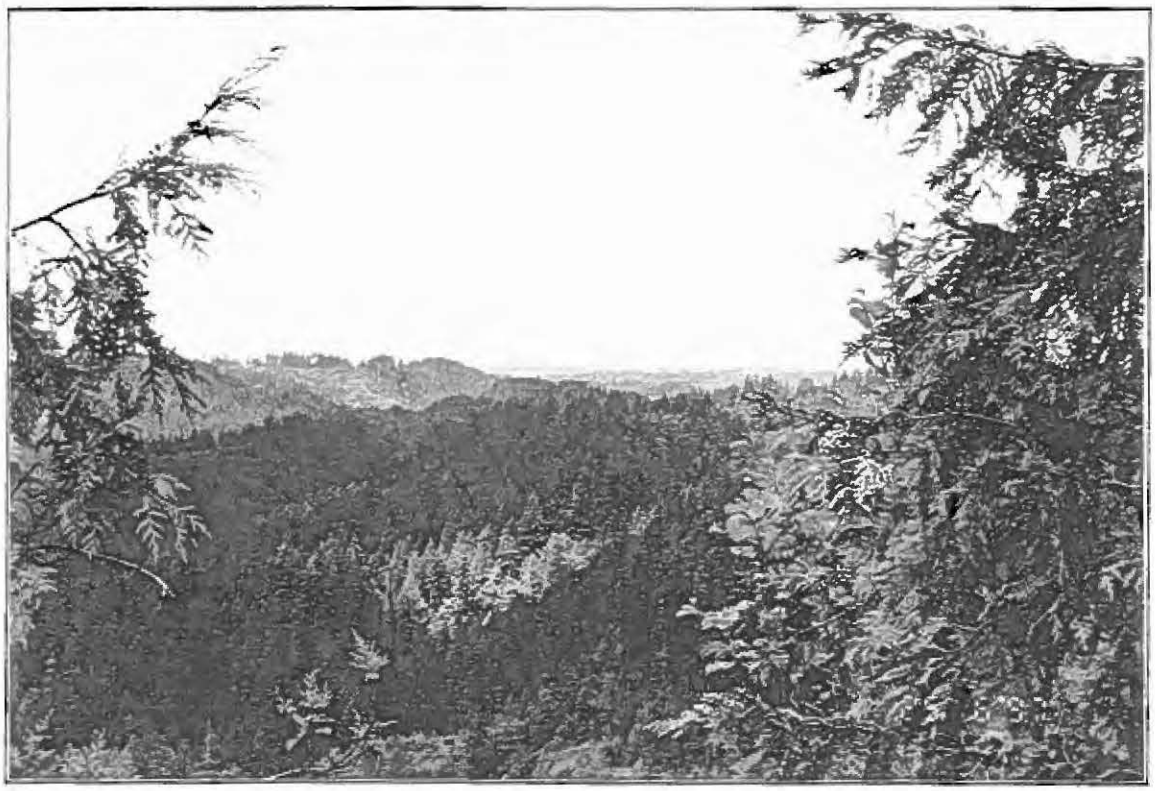
Lower Siuslaw Watershed Analysis



Prepared for

Siuslaw National Forest
Mapleton Ranger District

Prepared by

SRI/SHAPIRO/AGCO, Inc.

February 13, 1998

DRAFT

Lower Siuslaw Watershed Analysis

Prepared for

Siuslaw National Forest
Mapleton Ranger District
Florence, Oregon

Prepared by

Bruce Hollen, Robert House, John Johnson
Walt Knapp, Alison Rhea, Todd Reinwald
SRI/SHAPIRO/AGCO, Inc.
1650 N.W. Front Avenue, Suite 302
Portland, Oregon 97209
SRI/SHAPIRO/AGCO, Inc. Project #7975009

February 12, 1998

Table of Contents

1.0 INTRODUCTION **1**
2.0 CHARACTERIZATION **2**
2.1 THE ANALYSIS AREA 2
2.1.1 Geographic 2
2.1.2 Relief 2
2.1.3 Climate 2
2.2 LAND ALLOCATIONS, PLAN OBJECTIVES, AND REGULATORY CONSTRAINTS 3
2.3 HUMAN USES 5
2.3.1 Residents Within the Watershed Area 5
2.3.2 Tribal and Cultural Resources 5
2.3.3 Transportation Systems 5
2.3.4 Land Ownership 5
2.3.5 Public Access 6
2.3.6 Recreation 6
2.3.7 Landscape Aesthetics 6
2.3.8 Commodity Production 6
2.4 GEOLOGY AND HILLSLOPE EROSION 7
2.5 HYDROLOGY 9
2.5.1 Subwatersheds and Streams 9
2.5.2 Discharge 10
2.5.3 Lakes 12
2.5.4 Estuary/Wetlands 12
2.6 AQUATIC SPECIES AND HABITAT 14
2.6.1 Species 14
2.6.2 Habitat 15
2.7 VEGETATION PATTERNS 16
2.8 TERRESTRIAL WILDLIFE AND HABITAT 17
3.0 ISSUES AND KEY QUESTIONS **19**
3.1 INTRODUCTION 19
3.2 ISSUE 1: WHAT OPPORTUNITIES EXIST FOR PROTECTING, MAINTAINING AND RESTORING THE AQUATIC HABITAT IN THE WATERSHED? 19
3.2.1 Key Questions 19
3.3 ISSUE 2: WHAT CONDITION IS THE ROAD SYSTEM IN AND WHAT LEVEL OF ACCESS IS NEEDED IN THIS WATERSHED? 20
3.3.1 Key Questions 20
3.4 ISSUE 3: WHAT IS THE CONDITION OF THE LATE-SUCCESSIONAL RESERVE LANDS AND HOW CAN THEY BE MANAGED TO FUNCTION AS A LATE-SUCCESSIONAL ECOSYSTEM? 21
3.4.1 Key Questions 21
3.5 ISSUES OR INFORMATION NOT ANALYZED IN THIS ITERATION 23
3.6 DATA GAPS 23

