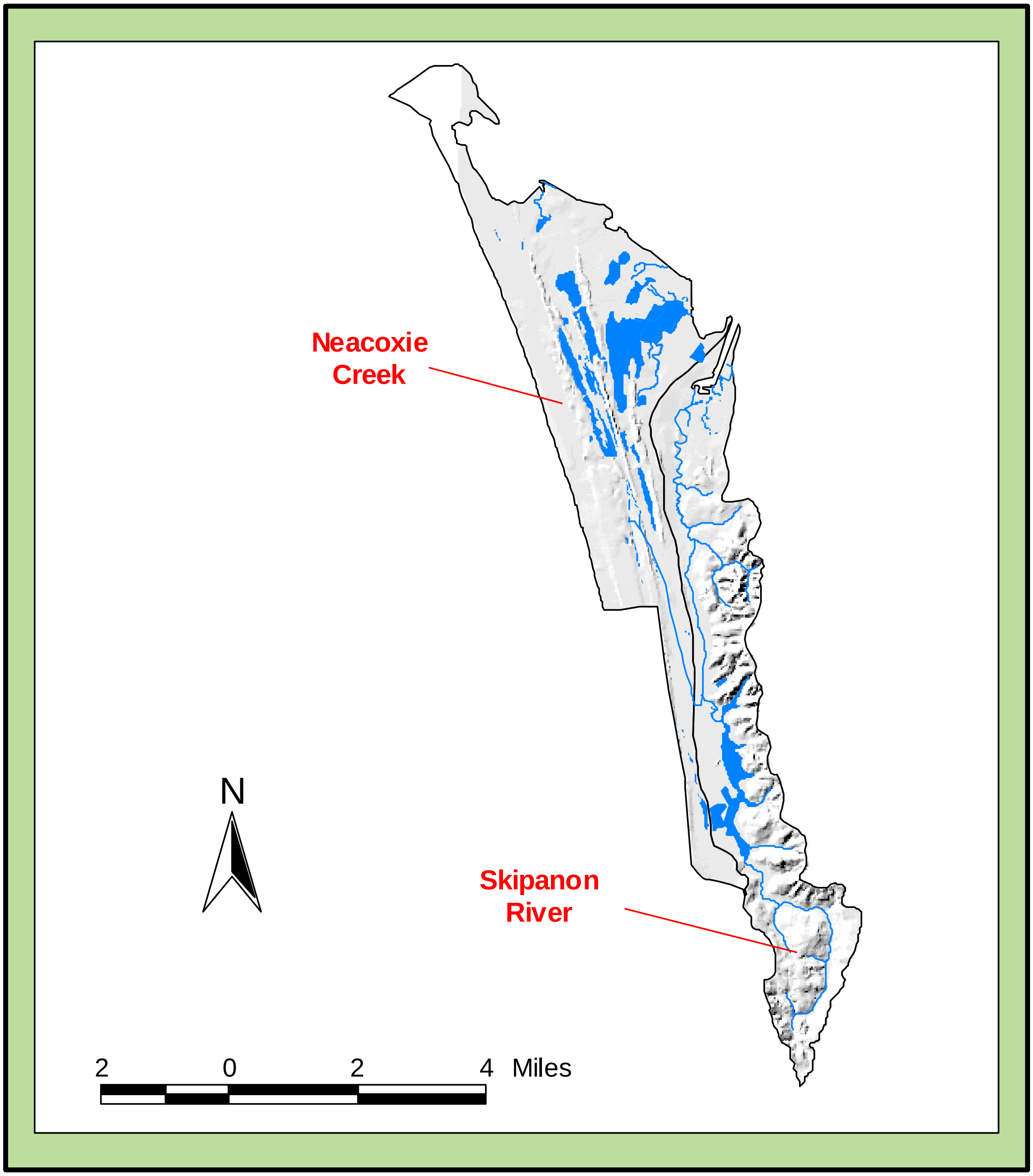
Skipanon Watershed Assessment



E&S Environmental Chemistry, Inc.
and
Skipanon Watershed Council

August, 2000

Skipanon River Watershed Assessment

Final Report

August, 2000

A report by:

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CHAPTER 1 INTRODUCTION

1.1 Purpose and Scope

The purpose of this watershed assessment is to inventory and characterize watershed conditions of the Skipanon River watershed and to provide recommendations that address the issues of water quality, fisheries and fish habitat, and watershed hydrology. This assessment was conducted by reviewing and synthesizing existing data sets and some new data collected by the watershed council, following the guidelines outlined in the Oregon Watershed Enhancement Board (OWEB) watershed assessment manual (WPN 1999).

It is important to note that many watershed processes cannot be characterized as either good or bad. Rather, these processes must be evaluated by their likely impact on valued resources such as salmonid habitat or water quantity and quality. By summarizing the existing conditions of the Skipanon River watershed we hope to help natural resource managers and watershed council members understand the complex interactions associated with watersheds. It is through this understanding that watersheds can be managed to protect the natural resources valued by local and national communities.

This assessment is diagnostic. It does not prescribe specific actions for specific stream segments. The intent of this assessment is to provide a decision-making framework for identifying areas of the watershed in need of protection and restoration. The assessment is conducted on a watershed level recognizing that all parts of a watershed function as a whole and that alteration or loss of one watershed process can affect many other processes in the watershed.

1.1.1 The Decision Making Framework

The main product of the OWEB watershed assessment is a set of wall-size maps (housed by the watershed council) to be used as a decision-making framework for selecting appropriate sites for on-the-ground restoration. The maps are organized so that they can be directly related to the U.S. Geological Survey (USGS) 1:24,000 quad sheets. Included on the maps are outlines of the quad sheet boundaries, township section, and range lines. These maps allow the information to be compiled by section (Public Land Survey System) and located. By compiling stream information by section, information can be used to make intelligent, science based decisions on where restoration will be most successful. All sites selected from the maps for restoration should be field checked before restoration or protection. Wall size maps provided to the watershed councils include anadromous fish distribution, channel habitat type, riparian conditions, and possible fish barrier locations. Additional data are provided in a digital format to the watershed councils. This document supplements and expands on the information contained in the maps. The maps in this document are intended to provide summary visual representation of the data used in this assessment. They are not meant to provide site-specific information. The wall size maps and digital data should be used for identification of on-the-ground restoration opportunities.

1.1.2 Geographic Information Systems (GIS) Data Used in this Assessment

Geographic Information Systems (GIS) are widely used to store and analyze environmental data for the purposes of evaluating watershed condition and guiding appropriate restoration activities. GIS data are only as accurate as its scale and source data. GIS data must be critically reviewed to assure an accurate representation of on-the-ground conditions in a watershed. Key GIS data sets were evaluated for confidence in positional accuracy and in representing actual watershed conditions.

Major GIS data that were used in the development of this assessment are listed in Table 1.1. Following is a description of each of the data layers used in developing this watershed assessment.

Streams (1:24,000): Stream coverages were obtained from the State Service Center for GIS (SSCGIS) and are a part of the Baseline 97 data set. Streams were digitized from the 1:24,000 USGS quads. A visual check of the stream coverage demonstrated that they match the USGS quadrangles, however the positions of the streams were often different from the streams on the aerial photos.

Channel Habitat Types (1:24,000): The 1:24,000 stream coverage was attributed with gradient, side slope constraint, and order and classified into channel habitat type classes according to the protocol outlined in the OWEB manual (WPN 1999).

Land Use (1:24,000): The land use map was created using three coverages- zoning from CREST (1:24,000), ownership (1:24,000), and a 1992 LANDSAT image obtained from CREST and C-CAP. The three coverages were combined and land use was delineated based on these three attributes. For example, if the LANDSAT image classified the land as bare, and zoning was Exclusive Farm Use, then this polygon was attributed as agriculture. Additionally, if the LANDSAT image classified the land as developed and the zoning was in the urban growth boundary, this polygon

Table 1.1 Primary GIS data used in developing this watershed assessment.

Coverage	Scale	Source	Notes
Streams	1:24,000	SSCGIS	
Channel Habitat Types	1:24,000	E&S	Streams attributed by E&S
Land use	1:24,000	E&S; CREST; C-CAP; SSCGIS	Created by E&S by combining data
Vegetation	30 meter	OSU-Extension	CLAMS 1995 LANDSAT
Aerial Photos	1 meter	Clatsop County Planning Office	MAY, JUNE, JULY 1994 natural color
Watershed Boundaries	1:24,000	SSCGIS	Created for the councils by SSCGIS
Roads	1:100,000	ODF	Updated DLG; Ad Hoc
Digital Elevation Models	10 meter	SSCGIS	
Riparian Vegetation	1:24,000	E&S	Attributed 1:24,000 streams from aerial photo interpretation
Riparian Shade	1:24,000	E&S	Attributed 1:24,000 streams from aerial photo interpretation
Salmonid Distribution	1:100,000	ODFW	Field Biologists
ODFW Habitat Surveys	1:100,000	ODFW	Attributed 1:100,000 streams from field surveys
Hatcheries, release sites, fish counts	1:250,000	BPA	Currently being corrected
Dikes	1:24,000	ACOE	Consistent with USGS quads
Debris Flow Potential		DOGAMI	
Points of Diversion	1:24,000	OWRD	Currently being updated

was attributed as developed. The forest lands were delineated by ownership, and categorized as Private Industrial Forest, Private Non-Industrial Forest, State Forest, or Miscellaneous Forest (for those areas where ownership was not specifically identified). All areas characterized as wetlands by the LANDSAT scene were maintained in the coverage.

Zoning. There is no metadata (data describing the coverage) associated with these data. This coverage was provided by CREST and is believed to be the most up to date zoning information for Clatsop County at the time of this assessment. The coverage is currently being updated.

Ownership. Ownership was characterized by Oregon State University (OSU) using the 1991 Atterbury Ownership maps. This coverage does not include land sales since 1991. It is our assumption that all land sales in the North Coast watersheds were sales that kept the land in the same category. For example, the sale of Cavenham lands to Willamette Industries kept the land in the Industrial Forest category.

C-CAP LANDSAT image. These data consist of one LANDSAT Thematic Mapper scene which was analyzed according to the Coastal Change Analysis Program (C-CAP) protocol to determine land cover. C-CAP inventories coastal submersed habitats, wetland habitats, and adjacent uplands through analysis of satellite imagery (primarily LANDSAT thematic mapper), aerial photography, and field data. These are interpreted, categorized, and integrated with other spatial data in a geographic information system. Details on the creation of these coverages can be found in the metadata provided to the watershed council.

<u>Vegetation:</u> The vegetation characterization was completed using a 1995 LANDSAT image from the Coastal Landscape Analysis and Modeling Study (CLAMS) being conducted jointly by the OSU Extension office and the Pacific Northwest Research Station. The LANDSAT scene was characterized into broadleaf, mixed, and conifer dominated stands, which were further delineated into four categories based on conifer size (small, medium, large and very large).

Aerial Photos: Aerial photos were obtained from the Clatsop County Planning Office and were taken in May, June, and July of 1994 by Spenser Gross. Aerial photos were natural color digital ortho photos with a 1 m pixel size.

Watershed Boundaries (1:24,000): Watershed boundaries were digitized and corrected by the SSCGIS, according to the watershed council's input. Sixth field subwatersheds were delineated using the Water Resources Department's Water Availability Basins as a base.

Roads (1:100,000): Road data were obtained from the Oregon Department of Forestry (ODF). ODF maintains fire road information for the entire state of Oregon. These road coverages were developed using the USGS digital line graphs (DLG) as a base and then updated on an ad-hoc basis, determined by data availability. The extent of updates that have been included in the roads coverage in these watersheds is unclear. However, a visual check of the data with the aerial photos demonstrated that the data were fairly thorough. A more detailed evaluation is needed to evaluate how well this data set represents 'real-world' values.

Digital Elevation Models (DEMs; 10 m): The 10 m resolution DEMs were obtained from the SSCGIS. Ten meter resolution refers to the cell size attributed with elevation data. Cell sizes in this coverage are 10 m by 10 m or approximately 1,000 sq. ft. DEMs were mosaiced and sinks were filled.

Riparian Vegetation and Shade: The 1:24,000 stream coverage was attributed from aerial photo interpretation (see Aerial Photos, above). Attributes include vegetation class and shade. Metadata have been provided with the digital data.

Salmonid Distribution (1:100,000): Salmonid distribution coverages were obtained from the Oregon Department of Fish and Wildlife (ODFW). ODFW mapped current salmonid distribution by attributing 1:100,000 stream coverages based on survey data and best professional judgment of local fish biologists. Distributions identified spawning, rearing and migration areas. Theses coverages are dynamic data sets that are scheduled to be updated every two years. These data are available on ODFW's website (*http://www.dfw.state.or.us*).

ODFW Fish Habitat Surveys (1:100,000): Field surveys of stream channel conditions by ODFW were attributed onto 1:100,000 scale stream layers. Two layers exist, including habitat units and reach level data. Reach level data generalize habitat unit data to give an overview of current habitat conditions. Reach level data can be used as a reference point for later comparative work or for the analysis of overall stream conditions. Habitat data are all of the unit data for the entire survey and are a representation of the condition of the stream at the time of survey. These data change annually since streams are dynamic systems.

Hatcheries, Release Sites, Fish Count Sites (1:250,000): Salmonid release, count, and hatcheries data were obtained from the Bonneville Power Administration on a 1:250,000 scale. Although the on-the-ground locations are not exact on our base map, they provide a general representation of the areas where fish were released or surveys were conducted.

National Wetlands Inventory (1:24,000): The primary source for wetland information used in this assessment was National Wetlands Inventory (NWI) maps created by the United States Fish and Wildlife Service. Very few of the NWI quads were digitized for the Youngs Bay or Nicolai-Wickiup watersheds, so information was generally derived from hard copy NWI maps. Digital data were used for the Skipanon River watershed. NWI maps were created from interpretation of 1:58,000-scale aerial photos that were taken in August of 1981 and were generated as an overlay for USGS quadrangles. It is important to note that NWI wetland 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.

Dikes: (1:24,000): The dikes coverage was created by the Army Corps of Engineers (ACOE) and came from an ACOE study on lower Columbia River flood control. Data were compared to dikes on the USGS quadrangles and found to be consistent.

Debris Flow Potential: The ODF created debris flow hazard maps based on underlying bedrock geology, slope steepness, historical landslide information, and stream channel confinement where applicable. Slope data were generated from 1:24,000 DEMs. These maps were created to show areas where on-the-ground investigation is prudent before conducting land management and development activities. Further information was provided with the digital data.

Points of Diversion (1:24,000): Points of diversion were mapped by the Oregon Water Resources Department (OWRD) by digitizing individual water rights into a township coverage. Only permitted and certificated rights were digitized. All water rights should be up-to-date and maintained by OWRD. Links from points of diversion to actual water rights were found to be missing in this assessment, probably due to the database needing updates (Bob Harmon pers. comm.).

1.1.3 Data Confidence

GIS data vary in how well they represent actual on-the-ground conditions. Several of the data sets used to develop this assessment need to be evaluated and compared to on-the-ground conditions before restoration or final conclusions are made about ecosystem processes. Data sets in need of further evaluation have been listed in the Recommendations section of this document. A few of these will be discussed here because they have characteristics that must be kept in mind while reading this document.

Land Use and Wetlands

The land use was refined from a LANDSAT scene, zoning, NWI, and ownership (see section 1.8), which have all been field verified. NWI data were not available digitally for the entire area and so were used only in the areas of digital coverage. Other wetland data were derived from the LANDSAT scene. NWI data are much more accurate because they are derived from aerial photo interpretation. Consequently, some areas that have been classified as wetlands are really agricultural fields. As NWI data becomes more readily available in digital format, the land use coverage should be updated. All land use categories should be field verified before restoration actions begin. We believe that this land use coverage is a fair representation of land use in the watershed for the scale of this assessment. It is most likely an under representation of wetland areas.

Roads

The roads coverage is a key coverage used to evaluate potential sediment sources and changes in watershed hydrology associated with road construction. However, it is not clear that road coverage accurately represents on-the-ground conditions in this watershed. The road coverage was developed from the 1:100,000 USGS digital line graphs. These coverages were then updated on an ad-hoc basis from aerial photos and other sources of information as it became available. A visual comparison of the data to aerial photos found the roads coverage to be fairly thorough. Although this coverage represents the best available data for roads, the data are suspect. A study needs to be developed to determine the accuracy of the roads data.

Channel Habitat Types

Channel habitat types were determined using GIS. Field verification found that these data accurately represent actual on-the-ground conditions (through visual comparison). However, the channel habitat type should be further verified in the field before any restoration actions begin.

Riparian Vegetation and Shade

Riparian conditions need to be further evaluated and ground truthed before restoration actions occur. A visual comparison of field checks to the aerial photo interpretations found the data to be fairly consistent. After site selection using the GIS data, the stream reach identified should be field checked for actual on-the-ground conditions. A more rigorous analysis of the GIS data could also be performed (field data have been provided to the watershed council).

Overall, the confidence in the GIS data is moderate. Field data are always a better choice; however, it is expensive, time intensive and often unfeasible for very large areas. Time can be saved by using the GIS data to select potential sites for restoration. Field verification can then define the exact conditions present. Used in this way the GIS data can provide an efficient decision-making framework to guide restoration activities.

1.2 Setting

The Skipanon River watershed is a small fifth field watershed located in the northwest corner of Clatsop County and includes a major portion of the city of Warrenton (Figure 1.1). The Skipanon River is a tributary to the Columbia River Estuary and drains approximately 28 sq. mi. of land. Lakes are a prominent landscape feature and include Coffinberry Lake and Cullaby Lake (Figure 1.2). The Skipanon River watershed is a unique watershed in that it is located on the Clatsop Plains and characterized by coastal dunes and wetlands in the lowlands, and forested areas in the higher elevations.

Skipanon Watershed

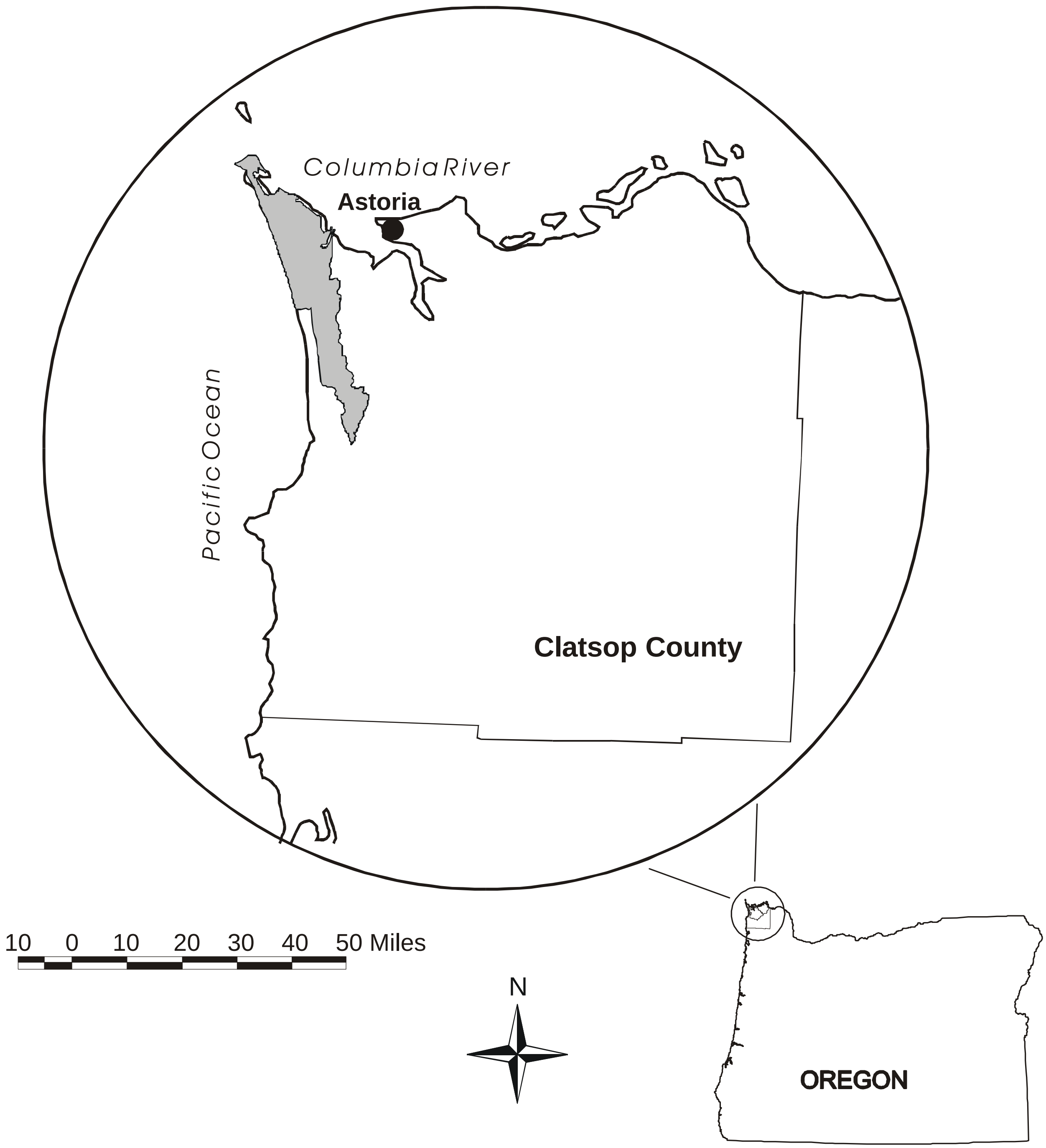

Figure 1.1. Physical location of the Skipanon River watershed.

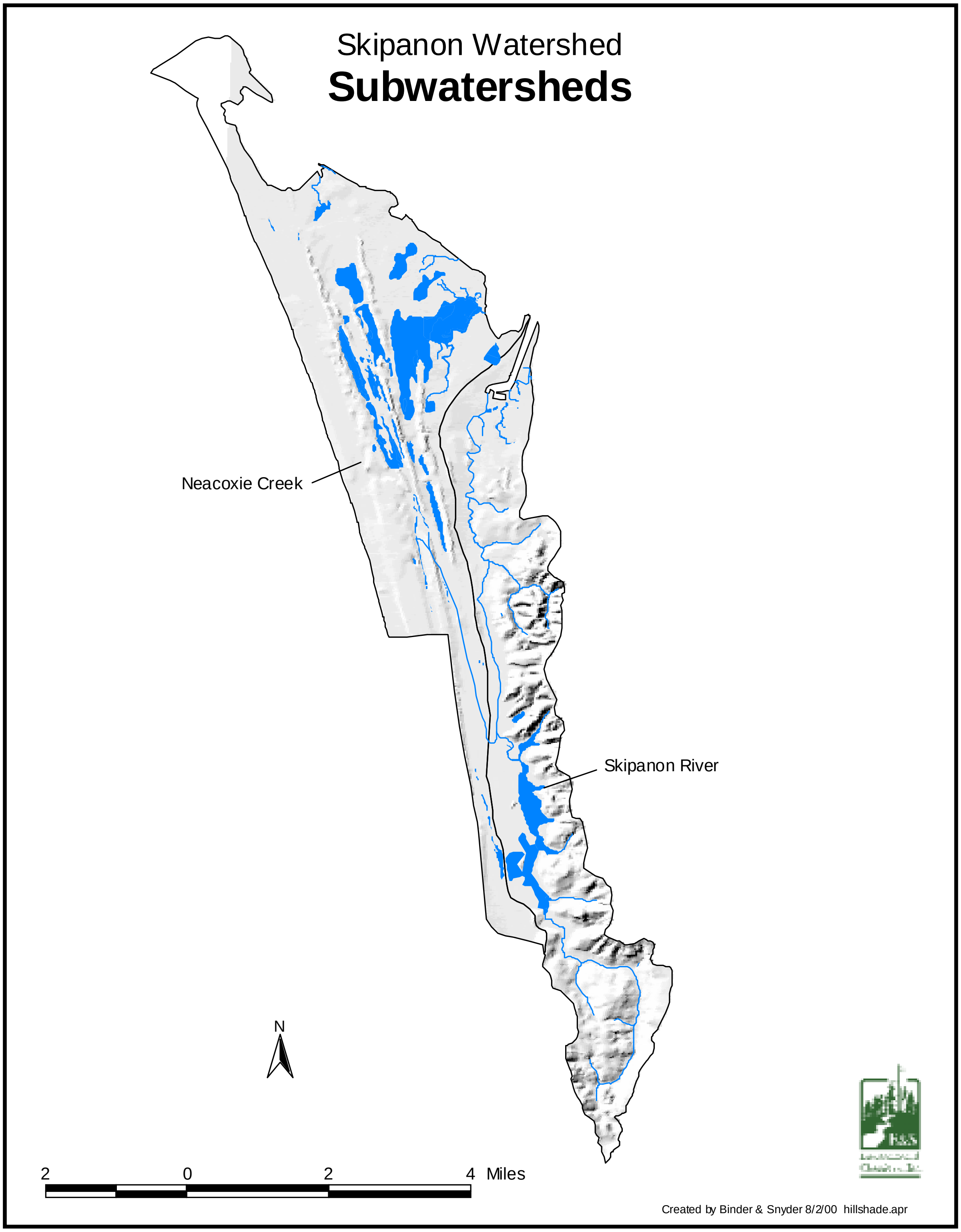

Figure 1.2. Subwatersheds of the Skipanon River watershed illustrating topography based on a 10-m Digital Elevation Model (DEM).

1.3 Ecoregions

The state of Oregon has been divided into ecoregions based on climate, geology, physiography, vegetation, land use, wildlife and hydrology. Each of these ecoregions has characteristic patterns of climate, geology, topography, and natural vegetation that shape and form the function of the watersheds. Dividing the state and the watersheds into different ecoregions permits regional characteristics to be applied to understand the processes in that region. The Skipanon River watershed spans portions of two ecoregions (Omernik 1987), the Coastal Lowlands and the Coastal Uplands.

The Coastal Lowland ecoregion occurs in the valley bottoms of the Oregon and Washington coast and is characterized by marine estuaries and terraces with low gradient meandering streams. Channelization and diking of these streams is common. Elevations in this ecoregion run from 0 to 300 ft and the watershed receives 60 to 85 in of annual rainfall. Potential natural vegetation includes Sitka spruce (*Picea sitchensis*), western hemlock (*Tsuga heterophylla*), western red cedar *(Thuja plicata*), Douglas-fir (*Pseudotsuga menziesii*), grand fir (*Abies grandis*) red alder *(Alnus rubra*), and estuarine wetland plants *(*Franklin and Dyrness 1973).

The Coastal Upland ecoregion extends along the Oregon and Washington coast and is typically associated with the upland areas that drain into the coastal lowland ecoregions. The Coastal Upland ecoregion is characterized by coastal upland and headland terraces with medium to high gradient streams. Elevations run from 0 to 500 ft and the watershed receives 70 to 125 in of precipitation. Potential natural vegetation includes Sitka spruce (*Picea sitchensis*), western hemlock (*Tsuga heterophylla*), western red cedar *(Thuja plicata*), Douglas-fir (*Pseudotsuga menziesii*), grand fir (*Abies grandis*) and red alder *(Alnus rubra*; Franklin and Dyrness 1973).

1.4 Population

Population in the Skipanon River Watershed is concentrated in the lower elevations, around the city of Warrenton (Figure 1.3). Since 1950, the population of Oregon has doubled and the cities of Astoria and Warrenton are predicted to increase in population at a rate of 1 percent annually (CH2MHill 1997, 1996). Historically, population growth in Oregon was associated with changes in the natural resource industries. However, recent changes in

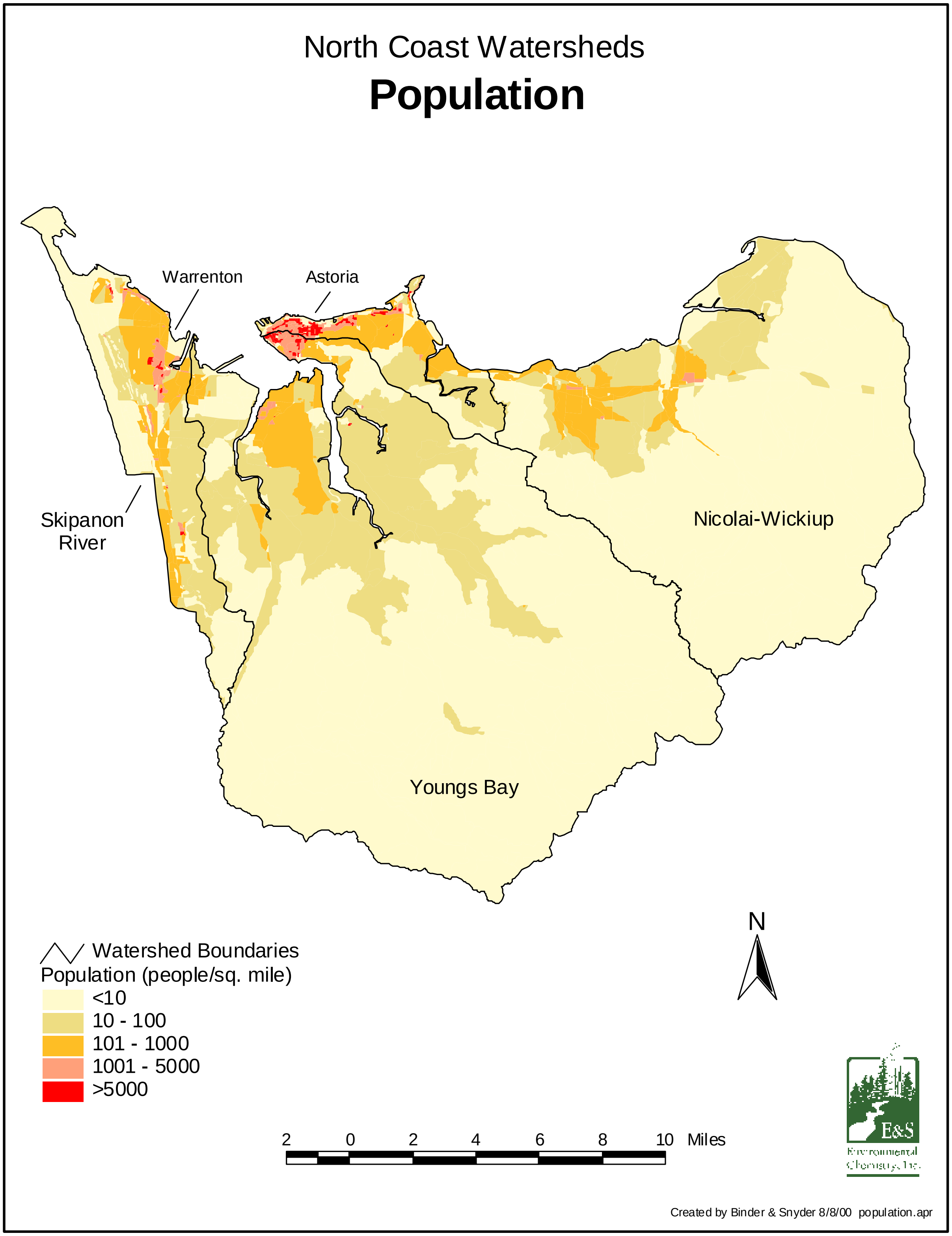

Figure 1.3. Population in the Skipanon, Youngs Bay, and Nicolai-Wickiup watersheds.

population have been more associated with in-migration due to quality of life concerns. Population growth can be attributed to in-migration and can be expected to continue to increase, leading to increased pressures and demands on natural resources, such as a need for more water and degradations in water quality.

