COWLITZ COUNTY
Grant No. G1200052

# SHORELINE ANALYSIS REPORT

## Shorelines in Cowlitz County and the Cities of Castle Rock, Kalama, Kelso, and Woodland

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# SHORELINE ANALYSIS REPORT

COWLITZ COUNTY AND THE CITIES OF CASTLE ROCK, KALAMA, KELSO, AND WOODLAND

## 1 INTRODUCTION

### 1.1 Background and Purpose

Cowlitz County (County) and the Cities of Castle Rock, Kalama, Kelso, and Woodland obtained a grant from the Washington Department of Ecology (Ecology) in 2012 to complete a comprehensive update of their Shoreline Master Programs (SMPs), prepared through a coordinated process. One of the first steps of the update process is to inventory and characterize the County and City shorelines as defined by the State's Shoreline Management Act (SMA) (RCW 90.58). This analysis was conducted in accordance with the Shoreline Master Program Guidelines (Guidelines, Chapter 173-26 WAC) and project Scope of Work promulgated by Ecology, and the analysis addresses all unincorporated areas within the County and the incorporated Cities of Castle Rock, Kalama, Kelso, and Woodland. Under these Guidelines, the County must identify and assemble the most current, applicable, accurate and complete scientific and technical information available.

This shoreline inventory and analysis will describe existing conditions, characterize ecological functions, and describe existing and anticipated land use in the shoreline jurisdiction. This assessment of current conditions will serve as the baseline of ecological and land use conditions, and this assessment could serve as a basis for comparison for adaptive management in future SMP updates. The Guidelines require that the County and Cities demonstrate that their updated SMPs yield "no net loss" in shoreline ecological functions relative to the baseline (current condition) due to their implementation. By describing and inventorying existing conditions, this analysis will be used to help inform the development of appropriate SMP policies, regulations, and environment designations to help meet the "no net loss" goal.

## 1.2 Shoreline Jurisdiction

As defined by the Shoreline Management Act of 1971, shorelines include certain waters of the state plus their associated "shorelands." At a minimum, the waterbodies designated as shorelines of the state are streams whose mean annual flow is 20 cubic feet per second (cfs) or greater, lakes whose area is greater than 20 acres, and all marine waters. Shorelands are defined as:

> "those lands extending landward for 200 feet in all directions as measured on a horizontal plane from the ordinary high water mark; floodways and contiguous floodplain areas landward 200 feet from such floodways; and all wetlands and river deltas associated with the streams, lakes, and tidal waters which are subject to the provisions of this chapter…Any county or city may determine that portion of a one-hundred-year-floodplain to be included in its master program as long as such portion includes, as a minimum, the floodway and the adjacent land extending landward two hundred feet therefrom… Any city or county may also include in its master program land necessary for buffers for critical areas [RCW 90.58.030(d), RCW 90.58.030(d)(i). and RCW 90.58.030(d)(ii)]"

The ordinary high water mark is:

> "that mark that will be found by examining the bed and banks and ascertaining where the presence and action of waters are so common and usual, and so long continued in all ordinary years, as to mark upon the soil a character distinct from that of the abutting upland, in respect to vegetation as that condition exists on June 1, 1971, as it may naturally change thereafter, or as it may change thereafter in accordance with permits issued by a local government or the department: PROVIDED, That in any area where the ordinary high water mark cannot be found, the ordinary high water mark adjoining salt water shall be the line of mean higher high tide and the ordinary high water mark adjoining fresh water shall be the line of mean high water" (RCW 90.58.030(2)(c)).

The upstream limit of shoreline jurisdiction for streams and rivers is that point where the mean annual flow becomes less than 20 cfs. Ecology GIS data (Suggested Shoreline Points, 2010) was consulted to verify the upstream limits of stream and river shoreline jurisdiction based on the USGS's 1998 study of the 20 cfs cut-off (Kresch 1998 ). The 1998 USGS study has resulted in some expansion

of shoreline jurisdiction, both in terms of including new waterbodies as well as extending jurisdiction further upstream than previously mapped. For example, Studebaker Creek (above Castle Lake), South Coldwater Creek, Coldwater Creek, Outlet Creek, and South Fork Mill Creek have all been designated as 20 cfs streams at some point along their watercourse. Similarly, an additional 5 lakes, beyond those listed in WACs 173-20-180 and 173-20-190, are also considered Shorelines of the State based on the 20-acre criterion and the NHD GIS polygons. These include: Coldwater and Castle Lakes, located within federally owned land; Swift Number Two Forebay, which connects Swift Reservoir with Yale Lake; and Kress Lake, a 24.6-acre lake and former gravel mine located within the City of Kalama's urban growth area. Longbell Log Pond, located within Longview's planned annexation boundary, though physically meeting the criterion for a lake under Shoreline jurisdiction, was determined not to be a shoreline lake by the Department of Ecology (Appendix H).

In total, this shoreline inventory has mapped 697 miles of streams, rivers, and lakes which meet shoreline jurisdiction criteria. The total acreage of upland shorelands is 48.6 square miles; this includes floodways and associated wetlands. Federal lands make up 6.6 percent of that acreage, or 2,064 acres total. The federal entities that own the majority of the federal land are the U.S. Forest Service (USFS) and the National Park Service (NPS). State owned lands occupy another 11.4 percent of the total shoreline acreage, or 3,555 acres.

All streams and rivers which have mean annual flow of 1,000 cfs or greater are considered Shorelines of Statewide Significance. This applies to the entirety of the Columbia River, Cowlitz River, Lewis River, and mainstem Toutle River, and to the Kalama River downstream from the National Forest boundary. All lakes greater than 1,000 acres are also considered Shorelines of Statewide Significance. Merwin Lake, Yale Reservoir, and Silver Lake (each listed in WAC 173-20-190) meet this criterion. For Shorelines of Statewide Significance, the Shoreline Management Act (SMA) sets specific preferences for uses and calls for a higher level of effort in implementing its objectives. A discussion of the entire jurisdiction assessment and determination process can be reviewed in full in Appendix A of this report. The proposed jurisdiction boundaries can be found in Appendices B and C, Figure 1.

## 1.3 Study Area

The study area for this report includes all land currently within proposed shoreline jurisdiction of the County or Cities. Further, the study area includes relevant discussion of the contributing watersheds. Cowlitz County and its cities are not required to plan following the Growth Management Act (GMA)(RCW 36.70A.040), and as such the cities are not required to establish Urban Growth Areas (UGAs) and Urban Growth Boundaries (UGBs). Thus, when UGAs and UGBs are discussed in this report, the terms are used to describe planning areas that have been established through agreements with the County, or are geographic areas provided in regional data from the Cowlitz-Wahkiakum Council of Governments (CWCOG), and are not established under the GMA.

### 1.3.1 Cowlitz County

Cowlitz County encompasses 1,166 square miles and is located in the south-central part of Washington. The southern border of the County is defined by the Columbia and Lewis Rivers. The County is bordered to the southwest by the State of Oregon, to the southeast by Clark County, to the west by Wahkiakum County, to the north by Lewis County, and to the east by Skamania County. The County includes portions of four Water Resource Inventory Areas (WRIAs), including the western portion of the Lewis Watershed (WRIA 27), the Cowlitz Watershed (WRIA 26), the eastern tributaries in the Grays-Elochoman Watershed (WRIA 25), and the southern portion of the Chehalis Watershed (WRIA 23).

The County is predominantly rural in nature, with unincorporated areas comprising most of the land area. Incorporated areas of the County include the cities of Castle Rock, Kalama, Kelso, and Woodland, participating in this regional SMP, as well as the City of Longview. Cowlitz County is also home to the Cowlitz Indian Tribe.

### 1.3.2 City of Castle Rock

Castle Rock is the northernmost City in Cowlitz County. Located approximately 31 miles east of Mount St. Helens, the City is situated on the Cowlitz River, approximately 1 mile downstream from its confluence with the Toutle River. The City covers an area of 1.91 square miles, with a population of 1,982 people in the 2010 US Census. The City of Castle Rock and Cowlitz County have an Urban Growth Management agreement. The City's Urban Growth Area includes approximately 1.25 square miles of unincorporated land, with a population of approximately 160 people.

#### 1.3.3 City of Kalama

The City of Kalama is situated on the Columbia River, near the mouth of the Kalama River. The City covers an area of 2.74 square miles, and has a population of 2,344 people, according to the 2010 US Census. The City has adopted an Urban Growth Boundary that includes approximately 2.52 square miles, with a population of approximately 500 people.

#### 1.3.4 City of Kelso

The City of Kelso is located at the confluence of the Columbia and Cowlitz Rivers, and includes a portion of the Coweeman River and a portion of Owl Creek. The western border is shared with the City of Longview. The City covers 8.4 square miles, with a population of 11,925, according to the 2010 US Census. Although the City of Kelso does not have an official Urban Growth Area, the assessment unit area for the purposes of this report for Kelso includes an additional 4.48 square miles of unincorporated land. This land is identified by the Cowlitz-Wahkiakum Council of Governments Geographic Information System as a planning area for Kelso.

#### 1.3.5 City of Woodland

The City of Woodland is located on the Lewis River, near its confluence with the Columbia River. A portion of the City extends into Clark County. The City, covering 4.32 square miles (including a 2011 annexation of 483 acres), has a population of 5,509 according to the 2010 US Census, of which 5,426 live in the Cowlitz County and 83 live in Clark County. The City's Urban Growth Boundary includes 50 acres of unincorporated land, with an estimated population of 80 people using an average of 2.67 people per household.

# 2 SUMMARY OF CURRENT REGULATORY FRAMEWORK

## 2.1 Shoreline Management Act

The Shoreline Management Act of 1971 brought about many changes for local jurisdictions. The legislative findings and policy intent of the SMA states:

> "There is, therefore, a clear and urgent demand for a planned, rational, and concerted effort, jointly performed by federal, state, and local governments, to prevent the inherent harm in an uncoordinated and piecemeal development of the state's shorelines (RCW 90.58.020)."

While protecting shoreline resources by regulating development, the SMA is also intended to provide balance by encouraging water-dependent or water-oriented uses while also conserving or enhancing shoreline ecological functions and values. SMPs will be based on state guidelines, but should be tailored to the specific conditions and needs of the local community.

## 2.2 Cowlitz County

Cowlitz County adopted its first Shoreline Master Program in 1977. Shoreline uses, developments, and activities regulated under the critical areas regulations are also subject to the County's Comprehensive Plan, County Code, and various other provisions of County, state and federal laws.

The current Shoreline Master Program designations for Cowlitz County (including the Cities of Castle Rock, Kalama, Kelso, and Woodland) are briefly described below.

- **Urban:** The Urban Shoreline District includes shoreline areas suitable for intensive recreation, residential, industrial, and commercial development.
- **Rural:** The Rural Shoreline District includes shoreline areas with soil and land areas suitable for intensive agriculture, capable of recreation site development, public access, and limited residential development.
- **Conservancy:** The Conservancy Shoreline District consists of shoreline areas containing natural resources that can be harvested and naturally replenished. This includes areas which, because of flooding, slide prone soils, or other natural parameters, are not suitable for intensive agriculture or high density use.
- **Natural:** The Natural Shoreline District consists of shoreline areas with unique features that would be severely affected by human intrusions.

The County Comprehensive Plan, adopted by the Board of County Commissioners on November 1, 1976, is a statement of policies and goals that guides growth and development throughout the County. All other development ordinances, including land use, subdivision, and environmental regulations must be consistent with the Comprehensive Plan. The County is currently in the final phases of the process of drafting its Comprehensive Plan Update.

The Final Vision Report (MPC and EA Blumen 2010) of the proposed Comprehensive Plan states, "We value our strengths: our historic rural and small town character and our irreplaceable natural environment – mountains, forests, agricultural and mineral lands; streams, lakes and shorelines; and plentiful clean air and water. Conservation of these features contributes to our economic well-being, sense of place and relationship to nature."

County regulations applicable to critical areas were adopted in 1996, and subsequently revised in 2009 to be consistent with Growth Management Act (GMA) requirements to update comprehensive land use plans and development regulations every 7 years [note that Cowlitz County does not plan under the GMA; WAC 365-196-030(1)(c)]. In those regulations, the County specifies fish and wildlife conservation buffers ranging from 50 to 150 feet depending on the category of stream/waterbody (CCC Title 19), with Type S waterbodies (i.e. Shorelines of the State) having a 150-foot buffer. The regulations require wetland buffers between 25 and 300 feet based on wetland classification, level of habitat functions, and the intensity of the proposed land use (CCC Title 19). Many shoreline and wetland areas within the County contain buffers of the required widths. Smaller buffers are found where developments existed prior to the critical areas regulations or where buffers of different widths were previously established in approved site plans or protected critical area easements. Section 6.2.2 provides an evaluation of these regulations in terms of meeting the criteria of the Shoreline Guidelines (WAC 173-26).

Cowlitz County is not subject to other provisions of the State's Growth Management Act, which only apply to the largest and fastest growing counties in the state; therefore, Urban Growth Areas (UGAs) are not established on a County-wide basis, although specific UGAs have been established in association with incorporated cities, as described below.

Each of the incorporated cities below has adopted the existing Cowlitz County Shoreline Master Program.

## 2.3 City of Castle Rock

The City updated its Comprehensive Plan in 2006. Citing the significance of lands both within the City limits and in the surrounding area of influence, the Plan extends beyond the City limits to address the area within a designated Urban Growth Boundary. Cowlitz County and the City of Castle Rock entered

into an Urban Growth Area (UGA) interlocal agreement in 1984. "The Urban Growth Boundary defines the area around Castle Rock (including the city limits) within which urban-density development is encouraged and is planned for service by public sewer and water systems. The boundary also marks the boundary in which urban residential infilling of vacant land is encouraged, where annexation by the city is logical, and where coordination of services and land use decisions is obtained in conjunction with Cowlitz County." The Environment Element of the Comprehensive Plan states, "Natural amenities including the Cowlitz River, forested hillsides, riverfront property, abundant fish and wildlife and many other factors all contribute significantly to the City's atmosphere and success. This chapter attempts to balance protection of critical areas and other natural amenities with the goals and policies found throughout the comprehensive plan."

The City updated its Critical Areas Regulations in 2002. Critical Areas Regulations specify fish and wildlife habitat conservation buffers ranging from 150 to 250 feet depending on the category of stream/waterbody and mass wasting potential (CRMC 18.10.130). The regulations require wetland buffers between 25 and 300 feet based on wetland classification and the intensity of the proposed land use (CRMC 18.10.120). Section 6.2.2 provides an evaluation of these regulations in terms of meeting the criteria of the Shoreline Guidelines (WAC 173-26).

## 2.4 City of Kalama

The Kalama City Council adopted a revised Kalama Comprehensive Plan on December 7, 2005. The City of Kalama is beginning to develop a growth management area similar to an official Urban Growth Boundary to help guide its growth and development. The Comprehensive Plan includes nine general goals to balance economic growth with environmental protection.

Chapter 15.02 of the Kalama Municipal Code addresses Critical Areas Protection. Revised in 2004, Critical Areas Protection Regulations specify fish and wildlife habitat conservation buffers ranging from 25 to 250 feet depending on the category of stream/waterbody and mass wasting potential (KMC 15.02.130). The regulations require wetland buffers between 25 and 300 feet based on wetland classification and the intensity of the proposed land use (KMC 15.02.120). Section 6.2.2 provides an evaluation of these regulations in terms of meeting the criteria of the Shoreline Guidelines (WAC 173-26).

## 2.5 City of Kelso

The Comprehensive Plan for the City of Kelso was adopted in 1980, with chapter updates in 1987 and 1992. Goals in the Comprehensive Plan are directed toward ensuring economic growth and security, public access, and environmental protection. The City is currently in the process of updating its Comprehensive Plan and Development Regulations.

Critical Areas Regulations in the City of Kelso were updated in 1997. Minimum wetland buffers range from 50 to 200 feet, depending on category (KMC 18.20.080). Specific buffers are not established for Fish and Wildlife Conservation Areas, although development performance standards are identified to limit development impacts on Fish and Wildlife Conservation Standards (KMC 18.20.090). Section 6.2.2 provides an evaluation of these regulations in terms of meeting the criteria of the Shoreline Guidelines (WAC 173-26).

## 2.6 City of Woodland

The City of Woodland is subject to provisions of the GMA because a small portion of its city limits is in Clark County, a GMA county. The Woodland Urban Growth Management Program was adopted in 1981, and it was last updated in 2002.

The City's Critical Areas Regulations were updated in 2006. Standard wetland buffer widths range from 25 feet to 300 feet, depending on wetland category, habitat functions, and intensity of proposed land use (WMC 15.08.350). Riparian Habitat Area widths range from 100 feet to 250 feet depending on stream type and mass wasting potential (WMC 15.08.730-1). Section 6.2.2 provides an evaluation of these regulations in terms of meeting the criteria of the Shoreline Guidelines (WAC 173-26).

## 2.7 State Agencies and Regulations

Aside from the Shoreline Management Act, State regulations most pertinent to development in the County and Cities' shorelines include the State Hydraulic Code, the Growth Management Act (Critical Area provisions), State Environmental Policy Act, tribal agreements and case law, Watershed Planning Act, Water Resources Act, and Salmon Recovery Act. A variety of agencies (e.g., Washington Department of Ecology, Washington Department of Fish and Wildlife, Washington Department of Natural Resources) are involved in

implementing these regulations. The Department of Ecology reviews all shoreline projects that require a shoreline permit, but has specific regulatory authority over shoreline conditional use permits and shoreline variances. Other agency reviews of shoreline developments are typically triggered by in- or over-water work, discharges of fill or pollutants into the water, or substantial land clearing.

