Table 8.7. The levels of phosphorus and nitrate at the up-stream sample site are undetectable. Sites downstream have several measurements above the limits of 0.05 mg/l for phosphorus and 0.30 mg/l for nitrate. This indicates that phosphorous and nitrate are introduced into the lower reaches of Ecola Creek. The discharge could be from the City waste water treatment system or other activities in the area but the specific sources have not been identified at this time.

Table 8.7 Nutrients – 1990 and 1991, mg/l

| | Estuary | | City Park/101 Bridge | | Up-stream from City Wet Lands | |
|---|---|---|---|---|---|---|
| | Phos. | Nitrate | Phos. | Nitrate | Phos | Nitrate |
| Average | 0.02 | 0.13 | 0.18 | 0.06 | 0.0 | 0.0 |
| Maximum | 0.3 | 2.0 | 3.0 | 1.0 | 0.0 | 0.0 |
| % Outside Limit | 7 | 6 | 50 | 6 | 0 | 0 |

During the 1994, 95, & 96 Cavenham water quality testing, ortho phosphate was not detected, but nitrate was found every time. Test site locations were T-5N R-10W WM lower West Fork at NW 1/4 NW 1/4 Sec 33 and lower North Fork SW 1/4 SW 1/4 Sec 28. As seen in Table 8.8, five out of 14 of the samples had concentrations above the 0.30 mg/L indicator level. Recordings ranged between a minimum of 0.11 and a maximum of 0.86 mg/L, with an average of 0.33mg/L.

Table 8.8 Nitrates

| Site | 10/12/94 | 10/27/94 | 1/9/95 | 4/11/95 | 7/13/95 | 10/11/95 | 4/24/96 |
|---|---|---|---|---|---|---|---|
| Lower West Fork | 0.14/0.14 | 0.85/0.86 | 0.18/0.18 | 0.17 | 0.15 | 0.61/0.64 | 0.4 |
| Lower North Fork | 0.11/0.12 | 0.62/0.61 | 0.15/0.15 | 0.15 | 0.2 | 0.52/0.53 | 0.26 |

Listings with (value #1)/(value #2) are for duplicate samples. Units are mg/L.
10/12/94 Duplicate water samples taken in summer low flow condition.
10/27/94 Duplicate water samples taken immediately after first major storm.
01/09/1995 Duplicate samples taken in mid-winter runoff conditions.
4/11/95 Single sample taken in winter low flow conditions.
7/13/95 Single sample taken in summer low flow conditions.
10/11/95 Duplicate samples taken immediately after first major storm.
4/24/96 Single sample taken after major storm event.
Source: Cavenham

8.6.4 Turbidity

Turbidity measures water clarity and is an indicator of suspended sediment from run off. Suspended sediment can damage the gills of fish and can be a carrier of other pollutants. The limit set for turbidity is 50 NTU (Nephelometric Turbidity Units) maximum. All of the turbidity measurements taken from Ecola Creek in the City's 1990-1991 and 1993-1994 samplings lie below the limit. The 1994, 95, 96 Cavenham measured turbidity on both the lower West Fork and lower North Fork at different points at times known to be critical for water quality: summer low flow, immediately after fall's first major storm, mid-winter runoff, and mid-winter low flow conditions. The highest turbidity Cavenham recorded was 12 NTU, safely below the 50 NTU maximum limit.

8.6.5 Organic Contaminants

Contaminants are chemicals that may be toxic to aquatic organisms. They are separated into organic and inorganic types. Organic contaminants are man made chemicals such as used in industrial activities and for pesticide and herbicidal uses.

The West Fork of Ecola Creek was sampled for volatile and synthetic organic contaminants at the City water filtration plant in September 1996. "Not Detected" results were found for all the organic compounds tested, as listed on Tables 8.9 and 8.10.

Table 8.9 Regulated Volatile Organic Contaminants

| Chemical | Max limit, mg/l | Min Detection Limit , mg/l |
|---|---|---|
| 1,1-Dichloroethylene | 0.007 | 0.0005 |
| 1,1,1-Trichloroethane | 0.20 | 0.0005 |
| 1,1,2-Trichloroethane | 0.005 | 0.0005 |
| 1,2-Dichloroethane | 0.005 | 0.0005 |
| 1,2-Dichloropropane | 0.005 | 0.0005 |
| 1,2,4-Trichlorobenzene | 0.07 | 0.0005 |
| Benzene | 0.005 | 0.0005 |
| Carbon Tetrachloride | 0.005 | 0.0005 |
| Cis-1,2-Dichloroethylene | 0.07 | 0.0005 |
| Dichloromethane | 0.005 | 0.0005 |
| Ethylbenzene | 0.70 | 0.0005 |
| Chlorobenzene | 0.10 | 0.0005 |
| 0-Dichlorobenzene | 0.600 | 0.0005 |
| p-Diclorobenzene | 0.075 | 0.0005 |
| Styrene | 0.10 | 0.0005 |
| Tetrachloroethylene | 0.005 | 0.0005 |
| Toluene | 1.0 | 0.0005 |
| Xylenes | 10.0 | 0.0005 |
| trans-1,2-Dichloroethylene | 0.10 | 0.0005 |
| Trichloroethylene | 0.005 | 0.0005 |
| Vinyl Chloride | 0.002 | 0.0005 |

Table 8.10 Other Volatile Organic Contaminants

| Chemical | Max limit, mg/l | Min Detection Limit , mg/l |
|---|---|---|
| 1,1-Dichloroethane | | 0.0005 |
| 1,1-Dichloropropene | | 0.0005 |
| 1,1,1,2-Tetrachloroethane | | 0.0005 |
| 1,1,2,2-Tetrachloroethane | | 0.0005 |
| 1,2,3-Trichloropropane | | 0.0005 |
| 1,3-Dichloropropene | | 0.0005 |
| 2,2-Dichloropropane | | 0.0005 |
| 1,3-Dichloropropane | | 0.0005 |
| Bromobenzene | | 0.0005 |
| Bromodichloromethane | | 0.0005 |
| Bromoform | | 0.0005 |
| Bromomethane | | 0.0005 |

| | | |
|---|---|---|
| Chloroethane | | 0.0005 |
| Chloroform | | 0.0005 |
| Chloromethane | | 0.0005 |
| Dibromochloromethane | | 0.0005 |
| m-Diclorobenzene | | 0.0005 |
| o-chlorotoluene | | 0.0005 |
| p-chlorotoluene | | 0.0005 |

In 1994 Cavenham made water quality monitoring on the North and West Forks of Ecola Creek. Duplicate tests were made on the following: Organochlorine pesticides listed in Table 8.11, Chlorinated herbicides listed in Table 8.12 and dissolved Metals on Table 8.13. Sampling was done on October 12, 1994 during late Summer, low flow conditions and on October 27, 1994 immediately after the first major storm.