1.5 Climate and Topography

The Skipanon River watershed experiences a coastal temperate climate strongly influenced by the Pacific Ocean and related weather patterns (Taylor and Hatton 1999). Climate in the Pacific Northwest usually includes an extended winter rainy season followed by a long, dry summer season. In Astoria, air temperatures range between a mean daily minimum of 35° F in January and a mean daily maximum of 70° F in August (OSU-Extension 2000).

The Skipanon River watershed receives approximately 76 in of precipitation annually ranging from 5 in during the summer and 53 during the winter season. Precipitation is predominantly rain with rare snowfall occurrences that are short in duration.

Topography in the Skipanon River watershed is characterized by flat lowland bordered by rolling hills and sand dunes. Elevations range from sea level at the confluence with the Columbia River Estuary to 466 ft in the highlands.

1.6 Geology

Geology in the Skipanon River watershed consists of a thick sequence of sedimentary rock characterized by weathered sandstone and tufaceous sandy shale. The lowlands are underlain by deposits of sand grading into sandstone and shale. Between Astoria and Tillamook Head is the Clatsop Sand Spit. This spit was formed after the Coast Range was uplifted. Sediments carried by the Columbia River were deposited by wind and wave action, building the spit over time. A jetty was constructed at the mouth of the Columbia River, causing additional accretion of the sand spit.

1.7 Vegetation

Vegetation cover in the Skipanon River watershed was characterized using the 1995 CLAMS data. CLAMS characterized the vegetation by classifying satellite imagery into 15 categories (Table 1.2). The satellite data were originally acquired in 1988 and were updated in

Table 1.2. Twelve categories of land cover present in the 1995 CLAMS data set. Categories 0 = background, 2=water, and 5= cloud are not shown (Garono and Brophy 1999). DBH is diameter at breast height.

Class	Cover type	Description
1	Shadow	Background (portions of the data file that do not contain image information)
3	Open	Open (0-40% vegetation cover)
4	Semi-closed	Semi-Closed (41-70% vegetation cover)
6	Broadleaf	Broadleaf (#70% broadleaf cover)
7	Mixed, small conifers	Mixed broadleaf/conifer: <70% broadleaf cover; small conifers (# 1 ft [25 cm] DBH)
8	Mixed, medium conifers	Mixed: <70% broadleaf cover; medium conifers (1-2 ft [26-50 cm] DBH)
9	Mixed, large conifers	Mixed: <70% broadleaf cover; large conifers (2-3 ft [51-75 cm] DBH)
10	Mixed, very large conifers	Mixed: <70% broadleaf cover; very large conifers (> 3 ft [75 cm] DBH)
11	Conifer, small	Conifer: >70% conifer cover, conifers small (#1 ft [25 cm] DBH)
12	Conifer, medium	Conifer: >70% conifer cover, conifers medium (1-2 ft [26-50 cm] DBH)
13	Conifer, large	Conifer: >70% conifer cover; conifers large (2-3 ft [51-75 cm] DBH)
14	Conifer, very large	Conifer: >70% conifer cover; conifers very large (>3 ft [75 cm] DBH)

1995. Garono and Brophy (1999) summarized CLAMS data for the Rock Creek watershed by combining these categories to describe the spatial patterns of conifers and open areas. We have used this same approach for the Skipanon River watershed.

1.7.1 Large Conifers

Prior to European settlement, Oregon coastal forests were dominated by conifers (Franklin and Dyrness 1988). These forests were changed dramatically by human activities such as forest harvest, which changed both the age structure and species present in these forests (Garono and Brophy 1999). Conifers, especially old growth, play an important role in ecosystem function in Oregon watersheds by providing shade and large woody debris to streams, slope stabilization, and habitat for wildlife (Naiman and Bilby 1998). Additionally, near-coast stands can receive precipitation in the form of fog drip. Old growth forests generate more fog drip precipitation than younger stands. However, it is not likely that this precipitation input will have much affect on stream flows. Understanding the age and distribution of conifers within a watershed is essential for managing the system to maintain ecosystem function.

Following the methodology provided in Garono and Brophy (1999), we divided large conifer data into two distinct classes: Mixed Forest/Large Conifers (Classes 9+10+13+14) and Large Conifers (Classes 13+14). The Mixed Forest/Large Conifers class contains those areas that include large conifers, but may be dominated by a broadleaf forest while the Large Conifer Class is actually dominated by large conifers (>70 percent conifer cover). Mixed Forest/Large Conifers represent less than 10 percent of the forests in the Skipanon River watershed (Table 1.3; Figure 1.4). The Skipanon River watershed is dominated by Broadleaf (20 percent) and small conifer (17 percent) stands. Less than 1 percent of the watershed is occupied by large conifer dominated stands. It is important to note that the Skipanon River watershed is a unique Oregon coastal basin dominated by low-elevation plains and a high density of wetlands and lakes. Only 52 percent of the watershed is forested, and less than 20 percent of the watershed is currently managed for timber harvest (see Land Use below). In the lowlands, wetlands may represent a more important channel feature for salmonids than large conifers in the riparian areas. Although large conifers are not common in the Skipanon River watershed, further analysis is needed to determine changes in vegetation and their role in maintaining ecosystem function in this unique watershed.

Table 1.3. Vegetation cover in the Skipanon River watershed, based on satellite imaging classification from the 1995 CLAMS study (OSU-Extension 1995).

	Total Area	Broadleaf	Lg. conifers	Mixed Lg. conifers	Mixed - Very lg. conifers	Very lg. conifers	Med. conifers	Mixed - Med. conifers	Mixed - Sm. conifers	Sm. conifers	Open	Semi-Closed	Shadow	(blank)	Water	
Subwatershed	mi^2	%	%	%	%	%	%	%	%	%	%	%	%	%	%	
Neacoxie Cr.	16.0	16.7	0.7	8.6	0.6	0.0	2.3	5.8	4.5	1.5	27.7	1.5	0.2	0.8	1.3	
Skipanon River	12.3	23.1	0.3	8.1	0.2	0.0	1.6	10.7	28.1	3.8	11.2	1.2	0.6	1.8	0.3	
Total	28.3	19.5	0.6	8.4	0.4	0.0	2.0	7.9	14.8	2.5	20.5	1.4	0.4	1.2	0.9	

1.8 Land Use

Watershed processes are often affected by land management practices which increase watershed disturbance. For example, management of forest land for timber harvest can influence watershed hydrology by increasing road densities and clearing vegetation (WPN 1999; Naiman and Bilby 1998). Wetlands are often drained for agriculture because of their rich organic soils, resulting in habitat loss and the disconnection of floodplains from the rivers. By understanding the land management activities and their associated economic values, land managers can better evaluate the effects on their watersheds and how to mitigate those impacts to maintain natural ecosystem processes.

The land use map was created using three coverages: zoning from the CREST, ownership, and a 1991 LANDSAT image obtained from CREST and the Coastal Change and Analysis Program (C-CAP). The three coverages were combined and land use was delineated based on these three attributes. For example, if the LANDSAT image classified the land as bare, and zoning was Exclusive Farm Use, then this polygon was attributed as agriculture. Additionally, if the LANDSAT image classified the land as developed and the zoning was in the urban growth boundary, this polygon was attributed as developed. The forest lands were delineated by ownership, and categorized as Private Industrial Forest, Private Non-Industrial Forest, State Forest, or Miscellaneous Forest (for those areas where ownership was not specifically identified). All areas characterized as wetlands by the LANDSAT scene were maintained in the coverage and verified using the National Wetlands Inventory (NWI) data where available. It is likely that many of the areas characterized as wetlands are actually farmed land. These wetlands are categorized by the NWI as farmed wetlands based on aerial photo interpretation. Since we have maintained NWI and satellite identified wetlands over all other categories (such as zoning or ownership), many agricultural areas are actually categorized as wetlands. Metadata (data describing the GIS coverage) for the LANDSAT image and the ownership coverage have been included with this document. There was no metadata provided with the zoning coverage.

The Skipanon River watershed is a unique coastal watershed that drains much of the Clatsop Plains. Land cover is dominated by non-industrial forests (35 percent), palustrine wetlands (19 percent), and grasslands (14 percent; Table 1.4, Figure 1.4). Industrial forests represent less than 20 percent of the land cover in the Skipanon River watershed. Lakes are also a prominent

Table 1.4 Land use in the Skipanon River watershed calculated from the refined land use coverage.

	Grand Total mi^2	Agriculture %	Developed %	Estuarine Wetland %	Grassland %	Industrial Forest %	Non-Industrial Forest %	Palustrine Wetland %	Shoreline %	State Forest %	Unknown Forest %	Water %
Subwatershed												
Neacoxie Creek	15.9	0.85	6.46	2.49	20.45	-	39.64	24.76	3.11	0.19	-	2.05
Skipanon River	12.3	2.27	3.85	0.12	5.06	43.31	29.71	10.73	-	1.94	-	3.01
Total	28.2	1.47	5.32	1.46	13.75	18.85	35.31	18.65	1.76	0.95	0.00	2.47

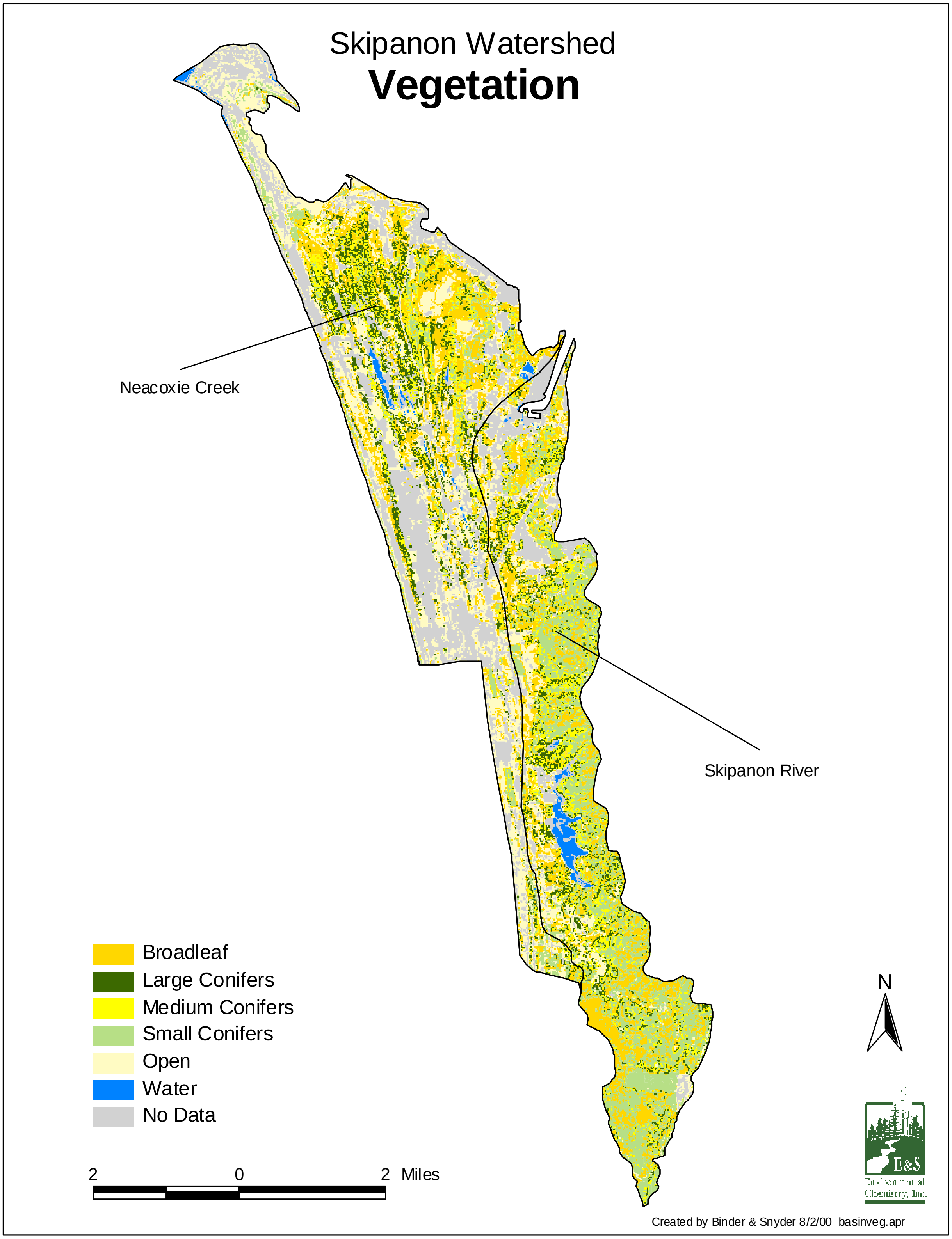

Figure 1.4. Vegetation cover in the Skipanon River watershed. Vegetation was characterized by the OSU-Extension using a 1995 LANDSAT scene. Vegetation categories have been aggregated to show the relative distribution of conifers.

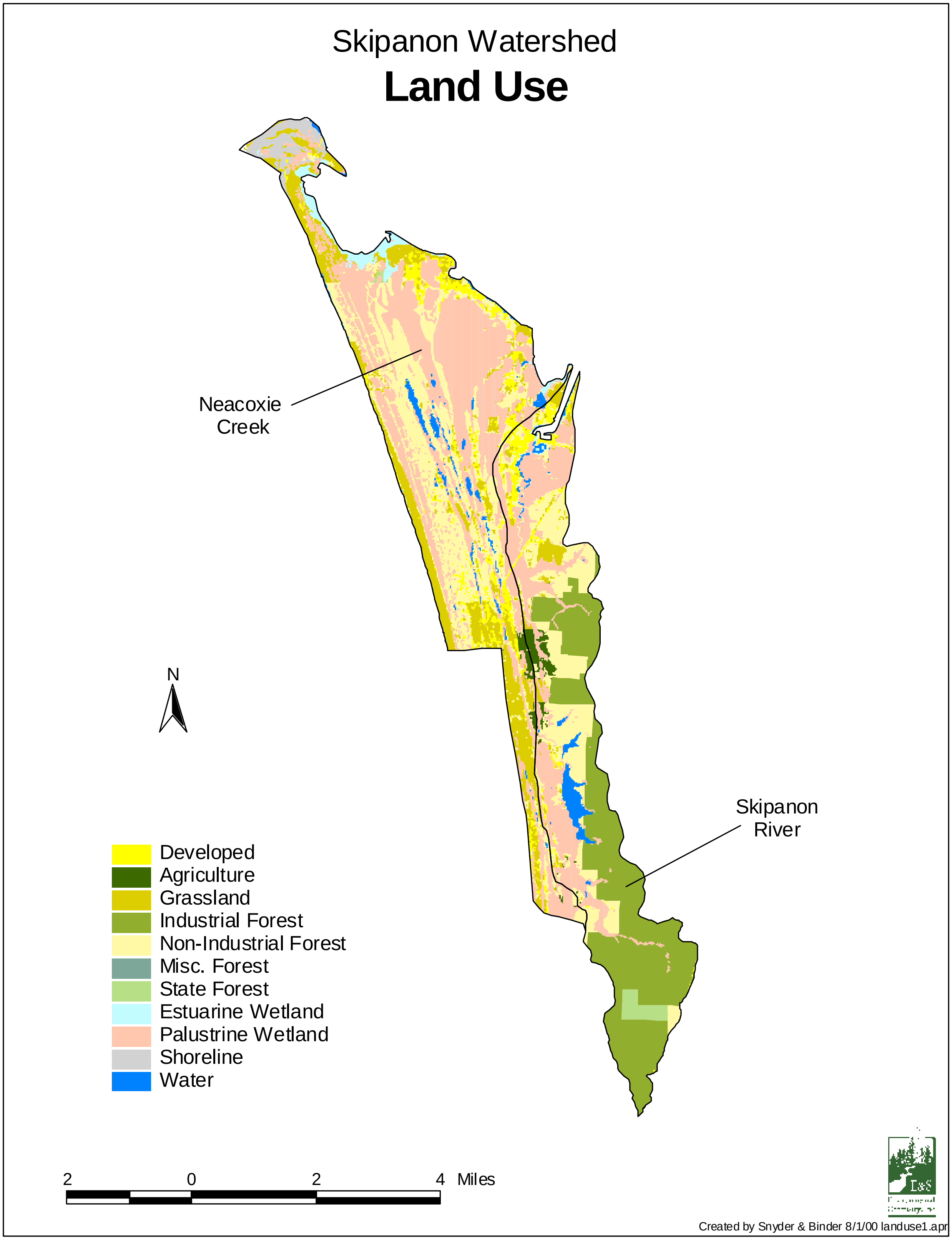

Figure 1.5. Land use in the Skipanon River watershed. Data displayed is from the refined land use coverage.

feature in the Skipanon River watershed including Cullaby Lake. Specific habitat and water quality related effects typically associated with land use activities are listed in Table 1.5.

1.9 Channel Habitat Types

Stream channel geomorphology is the result of the complex interaction of ecosystem conditions and processes including geology, climate, terrain, disturbance and biological factors. Stream channels can be categorized and grouped based on their geomorphologic characteristics. Differences in geomorphology produce different responses to similar watershed processes such as changes in discharge or sediment loading (Naiman and Bilby 1998). Stream channels with similar geomorphology will have a similar response to changes in land use and ecosystem structure. Classifying stream channels by geomorphology allows us to predict the response for watershed changes.

Stream channels were separated into channel habitat type (CHT) categories using the OWEB protocol. Categories were based on stream geomorphic structure including stream size, gradient, and side-slope constraint (Table 1.6). By identifying current channel forms in the watershed, we can understand how land use activities may have affected the channel form as well as identify how different channels may respond to particular restoration efforts. Ultimately, changes in watershed processes will affect channel form and produce changes in fish habitat.

Channel response to changes in ecosystem processes is strongly influenced by channel confinement and gradient (Naiman and Bilby 1998). For example, unconfined channels possess floodplains that mitigate peak flow effects and allow channel migration. In contrast, confined channels translate high flows into higher velocities with greater basal shear stress. Ultimately, these characteristics control stream conditions such as bedload material, sediment transport, and fish habitat quality. Generally, more confined, higher gradient streams demonstrate little response to watershed disturbances and restoration efforts (Figure 1.6). By grouping the channels into geomorphologic types, we can determine which channels are most responsive to disturbances in the watershed as well as those channels most likely to respond to restoration activities.

Channel habitat types with high sensitivities typically are low gradient streams with extensive floodplains. Approximately 97 percent of the channels in the Skipanon River watershed demonstrate a high sensitivity to both watershed disturbance and restoration activities

Table 1.5. Typical watershed issues organized by major land use activity (WPN 1999)

Land Use Category	Habitat-Related Effects	Water Quality Effects
Forestry	Channel modification Pool quantity and quality Large wood abundance Shade and canopy Substrate quality Flow alteration Passage barriers	Temperature Turbidity Fine sediments Pesticides and herbicides
Crop-land grazing	Channel modification Pool quantity and quality Large wood abundance Shade and canopy Substrate quality Flow alteration	Temperature Dissolved oxygen Turbidity Fine sediments Suspended sediments Nutrients, bacteria Pesticides and herbicides
Feedlots and dairies	Channel modification	Suspended sediments Nutrients Bacteria Pesticides Herbicides
Urban areas	Flow alteration Channel modification Pool quantity and quality Large wood abundance Shade and canopy Substrate quality Passage barriers	Temperature Dissolved oxygen Turbidity Suspended sediments Fine sediments Nutrients Organic and inorganic toxics Pesticides Herbicides Bacteria
Mining	Channel modification Pool quantity and quality Substrate quality	Turbidity Suspended sediments Fine sediments Nutrients Organic and inorganic toxics
Dams and irrigation works	Flow alteration Channel modification Pool quantity and quality Substrate quality Passage barriers	Temperature Dissolved oxygen Fine sediments
Road networks	Flow alteration Channel modification Pool quantity and quality Substrate quality Passage barriers	Turbidity Suspended sediments Fine sediments Pesticides Herbicides

Table 1.6. Channel habitat types and their associated channel geomorphologic conditions (WPN 1999)

Code	CHT Name	Channel Gradient	Channel Confinement	Channel Size
ES	Small Estuary	<1%	Unconfined to moderately confined	Small to medium
EL	Large Estuary	<1%	Unconfined to moderately confined	Large
FP1	Low Gradient Large Floodplain	<1%	Unconfined	Large
FP2	Low Gradient Medium Floodplain	<2%	Unconfined	Medium to large
FP3	Low Gradient Small Floodplain	<2%	Unconfined	Small to medium
AF	Alluvial Fan	1-5%	Variable	Small to medium
LM	Low Gradient Moderately Confined	<2%	Moderately confined	Variable
LC	Low Gradient Confined	<2%	Confined	Variable
MM	Moderate Gradient Moderately Confined	2-4%	Moderately confined	Variable
MC	Moderate Gradient Confined	2-4%	Confined	Variable
MH	Moderate Gradient Headwater	1-6%	Confined	Small
MV	Moderately Steep Narrow Valley	3-10%	Confined	Small to medium
BC	Bedrock Canyon	1 - >20%	Confined	Variable
SV	Steep Narrow Valley	8-16%	Confined	Small
VH	Very Steep Headwater	>16%	Confined	Small

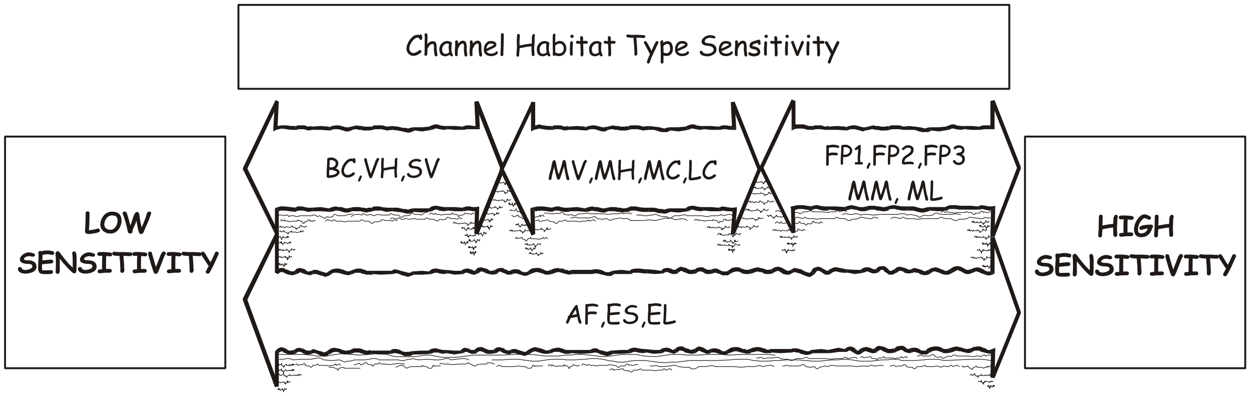

Figure 1.6. Different channel types respond differently to adjustment in channel pattern, location, width, depth, sediment storage, and bed roughness. Such changes may not only result in alteration of aquatic habitat, but the more responsive areas are most likely to exhibit physical changes from land management activities and restoration efforts. (WPN 1999)

(Table 1.7, Figure 1.7). Most of the channel types were FP1 and FP3 which are channels with significant floodplains. Channel geomorphologies in the Skipanon River watershed suggest that most streams within the watershed demonstrate a high sensitivity to watershed disturbance and restoration activities and occur in the lower and mid elevations of the watershed.

Table 1.7. Channel habitat types in the Skipanon River watershed. Channel habitat types are grouped by their sensitivity to watershed disturbance.

Channel Sensitivity		Percent Channel Habitat Type													
		High					Moderate						Low		
Subwatershed	Stream Length	% FP1	% FP2	% FP3	% LM	% MM	% EL	% ES	% LC	% MC	% MH	% MV	% BC	% SV	% VH
Neacoxie Creek	7	97	-	-	-	-	2.7	-	-	-	-	-	-	-	-
Skipanon River	22	45	3.1	27.1	10.3	10	-	-	-	-	-	3.6	-	-	-
Total	30	57.9	2.3	20.6	7.8	8.0	0.7	0.0	0.0	0.0	0.0	2.7	0.0	0.0	0.0

1.10 History

The history of a watershed is an important part of any watershed assessment because it provides information on how conditions have changed over time and provides a reference point

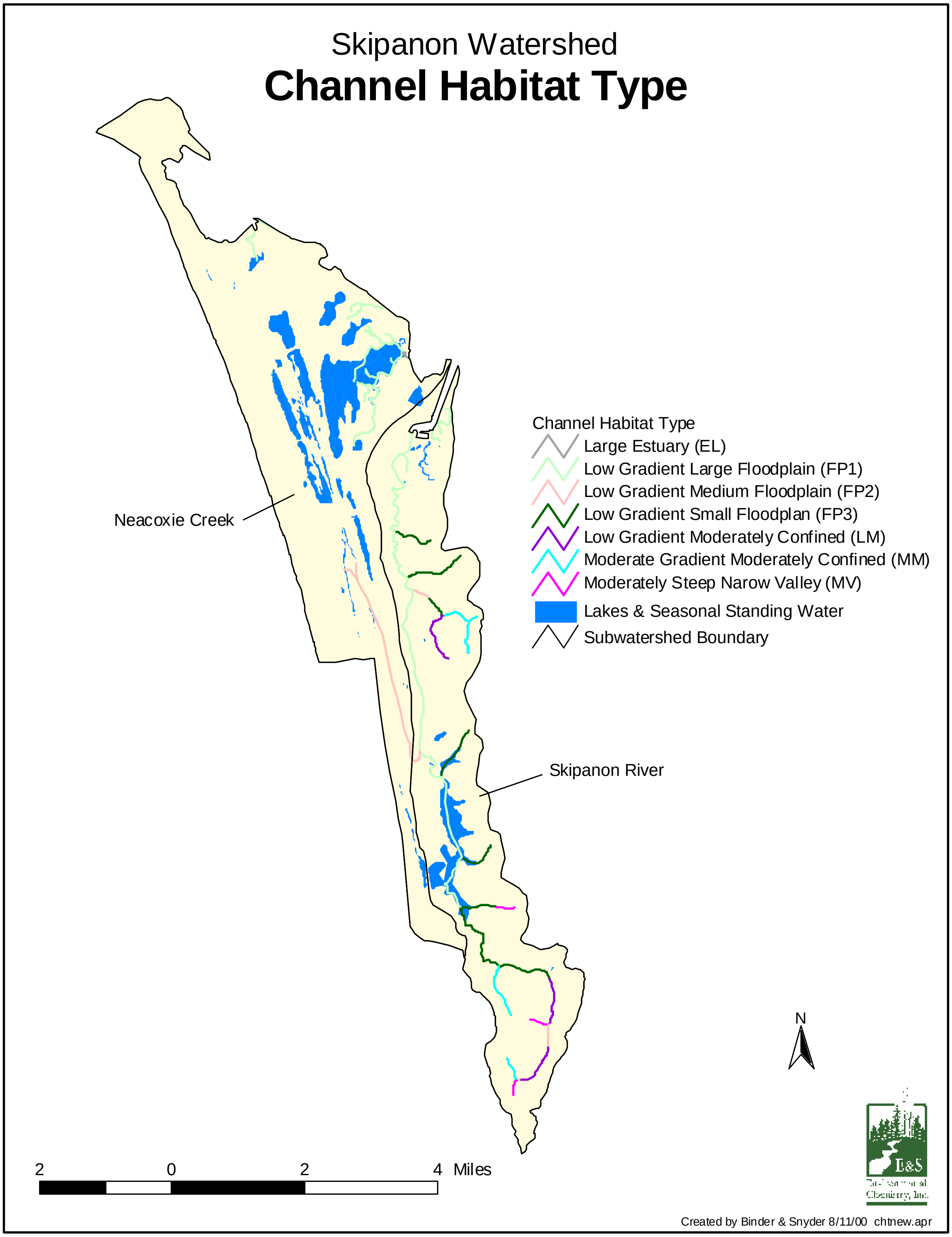

Figure 1.7. Channel habitat types in the Skipanon River watershed. Stream reaches were classified by slope, size, and side-slope according to OWEB protocols (WPN 1999).

for current conditions. The history of the Skipanon River watershed has been compiled by the watershed council (Lisa Heigh) and included in the Appendices of this document (Appendix A). The history section provides insight on issues that relate to landscape features such as aquatic/riparian habitat, fish populations, and water quality. Having information on these prior conditions will allow local stakeholders to develop appropriate reference conditions when conducting restoration activities.

CHAPTER 2 FISHERIES

2.1 Introduction

The OWEB assessment process focuses on watershed processes that affect salmonids and their associated habitats. Understanding the current condition of salmonid populations in a watershed is vital to identifying the effects of the spatial and temporal distribution of key habitat areas on salmonids. Additionally, salmonids are often used as indicator species under the assumption that salmonids are the most sensitive species in a stream network (WPN 1999, Bottom et al. 1998, Tuchmann et al. 1996). Habitat conditions that are good for salmon reflect good habitat conditions for most aquatic species. Understanding the complex life cycles, spatial distribution, and current status of salmonids in a watershed is key to evaluating watershed management practices and their effects on watershed health.

2.2 Fish Presence

There are numerous fish species that occur in the Columbia River Estuary that may use resources in the Skipanon River watershed. A 1967 report on fish species occurring in the Columbia River Estuary and tributaries identified 28 families and 77 species of fish (Reimers and Bond 1967). Excluding marine and introduced fish, six families and 17 species of freshwater fish remain. Sculpins (*Cottus* spp.) were found to be the most widely distributed species in lower Columbia River tributaries. Selected species occurring in the lower Columbia River tributaries are listed in Table 2.1.

2.3 Species of Concern

The National Marine Fisheries Service (NMFS) has listed several anadromous fish species that exist, or could potentially exist, in the watershed as threatened under the Endangered Species Act (Table 2.2). Chum and chinook are listed as threatened and steelhead is listed as a candidate by NMFS. Coho is listed as a candidate for listing while coastal cutthroat is proposed to be listed as threatened. Listing occurs for entire Evolutionarily Significant Units (ESU), which is defined as a genetically or ecologically distinctive group of Pacific salmon, steelhead, or sea-run cutthroat trout (Appendix B).