Depending on the nature of the proposed development, state regulations can play an important role in the design and implementation of a shoreline project, ensuring that impacts to shoreline functions and values are avoided, minimized, and/or mitigated. During the comprehensive SMP update, the County and Cities will consider other state regulations to ensure consistency as appropriate and feasible with the goal of streamlining the shoreline permitting process. A summary of some of the key state regulations and/or state agency responsibilities follows.

**Section 401 Water Quality Certification:** Section 401 of the federal Clean Water Act allows states to review, condition, and approve or deny certain federal permitted actions that result in discharges to State waters, including wetlands. In Washington, the Department of Ecology is the State agency responsible for conducting that review, with their primary review criteria of ensuring that State water quality standards are met. Actions within streams or wetlands within the shoreline zone that require a Section 404 permit (see Section 2.8) will also need to be reviewed by Ecology.

**Washington Department of Natural Resources:** Washington Department of Natural Resources (WDNR) is charged with protecting and managing use of state-owned aquatic lands. Toward that end, water-dependent uses waterward of the ordinary high water mark require review by WDNR to establish whether the project is on state-owned aquatic lands. Certain project activities, such as single-family or two-party joint-use residential docks, on state-owned aquatic lands are exempt from these requirements. WDNR recommends that all proponents of a project waterward of the ordinary high water mark contact WDNR to determine jurisdiction and requirements.

**Watershed Planning Act:** The Watershed Planning Act of 1998 (Chapter 90.82 RCW) was passed to encourage local planning of local water resources, recognizing that there are citizens and entities in each watershed that "have the greatest knowledge of both the resources and the aspirations of those who live

and work in the watershed; and who have the greatest stake in the proper, long-term management of the resources."

Cowlitz County is within four watershed basins. The planning staff from the County and the City of Kelso were involved in the development of the Grays-Elochoman and Cowlitz Watershed Management Plan (WRIA 25-26) and the Salmon-Washougal and Lewis Watershed Management Plan (WRIA 27-28). Over a period from 1999 to 2004, this Planning Unit undertook an assessment of water resource conditions, commissioned a series of technical memoranda on water resource issues and solutions, and oversaw preparation of the Management Plan. The Plans were completed in July 2006.

**Hydraulic Code:** Chapter 77.55 RCW (the Hydraulic Code) gives the Washington Department of Fish and Wildlife (WDFW) the authority to review, condition, and approve or deny "any construction activity that will use, divert, obstruct, or change the bed or flow of State waters." These activities may include stream alteration, culvert installation or replacement, pier and bulkhead repair or construction, among others. WDFW can condition projects to avoid, minimize, restore, and compensate adverse impacts.

**Water Pollution Control Act:** Chapter 90.48 RCW establishes the State's policy "to maintain the highest possible standards to insure the purity of all waters of the State consistent with public health and public enjoyment thereof, the propagation and protection of wild life, birds, game, fish and other aquatic life, and the industrial development of the State, and to that end require the use of all known available and reasonable methods by industries and others to prevent and control the pollution of the waters of the State of Washington." The Department of Ecology is the agency charged with crafting and implementing rules and regulations in accordance with this legislation.

## 2.8 Federal Regulations

Federal regulations most pertinent to development in the County and Cities' shorelines include the Endangered Species Act, the Clean Water Act, and the Rivers and Harbors Appropriation Act. Other relevant federal laws include the National Environmental Policy Act, Anadromous Fish Conservation Act, Clean Air Act, and the Migratory Bird Treaty Act. A variety of agencies (e.g., U.S. Army Corps of Engineers [Corps], National Marine Fisheries Service, U.S. Fish and Wildlife Service) are involved in implementing these regulations, but review

by these agencies of shoreline development in most cases would be triggered by in- or over-water work, or discharges of fill or pollutants into the water. Depending on the nature of the proposed development, federal regulations can play an important role in the design and implementation of a shoreline project, ensuring that impacts to shoreline functions and values are avoided, minimized, and/or mitigated. During the comprehensive SMP update, the County and Cities will consider other federal regulations to ensure consistency as appropriate and feasible with the goal of streamlining the shoreline permitting process. A summary of some of the key federal regulations and/or federal agency responsibilities follows.

**Section 404:** Section 404 of the federal Clean Water Act provides the Corps, under the oversight of the U.S. Environmental Protection Agency, with authority to regulate "discharge of dredged or fill material into waters of the United States, including wetlands" (http://www.epa.gov/owow/wetlands/pdf/reg_authority_pr.pdf). The extent of the Corps' authority and the definition of fill have been the subject of considerable legal activity. As applicable to the County's shoreline jurisdiction, however, it generally means that the Corps must review and approve most activities in streams and wetlands. These activities may include wetland fills, stream and wetland restoration, and culvert installation or replacement, among others. Similar to SEPA requirements, the Corps is interested in avoidance, minimization, restoration, and compensation of impacts.

**Section 10:** Section 10 of the federal Rivers and Harbors Appropriation Act of 1899 provides the U.S. Army Corps of Engineers (Corps) with authority to regulate activities that may affect navigation of "navigable" waters. Designated "navigable" waters in Cowlitz County include the Columbia River, including Burke, Coal Creek, Fisher Island, and Martin Island Sloughs and Carrolls Channel, Lewis River (lower 18 miles, including Horseshoe Lake), Cowlitz River (35.5 miles), Kalama River (lower 4 miles), Abernathy Creek (lower 0.3 mile), and Coweeman River and Sloughs (lower 4 miles). Accordingly, proposals to construct new or modify existing over-water structures (including bridges), to excavate or fill, or to "alter or modify the course, location, condition, or capacity of" navigable waters must be reviewed and approved by the Corps.

**Federal Endangered Species Act (ESA):** Section 9 of the ESA prohibits "take" of listed species. Take has been defined in Section 3 as: "harass, harm, pursue,

hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." The take prohibitions of the ESA apply to everyone, so any action that results in a take of listed fish or wildlife would be a violation of the ESA and is strictly prohibited. Per Section 7 of the ESA, activities with potential to affect federally listed or proposed species and that either require federal approval, receive federal funding, or occur on federal land must be reviewed by the National Marine Fisheries Service (NOAA Fisheries) and/or U.S. Fish and Wildlife Service (USFWS) via a process called "consultation." Activities requiring a Section 10 or Section 404 permit also require such consultation if these activities occur in waterbodies with listed species. Since the listing of chinook salmon, coho salmon, chum salmon, sockeye salmon, steelhead trout, and bull trout as Threatened under the ESA, the Corps, NOAA Fisheries and USFWS have jointly developed a number of Regional General Permits (RGPs) or programmatic consultations to streamline permitting of projects in waterbodies containing listed fish (e.g. RGP 8: Restoration on Forest Service Lands).

**Clean Water Act**: The federal Clean Water Act has a number of programs and regulatory components, but of particular relevance to Cowlitz County is the National Pollutant Discharge Elimination System (NPDES) program. In Washington State, the Department of Ecology has been delegated the responsibility by the U.S. Environmental Protection Agency for managing implementation of this program. The County is engaged in compliance with the NPDES Phase II Municipal Stormwater General Permit requirements that address stormwater system discharges to surface waters.

## 2.9 PacifiCorp Shoreline Management Plan

As a part of its Federal Energy Regulatory Commission relicensing process, PacifiCorp developed a Shoreline Management Plan in 2008 for the three major reservoirs in the upper Lewis River. The PacifiCorp Shoreline Management Plan applies to lands extending from the OHWM to the elevation 10 feet above the OHWM. PacifiCorp owns many of the lands within the Shoreline Management Plan boundary area, and it holds flowage easements on the other lands.

The PacifiCorp Shoreline Management Plan does not impose a duty or regulation on Cowlitz County and has not been developed to meet the "No Net Loss" standard, as required of the updated Shoreline Master Program plans; nevertheless, the PacifiCorp plan has many parallels that are consistent with the Shoreline Management Act requirements. The plan identifies three shoreline

classifications: Integrated Use, Project Works, and Resource Management. The majority of shoreline area is designated as Resource Management classification. The Plan identifies permitted and prohibited uses in each shoreline classification.

The PacifiCorp use matrix is replicated in Table 2-1, below.

**Table 2-1. Use matrix for the PacifiCorp Shoreline Management Plan shoreline classifications.**

| Uses and Facilities | Integrated Use | Resource Management | Project Operations |
|---|---|---|---|
| Multi-boat slips | YES | NO | NO |
| Community Docks | YES | NO | NO |
| Single Family docks | YES | NO | NO |
| Retaining walls | YES | NO | NO |
| Shoreline stabilization measures | YES | Only natural or bio control measures allowed | NO |
| Boat ramps | YES | NO | NO |
| Marine trestles, railways, trams & lifts | YES | NO | NO |
| Moorings | YES | YES | NO |
| Dredging | YES | NO | NO |
| Log booms | YES | YES | NO |
| Structures to accommodate municipal/agricultural water withdrawal & discharges | YES | YES | NO |
| Structures to accommodate private/residential water withdrawal | YES | YES | NO |
| Scientific Instrumentation | YES | YES | YES |
| Vegetation removal | YES | YES | NO |
| Vegetation plantings | YES | YES | NO |
| Stairways & walkways | YES | YES | NO |
| Footpaths | YES | YES | NO |
| Public Recreation Sites | YES | NO | NO |
| Fish/wildlife support activities & devices | YES | YES | YES |
| ≤ 50% In kind repair or replacement of Permitted Use within existing footprint | YES | YES | YES |
| Temporary Uses | YES | YES | YES |

# 3 INVENTORY AND ANALYSIS METHODS

## 3.1 Inventory Sources

Development of a shoreline inventory is intended to record the existing or baseline conditions to aid in the development of shoreline master program provisions and to ensure the adopted regulations provide no net loss of shoreline ecological functions. At a minimum, local jurisdictions shall gather the inventory elements listed in the Guidelines, to the extent information is relevant and readily available. Collected information included Watershed Resource Inventory Area (WRIA) documents, Cowlitz County studies, City documents, scientific literature, personal communications, aerial photographs, internet data, Geographic Information Systems (GIS) data from a variety of data providers. Historical aerial photographs were consulted to compare past and present conditions to assess the changes that have occurred in the County's shorelines and assess the cumulative impacts of existing development. Table 3-1 lists those relevant inventory elements for which data is available for the County and Cities' shorelines. The table also describes the information collected for each of the required inventory elements. Map figures are provided in the Map Folio (Appendices B and C), and they depict the various inventory pieces listed in the table, as well as additional analysis. Data gaps and limitations are discussed further in Section 3.2.

**Table 3-1. Shoreline inventory elements and information sources.**

| Inventory Element | Information Gathered | Data Source | Use/Assumptions/Limitations |
|---|---|---|---|
| Land Use Patterns | Current land use and land ownership | Cowlitz County, Parcel data 2012 | • Useful in assessing existing intensity and type of development at broad scale planning level (Figure 2, Appendices B and C)<br>• Gross scale characterization (e.g., urban, forest, rural/ag)<br>• Identifies publicly owned land by agency (e.g., USFS, WA Parks, County, City) (See Land Ownership, Figure 3, Appendix B and Figure 5 Appendix C)<br>• Identifies existing vacant lands (see Analysis of Future Land Use, Section 3.4.2, as well as Figure 4, Appendix B and Figure 6 Appendix C). |
| | Zoning | Cowlitz County | • Latest County zoning data is not available in GIS format, so a scanned copy of the official County zoning map is used for the map folio. (See Appendix E)<br>• Shoreline jurisdiction is not indicated on the County zoning map. |
| | | City of Castle Rock, 2012 | • City zoning applies only within city limits, and does not include UGAs (See Figure 4, Appendix C) |
| | | City of Kalama, 2007 | |
| | | City of Kelso, 2009 | |
| | | City of Woodland, 2005 | |
| | Future land use (Comprehensive Plan) | Overall | • Useful in planning to accommodate future land use changes at broad scale planning level<br>• Based on area-wide categorization- includes roads, easements, and utilities |

| Inventory Element | Information Gathered | Data Source | Use/Assumptions/Limitations |
|---|---|---|---|
| | | Cowlitz County | • County is presently undergoing an update of its Comprehensive Plan<br>• Official County Comprehensive Plan Map is not available in GIS, so an electronic version of the official County Comprehensive Plan map is used for the map folio (Appendix D).<br>• Shoreline jurisdiction is not indicated on the County comprehensive plan map. |
| | | City of Castle Rock, 2006 | • Data reflect future land use planning with the City limits and UGB. |
| | | City of Kalama, 2005 | • Data reflect future land use planning within City limits only; data do not include UGB area. |
| | | City of Kelso, 2009 | • Data reflects future land use planning within City limits only; data do not include UGB area.<br>• The City is currently in the process of updating its Comprehensive Plan and Development Regulations. |
| | | City of Woodland, 2011 | • Data reflect future land use planning with the City limits and UGB. |
| | Existing SMP | Cowlitz County, 1976 | • Cities have all adopted Cowlitz County SMP.<br>• Existing SMP will be revised.<br>• Existing Environment Designations Map is not included in the Inventory maps. |

| Inventory Element | Information Gathered | Data Source | Use/Assumptions/Limitations |
|---|---|---|---|
| Public Access Areas | • Parks<br>• Cowlitz County, WA Regional Trail System<br>• Boat Launches (handheld and motorized)<br>• Public Lands<br>• Forest Service Lands<br>• Utilities corridors | • Cowlitz County (Parks, Boat launches)<br>• Cowlitz County, Cities of Longview, Kelso, Kalama, Woodland, and Castle Rock,<br>• Washington State Parks and Recreation, 2012<br>• USDA Forest Service, 1999 | • Includes established parks and recreation sites<br>• County boat launch data has been updated to be consistent with County parks master plan document<br>• Public lands data from DNR is dated 2009 and might not be up-to-date.<br>• Trail data depicts general location of existing and proposed trails as adopted in the Cowlitz Regional Trails Plan, current through April, 2012.<br>• Mapping of public access areas does not include all WDFW water access sites which are depicted on the WDFW website. Notes have been added to public access descriptions within Chapter 5. |
| Impervious Surfaces | General impervious surface | NOAA Coastal Change Analysis Program (satellite imagery interpretation at 30-m resolution, developed to meet an 85% accuracy specification), 2006 | • Based on interpretation of multispectral imagery at 30 x 30 meter cell resolution (Figure 6, Appendix B and Figure 8 Appendix C).<br>• Useful for broad scale assessment of impervious surface coverage<br>• Data captures impervious surfaces (e.g., rooftops, roads, parking lots), but may not capture areas with reduced infiltration potential (e.g., compacted areas)<br>• May overestimate or underestimate impervious surface coverage<br>• Not useful for accurate characterization of fine scale data (e.g., City or parcel level) |

| Inventory Element | Information Gathered | Data Source | Use/Assumptions/Limitations |
|---|---|---|---|
| Vegetation | • Terrestrial vegetation type and land cover<br>• Forest Cover (Cities and UGAs only) | • Unincorporated Cowlitz County: NOAA Coastal Change Analysis Program (satellite imagery interpretation at 30-m resolution, developed to meet an 85% accuracy specification), 2006<br>• Cities and unincorporated areas within Urban Growth Boundaries: Forested vegetation digitized based on 2011 NAIP aerial photography | • Based on interpretation of multispectral imagery at 30 x 30 m cell resolution (Figure 7 Appendix B and Figure 9 Appendix C)<br>• Useful for broad scale assessment of vegetation coverage<br>• Not useful for accurate characterization of fine scale data (e.g., City or parcel level, species composition)<br>• For cities and UGBs, visual interpretation of satellite imagery is confounded by the presence of shadows, which may result in a slight overestimate of total forested area. |
| Frequently Flooded Areas | • Floodplains<br>• Floodways | • Unincorporated Cowlitz County: FEMA, Q3, 1996, GIS data from Department of Ecology<br>• Incorporated Cities: Draft Digital Flood Insurance Rate Map (DFIRM) FEMA, 2010, GIS data from CWCOG | • Q3 map does not reflect the most current flooding conditions (Figure 8 Appendix B).<br>• The draft DFIRM has not been finalized, and the County is contesting the draft DFIRM because of inaccuracies in specific areas, but it does represent the most recent attempt to capture existing flooding conditions (Figure 10 Appendix C). |
| Channel Migration Zone | • Floodplains<br>• Natural and artificial barriers to channel movement<br>• Roads | • Unincorporated Cowlitz County: FEMA, Q3, 1996, GIS data from Department of Ecology<br>• Incorporated Cities: Draft Digital Flood Insurance Rate Map (DFIRM) FEMA, 2010, GIS data from CWCOG | • Channel migration zone (CMZ) data is not available; therefore the 100 year floodplain was used as a proxy for the CMZ except where areas are separated from the channel by a legally existing artificial structure (Figure 9 Appendix B and Figure 11 Appendix C).<br>• Visual spot checks of aerial photos were used to identify locations where historic migration extends outside the floodplain (e.g. Toutle River sediment plain). |

| Inventory Element | Information Gathered | Data Source | Use/Assumptions/Limitations |
|---|---|---|---|
| Wetlands | Potential wetlands | U.S. Fish and Wildlife Service National Wetland Inventory, 2012 (based on 1979 delineation)<br>USDA NRCS Hydric Soils map, 1989 | • Useful for broad scale assessment of soil conditions and potential wetlands (Figure 10 Appendix B and Figure 12 Appendix C)<br>• NWI mapping based on interpretation of multi-spectral imagery<br>• Hydric soils based on broad scale soil mapping, not mapped in inventory because NWI tends to be more accurate.<br>• Many wetlands are not identified by NWI or hydric soils mapping; mapped wetlands may not meet wetland criteria.<br>• Not to be used in place of site-specific studies |
| Surface water | Surface water flowlines (includes streams, rivers, canals, ditches, springs, seeps, and artificial water paths)<br>Waterbodies (includes lakes, ponds, reservoirs, swamps, and marshes) | USGS, National Hydrography Dataset (NHD), 2011 | • Small, intermittent or ephemeral streams may not be identified in data (Figure 11 Appendix B and Figure 13 Appendix C)<br>• Upper Chehalis River (drainage basin) is excluded from this dataset<br>• Interactive map includes stream typing http://fortress.wa.gov/dnr/app1/fpars/viewer.htm |
| Surficial Geology | Geologic classifications | WA Department of Natural Resources, Division of Geology and Earth Resources, Surface Geology, June 2010 | • Based on broad scale geologic classifications (Figure 12 Appendix B and Figure 14 Appendix C)<br>• Useful for broad scale assessment of geologic conditions<br>• Not to be used in place of site-specific studies |
| Soils | Soil types | USDA NRCS (SSURGO), 1989 | • Based on broad scale soil mapping (Figure 13 Appendix B and Figure 15 Appendix C)<br>• Useful for broad scale assessment of soil conditions<br>• Not to be used in place of site-specific studies<br>• Per County Code, aquifer recharge areas are determined by mapped soil type. |