4.0 CURRENT AND REFERENCE CONDITIONS **24**
4.1 HUMAN USES 24
4.1.1 Cultural Resources and Area History 24
4.1.2 Logging History 26
4.1.3 Recreation 29
4.1.4 Landscape Aesthetics 30
4.1.5 Beneficial Uses of Water 30
4.1.6 Special Forest Products 31
4.1.7 Transportation Systems 32
4.2 EROSION PROCESSES - LANDSLIDES 38
4.3 STREAM TEMPERATURE 40
4.4 AQUATIC SPECIES AND HABITAT 41
4.4.1 Reference Conditions: Fish Species 41
4.4.2 Current Conditions: Fish Species 42
4.4.3 Reference Conditions: Fish Habitat 44
4.4.4 Current Conditions: Fish Habitat 45
4.5 VEGETATION PATTERNS 54
4.5.1 Plant Associations 54
4.5.2 Natural Disturbance Processes 56
4.5.3 Stand Structure and Seral Stages 58
4.5.4 Stand Dynamics 60
4.6 TERRESTRIAL WILDLIFE SPECIES AND HABITATS 62
4.6.1 Mature Forest Habitat and Associated Species 63
4.6.2 Interior Mature Forest Habitat 68
4.6.3 Riparian Habitat 69
4.6.4 Centers of Biodiversity 70
4.6.5 Special Habitats 70
4.6.6 Current and Proposed Land Uses 71
4.6.7 Roads 71
4.6.8 Late Successional Dependent Species 72
4.6.9 Threatened or Endangered Species, Candidate Species, and Species of Concern 74
4.6.10 Big-Game/Recreationally Important Species 79
4.6.11 Botanical Resources 80
4.6.12 Survey and Manage Plant Species 80
4.6.13 Noxious and Non-Native Vegetation 81
5.0 SYNTHESIS AND INTERPRETATION **82**
5.1 ISSUE #1 THE CAPABILITY OF THE WATERSHED TO MAINTAIN AND SUPPORT AQUATIC SPECIES AND HABITAT 82
5.1.1 Differences Between Reference and Current Conditions 82
5.1.2 Interactions of Biological, Physical, and Human Processes on Aquatic Hotspots 86
5.2 ISSUE #2 CONDITIONS OF THE EXISTING ROAD SYSTEM 88
5.2.1 Alterations to Reference Watershed Conditions from Roads 88
5.2.2 Proficiency of the Current Road System to Meet Current Management Objectives 89

5.3 ISSUE #3 THE CAPABILITY OF THE LATE-SUCCESSIONAL RESERVE TO FUNCTION AS A LATE SUCCESSIONAL ECOSYSTEM AND SUPPORT RELATED WILDLIFE SPECIES 90
5.3.1 Differences Between Reference and Current Late-Successional Habitat Characteristics and Distribution 90
5.3.2 Interactions of Biological, Physical, and Human Processes on Late-Successional Habitat Characteristics and Distribution 92
6.0 RECOMMENDATIONS 98
6.1 AQUATIC SPECIES AND HABITAT 98
6.1.1 Subwatersheds 98
6.1.2 Fish Species 99
6.1.3 Aquatic Habitat 99
6.2 ROADS 103
6.3 THE CAPABILITY OF THE LATE-SUCCESSIONAL RESERVE TO FUNCTION AS A LATE-SUCCESSIONAL ECOSYSTEM AND SUPPORT RELATED WILDLIFE SPECIES 105
6.3.1 Scoping Strategy 105
6.3.2 Treatments: General 106
6.3.3 Treatments: Managed Stands 106
6.3.4 Habitat Emphasis Considerations 107
6.4 LANDSCAPE SCALE PRIORITIZATION OF RECOMMENDATIONS 108
7.0 REFERENCES 110
7.1 FISHERIES REFERENCES 110
7.2 WILDLIFE REFERENCES 111
7.3 HYDROLOGY REFERENCES 116
7.4 VEGETATION REFERENCES 116
7.5 HUMAN USES REFERENCES 117
7.6 ROADS AND LANDSLIDE REFERENCES 119

List of Tables

		Page(s)
Table 1.	Land Ownership in the Lower Siuslaw Watershed	2
Table 2.	NWFP Land Allocations for Federal Land within the Lower Siuslaw Watershed Analysis Area	4
Table 3.	Murrelet Buffers Added to LSR Since 1994	4
Table 4.	Road Miles by Land Ownership	7
Table 5.	Acres and Stream Miles by Gradient for 23 Subwatersheds in the Lower Siuslaw Watershed	10
Table 6.	Estimated Water Yields from the Lower Siuslaw Watershed	11
Table 7.	Discharge Frequencies for the Lower Siuslaw Watershed	11
Table 8.	Habitat Summary of the Siuslaw River Estuary	13
Table 9.	Acres of Timber Harvest per Decade from National Forest and BLM Lands	29
Table 10.	Beneficial Uses of Surface Water in the Lower Siuslaw Watershed	31
Table 11.	Road Miles and Density by Subwatershed	35
Table 12.	Road Condition Assessment Results, Miles of Problem Sites by Ownership	37
Table 13.	Miles of Road by Berkley Slope Stability Model Rating	37
Table 14.	Berkley Slope Stability Model Rating	39
Table 15.	Number of Mapped Slides in Relation to Berkley Stability Ratings	39
Table 16.	Stream Temperature for Summer of 1996 in the Lower Siuslaw Watershed	41
Table 17.	Anadromous Salmonid Distribution in the Lower Siuslaw Watershed	43
Table 18.	Known General Impacts to Streams in the Lower Siuslaw Watershed	47
Table 19.	Stream Habitat Inventories Conducted in the Lower Siuslaw Watershed Since 1949	48
Table 20.	Current Stream Habitat Conditions based on R6 Stream Inventory Data for Selected Habitat Variables in the Lower Siuslaw Watershed	49
Table 21.	Current Fish Habitat Condition in Lower Siuslaw	51
Table 22.	Acreage and Percent of PAG by Subwatershed	55
Table 23.	Seral Stage of Forest Type by Subwatershed Showing Areas in Stem-Exclusion Phase of Development	59
Table 24.	Comparison of Seral Stages with Plantation Age Classifications	60
Table 25.	Seral Stages by Land Ownership, Lower Siuslaw Watershed	61
Table 26.	Current Seral Conditions by Ownership	64
Table 27.	Current Seral Conditions by Subwatershed	65
Table 28.	Potentially Suitable Northern Spotted Owl and Marbled Murrelet Habitat by Subwatershed	73
Table 29.	Terrestrial Wildlife Species Addressed in the Lower Siuslaw Watershed Analysis	75
Table 30.	Reference Values of Selected Habitat Variables for the Lower Siuslaw Watershed	83
Table 31.	Known Current and Reference Conditions and Relative Changes in the Watersheds of the Lower Siuslaw River	84
Table 32.	Overall Prioritization of Management Recommendations by Subwatershed	109