Table 8.11 Organochlorine Pesticides tested-Cavenham Sampling

| Chemical | Detection Limit | Units | West Fork Duplicates measured 10/12/94 | West Fork Duplicates measured 10/27/94 | North Fork Duplicates measured 10/12/94 | North Fork Duplicates measured 10/27/94 |
|---|---|---|---|---|---|---|
| Aldrin | 0.010 | ug/L | both ND | both ND | both ND | both ND |
| a-BHC | 0.010 | ug/L | both ND | both ND | both ND | both ND |
| b-BHC | 0.010 | ug/L | both ND | both ND | both ND | both ND |
| d-BHC | 0.010 | ug/L | both ND | both ND | both ND | both ND |
| g-BHC (Lindane) | 0.010 | ug/L | both ND | both ND | both ND | both ND |
| Chlordane | 0.100 | ug/L | both ND | both ND | both ND | both ND |
| DDD | 0.020 | ug/L | both ND | both ND | both ND | both ND |
| DDE | 0.020 | ug/L | both ND | both ND | both ND | both ND |
| DDT | 0.020 | ug/L | both ND | both ND | both ND | both ND |
| Dieldrin | 0.020 | ug/L | both ND | both ND | both ND | both ND |
| Endosulfan I | 0.020 | ug/L | both ND | both ND | both ND | both ND |
| Endosulfan II | 0.020 | ug/L | both ND | both ND | both ND | both ND |
| Endosulfan Sulfate | 0.020 | ug/L | both ND | both ND | both ND | both ND |
| Endrin | 0.020 | ug/L | both ND | both ND | both ND | both ND |
| Endrin Aldehyde | 0.020 | ug/L | both ND | both ND | both ND | both ND |
| Heptachlor | 0.010 | ug/L | both ND | both ND | both ND | both ND |
| Heptachlor Epoxide | 0.010 | ug/L | both ND | both ND | both ND | both ND |
| Methoxychlor | 0.050 | ug/L | both ND | both ND | both ND | both ND |
| Toxaphene | 1.000 | ug/L | both ND | both ND | both ND | both ND |

Note: ND (Not Detected)

| Table 8.12 CHLORINATED HERBICIDES—Cavenham Sampling | | | | | | |
|---|---|---|---|---|---|---|
| CHEMICAL | Detection Limit | Units | West Fork Duplicates measured 10/12/94 | West Fork Duplicates measured 10/27/94 | North Fork Duplicates measured 10/12/94 | North Fork Duplicates measured 10/2794 |
| 2,4-D | 0.300 | ug/L | both ND | both ND | both ND | both ND |
| 2,5-DB | 1.000 | ug/L | both ND | both ND | both ND | both ND |
| Dalapon | 0.200 | ug/L | both ND | both ND | both ND | both ND |
| Dicamba | 0.100 | ug/L | both ND | both ND | both ND | both ND |
| Dichlorprop | 0.200 | ug/L | both ND | both ND | both ND | both ND |
| Dinoseb | 0.200 | ug/L | both ND | both ND | both ND | both ND |
| MCPA | 10.000 | ug/L | both ND | both ND | both ND | |
| MCPP | 10.000 | ug/L | both ND | both ND | both ND | |
| Pentachlorophenol | 0.050 | ug/L | both ND | both ND | both ND | both ND |
| Picloram | 0.100 | ug/L | both ND | both ND | both ND | both ND |
| 2,4,5-T | 0.200 | ug/L | both ND | both ND | both ND | both ND |
| 2,4,5-TP | 0.100 | ug/L | both ND | both ND | both ND | both ND |
| | Note: ND (Not Detected) | | | | | |

8.6.6 Inorganic Contaminants

Inorganic contaminants are metal ions in the water. They can cause aquatic organisms sublethal effects such as physiological stress, growth inhibition and decreased reproduction. The hardness of the water affects the level of toxicity of most metals. The OWAM criteria summary gives toxicity levels for metal ions at two hardness levels, 25 and 100 mg/l. The Ecola Creek water was measured at 12.3 mg/l in a sampling by the City in 1999. Toxicity limits used in this evaluation are therefore those set for 25 mg/l hardness.

Data on inorganic ions in the creek water is available from the City sampling on September 1996 at the Filtration Plant and on July 1999 at the Highway 101 bridge. In addition, Cavenham Company made a sampling in October 1994. This data is shown in Table 8.13.

From the limited data available, it can be seen that no tests exceeded the OWAM limits, most metals are below the detection limits.

Table 8.13 Inorganic Contaminants

| | Toxicity Limit, µg/l* | MDL, µg/l | Filter Plant, 9/99 | HiW 101 Bridge 6/99 | Cavenham West Fork 10/94 | Cavenham North Fork 10/94 |
|---|---|---|---|---|---|---|
| Hardness, mg/l | | | NT | 12.3 | NT | NT |
| Antimony | | 0.001 | ND | ND | NT | NT |
| Arsenic | 190 | 0.002 | ND | ND | ND[1] | ND[1] |
| Asbestos | | 0.18 | ND | NT | NT | NT |
| Barium | | 0.10 | ND | 0.3 | NT | NT |
| Beryllium | | 0.0005 | ND | 0.0 | NT | NT |
| Cadmium | 0.4 | 0.0002 | ND | 0.1 | NT | NT |
| Chromium | 11.0 | 0.002 | ND | ND | ND[2] | ND[2] |
| Copper | 3.6 | | | 0.3 | NT | NT |
| Cyanide | | 0.02 | ND | NT | NT | NT |
| Fluoride | | 0.5 | ND | NT | NT | NT |
| Lead | 0.5 | 0.001 | ND | ND | 0.002 | 0.001 |
| Mercury | 0.012 | 0.0003 | ND | NT | ND[3] | ND[3] |
| Nickel | | 0.002 | ND | 1.3 | NT | NT |
| Selenium | | 0.002 | ND | NT | NT | NT |
| Sodium | | 0.05 | 8.2 | 6.7 | NT | NT |
| Sulfate | | 5.0 | ND | NT | NT | NT |
| Thallium | | 0.0005 | ND | ND | NT | NT |
| Zinc | 32.7 | | NT | 1.2 | NT | NT |

* at 25 mg/l Hardness
ND—Not Detected at test limit
NT—Not Tested
[1]—at 0.005 detection limit
[2]—at 0.001 detection limit
[3]—at 0.0005 detection limit