| Inventory Element | Information Gathered | Data Source | Use/Assumptions/Limitations |
|---|---|---|---|
| Geologically hazardous areas | • Slope stability<br>• Landslide hazard areas<br>• Seismic and tsunami hazard areas | Washington Department of Natural Resources, Geology and Earth Sciences Division, 2010 | • Useful for broad scale assessment of geologically hazardous areas (Figure 14 Appendix B and Figure 16 Appendix C)<br>• Specific type of geohazard (e.g., steep slope, seismic hazard) is not mapped<br>• Data are primarily DNR derived landslide hazard areas.<br>• Requires site-specific review to verify presence/absence of geohazards |
| WDFW Priority Habitats & Species (PHS) | • Priority fish, priority wildlife, priority habitats<br>• Intertidal vegetation | • WA Department of Fish and Wildlife, PHS, 2010<br>• WA Department of Fish and Wildlife, SalmonScape, 2012 | • Mapping of PHS information is presented in three maps to depict habitat regions, species and fish presence (Figures 15-17 Appendix B and Figures 17-19 Appendix C).<br>• WDFW maps do not capture every priority species location or habitat, particularly for rare species or species that use shoreline habitats seasonally or intermittently<br>• Absence of mapping information does not indicate absence of a particular species<br>• The number of documented species may reflect the relative amount of past survey efforts<br>• New data will need to be obtained at the time of a project application<br>• Interactive PHS and salmonid data available at http://wdfw.wa.gov/mapping/phs/ and http://wdfw.wa.gov/mapping/salmonscape/ |

| Inventory Element | Information Gathered | Data Source | Use/Assumptions/Limitations |
|---|---|---|---|
| Shoreline Modifications | • Docks and other overwater structures<br>• Levees<br>• Shoreline Stabilization within UGAs<br>• Dams<br>• Fish Passage Barriers | • WA Department of Natural Resources Shorezone dataset, 2007<br>• Department of Ecology, 2012<br>• Interpretation of aerial photography<br>• WDFW Salmonscape, 2012<br>• | • Overwater structures may include piers, docks, boatlifts, moorage covers, and bridges (Figure 18 Appendix B and Figure 20 Appendix C)<br>• Shoreline stabilization is a data gap at the County-scale<br>• Shoreline stabilization will be identified on a parcel by parcel basis using interpretation of aerial photography, and information will not be mapped, but will be reported by percentage of reach length.<br>• Levee data from the US Corps of Engineers and the Federal Emergency Management Agency was compiled by the Department of Ecology, with additional local/regional input. Uncertified levees and berms may not all be represented.<br>• Dam locations are represented by point data in the general vicinity of the actual dam.<br>• Interactive map of fish passage barriers is available at http://wdfw.wa.gov/mapping/salmonscape/<br>• Current understanding of known or potential fish passage barriers is incomplete. |
| Water quality impairment | 303(d) waters and regulated sites | WA Department of Ecology, Water Quality Assessment 305(b) Report, 2008 | • Only Category 4 and 5 waters are depicted in the map folio (Figure 19 Appendix B and Figure 21 Appendix C).<br>• Water quality impairments are based on monitoring at specific locations<br>• Impairments may extend beyond the mapped area |
| Wastewater facilities/ Stormwater facilities | Data not incorporated | | • This data was initially incorrectly not requested. Cowlitz County GIS and the Cowlitz-Wakiakum Council of Governments later offered the data, but it was not incorporated. |

| Inventory Element | Information Gathered | Data Source | Use/Assumptions/Limitations |
|---|---|---|---|
| Restoration opportunities | Site-specific and general projects | • EDT reaches, LCFRB (2010)<br>• Habitat Work Schedule (hws.ekosystem.us)<br>• Local staff provided information | • Identification of restoration opportunities is underway and are preliminarily reported in Chapter 5.<br>• Mapping of restoration opportunity locations are not included in this map set.<br>• This report will provide a preliminary look at restoration opportunities; however, restoration opportunities are not limited to those identified in this report, and restoration opportunities will be pursued further in the Shoreline Restoration Plan. |
| Historical Sites | Historical places available as point data, but not mapped in inventory | WA Department of Archaeology and Historic Preservation, Washington State Heritage Register, 2009 | • Data not mapped in shoreline inventory report<br>• Data represent only known sites; additional, presently unknown sites may exist |

## 3.2 Assessment Units

For the purpose of describing the shoreline inventory, analysis, and characterization, the County was divided by major river basin or watershed into various assessment units; because the Columbia River extends across three out of the four watersheds in the County, the Columbia River is addressed as a separate assessment unit. Similarly, because the Lewis River and Kalama River each consist of distinct basins entering the Columbia River, these two river basins will be addressed separately. The Cowlitz River Assessment Unit includes both the Toutle and Coweeman Rivers. Furthermore, because the scale of land use distinctions and management decisions is finer on the city-scale compared to the county-scale, each participating city and unincorporated areas identified by the Cowlitz-Wahkiakum Council of Governments as its Urban Growth Boundary (UGB) are addressed as separate assessment units. As described above, only the city of Castle Rock has an official UGB. The UGB areas shown for Kelso, Woodland, and Kalama are for general planning purposes. Based on this approach, County shorelines were divided into the following 10 assessment units.

1- Columbia River
2- Lewis River
3- Kalama River
4- Cowlitz River
5- Mill, Abernathy, and Germany Creeks
6- South Fork Chehalis River
7- City of Castle Rock and UGB
8- City of Kalama and UGB
9- City of Kelso and UGB
10- City of Woodland and UGB

The assessment unit discussions and calculations do not include data for the incorporated area of Longview, which is engaged in a separate SMP update process.

## 3.3 Ecological Characterization

### 3.3.1 Data Sources, Assumptions, and Data Gaps

The following discussion identifies assumptions and limitations for each of the inventory elements, and may provide a brief Countywide or watershed-wide

narrative where qualitative descriptions provide more information than quantitative measures. Despite data gaps and limitations, a substantial quantity of information is available for the shorelines of Cowlitz County to aid in the development of the inventory and analysis report, as well as the shoreline master program.

***Impervious Surfaces***

Impervious surface data was generated using NOAA's C-CAP classification (2006) of multispectral satellite imagery with 30x30-meter cell resolution. Given the relatively broad spatial resolution of the data, in cases where only a portion of cell coverage is impervious surface, the impervious surfaces may or may not be detected. With this limitation in mind, a comparison of impervious surface coverage among reaches provides useful information on broad scale spatial trends in impervious surface coverage.

***Vegetation***

The countywide vegetation data was generated using multi-spectral satellite imagery with 30x30-meter cell resolution. Spectral data was classified using NOAA's C-CAP classification. Maps of vegetative cover are found in Appendices B and C (Land Cover). Similar to the impervious surface coverage, the classification may over or under represent coverage when the type of coverage within cells is mixed. Documented non-vegetated areas in shorelines are open water, bare land, and perennial ice/snow. Because the ordinary high water mark changes over time, particularly in large, dynamic river systems, water is occasionally included within the total shoreline area used for the calculation of vegetation coverage. Any area identified as "Water" was excluded from the calculation of vegetation coverage.

The spatial resolution of the C-CAP data provides a good foundation for broad scale assessment of vegetation coverage. Its utility is higher in rural areas where vegetative cover is more uniform over broad areas compared to more developed Urban Growth Areas. In order to provide a more accurate representation of vegetative functions in incorporated cities and their UGBs, forested vegetation within UGBs was identified by visual interpretation of satellite imagery. While this data provides increased accuracy compared to the C-CAP data, visual interpretation is confounded by the presence of shadows, which may result in a slight overestimate of total forested area.

***Frequently Flooded Areas***

For all practical purposes, "frequently flooded areas" are those areas within the 100-year floodplain. Floodplain and floodway maps were developed using FEMA's Q3 map for unincorporated Cowlitz County. FEMA released a preliminary update to the digital Flood Insurance Rate Map (DFIRM) for Cowlitz County in May of 2012, and the draft DFIRM map results in an expansion of floodplain and floodway area compared to the presently adopted Q3 map. In developing the draft DFIRM, FEMA concentrated its efforts in the populated areas, thus the data is more accurate in the more highly developed areas such as the cities. However, based on potential concerns about mapping in less densely populated unincorporated areas, the County has contested the draft DFIRM map, and, therefore, the draft DFIRM was not used to represent frequently flooded areas in unincorporated areas of the County (including unincorporated UGA areas). Within the incorporated cities, FEMA's draft DFIRM data was acceptable to the cities and used per the direction of city staff. When future releases are available from FEMA the County will evaluate the area currently using the Q3 data and will determine whether to adopt the new DFIRM elevations at that time.

***Channel Migration Zone***

Channel Migration Zone data is not available for shorelines within Cowlitz County. For the purpose of this analysis report, the 100-year floodplain data, as described above, is being used as a proxy for the CMZ extent with the following conditions per WAC 173-26-221(3)(b):

- Within incorporated municipalities and urban growth areas:
    - Where available data indicates areas separated from the active river channel by legally existing artificial channel constraints that limit channel movement, those areas are excluded from the channel migration zone.
    - All areas separated from the active channel by a legally existing artificial structure(s) that is likely to restrain channel migration, including transportation facilities, built above or constructed to remain intact through the one hundred-year flood, will not be considered to be in the channel migration zone.
- In areas outside incorporated municipalities and urban growth areas, channel constraints and flood control structures built below the one

hundred-year flood elevation do not necessarily restrict channel migration and are included in the channel migration zone unless demonstrated otherwise.

- Where a visual spot check of aerial photos identifies historic migration outside the floodplain, those areas are considered within the channel migration zone. This is specific to the Toutle River where the sediment plain is a clear expansion of the Q3 FEMA floodplain. The CMZ was adjusted to expand to the outer edge of the sediment plain in the Toutle River.

In general – we expect that this approach may slightly over-estimate the CMZ in flatter lowland areas and slightly under-estimate the CMZ in high gradient mountainous areas.

***Wetlands***

Wetland mapping was assembled from the National Wetlands Inventory (NWI). Cowlitz County has not completed a County-wide inventory of potential wetlands and therefore the NWI dataset is being used as the most relevant and useful information. The NWI dataset was based on many factors, including soil inventories and aerial interpretations. Although it is very comprehensive and is fairly accurate in approximating wetland locations, it is acknowledged that many wetlands, especially small wetlands, are not identified by NWI. Likewise, some areas identified as NWI wetlands may not meet truly meet wetland criteria. Additionally, some wetlands may have been filled and others created as mitigation since the data was last updated. Whether or not they are captured by this mapping effort, actual wetland conditions that may or may not be found on a site will determine shoreline jurisdiction (as a potential shoreline associated wetland) on a site-specific basis.

***Soils***

Soil data are derived from the Natural Resource Conservation Service (NRCS) national soil survey. The Soils Survey Geographic (SSURGO) database was used in the analysis of functions to characterize soil erodibility, ranging from slight to very severe for off-road and off-trail uses. The survey also provides available water supply within the first meter of soil depth, which is calculated as the total volume of water in milliliters that should be available to vegetation when the soil is at field capacity. Finally, the forest productivity index provides soil-based information on the volume of wood fiber that is likely to be produced by the

most important tree species. Each of these calculations is based on soil characteristics, and not on climate or specific location, so the indices provide a broad scale sense of soil characteristics, but they are not useful at a site scale, and the actual conditions of a site may function differently than predicted by the indices based on actual rainfall, aspect and location.

***Geologically Hazardous Areas***

Maps of geologically hazardous areas were developed using WDNR data. Presumably, WDNR based those designations on topographic information and soil types as catalogued by the Natural Resources Conservation Service (NRCS).

The presence of geologically hazardous areas in shorelines can be a factor in determining suitability of the area for certain activities, including restoration and development. Human safety is an important concern for development in geologically hazardous areas. In addition, geologically hazardous areas can be important sources of large woody debris and sediment to the aquatic system, the latter to the benefit or detriment of aquatic life.

***Fish and Wildlife Habitat Conservation Areas***

WDFW Priority Habitat and Species maps are presented as three separate units: Habitat Regions (species or habitat ranges by area), Habitat Species (precise species locations; and Fish (fish species location by waterbody and extent presence upstream).

These maps do not capture every priority species location or habitat in shoreline jurisdiction, particularly rare species or species that use the water for foraging and drinking, but that nest or den farther from the shoreline. Absence of mapping information does not indicate that a particular species does not or could not utilize the shoreline or adjacent lands. Furthermore, the number of documented species may reflect the relative amount of past survey efforts rather than the presence or absence of suitable habitat.

***Shoreline Modifications***

Shoreline modifications are human-caused alterations to the natural water's edge. The most common types of shoreline modifications include overwater structures and shoreline armoring.

The Washington Department of Natural Resources (DNR) has digitized piers and other in-water structures such as boatlifts, boathouses, and moorage covers for

some waterbodies, such as Silver Lake. However, some waterbodies, such as Horseshoe Lake, have not been included in this dataset.

Although not technically overwater structures, boat ramps are also included in the DNR dataset for overwater structures. The dataset does not differentiate between each of these various types of overwater structures; therefore, reporting of overwater cover encompasses more than just piers, docks, and floats.

Countywide data were not available for shoreline stabilization in Cowlitz County. However, data from the Department of Ecology does identify the locations of levees.

For the purpose of the shoreline analysis, but not included in the shoreline inventory maps the proportion of shoreline stabilization and the presence and type of overwater structures was estimated on a parcel by parcel basis within UGAs using visual interpretation of aerial photography. Such estimates are likely to underestimate total shoreline stabilization, particularly bioengineered shoreline stabilization measures that are not apparent from an overhead aerial view. Estimates of overwater structures do not include bridges, and results will also likely underestimate the actual number of structures because some structures may be obscured by tree cover or have been installed more recently that the aerial photograph.

***Water Quality***

As a requirement of Section 303(d) of the federal Clean Water Act that all waterbodies be "fishable and swimmable," Ecology classifies waterbodies into five categories:

Category 1: Meets tested standards,
Category 2: Waters of concern,
Category 3: No data,
Category 4: polluted waters that do not require a TMDL, and
Category 5: polluted waters requiring a TMDL.

Individual waterbodies are assigned to particular "beneficial uses" (public water supply; protection for fish, shellfish, and wildlife; recreational, agricultural, industrial, navigational and aesthetic purposes). Waterbodies must meet certain numeric and narrative water quality criteria established to protect each of those established beneficial uses. Waterbodies may provide more than one beneficial use, and may have different levels of compliance with different criteria for those

beneficial uses in different segments of the stream or lake. As a result, many waterbodies may be on the 303(d) list for more than one parameter, and listings may occur in several distinct reaches of a given waterbody.

As presented in the Water Quality map of Appendices B and C, only Category 4 and 5 waters are depicted. For more information on specific waterbodies and their water quality classifications, Ecology provides an interactive on-line viewer at the following website: http://apps.ecy.wa.gov/wqawa2008/viewer.htm.

***Aquifer Recharge Areas***

Aquifer recharge areas were mapped showing areas of moderate and sever sensitivity. Mapped areas represent known areas of aquifer recharge, but areas not identified as sensitive aquifer recharge areas may also have close groundwater connections to aquifer areas.

### 3.3.2 Functional Evaluation Approach, Rationale and Limitations

A GIS-based quantitative method was developed to characterize the relative performance of relevant watershed ecological processes and functions by shoreline reach, as outlined in WAC 173-26-201(3)(d)(i). This assessment used the available information gathered as part of the Shoreline Inventory and applied a standardized ranking criterion for each independent shoreline reach to provide a consistent methodological treatment among reaches. These numerical results will ensure consistent and well-documented treatment of all reaches when assessing existing ecological conditions and reduce observer bias associated with the subjective assignment of ecological value. The numerical results are intended to complement the inventory information in Chapters 3 and 4 and the brief narrative discussions developed using the available data. ***Functional scores should not be viewed as an absolute measure of existing ecological function.***

***Reach Delineation***

In order to assess shoreline functions at a local scale, the ten assessment units within the county were broken into discrete reaches based on a review of maps and aerial photography. Initial breaks were made at city boundaries and UGBs.

The following methods were used to determine where to divide reaches when city boundaries or UGBs generally parallel but are located landward of the mapped OHWM. It should be noted that when a municipal boundary and mapped extent of shoreline jurisdiction end at the OHWM, that jurisdiction's regulatory authority extends past the OHWM to the centerline of each lake and river per RCW 35.21.160.

- If no parcel is mapped waterward of a city's boundary, the area waterward of the city boundary to the centerline of the stream is included in the City's shoreline reach and jurisdiction and addressed in the City/UGB assessment unit (See example in Figure 3-1).

- If a mapped parcel occurs waterward of a city's boundary and/or UGB and landward of the OHWM, that area is included in the unincorporated County assessment unit and is under the County's jurisdiction and included in the nearest County reach (See example in Figure 3-2).