Table 2.1 Selected species occurring in lower Columbia River tributaries.

Common Name	Species	Source
Coho	*Oncorhynchus kisutch*	ODFW 1995
Coastal Cutthroat	*Oncorhynchus clarki clarki*	ODFW 1995
Chum	*Oncorhynchus keta*	ODFW 1995
Chinook (Fall)	*Oncorhynchus tshawytscha*	ODFW 1995
Steelhead	*Oncorhynchus mykiss irideus*	ODFW 1995
Pacific Lamprey	*Lampetra tridentata* spp.	ODFW 1995
Northern Squawfish	*Ptychocheilus oregonensis*	ODFW 1995
Longnose Dace	*Rhinichthys cataractae*	ODFW 1995
Redside Shiner	*Richardsonius balteatus*	ODFW 1995
Sandroller	*Percopsis transmontana*	ODFW 1995
Sculpins	*Cottus spp.*	ODFW 1995; Reimers and Bond 1967
Leopard Dace	*Rhinichthys falcatus*	ODFW 1995

Table 2.2. Status of anadromous fish occurring in the Lower Columbia River ESU's. Listing status was obtained from the NMFS website (*http://www.nwr.noaa.gov/1salmon/salmesa/index.htm*).

Fish	ESU	Status
Coho	Lower Columbia River/Southwest Washington	Candidate
Coastal Cutthroat	Southwestern Washington/Columbia River	Proposed Threatened
Chum	Columbia River	Threatened
Chinook	Lower Columbia River	Threatened
Steelhead	Oregon Coast	Candidate

* An Evolutionarily Significant Unit or "ESU" is a distinctive group of Pacific salmon, steelhead, or sea-run cutthroat trout.

The Endangered Species Act requires that any land providing habitat for endangered species must be properly managed. Relationships between land cover and rare species decline has been established. An understanding of the land patterns associated with the distribution of these species can lead to a better understanding of how to preserve these species. The OWEB process focuses on salmonids in the watershed.

In addition to provisions of the Endangered Species Act, private timber, federal, and state owned lands have their own mandates for the protection and conservation of the habitats related to these threatened and endangered species. Private timber practices are regulated by the Forest Practices Act, which is designed to help protect important habitats. The Oregon Department of Forestry is developing an assessment and management plan to detail forest management practices within areas occupied by threatened species. Due to the complex interactions in watersheds, all of these practices must be coordinated with private landowners to manage the natural resources for the protection of the critical habitats associated with these species.

Many of the following paragraphs have been taken directly from ODFW's *Biennial Report on the Status of Wild Fish in Oregon* (ODFW 1995) or from the NMFS website (*http://www.nwr.noaa.gov/1salmon/salmesa/inde3.htm*).

2.4 Coho

2.4.1 Life History

The coho salmon (*Oncorhynchus kisutch*) is an anadromous species that rears for part of its life in the Pacific Ocean and spawns in freshwater streams in North America. Coho salmon spend several weeks to several months in freshwater before spawning, depending on the distance they migrate to reach their spawning grounds. Adults die within two weeks after spawning. Juveniles normally spend one summer and one winter in freshwater, although they may remain for one or two extra years in the coldest rivers in their range. They migrate to the ocean in the spring, generally one year after emergence, as silvery smolts about four to five inches long (Table 2.3). Most adults mature at three years of age (ODFW 1995).

2.4.2 Listing Status

On July 25, 1995, NMFS determined that listing was not warranted for the Lower Columbia Coho ESU (Appendix B). However, the ESU is designated as a candidate for listing due to concerns over specific risk factors. This ESU includes all naturally-spawned populations of coho salmon from Columbia River tributaries below the Klickitat River on the Washington side and below the Deschutes River on the Oregon side (including the Willamette River as far upriver as Willamette Falls), as well as coastal drainages in southwest Washington between the Columbia River and Point Grenville. Major river watersheds containing spawning and rearing habitat for this ESU comprise approximately 10,418 sq mi in Oregon and Washington. The

Table 2.3. Life history patterns for species of concern in the Skipanon River watershed.

Fish	Return	Spawn	Out-migration
Coho [1,2]	Aug-Dec	late Oct-Dec	spring
Chinook, fall [3]	Aug-Sep	fall	summer
Steelhead, winter [3]	Nov-Apr	Dec-Jun	Mar-June
Coastal Cutthroat[4]	Jul-Mar (Nov-Dec, peak)	Dec-June, Feb (peak)	Apr-Jun

[1] Status Review of Coho Salmon from Washington, Oregon, and California
[2] Joseph Sheahan, personal communication
[3] Status Report: Columbia River Fish Runs, 1938-1997
[4] Status Review of Coastal Cutthroat Trout from Washington, Oregon, and California

following counties lie partially or wholly within these watersheds: Oregon - Clackamas, Clatsop, Columbia, Hood River, Marion, Multnomah, Wasco, and Washington; Washington - Clark, Cowlitz, Grays Harbor, Jefferson, Klickitat, Lewis, Mason, Pacific, Skamania, Thurston, and Wahkiakum (Source: *http://www.nwr.noaa.gov/1salmon/salmesa/inde3.htm*).

2.4.3 Population Status

Coastal watershed wild coho production has declined from approximately 1.5 million fish at the turn of the century to approximately 70,000 in the 1990s. Wild populations still occur in most coastal watersheds and in the Clackamas and Sandy Rivers in the Columbia River watershed, and occur in some other tributaries of the lower Columbia River watershed. Remaining coho populations generally spawn and rear in small, low gradient (less than 3%) tributary streams, although rearing may also take place in lakes where available.

2.4.4 Species Distribution

ODFW mapped current coho distribution by attributing 1:100,000 stream coverages based on survey data and best professional judgment of local fish biologists. Distributions identified spawning, rearing and migration areas. These coverages are dynamic data sets that are scheduled to be updated every two years. These data are available on ODFW's website (*ftp://ftp.dfw.state.or.us/pub/gis*). Coho occurs along the entire extent of the Skipanon River (Figure 2.1). It is unlikely that native populations exist in the watershed today. Cullaby Lake may have been a key rearing area both before and after its drainage was altered. Currently, the warm water fishery in Cullaby Lake precludes successful coho rearing.

Spawning surveys were conducted in Cullaby Creek by ODFW in 1991 and 1992. Both juvenile and adult coho were found in Cullaby Creek as well as a few redds, suggesting coho is using Cullaby Creek for both spawning and rearing.

2.4.5 Hatcheries

Hatchery coho also may have contributed to the decline of wild coho salmon. Hatchery programs supported historical harvest rates in mixed-stock fisheries that were excessive for sustained wild fish production. Hatchery coho have also strayed to spawn with wild fish, which may have reduced the fitness and therefore survival of the wild populations through outbreeding depression (Hemmingsen et al 1986; Flemming and Gross 1989, 1993; ODFW 1995) and which lowered effective population sizes. Finally, hatcheries may have reduced survival of wild juveniles through increased competition for limited food in streams, bays, and the ocean in years of low ocean productivity, through attraction of predators during mass migrations, and through initiation or aggravation of disease problems (Nickelson et al. 1986). A large number of presmolt coho of various Columbia River stocks were released in the Skipanon River watershed for a couple of years in the early 1980s (Walt Weber pers. comm.). Currently, a STEP hatchery is operated by Warrenton High School on the Skipanon River.

2.5 Chinook

2.5.1 Life History

Oregon chinook salmon populations exhibit a wider range of life history diversity than coho or chum salmon, with variation in the date, size and age at juvenile ocean entry; in ocean migration patterns; and in adult migration season, spawning habitat selection, age at maturity and size (Nicholas and Hankin 1989; Healey 1994). Generally, subyearling juveniles rear in coastal streams from three to six months and rear in estuaries from one week to five months. Nearly all Oregon coastal chinook salmon enter the ocean during their first summer or fall. Columbia River fall chinook show a similar rearing pattern, but Columbia River spring chinook (and a small percentage of fish in coastal chinook populations) spend one summer and one winter in freshwater. Juvenile chinook salmon with this life history of prolonged freshwater rearing tend to move downstream from the area where they hatched into larger rivers during their first spring.

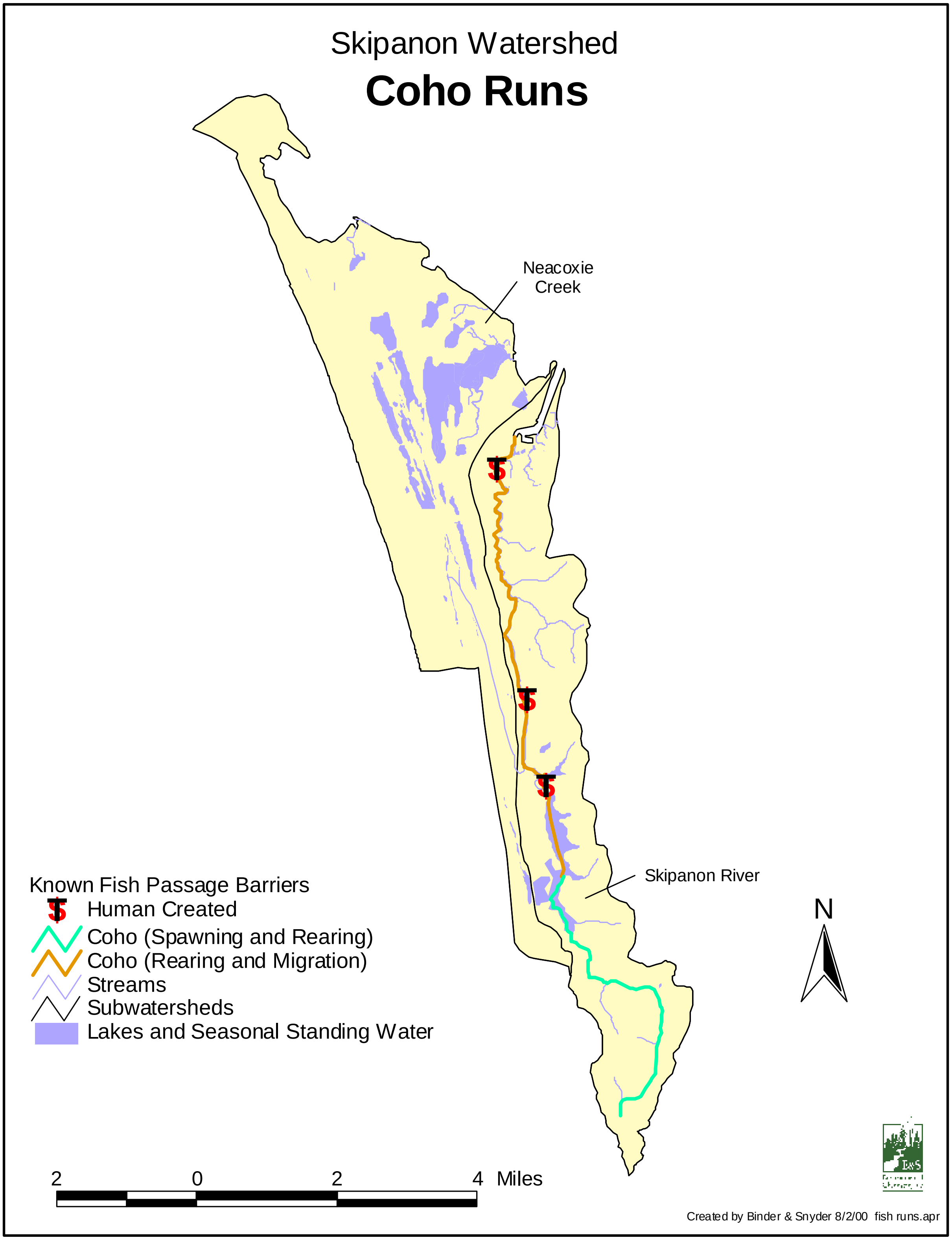

Figure 2.1. Coho and fall chinook distribution in the Skipanon River watershed showing the location of fish barriers and hatcheries. Distribution data were obtained from ODFW and based on local fish surveys and best professional judgement of local fish biologists. Fish barriers were identified by local watershed council members.

Migration to the ocean occurs during the second spring with variation in outmigration depending on amount and timing of spring runoff and individual population differences (ODFW 1995).

2.5.2 Listing Status

Chinook salmon was listed as a threatened species on March 24, 1999. The ESU includes all naturally spawned populations of chinook salmon from the Columbia River and its tributaries from its mouth at the Pacific Ocean, upstream to a transitional point between Washington and Oregon east of the Hood River and the White Salmon River. It includes the Willamette River to Willamette Falls, Oregon, exclusive of spring-run chinook salmon in the Clackamas River (Source: *http://www.nwr.noaa.gov/1salmon/salmesa/inde3.htm*).

2.5.3 Population Status

Lower Columbia Fall Chinook are chinook that enter the Columbia River as mature fish and spawn in small tributaries in the lower watershed. No wild populations have been sampled for allozyme (genetic) variation in this group, although Big Creek hatchery fish, founded from this group, were analyzed (Marshall 1993). The fish are distinctive from all other Columbia River watershed chinook in that they are mature upon river entry, have a short migration more similar to coastal populations, and spawn soon after arrival on the spawning grounds. Their ocean distribution is somewhat south of north coast populations, extending along the coasts of Washington and British Columbia. Juveniles have a subyearling life history. Scattered naturally spawning fish are still observed in the lower Clackamas River and in small streams such as Plympton Creek, Gnat Creek, Big Creek, Clatskanie River, Hood River, and in the Youngs Bay and Columbia Gorge areas. Observations by ODFW district staff indicate that these fish generally spawn from September to early November.

Most spawning has been observed in September, although fresh adults have been observed in late October and dead fish have been found in late November. Harvest management staff have concluded, based on expansions of coded-wire tag recoveries from these fish, that a huge proportion of the fish in these tributaries have been strays from Big Creek hatchery "tules" along with some strays of Rogue River "brights" released into Big Creek. The Plympton Creek "tules" were collected for hatchery broodstock in 1990, 1991 and 1994, with most of the females removed from the watershed in 1990. The information that is available indicates that the fall chinook populations in the lower Columbia River watershed are reduced from historical numbers, with much of the natural spawning dominated by hatchery fish from the 11 Oregon and Washington fall chinook hatcheries located in the lower Columbia.

2.5.4 Species Distribution

ODFW mapped current chinook distribution by attributing 1:100,000 stream coverages based on survey data and best professional judgment of local fish biologists. Distributions identified spawning, rearing and migration areas. These coverages are dynamic data sets that are scheduled to be updated every two years. These data are available on ODFW's website (*ftp://ftp.dfw.state.or.us/pub/gis*). Currently, fall chinook salmon do not occur in the Skipanon River watershed and it is suggested that they did not inhabit this watershed historically either (Walt Weber pers. comm.). Surveys conducted in Cullaby Creek by ODFW in 1991 and 1992 also did not identify any chinook in the watershed.

2.5.5 Hatcheries

Releases of "tule" fall chinook from Oregon facilities included 13-14 million smolts below Bonneville Dam, 10 million smolts in the Big Creek and Youngs Bay area, and 1-8 million smolts and fry in the lower Willamette in 1992 and 1993. Less than 5 percent of the fish are marked, so the number of returning hatchery adults straying to natural spawning areas must be estimated from limited tag recoveries. Based on expansions of coded-wire tags recovered in streams, most of the natural spawning can be attributed to hatchery strays. This pattern probably dates to the 1960s.

Fall chinook from the Rogue River were historically introduced into the lower Columbia River and were released into Big Creek and the Youngs Bay area. The purpose of this program was to provide a south migrating fall chinook for harvest along the Oregon coast and a "brighter" fall chinook in the lower river harvest. About 500,000 to 700,000 Rogue River smolts were released in 1992 and 1993. The fish are adapted to a long migration up the Rogue River and so enter the Columbia River "brighter" than the local populations. All Rogue River "brights" have been marked and straying is being monitored. There has been some straying into natural spawning areas and into lower Columbia River hatcheries. Their spawning time does not overlap with the later part of the natural spawning distribution of the local "tules." And, based on their marks, they are removed from the hatchery tule spawning escapement.

Hatchery spring chinook from the Willamette River are also released into the Youngs Bay area to provide fish for a sport and commercial harvest in the bay. About 400,000 smolts were released into the bay in 1992. These fish enter the lower Columbia River in the spring, long before "tule" populations are present. Potential impacts of these fish are unknown, but they probably do not survive through the summer to spawn in the lower river tributaries near their release sites due to a lack of adult holding habitat in the lower Columbia River watershed. They have not been found to stray into other areas.

2.6 Coastal Cutthroat

2.6.1 Life History

Coastal cutthroat trout exhibit diverse patterns in life history and migration behaviors. Populations of coastal cutthroat trout show marked differences in their preferred rearing environments (river, lake, estuary, or ocean); size and age at migration; timing of migrations; age at maturity; and frequency of repeat spawning. Anadromous or sea-run populations migrate to the ocean (or estuary) for usually less than a year before returning to freshwater. Anadromous cutthroat trout either spawn during the first winter or spring after their return or undergo a second ocean migration before maturing and spawning in freshwater. Anadromous cutthroat are present in most coastal rivers. Nonmigratory (resident) forms of coastal cutthroat trout occur in small headwater streams and exhibit little instream movement. They generally are smaller, become sexually mature at a younger age, and may have a shorter life span than many migratory cutthroat trout populations. Resident cutthroat trout populations are often isolated and restricted above waterfall barriers, but may also coexist with other life history types.

2.6.2 Listing Status

Cutthroat trout were proposed for listing as a threatened species on April 5, 1999. The ESU includes populations of coastal cutthroat trout in the Columbia River and its tributaries downstream from the Klickitat River in Washington and Fifteenmile Creek in Oregon (inclusive) and the Willamette River and its tributaries downstream from Willamette Falls. The ESU also includes coastal cutthroat trout populations in Washington coastal drainages from the Columbia River to Grays Harbor (inclusive). Major river watersheds containing spawning and rearing habitat for this ESU comprise approximately 12,136 square miles in Oregon and Washington. The following counties lie partially or wholly within these watersheds: Oregon - Clackamas, Clatsop, Columbia, Hood River, Marion, Multnomah, Wasco, and Washington; Washington - Clark, Cowlitz, Grays Harbor, Jefferson, Klickitat, Lewis, Mason, Pacific, Skamania, Thurston, Wahkiakum, and Yakima (Source: *http://www.nwr.noaa.gov/1salmon/salmesa/inde3.htm*).

2.6.3 Population Status

The abundance of sea-run cutthroat trout in the lower Columbia River watershed appears to have significantly declined in recent years. Although these populations are not routinely monitored, angler surveys conducted in the lower mainstem Columbia during the 1970s typically observed annual catches of up to 5,000 fish. Similar data in the late 1980s estimate the annual catch as low as 500 fish. Effective in 1994, all wild cutthroat trout caught by anglers in the Columbia River must be released unharmed.

Systematic abundance estimates also are not available for most resident, fluvial (migrate to spawning tributaries) or adfluvial (migrate between spawning tributaries and lakes) cutthroat populations. However, anecdotal observations indicate that they remain relatively abundant, even in streams where the abundance of sea-run fish has sharply declined. This pattern suggests that anadromous populations are most impacted by problems occurring along migration corridors, in estuaries, or in near-shore marine environments.

2.6.4 Species Distribution

Anadromous cutthroat trout have not been mapped by ODFW. The 1995 biennial report on the status of wild fish (ODFW 1995) reported that anadromous as well as resident cutthroat occur in the Skipanon River.

2.6.5 Hatcheries

The effects of long-term hatchery releases of sea-run cutthroat trout on wild stock abundance in this group is unknown. The hatchery broodstock used in most programs was developed from the wild population in Big Creek on the lower Columbia River. Legal size hatchery releases that were annually made into the Lewis and Clark River (10,000–15,000) were discontinued in 1990, and annual releases into the Klaskanine River (5,000), Big Creek (5,000), Gnat Creek (3,000), and Scappoose Creek (4,000) were discontinued after 1993. Starting in 1994, remaining lower Columbia River cutthroat trout releases have been switched to standing water bodies. Between March and May of 1995, Coffenbury Lake received 3,000 cutthroat and Cullaby Lake received 6,000 cutthroat.

2.6.6 Species Interactions

Cutthroat trout populations with different life history patterns may be sympatric (able to exchange genetic information) in the same river. The level of genetic exchange between cutthroat trout of different life history types, for example, between sea-run and resident forms, is poorly understood. A single population may be polymorphic for several life histories; or the life histories may form separate breeding populations through assortative mating, but still exchange low levels of gene flow; or the life history types may form completely reproductively isolated gene pools. Extensive genetic and life history surveys will be needed to clarify these relationships.

2.7 Steelhead

2.7.1 Life History

Most coastal steelhead in Oregon are winter-run fish, and summer steelhead are present only in a few large watersheds. The subspecies (*Oncorhynchus mykiss irideus*) includes a resident phenotype (rainbow trout) and an anadromous phenotype (coastal steelhead). The steelhead express a further array of life histories including various freshwater and saltwater rearing strategies and various adult spawning migration strategies. Juvenile steelhead may rear one to four years in freshwater prior to their first migration to saltwater. Saltwater residency may last one to three years. Adult steelhead may enter freshwater on spawning migrations year round if habitat is available for them, but generally spawn in the winter and spring. Adults that enter between November and April are called "winter-run" fish. These fish are more sexually mature upon freshwater entry and hold for a shorter time prior to spawning. Rainbow trout are thought to spawn at three to five years of age, generally in the winter or spring, although some populations vary from this pattern. Both rainbow and steelhead may spawn more than once. Steelhead return to salt water between spawning runs.

2.7.2 Listing Status

On March 19, 1998, NMFS determined that listing was not warranted for the Oregon Coast 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 sq. mi. in Oregon. The following counties lie partially or wholly within these basins: Benton, Clatsop, Columbia, Coos, Curry, Douglas, Jackson, Josephine, Lane, Lincoln, Polk, Tillamook, Washington, and Yamhill (Source: *http://www.nwr.noaa.gov/1salmon/salmesa/index.htm*).

2.7.3 Population Status

Most of the winter steelhead populations in the lower Columbia River watershed are small. Observations of sport catch in the Lewis & Clark River, and the South Fork Klaskanine River indicate these populations have more than 300 adults each; however, no comprehensive populations surveys have been done.

2.7.4 Species Distribution

ODFW mapped current steelhead distribution by attributing 1:100,000 stream coverages based on survey data and best professional judgment of local fish biologists. Distributions identified spawning, rearing and migration areas. These coverages are dynamic data sets that are scheduled to be updated every two years. These data are available on ODFW's website (*ftp://ftp.dfw.state.or.us/pub/gis*). According to these data, no winter or summer steelhead reside in the Skipanon River watershed. However, spawning surveys conducted in Cullaby Creek by ODFW in 1991 and 1992 identified steelhead in Cullaby Creek suggesting steelhead are using Cullaby Creek for both spawning and rearing. Steelhead that may be present in the Skipanon River watershed are strays from hatchery programs adjacent to the watershed or from the Warrenton High School hatchery program.

2.7.5 Hatcheries

Most of the lower Columbia River watershed steelhead populations have been planted with a winter steelhead broodstock founded from Big Creek in the lower Columbia River watershed. Releases of Big Creek stock have been discontinued in the Lewis & Clark, South Fork

Klaskanine, and Hood Rivers, effective in 1993. There were not any records found of releases of steelhead in the Skipanon River watershed. However, it was suggested that adult hatchery winter steelhead (Big Creek stock) were released in the Skipanon River in the last two years (Walt Weber pers.comm.).

2.8 Conclusions

The National Marine Fisheries Service has listed several anadromous fish species that exist, or could potentially exist, in the watershed as threatened. Chinook was listed as threatened and steelhead was listed as a candidate by NMFS. Coho has been listed as a candidate for listing while coastal cutthroat is proposed to be listed as threatened.

Fisheries in the Skipanon River watershed lack self-sustaining anadromous fish populations. Native coho and chinook have been eliminated (if there ever were any). Sea-run cutthroat trout appears to be at very low levels. Native winter steelhead is present in fair numbers only in the Lewis & Clark River (Youngs Bay watershed). Consequently, even if significant improvements were made in habitat and ocean conditions, anadromous fish levels in the Skipanon River watershed would most likely remain low (Walt Weber pers. comm.). To improve fisheries in the Skipanon River watershed, it is imperative that brood stock development programs be developed that provide fish stocks capable of using improved habitats to become self-sustaining populations. Possible brood stock sources include late spawning Cowlitz River hatchery coho, Washington lower Columbia River chum, Lewis & Clark River winter steelhead, and Clatskanie River or Lewis & Clark River sea-run cutthroat trout. The above list is not all inclusive, and establishment of these broodstocks must take into account current local terminal fishery programs and local gill-net fisheries. Potential issues include over-harvest of developing broodstocks, competition, predation, and attraction of avian predators.

CHAPTER 3 AQUATIC AND RIPARIAN HABITATS

3.1 Introduction

Distribution and abundance of salmonids within a given watershed varies with habitat conditions such as substrate and pool frequency, as well as biological factors such as food distribution (i.e. insects and algae). In addition, salmonids have complex life histories and use different areas of a watershed during different parts of their life cycle. For example, salmonids need gravel substrates for spawning but may move to different stream segments during rearing. The interactions of these factors in space and time make it difficult to determine specific factors affecting salmonid populations. Consequently, entire watersheds, not just individual components, must be managed to maintain fish habitats (Garano and Brophy 1999).

Understanding the spatial and temporal distribution of key aquatic habitat components is the first step in learning to maintain conditions suitable to sustain salmonid populations. These components must then be linked to larger scale watershed processes that may control them. For example, a stream that lacks sufficient large woody debris (LWD) often has poor LWD recruitment potential in the riparian areas of that stream. By identifying this link, riparian areas can be managed to include more conifers to increase LWD recruitment potential. Also, high stream temperatures can often be linked to lack of shade as a result of poorly vegetated riparian areas. By linking actual conditions to current watershed-level processes, land mangers can better understand how to manage the resources to maintain these key aquatic habitat components.

3.2 Aquatic Habitat Inventory Data

To assess current habitat conditions within a watershed we can use fish habitat survey data collected according to the ODFW protocol (Moore et al. 1997). There is no stream survey data available for the Skipanon River watershed. However, we have included a discussion of habitat survey data for future reference. Stream survey data are like a snapshot in time of current stream conditions. Streams are dynamic systems and channel conditions may change drastically from year to year, depending on environmental conditions. Nevertheless, these data are useful in describing trends in habitat conditions that may be linked to larger watershed processes. Through understanding these habitat distribution patterns, land managers can identify and address problem areas or processes.

ODFW has established statewide benchmark values as guidelines for an initial evaluation of habitat quality (Table 3.1). 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, and can help to identify patterns in habitat features that can lead to a better understanding of the effects of watershed processes on the current conditions of the stream channel.

Table 3.1. ODFW Aquatic Inventory and Analysis 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 (meters)		
Low Gradient (slope<3%)or small (<7m width)	<0.2	>0.5
High Gradient (slope >3%) or large (>7m width)	<0.5	>1
Riffles		
Gravel (percent area)	<15	>35
Large Woody Debris		
Pieces (per 100m)	<10	>20
Volume (m^3 per 100m)	<20	>30
"Key" Pieces (>60cm dia. & >10cm long per 100m)	<1	>3
Shade (reach average %)		
Stream Width <12 m	<60	>70
Stream Width >12 m	<50	>60
Riparian Conifers (30 m from both sides)		
Number > 20-in dbh/1,000-ft stream length)	<150	>300
Number > 35-in dbh/1,000-ft stream length)	<75	>200

3.3 Riparian Conditions

The riparian zone is the area along streams, rivers and other water bodies where there is direct interaction between the aquatic and terrestrial ecosystems. The riparian zone ecosystem is one of the most highly valued and highly threatened in the United States (Johnson and McCormick 1979, National Research Council 1995 in Kauffman et al. 1997). 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 and large woody debris to increase aquatic habitat diversity, filters surface runoff to reduce the amount of sediments and pollutants that enter the stream, provides wildlife habitat, dissipates flow of energy, and stores water during floods (Bischoff 2000). Natural and human degradation of riparian zones diminishes their ability to provide these critical ecosystem functions.

The Clatsop County GIS office provided digital orthophotos taken in 1994 for all of Clatsop County. The riparian assessment was performed using ArcInfo software. A stream channel data layer was overlayed on the orthophotos and a buffer was drawn on each side of the streams. The vegetation composition and continuity were assessed within this buffer.

The riparian assessment used two buffer widths for the evaluation of streamside vegetation. These two widths (RA1 and RA2) were based on ecoregion and side slope constraint and represent the area most likely to deliver large woody debris into the stream channel. The RA2 width was always 100 feet. RA1 widths are shown in Table 3.2.

Table 3.2 RA1 widths based on channel constrainment and ecoregion.

	RA1 Width (ft)		
Constraint	Coastal Lowlands	Coastal Uplands	Willapa Hills
Unconstrained	25	75	75
Moderately Constrained	25	50	50
Constrained	25	25	25

3.3.1 Large Woody Debris Recruitment Potential

The riparian zone is the primary source of natural large woody debris (LWD). Large woody debris is an important feature that adds to the complexity of the stream channel. Instream LWD provides important fish habitat features such as cover, production and maintenance of pool habitat, creation of surface turbulence, and retention of 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 habitat for aquatic organisms (Bischoff 2000, BLM 1996). LWD is most abundant in intermediate-sized channels in third- and fourth-order streams. In fifth-order and larger streams, the channel width is generally wider than 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.

Riparian vegetation was categorized as having a high, moderate, and low recruitment large woody debris recruitment potential. A high potential for LWD recruitment was those vegetation classes defined as coniferous or mixed in the large class (>24 inch dbh). Moderate potential for

LWD recruitment was defined as coniferous or mixed in the medium size class (12-24 inch dbh) and hardwoods in the medium to large class.

None of the riparian areas in the Skipanon River watershed demonstrated an adequate potential to contribute LWD to the stream channel (Table 3.3). Wetlands are a dominant landscape feature in the Skipanon River watershed. Riparian areas in the watershed are typically characterized by riparian wetlands accounting for 20 to 42 percent of the riparian areas (Figure 3.1). Although wetlands may or may not contribute LWD to the stream channel depending on the wetland type, they do provide several important habitat features such as back channels and cover. Many of these wetlands are diked and disconnected from the stream limiting access to this habitat. Wetland features in the Skipanon River watershed may have historically been a more important feature than LWD. Diking and wetlands is further discussed below in the wetland section (Section 3.6).

Table 3.3. Potential wood recruitment in the Skipanon River watershed, based on aerial photo interpretation conducted by E&S.