List of Maps

		Referenced On Page(s)
Map 1.	Lower Siuslaw Watershed Analysis Location Map	2
Map 2.	Land Ownership and Allocation	2,3,62
Map 3.	Watershed in Relation to Late Succession Reserves	4
Map 4.	Historic Vegetation- 1850	24,74
Map 5.	Historic Vegetation- 1890	24,74
Map 6.	Historic Vegetation- 1920	24,74
Map 7.	Historic Vegetation- 1940	24,74
Map 8.	Human Uses	25
Map 9.	Harvest Activity/Stand Origin by date	26,28
Map 10.	Approximation of Road Construction by Decade	32
Map 11.	Potential ATM Roads	33
Map 12.	Problem Culverts and Roads with Slope Stability Rated Roads	36,89
Map 13.	Approximation of Road Construction Prior to and after 1975	36
Map 14.	Berkley Slope Stability Model	37,39
Map 14a.	Slope Class	38
Map 15.	Current Fish Distribution	42
Map 16.	Physical Barriers to Fish Movement (Human-Caused)	44,86
Map 17.	Stream Habitat Conditions and Fish Production Hotspots	50,52,86
Map 17a.	Buffington Stream Gradient	52
Map 18.	LWD Recruitment Potential Model	52,53,87,89
Map 19.	Stream Shade Model and Stream Monitoring Site with Mature Seral Stages	53,87
Map 20.	Plant Association Group Model Predictions	54
Map 21.	Seral Stage Classifications	58,70
Map 22.	Mature Forest Habitat	63
Map 23.	Interior Mature Forest Habitat	68,105
Map 24.	Riparian Reserves on Federal Lands	69,77,92,96
Map 25.	Hotspots of Biodiversity	70,93
Map 26.	Special Habitats	70
Map 27.	Seral Stages on Matrix Lands Outside of Riparian Reserves	71,86
Map 28.	Potential High-Quality Bald Eagle Habitat Areas	95
Map 29.	Aquatic Restoration Opportunities and Priorities	98,99,100,101,102
Map 30.	Road Restoration Opportunities and Priorities	35,90,103
Map 30a.	Road Access to Plantations	90,104
Map 31.	Terrestrial Restoration Opportunities and Priorities	106
Map 32.	Overall Landscape Restoration Priority Areas	108

List of Appendices

Appendix A.	Hydrologic Discharge Methods
Appendix B.	Road Condition Inventories
Appendix C.	Shade Model
Appendix D.	Spotted Owl and Murrelet Appendix
Appendix E.	BLM Reptiles and Amphibians Survey Data
Appendix F.	SNF Epiphytic Macrolichen Plot Data
Appendix G.	NMFS Matrix and Stream Gradient Comparison

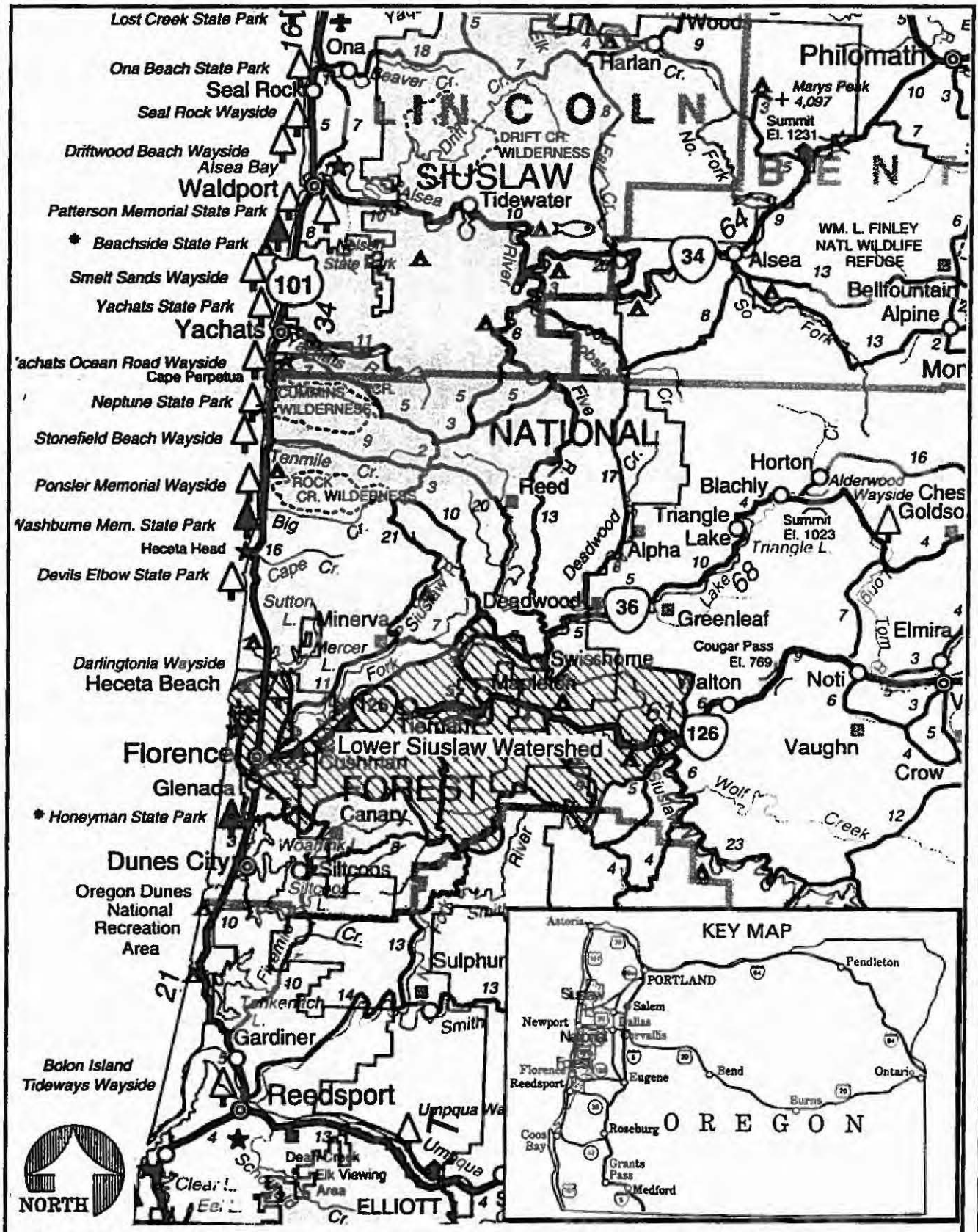
1.0 INTRODUCTION

The information and data contained here is ultimately provided and intended for use by federal land managers for making decisions pertaining to ecosystem management objectives specified in the "Record of Decision" (ROD) for Amendments to U.S. Forest Service (USFS) and Bureau of Land Management (BLM) Documents within the Range of the Northern Spotted Owl (USDA/USDI, 1994b).