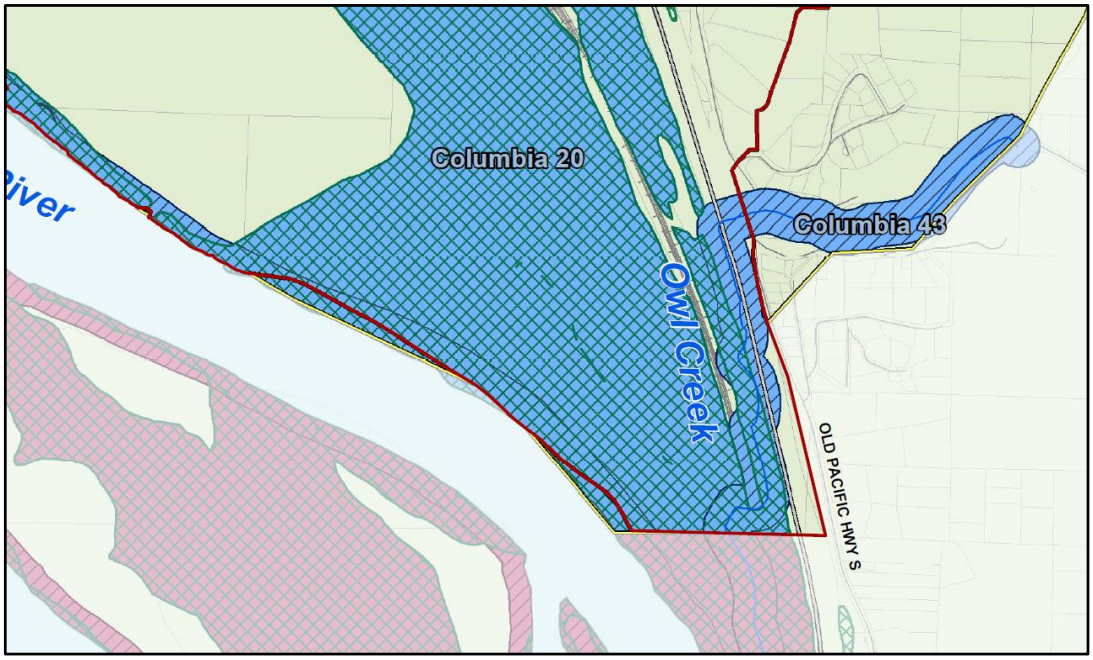


**Figure 3-1. Example of reach break scenario where no parcel is mapped waterward of the city/UGA boundary. In this case, lands to centerline of river are under the City's jurisdiction and included in the City reach.**

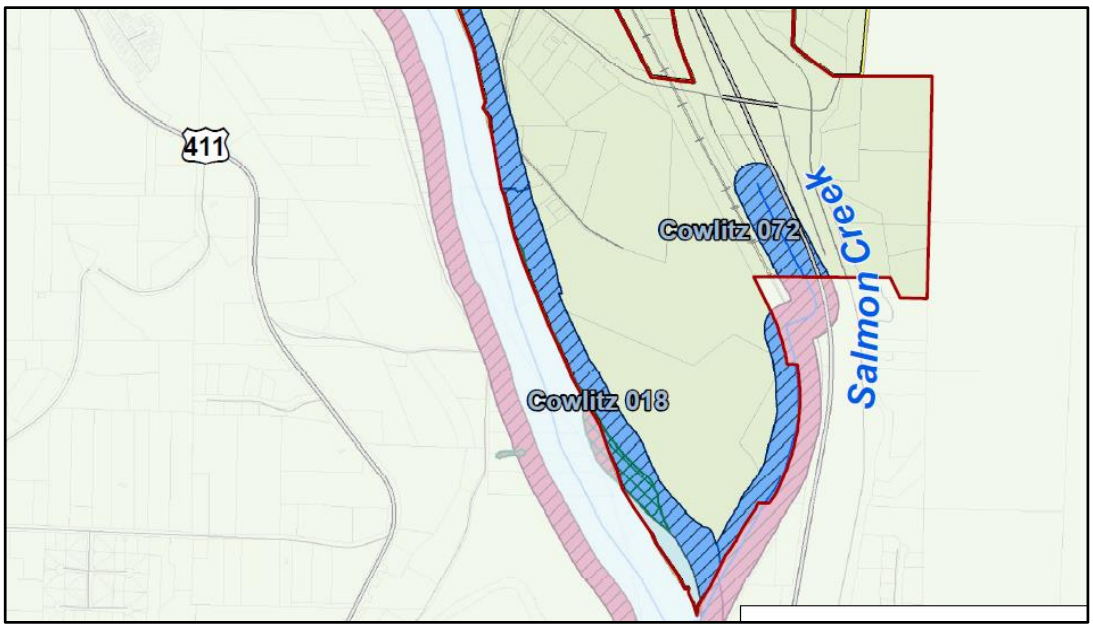


**Figure 3-2. Example of reach break scenario where a mapped parcel occurs waterward of a city/UGA boundary and landward of the OHWM. In this case, lands to centerline of the river are under the County's jurisdiction and included in the nearest County reach.**

Once divided by urban growth areas, and incorporated areas, the following criteria were used to determine reach break locations for riverine and lacustrine shorelines. Changes in land use patterns (e.g., adjacent land use patterns, zoning, shoreline uses, and ownership) were weighted heavily in determining reach break locations in recognition that the intensity and type of land use will affect shoreline ecological conditions. Furthermore, functional analysis outcomes will be more relevant for future determination of appropriate shoreline environment designations if the reach breaks occur at likely transition points in environment designations. In addition to land use, physical drivers of shoreline processes were used to establish an overall framework for determining reach break locations. Criteria for determining reach break locations are provided in Table 3-2.

**Table 3-2. Criteria for determining reach breaks.**

| Factors weighed in determining reach break location | Riverine | Lacustrine |
|---|---|---|
| 1 | Changes in land use[1] | Changes in land use[1] |
| 2 | Changes in vegetation (coverage and type) | Significant wetland areas[2] |
| 3 | Significant wetland areas[2] | Stream/River confluences |

| Factors weighed in determining reach break location | Riverine | Lacustrine |
|---|---|---|
| 4 | Changes in channel confinement, slope, and upland topography | Changes in vegetation (coverage and type) |
| 5 | Tributary confluences | Changes in topography |
| 6 | Artificial barriers (levees, dikes) | |

1 Reach breaks are generally identified at the nearest parcel boundary, except with large parcels, where physical or ecological factors changed notably within a single parcel.

2 In general, reach breaks are positioned to avoid dividing large wetlands.

Maps of reach breaks throughout the county are provided in Appendices B and C. As the Shoreline Master Program Update moves forward for each jurisdiction, reaches may need to be consolidated or split further based on additional reach specific information. Additionally, jurisdictions may choose to rename reaches for implementation purposes. As such, shoreline reaches in adopted Shoreline Master Programs may not be equal to those in this report. A summary of the number of reaches in each assessment unit is provided in Table 3-3.

**Table 3-3. Summary of reaches per assessment unit.**

| Assessment unit | Number of Reaches |
|---|---|
| Columbia River | 35 |
| Lewis River | 55 |
| Kalama River | 46 |
| Cowlitz River | 127 |
| Mill, Abernathy, Germany Creeks | 22 |
| South Fork Chehalis River | 1 |
| City of Castle Rock and UGA | 12 |
| City of Kalama and UGA | 11 |
| City of Kelso and UGA | 25 |
| City of Woodland and UGA | 6 |

### *Functions and Impairments*

The analysis of reach functions was based on the four major function categories identified in the Department of Ecology's guidelines: hydrologic, hyporheic, shoreline vegetation, and habitat. The four primary functional categories were further broken down into relevant functions which were used to evaluate reach performance (Table 3-4). A description of these functions as well as noting areas of typical human disturbance are listed in Table 3-5.

**Table 3-4. Key shoreline ecological functions evaluated.**

| Ecological Functions |
|---|
| **1. Hydrologic Functions**<br>• Erosion processes<br>• Transport of water and sediment<br>• Attenuating flow/wave energy<br>• Development of pools riffles, gravel bars, and off-channel habitat |
| **2. Hyporheic Functions**<br>• Removing excess nutrients and toxic compounds<br>• Water storage<br>• Support of vegetation<br>• Maintenance of base flows |
| **3. Vegetative Functions**<br>• Temperature regulation<br>• Provision of LWD and other organic matter<br>• Filtering excess nutrients, fine sediment, and toxic substances<br>• Slowing riverbank erosion; bank stabilization<br>• Attenuating flow/wave energy |
| **4. Habitat Functions**<br>• Wetland and riparian habitat<br>• Physical space and conditions for life history<br>  • Priority habitat regions and species<br>• Food production and delivery<br>  • Shoreline vegetation<br>  • Terrestrial subsidies to the aquatic environment |

Hyporheic functions are generally dependent on directional flow, and therefore, hyporheic functions are less meaningful in lake environments. For these reasons, hyporheic functions were not evaluated for lake shorelines.

The available information gathered County-wide in the Shoreline Inventory was used to determine the performance and relative rank score of these functions. Assessment of each function using this approach is based upon quantitative data results derived from the GIS inventory information described in Chapter 3.

**Table 3-5. Description of shoreline functions and common sources of human disturbance.**

| Hydrology | Hyporheic | Habitat | Vegetative |
|---|---|---|---|
| Erosion Processes Sediment transport is an integral process to building and maintaining instream habitat features. Metered sediment delivery typically occurs through bank erosion, landslides, and bedload transport. In Cowlitz County, the eruption of Mount St. Helens introduced massive quantities of sediment to many basins and watersheds.<br><br>Transport of Water and Sediment Transport of water and sediment in streams is controlled by local climate, geology, basin topography, land cover, and ocean climate patterns. Stream hydrology is closely related to the proportion of native vegetation in a watershed and the amount of impervious surface.<br><br>Wave and Flow Attenuation Floodplain areas provide a transition between upland and riverine or lacustrine habitats. Vegetated floodplains help slow and disperse flood flows. The extent to which local conditions affect flow is related to the position of a reach within a watershed and the size of the floodplain or wetland area relative to watershed size.<br><br>Development of Pools, Riffles, Gravel Bars, and Off-Channel Habitats Channel form, including meander formation and floodplain development affects the distribution and dimensions of aquatic habitats, such as pools and riffles. Large woody debris (LWD) recruitment from mature tree cover influences stream channel morphology and habitat complexity. Accumulations of LWD affect bank stability, scour, bar formation, and may also induce rapid channel adjustments and assists in pool formation. Mid-channel islands and off-channel habitats provide important high-flow refugia for fish and wildlife. | Removing Excess Nutrients Within shallow alluvial soils adjacent to streams, nutrients and toxic compounds may be filtered or removed by uptake, especially in floodplain areas.<br><br>Water storage Storage of peak flows is provided by floodplains, off channel areas and large wetland complexes; these features serve to reduce peak flows and contribute to summer low flows.<br><br>Support of Vegetation Hyporheic flow helps support broad forested floodplains. Maintenance of Base Flows Groundwater from shallow aquifers is often a substantial component of base flows in low-precipitation periods. The mixing of surface and groundwaters that occurs in the hyporheic zone also helps moderate stream temperatures. | Wetland/Riparian Habitats A nearly continuous riparian zone is the typical natural condition in the Pacific Northwest. Larger and wider riparian communities tend to have more complex vegetation communities and more habitat types. Wetlands adjacent to streams provide an important habitat niche for a variety of species, particularly amphibians.<br><br>Shoreline Vegetation Native forests filter upland pollutants, control hydrologic characteristics, and provide habitat for fish and wildlife. Shading and microclimate effects from riparian forest cover helps maintain cool water temperatures suitable for native fish.<br><br>Priority Habitats and Species Some areas support important or rare species assemblages or habitat features that require an elevated level of protection to ensure that these natural features are conserved.<br><br>Physical Space for Life History Many aquatic species, including some species of salmon, rely heavily on off–channel areas, for rearing. Riparian forested habitats are particularly important for breeding, foraging, and rearing of many terrestrial species. Landscape connectivity, both longitudinal (up- and downstream) and lateral (from aquatic to upland, terrestrial zones), is a critical component of habitat functions. | Shade Riparian vegetation helps maintain cool water temperatures through provision of shade and creation of a cool and humid microclimate over the stream.<br><br>LWD/Organic inputs Riparian vegetation provides a source of large woody debris recruitment, and provides organic matter which is important to the ecosystem in the form of leaves, branches, and terrestrial insects.<br><br>Removing Excess Nutrients Densely vegetated areas encourage infiltration of surface water. Nutrients and contaminants in subsurface water are filtered out of the soil and taken up by the roots of plants.<br><br>Shoreline Stabilization The root structure of woody vegetation stabilizes shoreline soils and prevents excessive erosion. |

| **Sources of human disturbance** | | | |
|---|---|---|---|
| Armored shorelines prevent natural erosion and sediment delivery processes. Shoreline armoring can accelerate erosion of adjacent properties and eliminate shoreline complexity.<br><br>Steep areas with highly erodible soils are particularly sensitive to destabilization and excessive erosion when vegetation is removed. Excess erosion of fine sediments fills pools and eliminates suitable spawning substrate.<br><br>Loss of mature native forests and wetlands affects the timing, rate, magnitude, and duration of stream flows. An increase in impervious surfaces results in increased frequency and intensity of flooding. Changes in flow volume or frequency can alter channel morphology and the sediment balance of the stream.<br><br>Dam regulation affects the timing, duration, and frequency of flood events, as well as sediment transport. | Impervious surfaces reduce infiltration, increasing surface flows. The net result is a reduction in shallow groundwater and hyporheic flows capable of maintaining summer low flows in streams and rivers.<br><br>Levees that limit channel migration and floodplain area also restrict hyporheic activity. | Loss of mature native forests and wetlands limits the availability of suitable habitat for aquatic and terrestrial species. Impervious surfaces lead to higher stream erosion rates, increases in sedimentation, and changes in substrate. Excessive fine sediment delivered to channels can suffocate salmonid eggs, inhibit emergence of fry from gravels, decrease feeding success, increase physiological stress, and through adsorption, may facilitate the transport and persistence of chemical contaminants.<br><br>Clearing of LWD for agriculture or urban development limits channel complexity. Roads and upland development limit lateral habitat connectivity.<br><br>Dams interrupt longitudinal habitat connectivity. Interruption of sediment sources from dams may interrupt the normal process of streambank erosion and deposition, which create diversity in channel form and suitable instream habitat function. Substrate removal through dredging of depositional areas such as deltas may limit the development of instream and upland habitat features. In water structures interrupt the longitudinal flow of sediment and alter habitat associations. | Clearing and grading for development often results in the removal of significant vegetation. Impervious surfaces related to roadways, driveways and parking areas tend to produce hydrocarbon pollutants and heavy metals. Depending on management activities, even pervious surfaces such as lawns and pastures can substantially increase nutrients from fertilizers and pollutants and toxins through herbicides and pesticides.<br><br>Armored shorelines can isolate the river or lake from potential sources of large woody debris recruitment. |

For each of the parameters used in the function assessment, the quantitative data was sorted into five categories, with 1 representing "low" function and 5 representing "high" function (e.g., vegetation coverage 0-5% = 1, >5-25% = 2, >25-50% = 3, >50-75=4, and >75% = 5). The sorting of quantitative data into scoring categories was based on best professional judgment related to known impacts of different parameters and distribution of data. Tables 3-6 and 3-7 provide a description of the metrics and how each data layer contributed to each functional score; a full list of scores for each function is provided in Appendix F.

Once scores were assigned to each function, they were averaged for each of the four major functional categories. The mean of each major function was calculated to provide a simple standardized tool useful for inter-reach functional comparison. The functional score is derived from a standardized numerical process that formalizes and enables a basis for comparison of ecological functions among reaches.