Subwatershed	Total Stream Miles	Inadequate (%)	Moderate (%)	Adequate (%)	Estuarine Wetlands (%)	Palustrine Wetlands (%)	Grasslands (%)
Neacoxie Creek	7	10.3	15.1	0.0	9.08	42.27	23
Skipanon River	22	57.3	17.2	0.0	0.31	20.74	4
Total	30	45.8	16.7	-	2.46	26	9.0

3.3.2 Stream Shading

Riparian vegetation also provides shade that helps control stream temperature in the warm summer months. While shade will not actually cool a stream, riparian vegetation blocks solar radiation before it reaches the stream preventing the stream from heating (Bischoff 2000, Beschta 1997, Boyd and Sturdevant 1997, Beschta et al. 1987). The shading ability of the riparian zone is determined by the quality and quantity of vegetation present. The wider the riparian zone and the taller and more dense the vegetation, the better the shading ability (Beschta 1997, Boyd and Sturdevant 1997).

Stream shading in the Skipanon River watershed was generally low (16 percent) to moderate (32 percent; Table 3.4). Stream reaches that demonstrated high stream shading were generally in the higher elevations of the watershed (Figure 3.2). Both subwatersheds had large

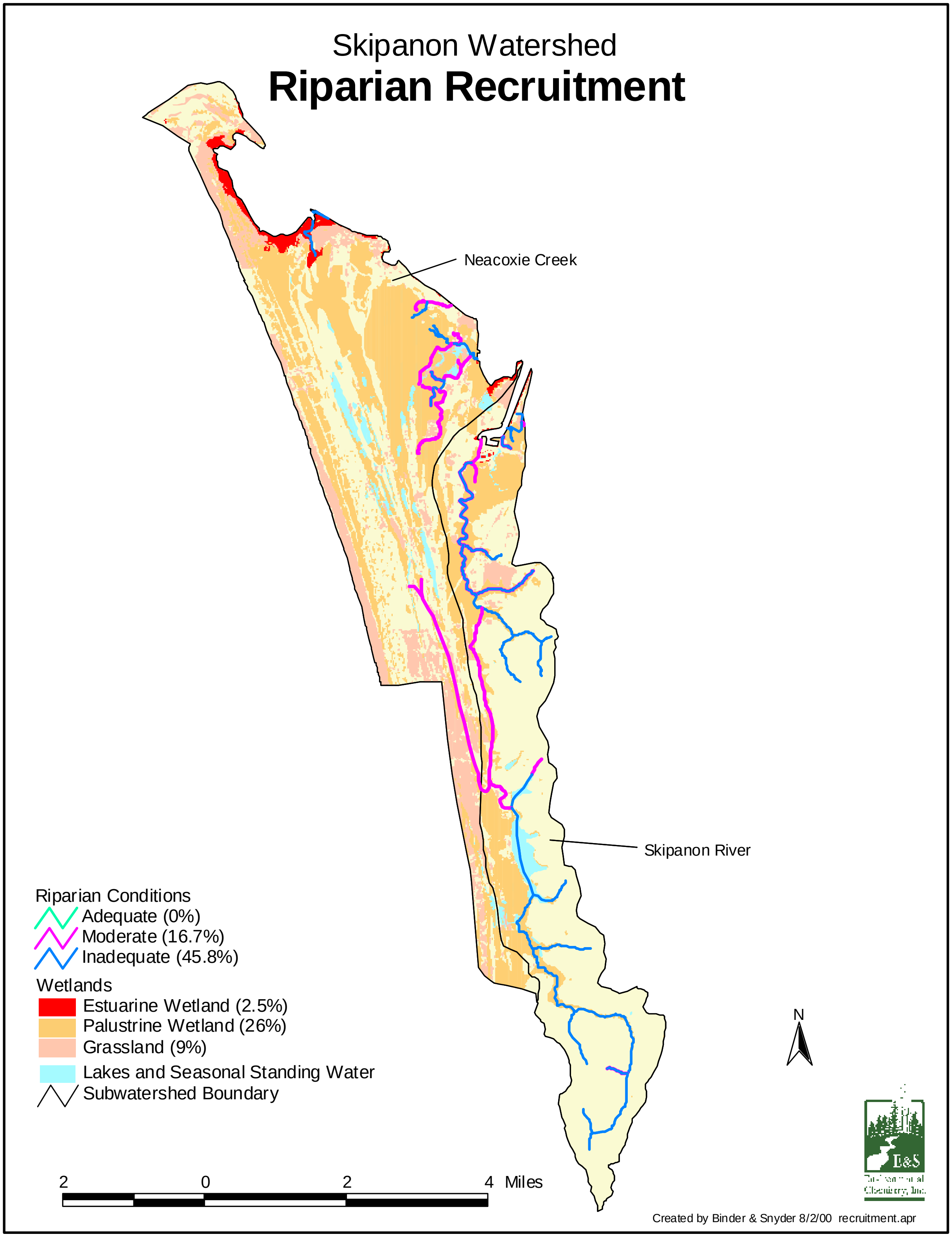

Figure 3.1. Large woody debris recruitment potential in the Skipanon River watershed. Data were developed from aerial photo interpretation conducted by E&S Environmental Chemistry, Inc. Photos used were black and white and taken in 1994.

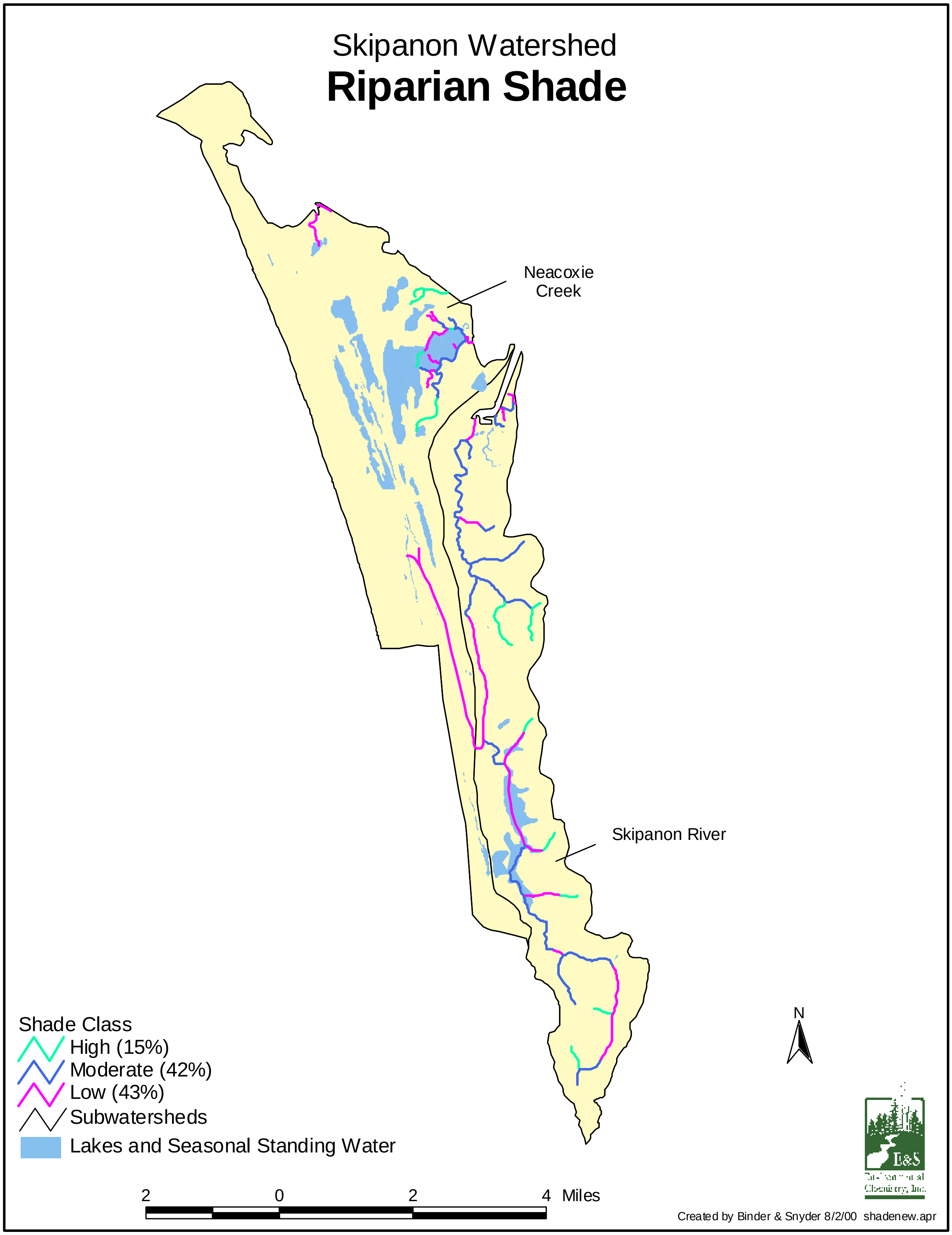

Figure 3.2. Riparian shade conditions in the Skipanon River watershed. Data were developed from aerial photo interpretation conducted by E&S Environmental Chemistry, Inc. Photos used were black and white and taken in 1994.

Table 3.4. Stream shading conditions in the Skipanon River watershed, based on aerial photo interpretation conducted by E&S.

	Total Stream Miles	% Low	% Medium	% High	Estuarine Wetlands (%)	Palustrine Wetlands (%)	Grasslands (%)
Neacoxie Creek	7	8	6	11	9.08	42.3	23
Skipanon River	22	18	40	16	0.31	20.7	4
Total	30	16	32	15	2.46	26	9

proportions of wetlands in the riparian areas, ranging from 20 to 42 percent. Wetlands can provide shade from vegetation, although many of these wetlands are diked and disconnected from the stream as a result of development and agriculture. Shading values of wetlands need to be evaluated on a wetland by wetland basis.

3.4 Fish Passage Barriers

Stream channels are often blocked by poorly designed road culverts at stream/road crossings which has resulted significant losses of fish habitat. Anadromous fish migrate upstream and downstream in search of food, habitat, shelter, spawning beds, and better water quality. Fish populations can be significantly limited by losing access to key habitat areas. One study estimated the loss of fish habitat from forest roads to be 13 percent of total coho summer rearing habitat (Beechie et al. 1994). Another study reported as many as 75 percent of culverts in given forested drainages are either outright blockages or impediments to fish passage based on surveys completed in Washington State (Conroy 1997). Surveys of county and state roads in Oregon have found hundreds of culverts that at least partially block fish passage. Potential effects from the loss of fish passage include loss of genetic diversity by isolation of reaches, loss of range for juvenile anadromous and resident fish and loss of resident fish from extreme flood or drought events (prevents return).

3.4.1 Culverts

Culverts can pose several types of problems including height, excessive water velocity, insufficient water depth in culvert, disorienting flow patterns and lack of resting pools between culverts. Culverts can also limit fish species during certain parts of their life cycles and not others. For example, a culvert may be passable to larger adult anadromous fish and not juveniles. Culverts may also only act as passage barriers during particular environmental conditions such as high flow events. It is for these reasons that we need to understand when key species are migrating.

There are 48 stream/road crossings in the Skipanon River watershed (Table 3.5). ODFW conducted a survey of culverts for state and county roads. Of the six culverts surveyed by ODFW, only two did not meet standards, suggesting that they block access to upstream habitat areas. Neither of these two culverts occurred on the mainstem Skipanon River (Figure 3.3). Culverts blocking access to critical fish habitat areas need to be upgraded to improve fish passage.

Table 3.5. Culverts and stream/road crossings in the Skipanon River watershed. Road/stream crossings were generated using GIS. Culvert data were provided by ODFW.

Subwatershed	Area (mi^2)	Surveyed Culverts*		Road-Stream Crossings	
		# Surveyed	# impassable	(#)	(#/mi^2)
Neacoxie Creek	16	3	1	15	0.9
Skipanon River	12	3	1	33	2.7

3.4.2 Tidegates

A tidegate survey was conducted in the summer and fall of 1999 by the Skipanon River Watershed Council, led by Lisa Heigh (Figure 3.3; Appendix C). Of the 23 tidegates surveyed, six were considered to be in need of repair. Three tidegates at the 8th street structure need to be further evaluated for impacts on water quality and fish passage. Tidegates that are not specifically designed to be "fish-friendly" can act as fish passage barriers. Many of the current tidegates are old iron doors that no longer work properly. Tidegates that control flow from fish bearing streams or sloughs need to be evaluated or replaced with "fish friendly" designs.

3.4.3 Other Barriers

There are three known possible fish passage barriers on the Skipanon River: the 8th Street structure, the Plyter Dam, and the Cullaby Lake Dam (Figure 3.3). Coho are found above these

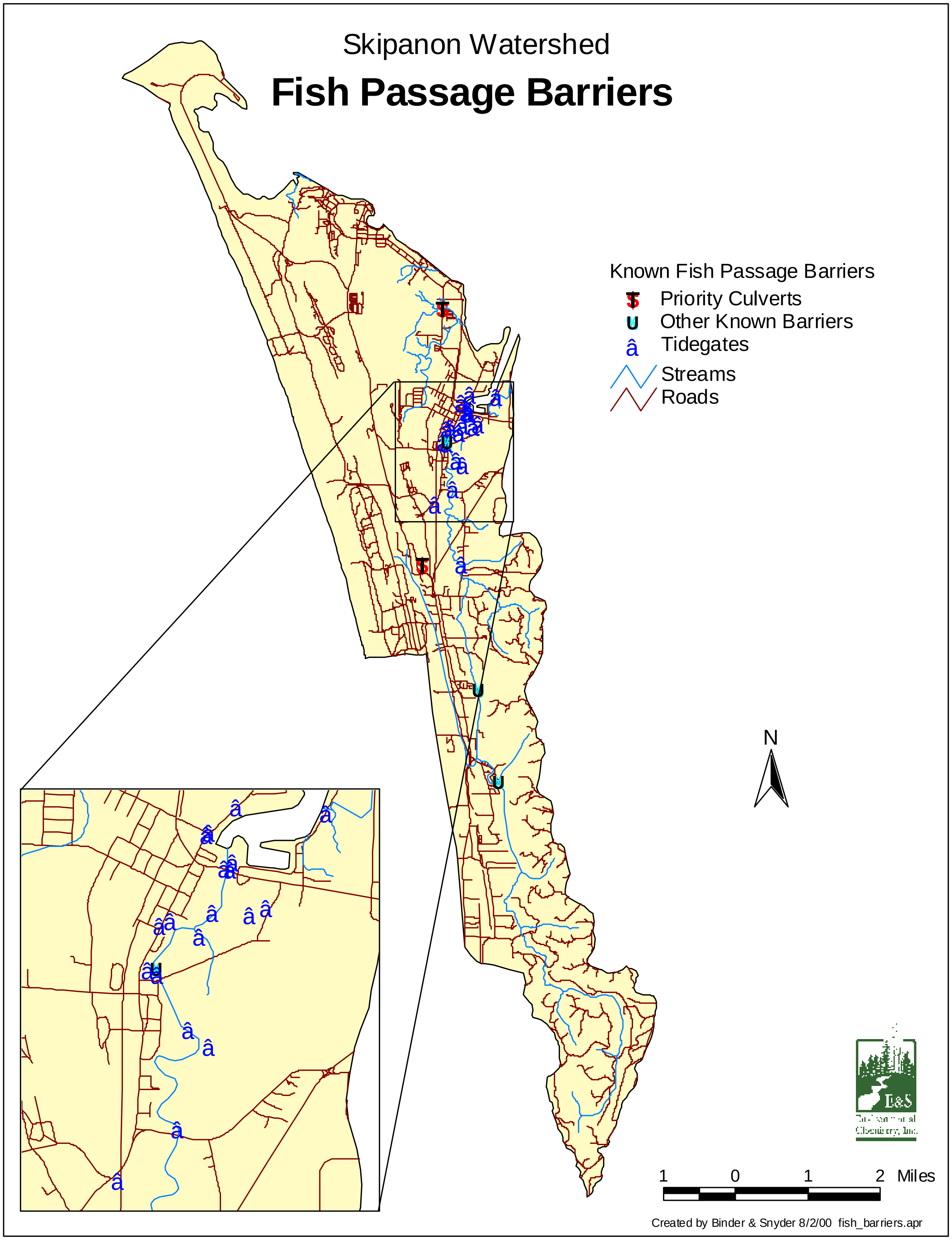

Figure 3.3. Road/stream crossings and known fish passage barriers in the Skipanon River watershed. Road/stream crossings were generated using GIS. Culvert data were provided by ODFW.

barriers. Consequently, these potential barriers need to be further evaluated for their effects on fish movement in the watershed.

3.5 Channel Modifications

In-channel structures and activities such as dams, dredging or filling can adversely affect aquatic organisms and their associated habitats by changing the physical character of the stream. These changes can ultimately lead to a change in the community composition of instream aquatic biota. Identifying channel modification activities can address how human-created channel disturbances affect channel morphology, aquatic habitat, and hydrologic functioning.

3.5.1 Channelization and Dredging

In 1931, the Skipanon River channel was dredged from the mouth to 4,500 ft above the railroad bridge at Warrenton (Swan Wooster Engineering 1969). Between 1934 and 1950, the channel was continually dredged to maintain this channel. No maintenance occurred from 1951 to 1961. In 1962, the channel was again cleared by removing logs and debris and then maintained through 1968. In 1999, 180,000 cubic yards of material were dredged out of the lower Skipanon River. The only known Dredged Material Disposal Site for Columbia River dredged material is located on the spit between Youngs Bay and the entrance to the Skipanon River (ACOE 1999).

3.5.2 Diking

Disconnecting the floodplain from the stream can lead to stream simplification and downcutting due to increased water velocities, resulting in deteriorated habitat conditions. Additionally, disconnection from the floodplain can lead to changes in the biotic structure of the stream by limiting nutrient and organic material exchanges between the stream and floodplain.

Except for the sand ridges of the Clatsop Plains, the land area of Warrenton was originally all wetlands. Diking in the Skipanon River began as early as 1860 at the mouth and east side of the river. Early on, city dike superintendents were responsible for maintenance of the dikes. Plans were approved in 1939 by the U.S. Army Corps of Engineers to go over the dikes in each of the districts, widening and adding height and distance in locations where the dikes had washed out. Between 1917 and 1939, extensive diking occurred in the Skipanon River, with dredge spoil disposal along the mouth. By 1950 dikes ringed the lowlands of the Skipanon (Figure 3.4).

Pile dikes are also found along the south jetty of the Clatsop Spit as well as in Youngs Bay. These pilings indicate that tugs and log booms have operated on these rivers almost to the present day tide head. The tide head for the Skipanon River is at river mile 4.3.

3.5.3 Log Storage

Historically, log storage was a common occurrence in the Columbia Estuary. Youngs Bay was historically used for in-water log handling and storage since it was protected from wind and waves (Envirosphere Company 1981). Logs were stored in the backwater areas and sloughs and extended up into the Youngs River and Lewis and Clark arms of Youngs Bay. Log storage can lead to losses of benthic habitats due to physical destruction as a result of log grounding and water quality degradation as a result of log leachate and debris.

3.5.4 Splash Damming

No reports of splash damming in the Skipanon River watershed were found.

3.5.5 Railroads

Railroads were used extensively throughout Clatsop County, to move logged timber to processing centers. Many of these railroads would follow the rivers and streams. Consequently, construction of the railroads led to dikes, bridges and other channel modifications that have impacted the habitats of the Skipanon River. More detailed information on the railroads in Clatsop County can be found in Appendix A.

3.6 Wetlands

Wetlands contribute critical functions to a watersheds health such as water quality improvement, flood attenuation, groundwater recharge and discharge, and fish and wildlife habitat. Because of the importance of these functions, wetlands are regulated by both State and Federal agencies. Determining the location and extent of wetlands within a watershed is critical to understanding watershed processes.

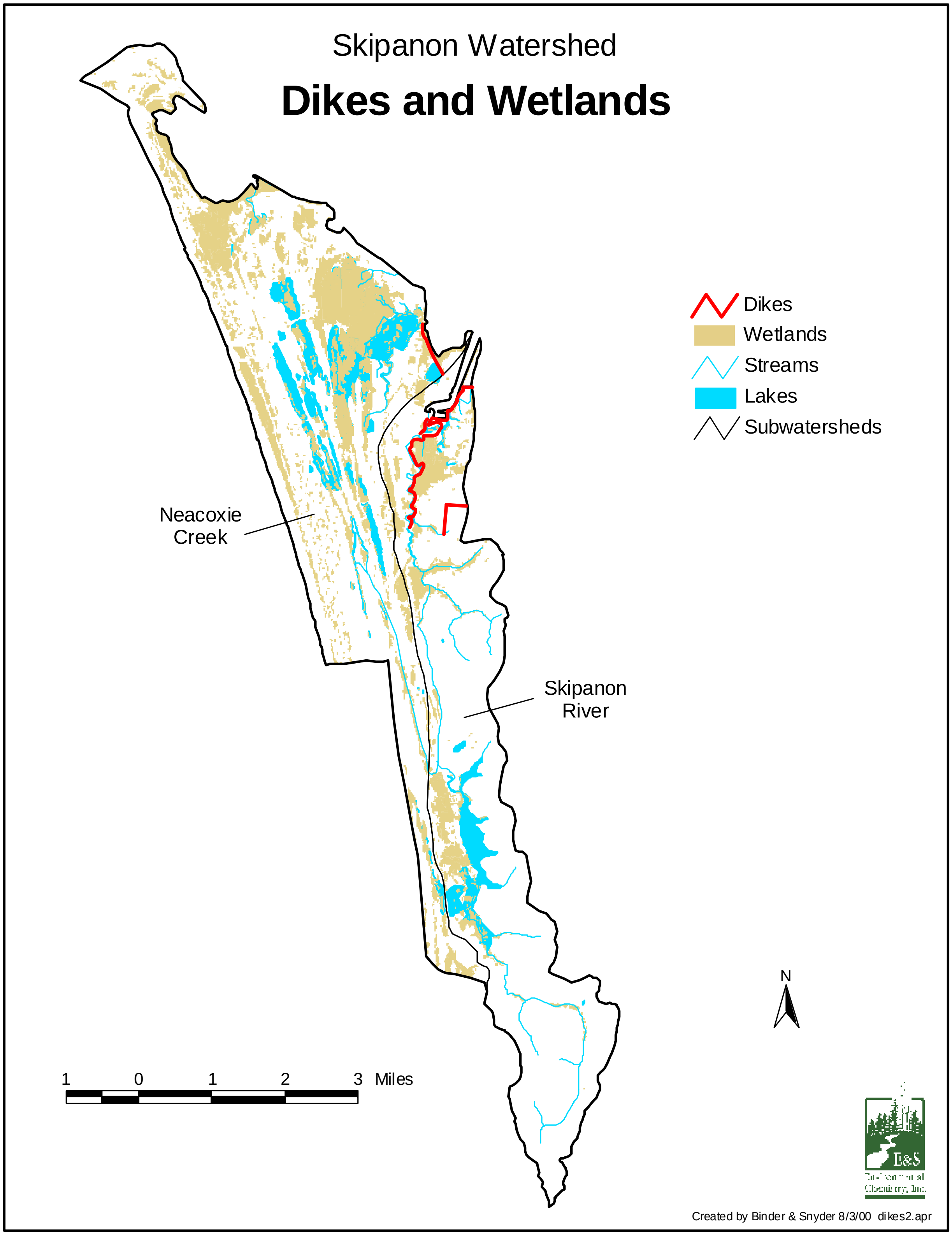

Figure 3.4. Location of dikes and wetlands in the Skipanon River watershed. Dike data were provided by the Army Corps of Engineers.

3.6.1 National Wetlands Inventory

The primary source for wetland information used in this assessment was National Wetlands Inventory maps created by the U.S. Fish and Wildlife Service. Almost all of the NWI quads were digitized for the Skipanon River watershed. NWI Maps were created from interpretation of 1:58,000-scale aerial photos that were taken in August of 1981. It is important to note that NWI wetland maps are based on aerial photo interpretation and not on ground-based inventories of wetlands. On-the-ground inventories of wetlands often identify extensive wetlands that are not on the NWI maps. A Local Wetlands Inventory (LWI) has been completed for the city of Warrenton.

3.6.2 Wetland Extent and Types

Wetland extent was calculated from the refined land use coverage generated as a part of this study. Digital NWI data were used to update the refined land use map. Wetlands are a dominant landscape feature in the Skipanon River watershed, representing a little more than 20 percent of the total watershed area (Table 3.6; Figure 3.5). The predominant wetland type is palustrine wetlands. Palustrine wetlands are 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 0.5 parts per thousand (Mitsch and Gosselink 1993, Cowardin et al. 1979). Estuarine wetlands represent less than 2 percent of the watershed and are located along the shores of the Clatsop Spit and are a part of the Neacoxie Creek subwatershed. Estuarine wetlands are defined as deepwater tidal habitats and adjacent tidal wetlands that are usually semiclosed 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 Gosselink 1993, Cowardin et al. 1979).

Table 3.6. Wetland area in the Skipanon River watershed. Wetland area was calculated from the refined land use cover (see Chapter 1).

Subwatershed	Grand Total mi^2	Estuarine Wetland %	Palustrine Wetland %
Neacoxie Creek	15.9	2.49	24.76
Skipanon River	12.3	0.12	10.73
Total	28.2	1.46	18.65

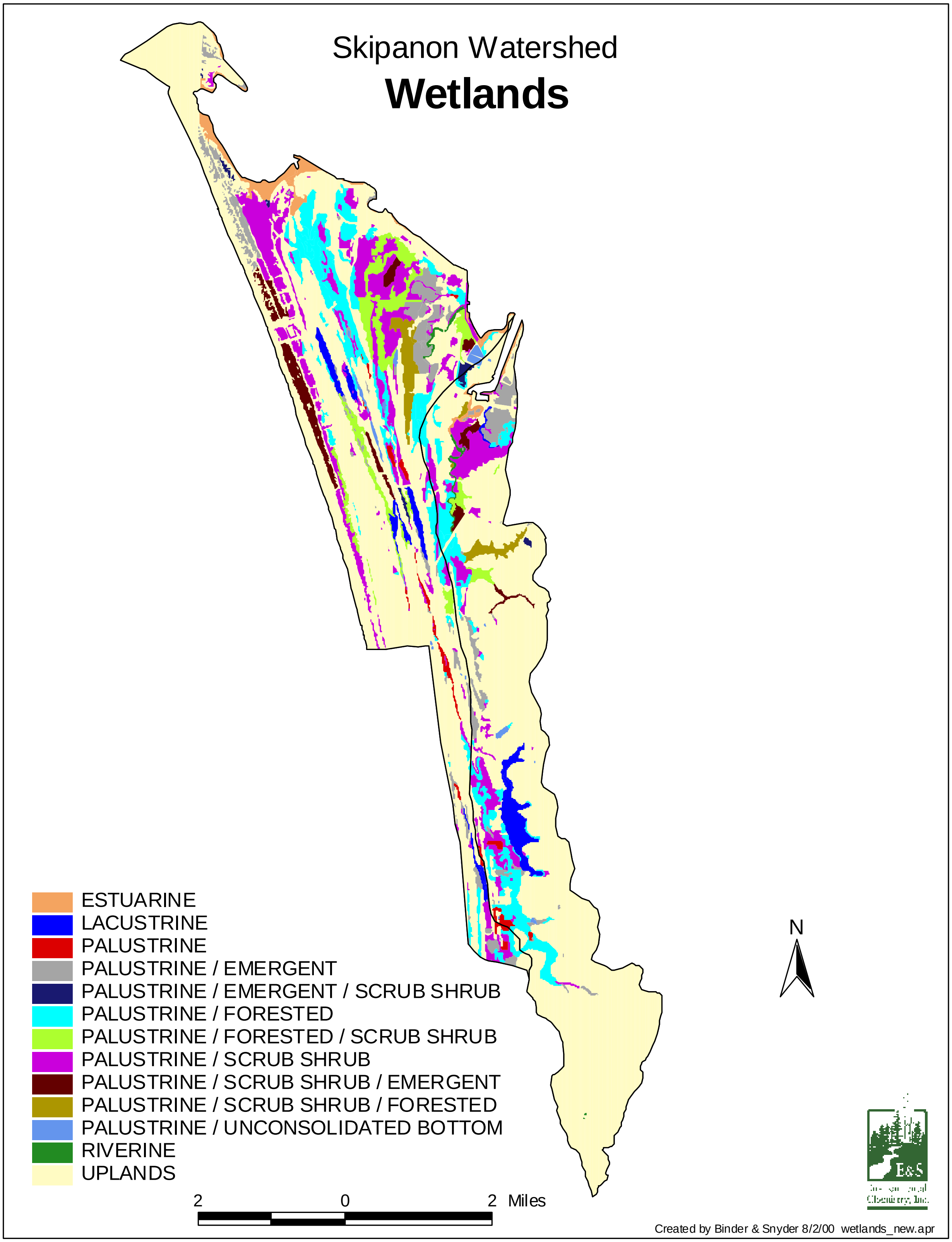

Figure 3.5. Wetlands and streams in the Skipanon River watershed. Data shown are from the refined land use coverage (see Chapter 1).

The Cowardin classification system is used by the NWI and others in classifying wetlands based on wetland type, vegetation or substrate 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 Skipanon River watershed are shown in Table 3.7.

Wetland types are dominated by palustrine emergent wetlands generally located in the lower elevations of the watershed. Palustrine wetlands are scattered across the Clatsop Plains and along the lower reaches (below Cullaby Lake) of the Skipanon River. Estuarine wetlands are concentrated along the Columbia Estuary side of the Clatsop Spit extending from the mouth of the Skipanon River to the end of the Clatsop Spit. The Swash Lake area is a large tidally influenced wetland, according to the NWI.

3.6.3 Wetlands and Salmonids

Wetlands play an important role in the life cycles of salmonids (Lebovitz 1992, Shreffler et al. 1992, MacDonald et al. 1987, Healey 1982, Simenstad et al. 1982). Estuarine wetlands provide holding and feeding areas for salmon smolts migrating out to the ocean. These estuarine wetlands also provide an acclimation area for smolts while they are adapting to marine environments. Riparian wetlands can reduce sediment loads by slowing down flood water, allowing sediments to fall out of the water column and accumulate (Mitsch and Gosselink 1993). Wetlands also provide cover and a food source in the form of a diverse aquatic invertebrate community. Backwater riparian wetlands also provide cover during high flow events, preventing juvenile salmon from being washed downstream.