This is the first iteration of the Lower Siuslaw watershed analysis. It was conducted as an initial step for implementing the Northwest Forest Plan (NWFP), as defined by the ROD, in the watershed. As with other watershed analyses within the region, this effort assesses current conditions and compares them with past conditions in an attempt to ascertain:

- A scientifically based understanding of the natural processes and human interactions occurring in the watershed;
- any conditions in the watershed that do not meet standards and guidelines as specified by the ROD; and
- opportunities and strategies that, if implemented, could help meet ROD objectives.

The six step process defined in, Ecosystem Analysis at the Watershed Scale-Federal Guide for Watershed Analysis, Version 2.2 (EPA, et al., 1995) was used to conduct this watershed analysis. The USFS provided a set of key issues and questions to expedite and narrow the focus of analysis.



Sources: ODOT 1992-1993 Official Highway Map of Oregon; Siuslaw National Forest Map, 1996

Lower Siuslaw Watershed Analysis
Location Map

Map 1

Produced by SRI/SHAPIRO/AGCO, Inc., 1998

2.0 CHARACTERIZATION

2.1 THE ANALYSIS AREA

2.1.1 Geographic

The Lower Siuslaw watershed is an 111,481-acre analysis area that lies in the southwestern portion of the Oregon Coast Range Physiographic Province (Map 1). It comprises about 23 percent of the entire Siuslaw River Basin.

- The watershed encompasses lands between the North Fork of the Siuslaw River to the north, and the Smith River to the south. It is bounded on the west by the Pacific Ocean and on the east by the mountains of the Coast Range. Florence and Mapleton are the primary towns in the watershed. The mouth of the watershed drains to the Pacific Ocean and occurs immediately west of Florence.

- There are a variety of landowners in the watershed (Table 1). Federal lands comprise about 43 percent (Map 2).

Table 1. Land Ownership in the Lower Siuslaw Watershed

Landowner	Acres	Percent of Watershed
USFS	42,990	39
BLM	4,563	4
Sate of Oregon	5,101	5
Private Industrial Forest Lands	34,783	31
Lane County	359	<1
Other Private Lands*	23,685	21

* Includes Florence, Mapleton, and Swisshome

2.1.2 Relief

The watershed ranges in elevation from sea level to about 2,160 feet near Walker Point, which is 25 miles inland.

- Approximately 8 percent of the watershed is a low relief coastal terrace adjacent to the coast. The remaining 92 percent is predominately steep, highly dissected mountainous terrain typical of the Coast Range.

2.1.3 Climate

- The climate of the area is best generalized as moderate, having a Mediterranean climate typified by wet winters and warm, dry summers (Oberlander and Muller, 1987). Mean annual temperatures are generally in the low 50's (degrees Fahrenheit), with mean annual summer temperatures in the low 60's, and mean annual winter

temperatures in the low 40's to high 30's. The range of average normal temperatures varies further inland from the coast; the highs increase slightly, while the lows decrease slightly (SCS, 1987).

- Most precipitation falls in the form of rain during the winter (November-February). Normal annual precipitation ranges from 60 to 80 inches on the coast, and from 80 to 100 inches in the Coast Range. Precipitation in a portion of upper Knowles Creek, along the south central ridge that defines the watershed divide, ranges from 100 to 150 inches annually (OSU, 1993).

- In winter, counterclockwise rotating low pressure centers that pass over the North Pacific dominate the weather pattern, bringing frontal, cyclonic storms with heavy rains and strong south to southwesterly winds. In summer, the pattern is dominated by fair weather and mild north-northwesterly winds with strong afternoon offshore breezes and coastal fog. Significant annual snow accumulations are rare, although light snow accumulations can occur at higher elevations during episodic cold fronts (Wiedemann, 1984).

2.2 LAND ALLOCATIONS, PLAN OBJECTIVES, AND REGULATORY CONSTRAINTS

- Siuslaw National Forest Land and Resource Management Plan (LRMP) March 7, 1990. The LRMP guides natural resource management activities. It establishes objectives and goals that, in part, enact a set of standards and guidelines that direct activities on the Siuslaw National Forest (SNF). A majority of the 1990 Forest Plan has been supplemented by the 1994 NWFP.

- Eugene District Proposed Resource Management Plan/Environmental Impact Statement (RMP) November 1994. The RMP, like the LRMP, guides natural resource management on BLM lands. It defines a resource management strategy for the proposed plan that was chosen from 5 different scenarios. Effects of implementing the chosen alternative are analyzed in detail in an environmental impact statement. Guidance within the document incorporates directives and policy set forth by the NWFP, and establishes a set of objectives for managing individual resources within BLM lands.

- Northwest Forest Plan (NWFP) April 13, 1994 (Map 2). The NWFP directs natural resource management activities by classifying Federal lands into allocations. Allocations have a set of specific objectives, standards, and guidelines for managing lands within them. Details of the land allocation standard and guidelines are listed in the ROD. Allocations designated by the NWFP are listed in Table 2.

Table 2. Land Allocations for Federal Land Within the Lower Siuslaw Watershed

Land Allocation	Acres		Percent of Watershed		Percent of Federal Land
	BLM	USFS	BLM	USFS	
Late Successional Reserve (LSR)	4,563	39,145	4	35	92
Riparian Reserves outside LSR*	0	1,484	0	1	3
Matrix Minus Riparian Reserves	0	2,361	0	3	5
Bald Eagle Management Areas	487	3,119	4	3	8

*Acres based on ROD default buffer widths for fish and non-fish bearing streams, not based on site potential tree height.

- There are two Late-Successional Reserve land allocations falling within the watershed (Map 3). The first, numbered R0268, comprises about 20 percent of the watershed, occurs almost entirely on Forest Service land, and lies primarily north of the Siuslaw River and Highway 126. Only about 5 percent of this LSR falls within the watershed. The second, numbered R0267, comprises about 35 percent of the watershed, occurs on Forest Service and BLM land, and lies primarily in the southern and eastern portions of the watershed. Approximately 25 percent of this LSR falls within the watershed.

- The Late-Successional Reserve (LSR) allocation on USFS lands has increased in acreage since the NWFP was enacted in 1994. This is due to an increase in marbled murrelet activity centers located since the inception of the plan (see Table 3). Suitable murrelet habitat within a half mile buffer circle around the activity centers requires protection mandated by standards in the N p+1XWFP. The acreage within those buffer circles is classified by the NWFP as LSR. Consequently, 547 acres of buffer circles, originally classified as Matrix in the initial NWFP land allocations, are considered LSR.

Table 3. Murrelet Buffers Added to LSR Since 1994

	Acres	Percent of Watershed
Murrelet Buffer (LSR) Located on Matrix Since 1994	4,410	4

2.3 HUMAN USES

2.3.1 Residents Within the Watershed Area

- The analysis area has a year-round population of around 12,000 residents. The Florence/Heceta Beach area has a population of about 10,000 people. There are another 2,000 people living in Mapleton, Swisshome, and on farms and small land holdings along the river or in side drainages.