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**Table 3-6. Summary of functional scoring approach.**

| Category | | Data | Hydrologic | | | | Hyporheic (Riverine Only) | | | | Habitat | | | | | Vegetative | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Moderated Sediment Delivery | Transport of sediment and water (riverine only) | Wave and/or flow attenuation | Development of pools, riffles, gravel bars, off-channel habitats (riverine only) | Remove excess nutrients and toxic compounds | Water storage | Support of vegetation | Sediment storage and maintenance of base flows | Wetland/riparian habitat | Shoreline vegetation | Direct shoreline alterations | Priority habitats/species | Physical Space and conditions for Life History | Shade (temperature regulation) | LWD and other organic recruitment | Ability to remove nutrients, fine sediment, and toxic substances | Shoreline soil stabilization | Wave/flow attenuation |
| **Method to summarize metrics into a functional score** | | | If levees or locks present, 1, else average of values | | | Value, except that mid-channel islands score 5 | Average of metrics | | | | Max value | Value | | Average of scores | | Value | Average of scores | | If levee present, 1, else average | |
| **Hydro features** | Floodplain | % Area | | | X (riverine) | | X | X | X | X | | | | | X | | X | | | |
| | Area of wetlands | % Area | | | | | | | | | X | | | | | | | | | |
| | Floodway | % Area | | | | | | | | | | | | | | | | | | |
| **Habitat** | Priority habitat regions | % Area | | | | | | | | | | | | X | | | | | | |
| | Priority species- Terrestrial | #/reach | | | | | | | | | | | | X | | | | | | |
| | Priority species- Aquatic and Fish Distribution | #/reach | | | | | | | | | | | | X | | | | | | |
| **Alterations** | Overwater structures | #/reach | | | | | | | | | | | X | | | | | | | |
| | Levees | Presence/ Absence | X | X | X | | | | | | | | | | | | | | X | X |
| | 303d listings - by Category 5,4,2,1 | Highest category in reach | | | | | | | | | | | | | | | | | | |
| **Vegetation** | Vegetation - total vegetation not including developed, cultivated, or bare (CCAP) | % Area | | | % within floodplain (riverine) | | % within floodplain | | | | | X | | | X | | | X | | % within floodplain |
| | Vegetation -% evergreen forest (CCAP) | % Area | | | | X | | | | | | | | | | | | | | |
| | Vegetation - CCAP upland tree/forest cover for County; digitized tree cover data for UGAs | % Area | | | | | | | | | | | | | | X | | | | |
| | Vegetation - % CCAP tree/shrub for County; digitized tree cover data for UGAs | % Area | X | | | | | | | | X | | | | | | X | | X | |
| **Soils, geology, topography** | Soils - Erosion Hazard Severely or Very Severely Erodible | % Area | X | | | | | | | | | | | | | | | | X | |
| | Soils- Erosion Hazard Slightly Erodible | % Area | X | | | | | | | | | | | | | | | | | |
| | Soils - Available Water Supply (0-100cm) | Average AWS | | | | | | X | | | | | | | | | | | | |
| | Soils - Forest Productivity | Cubic ft/Acre/Yr | | | | | | | X | | | | | | | | | | | |

| Category | | Data | Hydrologic | | | | Hyporheic (Riverine Only) | | | | Habitat | | | | | Vegetative | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Moderated Sediment Delivery | Transport of sediment and water (riverine only) | Wave and/or flow attenuation | Development of pools, riffles, gravel bars, off-channel habitats (riverine only) | Remove excess nutrients and toxic compounds | Water storage | Support of vegetation | Sediment storage and maintenance of base flows | Wetland/riparian habitat | Shoreline vegetation | Direct shoreline alterations | Priority habitats/species | Physical Space and conditions for Life History | Shade (temperature regulation) | LWD and other organic recruitment | Ability to remove nutrients, fine sediment, and toxic substances | Shoreline soil stabilization | Wave/flow attenuation |
| **Method to summarize metrics into a functional score** | | | If levees or locks present, 1, else average of values | | | Value, except that mid-channel islands score 5 | Average of metrics | | | | Max value | Value | | Average of scores | | Value | Average of scores | | If levee present, 1, else average | |
| | Geology- Quaternary alluvium | % Area | | | | | | | | X | | | | | | | | | | |
| | Slope <15% | % Area | | X (Reverse scoring) | | | | | | | | | | | | | | X | | |
| | Slope >40% | % Area | X | | | | | | | | | | | | | | | | | |

**Table 3-7. Functional score ranking by indicator metric.**

| Indicator Metric | Unit of Measure | Ranking score | | | | |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| Floodplain | % Area | 0-5 | 5-25 | 25-50 | 50-75 | 75-100 |
| Area of wetlands | % Area | 0-5 | 5-25 | 25-50 | 50-75 | 75-100 |
| Floodway | % Area | 0-5 | 5-25 | 26-50 | 50-75 | 76-100 |
| Priority habitat areas | % Area | 0-5 | 5-25 | 25-50 | 50-75 | 75-100 |
| Priority species- Terrestrial | #/reach | 0 | NA | 1-2 | NA | 3+ |
| Fish and Priority species- Aquatic | #/reach | 0 | 1-3 | 4-6 | 7-9 | 10+ |
| Overwater structures | #/reach | 6+ | NA | 1-5 | NA | 0 |
| Levees | Presence/ Absence | Present | NA | NA | NA | NA |
| 303d listings - by Category 5,4,2,1 | Highest category in reach | 5 | 4 | NA | 2 | 1 |
| Vegetation – total not including developed, cultivated, or bare | % Area | 0-10 | 10-25 | 25-50 | 50-75 | 75-100 |
| Vegetation – conifer | % Area | 0-10 | 10-25 | 25-50 | 50-75 | 75-100 |
| Vegetation – upland (tree/forest cover) | % Area | 0-5 | 5-25 | 25-50 | 50-75 | 75-100 |
| Vegetation – tree/shrub | % Area | 0-10 | 10-25 | 25-50 | 50-75 | 75-100 |
| Soils – Highly Erodible | % Area | 80-100 | 60-80 | 40-60 | 20-40 | 0-20 |
| Soils – Slightly Erodible | % Area | 0-20 | 20-40 | 40-60 | 60-80 | 80-100 |
| Soils – Available Water Supply (AWS) | Average AWS | 0-7.54 | 7.54-11.71 | 11.71-16.39 | 16.39-23.99 | 23.99+ |
| Soils – Forest Productivity Index | Cubic ft/Acre/Yr | 0-86 | 86-114 | 114-143 | 143-172 | 172+ |
| Geology – Quaternary alluvium and Quaternary younger alluvium | % Area | 0-20 | 21-40 | 41-60 | 61-80 | 81-100 |
| Slope <15% | % Area | 0-20 | 20-40 | 40-60 | 60-80 | 80-100 |
| Slope >40% | % Area | 30+ | 20-30 | 10-20 | 5-10 | 0-5 |

Within UGAs, additional data was collected using assessor data and analysis of aerial photography to calculate average parcel size, width, depth, setback width of the primary structure, average width of shoreline vegetated area, and vegetative density of the shoreline vegetated area. The setback was measured from the primary structure to the OHWM of the waterbody. The average depth of vegetated area was also measured. In many cases, the average depth of vegetated area was measured as a greater distance than the recorded setback. This would come up in a parcel where a house or structure in a large tax lot would have vegetation surrounding the building. An estimate of vegetative condition was assigned on a

parcel-by-parcel basis using a simple scale from 1 to 5, 1 being no vegetation to 5 being majority vegetated with some structure other than all grass. The metrics were averaged for all parcels within a reach to provide an overall characterization of the reach.

***Limitations***

This evaluation was limited by the quality and availability of inventory data. Therefore, limitations presented in Section 3.1 also apply to this evaluation.

The evaluation approach did not take into account that some areas naturally may function "lower" or "higher" than others, not because of any anthropogenic alteration or natural disturbance, but simply because of the combined effects of a particular locale's geology, aspect, or topography. For example, many functions operate "better" in this evaluation approach when there is a floodplain to capture sediments or store water, but there are a number of drainages in steep areas that do not have floodplains. This results in some areas with developed floodplains scoring as well as undeveloped reaches in steeper areas in an assessment unit. Nevertheless, despite this limitation, average scores for functional categories in areas with similar topography and channel confinement are generally consistent with the intuitive hypothesis that more highly developed areas score lower than areas that are generally less altered or protected under public ownership and established management plans.

In evaluating shoreline functions, the area of shoreline impacts and conditions assessed was generally limited to the area of shoreline jurisdiction. In many cases, shoreline impacts may occur at a site due to ecological and geomorphological processes that are disturbed at a remote site upstream, further inland, or up-current. This evaluation approach may not identify all of the functional responses occurring as a result of impacts to upstream or nearby areas.

The approach does not weigh shoreline ecological potential with the opportunity to perform a given function based on site-specific conditions. For example, the analysis assessed the ability of a shoreline to store water, but it did not consider the frequency of flooding downstream and the corresponding significance of such a function.

Finally, the ordinary high water mark (OHWM) used in the analysis is not an accurate, surveyed line; therefore, it occasionally is located waterward of the actual ordinary high water mark. In highly dynamic, braided reaches like the South Fork

Toutle River, the mapped OHWM may not correspond with the presently existing channel location. The analysis in these reaches may underestimate water and sediment storage functions.

### 3.3.3 Restoration Opportunities

Potential restoration opportunities were identified based on input from Cowlitz County and the participating cities and existing restoration planning document recommendations including the Lower Columbia Salmon Recovery and Fish and Wildlife Subbasin Plan (LCFRB 2010), the Salmon and Steelhead Limiting Factors Reports, the Habitat Work Schedule (hws.ekosystem.us), and other salmon recovery lead entity planning documents. Many of these restoration planning documents include protection of intact functions and processes as an integral component to restoration planning. Therefore, although protection is distinct from restoration at the site level, restoration opportunities presented in this document also include opportunities to protect high functioning areas.

In many cases, the LCFRB recommendations apply broadly to watershed areas (for example, "Protect existing rearing habitat to ensure no further degradation."). In this case, the functional analysis in this report can be used to identify high functioning areas that could benefit from protection (through regulatory or voluntary measures), as well as low to moderately functioning areas that may benefit from restoration actions.

Restoration opportunities are not limited to those identified in this report, and restoration opportunities will be pursued further in the Shoreline Restoration Plan.

## 3.4 Land Use Characterization

This shoreline inventory reviews current and planned land use within shoreline jurisdiction to provide a basis to establish a compatible use pattern over the 20-year planning period of the SMP and to identify current or planned preferred uses in shoreline jurisdiction that should be protected or promoted to meet SMA goals for water-oriented uses, shoreline access, and ecological protection.

The SMA promotes the following use preferences (RCW 90.58.020) for shorelines of statewide significance (identified in Section 1.2) in the stated order:

1. Recognize and protect the statewide interest over local interest;
2. Preserve the natural character of the shoreline;
3. Result in long term over short term benefit;

4. Protect the resources and ecology of the shoreline;
5. Increase public access to publicly owned areas of the shorelines;
6. Increase recreational opportunities for the public in the shoreline;
7. Provide for any other element as defined in RCW 90.58.100 deemed appropriate or necessary.

For all other shorelines of the state, the following use preferences apply:

1. Reserve appropriate areas for protecting and restoring ecological functions to control pollution and prevent damage to the natural environment and public health. In reserving areas, local governments should consider areas that are ecologically intact from the uplands through the aquatic zone of the area, aquatic areas that adjoin permanently protected uplands, and tidelands in public ownership. Local governments should ensure that these areas are reserved consistent with constitutional limits.
2. Reserve shoreline areas for water-dependent and associated water-related uses. Harbor areas, established pursuant to Article XV of the state Constitution, and other areas that have reasonable commercial navigational accessibility and necessary support facilities, such as transportation and utilities, should be reserved for water-dependent and water-related uses that are associated with commercial navigation unless the local governments can demonstrate that adequate shoreline is reserved for future water-dependent and water-related uses and unless protection of the existing natural resource values of such areas preclude such uses. Local governments may prepare master program provisions to allow mixed-use developments that include and support water-dependent uses and address specific conditions that affect water-dependent uses.
3. Reserve shoreline areas for other water-related and water-enjoyment uses that are compatible with ecological protection and restoration objectives.
4. Locate single-family residential uses where they are appropriate and can be developed without significant impact to ecological functions or displacement of water-dependent uses.
5. Limit nonwater-oriented uses to those locations where the above described uses are inappropriate or where nonwater-oriented uses demonstrably contribute to the objectives of the Shoreline Management Act [WAC 173-26-201(2)(d)(v)].

### 3.4.1 Data Sources, Assumptions, and Data Gaps

***Current Land Use***

Existing land use information provides a baseline understanding of land use intensity, character, and land cover found within the shoreline jurisdiction. Existing land use data for Cowlitz County shoreline jurisdiction was obtained from Cowlitz County's parcel data. County land use types were aggregated into broader land use categories for the purpose of conveying information relevant to the Shoreline Management Act priorities, including single-family residential and water-dependent uses. Aggregated land use categories include the following:

- single-family residential,
- multi-family residential,
- commercial,
- industrial,
- undeveloped,
- railroad,
- airport,
- right-of-way,
- ports,
- auto parking,
- diking right-of-way,
- public/education/assembly
- church,
- open space,
- agriculture,
- fishing activities,
- forestland, and
- other.

Parcels not characterized as resource lands (open space, agriculture, forestland, fishing activities, or other land use not associated with likely future development), nor publicly held and with an assessed improvement value of less than $10,000 were identified as vacant. Lands in PacifiCorp ownership were also excluded from the vacant lands assessment. These parcels provide an indication of the distribution of potentially developable areas within the County.

Current Land Use information is presented in Figure 2, Appendices B and C.

### *Zoning*

#### Cowlitz County

The most current County zoning data is not available in GIS format, a scanned copy of the official County zoning map is included in the map folio.

The County's zoned areas include three basic types of zoning districts.

- ***Residential*** zoning districts are intended primarily to preserve and protect housing and related developments and activities.
- ***Commercial*** zoning districts are areas set aside mainly for retail trade, services, and business activity.
- ***Industrial*** zoning districts are reserved for manufacturing, assembly, processing, and related activities.

#### City of Castle Rock

Zoning districts within the City of Castle Rock include:

- Low-density Residential
- High Density Residential
- Highway Business
- Retail Business
- Mixed Use Commercial/Industrial
- Industrial
- Parks, Recreation, and Open Space

#### City of Kalama

A description of zoning designations from the City of Kalama Municipal Code (CKMC 17.16.010) is provided in Table 3-8 below.

**Table 3-8. Zoning designations in the City of Kalama.**

| Description | Symbol | Typical Uses |
|---|---|---|
| Low-density residential district | R-1 | Single family dwellings and associated public and quasi-public uses. |
| High density residential district | R-2 | Single family, two family, triplexes and associated public and quasi-public uses per Section 17.22.020(B). |
| Medium density residential district | R-3 | Four-plexes, multi-family apartments, boarding houses, etc., and associated public and quasi-public uses per Section 17.24.020(C). |
| Central business district | C-1 | Retail activities, motels, service stations, etc. |
| Highway Commercial | C-2 | Regional commercial centers, automobile-oriented services, and manufacturing uses. |
| Industrial district | I-1 | Manufacturing, warehousing, and wholesale sales. |
| Recreational district | Rec. | Areas devoted to facilities and equipment for recreational purposes such as swimming, playgrounds, marinas, parks, and other similar uses. |
| Residential district for mobile homes | R--MH | Single family and associated public and quasi-public uses. |
| Single-family large lot | R-1(LL) | Single-family dwellings; agricultural and forestry activities and limited public and quasi-public uses per Section 17.21.020(E). Large-lot estates are limited to the R-1 zone only. |
| Single-family small lot | SF-SL | Single-family dwellings, and associated public and quasi-public uses per Section 17.20.030(B) on small lot less than the standard lot size assigned the underlying residential zone, subject to site plan approval, allowable in all residential zones. |

**City of Kelso**

A description of zoning designations in the City of Kelso Municipal Code is provided below (CKMC 17.20.020).

- RSF-15, residential single-family 15 zone allows fifteen-thousand-square-foot minimum lot area per dwelling unit at a maximum density of approximately three units per acre;
- RSF-10, residential single-family 10 zone allows ten-thousand-square-foot minimum lot area per dwelling unit at a maximum density of approximately four units per acre;
- RSF-5, residential single-family 5 zone allows five-thousand-square-foot minimum lot area per dwelling unit at a maximum density of approximately eight units per acre;
- RMF, residential multifamily zone allows one-thousand-three-hundred-fifty-square-foot minimum lot area per dwelling unit at a maximum density of approximately thirty-two units per acre;
- OPN, open space zone;

- CTC, town center commercial zone;
- CWK, west Kelso commercial zone;
- CNH, neighborhood service center commercial zone;
- CSR, specialty retail and services commercial zone;
- CMR, major retail commercial zone;
- ILM, light manufacturing industrial zone;
- IGM, general manufacturing industrial zone;
- PO, airport overlay zone;
- DDO, downtown design guidelines overlay zone

**City of Woodland**

Zoning designations in the City of Woodland are identified in Woodland Municipal Code (WMC 17.12.010), reproduced in the Table 3-9 below.

**Table 3-9. Zoning designations in the City of Woodland.**

| Code | Zoning Designation |
|---|---|
| LDR | Low-density residential districts (LDR-6, LDR-7.2, LDR-8.5, LDR-10 |
| MDR | Medium density multifamily residential district |
| HDR | High density multifamily residential district |
| FW | Floodway use district |
| C-1 | Central business district |
| C-2 | Highway commercial use district |
| C-3 | Neighborhood commercial use district |
| I-1 | Light industrial use district |
| I-2 | Heavy industrial use district |

***Comprehensive Plan***

Comprehensive Plan data provides a source of information on future land use changes on a broad scale basis. Future land use categories are based on Comprehensive Plan designations and are reported in distinct locally adopted categories. Future land use data is based on area-wide classifications, which includes roads and other features in the coverage area; this tends to make the calculated proportional coverage of future land use areas seem greater than existing land use area calculations for the same area.

The Comprehensive Plan establishes the overall direction and guidance for location of future growth in the County and cities. It does this, in part, through establishing land use designations which are applied to property throughout the

County that describe the types of uses that can occur on these properties. The Comprehensive Plans for the Cities of Castle Rock and Woodland apply to lands within city limits, as well as to lands outside of the adopted city limits, but within the UGA.

**Cowlitz County**

The County is presently undergoing an update of its Comprehensive Plan. Existing comprehensive plan data is not available in electronic format; rather the official comprehensive plan map is a paper copy that was scanned and included in Appendix D. A draft comprehensive plan map is expected in February 2014; at that time, the new plan and map data will be referenced in developing SMP environment designations, policies, and regulations.

**City of Castle Rock, City of Kalama. City of Kelso, City of Woodland**

Comprehensive plan designations in the City of Castle Rock and the City of Woodland reflect anticipated future land use in the city limits, as well as in unincorporated areas in the Cities' UGAs. Comprehensive plan designations in the City of Kalama and the City of Kelso apply only within city limits.

***Existing and Potential Shoreline Public Access***

Existing, formally established recreational areas with shoreline public access are identified in Chapter 5 of this document in the Existing and Potential Shoreline Public Access sections and on Public Access Maps in Appendices B and C. Recreational areas identified include those provided by local, state, and federal government agencies, as well as private recreational areas that are open to the general public.

Potential shoreline public access opportunities were principally gathered by reviewing pertinent park and recreation planning documents (e.g. the Cowlitz County Comprehensive Park Plan Update). However, the planning documents reviewed did not cover the full range of park and recreation areas (e.g. a planning document for WDFW Water Access Sites in Cowlitz County was unavailable). Therefore, the sections on potential shoreline public access opportunities may not include all future plans by from all stakeholders.