Wetlands that intersect streams represent important salmonid habitats (WPN 1999, Lebovitz 1992). Stream lengths that ran through both estuarine and palustrine wetlands were calculated using GIS. Of the 29 mi of streams in the Skipanon River watershed, 7.5 mi (26 percent) passed through or are a part of palustrine and estuarine wetlands (Figure 3.5; Table 3.8). These wetlands are of particular importance to salmonids in that they are connected to streams and are accessible for habitat. However, the current functioning of the wetlands is unclear, i.e., are they modified or disconnected from the stream.

Table 3.7. Common NWI wetland types listed in the Skipanon River watershed.

Code	System	Class	Water Regime
E1UBL	E=estuarine	UB=Unconsolidated Bottom	L= Subtidal
E2EMN	E=estuarine	EM=emergent	N=Regularly Flooded
E2EMP	E=estuarine	EM=emergent	P=Irregularly Flooded
E2USN	E=estuarine	US=Unconsolidated shore	N=Regularly Flooded
E2USP	E=estuarine	US=Unconsolidated shore	P=Irregularly Flooded
PABH	P= palustrine	AB=Aquatic bed	H=Permanently Flooded
PEM/SSC	P= palustrine	EM=emergent SS=Scrub/Shrub	C = Seasonally flooded
PEM/SSF	P= palustrine	EM=emergent SS=Scrub/Shrub	F= Semipermanently flooded
PEM/SSFH	P= palustrine	EM=emergent SS=Scrub/Shrub	F= Semipermanently flooded
PEMA	P= palustrine	EM=emergent	A=Temporarily Flooded
PEMC	P= palustrine	EM=emergent	C = Seasonally flooded
PEMCH	P= palustrine	EM=emergent	C = Seasonally flooded
PEMF	P= palustrine	EM=emergent	F= Semipermanently flooded
PEMFb	P= palustrine	EM=emergent	F= Semipermanently flooded
PEMR	P= palustrine	EM=emergent	R=Seasonal/Tidal
PEMS	P= palustrine	EM=emergent	S=Temporary tidal
PEMV	P= palustrine	EM=emergent	V=Permanent tidal
Pf	P= palustrine		f=Farmed
PFO/SSC	P= palustrine	FO=Forested SS=Scrub/Shrub	C = Seasonally flooded
PFO/SSR	P= palustrine	FO=Forested SS=Scrub/Shrub	R=Seasonal/Tidal
PFOA	P= palustrine	FO=Forested	A=Temporarily Flooded
PFOB	P= palustrine	FO=Forested	B=Saturated
PFOC	P= palustrine	FO=Forested	C = Seasonally flooded
PFOR	P= palustrine	FO=Forested	R=Seasonal/Tidal
PFOS	P= palustrine	FO=Forested	S=Temporary tidal
PSS/EMA	P= palustrine	SS=Scrub/Shrub	A=Temporarily Flooded
PSS/EMC	P= palustrine	SS=Scrub/Shrub	C = Seasonally flooded
PSS/EMR	P= palustrine	SS=Scrub/Shrub	R=Seasonal/Tidal
PSS/FOA	P= palustrine	SS=Scrub/Shrub	A=Temporarily Flooded
PSS/FOC	P= palustrine	SS=Scrub/Shrub	C = Seasonally flooded
PSSA	P= palustrine	SS=Scrub/Shrub	A=Temporarily Flooded
PSSB	P= palustrine	SS=Scrub/Shrub	
PSSC	P= palustrine	SS=Scrub/Shrub	C = Seasonally flooded

Code	System	Class	Water Regime
PSSCb	P= palustrine	SS=Scrub/Shrub	C = Seasonally flooded
PSSF	P= palustrine	SS=Scrub/Shrub	F= Semipermanently flooded
PSSR	P= palustrine	SS=Scrub/Shrub	R=Seasonal/Tidal
PUBF	P= palustrine	UB=Unconsolidated Bottom	F= Semipermanently flooded
PUBFb	P= palustrine	UB=Unconsolidated Bottom	F= Semipermanently flooded b=Beaver
PUBFx	P= palustrine	UB=Unconsolidated Bottom	F= Semipermanently flooded x=Excavated
PUBH	P= palustrine	UB=Unconsolidated Bottom	H=Permanently flooded
PUBHx	P= palustrine	UB=Unconsolidated Bottom	x=Excavated H=Permanently flooded
PUBKHX	P= palustrine	UB=Unconsolidated Bottom	K=artificially flooded x=Excavated
PUBKX	P= palustrine	UB=Unconsolidated Bottom	K=artificially flooded x=Excavated

3.6.4 Filling and Diking of Wetlands

Wetlands have been one of the landscape features most impacted by human disturbances. In the Pacific Northwest, it is estimated that 75 percent of wetlands have been lost to human disturbances (U.S. Fish and Wildlife Service and Canadian Wildlife Service 1990). Somewhere between 50 and 90 percent of tidal marshes in individual Oregon estuaries have been lost, most as a result of agricultural activities (Frenkel and Morlan 1991, Boulé and Bierly 1987). Loss of wetlands connected to the stream system can lead to salmonid habitat loss and loss of flood attenuation.

Table 3.8. Percent stream channel lengths that intersect wetlands in the Skipanon River watershed.

	Total Stream Miles	Estuarine Wetlands (%)	Palustrine Wetlands (%)
Neacoxie Creek	7	9.08	42.27
Skipanon River	22	0.31	20.74
Total	29	2.46	26

Wetlands in the lower elevations of the watershed have been diked and disconnected from the streams (Figure 3.4). Extensive diking has occurred at the mouth of the Skipanon River. Many of these wetlands may have once been tidal estuarine wetlands that were disconnected as a result of draining with tidegates and dike construction. These practices remove the tidal influence, resulting in the loss of saltwater influences and leading to changes in the structure of the wetland.

3.6.5 Wetlands and Future Development

Development is generally restricted to the urban growth boundary which extends around the cities of Astoria and Warrenton. The urban growth boundary encompasses an area of approximately 10 sq. mi. (36 percent of the watershed) in the lower elevations of the watershed. Almost 28 percent of the land within this urban growth boundary is occupied by wetlands according to the land use cover. In fact, this is most likely an under representation of wetland extent in the urban growth boundary, since local wetland inventories tend to identify many more wetlands than are on the NWI maps. Consequently, development has the potential to greatly impact wetlands within the urban growth boundary which may lead to the loss of important wetland functions. Wetlands are regulated so that filling of wetlands must be mitigated by either wetland construction or restoration (some exceptions may occur after evaluation by the Division of State Lands). However, it is unclear whether the mitigation wetland can replace the lost functions of a filled wetland.

3.7 Conclusions

Overall, data were insufficient to evaluate current fish passage problems in the Skipanon River watershed. Only a small number of culverts have been evaluated. There are 48 stream/road crossings in the Skipanon River watershed. ODFW conducted a survey of culverts for state and county roads. Of the six culverts surveyed by ODFW, only two did not meet standards, suggesting that they block access to upstream habitat areas. Neither of these two culverts occurred on the mainstem Skipanon River. Culverts blocking access to critical fish habitat areas need to be upgraded to improve fish passage.

A tidegate survey was conducted in the summer and fall of 1999 by the Skipanon River watershed Council led by Lisa Heigh (Appendix C). Of the 23 tidegates surveyed, six were considered to be in need of repair. Tidegates not fitted with fish passage facilities act as fish passage barriers. Tidegates that control flow from fish bearing streams or sloughs need to be evaluated and removed or replaced with “fish friendly” designs.

There are three possible fish passage barriers on the Skipanon River, the dams at the 8th Street road crossing, the Plyter Dam, and the Cullaby Lake Dam. These possible barriers are all fitted with fish passage facilities but still may represent partial fish passage barriers that need to be further evaluated.

None of the riparian areas in the Skipanon River watershed demonstrated an adequate potential to contribute LWD to the stream channel. Wetlands are a dominant landscape feature in the Skipanon River watershed. Although wetlands may or may not contribute LWD to the stream channel depending on the wetland type, they do provide several important habitat features such as back channels and cover. Many of these wetlands are diked and disconnected from the stream, limiting access to this habitat. Wetland features in the Skipanon River watershed may have historically been a more important feature than LWD.

Stream shading in the Skipanon River watershed was generally low to moderate. Both subwatersheds had large proportions of wetlands in the riparian areas, ranging from 20 to 42 percent. Wetlands can provide shade from vegetation although many of these wetlands are diked and disconnected from the stream. Stream temperatures need to be monitored in these riparian wetlands.

Estuarine wetlands were once common in the Columbia River estuary and the Skipanon River watershed. Many of these wetlands have been diked, disconnecting them from saltwater influences and changing the structure of the wetland. All existing estuarine wetlands currently accessible to salmonids need to be protected or restored. Those wetlands disconnected by dikes and tidegates need to be evaluated for potential restoration.

Palustrine wetlands are a dominant feature in the Skipanon River watershed. Streamside wetlands need to be protected, especially those that are in current salmonid distributions. Streamside wetlands that have been disconnected due to diking need to be evaluated for restoration opportunities. Other wetlands should be protected for their roles in maintaining water quality, flood attenuation, and habitat.

CHAPTER 4 HYDROLOGY

4.1 Introduction

Human activities in a watershed can alter the natural hydrologic cycle, potentially causing changes in water quality and aquatic habitats. These types of changes in the landscape can increase or decrease the volume, size, and timing of runoff events and affect low flows by changing groundwater recharge. Some examples of human activities that can affect watershed hydrology are timber harvesting, urbanization, conversion of forested land to agriculture, and construction of road networks. The focus of the hydrologic analysis component of this assessment is to evaluate the potential impacts from land and water use on the hydrology of the watershed (WPN 1999). It is important to note that this assessment only provides a screening for potential hydrologic impacts based on current land use activities in a watershed. Identifying those activities that are actually affecting the hydrology of the watershed would require a more in-depth analysis and is beyond the scope of this assessment.

4.2 General Watershed Characteristics and Peak Flow Processes

Peak flows occur as water moves from the landscape into surface waters. Peak flows are a natural process in any stream and are characterized by the duration and volume of water during the rise and fall of a hydrograph. The primary peak flow generating process for the Coast Range and its associated ecoregions is rain events. The Coast Range generally develops very little snow pack. Snow pack that does develop in the coastal mountains is only on the highest peaks and is of short duration. Rain-on-snow events are infrequent in the Coast Range although these events have contributed to some of the major floods, including the floods of 1964 and 1996. These large floods are rare events, and it is unlikely that current land use practices have exacerbated the flooding effects from rain-on-snow events. Additionally, none of the subwatersheds have mean elevations above 1,000 ft in the rain-on-snow zone (Table 4.1). This hydrologic analysis focuses on the effects of land use practices on the hydrology of these watersheds, using rain events as the primary hydrologic process.

Table 4.1. Topographic features and precipitation amounts for the Skipanon River watershed, based on GIS calculations. Annual precipitation was estimated from the PRISM model (Daly 1994).

Subwatershed	Subwatershed Area (mi^2)	Mean Elevation (ft)	Minimum Elevation (ft)	Maximum Elevation (ft)	Mean Annual Precipitation (in)
Neacoxie Creek	16	16	0	165	75
Skipanon River	12	85	0	465	77
Total	28	53	0	465	76

4.3 Hydrologic Characterization

There is no continuous discharge data available for the Skipanon River. Some data were available from other studies (NRCS 1999); however these were point data for only a few dates. At least a ten-year period of record is needed for a gage to be considered representative for this screening level assessment (WPN 1999). The Skipanon River is derived mostly from ground water and is fed by the outflow from Cullaby Lake. Measurements made by the U.S. Geological Survey in the late 1960s in September indicated that flow over the spillway at Cullaby Lake was about 0.5 cfs at a time when inflow to Neacoxie Creek was non-existent. Thus, groundwater flow to Cullaby Lake is sufficient to compensate for evaporation from the lake surface and still provide some excess for discharge to the Skipanon River.

Direct precipitation is the primary source of water entering the Clatsop Plains aquifer, although some natural inflow may occur as underflow from the foothills of the Coast Range or in small ephemeral foothill streams that percolate into the ground at the base of the hills. Water leaves the aquifer by discharge to the ocean, either directly as subsurface flow or indirectly as discharge to surface streams, primarily the Skipanon River and Neacoxie Creek.

4.4 Potential Land Use Impacts on Peak Flows

Increased peak flows can have deleterious effects on aquatic habitats by increasing streambank erosion and scouring (ODFW 1997). Furthermore, increased peak flows can cause downcutting of channels, resulting in a disconnection from their floodplain. Once a stream is disconnected from its floodplain, the downcutting can be further exacerbated by increased flow velocities as a result of channelization.

All subwatersheds in this component were screened for potential land use practices that may be influencing the hydrologic process associated with these watersheds (WPN 1999). This screening process only deals with the most significant processes affected by land use (i.e., runoff). There are four potential land use practices that can affect the hydrology of a watershed: forestry, agriculture and rangeland, forest and rural roads, and urban or rural residential development.

4.4.1 Forestry Practices

The forestry portion of this analysis focuses heavily on the effects of forestry practices, such as timber harvest, on the peak flows in a watershed. These effects are generally most noticeable during either spring snowmelt events or rain-on-snow events (WPN 1999, Naiman and Bilby 1998). Since snow accumulation is rare in the Skipanon River watershed, it is unlikely that forest harvest practices are enhancing peak flows as a result of rain-on-snow events. However, because forest harvest practices are common in the watershed, there may be other effects on the watershed's hydrology, such as reductions in evapotranspiration, increased infiltration and subsurface flow, and increased overland flow. These changes may result in modified peak and low flows (Naiman and Bilby 1998).

4.4.2 Agriculture and Rangeland

The largest effect on the hydrology of the Skipanon River watershed from agricultural land use may be the draining and diking of wetlands, since the Skipanon River is generally groundwater dominated and the watershed is approximately 28 percent wetland (Table 4.6). Agricultural land use is concentrated in the floodplains of the Skipanon River. Historically, these floodplains were wetland areas that trapped rich sediments and accumulated plant material, resulting in rich fertile soils. Recognizing the economic value of these soils, these floodplains were drained and diked for agricultural purposes. Disconnecting the floodplain from the rivers can result in the loss of flood attenuation that is naturally provided by the floodplains ability to store and impede peak flows which can result in the downcutting of channels and increased flow velocities. There also may be effects from wetland loss since the Skipanon River is derived mostly from groundwater. Losing wetlands in the Skipanon River watershed may lead to a lower groundwater recharge that is often associated with wetlands. Further analysis is needed to understand the effects of wetland loss on the hydrology of the Skipanon River. Further discussion of disconnection of the floodplain and wetland loss can be found in Chapter 3 (Aquatic and Riparian Habitats).

The tidegates at the 8th street structure may also be affecting the hydrology of the Skipanon River. The tidegates were installed to provide protection from high tides during low and high flow events. In 1999, the NRCS evaluated the effects of these structures on flood flows and determined the structures may be undersized for flood protection (NRCS 1999). However, the NRCS did not evaluate the effects on anadromous fish or water quality and quantity. The tidegates at the 8th street structure need to be evaluated for their effects on water quality and anadromous fish.

4.4.3 Forest and Rural Roads

Road construction associated with timber harvest and rural development has been shown to increase wintertime peak flows of smaller floods in Oregon Coast Range watersheds (Harr 1983; Hicks 1990). This assessment uses a roaded area threshold of 8 percent to screen for potential impacts on peak flows (discharge increase >20 percent; WPN 1999). Watersheds with a greater than 8 percent roaded area are considered to have a high potential hydrologic impact, 4-8 percent has a moderate potential, and less than 4 percent has a low potential.

Forest road densities in the Skipanon River watershed demonstrate a moderate potential for enhancing peak flows (Table 4.2). Approximately half of the Skipanon River watershed is forested with only 19 percent of the watershed being managed for timber harvest. Forest roads may be enhancing peak flows in the Skipanon River watershed.

Table 4.2. Forest road summary for the Skipanon River watershed based on GIS calculations. The roads coverage data used for this analysis were obtained from the BLM (fire roads).

Subwatershed	Subwatershed Area (mi^2)	Area Forested (mi^2)	Forest Roads (mi)	Roaded Area (mi^2)*	Percent Forested Area in Roads	Relative Potential Impact
Neacoxie Creek	16.0	6.3	105	0.49	7.8	moderate
Skipanon River	12.3	9.2	79	0.37	4.0	moderate
Total	28.3	15.6	184	0.86	5.5	moderate

* Width used to calculate roaded area was 25 ft.

Rural areas (defined as agriculture and rural residential areas) in the Skipanon River watershed currently represent only small portions of the watershed (<2 percent; Table 4.3). Although road densities are high, especially in the Neacoxie Creek subwatersheds (10 percent roaded area), it is unclear what effects there may be on peak flows since rural areas occupy such a small proportion of the watershed. Because the Skipanon River and many of its tributaries are heavily influenced by groundwater, there may be potential effects from changes in infiltration.

Table 4.3. Rural road summary for the Skipanon River watershed based on GIS calculations. The roads coverage data used for this analysis were obtained from the BLM (fire roads).

Subwatershed	Subwatershed Area (mi^2)	Rural Area (mi^2)	Rural Roads (mi)	Roaded Area* (mi^2)	Percent Rural Area in Roads	Relative Potential for Peak-Flow Enhancement
Neacoxie Creek	16.0	6.3	105	0.49	7.8	moderate
Skipanon River	12.3	9.2	79	0.37	4.0	moderate
Total	28.3	15.6	184	0.86	5.5	moderate

* Width used to calculate roaded area was 25 ft.

4.4.4 Urban and Rural Residential Areas

One of the primary pressures on the natural resources in the Skipanon River watershed is from increased urban sprawl associated with the growth of the city of Warrenton. Currently, less than one percent of the Skipanon River watershed is developed suggesting, that impervious areas are not affecting peak flows. However, as local populations continue to increase, the amount of development will increase. Current land cover within the urban growth boundary is dominated by wetland and grassland features. Loss of these wetland areas may lead to changes in the hydrology of the watershed by decreasing flood water storage. Wetland loss is further discussed in Chapter 3 (Aquatic and Riparian Habitats).

4.5 Conclusions

Current land use practices in the Skipanon River watershed demonstrate a moderate potential for increasing peak flows as a result of the construction of forest and rural roads and establishment of urban and suburban areas. Urban, suburban, and agricultural development is concentrated in the lower elevations of the watershed. These land management activities often result in the channelization and diking of the rivers for flood protection. By channelizing and disconnecting the rivers from their floodplains, downcutting of the channel can occur, increasing flow velocities and changing peak flows. Current land cover within the urban growth boundary is dominated by wetland and grassland features. Loss of these wetland areas may lead to changes in the hydrology of the watershed by decreasing flood water storage and reducing groundwater recharge. There are several tidegates at the 8^{th} street structure on the Skipanon River that were installed for flood protection. These structures need to be evaluated for their effects on the Skipanon River's hydrology and the resulting changes in water quality and quantity. Additionally, these tidegates need to be evaluated for their effects on local anadromous fish populations. Determining the level of impact from diking, channelization, and wetland loss warrants further investigation.

CHAPTER 5 WATER USE

Under Oregon law, all water is publicly owned. Consequently, withdrawal of water from surface and some groundwater sources requires a permit, with a few exceptions. The Oregon Water Resources Department administers state water law through a permitting process that issues water rights to many private and public users (Bastasch 1998). In Oregon, water rights are issued as a 'first in time; first in right' permit, which means that older water rights have priority over newer rights. Water rights and water use were examined for each of the water availability watersheds (watersheds defined by the Oregon Water Resources Department for the assessment of flow modification).

Water that is withdrawn from the stream has the potential to affect instream habitats by dewatering that stream. Dewatering a stream refers to the permanent removal of water from the stream channel, thus lowering the natural instream flows. For example, a percentage of the water that is removed from the channel for irrigation is permanently lost from that watershed as a result of plant transpiration and evaporation. Instream habitats can be altered as a result of this dewatering. Possible effects of stream dewatering include increased stream temperatures and the creation of fish passage barriers.

Water is appropriated at a rate of withdrawal that is usually measured in cubic feet per second (cfs). For example, a water right for 2 cfs of irrigation allows a farmer to withdraw water from the stream at a rate of 2 cfs. Typically, there are further restrictions put on these water rights, including a maximum withdrawal amount allowed and the months that the water right can be exercised. Identifying all of these limits is a time-consuming and difficult task, which is beyond the scope of this assessment. However, for subwatersheds identified as high priority basins this should be the next step.

5.1 Instream Water Rights

Instream water rights were established by the Oregon Water Resources Department for the protection of fisheries and aquatic life, and pollution abatement; however, many remain junior to most other water rights in these watersheds. There are currently no instream water rights for the Skipanon River or its tributaries.

5.2 Consumptive Water Use

5.2.1 Agriculture

The largest water use in the Skipanon River watershed is for agriculture (Table 5.1). Agricultural uses of water are those uses associated with agricultural practices other than irrigation (see below). Some examples include flood harvesting of cranberries and frost protection. All of these water rights involve water being withdrawn from either Cullaby Creek or Cullaby Lake and are mostly used in cranberry production (Figure 5.1). Two of the largest water rights (15 cfs each from Cullaby Creek) are only allowed for a 30 day period and have a total limit of 5 acre-feet. These water rights are most likely associated with cranberry production as well. The period in which this water is withdrawn needs to be identified to evaluate the possible effects on dewatering the Skipanon River.

5.2.2 Irrigation

The second largest consumptive use in the Skipanon River watershed is for irrigation (Table 5.1). Irrigation is defined as the artificial application of water to crops or plants to promote growth or nourish plants (Bastasch 1998). Irrigation represents less than five percent of the total withdrawals from the Skipanon River. Consequently, it has little affect on the river.

Table 5.1 Water use and storage in the Skipanon River Watershed. Numbers in parentheses are for water storage in acre-feet. Data were obtained from the Oregon Water Resources Department.

Water Availability Basin	Agriculture (cfs)	Irrigation (cfs)	Fish/Wildlife (cfs)	Total Use (cfs)
Skipanon R. @ mouth	42.36	2.15	0.08 (1.00)	44.59

5.3 Non-Consumptive Water Use

5.3.1 Fish and Wildlife

A small amount of water is appropriated for fish and wildlife. The primary use is for aquaculture (STEP hatchery at Warrenton High School) and the water is drawn from the mainstem of the Skipanon River. A second withdrawal is from a runoff reservoir for the protection of wildlife. Neither of these withdrawals have much affect on the Skipanon River.

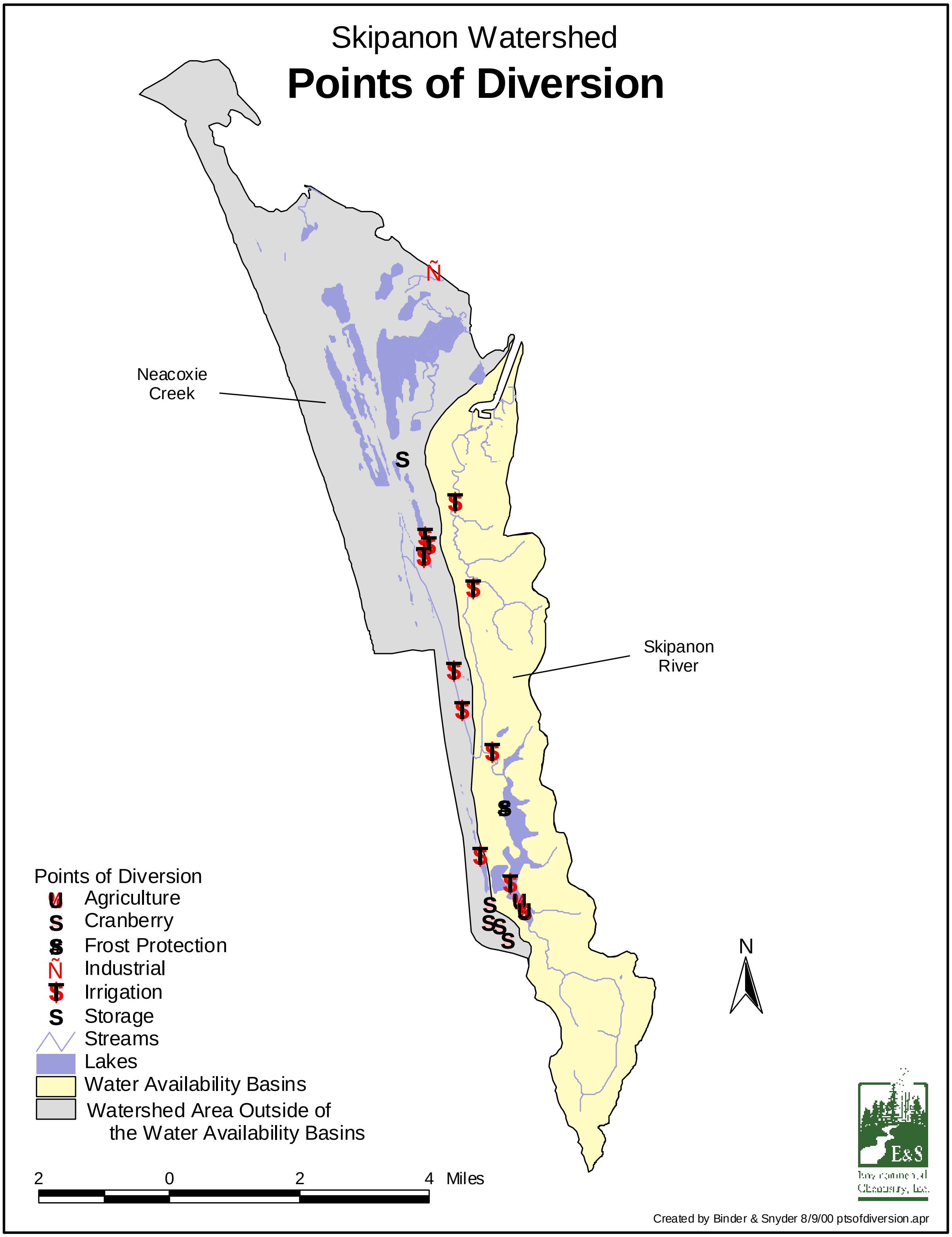

Figure 5.1. Water withdrawals in the Skipanon River watershed. Data were obtained from the Oregon Water Resources Department.

5.4 Water Availability

The dewatering potential in the Skipanon River watershed is low (Table 5.2). However, a low flow problem is considered to exist in the Skipanon River (Michelle Wright pers. comm.). The apparent low flow problem needs to be further evaluated since the data suggest it is not a result of water withdrawals from the Skipanon River. Additionally, water is impounded at Cullaby Lake, which may cause or enhance low flows during the summer months. The primary use of water in the watershed is for agricultural practices most likely associated with cranberry production above Cullaby Lake. Although most of the city of Warrenton lies in the Skipanon River watershed, Warrenton's primary source of water is from the Lewis & Clark River. Warrenton's back-up in the event of water shortage is to pipe water from the city of Seaside. It is predicted that Warrenton will experience a water shortage over the next twenty years. Current options to deal with the potential shortage suggest more efficient use of the current water supply, with additional storage capabilities (CH2M Hill 1997). It is unlikely that the Skipanon River will become a water source for Warrenton in the near future.

Table 5.2 Dewatering potential in the Skipanon River watershed based on a 50 percent exceedence*. The dewatering potential is the percent of instream flows that are appropriated for consumptive use during the low flow months. In some cases water has been over-appropriated, resulting in a percentage greater than 100.

	Dewatering Potential*					Overall Dewatering Potential	
Water Availability Watershed	Jun	Jul	Aug	Sep	Oct	Average Percent Withdrawal	Potential
Skipanon River @ mouth	3.1	10.4	9.4	1.4	0.3	4.92	Low

* A 50% exceedence represents the amount of water than can be expected to be in the channel 50% of the time or one out of every two years.

5.5 Conclusions

Water uses from the Skipanon River appear to have little affect on the current stream flows in the Skipanon River. However, a low flow problem is considered to exist in the Skipanon River (Michelle Wright pers. comm.). The apparent low flow problem needs to be further evaluated since the data suggest it is not a result of water withdrawals from the Skipanon River. Additionally, water is impounded at Cullaby Lake which may cause or enhance low flows during the summer months. There are currently no instream water rights to protect flows for aquatic life or anadromous and resident fish. With the city of Warrenton projected to face a water shortage in the next 20 years, there is potential that the Skipanon River may be viewed in the long-term as a water source to fill these needs. It is important that instream water rights be established to protect the aquatic resources of the Skipanon River.

CHAPTER 6 SEDIMENT SOURCES

6.1 Introduction

Landslides are a natural watershed process in the Oregon Coast Range. However, most experts agree that land use practices have increased landslide frequency and magnitude (WPN 1999; Naiman and Bilby 1998). Separating landslide activity into natural and human-induced events is difficult. It is perhaps even more difficult to identify the amount of sediment that is too much for fish and aquatic organisms. In general, the more a stream deviates from natural sediment levels, the greater the chance for adverse affects on aquatic communities (WPN 1999, Newcombe and MacDonald 1991).

There were several assumptions made about the nature of sediment in this watershed (WPN 1999). First, sediment is a normal and critical component of stream habitat for fish and other aquatic organisms. The more that sediment levels deviate (either up or down) from the natural pattern in a watershed, the more likely it is that aquatic habitat conditions will be altered. Second, human-caused increases in sediment occur at a limited number of locations within the watershed that can be identified by a combination of site characteristics and land use practices. Third, sediment movement is often episodic, with most erosion and downstream soil movement occurring during infrequent and intense runoff events.

Knowledge of current sources of sediment can provide a better understanding of the locations and conditions under which sediment is likely to be contributed in the future. These sources can then be evaluated and prioritized based on their potential affects on fish habitat and water quality to help maintain natural ecosystem functioning.

6.2 Screening for Potential Sediment Sources

Eight potential sediment sources have been identified by OWEB that have significant impacts on watershed conditions (WPN 1999). Not all are present in every watershed, and they vary in influence depending on where and how often they occur. The potential sediment sources include slope instability, road instability, rural road runoff, urban area runoff, crop land, range or pasture lands, burned areas, and other identified sources.

In this watershed, slope instability, road instability, and rural road runoff were determined to be the most significant sediment sources based on the location of the watersheds (Oregon Coast Range) and the local land use. This screening process is outlined in the OWEB watershed assessment manual (WPN 1999). Shallow landslides and deep-seated slumps are common in the

Oregon Coast Range. Streamside landslides and slumps can be major contributors of sediment to streams, and shallow landslides frequently initiate debris flows. Rural roads are a common feature of this watershed. Washouts from rural roads contribute sediment to streams, and sometimes initiate debris flows. The density of rural roads, especially unpaved gravel and dirt roads, indicates a high potential for sediment contribution to the stream network.

Urban runoff and surface erosion from crop and range or pasture lands were not analyzed in this assessment. Agricultural lands account for less than two percent of the watershed and are mostly located in the valley bottoms of the watersheds or floodplains of the Columbia River. Developed lands currently occupy less than five percent of the Skipanon River watershed. There have been no large wildfires in the watershed in the past five years, so burned areas were not a significant sediment source.