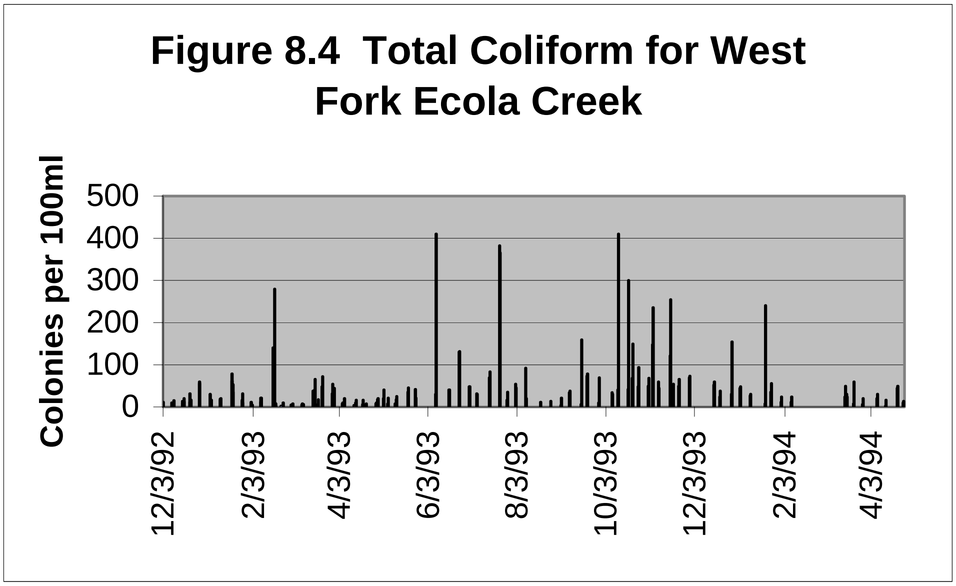
### 8.6.7 Bacteria

The sensitive beneficial uses impacted by bacterial contamination are the water contact recreational uses, drinking water, and shellfish consumption. Bacterial contamination of the stream was monitored in 1993 and 1994. Samples were taken from the West Fork by the Elk Creek Road bridge as part of the City's Pilot Plant Testing Program to Evaluate Feasibility of Slow Sand Filtration.

Sampling for bacteria is also done on the waste water treatment facility effluent. Because the samples are taken from the outfall, they would not fairly represent the concentrations of bacteria in Ecola Creek and are not included here.

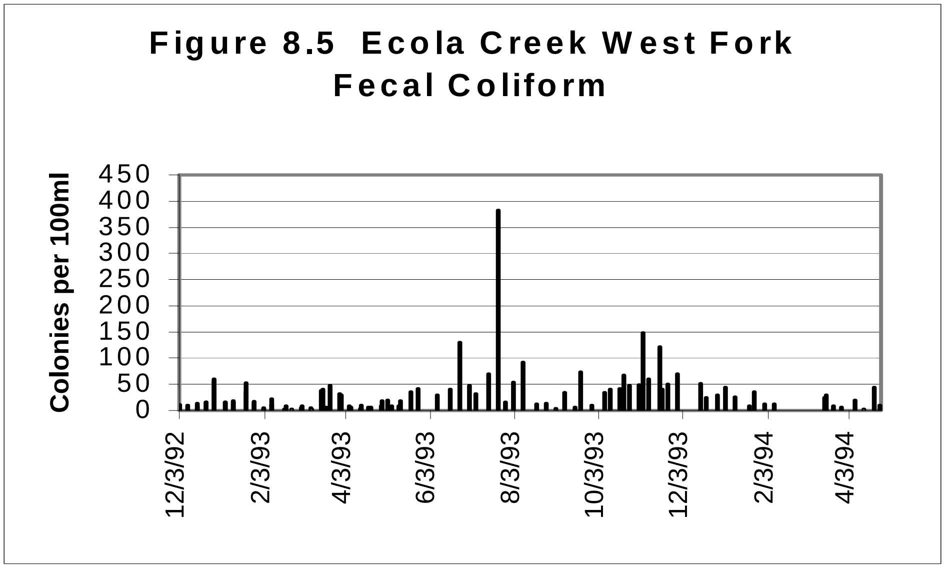
OWAM criteria for bacteria are as shown in Table 8.14 and test results are shown in Figures 8.4 and 8.5. The tests done were for fecal coliform and total coliform.

| Table 8.14 Bacteria Limits for Water contact recreation | |
|---|---|
| E. coli | 126/100ml (30 day log mean; 5 samples) |
| E coli | 406/100ml (single sample maximum) |
| Note: E. Coli, is the current bacterial standard. | |




TNTC (Too Numerous To Count) is plotted as 410 on Figure 8.4 for illustration only. Maximum Total Coliform colony actual count was 366 on 7/22/93, plus there are two listed TNTC, on 6/8/93 and 10/11/93, presumably having counts higher than 366. Assuming TNTC > 366, it might be concluded that from 10/11/93 to 11/04/93, the 126/100 ml (30 day log mean: 5 samples), criteria, may have been exceeded. But, as will be seen in the conclusion for fecal coliform testing, the West Fork coliform tests were in compliance for E. Coli bacteria.

The maximum fecal coliform colony count was 382/ml on 7/22/93. No fecal coliform samples exceeded the screening criteria for E. Coli. Because E. Coli would show up as part of the fecal coliform colony count, it is concluded that the West Fork of Ecola Creek was in compliance each time it was tested.



# CHAPTER 9 ACTION PLAN

## Chapter 2. CHANNEL HABITAT TYPE

Commentary:

It appears that our actual knowledge of specific channel habitat types (CHT) throughout the entire basin is limited and is in need of further investigation. The rather broad identification did reveal that the lower watershed had the most sensitive reaches, which are in need of restoration efforts. Urbanization has produced the most profound effect by confining the channel.

Objective 1: Determine distribution of CHT's throughout watershed

Comment: CHT's were obtained by using a mapping system as identified in the introduction pg. 1-3 par. 3. This method has limitations which exposed actual stream locations based on ground truthing have revealed differences.

Actions: Verify actual CHT's by ground truthing what is determined an acceptable percent of total stream corridor.

Objective 2: Determine the actual location of CHT's that are likely to provide specific aquatic habitat features as well as those areas most sensitive to changes in watershed conditions.

Comment: CHT's specific aquatic features & areas most sensitive to change need to be ground truthed as this determination was conducted through mapping.

Actions: Same as above Objective 1 action

## Chapter 3. HYDROLOGY

Commentary:

The assessment concludes that the only significant hydrological impact is to lower Ecola Creek. Moderate impact resulted from the alteration of the Creek and adjacent wetlands during the urbanization of Cannon Beach.

Objective: Mitigate the adverse effects of the built environment and control development, where possible, to minimize further environmental degradation.

Actions:

A) Limit maximum lot coverage for structures and other impervious surfaces in order to maximize ground water recharge, thereby increasing its availability to Ecola Creek during periods of low flow.
B) Require all runoff from impervious surfaces to be delivered into the storm water drainage system.
C) Discharge storm water from the Ecola Creek drainage into the creek at multiple locations adequately spaced to minimize pollutant concentrations and to minimize cutting of the stream bank.
D) Control or prohibit the discharge into the storm water drainage system of insecticides, herbicides and toxic leachates from construction or other materials.
E) Acquire property and develop it into catchments similar to Little Pompey wetlands as was recently done in the Logan Creek watershed.
F) Modify the tide gate at Little Pompey wetland to enable tidal influence and fish passage to occur.
G) Restore wetlands wherever feasible.

## Chapter 4. WATER USE

Commentary:

The Principal user of water from Ecola Creek is the city of Cannon Beach. The right to instream water for aquatic use depends upon the withdrawals of other water right holders, all of whom are senior. Withdrawals to satisfy the city's needs during periods of low flow may jeopardize fish viability. Low flows may also limit population growth of the city.

Objective 1: Determine the rate and amount of domestic and municipal water consumption and project future needs.

Actions:

A) Continuously measure and record actual water flows using the soon to be installed stream gauges. Also, accurately measure water flow from the springs that are Cannon Beach's principal supplier.
B) Determine current water consumption using water meter records, and also ascertain fire department use.
C) Project future domestic and municipal water demand.