***Water-oriented Uses***

According to Ecology's SMP Guidelines (173-26-020(41) WAC), "water-oriented use means a use that is water-dependent, water-related, or water-enjoyment, or a combination of such uses." The Shoreline Management Act promotes uses that are "unique to or dependent upon use of the state's shoreline" as well as "ports,

shoreline recreational uses including but not limited to parks, marinas, piers, and other improvements facilitating public access to shorelines of the state, industrial and commercial developments which are particularly dependent on their location on or use of the shorelines of the state and other development that will provide an opportunity for substantial numbers of the people to enjoy the shorelines of the state." (RCW 90.58.020)

Definitions and examples of water-oriented uses are included in Table 3-10 below.

**Table 3-10. Water-oriented uses definitions and examples.**

| Water-Oriented Use Definitions | Examples |
|---|---|
| "Water-dependent use" means a use or portion of a use which cannot exist in a location that is not adjacent to the water and which is dependent on the water by reason of the intrinsic nature of its operations. (WAC 173-26-020(39)) | Examples of water-dependent uses may include marine terminals of ship cargo loading areas, ferry and passenger terminals, marinas, aquaculture, float plane facilities and sewer outfalls. |
| "Water-related use" means a use or portion of a use which is not intrinsically dependent on a waterfront location but whose economic viability is dependent upon a waterfront location because:<br>(a) The use has a functional requirement for a waterfront location such as the arrival or shipment of materials by water or the need for large quantities of water; or<br>(b) The use provides a necessary service supportive of the water-dependent uses and the proximity of the use to its customers makes its services less expensive and/or more convenient. (WAC 173-26-020 (43)) | Examples of water-related uses may include warehousing of goods transported by water, seafood processing plants, hydroelectric generating plants, gravel storage when transported by barge, oil refineries where transport is by tanker, log storage, and potentially agriculture. |
| "Water-enjoyment use" means a recreational use or other use that facilitates public access to the shoreline as a primary characteristic of the use; or a use that provides for recreational use or aesthetic enjoyment of the shoreline for a substantial number of people as a general characteristic of the use and which through location, design, and operation ensures the public's ability to enjoy the physical and aesthetic qualities of the shoreline. In order to qualify as a water-enjoyment use, the use must be open to the general public and the shoreline-oriented space within the project must be devoted to the specific aspects of the use that fosters shoreline enjoyment. (WAC 173-26-020 (40)) | Primary water-enjoyment uses may include, but are not limited to, parks, piers and other improvements facilitating public access to the shorelines of the state; and general water-enjoyment uses may include, but are not limited to restaurants, museums, aquariums, scientific/ecological reserves, and resorts/hotels. |

The following current land use categories (from the categories mapped on Appendices B and C, Figure 2, Current Land Use) are particularly likely to include uses that meet the definition of water-oriented uses in Table 3-10:

- Ports
- Fishing Activities
- Recreation
- Industrial
- Commercial
- Transportation

However, a comprehensive inventory of water-oriented uses in the County could not be assembled from available data sources. The major reason for this is that whether a particular use meets the definition as "water-dependent," "water-related," or "water-enjoyment" is not always immediately apparent and often determined on a case-by-case basis. For example, a restaurant with an expansive view of the Columbia River would likely qualify as a water-enjoyment use; however, a restaurant with windows oriented towards a road would likely not qualify.

Therefore, the Water-oriented Uses sections in Chapter 5 of this document should not be considered comprehensive. These sections only selectively identify certain water-oriented uses (either significant or more obvious). More specifically, these sections identify only certain water-dependent and water-related uses. Water-enjoyment uses are discussed in the sections titled Existing and Potential Shoreline Public Access. A more thorough review of water-oriented uses will be considered in the development of the SMP based on public input.

Water-dependent and water-related uses were not mapped in the shoreline inventory map folio; however, many water-enjoyment uses are shown on Public Access maps in Appendices B and C.

***Historical or Archaeological Sites***

Historical sites that may fall within shoreline jurisdiction in Cowlitz County (excluding the City of Longview) were identified using the Washington State Department of Archaeology and Historic Preservation's WISAARD searchable cultural database.

### 3.4.2 Analysis of Future Land Use

***Comparative Analysis of Current Land Use***

A comparative analysis of land use data for the years 2002 and 2012 was conducted in order to identify changes in land use type and intensity over a ten-year period.

Parcel data from 2002 and 2012 from the Cowlitz County Assessor's Office provided basic attributes for comparison, including parcel or tax identification number, location, improvement value, and land use description. The comparative analysis was based on attributes contained in the data and assigned by the County Assessor. Each dataset is believed to be adequate to provide a general snapshot of development conditions for each year.

Due to differences in the structure and attributes contained in each dataset, minor adjustments were made in order to facilitate a direct comparison of land use between years. Specific land use types for each year were aggregated into 20 general land use categories:

- Unclassified
- Airport
- Auto Parking
- Agriculture
- Church
- Commercial
- Diking Right-of-Way
- Fishing Activities
- Forestland
- Industrial
- Multi-Family Residential
- Open Space
- Other
- Ports
- Public/Education/Assembly
- Recreation
- Single Family Residential
- Transportation
- Undeveloped Land
- Utilities

Analysis was limited to the portion of each parcel occurring within shoreline jurisdiction or potentially associated wetlands. Parcels were filtered and clipped by overlaying digital geospatial data and grouped by shoreline assessment unit. To resolve discrepancies in parcel geometry between the 2002 and 2012 datasets, records were cross-referenced by tax id number, ensuring that each parcel would be assigned to the same assessment unit across comparative years. Land use categories are presented by assessment unit as percent of total acreage for each unit.

The total area of vacant lands was also calculated for 2002 and 2012 using the same methodology as used in the Shoreline Inventory, where parcels not characterized as resource lands (open space, agriculture, forestland, fishing activities, or other land use not associated with likely future development), nor publicly held and with an assessed improvement value of less than $10,000 were identified as vacant. Lands in PacifiCorp ownership were also excluded from the vacant lands assessment.

Because the undeveloped land category is a land use type designated by the Assessor, whereas vacant lands are lands outside of resource and publicly owned lands that fall below a specific improvement value, it is possible to have disparate trends in undeveloped and vacant lands.

Comparative analysis results are presented as the change in percent of total acreage from 2002 to 2012. Due to changes in parcel shape and area, the total acreage of some assessment units varied between the two analysis years by an average of 1.3 percent.

**Permit History Data Analysis Methodology**

A review of shoreline development permits previously issued by Cowlitz County was undertaken in order to better understand the type and extent of recent development actions occurring in the County, and to help anticipate future trends in shoreline land use changes and shoreline modifications. The development permits reviewed were limited to those issued between 2001 and 2011, the most recent ten-year period for which data was available.

The permit history data provided by Cowlitz County for this purpose came in two basic database formats. One database format had permits dating to the late 1970s and was organized by permit type and waterbody. The other database format had permits from the 2001 to 2011 time period and was organized by application year. While these two databases had some overlap, they were not mutually inclusive. Therefore, the two

databases were cross-referenced to assemble an all-inclusive permit database for the time period from 2001 to 2011.

Permits were then classified by the type of shoreline use (e.g. residential, commercial) or shoreline modification (e.g. bank stabilization, boat launch) permitted. Where a single permit application involved multiple uses or modifications, a single permit was counted in each applicable use or modification category. Permits were recorded by year the permit was issued (not the application date). When the data did not state the year a permit was issued, it was assumed that the permit was issued the same year as the application.

Notably, the permit data reflect all permits issued in any area under the jurisdiction of Cowlitz County, including unincorporated urban growth areas, at the time the permit was issued. Therefore, permit data for unincorporated UGAs is reported in the permit totals for the unincorporated County assessment units rather than the City assessment units. It is also worth noting that shoreline exemptions are generally not captured in the permit data. Therefore, no data on the type and extent of development actions exempt from shoreline permits (such as single-family residential housing development or single-family residential bulkhead construction) are available. Moreover, any unpermitted development is not reflected in the data.

# 4 SUMMARY OF COUNTY ECOSYSTEM CONDITIONS

The Lower Columbia Salmon Recovery and Fish and Wildlife Subbasin Plan (LCFRB 2010) provides detailed descriptions of each of the watersheds and major subbasins within Cowlitz County. The information presented below is drawn from this plan, with additional information and details specific to Cowlitz County shorelines added where applicable.

## 4.1 Climate

The climate in Cowlitz County is typical of the West Coast marine areas with mild, wet winters and warm, dry summers. Annual precipitation varies from 45 inches near Kelso to over 150 inches on Mount Rainier, Adams, and St. Helens (Wade 2000a), and precipitation is concentrated in the period between October and March. Snow and freezing temperatures are common at higher elevations. Rain-on-snow events in intermediate elevations can result in significant flooding events.

## 4.2 Geography, Topography, Geology, and Drainage Patterns

Portions of four major watersheds are located within Cowlitz County, the Lewis watershed, the Cowlitz Watershed, the Grays/Elochoman Watershed, and the Chehalis Watershed. Generally, these watersheds are identified by the state as Water Resource Inventory Areas (WRIA). A map of the WRIAs within Cowlitz County is provided in Figure 4-1. Table 4-1 provides a summary of subbasins and WRIAs within Cowlitz County, as well as anadromous salmonids associated with each basin. Priority wildlife species and habitats in Cowlitz County are identified in Table 4-2, and rare plant species in Cowlitz County are listed in Table 4-3. Note that not all listed species or habitats necessarily occur within shoreline jurisdiction in the county.

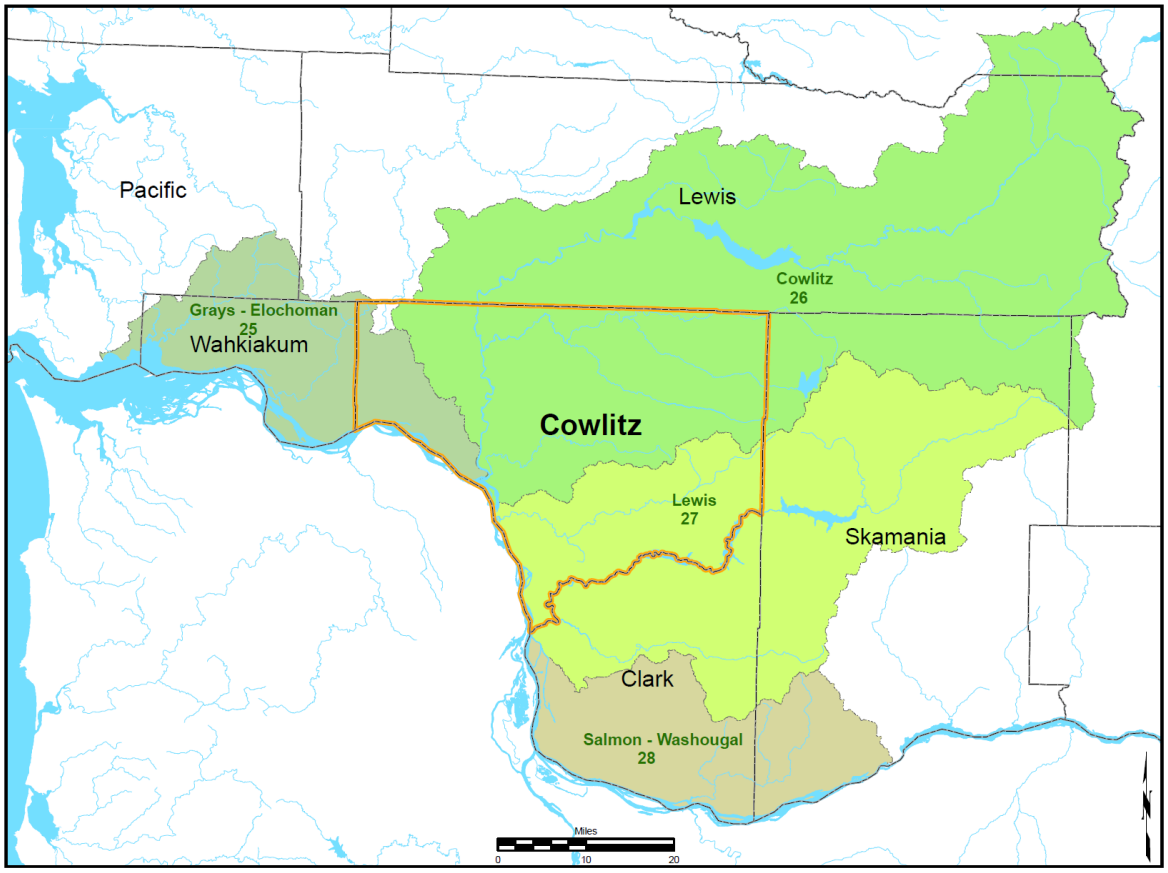


**Figure 4-1. Map of Water Resource Inventory Areas in Cowlitz County (Source: Washington Department of Ecology, GIS Technical Services).**

### 4.2.1 Columbia River

The Columbia River estuary was formed by the forces of glaciation, volcanism, hydrology, and erosion and accretion of sediments. The Cascade mountain range was formed 50 to 35 million years ago, at which time, uplift of the Rocky Mountains combined with subduction of the oceanic plates of the Pacific Ocean, creating the flow

path for the River (Simenstad et al. 2011). Subsequent glaciation restructured and expanded the extent of the Columbia River basin (Simenstad et al. 2011). Near the end of the last glacial period, the Missoula Floods shaped the physical landscape, transporting and depositing silt, sand, and gravel that now form much of the landscape in the Columbia River basin (Simenstad et al. 2011). Volcanism, lava flows, and lahars occurring in the Holocene period, have contributed much of the bedload of the lower Columbia River (Simenstad et al. 2011). Circulation of sediments and nutrients throughout the lower river and estuary are driven by river hydrology and coastal oceanography. Sea level rise since the late Pleistocene period has submerged river channels and caused deposition of coarse and fine sands (Marriott et al. 2001), which shape today's shallow estuarine habitats.

The hydrology of the Columbia River Basin reflects the interaction of topography geology, and climate. Most of the drainage of the Columbia River falls as snow in the Rocky Mountains and in the Cascade Range (Simenstad et al. 2011). Annual peak discharges occur in the spring (April to June), and generally result from snowmelt in the interior subbasin. Historically, flood flows peaked at 1.2 million cfs (Simenstad et al. 2011). Today, as a result of dam regulation, the highest flows occur from April to June, with discharge at the mouth of the river ranging from 100,000 to 500,000 cfs (Neal 1972, Marriott et al. 2002). The lower basin, where precipitation generally occurs as rain, contributes to peak winter discharges (Simenstad et al. 2011).

Within Cowlitz County, the Columbia River transitions from a confined valley to the east into broad bottomlands to the west. The River includes large, mid-channel islands with forested and scrub-shrub wetlands, distributary channels and sloughs, and floodplains.

Tidal impacts in water level have been observed as far upstream as Bonneville Dam (RM 146) during low flow, reversal of river flow has been measured as far upstream as Oak Point, west of Longview (RM 53) (LCFRB 2010). The mean daily tidal fluctuation is approximately 3 feet in Cowlitz County near the City of Kelso (Johnson 2010). The extent of saltwater intrusion is limited to the River downstream from Harrington Point (RM 23) (LCFRB 2010).

### 4.2.2 Lewis River

The Lewis basin developed as a result of volcanic, glacial, and erosional processes. Intermittent eruptions of Mt. St. Helens and Mt. Adams over the last 400,000 years have provided volcanic material that has formed the Lewis River basin. More recent pyroclastic flows and lahars have shaped the current landscape (LCFRB 2010). Steep

slopes resulting from glaciation, combined with the abundance of volcanic material, have created a high potential for erosion throughout the basin (LCFRB 2010).

A series of three dams and three reservoirs, Lake Merwin, Yale Lake, and Swift Reservoir, are located in the upper portion of the Lewis River Basin. Below Merwin Dam, the Lewis River flows through a steep canyon for approximately 4 miles. The lower twelve miles of River flow through a broad alluvial valley, where the River is extensively channelized. Tidal influence extends to approximately RM 11 (LCFRB 2010).

Precipitation is primarily rainfall dominated, but much of the upper basin receives abundant snowfall, and experiences rain-on-snow zone events. As a result, the basin is subject to winter freshets and flooding, although dam operations moderate peak flows (LCFRB 2010).

### 4.2.3 Kalama River

The topography of the upper subbasin is mountainous, leveling out in the lower eight miles. The geology of the Kalama River subbasin have been extensively shaped by volcanic activity of Mt. St. Helens in the last 20,000 years (USFS 1996 cited in Wade 2000b). Steep slopes and erodible material allow for the significant mass wasting potential in the upper watershed (Wade 2000b). Keefe et al. (2004) summarized geologic data presented in Washington Department of Natural Resource's *Geologic Map of Washington – Southwest Quadrant* (Walsh et al., 1987) as follows:

> "The upper Kalama River flows through volcaniclastic deposits of pyroclastic flows, lahars, and debris avalanches, from its headwaters downstream to below Bush Creek near river mile (RM) 30 (Walsh et al. 1987). These deposits produce fine sediments that are typically composed of fine to medium size grains. There are isolated lahar areas distributed as patches throughout the middle Kalama River section, containing mixtures of cobble and boulders supported by a matrix of sand or mud."

Merrill Lake formed when these lahar deposits from Mt. St. Helens blocked the historic stream valley.

Keefe et al. (2004) go on to describe the geology of the Lower Kalama River Basin:

> Between RM 30 and Marietta Falls, near RM 6, the mainstem flows through fine grained igneous, Lower Oligocene to upper Eocene andesite flows. Most of the tributaries to the Kalama River entering below upper Kalama Falls also flow through the same fine grained igneous andesite flow material as the middle

> mainstem river (Walsh et al. 1987; Foster 1983). Below Marietta Falls, the Kalama River flows through predominantly alluvial deposits containing sand and gravel."