- The Eugene/Springfield metropolitan area, population 225,000, is only 45 miles east of the center of the analysis area.

- The National Forest, BLM, State of Oregon, and Lane County lands, waters, dunes, and forests serve as an extended "backyard" for the local residents as well as the many recreationists that, during peak periods, can fill campgrounds, RV parks, vacation homes, and waterways.

2.3.2 Tribal and Cultural Resources

- There are no known treaty obligations related to the analysis area. Prior to settlement of the area by Euro/Americans, the area was home to Siuslaw Indians (Beckham, 1982).

- There are a number of cultural resource sites in the area. A determination of eligibility for the National Historic Register has not been completed for these sites (Steeves, 1997).

- Data from the 1990 census indicates that 240 individuals within the analysis area are American Indian, Eskimo, or Aleut.

2.3.3 Transportation Systems

- U.S. Highway 101 provides access across the western portion of the area. State Highways 126 and 36 follow the Siuslaw River and Knowles Creek routes. Access to and through the watershed is provided by a system of county, private residential, and forest development roads.

2.3.4 Land Ownership

- The Florence/Heceta Beach area is the most densely populated. Most homes and businesses are on relatively small lots.

- Small farms and rural residents form a corridor of private lands along State Highways 126 and 36 between Florence and Swisshome. Most of the National Forest lands are located in the uplands adjacent to the Siuslaw River. BLM, State of Oregon, and industrial forest lands are found in the eastern portions of the analysis area.

2.3.5 Public Access

- There is adequate access to most publicly owned land. There are a few isolated parcels of National Forest land that do not have open access from public roads. In May 1995, the public was involved in the revision of the Siuslaw National Forest Access and Travel Management Guide. This map and guide represents the road system needed to maintain adequate public access to and management of the national forest lands.

2.3.6 Recreation

- Recreation is a major activity along the Pacific Coast and inland dunes that form the western boundary of the watershed analysis area. The Florence/Heceta Beach area is heavily focused on tourist activities. There are numerous public facilities and accommodations in the area.

- The Siuslaw River is a major chinook salmon and steelhead fishing area. Within the area of tidal influence, most of the angling is done from boats. There are a number of marinas and boat launches along the river between Florence and Swisshome.

- Upland activities include hiking, gathering berries and mushrooms, as well as hunting for deer and elk. The USFS maintains four trail facilities in the Sweet Creek area and a nine-unit campground on Knowles Creek.

2.3.7 Landscape Aesthetics

- The landscape has changed through land clearing, agriculture, logging, dikes, and the development of businesses, homes, roads, and railroads. Once out of the heavily developed areas, the general surroundings are a pleasant mixture of coastline, dune, estuary, farm, pasture, river, and forest.

- Managed timber stands have quickly regenerated into a dense forest of young trees.

2.3.8 Commodity Production

Timber

- Prior to 1993, there was considerable focus on commodity production from National Forest, BLM, State of Oregon, and private industrial forest lands. Timber has been harvested at least once from 49 percent of the land in the watershed.

- The NWFP allocated most of the national forest and BLM lands within the analysis area to Late-Successional Reserves. As a result, the amount of National Forest and BLM timber programmed for harvest within the analysis area has been greatly reduced.

Special Forest Products

- The watershed is used to gather a number of small forest products. Firewood, boughs, mushrooms, ferns, moss and other natural materials are removed for personal and commercial uses.

Roads

- A road system totaling 558 miles has been developed within the area. Three highways, totaling 37.2 miles, are the primary arterial routes through the watershed. They are U.S. Highway. 101 (5.5 miles), State Route 36 (21.1 miles), and State Route 126 (10.6 miles). Most of the roads exist on privately owned and USFS lands (Table 4).

Table 4. Road Miles by Land Ownership (% of total)

Private	State	USFS	BLM
339 (61%)	11 (2%)	193 (35%)	11 (2%)

Mining

There are no known sources of locatable minerals in the analysis area. Several rock quarries provide rock for local and forest road development.

Commercial Fisheries

In the past, the streams in the watershed provided spawning and rearing habitat for large runs of salmon and steelhead.

2.4 GEOLOGY AND HILLSLOPE EROSION

- As with much of the southwestern coast range, including adjacent watersheds to the north, 85 percent of the Lower Siuslaw River watershed is underlain by layered, marine sedimentary rock formations that have been tilted generally north by tectonic uplift (USDA, 1997). Locally known as the Tyee Formation, this geologic unit has been widely researched. The steep slopes associated with the Tyee Formation are well known for exhibiting widespread unstable conditions prone to mass wasting.

- A small proportion of the watershed contains basalt intrusions (a type of igneous rock formation). They cap the prominent ridgelines of the northeastern and southern divides of the watershed, and comprise prominent mountain tops such as Mount Peter, Sunset Mountain, Goodwin Peak, and Walker Point. These formations are also known to exhibit unstable slope conditions.

- The western boundary of the watershed is bounded by the Pacific Ocean. Landforms adjacent to the coast are dominated by beach and dune landforms. Lands between the beach and the Coast Range mountains are comprised of gently rolling to flat lowlands underlain by marine sedimentary formations.

- Nine Land Type Associations (LTA) that partition areas of similar geomorphic, geologic, soil, and vegetative types across landscapes in the Coast Range are represented in the watershed. They consist chiefly of two recognized divisions called, the Alsea subsection and the Umpqua subsection (USDA, 1997).

- Descriptions of the individual LTA's in the watershed recognize debris slides and torrents as being the dominant hillslope erosion processes occurring in the watershed (USDA, 1997). Mass wasting and fluvial processes produce and transport sediments from the uplands to the lowlands. The highly dissected mountains of the watershed are shaped by these processes.

- Mass wasting or landslides in the Coast Range are often episodic events generally associated with high precipitation, wintertime storms. They can contribute large quantities of sediment to streams, and are considered to be a dominant process that historically introduced large woody debris into stream systems (Swanson, et al., 1982). Deep seated slumps and rotational mass movements occur less frequently. Landslides occur throughout the watershed except on the beach and coastal lowlands.

- Fluvial erosion, especially during flood events, also accounts for relatively large amounts of sediment to be transported downstream. Steep, incised drainageways are in part, shaped by fluvial erosion. The broad floodplain and tidal flats on the lower reaches of the mainstem river between Hoffman Creek and the town of Florence are shaped by the deposition of sediment transported by the river.