Objective 2: Determine current and future water deficits, with the information thus gained, under all conditions of creek and spring flow and the storage capacity required to assure adequate supplies.

Actions:

A) Compare current and projected water needs with water available on a month-by-month basis and quantify the deficits.
B) Determine the needed reserve capacity, e.g., days, weeks, and calculate the amount of storage capacity required to augment that already existing.

Objective 3: Implement measures to acquire added capacity, minimize consumption, and assure continued availability of water from all sources.

Actions:

A) Construct new storage facilities and related infrastructure.
B) Develop measures to be implemented during periods of low water availability,
C) Acquire easements protecting the watershed that feeds the springs.

## Chapter 6. AQUATIC AND RIPARIAN HABITATS

Objective I. Determine the pool & substrate conditions

Comment: Limited data which is based on field work conducted in 1992 & 1994, and the variable nature of stream channel configuration over time, indicates a serious data gap exists which needs to be addressed. Pool area, pool frequency, residual pools, complex pools & silt-sand-organics were generally rated undesirable, further it appears 94 conditions were worse then those in 92.

Actions: Conduct fieldwork to verify the current presence of pools & substrate conditions. Focus on those areas previously identified undesirable. Prioritize those areas most in need & initiate restoration programs.

Objective 2. Determine large woody debris conditions

Comment: Limited data which is available from fieldwork conducted in 1992 & 1994, indicates a data gap. Though not mentioned specifically, the North entrance to Cannon Beach through contract with the Oregon Dept. of Transportation is about to undergo significant modification, which will change the dynamics within this basin. Under the present plan for this highway improvement, the entire forest encompassed within this zone will be cut. A window of opportunity exists for using these about to be cut trees for large woody debris within those steam areas most in need. This will require approval from City, State, & Federal agencies as well as private landowners.

Productive contacts have been made at all levels with the exception of the Federal. Potential placement has been identified on the West Fork of Ecola Creek.

Actions:

A) Same as AP above but insert LWD.

B) Utilize trees available from the North entrance 101 project to improve LWD conditions in those stream corridors deemed most in need. Obtain pertinent permits & technical assistance along with funding if it becomes essential.

Objective 3. Determine Riparian Habitat Conditions

Comment: Same as above Comment Objective 2. This objective clearly needs a major focus, since little data was collected during previous studies and what was done indicated confers greater >35 dbh (diameter-breast-height) and >50dbh were lacking. Conversion of the present alder dominated stream bank vegetative cover must be aggressively converted to a conifer based cover to meet needs for LWD recruitment, shading and water temperature reduction. During 1999 and again 2001 the Ecola Creek Watershed Council initiated tree planting activities designed to improve RHC. In 1999 on Willamette Industries land various types of conifers were planted by watershed volunteers to meet this objective. In 2001 a similar activity resulted in the planting of 200 hooker willow under Pacific Power and Light power lines. Hooker was selected for its low height at maturity characteristic.

Actions:

A) Same as Action Plan Objective 2, A) above but insert RHC.

B) Prioritize those areas where red alder is most dominant along stream channels and natural conifer regeneration is minimal. Plant priority areas with conifer seedlings.

C) Create coniferous tree nurseries by using seeds from present Ecola Creek old growth conifers. Resulting tree stands might contribute to stream identification for migratory salamonids.

Objective 4. Determine wetland locations

Comment: Maps used to identify wetland locations in this project were on too large a scale to be accurate when actual field verification found many inconsistencies. Historic wetland locations need further identification.

Actions:

A) Conduct formal functional wetlands assessment to verify status of current wetlands.

B) Locate extent of historic wetlands and evaluate their potential, if any, for restoration.

Objective 5. Determine extent and type of wetland

Comment: Since Objective 4 indicates not all wetlands have been mapped or delineated the same goes for classifying wetlands in the future. No indications are given of the actual area or the historical area considered to be wetlands. Portions of the present wetland area have been disconnected through failed culverts and others diked and filled in the interest of human pursuits. The City of Cannon Beach has produced a working document for their storm sewer system known as Surface Water Management Plan For the Downtown and Logan Creek Basins produced by URS Greiner Woodward Clyde 1999. Chapter III. Natural Resources 3.8 Enhancement Opportunities focus on Little Pompey Wetland, Logan Creek and Elm Basin.

Actions:

A) Reconnect Little Pompey Wetland to its historic tidal roots through Ecola Estuary. Continue dialog with City and apply for grants or incorporate funds into City budget for project, which would include: 1) Determining the surface water hydrology and how it is affected by the upstream flow. 2) Assurances that every effort is made to remove highly toxic automotive residues from the storm water runoff prior to flowing into this wetland. 3) Replacing the three culverts and tide gate at Second Street with a single new culvert and self-regulating tide gate as recommended on page 5-13 in the above mentioned document which has an estimated cost of $55,000.00 (1999 estimate). The present system is under modification and it seems appropriate that the ECWC continue their work with the Public Works Director and the Public Works Committee to accomplish this and many other joint tasks.

B) Determine historical and present day total wetland area in watershed.

C) The West Fork of Logan Creek has an interesting series of wetland pockets defined as the area East of Laurel on 7th. The lengthy culverts connecting these wetlands to the main fork of Logan Creek should be replaced by larger more fish friendly structures.

D) The area between Les Shirley Park including the Elm Street Basin has a horse trail which according to URS Greiner Woodward Clyde 1999 pg.3-16, "The location of the trail degrades the biologic health of the riparian corridor & the water quality as Logan Creek discharges into Ecola Creek.". **Not sure but Swigarts may have documentation, based on water quality testing, to disprove this claim. The Woodward Clyde 1999 report (pg.3-16) indicates a low impact creek crossing could be facilitated through construction of a raised boardwalk. We should further explore this possibility & make grant applications to fund such a project as needs arise.

E) The small wetland west of Highway 101 and south of the eastern sewage basin needs to be reconnected to the main Ecola system by maintaining an adequate culvert system. Two culverts are involved, one under 2nd St at the East end near 101 and the second one located under the roadway which provides access to the wastewater treatment plant from Hwy 101.

## Chapter 7. SEDIMENT SOURCES

Objective 1: Verify data accumulated during the assessment stage and considered to be incomplete.

Actions:

A) Conduct road inventory in order to complete the road instability section. Geologic information, road age, soils and rainfall patterns are some examples of information sources that should be consulted to provide clues to road instability problems.

B) Conduct an inventory of existing and high potential landslide areas to complete the slope instability section. Consider local knowledge, field visits and aerial photos are the most readily available information sources for this portion of the assessment.

C) Complete the rural roads assessment.

Objective 2: Continue to work together with private and public landowners on the issues of sediment sources in the watershed.

Actions:

A) Work with the City to find the most appropriate ways to reduce the amount of sediments and pollutants discharged from urban areas into Ecola Creek and associated wetland areas.

B) Collaborate with landowners in watershed regarding sediment producing activities mentioned under Objective 1.

## Chapter 8. WATER QUALITY

Objective 1: Verify data accumulated during the assessment stage and considered to be incomplete.