6.3 Slope Instability

Slope instability is evaluated by collecting information about recent landslide activity and high risk areas that are likely to be active in the future (WPN 1999). Data on recent landslide activity are relatively scarce and no comprehensive on-the-ground inventories of landslides have been conducted in this watershed. The Department of Geological and Mineral Industries (DOGAMI) has created debris flow hazard maps to characterize the future potential for landslide activity based on watershed features such as slope, soils, and geology.

According to potential debris flow hazard maps created by DOGAMI, only 2.6 percent of the Skipanon River watershed is in the debris flow activity zone (Figure 6.1) and none of the watershed is in the high-risk category (Table 6.1). All of the debris flow risk area is on the steeper portion of the Skipanon River subwatershed.

Table 6.1. Potential debris flow hazard in the Skipanon River watershed (DOGAMI 1999).

Subwatershed	Watershed Area (sq. mi.)	High (%)	Moderate (%)	High + Mod. (%)
Skipanon River	12	-	2.6	2.6
Neacoxie Creek	16	-	-	-
TOTAL	28	0.0	1.1	1.1

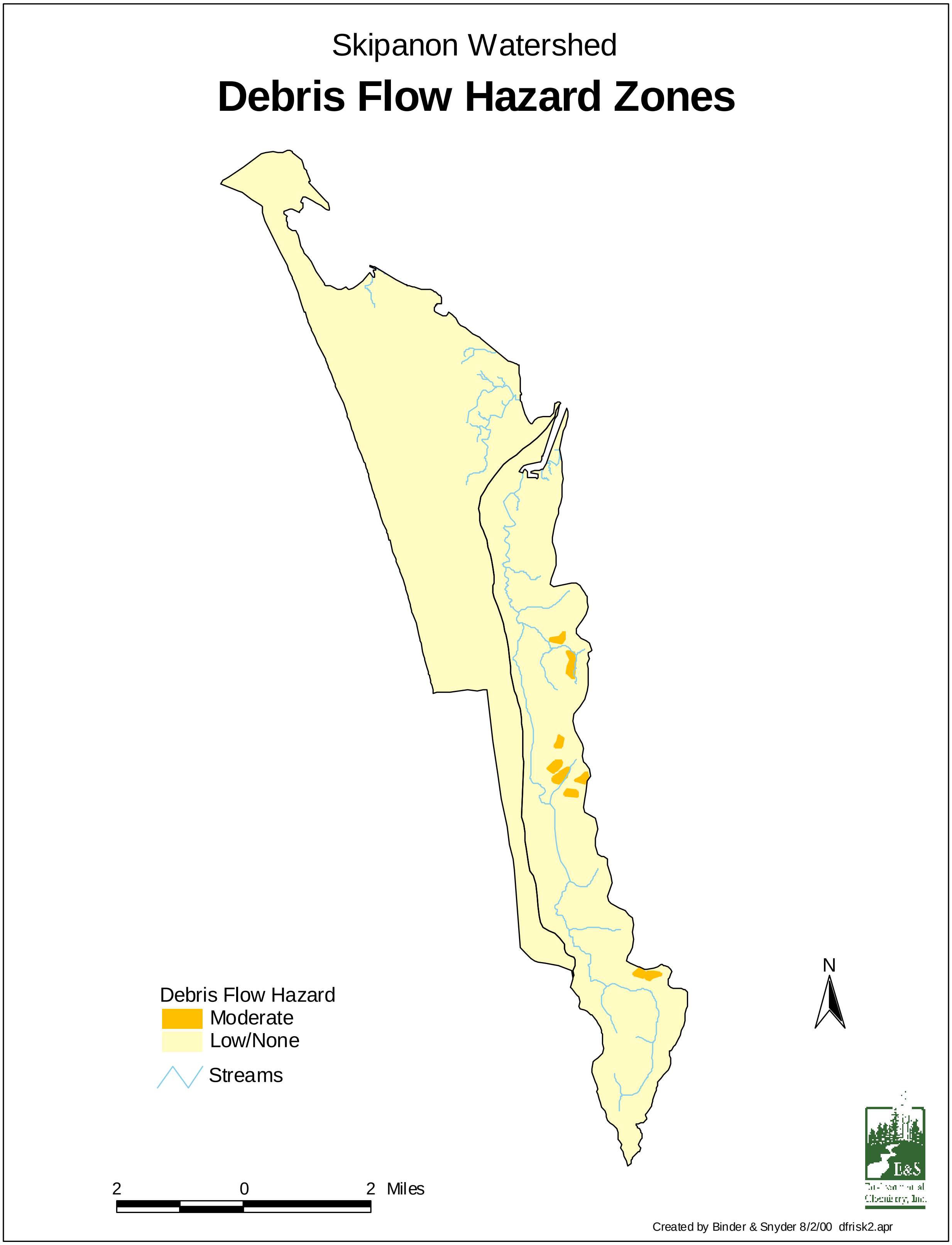

Figure 6.1. Debris flow hazard zones for the Skipanon River watershed. Data were obtained from DOGAMI.

6.4 Road Instability

Road construction, especially on steep slopes, can lead to slope failure and result in increased landslide activity (WPN 1999, Sessions et al. 1987). Road stability can be affected by the type of construction. For example, sidecast roads are built by using soil from the inside portion of a road to build up the outside, less stable portion of the road. Sidecast roads work well in moderately steep terrain, but can lead to problems on steep terrain. Road crossings with poorly designed culverts can fail and wash out, create gullies, and deliver large pulses of sediment to the channel. To quantify rural road instability requires data about recent road washouts, including the factors that may have led to these events, and high risk situations that may lead to future washouts.

Road inventories are the primary source of data used to evaluate the current conditions of roads in the watersheds. The road inventory conducted by ODF is not up-to-date, and is only available in the form of field notebooks (Rick Thoreson pers. comm.). ODF is currently in the process of updating their road inventory. Willamette Industries has conducted an extensive road inventory on their lands, which has been summarized below. Remaining roads have either not been assessed or were unavailable at the time of this assessment.

6.4.1 Willamette Industries, Inc. 10-year Legacy Road Improvement/Decommissioning Plan

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). The North Coast Resource Area inventoried approximately 1700 miles of road on company managed forestland in Tillamook, Columbia, and Clatsop Counties. Road features were given a priority class from one to five, with one being highest priority for repair and five being no action needed.

In 1999 the road inventory had been completed and a legacy road improvement and decommissioning plan was developed. The plan has all road segments identified as needing action either repaired or decommissioned within the next 10 years. The plan breaks the road inventory priorities into subclasses. The subclasses in order of singular impact or concern are safety, sedimentation into live streams, mass wasting, sedimentation depositing outside of live streams, and fish passage. An example of this system is that a priority one with a safety concern will be repaired/decommissioned before a priority one that has fish passage issues.

Under the North Coast Resource Area 10-year road plan, all priority one road segments will be repaired/decommissioned by the fall of 2001, and all road segments requiring action will be repaired/decommissioned by the fall of 2008.

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 and reconstruction, maintenance and erosion control. 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. Ditch relief culverts or ditchouts are placed with a minimum 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'to100' ahead of all stream crossing culverts. This allows ditch water to filter through vegetation on the forest floor prior to entering flowing water. Stream crossing culverts are required to be designed to pass a 50 year flood event, but all crossing installed by the North Coast Resource Area will pass a 100 year event. 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 in now hauled to stable waste areas.

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 onto 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 will be 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 performed as needed.

Where there is a 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. Seeding and hand mulching or hydro mulching are used to vegetate surfaces to prevent erosion.

6.4.2 Landslide Data

In 1999, DOGAMI compiled and mapped landslide information on state and federal lands for all of western Oregon. None of these landslides were in the Skipanon River watershed. However, the Willamette Industries road inventory may contain information regarding road-related slides on their lands. It would be advisable to conduct an inventory of road-related slides on non-private and industrial lands.

6.4.3 Culverts

Both Oregon Department of Transportation and Willamette Industries have assembled databases of culverts that are in need of repair, or are at risk of causing damage to the stream network. The highest density of high-priority culverts is in the Skipanon River subwatershed, at 0.7/sq. mi. Density of high-priority culverts in the Neacoxie Creek subwatershed is fairly low, at 0.2/sq. mi. GIS-based analysis of road stream crossings reveals a density of 2.7 crossings/sq. mi. in the Skipanon River subwatershed, and 0.9 in the Neacoxie Creek subwatershed. (Table 6.2).

Table 6.2. Stream/road crossings in the Skipanon River watershed. Data were calculated using GIS.

Subwatershed	Watershed Area (sq. mi.)	Road-Stream Crossings	
		(#)	(#/sq. mi.)
Neacoxie Creek	16	15	0.9
Skipanon River	12	33	2.7

6.5 Road Runoff

The water draining from roads can constitute a significant sediment source into streams. However, the amount of sediment potentially contained in road runoff is difficult to quantify because road conditions and the frequency and timing of use can change rapidly. Poor road surfaces that are used primarily in dry weather may have a smaller impact on sediment production than roads with high quality surfaces that have higher traffic and are used primarily in the rainy season. ODF fire-road data were used to assess potential sediment contribution from road runoff. Road density within 200 ft of a stream and on slopes greater than 50 percent was calculated using GIS.

Roads in the Skipanon River watershed demonstrate a moderate potential for acting as a sediment source to surface waters as a result of moderate road densities within 200 feet from the stream (Table 6.3). The density of roads within 200 feet of a stream was 0.26 to 0.36 miles of road per mile of stream for Skipanon River and Neacoxie Creek, respectively. The most common road surface in the Skipanon River watershed is asphalt pavement, accounting for approximately 53 percent of all the roads in the basin (Table 6.3).

Roads with steeper side slopes tend to accumulate more sediment in their associated drainage ditches, resulting in greater loading of sediments to surface waters. If these ditches become plugged, road failure often ensues. However, less than 1 percent of the roads in the Skipanon River watershed were constructed on slopes steeper than 50 percent in gradient (Table 6.3). It is unlikely that road construction on steeper slopes has increased sediment loads from rural roads in the Skipanon River watershed.

Table 6.3. Current road conditions in the Skipanon River watershed. The ODF fire roads coverage was used to calculate these numbers in GIS (see GIS data evaluation).

Subwatershed	Stream Length mi	Road Length mi	Gravel %	Dirt %	Paved %	Roads <200' from Stream mi/mi*		Roads <200' from Stream and >50% Slope (%)
Neacoxie Creek	7	100	42	0.5	57	2.6	0.36	0.00
Skipanon River	22	75	68	3.8	28	5.9	0.26	0.6
Watershed Total	30	175	45	2.0	53	8.5	0.05	0.43

* Units are miles of road per mile of stream

6.6 Conclusions

Sediment sources are variable across the Skipanon River watershed. Unfortunately, there were insufficient data to identify the magnitude of sediment contribution from landslides (either human induced or natural). However, it appears that conditions in the Skipanon River watershed are not conducive to frequent landslides or debris flows. In addition, road density is not high. Consequently, other than an occasional slump or landslide, road runoff is likely to be the greatest contributor of sediment in the watershed.

CHAPTER 7 WATER QUALITY

7.1 Introduction

The purpose of the water quality assessment, according to the OWEB manual (WPN 1999), is to complete a screening-level analysis of water quality. A screening-level analysis serves to identify obvious areas of water quality impairment by comparing selected measurements of water quality to certain evaluation criteria. The screening-level analysis uses existing data obtained from a variety of sources. This assessment does not include statistical evaluation of seasonal fluctuations or trends through time, and does not evaluate specific sources of pollution through upstream/downstream comparisons.

7.1.1 Assessment Overview

The water quality assessment proceeds in steps. The first step is to identify uses of the water that are sensitive to adverse changes in water quality, and identify potential sources of pollution in the watershed. The second step establishes the evaluation criteria. The third step examines the existing water quality data in light of the evaluation criteria. Conclusions can then be made about the presence of obvious water quality problems in the watershed, and whether or not additional studies are necessary.

Water quality is evaluated by comparing key indicators against evaluation criteria. Indicators are selected to represent pollution categories. Some aspects of water quality, such as fine sediment and temperature processes, are addressed in other sections of this watershed assessment. Although there are many constituents that contribute to the "water quality" of a stream, the watershed assessment focused on seven that are most often measured, and that may have the most direct effect on aquatic organisms: temperature, dissolved oxygen, pH, nutrients, bacteria, turbidity, and chemical contaminants. Evaluation criteria, discussed in Section 7.4, have been determined based on values of these constituents that are generally protective of aquatic life.

7.1.2 Components of Water Quality

Temperature

Cool water temperatures are necessary for the survival and success of native salmon, trout, and other aquatic life. Excessively warm temperatures can adversely affect the survival and growth of many native species. Although there is some debate about which specific temperatures should apply, and during which part of the year, standards have been set that can be used to determine if the waters in the stream are too warm. Because temperature in the stream varies throughout the day and among the seasons, multiple measurements throughout the day and in different seasons are needed to adequately assess water temperature conditions.

Dissolved Oxygen

Aquatic organisms need oxygen to survive. Oxygen from the air dissolves in water in inverse proportion to the water temperature. Warmer water contains less dissolved oxygen at saturated conditions. Organisms adapted to cool water are also generally adapted to relatively high dissolved oxygen conditions. If the dissolved oxygen is too low, the growth and survival of the organisms is jeopardize. As with temperature, dissolved oxygen can vary throughout the day and among the seasons, so multiple measurements, both daily and seasonally, are required for an adequate analysis of water quality conditions.

pH

The pH is a measure of the acidity of water. The chemical form and availability of nutrients, as well as the toxicity of pollutants, can be strongly influenced by pH. Pollutants can contribute to changes in pH as can the growth of aquatic plants through photosynthesis. Excessively high or low pH can create conditions toxic to aquatic organisms.

Nutrients

Nitrogen and phosphorus, the most important plant nutrients in aquatic systems, can contribute to adverse water quality conditions if present in too great abundance. Excessive algae and aquatic plant growth that results from excessive nutrient concentration can result in excessively high pH and low dissolved oxygen, can interfere with recreational use of the water, and in some cases, can produce toxins harmful to livestock and humans.

Bacteria

Bacterial contamination of water from mammalian or avian sources can cause the spread of disease through contaminated shellfish, contact recreation or ingestion of the water itself. Bacteria of the coliform group are used as an indicator of bacterial contamination.

Turbidity

Turbidity is a measure of the clarity of the water. High turbidity is associated with high suspended solids, and can be an indicator of erosion in the watershed. At high levels, the ability of salmonids to see their prey is impaired. As discussed elsewhere, high suspended sediment can have a number of adverse effects on fish and aquatic organisms.

Chemical Contaminants

Synthetic organic compounds, pesticides, and metals can be toxic to aquatic organisms. The presences of such contaminants in the water suggests the presence of sources of pollution that could be having an adverse effect on the stream ecosystem.

7.2 Beneficial Uses

The Clean Water Act requires that water quality standards be set to protect the beneficial uses that are present in each water body. The Oregon Department of Environmental Quality (ODEQ) has established the beneficial uses applicable to the 18 major river basins in the State. The Skipanon River watershed is in the North Coast–Lower Columbia Basin. The beneficial uses established for all streams and tributaries in the basin are (OAR 340-41-202):

Public domestic water supply[1]
Private domestic water supply[1]
Industrial water supply
Irrigation
Livestock watering
Anadromous fish passage
Salmonid fish rearing
Salmonid fish spawning
Resident fish and aquatic life
Wildlife and hunting
Fishing
Boating
Water contact recreation
Aesthetic quality

In addition, the Columbia River supports a beneficial use of commercial navigation and transportation. Estuaries and adjacent marine waters are considered to support the above beneficial uses as well, not including public or private water supply, irrigation, or livestock watering. Water quality must be managed so the beneficial uses are not impaired.

[1] With adequate pretreatment (filtration and disinfection) and natural quality to meet drinking water standards.

7.2.1 Water Uses Sensitive to Water Quality

Not all beneficial uses are equally sensitive to change in water quality. For example, use of the water body for domestic water supply would be impaired long before its use for commercial navigation. In general, water quality is managed to protect the most sensitive beneficial use. In the case of the Skipanon River watershed, the most sensitive beneficial use is probably salmonid fish spawning. It is assumed that if the water quality is sufficient to support the most sensitive use, then all other less sensitive uses will also be supported.

7.3 Pollutant Sources

7.3.1 Point Sources

NPDES permitted discharges

The Clean Water Act prohibits discharge of waste to surface water. In order to discharge any waste, a facility must first obtain a permit from the State. ODEQ issues two primary types of discharge permit. Dischargers with Water Pollution Control Facility (WPCF) permits are not allowed to discharge to a water body. Most WPCF permits are issued for on-site sewage disposal systems. Holders of National Pollutant Discharge Elimination System (NPDES) permits are allowed to discharge wastes to waters of the state, directly or indirectly, but their discharge must meet certain quality standards as specified in their permits. Permits set limits on pollutants from industrial and municipal dischargers based on the ability of the receiving stream to absorb and dissipate the pollutants. Industries, municipal wastewater treatment facilities, fish hatcheries, and similar facilities typically have NPDES permits. The current discharge permits for the Skipanon River watershed are listed in Table 7.1.

Table 7.1. Permitted facilities that have discharges in the Skipanon River watershed (ODEQ 2000).

Facility Name	Category	Type	River mile
Glenwood Village Mobile Home Park	D	WPCF	--
Oregon Ocean Seafoods	I	NPDES	1.7
Safekeeping Ministorage, Inc	D	WPCF	3.2
Shoreline Sanitary District	D	NPDES	8

D = domestic, I = industrial, A = agricultural, including fish hatcheries

7.3.2 Non-point Sources

The largest current source of pollutants to Oregon's waters is not point sources such as factories and sewage treatment plants. The largest source of water pollution comes from surface water runoff, often called "non-point source" pollution. Rainwater, snowmelt, and irrigation water flowing over roofs, driveways, streets, lawns, agricultural lands, construction sites, and logging operations carry more pollution, such as nutrients, bacteria, and suspended solids, than discharges from industry.

Land use can have a strong influence on the quantity and quality of water flowing from a watershed. An undisturbed watershed with natural vegetation in and along streams and rivers and a diversity of habitats on the uplands provides clean water that supports the desirable beneficial uses of the waterway. As the watershed is affected by industrial forestry, agriculture, and urbanization, the water quality in the waterways can become degraded. The percent of the affected land area of the Skipanon River watershed is shown in Table 7.2. Table 1.3 shows the distribution of all land use types in the watershed. Table 1.4 lists possible water quality effects resulting from various types of land use.

Table 7.2. Percent area of the Skipanon River watershed by selected land uses.

Land Use Type	Area (sq mi)	Percent of Total Area
Industrial Forest	5.32	18.8
Agriculture	0.41	1.5
Developed	1.5	5.3

The most prominent type of land use in the Skipanon River watershed is forestry, with relatively little land in developed areas. This land use pattern suggests that water quality problems associated with toxic industrial chemicals are likely to be of relatively little importance, while problems associated with sediment, turbidity, temperature, and possibly bacteria are likely to be more important. To the extent that herbicides and pesticides are used in forestry and agriculture operations, these compounds may assume greater importance.

7.3.3 Water Quality Limited Water Bodies

Sometimes, applying the best available treatment technology to all the point sources in a basin does not bring the stream into compliance with water quality standards. The combination of pollutants from all sources, point and non-point, within the watershed may contribute more pollution than the stream can handle. Under this circumstance, when a stream consistently fails to meet water quality standards for a particular pollutant, it is declared by ODEQ to be “water quality limited” as required by the Clean Water Act Section 303(d). Water bodies on the “303d List” must be analyzed to determine the total amount of pollutant that can be accommodated by the stream (the total maximum daily load – TMDL). This load is then allocated to all the dischargers, including non-point. Dischargers must then take the steps necessary to meet their allocated load.

The water quality limited water bodies in the Skipanon River watershed are listed in Table 7.3.

Table 7.3. Water quality limited water bodies in the Skipanon River watershed (ODEQ 1999).

Water Body	Segment	Parameter	Criteria	Season
Cullaby Lake	Whole lake	Aquatic weeds or algae	Fanwort	Summer
Skipanon River	Mouth to headwaters	Dissolved oxygen		May 1 - September 30
Skipanon River	Mouth to headwaters	Dissolved oxygen	Salmonid spawning: water DO 11 mg/L	October 1 - April 30
Smith Lake	Whole Lake	Aquatic weeds or algae	Aquatic weeds	Summer

Although the 303(d) list identifies water bodies that are known not to meet current water quality standards, the list is not necessarily a complete indicator of water quality in a particular basin. For many stream reaches there is not enough data to make a determination. In addition, the 303(d) listing is tied to the total amount of monitoring done, which is influenced by the number of special monitoring studies completed by ODEQ. Because special studies are frequently concentrated where water quality degradation is a concern, the list is weighted toward poorer quality waters. Consequently the ODEQ has developed the Oregon Water Quality Index (OWQI) as a water quality benchmark that is keyed to indicator sites monitored regularly by ODEQ.

The OWQI integrates measurements of eight selected water quality parameters (temperature, dissolved oxygen, biochemical oxygen demand, pH, ammonia+nitrate nitrogen, total phosphates, total solids, fecal coliform) into a single index value that ranges from 10 (the worst) to 100 (the best). The Skipanon River at Highway 101 (RM 4.9) has an index value of 59 and is ranked in the "Poor" category.

In order to assess more adequately the water quality conditions in the Skipanon River watershed we assembled available data from a variety of sources.

7.4 Evaluation Criteria

The evaluation criteria used for the watershed assessment are based on the Oregon Water Quality Standards for the North Coast Basin (ORS 340-41-205) and on literature values where there are no applicable standards, as for example, for nutrients (WPN 1999). They are not identical to the water quality standards in that not all seasonal variations are included. The evaluation criteria are used as indicators that a possible problem may exist. The evaluation criteria are listed in Table 7.4.

The water quality evaluation criteria are applied to the data by noting how many, if any, of the water quality data available for the assessment exceed the criteria. If sufficient data are available, a judgement is made based on the percent exceedence of the criteria as shown in Table 7.5. If insufficient, or no, data are available, it is noted as a data gap to be filled by future monitoring. If any water quality parameter is rated as "moderately impaired" or "impaired", water quality in the stream reach in question is considered impaired. The condition that caused the impairment should be addressed through stream restoration activities.

7.5 Water Quality Data

7.5.1 STORET

Data were obtained from the EPA STORET[2] database for the period 1965 through 1999. There were 277 sites in the ODEQ North Coast basin that had water quality data in the STORET database. Of these 277 sites, 85 were from ambient stream or lake stations. The remaining sites were from such locations as point discharges, wells, sewers, pump stations, and similar locations. The ambient water quality sites were distributed among the three watersheds in the North Coast basin as shown in Table 7.6.

[2] STORET data are available on CD-ROM from Earth Info, Inc. 5541 Central Ave., Boulder, CO 80301; (303) 938-1788.

Table 7.4. Water quality criteria and evaluation indicators (WPN 1999)

Water Quality Attribute	Evaluation Criteria
Temperature	Daily maximum of 64° F (17.8° C) (7-day moving average)
Dissolved Oxygen	8.0 mg/L
pH	Between 6.5 to 8.5 units
Nutrients	
Total Phosphorus	0.05 mg/L
Total Nitrate	0.30 mg/L
Bacteria	Water-contact recreation 126 E. coli/100 mL (30-day log mean, 5 sample minimum) 406 E. coli/100 mL (single sample maximum) Marine water and shellfish areas 14 fecal coliform/100 mL (median) 43 fecal coliform/100 mL (not more than 10% of samples)
Turbidity	50 NTU maximum
Organic Contaminants	Any detectable amount
Metal Contaminants	
Arsenic	190 µg/L
Cadmium	0.4 µg/L
Chromium (hex)	11.0 µg/L
Copper	3.6 µg/L
Lead	0.5 µg/L
Mercury	0.012 µg/L
Zinc	32.7 µg/L

Table 7.5. Criteria for evaluating water quality impairment (WPN 1999).

Percent of Data Exceeding the Criterion	Impairment Category
Less than 15 percent	No impairment
15 to 50 percent	Moderately impaired
More than 50 percent	Impaired
Insufficient data	Unknown

Table 7.6. The distribution of STORET water quality sampling sites in the Oregon North Coast basin.

Description	Skipanon River Watershed	Youngs Bay Watershed	Nicolai-Wickiup Watershed
Total ambient sites	38	38	9
Number of sites sampled more than once	7	8	7
Number of sites sampled more than once since 1989	3	3	1

Sites sampled only once over a period of 30 years do not provide adequate data to make judgements about water quality. Likewise data from more than ten years ago may not be representative for current conditions. For these reasons only data since 1989 from sites that had been sampled multiple times were used in this analysis. This is consistent with the practice of ODEQ in establishing the Oregon Water Quality Index.

The ambient water quality sites sampled more than once in the Skipanon River watershed are listed in Table 7.7 and displayed in Figure 7.1.

7.5.2 ODEQ Sites

Oregon Department of Environmental Quality currently maintains one site on the Skipanon River at Highway 101 as part of their ongoing ambient water quality monitoring network. As can be seen from Table 7.7, this is the most frequently sampled site, and also has the most recent data.

Table 7.8 shows a numerical summary of grouped data from all the STORET sites that have been sampled since 1990 in the Skipanon River watershed for the parameters under consideration in this assessment.

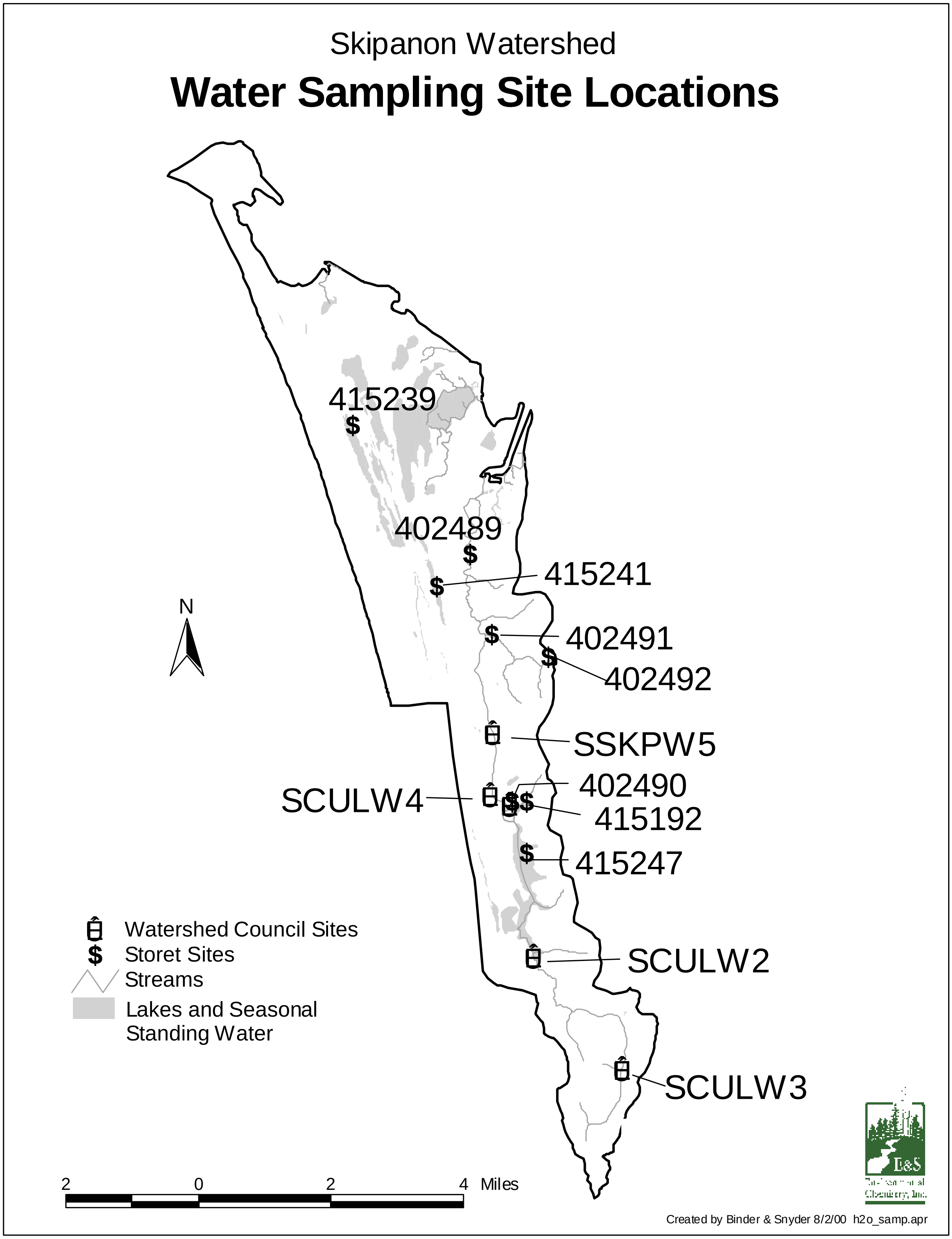

Figure 7.1. Sampling sites in the Skipanon River watershed with more than one sample since 1965. Site descriptions are provided in Table 7.7.