- Two other erosion processes in the watershed, though not widespread, are wind erosion and wave action that act upon the frontal coast landforms. The beach and sand dune landforms in the watershed are shaped by these processes.

- Total sediment production in the watershed is believed to have been increased to some degree between 1950 and 1980 due to a period of intense timber extraction activities that occurred in and along stream or valley bottoms. The difference between existing and pre-settlement sediment production is unknown. However, human induced accelerated erosion may be on the decline since, on the whole, timber harvest activities have decreased in the watershed over the last two decades, primarily on public lands.

2.5 HYDROLOGY

2.5.1 Subwatersheds and Streams

- The Lower Siuslaw watershed is approximately 174 square miles (111,481 acres) in size, and is divided into 23 subwatersheds. The Florence subwatershed represents the largest percentage and Cox Island the smallest percentage of the watershed (Table 5). The Lower Siuslaw watershed area comprises about 22 percentof the 775 square miles in the Siuslaw River Basin.

- The Lower Siuslaw watershed contains about 1,035 miles of perennial and intermittent streams. The mainstem Lower Siuslaw River, a seventh order river above Lake Creek and eighth below the creek, is a low gradient, moderately confined to unconfined channel. The Siuslaw River is tidally influenced up to river mile 27 at Cleveland Creek in the town of Tide.

- Table 5 displays miles of stream in gradient categories according to a classification scheme (Montgomery and Buffington, 1993). Gradient was determined using a digital elevation model (DEM) rather than querying Forest Service stream database records, since they were incomplete. Gradient records for many stream reaches on Forest Service land were lacking, and there were no records of stream gradient on private lands. Consequently, the DEM was used to approximate stream gradients. Data resulting from the method, and compiled here, indicate that approximately 53 percent of stream miles in the watershed have a gradient greater than 20 percent. In contrast, about 9 percent of the stream miles have gradients less than 4 percent. Tributaries of the Lower Siuslaw River, with the exception of Sweet and Knowles Creeks, are typically short, third and fourth order streams. Their lower reaches generally have lower gradients and unconfined channels (Rosgen C and E channels), while their upper reaches are steeper and more confined (mostly Rosgen A and some B channels; Rosgen, 1996).

Table 5. Acres and Stream Miles by Gradient for Subwatersheds in the Lower Siuslaw Watershed

Subwatershed	Acres (% of watershed)	STREAM GRADIENT (MI.)*		
		0-3%	3-20%	>20%
Barber	3,056 (3)	0.6	12.3	16.0
Berkshire	3,825 (3)	6.9	12.6	14.8
Cedar	4,572 (4)	0.9	22.4	32.9
Cox Island	1,649 (1)	7.0	4.4	3.1
Divide	8,738 (8)	14.0	32.6	37.8
Florence	11,439 (10)	24.6	7.8	0.3
Hadsall	5,457 (5)	1.5	24.7	33.1
Hand	7,668 (7)	4.2	37.6	48.1
Hoffman	2,715 (2)	0.5	12.5	28.0
Hood	2,203 (2)	0.7	7.7	8.0
Knowles	3,605 (3)	1.6	14.3	16.6
Lawson	3,956 (4)	3.5	17.7	30.5
Lower Sweet	3,710 (3)	3.8	16.8	26.8
Meadow	5,437 (5)	1.0	21.4	28.9
San Antone	3,483 (3)	0.3	13.2	14.1
Siboco	4,132 (4)	5.2	19.4	13.1
Thompson	7,543 (7)	3.0	32.3	39.8
Tilden	6,707 (6)	3.3	18.4	29.5
Turner	3,693 (3)	1.2	15.4	19.6
Upper Divide	2,615 (2)	0.5	13.2	13.9
Upper Knowles	6,621 (6)	1.1	22.7	39.6
Waite	3,872 (3)	1.6	12.3	16.4
Walker	4,785 (4)	3.7	14.7	26.9
Total	**111,481**	**90.7**	**406.4**	**538.0**

* Stream gradient ranges as defined by Montgomery and Buffington, 1993.

- Major tributaries in the watershed include the large, fifth order Sweet and Knowles Creeks and the smaller fifth order Lawson, Hoffman, Hadsall, and Turner Creeks. Medium-sized fourth order tributaries include Karnowsky, Divide, Walker, Thompson, Brush, Barker, San Antone, and Waite Creeks. The remaining named streams, (Siboco, South Inlet [Canary], Cedar, Elk Wallow, Fall, South Canyon, Hand, Gravel, South Fork Sweet, Sheep Ranch, Cabbage, Beaver, Deer, Jackson, Dinner, Hood, Sulphur, Old Man, Rack, Meadow, Smith, Rock, Beech, Pat, Tilden, Cleveland, Shoemaker, Berkshire, Hollenbeck, Saunders, Hansen, Schoolhouse, and Munsel Creeks), are small second, third, and fourth order streams flowing either directly into the Siuslaw River or are tributaries to Sweet or Knowles Creeks.

2.5.2 Discharge

- There is only one stream gage in the basin, a US Geological Survey (USGS) gage on the Siuslaw River, located in Mapleton (Lat.44(03'45", Long. 123(52'55", USGS gage #14307620). Data generated from this gage was used to estimate discharge quantities for the Lower Siuslaw watershed. The period of record for the Mapleton gage is 1967-1987.

- The estimated monthly average stream flow for the Lower Siuslaw is 637 cubic feet per second (cfs). Extrapolated maximum and minimum monthly stream flows are 1,330 cfs and 120 cfs, respectively. The extrapolated average annual base flow for the Lower Siuslaw is 25 cfs.

- The total average annual yield for the Lower Siuslaw watershed, using extrapolated data, is 458,969 acre-feet per year (ac-ft/yr) (Table 6).

Table 6. Estimated Water Yields from the Lower Siuslaw Watershed

	Lower Siuslaw*	Siuslaw Basin
Avg. Annual Total Yield (ac-ft/yr)	458,969.	1,551,000
Maximum Recorded Flow(cfs)	14,618	49,400
Minimum Recorded Flow (cfs)	13	45
Average Recorded Flow(cfs)	634	2,141

*Extrapolated from total basin data

cfs=cubic feet per second
ac-ft/yr=acre feet per year

- A recurrence interval is the probability that a certain magnitude of flood event will occur over a given time period. The USGS has estimated statistical measurements of the 1.25, 2, 5, 10, 25, and 50-year events for the watershed. The 100-year event was not included in the tabular USGS data because of an inadequate period of record. However, the 100-year event was computed by the USGS based on stage discharge relationship for the available years of data (Hubbard, pers. comm., 1998). Data provided by the USGS also were extrapolated from the representative watershed and are presented in Table 7 (for methodology, see Appendix A). Since the gauging station for the representative watershed was discontinued in 1987, data from the 1996 flood were not evaluated and reported. However, based on a mud line created in the dismantled gauging station at Mapleton, Oregon, by the 1996 flooding, it was estimated that the 1996 flood event was just under a 50-year event and produced an extrapolated discharge of 17,205 cfs.