Actions:

A) Dissolved Oxygen (DO)
Current data is only from single samples take on an approximately weekly basis. The data base should be extended by taking 24 hour profiles of each fork. Sampling at times of extreme seasonal variation is also needed.

B) Temperature
Temperature data is available from the City and Willamette covering the summer period. Additional data is needed during time of the season critical to:

Egg hatching at end of winter—April/May
Low flows at end of summer—September/October

Monitoring of temperature in side channels where no temperature data is currently available needs to be made. Simultaneous monitoring upstream and downstream of the North Fork power line crossing to quantify the solar gain of that unshaded reach and to determine the effectiveness of proposed restoration actions.

C) Waste Treatment Facility out-fall monitoring
The City of Cannon Beach is making sampling and tests around the waste treatment effluent outfall, in coordination with DEQ. The ECWC needs to monitor the data generated.

D) Macroinvertebrates
Five sets of data are available. These need to be evaluated and a base line established to compared Ecola Creek to other similar streams
Available data:

Willamette
Charlie Dewberry
J. Arnold

E) Ammonia
Data for ammonia is limited. A new series of testing is being made in relation to the waste treatment effluent. Work with City Public Works to establish data in mixing zone and lower reaches of E Creek

F) Identify Other Indicators of Watershed Health
Investigate whether other factors such as birds and animal types and frequency of occurrence can be used to measure stream quality.

Objective 2: Find ways for the Watershed Council to work together with the City as the City water usage and waste water treatment have a major effect on Ecola Creek. Look for ways to minimizing the effects of water use and effluent discharge on the Creek.

- Public awareness
- Means of reducing water use
- Storm sewer system
- Oil/hydrocarbons
- Catch basin material disposal
- Street sweeping
- Water availability and water rights
- Better definition of water sources—springs, below ground and surface
- Flow surveys

Objective 3: Develop a DEQ approved monitoring plan

Develop and implement a DEQ approved monitoring plan complete with Quality Assurance/ Quality Control (QA/QC) safeguards and procedures, a plan designed to dovetail with DEQ's ongoing coast-wide water quality monitoring effort. DEQ's effort produces an index of water quality. The index tracked over a period of years gives trend plus the ability to compare one stream to another.

# CHAPTER 10 REFERENCES


Alt, D. and D. Hyndman, 2000. Roadside Geology of Oregon. Mountain Press Publishing Co.: Missoula, Montana.

Andres, F. Small army battling keep blaze out of town. Astorian Budget. 7 Sept. 1949:1.

Arnold, J. 2001. Personal Interview, January 20.

Bartl, R. 2000. Personal communication with Shelley Parker (Project Manager). City Planner. City of Cannon Beach, Cannon Beach, Oregon.

Bartl, R. 2001. Personal communication with Shelley Parker (Project Manager). City Planner. City of Cannon Beach, Cannon Beach, Oregon.

Beeson, M.H., R. Perttu, and J. Perttu. 1979. The Origin of the Miocene Basalts of Coastal Oregon and Washington: an Alternative Hypothesis. Oregon Geology 41: 159-161. In Schultz, 1990.

Bischoff, J.M., R.B. Raymond, K.U. Snyder, J. Bergeron and S.K. Binder. 2000. Nicolai-Wickiup Watershed Assessment. E&S Environmental Chemistry, Inc. and Nicolai-Wickiup Watershed Council. Corvallis, OR. August 2000.

Cannon Beach Gazette, Letter to the Editor. Paul Brinkman, Jr. Cannon Beach, Jan. 13,1983.

Cannon Beach Historical Society. 1999. Water system file.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. US Fish and Wildlife Service, FWS/OBS-79-31, Washington DC.

Dept. of Housing and Urban Development, Flood Insurance Admin., 1978. Flood Insurance Study, City of Cannon Beach. (Federal flood insurance programs are now the responsibility of the Federal Emergency Management Agency (FEMA)).

Deur, D. PhD. 2000. Personal communication with Shelley Parker (Project Manager). Cannon Beach, Oregon.

Economic and Engineering Services, Inc. 2001. City of Cannon Beach Water Master Plan Final Report. Portland, OR. January 2001.

EPA, 1993. Cannon Beach Wooded Wetlands for Wastewater Treatment. September 1993.

Fishman Environmental Services and Marc Barnes. 1993. Cannon Beach Wetlands Study: Local Wetlands Inventory; Conflicting Uses; ESEE Analysis; and Standards, Overlay Zones, and Related Amendments.

Franklin, J. and C, Dyrness. 1973. Natural Vegetation of Oregon and Washington. OSU Press.

Hafele, R. 1978. Effects of Controlled Flow Reductions on the Insect Community of an Oregon Coastal Stream. M.S. Thesis, Oregon State University.

Howell, D. June 1999. Personal interview with Shelley Parker (Project Manager).

Ice, G. G., 1985, Catalog of Landslide Inventories for the Northwest. National Council of the paper Industry for Air and Stream Improvement (NCASI) Technical Bulletin 456, 78 p plus appendices.

Kaczski, V.W., 1995, Ecola Creek Baseline Conditions in 1994-1995. A report prepared for Cavenham Forest Industries. Seaside, Oregon.

KCM, Inc. 1991. City of Cannon Beach Water Distribution System Master Plan.

KCM, Inc. 1995. City of Cannon Beach Storm Drainage Master Plan.

Knispel, W. 1999. Personal communication with Shelley Parker (Project Manager). Retired ODFW district biologist. Seaside, OR.

Long, M. 1999. Personal communication with Shelley Parker (Project Manager) via e-mail. Fish Biologist. Oregon Department of Fish and Wildlife, Tillamook, Oregon.

McGreer, D. 1995, Ecola Creek Watershed Analysis.

McKeever/Morris, Inc. 1997. Clatsop County Water Resources and Land Use Planning.

Moore, K, K. Jones, and J. Dambacher. 1997. Methods for Stream Habitat Surveys. Aquatic Inventory Project. Oregon Department of Fish and Wildlife, Natural Production Program, Corvallis, OR.

Morgans, M. 1999. Personal communication with the Ecola Creek Watershed Council. Willamette Industries, Inc. Seaside, Oregon.

O'Donnell, Terrence. 1996. Cannon Beach: A Place by the Sea. Portland: Oregon Historical Society Press.

Oregon Department of Fish and Wildlife (ODFW). 1997. Information Report. Astoria.

Oregon Department of Fish and Wildlife. 1979. Draft Fish Management Plan. Elk Creek (Ecola Creek). Astoria.

Oregon Department of Fish and Wildlife. 1975. Memo to Warren Knispel. Astoria.

Oregon Department of Transportation. 2001. Biological Assessment: Oregon Coast Highway at Cannon Beach North Entrance Project.

Oregon Department of Water Resources website: www.wrd.state.or.us

Oregon State University Extension Service (OSUES). 1998. Watershed Stewardship: A Learning Guide. July 1998. EM 8714. Oregon State University: Corvallis, OR.

National Marine Fisheries website: www.nwr.noaa.gov/1salmon/salmesa/index.htm

Neel, R. 1976. Geology of Tillamook Head-Necanicum Junction Area. Clatsop County, Northwest Oregon. Unpublished M.S. Thesis, Oregon State University: Corvallis, OR. p. 204.