Hydrology is driven by rainfall from fall through spring as only a small portion of the basin is above the snowline. Tidal influence of the Columbia extends up to approximately Modrow Bridge at RM 2.8 (Wade 2000b). Tidal elevations at the mouth of the Kalama River vary from 6 to 14 feet (Powers and Tyler 2009).

### 4.2.4 Cowlitz Watershed

The Cowlitz River watershed originates in steep, volcanic peaks of Mount Rainier, Mouth Saint Helens, and Mount Adams. The eastern part of the Cowlitz River valley is located in the Cascade physiographic province, and it is characterized by a deeply cut trough and flat bottomlands, and terraces (Wade 2000a). The river flows west through a valley heavily influenced by alpine glaciers, where the river has moderate relief and broad floodplain areas (Wade 2000a).

Wade (2000) described the geology of the Cowlitz Watershed as follows,

> "During the Pleistocene (3 million years to 8,000 years ago) several alpine glaciers moved down the Cowlitz River valley depositing till and outwash (glacial river sand and gravel deposits). These glaciers, 1000 feet thick or more, cut down into the former river channel and underlying bedrock (Coombs 1989 as cited in Harza 1999c). At least six alpine glacial advances have been documented. Glacial outwash sands and gravels form terraces in the vicinity of the Cowlitz River and were deposited by streams from the melting alpine glaciers located up the valley. Silt-loam loess, representing windblown glacial silt, blankets large areas of the basin (Crandall and Miller 1974 as cited in Harza 1999c). The thickness of the loess varies from a few feet to 20 feet.
>
> Following deposition of the youngest glacial deposits, approximately 13,000 to 25,000 years ago, the Cowlitz River eroded and reworked the glacial deposits. The resulting alluvial deposits range from coarse boulders to cobbly gravel to fine sand and silty sand. Thick alluvium is generally confined to the area of the immediate Cowlitz River flood plain (Harza 1999c)."

The 1980 eruption of Mt. St. Helens is an important factor in soil composition and channel form. The Corps predicts that without dredging operations, the bed elevation of the Cowlitz River will rise between 0 to 2 feet near the Toutle River confluence, and between 3 to 5 feet in downstream areas (Corps 2002). A rise in water surface elevations

related to the sedimentation is expected to be approximately 1.5 feet downstream from the Toutle River confluence (Corps 2002).

Soils derived from the volcanic deposits range from gravelly coarse sands to silt loams. As a result of its geology and soils, the Cowlitz watershed is prone to potentially severe erosion. In fact, 83 percent of the land in the watershed would be highly erodible if vegetative cover was removed (Wade 2000a). Over 81 percent of the land with severe to very severe erosion hazard is in commercial forest use (USSCS 1974 cited in Wade 2000a).

The hydrologic regime is driven by a mix of rainfall at lower elevations and snowmelt from the headwaters. A few major tributaries drain glaciers on Cascade peaks and contribute glacial meltwater during the summer months (Wade 2000a). The majority of peak flows occur between November and February, as a result of winter rain or rain-on-snow events.

Three major hydroelectric projects have been constructed on the mainstem Cowlitz River. Cowlitz Falls Dam, Mossyrock Dam, and Mayfield Dam in Lewis County are maintained for flood control and hydropower production. Mayfield Dam and Mossyrock Dam are operated by Tacoma Power, and Cowlitz Falls Dam, a smaller, run-of-the-river dam, is operated by Public Utility District No. 1 of Lewis County. Historically, the portion of the stream inundated by the three reservoirs was made up of a series of deep canyons. Today, dam operations limit the frequency and intensity of flood flows and result in higher flows during the summer low-flow period. In November 1997, an agreement was reached between Tacoma Power and the Washington Department of Fish and Wildlife regarding flow operations intended to protect salmon and steelhead resources in the lower Cowlitz mainstem.

The Toutle and Coweeman Rivers are unregulated, contributing to flow variability in the lower Cowlitz River. The annual hydrograph of the Toutle River has been altered since the Mt. St. Helens eruption, in part because sediment load in the river and its floodplains reduced the capacity of the river, and in part because deforestation resulting eruption reduced infiltration capacity, creating a flashier system (Tetra Tech 2007).

Silver Lake, the largest lake in Cowlitz County, was formed approximately 2,500 years ago, when lahars from Mt. St. Helens blocked the drainage of Outlet Creek (Cowlitz Conservation District 1994). A control structure was built in the 19070's to moderate seasonal fluctuations in the lake level and accommodate increasing development along the Lake's shorelines (Cowlitz Conservation District 1994).

### 4.2.5 Mill, Abernathy, Germany Creeks

The Mill/Abernathy/Germany subbasin is a low elevation system with an average slope of 21 percent (Wade 2002). The subbasin is comprised primarily of volcanic (85 percent) and sedimentary and metamorphic rocks (13 percent) (Wade 2002). Given the lower elevation of these watersheds, the hydrologic regime is driven by rainfall, with peak flows occurring during winter months. Less than 10 percent of the watershed area is within the rain-on-snow zone (Wade 2002). Wade (2002) provides a detailed description of soils in the subbasin.

### 4.2.6 South Fork Chehalis River

Tectonic and glacial activity gave rise to the Chehalis River valley. During the Pleistocene period, glacial drift from the Cascade and Olympic mountains and the Puget lobe of the Cordilleran Ice Sheet drained to the ocean through the Chehalis River valley (Gendazsek 2011). Recent alluvium overlies much of the glacial deposits (Gendazsek 2011).

The Chehalis River system is a low gradient, and therefore, slow moving river compared to other large rivers in Washington State. Its headwaters drains four mountain ranges (or hills), including the western side of the Willapa Hills, the Black Hills, the west side of the Cascade Range, and the lower south slopes of the Olympic Range. As a result of the low elevation headwaters, precipitation primarily falls in the form of rain, although snowfall in the upper elevations of the watershed allows for floods relating to rain-on-snow events. Mean annual (1971–2000) precipitation ranges from more than 250 in. in the headwaters of the Wynoochee and Humptulips Rivers to 43 in. near the cities of Chehalis and Centralia (PRISM 2011 cited in Gendazsek 2011). The majority of precipitation generally falls between October and March (Gendazsek 2011).

The lower South Fork Chehalis has a low gradient from its mouth until RM 16.8. In the upper South Fork, within Cowlitz County, the river narrows substantially as it flows through steep terrain.

## 4.3 Ecosystem Context

The Lower Columbia River and tributaries can be considered a distinct ecosystem region within the entire Columbia River watersheds. The complexity of topography, stream gradient, flow and other features, however, tends to distinguish ecological functions of the Columbia River and tributaries. The Lower Columbia River itself functions largely as an estuary. Tributaries tend to function more as headwater streams. Portions of four major watersheds are located within Cowlitz County, the Lewis watershed, the Cowlitz Watershed, the Grays/Elochoman Watershed, and the Chehalis Watershed. Generally,

these watersheds are identified by the state as Water Resource Inventory Areas (WRIA). A map of the WRIAs within Cowlitz County is provided in Figure 4-1. Table 4-1 provides a summary of subbasins and WRIAs within Cowlitz County, as well as anadromous salmonids associated with each basin.

**Table 4-1. Summaries of Cowlitz County subbasins from the Lower Columbia Salmon Recovery and Fish and Wildlife Subbasin Plan (2010).**

| Subbasin | Strata WRIA | County(s) | Watershed Area | Elevation (max) | Historic Anadromous Stream Miles | Focal Species[1] |
|---|---|---|---|---|---|---|
| Mill, Abernathy, Germany | Coast 25 | Cowlitz, Wahkiakum | 100 $mi^2$ | 1300 ft | 110 | CHF, Chum, Coho, STW |
| Cowlitz (lower) | Cascade 26 | Cowlitz, Lewis | 440 $mi^2$ | 1,000 ft | 360 | CHF, Chum, Coho, STW |
| Cowlitz (upper) | | Lewis, Pierce, Skamania | 1,400 $mi^2$ | 14,000 ft | 110 | CHF, CHS, STW, Coho |
| Coweeman | | Cowlitz | 200 $mi^2$ | 3,000 ft | 90 | CHF, STW, Chum, Coho, |
| Toutle | | Cowlitz | 510 $mi^2$ | 8,000 ft | 310 | CHF, CHS, STW, Chum, Coho, |
| Kalama | Cascade 27 | Cowlitz | 210 $mi^2$ | 8,000 ft | 120 | CHF, CHS, Chum, Coho, STW, STS |
| North Fork Lewis | | Clark, Cowlitz, Skamania | 830 $mi^2$ | 12,000 ft | 100 | CHF, CHS, Chum, Coho, STW, STS, BT |

1 CHF= fall Chinook, CHS= spring Chinook, STW= winter steelhead, STS= summer steelhead, BT= bull trout

**Table 4-2. Priority species and habitats in Cowlitz County (WDFW 2010).**

| | Species/ Habitats | State Status | Federal Status |
|---|---|---|---|
| Habitats | Aspen Stands | | |
| | Biodiversity Areas and Corridors | | |
| | Herbaceous Balds | | |
| | Old-Growth/Mature Forest | | |
| | Oregon White Oak Woodlands | | |
| | West Side Prairie | | |
| | Riparian | | |

| | Species/ Habitats | State Status | Federal Status |
|---|---|---|---|
| | Freshwater Wetlands & Fresh Deepwater | | |
| | Instream | | |
| | Caves | | |
| | Cliffs | | |
| | Snags and Logs | | |
| | Talus | | |
| Fishes | Pacific Lamprey | | Species of Concern |
| | River Lamprey | Candidate | Species of Concern |
| | Green Sturgeon | | Threatened |
| | White Sturgeon | | |
| | Olympic Mudminnow | Sensitive | |
| | Leopard Dace | Candidate | |
| | Mountain Sucker | Candidate | |
| | Eulachon | Candidate | Threatened |
| | Bull Trout | Candidate * | Threatened * |
| | Chinook Salmon | Candidate | Threatened (Upper Columbia Spring run is Endangered) |
| | Chum Salmon | Candidate | Threatened |
| | Coastal Res./ Searun Cutthroat | | Species of Concern |
| | Coho | | Threatened – Lower Columbia |
| | Kokanee | | |
| | Pink Salmon | | |
| | Steelhead Trout | Candidate ** | Threatened ** |
| | Sockeye Salmon | Candidate | |
| Amphibians | Cascade Torrent Salamander | Candidate | |
| | Dunn's Salamander | Candidate | |
| | Larch Mountain Salamander | Sensitive | Species of Concern |
| | Van Dyke's Salamander | Candidate | Species of Concern |
| | Western Toad | Candidate | Species of Concern |
| Reptiles | Pacific Pond Turtle (also known as Western Pond Turtle) | Endangered | Species of Concern |
| Birds | Western grebe | Candidate | |
| | Great Blue Heron | | |
| | Cavity-nesting ducks: Wood Duck, Barrow's Goldeneye, Common Goldeneye, Bufflehead, Hooded Merganser | | |
| | Nonbreeding concentrations of: Barrow's Goldeneye, Common Goldeneye, Bufflehead | | |
| | Harlequin Duck | | |

| | Species/ Habitats | State Status | Federal Status |
|---|---|---|---|
| | Trumpeter Swan | | |
| | Tundra Swan | | |
| | Waterfowl Concentrations | | |
| | Bald Eagle | Sensitive | Species of Concern |
| | Golden Eagle | Candidate | |
| | Northern Goshawk | Candidate | Species of Concern |
| | Peregrine Falcon | Sensitive | Species of Concern |
| | Sooty Grouse | | |
| | Wild Turkey | | |
| | Sandhill Crane | Endangered | |
| | Nonbreeding concentrations of: Charadriidae, Scolopacidae, Phalaropodidae | | |
| | Band-tailed Pigeon | | |
| | Yellow-billed Cuckoo | Candidate | Candidate |
| | Spotted Owl | Endangered | Threatened |
| | Vaux's Swift | Candidate | |
| | Pileated Woodpecker | Candidate | |
| | Purple Martin | Candidate | |
| | Slender-billed White-breasted Nuthatch | Candidate | Species of Concern |
| Mammals | Harbor Seal | | |
| | Roosting Concentrations of: Big-brown Bat, Myotis bats, Pallid Bat | | |
| | Townsend's Big-eared Bat | Candidate | Species of Concern |
| | Fisher | Endangered | Candidate |
| | Marten | | |
| | Wolverine | Candidate | Candidate |
| | Columbian Black-tailed Deer | | |
| | Columbian White-tailed Deer | Endangered | Endangered |
| | Elk | | |
| Invertebrates | Blue-gray Taildropper | Candidate | |
| | Valley Silverspot | Candidate | Species of Concern |

**Table 4-3. Threatened and endangered plant species in Cowlitz County.**

| Scientific Name | Common Name | Status[1] | Historic Record[2] |
|---|---|---|---|
| *Agoseris elata* | Tall agoseris | WS | |
| *Cimicifuga elata var. elata* | Tall bugbane | SC, WS | H |
| *Corydalis aquae-gelidae* | Clackamas corydalis | SC, WS | |
| *Erythronium revolutum* | Pink fawn-lily | WS | |

| | | | |
|---|---|---|---|
| *Euonymus occidentalis var. occidentalis* | Western wahoo | WS | |
| *Isoetes nuttallii* | Nuttall's quillwort | WS | |
| *Physostegia parviflora* | Western false dragonhead | WS | H |
| *Poa laxiflora* | Loose-flowered bluegrass | WS | |
| *Poa nervosa* | Wheeler's bluegrass | WS | |
| *Salix sessilifolia* | Soft-leaved willow | WS | |
| *Sidalcea nelsoniana* | Nelson's checker-mallow | FT, WE | |

1 Listing status: FT = Federal threatened, FE = Federal endangered, FC = Federal candidate, FS = Federal species of concern, WE = Washington endangered, WT = Washington threatened, WS = Washington sensitive.

2 H indicates that most recent record in the County was before 1977.

In addition to rare plant species identified in Table 4-3, the following rare plant communities have also been documented to occur in Cowlitz County.

- Pacific Silver Fir / Oval-leaf Blueberry
- Noble Fir Forest
- Bluejoint Reedgrass
- Sitka Sedge
- Western Inflated Sedge
- Shore Sedge
- Northwest Territory Sedge
- Creeping Spikerush
- Idaho Fescue Community
- Mid-elevation Freshwater Wetland WC
- Lodgepole Pine / Kinikinnick
- Douglas-fir - Western Hemlock / Swordfern
- Douglas-fir / Beaked Hazel / Swordfern
- Oregon White Oak / Oval-leaf Viburnum - Poison-oak
- Sitka Willow
- Western Hemlock / Swordfern
- Western Hemlock / Oval-leaf Blueberry

### 4.3.1 Columbia River

The Columbia River is the largest river in the Pacific Northwest, and the fourth largest river in the United States by volume. The Columbia River watershed originates in Canada, and the drainage area of over 258,000 square miles includes areas of Washington, Oregon, Montana, Idaho, Wyoming, and Nevada.

Cowlitz County is located along the lower Columbia River, in the tidal freshwater subsystem. The Willamette River is the largest tributary to the lower Columbia River.

Major tributaries originating in the Cascades include the Lewis, Kalama and Cowlitz Rivers in Cowlitz County, as well as the Sandy River in Oregon and the Washougal River, in Washington. Major Coast Range tributaries include the Elochoman and Grays Rivers, the Lewis and Clark, Young, and Clatskanie Rivers in Oregon.

The Columbia River Estuary and Lower Columbia Subbasin support an abundance of fish and wildlife species. Columbia River populations compose 12 of the 26 evolutionary significant units of Pacific salmon protected under the Endangered Species Act of 1973 (Bottom *et al.* 2005).

Estuaries provide a variety of functions critical to a variety of species. Estuarine habitats also provide young salmonids with a productive feeding area, protection from large piscivorous predators, and an area where smolts can undergo the physiological changes necessary to acclimate to the saltwater environment. The natural structure including sinuous channels, overhanging vegetation, and undercut banks in these habitats offers high densities of insect prey and potential refuge from predators (McIvor and Odum 1988). The connectedness of these habitats likely determines the extent to which juvenile salmonids access the spectrum of available estuarine habitats (Beamer et al. 2005).

Smelt (eulachon) in the Northwest Pacific Ocean depend on the lower Columbia River and its tributaries to support the largest known spawning run, which historically represented half of the species' abundance. The mainstem of the lower Columbia River provides spawning and incubation sites, as well as a migratory corridor to spawning areas in the tributaries. Spawning grounds are typically in the lower reaches of larger rivers. Eggs commonly adhere to sand or pea-sized gravel. Eggs found in areas of silt or organic debris reportedly suffer much higher mortality (NMFS 2011).

### 4.3.2 Lewis River

The Lewis River is part of WRIA 27, which covers 1,310 square miles, including the eastern portion of Cowlitz County. Originating on the slopes of Mount Adams and Mount St. Helens, the Lewis River has two major forks, the North Fork, which forms the southeastern boundary of Cowlitz County, and the East Fork, which is located in Skamania and Clark Counties. The North Fork Lewis River includes three significant impoundments: Swift Reservoir (RM 47.9), Yale Reservoir (RM 34.2), and Merwin Lake (RM 19.5). The northern shorelines of Yale Reservoir and Merwin Lake are located in Cowlitz County, and Swift Reservoir is located to the east in Skamania County. Major tributaries to the Lower Lewis include the EF Lewis, Cougar Creek, and Speelyai Creek. The majority of WRIA 27 is in managed forest lands, primarily concentrated in the upper watershed.

Anadromous fish species in WRIA 27 include chum salmon, coho salmon, Chinook salmon, steelhead, bull trout, and sockeye salmon. Each of these anadromous salmonid species are federally listed as threatened under the Endangered Species Act with the exception of sockeye, which are rare in the county. Merwin Dam at RM 19.5, is a complete barrier to for anadromous fish passage (LCFRB 2010). Below Merwin Dam, the lower North Fork flows through a deep canyon until it opens to a broad alluvial valley at RM 12 (LCFRB 2010). Tidal influence extends up to RM 11 (LCFRB 2010).