Table 7. Discharge Frequencies for the Siuslaw River (Hubbard, pers. comm.)

Recurrence Interval (years)	Exceedance Probability (%)	Discharge (cfs)
1.25	80	5,593
2	50	7,990
5	20	11,304
10	10	13,464
25	4	16,187
50	2	18,199
100	1	20,321

2.5.3 Lakes

Munsel, Ackerley, Clear, and Collard Lakes, in the Florence subwatershed total approximately 20 acres, and are the only lakes in the Lower Siuslaw watershed area.

2.5.4 Estuary/Wetlands

- The Siuslaw River estuary is about 3,067 acres in size and is dominated by sand bottom in the subtidal zone and high salt marsh in the intertidal zone (Table 8). Most of the estuary has been designated as rural, with exclusive farm use (1,304 acres), impacted forest lands (645 acres), and natural resources (573 acres) as the dominate shoreland zones (Cortright, et al., 1987). Twenty dredged material disposal sites, totaling 143 acres, have been designated in the estuary (Cortright, et al., 1987). Only 58 acres have been identified for mitigation and/or restoration of subtidal/intertidal habitat.

- Wetlands within the Lower Siuslaw watershed are generally confined to riverine systems at the lower elevations. Using the National Wetland Inventory (NWI) maps and the Cowardin classification (Cowardin, et al., 1979), most wetlands are palustrine emergent systems (PEM) except for the estuary. Palustrine emergent systems are typified by nontidal wetlands dominated by persistent emergent vegetation with the following general characteristics: (1) less than 20 acres in size; (2) active wave-formed or bedrock shoreline features are lacking; (3) water depth in the deepest part of the basin is less than 2 meters (6 feet) at low water; and (4) salinity due to ocean-derived salts is less than 0.5 parts per thousand (Cowardin, et al., 1979).

Table 8. Habitat Summary of the Siuslaw River Estuary

Zone	Habitat Class	Habitat Subclass	Area (Acres)	% Of Estuary
Subtidal	Unconsolidated bottom	Unspecified type	347	11.3
		Sand	682	22.3
		Sand/mud	396	12.8
		Cobble/gravel	5	0.3
	Rock bottom	Bedrock	9	0.3
	Aquatic bed	Seagrass	6	0.2
Intertidal	Shore	Unspecified type	19	0.6
		Sand	51	1.7
		Sand/mud	23	0.7
		Mud	5	0.2
		Cobble/gravel	1	0.0
		Boulder	22	0.7
		Bedrock	14	0.5
	Flat	Unspecified type	22	0.7
		Sand	140	4.6
		Sand/mud	80	2.6
		Mud	134	4.4
	Aquatic bed	Unspecified type	2	0.0
		Seagrass	243	7.9
		Seagrass/algea	68	2.2
		Algea	16	0.5
		On sand	4	0.1
	Beach/bar	Sand	31	1.0
	Tidal marsh	Unspecified type	5	0.2
		Low salt marsh	58	1.9
		High salt marsh	684	22.3
Totals			**3,067**	**100**

Source: Cortright, et al., 1987

- The estuary is classified as estuarine subtidal and intertidal systems (E1 and E2, respectively) with areas of exposed surfaces and some areas of emergent irregularly exposed systems. The estuarine system has been highly influenced by diking and levee construction.

- The Lane County Soil Survey (USDA, 1987) displays approximately 6.5 miles of levees occurring along portions of Duncan Inlet, South Slough, the mainstem river, and Lawson Creek. About 4.1 miles occur around Duncan Inlet and, according to aerial photo interpretation, were constructed sometime after 1945. Levees constructed in the South Slough area and along the mainstem river reaches (approximately 1.7 miles) appear to have been constructed at several different times, some before 1945, other portions after 1963. The levees (0.7 mile) occurring along

the lower reaches of Lawson Creek appear to have been constructed between 1945 and 1963. The specific intention of these levees was not determined. They likely have altered the extent and function of the estuary to some degree.

2.6 AQUATIC SPECIES AND HABITAT

2.6.1 Species

- Five anadromous salmonid fish species occur in the mainstem Siuslaw River and most of the larger tributaries of the watershed. They are spring and fall chinook *salmon (Oncorhynchus tshawytscha)*, coho salmon (*O. kisutch*), chum salmon (*O. keta*), winter and summer steelhead (*O. mykiss*), and sea-run coastal cutthroat trout (*O. clarki*). Coho salmon were historically the most numerous salmonid in the watershed, followed by cutthroat trout and steelhead (Dewberry, 1995).

- The anadromous Pacific Lamprey (*Lampetra tridentata*) also occurs in the same streams as anadromous salmonids. Also, American shad (*Alosa sapidissima*), white sturgeon (*Acipenser transmontanus*) and green sturgeon (*Acipenser medirostris*) are found in the lower reaches and estuary of the Siuslaw River.

- Resident fish species inhabiting the watershed include coastal cutthroat trout, western brook lamprey (*Lampetra richardsoni*), riffle sculpin (*Cottus gulosus*), reticulate sculpin (*C. perplexus*), coast range sculpin (*C. aleuticus*), prickly sculpin (*C. asper*), dace (*Rhinichthys spp*), northern squawfish (*Ptychecheilus oregenensis*), shiners (*Richardsonius spp.*), suckers (*Catostomus spp.*), and marine and freshwater threespine stickleback (*Gasterosteus aculeatus*).

- Resident cutthroat trout and sculpin are widely distributed throughout the watershed and are probably found in most, if not all, third order and larger perennial streams.

- Spring and fall chinook salmon runs are found in the 46.6 miles of mainstem Siuslaw River and three miles of Duncan Inlet. Fall chinook salmon spawn in about 1.5 miles of Barber Creek, one-tenth mile of Brush Creek, 3.7 miles of South Inlet Creek, 9 miles of Sweet Creek, 1.3 miles of Turner Creek, 0.7 miles of Waite Creek, and about 10 miles of mainstem Knowles Creek.

- Chum salmon are found 16 miles upstream on mainstem Siuslaw River, upstream about 1.5 miles in Sweet Creek, and one mile in Divide Creek.