Niem, A. 1989. Hydrogeologic Investigation for Development of Further Groundwater Resources to Augment the Municipal Water Supply of the City of Cannon Beach.

Niem, A. 1976. Tertiary Volcaniclastic Deltas in an Arc-trench Gap, Oregon Coast Range. Geological Society of America Abstracts with Program. v. 8, no. 3 p. 400. In Niem, A. 1989

Niem. A. and W. Niem. 1985. Oil and Gas Investigation of the Astoria Basin, Clatsop and Northern most Tillamook Counties, Northwest Oregon. State of Oregon Department of Geology and Mineral Industries Oil and Gas Investigation No. 14.

Niem, A. and R. Van Atta. 1973. Cenozoic Stratigraphy of Northwestern Oregon and Adjacent Southwestern Washington. In Niem, A. 1989.

Science Findings. 1999. Issue seventeen. August 1999.

Schlicker, et al. 1972. Environmental Geology Tillamook & Clatsop Counties, OR. State of Oregon Department of Geology and Mineral Industries No. 74.

Schultz, S. 1990. The Northwest Coast: A Natural History. Timber Press: Portland, Oregon.

Sheahan, J. 1998. Personal communication with Shelley Parker (Project Manager). Assistant District Biologist. Oregon Department of Fish and Wildlife, Astoria, Oregon.

Shields, G. April, 1999. Personal communication with Shelley Parker (Project Manger). April 5.

Sidle, R.C., A. J. Pearce, and C. L. O'Loughlin, 1985, Hillslope Stability and Land Use. American Geophysical Union, Water Resources Monograph 11, 140 p.

Soil Conservation Service. 1988. Soil Survey of Clatsop County, Oregon. United States Department of Agriculture.

Teagle, B. 1999. Personal communication in a telephone interview with Shelley Parker (Project Manager).

Teagle, B. 2001. Personal communication during an assessment review with Shelley Parker (Project Manager).

U.S. Army Corps of Engineers, 1974. Elk Creek at Cannon Beach, OR Draft Detailed Project Report.

URS Greiner Woodward Clyde. 1999. City of Cannon Beach Surface Water Management Plans for the Downtown and Logan Creek Basins.

Watershed Professionals Network (WPN). 1999. Oregon Watershed Assessment Manual. January 1999. Prepared for the Governor's Watershed Enhancement Board, Salem, OR.

Watershed Professionals Network (WPN). 1999. Oregon Watershed Assessment Manual. June 1999. Prepared for the Governor's Watershed Enhancement Board, Salem, OR.

Webb, J. 1999. Personal communication with Shelley Parker (Project Manager).

Western Watershed Analysts. 1995. Ecola Creek Watershed Analysis. Prepared for Cavenham Forest Industries Division Hanson Natural Resources Company now in the possession of Willamette Industries, Seaside, OR

# APPENDIX A : HISTORICAL TIME-LINE AND NARRATIVE OF THE ECOLA CREEK WATERSHED

**Prepared by**

**Shelley Parker**
**for the**
**Ecola Creek Watershed Council**

**Historical Timeline of the Ecola Creek Watershed**

| | |
|---|---|
| 1806 ------------- | Captain William Clark, while on a search for whale blubber and oil, is the first white man to visit Ecola Creek area. He named Ecola Creek E-Co-La or Whale Creek (O'Donnell, 1996). |
| Pre 1850's-------- | No-cost (Tillamook) villages located near mouth of Ecola Creek (O'Donnell, 1966). By the time the first homesteaders arrived, the No-cost villages had perished from disease brought by white traders and settlers (Deur pers. comm. 2000). |
| 1851 ------------- | The Tillamook cede their land to the United States (O'Donnell, 1996). |
| 1850-1870 ------- | First Homesteaders in Cannon Beach area. These early settlers vanish before the Toll Road (the first road connecting Seaside to present day Cannon Beach) is built in 1890. |
| 1890 ------------- | Elk Creek Toll Road built connecting Seaside with Cannon Beach (known to early settlers as Elk Creek). |
| 1890 ------------- | True permanent settlement begins in Elk Creek area. |
| 1910-------------- | The first post office established in present day Cannon Beach. It was called the Ecola Post, after the name coined by Captain Clark and used by the first families who vacationed in the area from Portland. |
| 1910-------------- | Sylvester White discovers artesian springs (Brinkman, 1983; O'Donnell, 1996). Initial water system consisted of wooden pipes carrying spring water to Brooklyn Camp (between present day Gower St. and Monroe St.). Earliest known manager of Cannon Beach's water system was Orin Kellogg. At a later date, Henry McKay became the system's owner who then sold to Mr. Firebaugh (1940's). Firebaugh eventually acquired all the water systems in Cannon Beach and Tolovana Park. Later his son Dave Firebaugh took over his father's business, which he eventually sold to the city of Cannon Beach (Brinkman, 1983). |
| 1911------------- | Ecola Creek finally bridged (previous crossing had been by ferry, floating bridge or through the creek)(O'Donnell, 1996). |

| | |
|---|---|
| 1911--------------- | Logging camp and mill built in area. Spruce districts established harvesting the best spruce for airplanes in WWI. |
| Early 1920's ---- | Riding stables established on the banks of Elk Creek. The Elk Creek Riding Academy was established in 1922 by W.L. Spalding (Elk Creek Riding…, 1947). Another stable located south of Ecola Inn (O'Donnell, 1996). |
| 1921-------------- | One room school house built near present day school. |
| 1922-------------- | Ecola residents successful in petitioning for name change to Cannon Beach. |
| 1922-------------- | Spruce mill built near Sunset Blvd and Hwy 101 (Howell, 1999). |
| 1923-------------- | New and sturdier bridge built over Ecola Creek (O'Donnell, 1996). |
| 1931-------------- | Elk Creek Light and Water owned by Mr. Michael Barrie MacKay (permit # 10277, Water system file). |
| 1939-------------- | Forest Fires nearly engulf town (O'Donnell 1966). |
| 1939-------------- | Major storm/flood event. Surf tears away seafront of several cottages in downtown area. May be prelude to seafront walls (O'Donnell 1996 and Bartl pers. comm. 2000). |
| Late 30's -------- | George VanVleet Logging Company begins operations in town (Shields pers. comm. 1999). |
| 1940-------------- | Arch Cape tunnel opens and connects Cannon Beach to HWY 101 (O'Donnell, 1996). |
| 1942------------- | Mr. Firebaugh buys Elk Creek Light and Water (Water system file). |
| 1948------------- | Sunset Hwy opens connecting Portland directly to Seaside. (O'Donnell, p. xviii) |
| 1949------------- | Forest Fires east of town approaches Cannon Beach via Elk Canyon (West Fork). Fires caused by slash burns on Crown Zellerbach property east of Sugar Loaf (Andres, 1949, p. 1). |
| 1950------------- | Present main school building constructed (Rippet pers. comm. '00). |
| 1950------------- | New Hwy between Seaside and Cannon Beach replaces Toll Road and speeds up travel time (O'Donnell, 1996). |