Table 7.7. Ambient water quality sampling sites used for water quality assessment in the Skipanon River watershed (EPA 2000).							
Site number	First sample	Last Sample	No. of Samples	No. of Analyses	Location	N Latitude	W Longitude
4610531235 40927	09/25/84	09/25/84	2	28	Skipanon R Site 2-ex27	46:10:53	123:54:09
402488	06/03/69	04/01/75	8	175	Skipanon River at 8th Street Dam	46:10:07	123:54:57
402489	01/01/01	12/10/97	50	1175	Skipanon River at Hwy 101	46:08:56	123:55:28
402490	06/03/69	04/01/75	10	119	Skipanon River at Cullaby Lake	46:05:43	123:54:29
402491	06/03/69	04/01/75	9	105	East Neacoxie Creek at Mouth	46:07:54	123:55:00
402492	06/03/69	04/01/75	10	119	East Neacoxie Creek at Camp Rilea	46:07:38	123:53:56
405485	04/29/96	10/21/96	3	248	Sunset Lake at Camp Rilea	46:06:48	123:55:53
415192	04/17/82	07/09/92	4	59	Cullaby Lake at North End Fishing Dock	46:05:44	123:54:13
415239	10/16/82	10/16/82	1	21	Coffenbury Lake North End	46:10:34	123:57:47
415241	10/16/82	10/16/82	1	21	Smith Lake Middle of Lake	46:08:30	123:56:05
415247	04/17/82	10/16/82	2	23	Cullaby Lake Middle of Lake	46:05:03	123:54:11
402489	01/01/01	01/01/01	1	2	Skipanon River at Hwy 101	46:08:56	123:55:28

Table 7.8. Numerical data summary for water quality parameters: Skipanon River watershed STORET data.								
Descriptors	Temperature (°C)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	pH (units)	Total Nitrate (mg/L)	Total Phosphorus (mg/L)	Fecal coliform (no/100 mL)	*E. coli* (no/100 mL)
Number of observations	51	37	46	58	47	80	14	13
Minimum	5.5	3	4.1	6	0.02	0.038	2	8
Maximum	24	12	10.3	7.2	0.76	0.156	345	480
Mean	13.53	6.57	7.84	6.78	0.22	0.084	136	121
Standard dev.	4.82	2.18	1.69	0.30	0.16	0.028	98	120
1st quartile[1]	9.75	5.00	6.50	6.60	0.12	0.060	72	68
Median[2]	12.00	6.00	8.35	6.80	0.18	0.080	131	96
3rd quartile[3]	17.60	8.00	9.20	7.08	0.26	0.090	169	140
Std dev of mean	0.67	0.36	0.25	0.04	0.02	0.003	26	33

[1] 25 percent of values were less than or equal to the 1st quartile value
[2] 50 percent of values were less than or equal to the median value
[3] 75 percent of values were less than or equal to the 3rd quartile value

7.5.3 Other Data Sources

Staff and volunteers from the Skipanon River watershed council collected temperature data during 1999 from five sites along the Skipanon River. These sites are listed in Table 7.9. Temperature data collected by the watershed council were collected at hourly intervals, so it is

Table 7.9. Temperature monitoring sites on the Skipanon River.			
Site ID	Location	N Latitude	W Longitude
SCULW1	Cullaby Creek	46:02:16	123:52:13
SCULW2	Maki Bridge	46:03:42	123:53:58
SCULW3	Cullaby Lake outlet	46:02:16	123:52:13
SSKPW4	Sand and gravel site	46:05:40	123:54:32
SSKPW5	Estuary, marina	46:06:37	123:54:54

particularly useful for water quality assessment. Additional data collected by the watershed council for the parameters under consideration here included grab samples for pH and dissolved oxygen. A numerical summary of the water quality data collected by the watershed council is included in Table 7-10.

7.6 Water Quality Constituents

7.6.1 Temperature

Temperature data available from STORET are shown in Figure 7.2. Of the data available for assessment, 25.5 percent of values were above 17.8° C and 50.9 percent of values were above the evaluation criterion of 12.8° C.

Maximum daily temperature data (7-day moving average) for an upstream site (Cullaby Creek) in the Skipanon River watershed are shown in Figure 7.3. Similar data for a downstream site (Skipanon River at Perkins Road) are shown in Figure 7.4. All temperatures at the upstream site are greater than 12.8° C for the period of record (summer 1999). Temperatures exceed the evaluation criterion of 17.8° C from about July 21st until the end of the record in mid-August. At the downstream site, temperatures exceed the evaluation criterion for the entire period of record. These data indicate that water quality in the Skipanon River is impaired with respect to temperature.

Table 7-10. Numerical summary of water quality measured or grab samples collected at various sites in the Skipanon River from July through November, 1999.

Descriptors	Water Temperature (°F)	Air Temperature (°F)	pH (units)	Dissolved Oxygen (mg/L)
Number of observations	79	49	80	73
Minimum	48.5	45.6	6.34	3.5
Maximum	75.3	77	8.2	11.65
Mean	60.1	62.8	6.95	9.05
Standard deviation	6.6	7.4	0.29	1.56
1st quartile[1]	55.2	55	6.79	8.12
Median[2]	59.6	64.1	6.94	9.54
3rd quartile[3]	66.2	67.3	7.12	10.15
Std. Dev. of mean	0.75	1.05	0.03	0.18

[1] 25 percent of values were less than or equal to the 1st quartile value
[2] 50 percent of values were less than or equal to the median value
[3] 75 percent of values were less than or equal to the 3rd quartile value

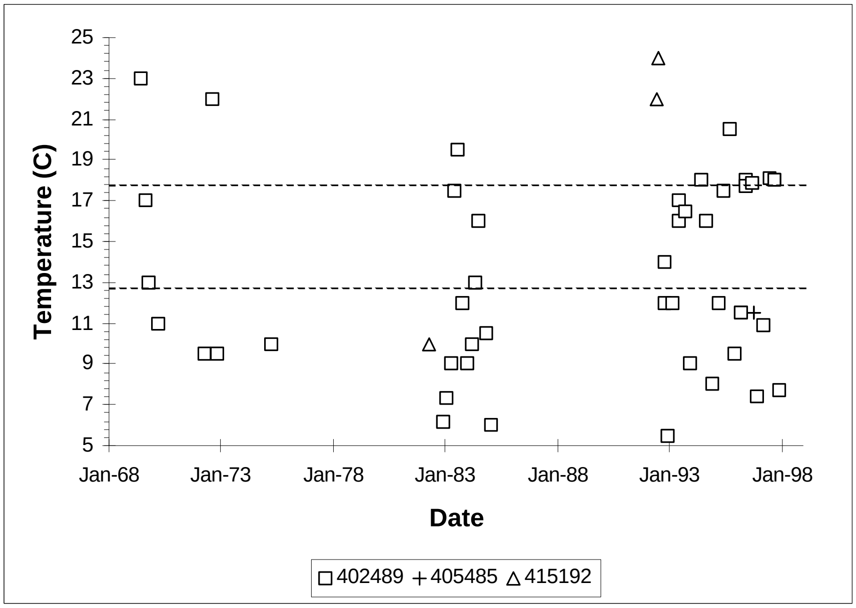

Figure 7.2. Temperature data collected at ODEQ ambient monitoring sites in the Skipanon River watershed. (402489=Skipanon River at Highway 101; 405485=Sunset Lake at Camp Rilea; 415192=Cullaby Lake at north end of fishing dock). Horizontal lines mark evaluation criteria of 12.8° C (spawning) and 17.8° C (salmonid rearing).

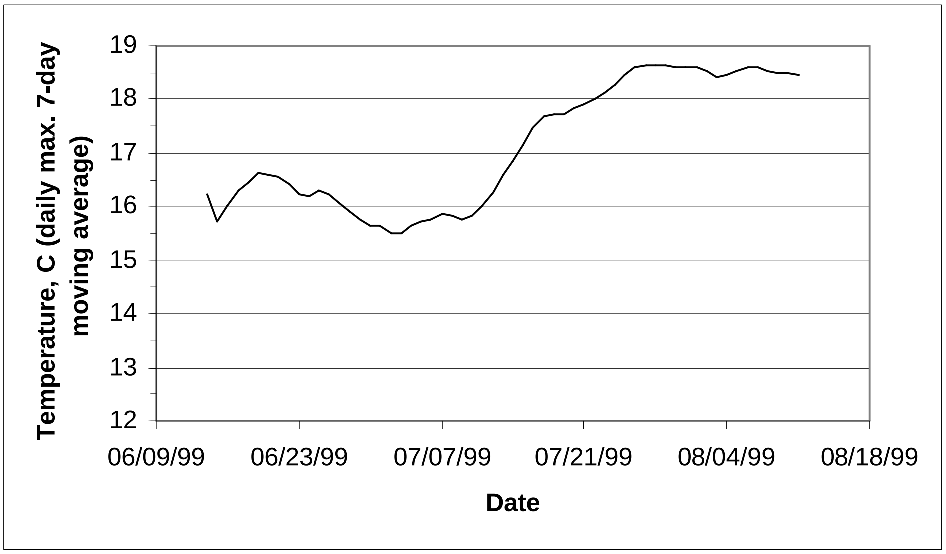

Figure 7.3. Daily maximum temperature (7-day running average) measured in Cullaby Creek (Site SCULW1) in the headwaters of the Skipanon River.

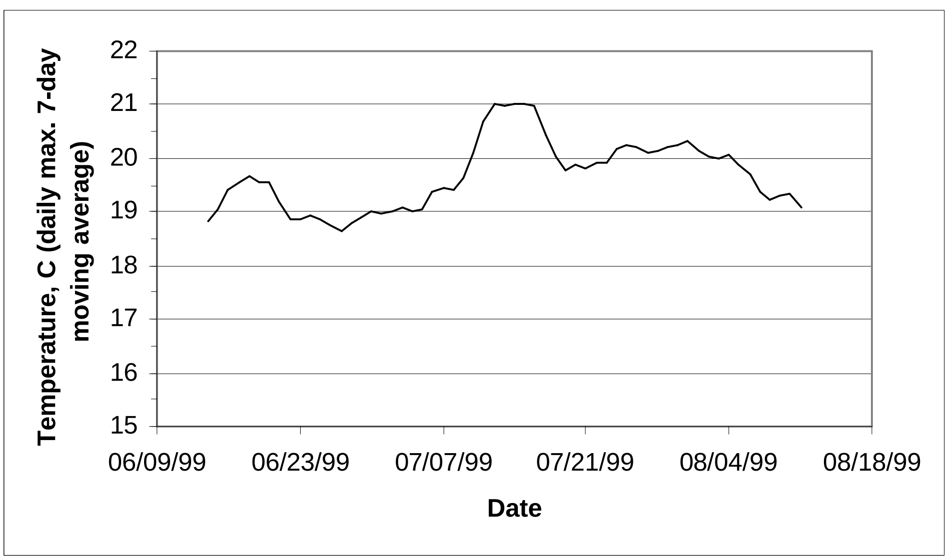

Figure 7.4. Daily maximum temperature (7-day running average) measured in the Skipanon River near Perkins Road (Site SSKPW4).

7.6.2 Dissolved Oxygen

Dissolved oxygen data from STORET for the Skipanon River at Highway 101 are shown in Figure 7.5. Of the data available for assessment, 39.1 percent of the values were below the evaluation criterion of 8.0 mg/L. For the 1999 grab samples, 24.3 percent of the values were below the evaluation criterion. Based on this information, the Skipanon River is classified as moderately impaired with respect to dissolved oxygen.

7.6.3 pH

Data for pH are presented in Figure 7.6. Of the available data, 12.1 percent of the STORET data and 2.5 percent of the 1999 grab samples fell below the evaluation criterion of 6.5 units. Although these are low pH values, it is possible that they do not indicate water quality impairment. The Skipanon River is heavily influenced by rainfall and water flowing through wetland soils which can have a pH of less than 6.0 under natural conditions. It is possible that

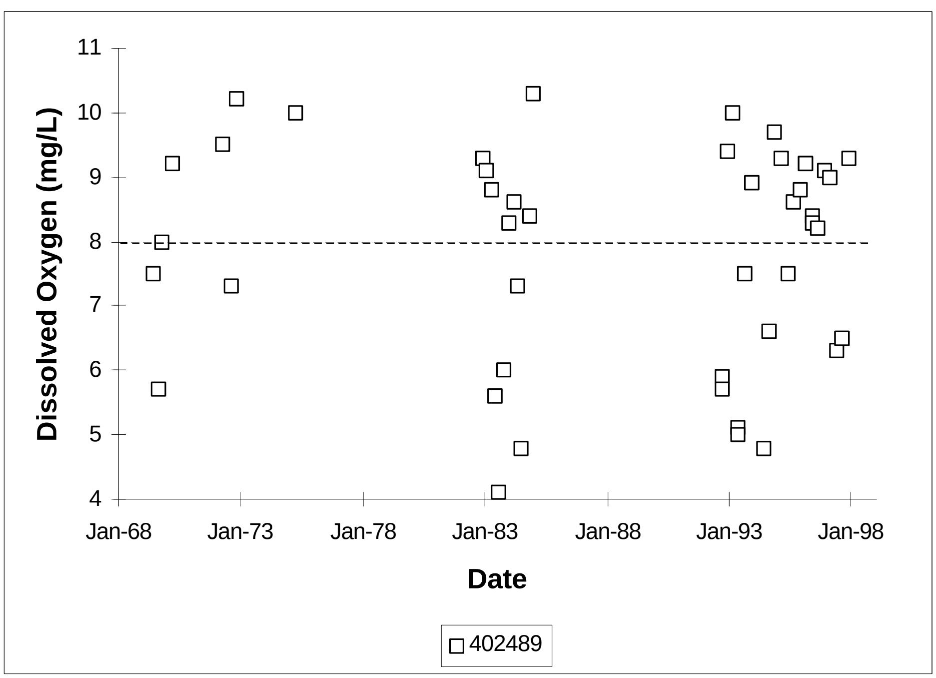

Figure 7.5. Dissolved oxygen data collected at the ODEQ ambient water quality sampling sites in the Skipanon River watershed at Cullaby Lake at north end of fishing dock. Horizontal line marks evaluation criterion of 8.0 mg/L.

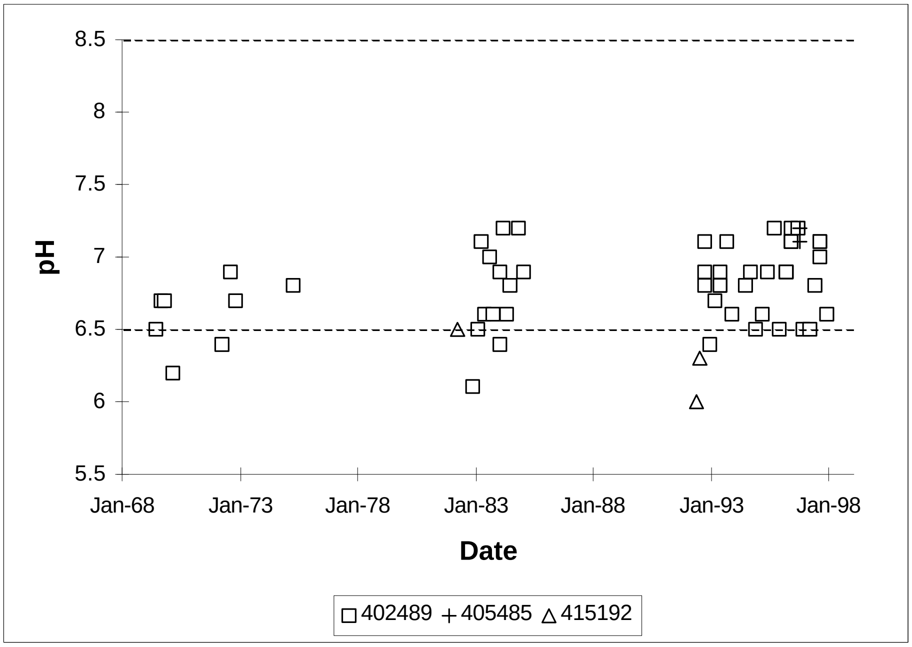

Figure 7.6. pH data collected at the ODEQ ambient water quality sampling sites in the Skipanon River watershed (402489= Skipanon River at Highway 101; 405485=Sunset Lake at Camp Rilea; 415192= Cullaby Lake at north end of fishing dock). Horizontal lines mark evaluation criterion of 6.5 and 8.5.

the low pH values observed in the Skipanon River are a natural phenomenon. Alternatively, the low pH could result from excess respiration by over-abundant aquatic plants. In this case, the low pH would indicate a water quality impairment. Additional monitoring, including multiple samples during the day and during multiple seasons, will be required to further assess this condition.

7.6.4 Nutrients

Total Phosphorus

The available phosphorus data are presented in Figure 7.7. Ninety-five percent of the phosphorus values are greater than the evaluation criterion of 0.05 mg/L. This suggests that the stream is receiving excess phosphorus from other than natural causes. A water sampling plan could be developed to determine the source of the excess phosphorus.

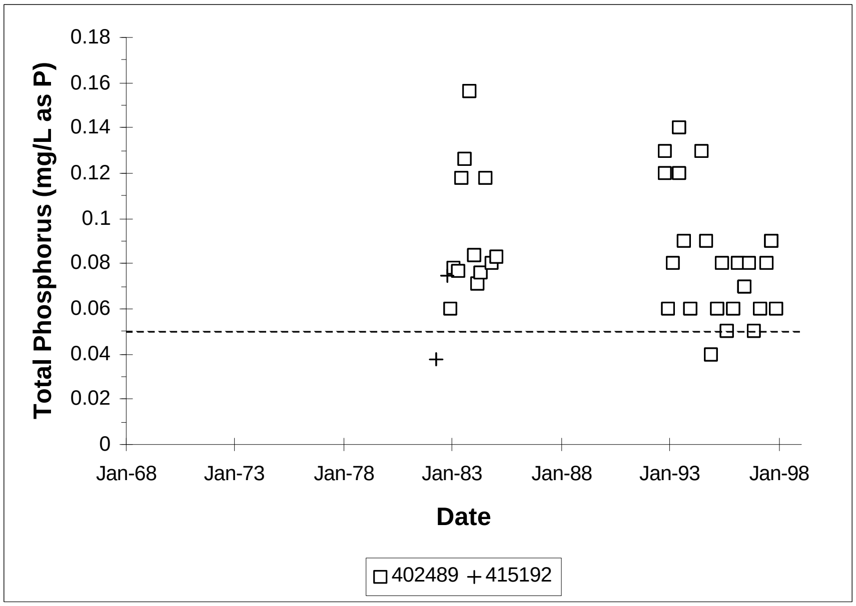

Figure 7.7. Total phosphorus data collected at the ODEQ ambient water quality sampling sites in the Skipanon River watershed (402489= Skipanon River at Highway 101; 415192=Cullaby Lake at north end of fishing dock). Horizontal line marks evaluation criterion of 0.05 mg/L.

Total Nitrate

Data for total nitrate nitrogen are presented in Figure 7.8. Of the available data, 21.3 percent are greater than the evaluation criterion of 0.30 mg/L.

The available data suggest that the Skipanon River be classified as moderately impaired to impaired with respect to nutrients.

7.6.5 Bacteria

Data for bacteria are presented in Figures 7.9 (Fecal coliform) and 7.10 (*E. coli*). In unimpaired waters, not more than 50 percent of the samples should exceed 14 fecal coliform bacteria per 100 mL, and not more than 10 percent should exceed 43 per 100 mL. For the available STORET data, 89.1 percent had greater than 14 fecal coliform bacteria per 100 mL and 71.7 exceeded 43 per 100 mL. It is not clear how the criterion for marine waters applies to freshwater samples, but the number of samples exceeding the criterion suggest that a problem exists. Only one value for *E. coli* exceeds the single-sample maximum criterion, while almost all of the samples tested were below the evaluation criterion for the 30-day mean (5 sample minimum).

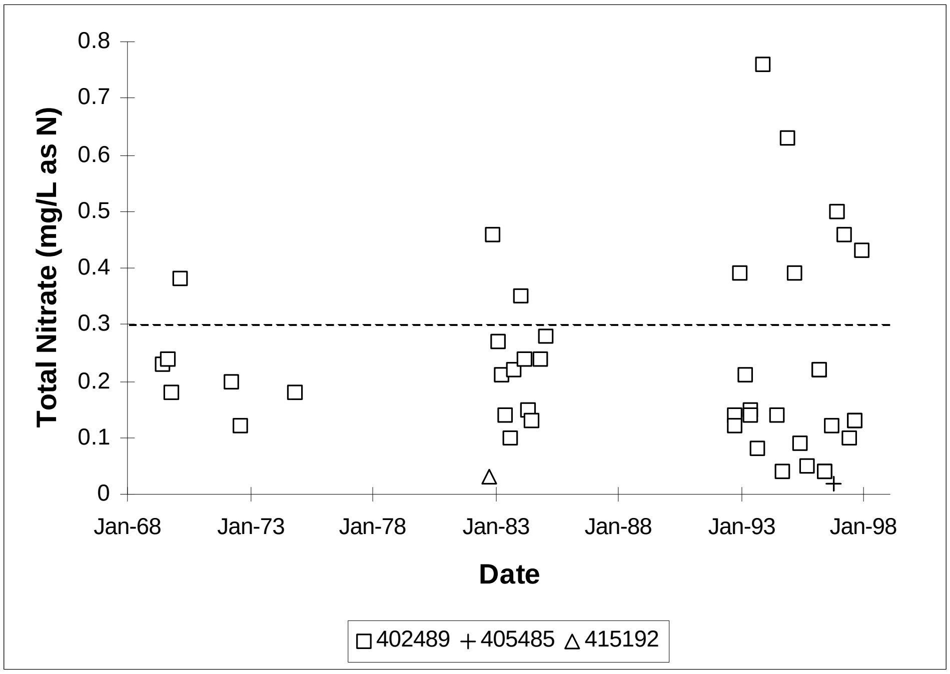

Figure 7.8. Total nitrate data collected at the ODEQ ambient water quality sampling sites in the Skipanon River watershed. (402485= Skipanon River at Highway 101; 405485=Sunset Lake at Camp Rilea; 415192=Cullaby Lake at north end of fishing dock). Horizontal line marks evaluation criterion of 0.30 mg/L.

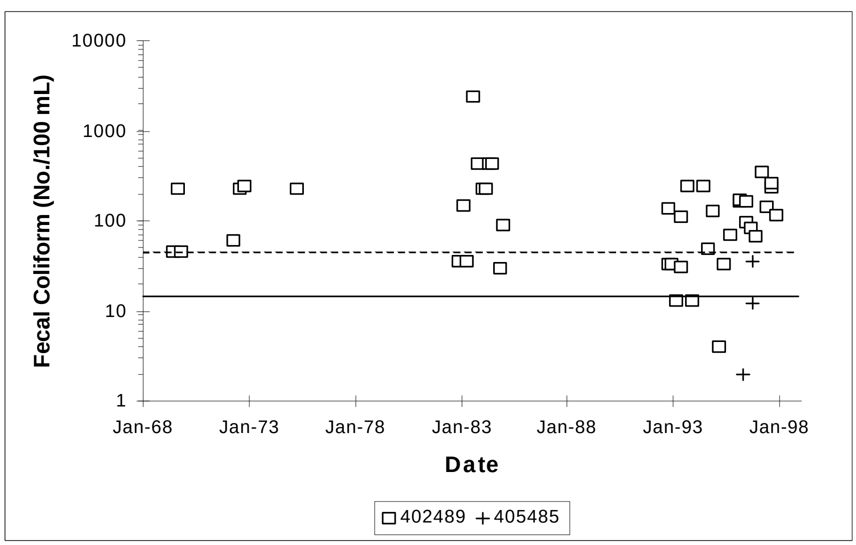

Figure 7.9. Fecal coliform data collected at the ODEQ ambient water quality sampling sites in the Skipanon River watershed (402489=Skipanon River at Highway 101; 405485=Sunset Lake at Camp Rilea). Horizontal lines mark 90th percentile (43/100 mL) and 50th percentile (14/100 mL) evaluation criteria.

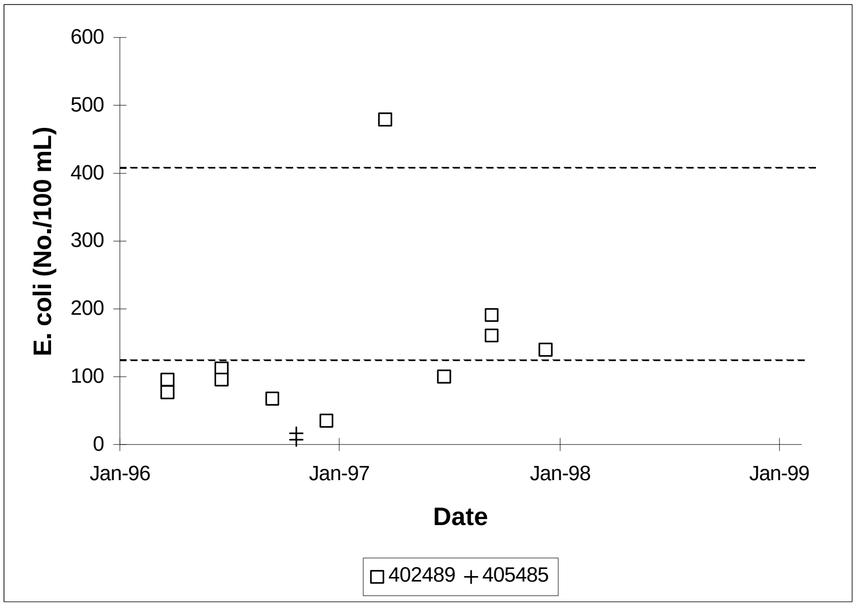

Figure 7.10. Bacteria (*E. coli*) data collected at the ODEQ ambient water quality sampling sites in the Skipanon River watershed (402489= Skipanon River at Highway 101; 405485= Sunset Lake at Camp Rilea). Horizontal lines mark single sample (406/100 mL) and log-mean (126) evaluation criteria.

The bacteria data suggest slight to moderately impaired water quality with respect to bacteria. However, it is probable that most of the samples used for this assessment were not taken during periods of rain and high runoff. Bacteria concentration in surface water can increase dramatically during periods of surface water runoff. The samples used for the assessment may under estimate the conditions of bacterial contamination in the River. Additional sampling will be required to verify the level of impairment.

7.6.6 Turbidity

Turbidity data are presented in Figure 7.11. No value exceeded the evaluation criterion of 50 NTU. The Skipanon River is classified as not impaired with respect to turbidity. However, as with bacteria, turbidity can show dramatic increases during periods of rainfall and surface runoff. A thorough evaluation of the condition of the River with respect to turbidity will require sampling during rainfall events.

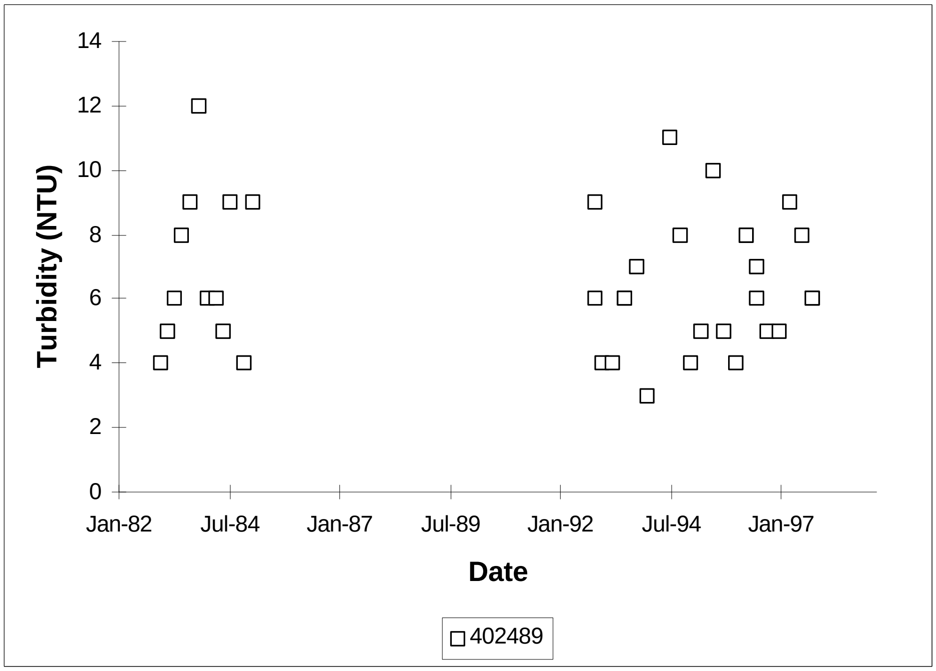

Figure 7.11. Turbidity data collected at the ODEQ ambient water quality sampling at the Skipanon River at Highway 101. The evaluation criterion is 50 NTUs.

7.6.7 Contaminants

Two samples from Sunset Lake at Camp Rilea were analyzed for a suite of organic contaminants, pesticides, and herbicides. None of the compounds tested for was present in delectable amounts.

7.7 Water Quality Conditions

At the screening level of this assessment, water quality in the Skipanon River is classified as impaired because of the frequency of exceedence of the evaluation criteria for temperature, dissolved oxygen, nutrients (nitrogen and phosphorus), bacteria, and possibly pH. These issues should be addressed through stream and watershed restoration activities. In order to adequately address the causes of impairment, additional data should be obtained through a carefully designed water quality monitoring program.

CHAPTER 8 WATERSHED CONDITION SUMMARY

8.1 Introduction

Summarizing current conditions and data gaps within a watershed will help to identify how current and past resource management is impacting aquatic resources. Through this summarization, we have attempted to create a decision-making framework for identifying key restoration activities that will improve water quality and aquatic habitats. Following is a summary of key findings and data gaps from the primary components of this watershed including fisheries, fish habitat, hydrology, water use, sediment sources, water quality and wetlands.

8.2 Important Fisheries

Fisheries within the Skipanon River watershed have undergone significant changes during the twentieth century. The types of fish present and their locations have been altered from historical conditions in the watershed. Arguably, the most significant activities to affect the fisheries during the last one hundred years are habitat modifications, hatchery programs and harvest.

The National Marine Fisheries Service (NMFS) has listed several anadromous fish species that do and could potentially exist in the watershed as threatened (Table 8.1). Chum and chinook have been listed as threatened by NMFS. Steelhead and coho have been listed as candidates for listing, while coastal cutthroat are proposed to be listed as threatened. Listing occurs for entire Evolutionarily Significant Units (ESU), defined as a genetically or ecologically distinctive group of Pacific salmon, steelhead, or sea-run cutthroat trout.

Table 8.1. Status of anadromous fish occurring in the Lower Columbia ESU's[1]. Listing status was obtained from the NMFS website (http://www.nwr.noaa.gov/lsalmon/salmonesu/ index.htm).

Fish	ESU	Status
Coho	Lower Columbia River/Southwest Washington	Candidate
Coastal Cutthroat	Southwestern Washington/Columbia River	Proposed Threatened
Chum	Columbia River	Threatened
Chinook	Lower Columbia River	Threatened
Steelhead	Oregon Coast	Candidate

[1] An Evolutionarily Significant Unit or "ESU" is a genetically or ecologically distinctive group of Pacific salmon, steelhead, or sea-run cutthroat trout.

Fisheries in the Skipanon River watershed lack self-sustaining anadromous fish populations. Native coho and chinook have been eliminated (if there ever were any) . Sea-run cutthroat trout appear to be at very low levels. Native winter steelhead are present in moderate numbers only in the Lewis & Clark River (Youngs Bay watershed). Consequently, even if significant improvements were made in habitat and ocean conditions, anadromous fish levels in the Skipanon River watershed would most likely remain low (Walt Weber pers. comm.). To improve fisheries in the Skipanon River watershed, it is imperative that brood stock development programs be developed that provide fish stocks capable of using improved habitats and becoming self-sustaining populations. Possible brood stock sources include late spawning Cowlitz River hatchery coho, Washington lower Columbia River chum, Lewis & Clark River winter steelhead, and Clatskanie River or Lewis & Clark River sea-run cutthroat trout. This list is not all-inclusive, and establishment of these broodstocks must take into account current local terminal fishery programs and local gill-net fisheries. Potential issues include over-harvest of developing broodstocks, competition, predation, and attraction of avian predators.