The Lewis River has produced very large smelt runs periodically. During spawning, eulachon typically move upstream about 16 km (10 miles; to Eagle Island), but they have been observed upstream to the Merwin Dam (NMFS 2011).

### 4.3.3 Kalama River

The Kalama River originates on the southwest slope of Mt. St. Helens, from the Dryer Glacier, and flows 44 miles west-southwest to the Columbia River. Nearly all of the 205 square mile drainage area is within Cowlitz County. Shorelines of the State in the Kalama River basin include the North Fork Kalama River, Fossil, Langdon, Elk, Jacks, Arnold, Gobar, and Wild Horse Creeks. Dry Creek and Merrill Lake are also shorelines of the state within the Kalama River basin.

The lower basin is low gradient. Historically, Lower Kalama Falls blocked most anadromous passage at RM 10. A fish ladder, constructed in 1936, allows passage above the falls; however, only steelhead and excess spring chinook are passed above the lower falls by Washington Department of Fish and Wildlife (WDFW) (Wagemann 1999, personal comm. cited in Wade 2000b). Above RM 10 the river flows in a narrow valley. An impassable falls blocks all anadromous passage at RM 35 (Wade 2000b). Many of the tributaries to the Kalama have steep gradients, with only the lower portions of the streams accessible to anadromous fish.

The extent of smelt spawning within the Kalama River is from the confluence with the Columbia River to the confluence with Indian Creek (NMFS 2011).

### 4.3.4 Cowlitz River

The Cowlitz River drains approximately 2,480 square miles over a distance of 151 miles. Originating on the west slope of the Cascade Mountain Range and draining portions of Mount Rainier, Mount Adams and Mount St. Helens, the River flows west, then south to its confluence with the Columbia River at Kelso. The Toutle and Coweeman Rivers are the largest tributaries of the Cowlitz River. Other tributaries to the Cowlitz River that qualify as shorelines of the state in Cowlitz County include Olequa, Arkansas,

Delameter, and Ostrander Creeks. Two major dams, Mayfield dam and Mossyrock dam, occur in Lewis County on the Upper Cowlitz River.

The Toutle River originates on Mt. St. Helens, with headwaters near 8,000 feet in elevation, and drains the north and west sides of the mountain, flowing westward to its confluence with the Cowlitz River at RM 20. The subbasin includes three main drainages, the North Fork Toutle, the South Fork Toutle, and the Green River. Much of the upper basin is within the Mt. St. Helens National Volcanic Monument. Other shorelines of the state along the Toutle River include the following: Shultz, Studebaker, Coldwater, Maratta, Hoffstadt, Bear (2), Deer, Alder, Wyant, Hemlock, Outlet, Johnson, Harrington, Trouble, and Coldspring Creeks. Castle Lake, Coldwater Lake, and Fawn Lake each drain to the North Fork Toutle River. Silver Lake drains to the mainstem Toutle River via Outlet Creek.

The Coweeman River originates in the cascade foothills around 3,000 feet in elevation. Principal tributaries that are shorelines of the state include Goble, Mulholland, and Baird Creeks. The Coweeman River joins the mainstem Cowlitz at RM 1.7.

The 1980 eruption of Mount St. Helens had a significant influence on watershed conditions including significant effect on fisheries populations and their habitats in the North and South Fork Toutle River watersheds (Jones and Salo 1986). Debris flows buried a 23 square mile area to an average depth of 150 feet, including more than 27 miles of anadromous stream habitat (Jones and Salo 1986).

Populations of anadromous salmon, although present, are substantially reduced from historic numbers. Sturgeon and pacific lamprey are present in the lower reaches in reduced numbers, and smelt runs still occur cyclically. The Cowlitz River is likely the most productive and important spawning river for smelt within the Columbia River system. Spawning adults typically move upstream about 26 km (16 miles) to Castle Rock or beyond to the confluence with the Toutle River and are occasionally sighted as far as 80 km (50 miles) upstream (NMFS 2011).

### 4.3.5 Mill, Abernathy, Germany Creeks

Mill, Abernathy, and Germany Creeks are a part of WRIA 25 (the Grays/Elochoman watershed). The watershed consists of several small, low elevation, rain dominated systems that experience tidal influences from the Columbia. In addition to the above listed Creeks, Cameron Creek and Ordway Creek occur in WRIA 25 in Cowlitz County. The upper reaches of the Elochoman River also extend into the westernmost portion of Cowlitz County.

Focal salmonid species include chum, coho, winter steelhead, and fall Chinook. Salmon and steelhead numbers have declined to only a fraction of historical levels and extinction risks are significant for all focal species. Returns of winter steelhead and coho include both natural and hatchery produced fish. Natural fall Chinook spawning returns have been highly influenced by the release of Spring Creek Hatchery stock released at the Abernathy Creek NFH which was discontinued in 1995. Fall Chinook hatchery strays continue to be present in the subbasin.

### 4.3.6 South Fork Chehalis River

A portion of the northwestern corner of Cowlitz County forms the headwaters of the South Fork Chehalis River. The River flows north into Lewis County where it joins the North Fork Chehalis River before heading west toward Grays Harbor. Other tributaries to the mainstem Chehalis River include the Newaukum, Skookumchuck, Black, Satsop, and Wynoochee Rivers.

The South Fork Chehalis River is used by fall and spring Chinook salmon, coho salmon, cutthroat, and steelhead (Grays Harbor County Lead Entity 2011).

## 4.4 Major Land Use Changes and Current Shoreline Condition

### 4.4.1 Columbia River

Human influences have resulted in substantial changes to the shorelines of the Columbia River. The most significant changes to the River's shorelines have resulted from European settlement following the Lewis and Clark expedition in the early 1800s. Grazing and farming activities along the estuarine floodplain for expanded between the early 1800s through the early 1900's. Extensive diking of the shorelines occurred to protect agricultural fields from flooding, and as a consequence, large areas of the floodplain were isolated from the river.

Concurrent with the expansion of agriculture, commercial fishing, processing, and canning emerged as major industrial activities on the Columbia. The commercial fishing industry led to the extensive construction of canneries, warehouses, fish traps, and other similar structures along the shores and in the river (Christy and Putera 1992, Lichatowich 1999). The piles associated with many derelict structures are still present today in many places along the River. Timber production and transport also developed during this period, shaping the vegetative landscape.

Today, the Columbia River Basin supports significant water-dependent or water-oriented commercial and industrial uses including pulp mills, aluminum plants, and commercial fishing (see Appendix G, Demand for Water-oriented Uses). Agriculture is

also a significant land use in the basin. Recreational activities include fishing, boating, and hiking.

Flow regulation and diking in the Columbia River have eliminated or limited tidal inundation and disconnected the river from its floodplain, limiting natural disruptions that form new wetlands and create shifting mosaics of wetland habitats (Bottom et al. 2005). Furthermore, channel dredging and flow regulation in the Columbia River have combined to consolidate the river current into a single channel and reduce flow through peripheral wetland and marsh habitats (Bottom et al. 2005). The combination of dikes and water flow regulation has contributed to a 62 percent loss in the shallow water habitat available to juvenile Chinook salmon in the lower estuary (Kukulka and Jay 2003).

The 21 dams built in the Columbia and Snake Rivers since 1933 have substantially altered the Columbia River hydrograph. Dam operations have reduced the frequency of spring freshets, which historically aided the migration of juvenile salmon and helped maintain floodplain habitat connectivity. Today, over-bank flows and associated large woody debris recruitment and sediment transport processes have been substantially reduced.

Historic and ongoing dredging operations are responsible for maintaining a viable navigation channel to support five deep-water ports (two in Cowlitz County), which transport 30 million tons of goods annually. However, the dredge operations also have limited the natural formation of new estuarine marshes (Bottom and Simenstad 2001).

Today, hundreds of fish and wildlife species reside in or migrate through the Lower Columbia River and its estuary. Current wild populations of salmon in the Columbia River basin represent only 12 percent of their historic numbers (Bottom et al. 2005). The period of estuarine residency provides opportunities for juvenile salmon (particularly fall Chinook salmon). Shallow water habitats may provide spatial separation from aquatic predators that reside in deeper waters, improved protection from predators through higher turbidity levels (Gregory and Levings 1998), as well improved foraging capacity (Levings et al. 1991). In the Lower Columbia, salmonids are impacted by primarily impacted by disconnected or lost habitats. Predation impacts from Caspian terns and northern pikeminnow are also significant.

### 4.4.2 Lewis River

Three dams in the upper watershed have significant effects throughout the basin. The dams block access to approximately 80 percent of historic steelhead spawning habitat.

Per provisions in the FERC settlement agreement (PacifiCorp 2004), PacifiCorp began a program in 2011 to reintroduce anadromous fish to 170 miles of habitat upstream of the dams. The dams affect peak flows and baseflows, restrict downstream transport of LWD, and affect natural sediment transport processes. To offset habitat impacts resulting from continued operation of its hydroelectric projects on the Lewis River, PacifiCorp Energy manages 10,085 acres around the reservoirs in accordance with the Lewis River Shoreline Management Plan (PacifiCorp 2008a) and the Lewis River Wildlife Habitat Management Plan (PacifiCorp 2008b). The Wildlife Habitat Plan includes goals, objectives, actions, and monitoring plans for habitats within the managed area (PacifiCorp, 2008b). Despite sediment retention above the dams, landslides below the dams on the North Fork Lewis River appear to provide sufficient spawning gravels to the lower North Fork (Steel et al. 2007).

Levees were built in the lower Lewis River in an effort to control flooding. The first successful levee was built near Woodland in 1921 (Steel et al. 2007). Today, the lower seven miles of the Lewis River are disconnected from the floodplain as a result of extensive diking and levee construction (Wade 2000). Riparian vegetation is largely lacking in the lower River as a result of levees and floodplain development (Wade 2000).

The upper watershed is heavily-forested and largely managed for public and private industrial timber production. However, in recent years, the area has seen increased demand for recreational use and residential development (EA Engineering in Wade 2000). Road densities in the basin range from 4.96 miles/square mile in the lower North Fork below Merwin Dam (Lewis County GIS 1999 cited in Wade 2000b) to as low as 2.01 miles/square mile in the upper portions of the watershed on Forest Service lands (USFS 1995c cited in Wade 2000b).

Most of the Upper North Fork is within the Gifford Pinchot National Forest or the Mt. St. Helens National Volcanic Monument. The majority of the headwaters of the basin are forested and in public ownership; active logging was common until the 1980s, but current logging activities are greatly reduced. Current vegetation in the Upper North Fork Lewis watershed is a mix of early, mid, and late seral stage forests, various aged clear-cuts, native grasslands, shrubs, burned areas, and rock and snow in the higher elevations (Steel et al. 2007). Agriculture and residential uses dominate the lower valley. The only urban area in the subbasin is the City of Woodland.

### 4.4.3 Kalama River

The watershed is heavily-forested and approximately 96 percent of the Kalama River Watershed is owned and managed by private timber companies. Most of the watershed

was logged in the 1960s through the early 1980s. As a result, existing forest stands are young, and an extensive road network (1,292 miles of roads) covers the forestry lands, with a road density of 5.75-miles/square mile of area (Lewis County GIS 1999 cited in LCFRB 2010). Although the banks of the Kalama River are generally considered to be stable, the proportion of fine sediment in the River substrate is likely related to past forestry practices and road densities (Wade 2000). The upper watershed is within the Mount St. Helens National Volcanic Monument, which is primarily managed for natural resource conservation.

Stand replacing fires, which burned large portions of the basin between 1902 and 1952, have had lasting effects on basin hydrology, sediment transport, soil conditions, and riparian function. Large Woody Debris (LWD) is limited throughout the mainstem river and all of the major tributaries, and given the degraded nature of existing riparian conditions, future recruitment of LWD is also limited (Wade 2000).

The City of Kalama is the only urban area in the subbasin. Extensive industrial development has occurred within the historic floodplains in the lower two miles of the Kalama, especially to the west of I-5 (see Appendix G, Demand for Water-oriented Uses). Most of the lower river has been channelized and diked to facilitate this development. Given the naturally steep topography of the Kalama River throughout much of the basin, isolation of floodplain habitats in the lower river exacerbates a natural limiting factor (Wade 2000). Residential development has increased along the lower river as well. The lower ten miles of the Kalama River are impaired by high water temperatures.

### 4.4.4 Cowlitz Watershed

Forestry is by far the most dominant land use for all subbasins within the Cowlitz watershed. Forestry activities have the potential to affect temperature and hydrologic regime in the watershed. Despite a history of logging, the watershed still includes several areas of mature forests. Within Cowlitz County, nearly 20 percent of the watershed's shorelines are in agricultural use.

The construction of Mayfield and Mossyrock Dams contributed to the decline of anadromous fish populations. Historically, all of the spring Chinook salmon, 46 percent of the fall Chinook salmon, 77 percent of the coho salmon and 80 percent of the steelhead were estimated to have spawned in the upper watershed (GAIA 1994 cited in Dammers et al. 2002). The construction of the two dams effectively cut off any use of the upper watershed by anadromous salmon. In 1994, a trap and haul program began to reintroduce anadromous salmonids to the watershed above the dam complex. Today,

adults collected at the hatchery complex below the dams are trucked upstream and released to spawn naturally, and juveniles produced at the hatchery are released in the upper watershed to produce additional smolts.

The 1980 eruption of Mt. St. Helens dramatically degraded the habitat conditions of the Toutle River system and the mainstem Cowlitz River below the mouth of the Toutle. Melted ice, ash, and pumice eroded down the Toutle Valley into the Cowlitz River, and carried coarse sandy material and debris to the Columbia River. The eruption wiped out areas of existing forests, which are now recovering in young vegetative conditions.

Following the eruption, the debris flows filling the rivers caused concern for potential flooding of the Cities of Castle Rock, Kelso, and Longview. In response to this concern, the U.S. Army Corps of Engineers (Corps) removed over 74 million cubic yards of material from the Cowlitz River. Floodplain areas along portions of the lower Cowlitz and Toutle Rivers were filled with the fine sediment from dredge spoils. In order to limit future downstream sedimentation and associated flood risk in the North Fork Toutle River, the Corps constructed a sediment retention structure (SRS) on the North Fork Toutle River. The 125 foot tall and 2,200 foot long SRS totally blocked volitional upstream access to as many as 50 miles of habitat for anadromous fish (Corps 2007). Despite the SRS, a significant quantity of sediment is continuing to move through the Toutle system into the Lower Toutle and Lower Cowlitz Rivers. Because of continued filling of the sediment retention structure, the Corps is planning to raise the height of the spillway by 10 feet within the next year in order to reduce downstream sediment delivery and provide additional flood control measures in the Cowlitz River downstream of the Toutle confluence (Corps 2012).

Also following the eruption of Mount St. Helens, two new shoreline lakes, Coldwater Lake and Castle Lake, were created by lahars blocking the North Fork Toutle channel. In order to prevent catastrophic failure of the new earthen berms that formed these lakes, the Corps of Engineers constructed hardened spillway channels at their outlets.

The mainstem Cowlitz and many tributaries have experienced losses in key habitat areas and habitat diversity for most salmonid life-stages due to channel simplification and diking. Below the confluence with the Toutle River, the Cowlitz River channel is extensively armored and diked, and most of the floodplain has been filled with deposits from the eruption of Mt. St. Helens (Wade 2000). Grazing, agriculture, forestry, and residential and commercial development have contributed to a reduction in riparian function, increased bank instability, and added fine sediments. The watershed includes a significant area of highly erodible soils. The greatest erosion problems occur as a result

of ground disturbance from road building and other activities associated with logging. Water quality is generally good within the Cowlitz River, but elevated water temperatures and turbidity are a concern in the Coweeman watershed.

Incorporated urban areas include the Cities of Kelso, Longview, and Castle Rock.

### 4.4.5 Mill, Abernathy, Germany Creeks

The upper watershed area is heavily-forested and largely managed for public and private industrial timber production. Historic logging contributed to the degradation of riparian and instream habitat, although riparian and forest conditions are recovering. The middle reaches have considerable agricultural and development impacts, including limited vegetated riparian areas and disconnected floodplains. The lower reaches of Germany Creek flows through predominantly agricultural land uses, and the Creek is somewhat entrenched. Large woody debris has the potential to restore a more natural channel form, but large woody debris has been periodically removed from the Creek by local residents (Wade 2002). Floodplain connectivity throughout lower Mill Creek has been impaired by historic splash damming, which has resulted in an incised channel along most of the lower 1.5 miles (Wade 2002). Similarly, the lower five miles of Abernathy Creek are incised and confined by adjacent roads and railroads (Wade 2002). Excessive fine sediment has been observed in lower Germany Creek; the source of fine sediment may be a combination of adjacent agricultural erosion and upstream mass wasting (Wade 2002).

### 4.4.6 South Fork Chehalis River

Dominant land use in the upper South Fork is commercial forestry, and agricultural uses predominate in the lower river. Both agricultural and forestry uses have resulted in significant alterations to the shorelines of the South Fork Chehalis River. Today, riparian vegetation is limited in extent and maturity compared to historic conditions (Grays Harbor County Lead Entity 2011). The South Fork contributes to high sediment loads in the mainstem Chehalis River; these sediment loads are likely related to a high density of forest roads and logging practices that affect headwater streams, as well as erosion associated with agriculture (Grays Harbor County Lead Entity 2011). Culverts throughout the South Fork Chehalis River present fish passage barriers for anadromous salmonids (Grays Harbor County Lead Entity 2011).

# 5 INVENTORY AND ANALYSIS OF CONDITIONS

The following section discusses conditions and characteristics of each shoreline assessment unit with respect to both ecological characterization (physical processes,