| | |
|---|---|
| 1951------------- | Elk Creek Light and Water changes name to Cannon Beach Water Co., still owned by Mr. Firebaugh (Water system file). |
| 1955------------- | Cannon Beach becomes an official city due to the need for a sewage system (Water system file, and O'Donnell, 1996). |
| 1958------------- | Two eastern most sewage ponds and extension of 2nd St. to Hwy 101 established east of downtown. This development altered the drainage patterns of this area, which had previously been an open floodplain. The lagoons were diked and cut off from floodwaters, leaving only the portion north of the levee on 2nd St. open to overflow and high tide waters (URS Greenward Woodward Clyde, 1999 and KCM, 1991). |
| Early 60's ----- | Brush fires burn hillside above S curves and Crown brought in to help put fires out (Teagle pers. comm. '99 and Howell pers. comm. '99). |
| 1963------------- | Crown Zellerbach purchases George VanVleet. Forestland almost entirely clear cut. VanVleet's regeneration methods included seed trees and seed blocks. Crown Zellerbach began aerial seeding and hand planting (Teagle pers. comm. 1999). |
| 1964------------- | Tsunami hits Cannon Beach. Takes out bridge and homes leaving town under several feet of water (O'Donnell, 1996 and URS). |
| 1967------------- | High velocity west winds combine with very high tides to flood Cannon Beach downtown under 2.5 feet of water (U.S. Army…, 1974). Flooding was a common occurrence in Cannon Beach, but prior flooding was not of this magnitude (URS, 1999). |
| 1968------------- | Tolovana Park annexed to Cannon Beach due to sewage problems (O'Donnell, 1996). |
| 1968------------- | Major roadbed failure off Hwy 101 above Cannon Beach's north exit closing highway to one lane traffic. The slide inundated Logan Creek with fill from the failure. |
| 1969------------- | Another major flood in town. (O'Donnell, 1996) |
| 1970------------- | The third sewage treatment pond is constructed. (U.S. Army, 1974) |

| | |
|---|---|
| 1970 ------------- | City builds low levee extending north from Second St. to Elm St. in order to prevent ordinary tidal flooding. Materials excavated from sewage lagoon construction were used for the project. |
| 1972--------------- | Congress passes the Clean Water Act. More stringent effluent quality standards set by the DEQ lead to plans for an improved wastewater facility in Cannon Beach. Twelve years later (1984) the wooded wetlands addition and system upgrade are finished (EPA, 1993). |
| 1972-------------- | Forest Practices Act -establishes timber harvest regulations. |
| 1973-------------- | Annual releases of yearling cutthroat terminated after 1973 (ODFW file, #2). |
| 1973 ------------- | City takes over the water system owned and operated by Dave Firebaugh. System was not metered and needed updating. City began ownership by doubling rates. Master metered 1 million gallon tank constructed near RV area (Howell pers. comm. 1999 and Water system file). |
| 1973-------------- | New regulations from Oregon Health Division requiring chlorination, new mainline, turbidity readings, etc. Town upset over chlorinated water (Archibald, 1975; Howell pers. comm. 1999; and Water system file). |
| 1974-------------- | Gauging stations placed on West and North Forks of Ecola Creek. Gauging stations in operation until 1986 (ODFW file). |
| 1974-------------- | Elk Creek renamed Ecola Creek (McArthur, 1982). |
| 1974-------------- | Corps of Engineers complete study on flood control in Cannon Beach (U.S. Army, 1974). |
| 1974-75---------- | Biological response to reduced stream flow study on Ecola Creek. Study diverts 25, 50 and 75 % of water flow from North Fork into the West fork and measures biological response to reduced N. Fork flows. |
| 1974-------------- | Coho hatchery adults released on both forks of Ecola. |
| 1978-------------- | Flood Insurance study completed for the US Dept. of Housing and Urban Development (URS, p.5-1). |

| | |
|---|---|
| 1979-------------- | Water shortage in Cannon Beach due to winter drought of 1976-1977 (Howell pers. comm. 1999 and Pierce, 1979. p.1). |
| 1979--------------- | Breaker's point built on north bank of estuary (O'Donnell, 1996). |
| Early 80's-------- | City initiates discussions concerning clearcuts on Crown Zellerbach property north of town off HWY 101. Crown Zellerbach transplanted four foot Douglas firs along the strip adjacent to Hwy 101 to quicken reforestation. |
| 1982--------------- | Conservation Easement designated by the Oregon Department of Forestry and Crown Zellerbach with the Nature Conservancy on Onion Peak to protect unique rock habitat plant species. |
| 1983-------------- | Landslide at lower springs reaches Ecola Creek. |
| 1984-------------- | One of the nation's first ecologically interactive sewage-treatment facilities built in Cannon Beach (O'Donnell, 1996). Aeration basin, wetlands, chlorine contact chamber, as well as other system upgrades are added to wastewater system (EPA, 1993). |
| 1984-------------- | Tolovana Park Reservoir site sold to City of Cannon Beach by Crown Zellerbach (Teagle pers. comm. 2001). |
| 1985-------------- | Road improvement efforts increased on Crown property. Roads inadequate and dangerous. Garbage dumping, wood theft, keg parties and accidents are common. Crown Zellerbach gated the property on the Tolovana Mainline, Warren Road and Hug Point Road. (Teagle pers. comm. 1999). |
| 1986-------------- | Cavenham takes possession of Crown Zellerbach property in a hostile takeover by Sir James Goldsmith. Goldsmith sells paper mills to James River (Teagle pers. comm. 1999). |
| 1987-------------- | Prospective 1500-acre resort adjacent to Warren Rd behind Tolovana Park proposed by Goldsmith. Goldsmith eventually withdrew proposal (Teagle pers. comm. 1999). While the property was County owned, the proposal led the Cannon Beach City Council to adopt a Comprehensive Plan policy stating their opposition to destination resorts (Bartl pers. comm. 2001). |

| | |
|---|---|
| 1990-------------- | Cavenham gates the remainder of their property, closing the watershed to car and foot traffic due to poor road conditions and other liability concerns. (Teagle pers. comm. 1999). |
| 1991-------------- | Cavenham sold to Hanson, PLC. Hanson PLC more community oriented than Goldsmith's foreign owned corporation. Set up scholarship program for local schools, donated money to Hamlet Fire Dept, etc. (Teagle pers. comm. 1999). |
| June 2, 1994----- | Cavenham Vice President Dick Dahlin addresses Cannon Beach home owners' and the Communication Committee is established (Teagle pers. comm. 2001). |
| 1994-------------- | City builds sand filtration plant on banks of West Fork of Ecola Creek. Land was acquired from a land exchange with Cavenham. |
| 1995-------------- | ODFW Restoration project on West Fork placing LWD in stream. Stream possibly seeded with juvenile fish (ODFW file, #16 ). |
| 1995-------------- | Storm Drainage Master Plan developed by KCM for the City of Cannon Beach. Management strategies and capitol improvement projects for most drainages in Cannon Beach are identified. The adequacy of the drainages to handle current and expected future stormwater runoff determined. Downtown and Logan Creek drainages not included in report (URS, 1999). |
| 1996-------------- | Willamette Industries buys Cavenham Industries. Willamette pledges to continue talks with city and the co-op started with Cavenham (Teagle pers. comm. 1999). |
| 1997 ------------- | Coastal Salmon Recovery Initiative (CSRI) developed to avoid federal listing for Coho and other fish species of concern. |
| 1998 -------------- | SHED committee established to prepare storm water management plans for Downtown, Logan and Elm basins. Findings published in 1999 publication "Surface Water Management Plans for the Downtown and Logan Creek Basins" (URS, 1999). |
| 1998-------------- | Oregon Coastal Coho listed as threatened species on Aug. 3rd. (URS, 1999). |

1998-------------- CSRI superceded with the Oregon Plan.