8.3 Hydrology and Water Use

8.3.1 Hydrology

Human activities in a watershed can alter the natural hydrologic cycle, potentially causing changes in water quality and aquatic habitats. These types of changes in the landscape can increase or decrease the volume, size, and timing of runoff events and affect low flows by changing groundwater recharge. Some examples of human activities that can impact watershed hydrology are timber harvesting, urbanization, conversion of forested land to agriculture, and construction of road networks. The focus of the hydrologic analysis component of this assessment is to evaluate the potential impacts from land and water use on the hydrology of this watershed (WPN 1999). It is important to note that this assessment only provides a screen for potential hydrologic impacts based on current land use activities in a watershed. Identifying those activities that are actually affecting the hydrology of the watershed would require a more in-depth analysis and is beyond the scope of this assessment.

Current land use practices in the Skipanon River watershed demonstrate a low potential for enhancing peak flows as a result of the construction of forest and rural roads and establishment of urban and suburban areas (Table 8.2). Since rain events are the predominant form of

Table 8.2. Potential effects on peak flows from land use practices[1]. Impact ratings for forest and rural roads are based on calculations from the ODF fire roads coverage.

	Area (mi^2)	Forestry Impacts	Forest Road Impacts	Rural Road Impacts
Skipanon River	12	Low	Moderate	Moderate
Neacoxie Creek	16	Low	Moderate	Moderate

[1] Impact ratings were based on standards set in the OWEB watershed assessment manual.

precipitation, there is only a small chance for forestry practices to enhance peak flows. Rain-on-snow events that do occur are large and rare events, and it is unlikely that forest practices are increasing the magnitude of these events. It is generally believed that forest harvest practices have the greatest effect on common storm events (peak flows), and not these large rare events (Naiman and Bilby 1998, Dunne 1983). The Skipanon River is generally groundwater-driven and changes in the groundwater hydrology will most likely have greater effects than changes in the upper elevations of the watershed which represents proportionally less area. It is possible that there are other impacts to the watershed's hydrology, such as reductions in evapotranspiration, increased infiltration and subsurface flow, and increased overland flow from these forestry practices. Forest road densities suggest that there is a moderate potential for peak flow enhancement in the upper elevations of the watershed.

Urban, suburban, and agricultural development is concentrated in the lower elevations of the watershed. These land management activities often result in the channelization and diking of the rivers for flood protection. By channelizing and disconnecting the rivers from their floodplains, downcutting of the channel can occur, increasing flow velocities and changing peak flows (Naiman and Bilby 1998). Current land cover within the urban growth boundary is dominated by wetland and grassland features. Loss of these wetland areas may lead to changes in the hydrology of the watershed by decreasing flood water storage and groundwater recharge. Determining the level of impact from diking, channelization, tidegates, and wetland loss warrants further investigation.

8.3.2 Water Use

Water is withdrawn from both surface and subsurface water supplies within almost all the watersheds in Oregon. Much of this water is for beneficial uses, such as irrigation, municipal water supply, and stock watering. When water is removed from these stores, a certain percentage is lost through processes such as evapotranspiration. Water that is "consumed " through these processes does not return to the stream or aquifer, resulting in reduced instream flows, which can adversely affect aquatic communities that are dependent upon this water. In fact, the dewatering of streams has often been cited as one of the major reasons for salmonid declines in the state of Oregon.

Water availability was assessed by ranking subwatersheds according to their dewatering potential (Table 8.3). Dewatering potential is defined as the potential for large proportions of instream flows to be lost from the stream channel through consumptive use.

Table 8.3 Dewatering potential and associated beneficial uses of water in the Skipanon River watershed.

Water Availability Watershed	Fish Use	Avg. Percent Withdrawn[1]	Dominant Water Use	Dewatering Potential[2]
Skipanon R. @ mouth	Coho	5	Agriculture	Low

[1] Average of low flow months (June, July, August, September, October).
[2] Greater than 30% is high, 10 to 30% is moderate, and less than 10% is low.

Water uses from the Skipanon River appear to have little affect on the current stream flows in the Skipanon River. However, a low flow problem is considered to exist in the Skipanon River (Michelle Wright pers. comm.). The apparent low flow problem needs to be further evaluated since the data suggest it is not a result of water withdrawals from the Skipanon River. Additionally, water is impounded at Cullaby Lake which may cause or enhance low flows during the summer months. There are currently no instream water rights to protect flows for aquatic life or anadromous and resident fish. With the city of Warrenton projected to face a water shortage in the next 20 years, there is potential that the Skipanon River may be viewed in the long-term as a water source to fill these needs. It is important that instream water rights be established to protect the aquatic resources of the Skipanon River.

Getting appropriated water back into the stream channel can be a difficult process. The Oregon Water Resources Board offers several programs, including water right leasing and conversion, in an attempt to put water back into the stream channel. However, much of this water has high economic value to its users, generating a demand for the water. Alternatives should be identified to conserve water.

8.4 Aquatic Habitats

Distribution and abundance of salmonids within a given watershed varies with habitat conditions such as substrate and pool frequency as well as biological factors such as food distribution (i.e. insects and algae). In addition, salmonids have complex life histories and use different areas of a watershed during different parts of their life cycle. For example, salmonids need gravel substrates for spawning but may move to different stream segments during rearing. The interactions of these factors in space and time make it difficult to determine specific factors affecting salmonid populations. Consequently, entire watersheds, not just individual components, must be managed to maintain fish habitats (Garano and Brophy 1999).

The Endangered Species Act requires that forests providing habitat for endangered species must be properly managed. Relationships between land cover and rare species decline has been established (Tuchmann et al. 1996). An understanding of the land patterns associated with the distribution of these species can lead to a better understanding of how to conserve these species. The OWEB process focuses on salmonids in the watershed.

8.4.1 Fish Passage

Culverts can pose several types of problems including excess height, excessive water velocity, insufficient water depth in culvert, disorienting flow patterns and lack of resting pools between culverts. Culverts can also limit fish species during certain parts of their life cycles and not others. For example, a culvert may be passable to larger adult anadromous fish and not juveniles. Culverts may also act as passage barriers only during particular environmental conditions such as high flow events. Because of these variable effects, it is important to understand the interactions of habitat conditions and life stage for anadromous fish.

Overall, data were insufficient to evaluate current fish passage problems in the Skipanon River watershed (Table 8.4). Only a small proportion of culverts have been evaluated. There are 48 stream/road crossings in the Skipanon River watershed (Table 8.4). ODFW conducted a survey of culverts for state and county roads. Of the six culverts surveyed by ODFW, only two did not meet standards, suggesting that they block access to upstream habitat areas. Neither of

Table 8.4 Fish passage conditions in the Skipanon River watershed.

Subwatershed	Stream Miles	Salmonid Use	Miles Salmonid Use	# Known Impassable culverts	# Road/ Stream Crossings	Rank
Neacoxie Creek	15	Coho	0.0	1	15	Insufficient data
Skipanon River	45	Coho	12.7	1	33	Insufficient data

these two culverts occur on the mainstem Skipanon River. Culverts blocking access to critical fish habitat areas need to be upgraded to improve fish passage.

A tidegate survey was conducted in the summer and fall of 1999 by the Skipanon River watershed Council led by Lisa Heigh (Appendix C). Of the 23 tidegates surveyed, six were considered to be in need of repair. Tidegates not fitted with fish passage facilities act as fish passage barriers. Tidegates that control flow from fish bearing streams or sloughs need to be evaluated and removed or replaced with "fish friendly" designs.

There are three possible fish passage barriers on the Skipanon River which are the dams at the 8th Street road crossing, the Plyter Dam, and the Cullaby Lake Dam. These possible barriers are all fitted with fish passage facilities but still may represent partial fish passage barriers that need to be further evaluated.

8.4.2 Fish Habitats

Understanding the spatial and temporal distribution of key aquatic habitat components is the first step in learning to maintain conditions suitable to sustain salmonid populations. These components must then be linked to larger scale watershed processes that may control them. For example, a stream that lacks sufficient large woody debris (LWD) often has poor LWD recruitment potential in the riparian areas of that stream. By identifying this linkage, riparian areas can be managed to include more conifers to increase LWD recruitment potential. Also, high stream temperatures can often be linked to lack of shade as a result of poorly vegetated riparian areas. By linking actual conditions to current watershed-level processes, land mangers can better understand how to manage the resources to maintain these key aquatic habitat components.

Large Woody Debris

Large woody debris is an important feature that adds to the complexity of 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 habitat for aquatic organisms (Bischoff 2000, BLM 1996).

None of the riparian areas in the Skipanon River watershed demonstrated an adequate potential to contribute LWD to the stream channel (Table 8.5). Wetlands are a dominant landscape feature in the Skipanon River watershed. Although wetlands may or may not contribute LWD to the stream channel depending on the wetland type, they do provide several important habitat features, such as back channels and cover. Many of these wetlands are diked and disconnected from the stream, limiting access to this habitat. Wetland features in the Skipanon River watershed may have historically been a more important feature than LWD.

Stream shading in the Skipanon River watershed was generally low to moderate (Table 8.5). Both subwatersheds had large proportions of wetlands in the riparian areas, ranging from 20 to 42 percent. Wetlands can provide shade from vegetation although many of these wetlands are diked and disconnected from the stream. Stream temperatures need to be monitored in these riparian wetlands.

Table 8.5. Riparian and instream LWD conditions in the Skipanon River watershed.

Subwatershed	Stream Miles	Fish Use	Riparian Recruitment[1]	Riparian Shade[1]	Instream LWD
Neacoxie Creek	15	Coho	Adequate	Adequate	--
Skipanon River	45	Coho	Inadequate	Moderate	–

[1] From aerial photo interpretation conducted by E&S Environmental Chemistry, Inc.

Wetlands

Wetlands contribute critical functions to a watershed's health such as water quality improvement, flood attenuation, groundwater recharge and discharge, and fish and wildlife habitat (Mitsch and Gosselink 1993). Because of the importance of these functions, wetlands are regulated by both State and Federal agencies. Additionally, wetlands play an important role in the life cycles of salmonids (Lebovitz 1992). Estuarine wetlands provide holding and feeding areas for salmon smolts migrating out to the ocean. These estuarine wetlands also provide an acclimation area for smolts while they are adapting to marine environments. Riparian wetlands can reduce sediment loads by slowing down flood water, allowing sediments to fall out of the water column and accumulate. Wetlands provide cover and a food source in the form of a diverse aquatic invertebrate community. Backwater riparian wetlands also provide cover during high flow events, preventing juvenile salmon from being washed downstream. Wetlands, especially those providing salmonid habitat, need to be protected and restored in the Skipanon River watershed.

Estuarine Wetlands

Estuarine wetlands were once common in the Columbia River estuary and the Skipanon River watershed (Boulé and Bierly 1987). Many of these wetlands have been diked, disconnecting them from saltwater influences and changing the structure of the wetland. All existing estuarine wetlands currently accessible to salmonids need to be protected or restored. Those wetlands disconnected by dikes and tidegates need to be evaluated for potential restoration.

Palustrine Wetlands

Palustrine wetlands are a dominant feature in the Skipanon River watershed. Streamside wetlands need to be protected, especially those that are in the current salmonid distribution. Streamside wetlands that have been disconnected due to diking need to be evaluated for restoration opportunities. Other wetlands should be protected for their roles in maintaining water quality, flood attenuation, and habitat.

8.5 Sediment Sources

In this watershed, slope instability, road instability, and rural road runoff were determined to be the most significant potential sediment sources. Shallow landslides and deep-seated slumps are known to be common in the Oregon Coast Range. Streamside landslides and slumps can be major contributors of sediment to streams, and shallow landslides frequently initiate debris flows. Rural roads are a common feature of this watershed, and many are present on steep slopes. Washouts from rural roads contribute sediment to streams, and sometimes initiate debris flows. The density of rural roads, especially unpaved gravel and dirt roads, indicates a high potential for sediment contribution to the stream network.

Sediment sources are variable across the Skipanon River watershed (Table 8.6). Unfortunately, there were insufficient data to identify the magnitude of sediment contribution from landslides (either human-induced or natural). However, it appears that conditions in the Skipanon River watershed are not conducive to frequent landslides or debris flows. In addition, road density is not high. Consequently, other than an occasional slump or landslide, road runoff is likely to be the greatest contributor of sediment in the watershed. Road survey data needs to be updated or evaluated for sediment inputs from road instability or road runoff.

Table 8.6. Potential sediment source conditions in the Skipanon River watershed.

	Area (mi^2)	Slope Instability*	Road Instability	Road Runoff	Stream Bank Erosion
Neacoxie Creek	12.0	Low	Insufficient data	Insufficient data	Insufficient data
Skipanon Rover	16.0	Low	Insufficient data	Insufficient data	Insufficient data

* High was >20% area in high and moderate categories from DOGAMI slope instability analysis. Moderate was 10 to 20% and low was < 10%.

8.6 Water Quality

Water quality is controlled by the interaction of natural and human processes in the watershed. Processes that occur on the hillslope can ultimately control instream water quality. Pollutants are mobilized through surface and subsurface runoff and can cause degradation of stream water quality for both human use and fish habitat. Consequently, many water quality parameters are highly episodic in nature and often associated with certain land use practices. The water quality assessment is based on a process that identifies the beneficial use of water, identifies the criteria that protects these benefits, and evaluates the current water quality conditions using these criteria as a rule set (WPN 1999).

Assessment of water quality by subwatershed is difficult because there is so little data available in the watershed. A summary of the water quality assessment is provided in Table 8.7. In the assessment, if any one of the parameters was judged impaired, or moderately impaired, water quality was judged impaired for that subwatershed. Additional data will be required to ascertain the causes of impairment and to devise restoration activities that might improve water quality.

Table 8.7. Water quality impairment in the Skipanon River watershed.

Subwatershed	Temperature	Dissolved oxygen	pH	Nutrients	Turbidity	Bacteria	Toxics	Impairment Summary
Skipanon River	impaired	moderately impaired	possibly impaired	moderately impaired	not impaired	slightly impaired	no data	impaired
Neacoxie Creek	no data	no data	no data	no date	no data	no data	not impaired	insufficient data

CHAPTER 9 RECOMMENDATIONS

9.1 General

- Prioritize restoration and watershed management activities based on information in this assessment and any other assessment work conducted in the watershed. One example is the instream habitat restoration guide developed by ODFW (ODFW 1997). Prioritize areas with known salmonid use for both spawning and rearing. Focus on areas with sufficient water quality for salmonids (low temperature, low turbidity) and areas with good stream channel characteristics (responsive channel habitat type, good geomorphologic conditions, good riparian shade and recruitment potential).

- Maintain relationships and contacts with the Oregon Department of Forestry, the cities of Astoria and Warrenton, and private timber owners to keep up-to-date on data collection, further assessment, and restoration activities on their lands. Update assessment data sets accordingly.

- Develop an understanding of the Forest Practices Act (a copy is housed at the watershed council office). This will provide a better understanding of regulations and mitigation actions necessary for timber harvest.

9.2 General Data

- Use a standardized set of base maps. As a part of this assessment, a series of 1:24,000 base map layers were developed. We recommend that these layers be used as a base map and additional data be maintained at a scale of 1:24,000 or larger (i.e. 1:12,000). All of these layers will relate directly to the USGS 7.5 minute quadrangles which can be used to list later information and find locations in the field.

- Georeference all field data at a scale of 1:24,000 or better. This can be accomplished by using GPS to record latitude and longitude or by marking the location on the USGS quadrangle maps.

- Maintain data in an accessible location and format. The watershed council office is the best place for this. Most data should be maintained in a GIS format and updated annually Some coverages will be updated periodically by the agency that created the coverage (i.e. salmonid distribution data from ODFW). These data sets should remain current in the watershed council's database.

- Collect additional data in priority areas. The decision-making framework provided with this document allows the user to select strategic locations for data collection based on features such as channel habitat type, known salmonid distribution, and water quality conditions.

- Get expert advice on data collection and processing. Consult with the Technical Advisory Committee, federal and state agencies, and consultants to develop appropriate sampling collection, quality control, and data analysis protocols.

- Evaluate the GIS data layers. Several of the data sets used to develop this assessment need to be evaluated and compared to on-the-ground conditions before restoration or final conclusions are made about ecosystem processes. Layers that need further evaluation or updating include:

  <u>Land Use and Wetlands</u>
  The land use was refined from a LANDSAT scene, zoning, National Wetlands Inventory (NWI), and ownership (see section 1.8) which have all been field verified. NWI data were not available digitally for the entire area and so were used only in the areas of digital coverage. Additional wetland data were derived from the LANDSAT scene. NWI data are much more accurate since NWI is derived from aerial photo interpretation. Consequently, some areas that have been classified as wetlands are really agricultural fields. As NWI data become more readily available in digital format, the land use coverage should be updated. All land use categories should be field verified before restoration actions occur.

  <u>Roads</u>
  The roads coverage is a key coverage used to evaluate potential sediment sources and changes in watershed hydrology associated with road construction. However, the roads coverage may not accurately represent on-the-ground conditions in this watershed. The road coverage was developed from the 1:100,000 USGS Digital Line Graphs (DLG) updated on an ad-hoc basis from aerial photos and other sources as they were discovered. Although this coverage represents the best available data for roads, its accuracy is suspect. A study needs to be developed to verify the accuracy of the roads coverage.

  <u>Channel Habitat Types</u>
  Channel habitat types were determined using GIS. Field verification of these data suggest that the data accurately represent actual on-the-ground conditions (through visual comparison). However, the channel habitat type should be further verified in the field before any restoration actions occur.

  <u>Riparian Vegetation and Shade</u>
  Riparian conditions need to be further evaluated before restoration actions occur. A visual comparison of field checks to the aerial photo interpretations found the data to be fairly consistent. After site selection using the GIS data, the stream reach identified should be field checked for actual on-the-ground conditions. A more rigorous analysis of the GIS data could also be performed (field data have been provided to the watershed council).

- Refine the land use layer. Continue to develop the land use layer to reflect changes in land use. Update the layer with digital NWI data as they become available.

9.3 Fisheries

- Develop and update a fish limits coverage. This process has been started by ODF.
- Work with ODFW to identify viable populations and distributions of sensitive species, particularly salmonids. These data are critical in developing watershed enhancement strategies.
- Identify and survey areas currently used by salmonids. Collect stream survey data according to ODFW protocols. These data will help identify habitat limitations and areas that may provide good habitat but are currently blocked by a barrier.
- Work with ODFW to establish a brood stock development program that will provide fish stocks capable of establishing self-sustaining populations of coho, chum, chinook, sea-run cutthroat, and steelhead. A brood stock development program will help provide fish capable of using improved habitats, leading to self-sustaining populations of fish.

9.4 Aquatic Habitats

9.4.1 Instream Habitat Conditions

- Field verify the channel habitat type GIS data layer (see section 9.2). Some data have already been collected and visually compared to the layers. A statistical approach should be applied to these data.

9.4.2 Riparian Zones

- Field verify the riparian GIS data layers (see section 9.2). Some data have already been collected and visually compared to the layers. A statistical approach should be applied to these data.
- Prioritize stream reaches for restoration of riparian vegetation. Start in areas currently used by salmonids and lacking in LWD recruitment potential, good shade conditions, or instream LWD.
- Plant riparian conifers and native species in areas lacking LWD recruitment potential. Start in areas of known salmonid use, and use the riparian vegetation map provided with this assessment and ODFW stream surveys to identify candidate reaches. Before any reaches are targeted for planting, they should be field verified for suitability and actual conditions. Vegetation planting should use only native species and mimic comparable undisturbed sites.
- Develop a riparian fencing strategy to maintain riparian vegetation.

9.4.3 Fish Passage

- Complete a culvert survey of all culverts that have not been evaluated for fish passage. Data should be maintained in a GIS. The road/stream crossing coverage is a good place to start. The culvert survey should begin in priority subwatersheds at the mouth of each of the streams. Establish priorities for culvert replacement.

- Replace priority culverts identified in the culvert survey.

- Install fish passages at known fish passage barriers that are caused by human influences.

9.4.4 Wetlands

- Prioritize estuarine wetlands for restoration options based on their value to salmonids for restoration, creation, or maintenance. Landowners with priority wetlands can then be contacted for possible wetland restoration.

- Prioritize for restoration, creation, or maintenance, palustrine wetlands that are connected to streams and provide back water rearing areas for salmonids. Start in areas with known salmonid rearing and spawning habitat.

- Create, restore, and maintain estuarine wetlands based on their prioritization.

- Create, restore, and maintain palustrine wetlands based on their prioritization.

9.5 Hydrology and Water Use

- Update and refine the roads layer (see section 9.2). Keep in contact with ODF and other groups (private land owners) as the roads layer is updated to evaluate its accuracy.

- Develop a strategy to collect continuous discharge data in the primary rivers that flow into Young's Bay. One strategy may be to install a level logger on the Lewis & Clark River and model the other rivers based on these data. Discharge data are essential to evaluate current low flow and peak flow conditions on the watershed. Work with OWRD or the USGS to get stream gages installed.

- Collect meteorologic data and rainfall data to improve modeling capabilities for water availability and flooding. This could be accomplished through local high schools or volunteers.

- Develop an outreach program to encourage water conservation. One of the primary water withdrawals is for municipal use. Educate the public about dewatering effects and how water conservation will help salmonids in the watersheds.

- Identify water rights that are not currently in use and that may be available for instream water rights through leasing or conversion.

9.6 Sediment

- Update and refine the roads layer (see section 9.2). Keep in contact with ODF as the roads layer is updated. Check with other groups (private land owners) to update the roads layer and evaluate its accuracy.

- Identify roads that have not been surveyed for current conditions and fill these data gaps. Work with ODF to develop road survey methodologies.

- Map road failures in areas where data are lacking. Coordinate with watershed stakeholders that are currently collecting road data such as ODF and private timber companies. Develop a strategy to fill in the data gaps.

- Map culvert locations and conditions in conjunction with the culvert survey conducted for fish passage barriers. Check with ODF, ODFW, and local foresters for the best methodologies and data to collect.

- Map all debris flows and landslides. Begin in the areas most susceptible to landslide activity as identified in the DOGAMI debris flow hazard map.

- Where possible, conduct road restoration activities such as road reconstruction, decommissioning, and obliteration.

- Replace undersized culverts that are at risk of washing out. Prioritize these culverts from the culvert surveys.

9.7 Water Quality

- Develop a systematic water quality monitoring program for areas with high priority for restoration activity. Focus the water quality monitoring on constituents that are important for the specific area being restored. Use the water quality data to refine the restoration plans.

- Develop or expand the continuous temperature monitoring network with monitors at strategically located points such as the mouths of tributary streams, locations of known spawning beds, at the interface between major land use types, or downstream of activities with the potential to influence water temperature.

- Include a plan for long-term monitoring in any restoration plan to measure the effects of the restoration activity.

- Begin to develop the capacity within the watershed council to conduct high quality, long term water quality monitoring to document the success of restoration activities.

- Locate and map potential sources of nitrogen, phosphorus, and bacteria in the watershed.

- Conduct all water quality monitoring activities according to established guidelines such as those published by the Oregon Plan for Salmon and Watersheds (OPSW 1999), or EPA (1997, 1993).

- Cooperate with DEQ and other agencies to share data and expertise. Coordinate the council's monitoring activities with those of the agencies, including DEQ's efforts to develop Total Maximum Daily Loads for water quality limited stream segments.

CHAPTER 10 MONITORING PLAN

10.1 Introduction

There are several possible functions of a monitoring plan: to answer questions that arise as a result of the watershed assessment, to fill critical data gaps, and to measure the success of restoration efforts developed as a result of the watershed assessment. Procedures for developing a monitoring plan are provided in some detail in Component XI of the OWEB Assessment Manual (WPN 1999). Those procedures will be summarized here. For further information, refer to the OWEB Manual.

The monitoring plan describes what is being monitored, and why, and lays out an organized approach to the monitoring. It does not necessarily include detailed procedures for actually collecting data. Those procedures can be found in a number of references such as the Oregon Plan Technical Guide (OPSW 1999). Although trained volunteers can often implement all or part of a monitoring program once a plan is developed, developing the plan requires specific knowledge of the appropriate monitoring techniques, data analysis, statistics, and quality assurance. Watershed councils should obtain help from specialists such as agency resource scientists or monitoring consultants when developing a monitoring program.

Monitoring may be undertaken for a number of reasons: 1) to evaluate the existing condition or status of the resource (fill a data gap), 2) to identify cause-and-effect relationships within the watershed, and 3) to determine trends in conditions in response to specific activities. The first type is conducted when little or no information exists about a particular condition, to identify if a problem exists, or to clarify the magnitude of a particular problem. The second type is usually designed to pinpoint the particular cause of a problem and to devise corrective measures. The third type is undertaken to document the effects of a particular restoration action, and may require intensive monitoring over many years or several decades to detect a trend.

It is critical that the objective of any monitoring effort be clearly identified before data collection efforts are planned. The monitoring objective will determine the location, duration, and frequency of field observation or sample collection.

10.2 Filling Data Gaps

The watershed assessment has identified data gaps and other information needs. These needs should be addressed before costly restoration activities are undertaken. Some data gaps, such as riparian condition assessment or verifying wetland location, can be filled through field observation. Others, such as water quality monitoring, require sample collection and analysis following standardized procedures. Still others, such as evaluation of hydrologic impacts cannot be readily monitored and must rely on models and professional expertise.

Field observations to verify assumptions can often be conducted at relatively little expense by volunteers who have been trained by a resource professional in the proper protocols and documentation procedures. More intensive studies involving the collection and analysis of samples are more expensive, and may require the assistance of professional scientists to be successful.

10.3 Monitoring Restoration Activities

The first aspect of monitoring a restoration activity is to document that the activity or practice was implemented correctly. This should be part of every project and should be conducted during or shortly after the activity takes place. It usually consists of visual inspections, field notes, and photographs. Implementation monitoring is a simple and cost-efficient form of monitoring. Although it may seem obvious, complete documentation of what was actually completed is frequently overlooked.

The second aspect of monitoring a restoration activity is to document that the activity or practice was effective, that it actually achieved the desired outcome. This is more complex than implementation monitoring, and may require the commitment of resources for up to several decades in order to detect a trend in highly variable constituents such as stream temperature.

10.4 Developing a Monitoring Plan

The first step toward a monitoring plan is to identify data gaps and prioritize monitoring needs. Once this is done, the monitoring plan can be developed to answer specific questions or fill specific data gaps. The monitoring plan describes the objectives for the monitoring, identifies the resources needed to conduct the monitoring, and describes what activities will take place, at what times, and in what locations. Developing a monitoring plan is an iterative process, and proceeds in stages. Stages may be revisited as the plan is developed and refined.

10.4.1 Objectives

The objectives of a monitoring plan arise from the data gap or question that is being addressed. An example question is, "Does this stream meet the ODEQ water quality standard for temperature?" With the question in mind, the specific objective can be stated, and a preliminary monitoring strategy can be developed. An example of a preliminary strategy is provided in Table 10.1.

Table 10.1 An example of an initial monitoring strategy (WPN 1999)

Question or data gap	Does the stream meet state standards for temperature?
Objective	Measure temperature during critical seasons and times of day to detect exceedence of criteria.
Constituents	Temperature
Methods	TidBit temperature data loggers
Study design	Upstream and downstream of major canopy openings.
Locations	Based on access, study design, security, etc.
Duration	At least 6 months including summer
Frequency	Hourly

10.4.2 Resources

During this stage, all the resources needed to conduct the monitoring plan are identified. This includes people, money, field equipment, laboratory services, supplies, and any other resources that might be required for the successful completion of the plan.

10.4.3 Details

Identify the specific constituents or parameters that will be measured: the specific location of the monitoring sites; the frequency of sampling and the time of sampling (both seasonal and daily); and the individuals who will conduct the sampling, data reduction, and analysis.

10.4.4 Verification

Conduct a pilot study to ensure that the plan is workable, that all monitoring sites are safely accessible in all seasons that will be required, that all field procedures can be conducted properly, that all field equipment needed is available and is in working order, and that field personnel understand the protocols and can conduct them properly.

10.4.5 Refinement

Refine the monitoring plan based on the results of the pilot study. Use the data collected during the pilot study to determine if the information will meet the monitoring objective and the quality assurance requirements. Make any changes to the protocols, such as moving a sample site or changing a field method, that are necessary to obtain acceptable data.

10.4.6 Write the Plan

It is critical that a written plan be prepared that documents why, how, when, and where the monitoring will be conducted. This is necessary in order to maintain consistency throughout the life of the monitoring plan, and to document your efforts for the benefit of others. The components of a written monitoring plan are included below (WPN 1999).

10.5 Monitoring Protocols

A number of protocols have been developed for use by volunteer groups working in watersheds. The council should seek the help of resource professionals in selecting potential monitoring protocols, and should consider carefully what can actually be accomplished by volunteers before designing a monitoring plan.

Some useful reference materials are listed below.

MONITORING PLAN COMPONENTS

Background
This information can be summarized directly from the Watershed Condition Evaluation Assessment component. Describe the watershed and the previous studies and data available on the issue. This section, as does the rest of the monitoring plan, communicates to others about your monitoring project. The background section provides the basic content for the study and includes such facts as geology, soils, land uses, channel types, and historical content.

Problem Statement, Goals, and Objectives
Summarize the information derived from Stage 1 to document the statement of the data gap to be addressed or the question to be answered.

Site Description
The site description provides the context of the sampling sites in comparison to other sites in the watershed and provides comparability to potential reference sites in other watersheds. The site description can be based on the information from maps generated during the watershed assessment such as channel habitat type, adjacent riparian condition, and elevation. Monitoring sites need to be located specifically on a topographic map so that the exact location can be described using the latitude and longitude.

Methods
The methods section describes the technical portion of the monitoring project. It documents the techniques that will be used to collect samples or field measurements, equipment and equipment calibration, what specific parameters are to be collected, and target periods. This section documents the decisions made in Stage 3 of the planning process. Quality assurance and quality control (QA/QC) are essential elements of any monitoring plan. They provide you with evidence that your data is accurate and precise enough to address the questions being asked. These elements are addressed in detail in the OPSW Water Quality Monitoring Guidebook.

Data Storage and Analysis
Thinking through this section is critical early in the monitoring process so you have the support necessary to store, transport, or analyze the data. The Oregon Department of environmental Quality has developed a data storage template that can be used to format data records (see OPSW Water Quality Monitoring Guidebook for details). Planning ahead can save time and money, and spare the agony of lost data.

Timetable and Staff Requirements
Each monitoring project will have a unique schedule of activities that must occur for it to be successful. these planning and implementation activities take time. The OPSW Water Quality Monitoring Guidebook contains general examples of the sequencing of stages and time requirements for a monitoring project.

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