- Coho salmon, steelhead, sea-run cutthroat trout, and Pacific lamprey are found, in combination, in all accessible fourth order and larger low gradient (<3 percent), depositional channel reaches and some of their smaller, higher gradient (3-20 percent) channel reaches, totaling about 63 miles of stream. Streams identified as supporting only coho salmon, steelhead, and sea-run cutthroat trout are; Demming, Hoffman, Karnowsky, Lawson, Hanson, upper Divide, Walker, Thompson, Cleveland,

Shoemaker, Hollenbeck, Berkshire, Tilden, Pat, Beech, San Antone, Smith, Meadow, Rock, and Hadsall creeks. Munsel Creek probably contains only coho salmon and possibly sea-run cutthroat trout.

- The Ecological Significant Unit (ESU) for Oregon Coastal coho salmon has been designated as a Candidate Species for listing by the National Marine Fisheries Service (NMFS) and will be reevaluated in 2000. The NMFS postponed their decision on this ESU based on the strength of the Governor's Memorandum of Understanding on May 1997 and Oregon's Coastal Salmon Restoration Initiative Conservation Plan (March, 1997). The decision for Oregon coastal steelhead ESU has been extended for six months to review disagreements in the science that originally designated this ESU as threatened under the Endangered Species Act (ESA) of 1973. A decision regarding the listing of Oregon coastal steelhead is expected by February 9, 1998.

- The Oregon Rivers Information System (ORIS), developed by ODFW and the Bonneville Power Administration was also queried to provide additional information of potential fish distributions in the watershed (Forsberg, 1994). ORIS fish population information was available for most named tributaries in the Lower Siuslaw River watershed.

2.6.2 Habitat

- Stream reaches are stratified into source (>20 percent gradient), transport (3 to 20 percent gradient), and deposition (response) (<3 percent gradient) channels (Montgomery and Buffington, 1993). Based on Montgomery and Buffington stratifications, there are about 538 miles of source, 406 miles of transport, and 91 miles of response (depositional) stream channels in the Lower Siuslaw watershed.

- Depositional reaches, also referred to as "flats," "hotspots," or depositional areas, are treated with special concern, since they are most susceptible to change in channel morphology and habitat conditions and are usually the most productive stream reaches occupied by anadromous fish.

- Historically with the absence of agricultural development and logging in the watershed, tributary stream channels were generally in good to excellent condition and functioning properly, with habitat units within the bounds of natural distributions for habitat variables. However, natural epizotic events (pre-European settlement) in individual subwatersheds or tributaries that varied in intensity, time, and space, dictated the historic conditions of streams.

- Most, if not all, tributary streams occupied by anadromous salmonids probably contained high quality fish habitat most of the time. Although the quality and quantity of habitat varied over time, streams generally contained large amounts of scattered and clumped large woody debris (LWD pieces greater than 24 inches in diameter and 50 feet in length), good numbers of large, deep, complex pools, and sufficient amounts of high quality spawning gravel.

- Streams were bordered by riparian areas composed of late seral stage coniferous and deciduous forest. Beaver also played an important role in maintaining productive habitat conditions for resident and anadromous fish. Also, streams used by anadromous fish (especially coho and chinook salmon) were probably higher in nutrients due to high numbers of decaying, spawned-out carcasses.

- Currently, wild runs of anadromous salmonids (except fall chinook salmon) along the Oregon coast, including the Siuslaw River basin, have declined precipitously (ODFW, 1992). The spring chinook salmon run is listed as present in the Siuslaw River Basin, but in an unknown status (ODFW, 1992). Much of this decline can be attributed to degradation of fish habitat. Streams used by anadromous salmonids in the Lower Siuslaw watershed currently lack LWD, large quality pools, and mature trees in riparian areas.

2.7 VEGETATION PATTERNS

- The overall vegetation pattern of the watershed is highly fragmented, especially south of the Siuslaw River and on private forest land.

- The historic vegetation pattern in the watershed was formed by wildfires that burned across large areas of the landscape (Maps 4-7).

- Natural disturbances in the watershed were common in the past. Logging activities have now formed the present vegetative landscape.

- Virtually all of the present-day forest stands in the watershed are even-aged, with a single canopy and a simple structure.

- Conifers dominate species composition.

- Young conifer plantations occupy 25 percent of the watershed. These areas range from early seral conditions resulting from clearcutting to pole-sized stands established by reforestation planting.

- Industrial forestry companies own almost half of the young stands (47 percent).

- Many stands are commercial size. Over half of these stands are in the national forest.

- A few stands have been commercially thinned on federal lands (about 2,000 acres).

- Hardwoods and mixed hardwood/conifer stands occupy about one fourth of the watershed. Many of these stands are found in riparian zones.

- There are no significant areas in the watershed that currently meet the scientific definition of "old growth."

2.8 TERRESTRIAL WILDLIFE AND HABITAT

- Late-Successional Reserves (LSR R0267 and LSR R0268) comprise 92 percent of the federal land in the watershed; however, only 48 percent of the designated LSR has late-successional characteristics. The average stand age on federal lands is not known because stand birth date for all stands in the watershed is not complete.

- Large scale, stand replacement fires occurred in the western portion of watershed in the mid-1800s and in the northeastern corner prior to the 1920s. The influence of fires on habitat characteristics within the watershed has largely been eliminated by more recent land management activities.

- The majority (68 percent) of late successional forest within the watershed occurs on federal lands.

- Portions (6 percent) of the watershed currently contain forest stands that are unsuitable for mature and late successional forest dependent species. Many of these stands are young, dense stands with closed canopies which do not exhibit late successional characteristics.

- Private industrial forest lands may provide some foraging habitat for some late-successional forest dependent species. They also provide habitat for early- and mid-successional associated species.

- There are 20 spotted owl activity centers including three known nest sites and one territorial single (18 owl activity centers and all of the nest sites are on federal land).

- There are 36 occupied marbled murrelet sites documented in the watershed, 22 of which are centered on federal land.

- All the federal land within the LSR is designated as Critical Habitat for the marbled murrelet (USDI, 1996).

- The majority of federal land in the watershed south of the Siuslaw River is designated Critical Habitat for the spotted owl (USDI, 1992).

- There are three bald eagle management areas within the watershed (two on SNF lands, one on BLM lands).

- A variable width band of private lands bisects the watershed from east to west. The majority of private lands are located in the southeast portion of the watershed. These private lands are dominantly industrial forest lands. Private industrial forests generally provide limited or no habitat for most late successional forest dependent species and are not expected to provide this habitat in the future.

- The City of Florence is located in the far western portion of the watershed. The town of Mapleton and the communities of Siuslaw and Swisshome are located along the Siuslaw River. Generally, these areas do not provide habitat for any forest dependent species.

- Recreationally important species, such as Roosevelt elk, cougar, and black bear occur within the watershed. Habitat for these species is well distributed throughout the watershed on both private and federal lands.