1999-------------- Willamette says they will not spray herbicides in Ecola Creek Watershed. (Morgans pers. comm.1999).

2000-------------- City purchases 1.5 acres from Willamette Industries for North end reservoir site. Reservoir tank to be constructed in 2001.

## Historical Conditions Narrative for the Ecola Creek Watershed

### I. Watershed Resources at the Time of Exploration/Settlement

**Vegetation**: Early homesteader describes, "The terrain was rough, mountainous and covered with virgin timber…" (Griffin and Green, 1983, p.7).

**Fish Species and Abundance**: ODFW Fish Management Plan in 1978 estimated the annual run of coho not to exceed 275 fish due to the limited accessibility of the system. In addition, the steelhead run was thought to be on the order of 100-300 fish and representing maximum capacity in 1978. Historical population estimates of resident cutthroat were inconclusive in the 1978 report, while later in an 1997 ODFW Information Report, both populations of sea-run and resident cutthroat were reported as unknown. Local accounts indicate that Ecola was filled with fish during spawning season and cutthroat were always to be found (Shields, 1999). An 1891 article in the Daily Astorian proclaimed, "Is fishing looked for? Elk Creek abounds in fish…" (O'Donnell, 1996, p. 18). Another narrative further describes the area in the beginning of settlement, "The beach in the early years we spent there was pretty much as the Indians had left it; primitive, unspoiled, with everything in abundance, including clams, crabs and fish." (Giffin and Green, 1983).

**Natural Disturbance Patterns**: Along the wet coastal fringe of the Coast Range, fire has been insignificant in the history of forest development. Here, disturbance by wind to patches varying in size from one tree, to many hectares, is a major force shaping the development of forests and creating a very different pattern of stand development than would a fire. Wind generation leads to a complex structured forest with many canopy layers and ages of trees; where as fire-origin forests have fewer layers and age classes of trees (Pojar and Mackinnon, 1994).

**Floods**: "Even more frequent, almost yearly, was the flooding of the downtown caused by storm tides flowing up Elk Creek, spilling into what was then the low swampland east of main street, and finally receding into the main street itself." (O'Donnell, 1996, p. 77).

**Native Americans**: Evidence of multiple villages and peripheral houses (places for fishing) exist at the mouth and upstream in the Ecola Creek watershed prior to the arrival of Lewis and Clark in 1805. The Indians fished, gathered Yeska root, as well as harvested off Haystack (seals, bird eggs, fish, clams and crab). Huckleberry patches were managed and burned to maintain supplies (Deur, 2000).

## II. <u>Historical Settlement, Land Use and Resource Management Patterns and Trends</u>

**Settlement**: An 1891 article in the Daily Astorian (just a year after the Toll Road opened) describes "Elk Creek Country" , "…and the grand old forest, though fast disappearing before the ax of the settler, yet shelter in their shadowy recesses abundance of game." (O'Donnell, p. 18)

**Logging**: A 1983 publication of life in Cannon Beach from an early homesteading family states, "No longer does the beach have the green virgin forest background, logging has taken care of that;"(Griffen and Green 1983, p.1). By the time of a 1952 ODFW stream survey, most of the riparian areas adjacent to Ecola Creek, and both its forks, had been logged (ODFW 1952, #7). By that time the watershed was predominately owned by a timber company as it is today.

**Fish stocking and Management Trends**: "Annual releases of yearling cutthroat were terminated after 1973 according to an 1973 ODFW Information Report. Plans at one time were to increase production of coho by "management of the wild stock and releasing adults above the falls." according to an ODFW 1975 memo. Stocking of coho in 1974 is the only year documented. By 1978, Ecola Creek was being managed for wild fish. An ODFW 1997 Information Report describes the coho population as "relatively good, but has experienced considerable decreases in recent years. Counts in the mid 80's ranged from 50-75 fish. There were 21 fish seen in 1996, but only one in 1992 and 1993 according to the 1997 ODFW Information Report.

**Fishing**: Ecola Creek is closed to all fishing from Apr. 1st through Oct. 31st. The only open season is for adipose fin-clipped steelhead Jan. 1st through March 31st and Nov. 1st through Dec. 31st. All wild steelhead must be released unharmed. The portion of the stream open for the above season is from the mouth, including tidewater, upstream to the forks located 1 mile upstream from the Hwy. 101 bridge.

**Changes in Disturbance Patterns**: Three fires of human origin have been documented in Cannon Beach since 1939. The fire in 1949 was well documented in the watershed and affected predominately the North Fork of Ecola (Andres, 1949, p.1). A 1952 ODFW stream survey noted evidence of the fire approximately 1.5 miles up the North Fork from its mouth, not far from the first falls.

The sewage lagoons and wetland treatment facility, combined with the low levee, have cut off that portion of the Ecola drainage and the downtown area to Ecola Creek's floodplain and to annual flooding that once occurred.

**Water Use:** The water supply for the City of Cannon Beach comes from a group of springs that drain into the W. Fork of Ecola and from the West Fork itself in an area located east of the city above the Sand Filtration System. The effects of the city's water use on water quality and salmon runs are unknown. Data from the water resources department indicates that water use on the West Fork and the mainstem of Ecola Creek is over allocated during certain months of the year. This may or may not reflect an effect for salmon and aquatic species.

# APPENDIX B: DEQ MIXING STUDY

## DEQ Mixing Zone Study
## Cover Sheet

The issues raised in the DEQ Mixing Zone Study are currently being addressed by the City of Cannon Beach. Measures already underway include:

- Creek water quality monitoring program:
  - ⇒ Dissolved Oxygen (DO)
  - ⇒ Biochemical Oxygen Demand$_5$ ($BOD_5$)
  - ⇒ pH
  - ⇒ Total Suspended Solids (TSS)
  - ⇒ Temperature
  - ⇒ Phosphorus, Total and Phosphates
  - ⇒ Nitrate, Nitrite, and Ammonia
  - ⇒ Salinity (Ammonia toxicity limits are salinity dependent)
  - ⇒ Fecal Coliform
  - ⇒ Chlorine concentration
  - ⇒ Barometric pressure (DO is dependent on barometric pressure)
  - ⇒ Rainfall

- Gauging stations to continuously measure flow and temperature; sites selected on the North and West Forks and Main Stem; funding budgeted; equipment selected

## APPENDIX C : WILLAMETTE INDUSTRIES 1995-1996 WILDLIFE SURVEYS OF CANNON BEACH TRACT

**Surveys and Report**
**by**
**Fauna and Flora**
**Barry Schreiber**
**Wildlife Biologist**
**08/96**